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AS/400 Communication Performance Investigation - V3R6/V3R7

December 1997

IBM
International Technical Support Organization
Rochester Center

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Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix J, “Special Notices” on page 389.

First Edition (December 1997)

This edition applies to Version 3, Release 7, Modification 0 of the AS/400 Operating System and to all subsequent releases until otherwise indicated in new editions or technical bulletins.

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Contents

Preface

Improving communication performance is not a trivial task. The purpose of this redbook is to discuss how to manage communications performance and ways to locate the problem areas in communication performance. This redbook collects a large amount of the performance information from several sources and presents it in an ordered manner. The databases created by the Performance Tools/400 were used to give the key performance indicators.

This redbook is intended for technical professionals including network designers who want to tune the IBM AS/400 system to improve communications performance.

An intermediate knowledge of the Performance Tools/400 (5716-PT1) and Query/400 (5716-QU1) is assumed.

The Team That Wrote This Redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization Rochester Center.

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This document is based on the ITSO redbook, *AS/400 Communication Performance Investigation*, GG24-4669.

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Chapter 1. Tools Used for Finding Performance Problems

Finding a performance problem is similar to solving a three-dimensional crossword puzzle: all of the puzzles are different from each other but after solving several puzzles, you begin to grasp a pattern. For example, you start the puzzle from the lower left-hand corner and continue systematically towards the upper right-hand corner. Solving a communications performance problem is a task even more challenging. You need to have the AS/400 system tuned properly before trying to figure out what is causing the communications performance problem.

As it is impossible to give anyone explicit instructions for solving a crossword puzzle, it is impossible to give you an exact check-list to be followed to find and solve a communications performance problem. In this book, we are leading you to the beginning of a never-ending task of finding the perfect performance.

The first step of solving a communication performance problem is to collect material to be analyzed with the tools available. The collection is done by entering the Start Performance Monitor (STRPFRMON) command that is described in Section 1.2, "Collecting Communications Performance Data" on page 2.

The tools you need to solve a performance problem are:

- CL commands described in more detail in Chapter 2, "Using CL Commands to Find Performance Problems" on page 11:
  – WRKSYSVAL, Work with System Values
  – WRKSYSSTS, Work with System Status
  – WRKACTJOB, Work with Active Jobs
  – WRKDSKSTS, Work with Disk Status
- *Performance tools/400* is described in Chapter 3, "Using Performance Tools/400" on page 27 and consists of the following parts:
  – WRKSYSACT, Work with System Activity command
    This command differs from the rest of the performance tools because it is the only tool used for a real-time analysis. For information about using this command, see Chapter 2, "Using CL Commands to Find Performance Problems" on page 11.
  – DSPPFRDTA, Display Performance Data command
  – Advisor
  – Reports
  – BEST/1 is used to plan for system growth and analyze the effect of work load and hardware changes. Using this tool is discussed in Chapter 4, "Using BEST/1 for Communications Performance Analysis and Capacity Planning" on page 53.
  – Programmer performance utilities such as:
    - Job trace
    - Disk Data Collection
    - Analyze Process Access Group
    - Performance Explorer
- System Service Tools is discussed in Chapter 5, "Using System Service Tools" on page 71.
- Communications Trace is discussed in Chapter 5, "Using System Service Tools" on page 71.

The tools should be used in sequence from top to bottom. First, use the Work with System Values command to find out the settings of the allocation system values. After that, check the overall performance by using the Work with System Status command. Then find out if any individual jobs are using too much of the systems′ resources by using the Work with Active Jobs command. The Work with Disk Status command helps you to determine if any of the actuators are being over-committed or whether the total amount of disk arms is adequate.

By using the Performance tools, you find out the bottlenecks of the performance that can be analyzed more thoroughly by running queries to the performance tools database. Communications trace is used to find out how the data is passed between the AS/400 system and the remote end.

Please note that the users on a local token-ring are considered as remote users.

1.1 Usual Symptoms of Degraded Performance

There are several ways of finding out if your AS/400 system is having a performance problem in the communications area, but a good starting point is to ask users what they think about response times. Bear in mind that usually workstation users are not satisfied with the response time even if it were something similar to a sub-second...

The indicators to pay attention to are:

- Poor response time
- Reduced throughput
- Heavy faulting rate in the main storage
- High usage of system resources such as CPU, IOP, or DISK

Normally the degradation of response times is the first indication of something getting out of order. Be aware that usually the response times get longer little by little so noticing the degradation is almost impossible without a regular observation of system performance.

1.2 Collecting Communications Performance Data

Before collecting the performance data to solve a communications performance problem, decide what might be the problem to be investigated. The problem description does not need to be overly detailed or technical, just try to simply describe one problem. For example:

- Remote response time seems too slow.
- File transfer should go faster.
- At times, the entire system seems sluggish.

Next, determine when the problem usually occurs. Maybe remote response time is slow the first thing in the morning, or the file transfers seem slow late in the afternoon.

When you can describe the communications performance problem and have determined when it seems to occur, you are ready to collect communications performance data for your analysis.

If possible, focus on collecting data for one problem at a time. Of course, try to collect the data when the problem is the most likely to appear. You can decide later how much of the data you want to analyze. For more information about when to collect performance data and how much to collect, see the first few pages of Chapter 4 in the *AS/400 Performance Tools/400 Guide*.

1.2.1 Why Collect Performance Data

Collect performance data on a **regular basis** and create historical data out of the material collected. For example, you can run the performance data collection for two hours on every Wednesday afternoon with the default parameters; the trace data is not needed for the historical data. The reason for doing this is that viewing the historical data graphics is the easiest way to notice any trends in system performance if you are not using the Performance Monitor/400 software.

Another reason for collecting data regularly is that without having a baseline to compare your performance data with, you have no way of telling whether the performance is improving or degrading.

1.2.2 How to Collect Performance Data

You do not need Performance Tools/400 to collect the data, the collection part is done by entering the Start Performance Monitor (STRPFRMON) command. This generates several performance database files that contain statistics for each communications protocol used. When collecting performance data to analyze a communications performance problem, set the sampling interval to the smallest value possible.

1.2.2.1 Start Performance Monitor (STRPFRMON) Command

Figure 1 shows an example of how to collect performance data to generate communications statistics to be analyzed either by the advisor or Performance Tools/400

```
                    Start Performance Monitor (STRPFRMON)

   Type choices, press Enter.

   Member . . . . . . . . . . . . . . MBR            *GEN
   Library  . . . . . . . . . . . . . LIB             QPFRxx 1
   Text 'description' . . . . . . . TEXT           Comm. PFR Analysis 2
 10/25/96
   Time interval (in minutes) . . . INTERVAL       5   3
   Stops data collection  . . . . . ENDTYPE        *ELAPSED
   Days from current day  . . . . . DAY            0
   Hour . . . . . . . . . . . . . . HOUR           2
   Minutes  . . . . . . . . . . . . MINUTE         0
   Data type  . . . . . . . . . . . DATA           *ALL 4
   Trace type . . . . . . . . . . . TRACE          *NONE
   Dump the trace . . . . . . . . . DMPTRC         *YES
   Job trace interval . . . . . . . JOBTRCITV      .5
   Job types  . . . . . . . . . . . JOBTYPE        *DFT
                             + for more values
   Start database monitor . . . . . STRDBMON       *NO  5
                                                                    More...
   F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
   F24=More keys
```

Figure 1. STRPFRMON Command

Notes:

1 When collecting performance data, you can use the default library QPFRDATA or you can create a specific library for your data. For example, you can create a library with your customer name.

2 As you may have several performance members in that library, put a text description of each member collected to help identify them. Usually, it is a good idea to include the date of the collection in the description field.

3 Set the time interval to five minutes.

4 This specifies the type of information collected.
The possible values are:

***ALL** All of the information is collected including system information, communications information, and input/output processor (IOP) information.

***SYS** Only system information is collected. IOP information is not collected.

5 This parameter is new from Version 3 Release 6. Specifying *YES starts Database monitoring for all the jobs in the system and that usually is not preferable.

1.2.2.2 Start Database Monitor (STRDBMON) Command

You may use the STRDBMON command to start monitoring database activities if special information is required. Entering the STRDBMON command provides you with the following display:

```
                       Start Database Monitor (STRDBMON)

 Type choices, press Enter.

 File to receive output . . . . .   _______ 1     Name
   Library  . . . . . . . . . . .     *LIBL       Name, *LIBL, *CURLIB
 Output member options:
   Member to receive output . . .   *FIRST        Name, *FIRST
   Replace or add records . . . .   *REPLACE      *REPLACE, *ADD
 Job name . . . . . . . . . . . .   *       2     Name, *, *ALL
   User . . . . . . . . . . . . .     __________  Name
   Number . . . . . . . . . . . .     ______      000000-999999
 Type of records  . . . . . . . .   *SUMMARY      *SUMMARY, *DETAIL
 Force record write . . . . . . .   *CALC         0-32767, *CALC
 Comment  . . . . . . . . . . . .   *BLANK   3



                                                                   Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 2. STRDBMON Command

Notes:

1 Use this parameter to specify both the library and the file name to which the performance statistics are written. If the file does not exist, one is created based on the QAQQDBMN file in library QSYS.

2 Use this parameter to choose the job or jobs whose database activities are to be monitored.

3 Enter up to 100 characters of descriptive text on this input field.

Please note that at the time this publication was being written, there were no tools available for analyzing the data collected. Be extremely careful when collecting data because there is no way of knowing whether database monitoring is active or not.

Usually the data collected through the STRDBMON command includes no data directly related to communications performance.

IMPORTANT!

If you forget to turn the monitoring off, you may eventually fill up all of the disk space on the AS/400 system.

1.2.3 Automatic Data Collection

Automatic data collection allows you to select specific days of the week to collect the data using the OS/400 performance monitor. Use the Add Performance Collection (ADDPFRCOL) command or choose option 1 (add) on the Work with Performance Collection menu (achieved by entering WRKPFRCOL command) to establish a regular schedule for collecting performance data automatically on any day of the week.

You may either specify the day and the time to collect the performance data or just specify starting and ending times and run it every day of the week. Please make sure that the collection time includes the peak hours or the period you want to monitor.

Note: The default value of the RMTRSPTIME (Remote Response Time) parameter is *NONE which means that remote workstation response time is **not** collected unless otherwise specified.

1.2.4 Performance Management/400

One tool that is completely different from all the other tools discussed in this publication is Performance Management/400. It is a tool that is a combination of both collecting and analyzing the performance data.

Performance Management/400 (PM/400) is an IBM system management service offering that assists customers by helping them to plan and manage system resources through regular analysis of key performance indicators.

The service uses a set of software and procedures installed on the customer's system. The software collects performance data and summarizes and transmits the summarized data weekly to your local service provider.

PM/400 automates these functions and provides a summary of capacity and performance information. Reports and graphs are produced in a format that both non-technical and technical persons can understand.

Performance data is both analyzed and maintained by IBM. Contact your local service provider for more information about using PM/400.

PM/400 does not require Performance Tools/400 (5716-PT1) and has no intention to replace that product.

1.3 Using CL Commands Interactively

You have several commands to use for identifying the performance problem interactively:

WRKSYSSTS This command is used to get a quick look at the system wide performance figures such as:

- CPU usage
- Disk usage
- Memory usage

  Note: There is no way of knowing the amount of memory used; you can only observe the rate of paging, which indirectly tells you whether there is enough storage available or not.
- Job State transition rates

WRKACTJOB With this command, you can easily find out how the individual jobs are using system resources.

WRKDSKSTS With this command, you can observe the performance of each disk arm on the system.

WRKSYSACT With this command, you can observe both external jobs and internal task or processes. This command is actually the two previous commands in one package and is **only** available as a part of the Performance Tools/400 licensed program.

NOTICE!

Please bear in mind that using these commands can add a significant amount of workload to the system, especially if you are using the console display. In other words, analyzing a performance problem can cause more performance problems.

1.4 Using Performance Tools/400

Performance Tools/400 provides more ways for you to display performance related information about the system being analyzed.

1.4.1 WRKSYSACT Command

The Work with System Activity display allows you to view performance data in a real-time fashion. The data is reported for any selected job or task that is currently active on the system. Besides having the capacity to view this data on the display station, you may also direct the data to be stored in a database file for future use.

1.4.2 PRTACTRPT Command

The Print Activity Report (PRTACTRPT) command generates reports based on the data collected by the Work With System Activity (WRKSYSACT) command.

1.4.3 DSPPFRDTA Command

The Display Performance Data (DSPPFRDTA) command starts the interactive displays that are used for showing the performance data.

Note: This command can **only** be used when previously collected performance data is available.

1.4.4 The Advisor

Pay attention to any communications related recommendations or conclusions.

1.4.5 Produce Reports

The following list contains reports that you can produce by using the Performance Tools/400 licensed software.

System report Prints an overview of what happened on the system.

Component report
Prints performance data by job, user, pool, disk, IOP, local workstation, and exception.

Transaction report
Prints information about the transactions that occurred during the time that the performance data was collected.

The transaction report may be extended to print:

- Transaction detail report
- Transition detail report

Note: The transaction detail and transition detail reports are quite detailed. Use select/omit parameters to choose specific jobs, users, and time intervals only.

Lock report Prints a report that is used to determine whether jobs are delayed during processing because of unsatisfied lock requests or internal machine waits.

Job report Prints performance data about jobs that were active during the time that the performance data was collected.

Pool report Prints performance data about pools.

Resource report
Prints performance data about the system resources such as disks and workstation controllers.

Batch job report
Prints performance data about batch jobs traced through time. Resources utilized, exceptions, and state transitions are reported.

1.5 What to Look For

Follow the flow chart shown in Figure 3 on page 9 to solve your communication performance problem.

Questions to ask yourself about the performance problems are:

- Is the performance always unacceptable?
- Is the AS/400 system balanced? If it is not, follow the map in Figure 7 on page 20 or contact your service provider to get assistance with tuning the system.
- Is there a specific time of day/week/month when performance is poor?
- Are there batch jobs or file transfer jobs running during the poor performance time?
  - If the answer is yes, are the batch jobs running in the same storage pool as the communication jobs?
  - If the answer is yes, consider creating a separate storage pool for either batch jobs or the communication jobs.
- Are all of the users affected?
- Are only remote users affected?
- What do the complaining users have in common?
  - Is the same application used both in remote locations and locally?
  - Are all of the users for this application complaining?
  - Is there only one group of users having a problem?
  - Are all of the users connected to the same controller/line/IOP?

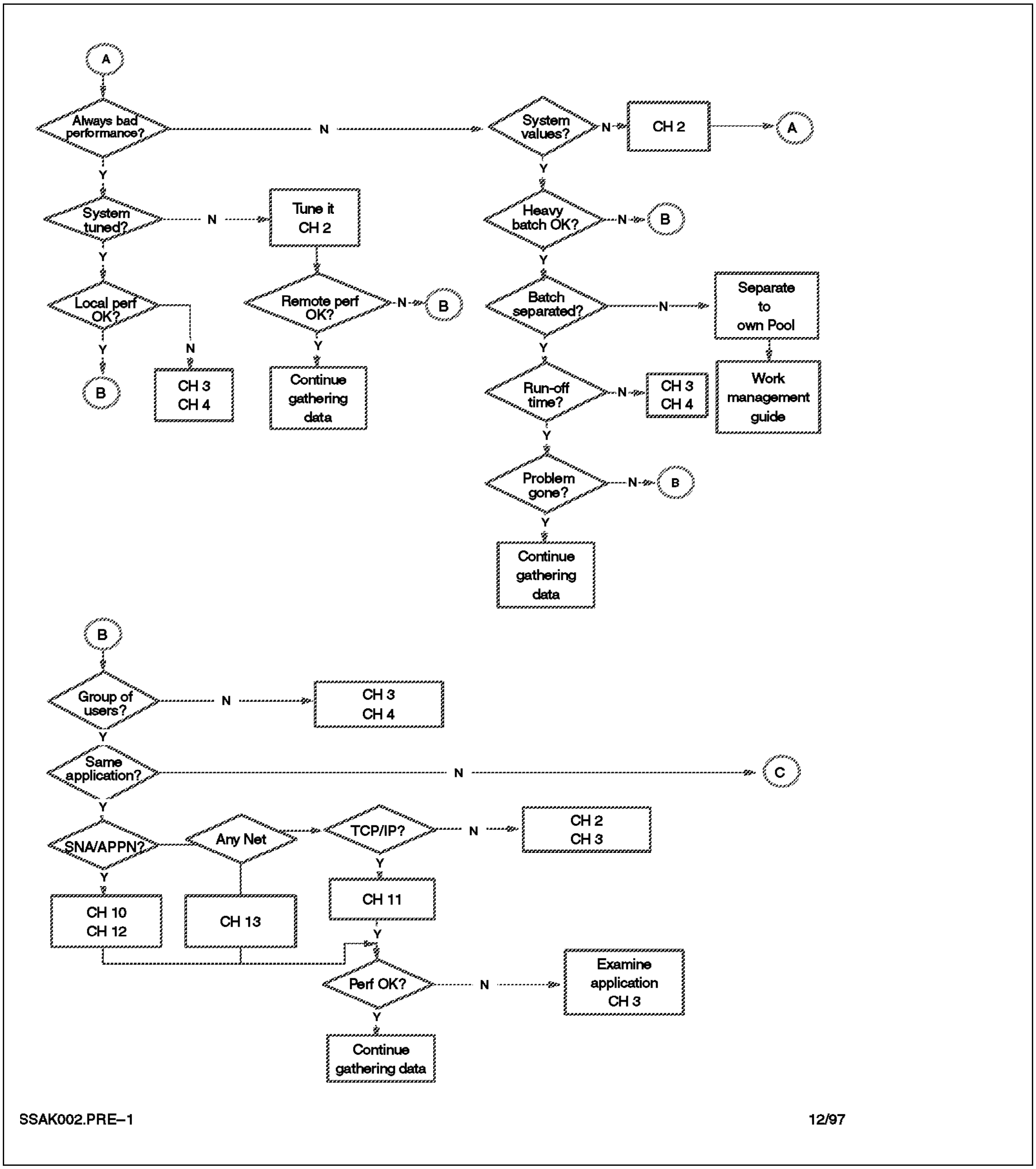

Figure 3. Where to Read, 1 of 2

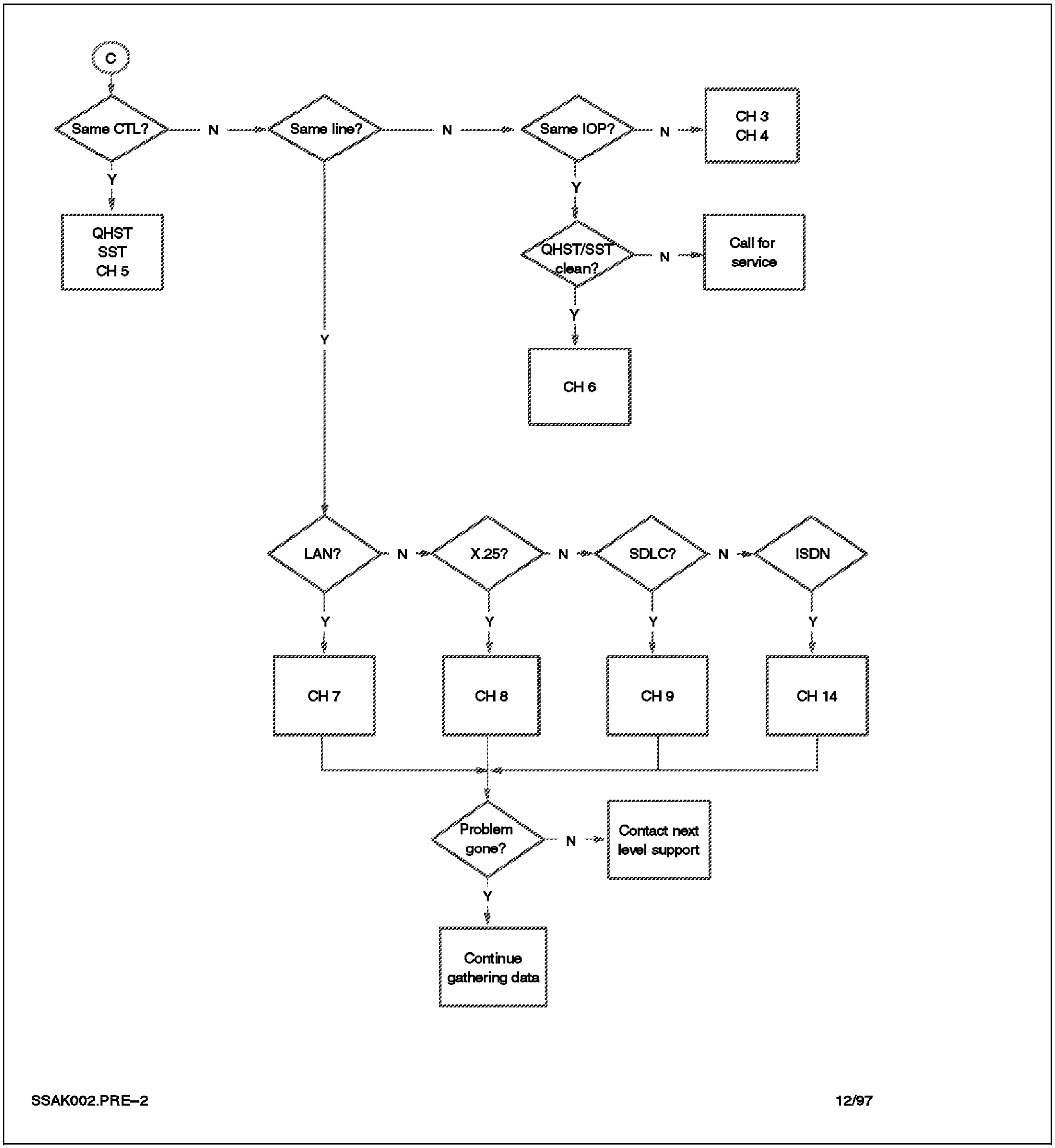

Figure 4. Where to Read, 2 of 2

Chapter 2. Using CL Commands to Find Performance Problems

This chapter provides information about identifying a communications performance problem by using command language (CL) commands interactively.

Please bear in mind that using these commands can add a significant amount of workload to the system, especially if you are using the console display. In other words, analyzing a performance problem can cause more performance problems.

2.1 WRKSYSVAL Command

System values are pieces of information that affect the operating environment in the entire system. System values are **not** objects and, therefore, they cannot be passed as parameter values the same as CL variables.

There are some system values that affect performance such as QTOTJOB, QACTJOB, QMAXACTLVL, QMCHPOOL, and QCMNRCYLMT. Review these values first because they can relate to your situation.

2.1.1 QTOTJOB

This value controls the **total** number of jobs for which the storage is allocated during IPL.

The correct setting of this system value can be obtained by entering the WRKSYSSTS command. Pay attention to the value displayed in the ″Jobs in system″ field because the amount of jobs in the system should never be greater than the value of QTOTJOB. Add 15% to the number of ″Jobs in system″ field and set this to be the system value QTOTJOB **provided that the following cautions are followed**:

- Remember to clear output queues regularly because OS/400 reserves storage for a job as long as there is at least one spooled output file for that job even though the job is inactive. The more files there are in output queues, the more jobs you see on the Work with System Status display.
- If you have a high number of spooled files on the system while using the WRKSYSSTS command and you add 15% more to set the QTOTJOB value, you **significantly** increase the time it takes to IPL the system. Performance is also affected at run time of any system functions that search through the system wide Work Control Block Table (WCBT). These functions include the WRKACTJOB command, WRKJOB command, and STRSBS command.
- Consider using the AS/400 Operational Assistant options to clean the obsolete spooled files such as old job logs and program dumps from the system. This can be done by entering `GO CLEANUP` on any command line.

If the amount of ″Jobs in system″ reaches this value, all of the jobs are paged out from the main storage and the amount of job structures given with the QADLTOTJ system value (the shipped value is 10) is created before all of the jobs are paged into the main storage and normal processing continues.

You can suspect a wrong setting of QTOTJOB if the system seems to ″slow down″ periodically with no apparent reason such as a heavy batch job visible. The ″hang up″ situation normally lasts a couple minutes after which normal processing continues until the previously created job structures are used up and a new ″hang up″ situation arises.

The value shipped with the operating system is 30 which normally is not large enough.

Note: A change of this system value is effective only after the next IPL.

2.1.2 QACTJOB

This value controls the initial number of **active** jobs for which storage is to be allocated during IPL. The amount of storage allocated for each active job is approximately 110K.

The correct setting for this value can be determined by entering the WRKACTJOB command; on the right-hand top corner of the display is the amount of active jobs in the system. Find out what is the highest amount of the active jobs during a busy day, add 10% to the number, and you have found the correct setting for the QACTJOB system value. The number of active jobs should not exceed this value, or all of the jobs are paged out from main storage until a number of job structures given with QADLACTJ are created.

You can suspect a wrong setting of QACTJOB if the system seems to ″fall asleep″ periodically with no apparent reason visible. The ″sluggish performance″ situation normally lasts a couple of minutes after which normal processing continues **until** the amount of previously created job structures are used up and a new ″hang up″ situation arises.

The value shipped with the operating system is 20 which normally is not large enough.

Note: A change of this system value is effective only after the next IPL.

Do Not Set the Values Too Large!

You must keep QACTJOB, QTOTJOB, QADLACTJ, and QADLTOTJ at reasonable values. If you make QACTJOB and QTOTJOB excessively high, the IPL is slower due to excessive storage allocation. If you make QACTJOB and QTOTJOB too small for your environment and you make QADLTOTJ and QADLACTJ excessively large, run-time performance can be impacted.

2.1.3 QMAXACTLVL

This value determines the maximum activity level of the system. This is the number of all the jobs that can compete at the same time for main storage and processor resources. If a job cannot be processed because no activity levels are available, the job is held until another job reaches a time slice end or a long wait. See Chapter 14 in the *Work Management Guide* for information about job state transitions.

Even though the value shipped with V3R7 is *NOMAX, ensure that this is the setting on your AS/400 system. This is because the value shipped with the previous releases (prior to V3R1M0) was 100 and **normally** the system values are not changed during the update of the operating system. A change to this system value takes effect immediately.

2.1.4 QMCHPOOL

This system value affects the size of the *MACHINE storage pool. The machine storage pool contains the highly-shared microcode and operating system programs. Some of the programs are pageable and some of them are not pageable. This means that you must be careful when changing the size for this storage pool because system performance may be impaired if the storage pool is too small.

Notes:

1. A change to this system value takes effect immediately. The shipped value is 20 000KB.
2. This value may be changed by the performance adjust support when the system value QPFRADJ is set to 1, 2, or 3.

You can also change the setting of the QMCHPOOL system value by using the Work with System Status display as described in the Section 2.4, "WRKSYSSTS Command" on page 16.

The third way of changing this system value is done by using the WRKSHRPOOL (Work with Shared Pools) command.

2.1.5 QCMNRCYLMT

This system value provides recovery limits for system communications recovery. It specifies the number of recovery attempts to make and when to send an inquiry message to the system operator if the specified number of recovery attempts has been reached.

The recommended value is (2 5), which means that two communication line or control unit retries are tried within a 5-minute interval. Never set the first value (count limit) equal to or greater than the second value (time interval) excluding (0 0).

If the count limit is 0, regardless of the time interval, no recovery attempts are made. When the count limit is greater than 0 and the time interval is 0, **infinite recovery** attempts are being made. If the count limit is greater than 0 and the time interval is greater than 0, the specified number of recovery attempts are made and an inquiry message is sent to the operator after the specified time interval.

Table 1. QCMNRCYLMT Settings Examples

Count Limit	Time Interval	Action
0	0	No recovery
0	1 through 120	No recovery
1 through 99	0	Infinite recovery
1 through 99	1 through 120	Count and time recovery

An incorrect setting of a QCMNRCYLMT value can cause the system to perform the line or controller recovery continuously. Under some conditions, the continuous retries can consume a significant amount of system resources. If this occurs, stop the process by varying the configuration object off.

2.2 PRTERRLOG Command

The next step of solving a communications performance problem is to verify that the hardware is functioning properly. This can be done with the PRTERRLOG (Print Error Log) command that is used **primarily** for problem analysis tasks. The command places a formatted printer file of the data in the system error log (in case there are errors reported) into a spooled printer device file named QPCSMPRT or into a specified output file.

This command is shipped with public *EXCLUDE authority. The following user profiles have private authorities to use the command: QPGMR, QSYSOPR, QSRV, and QSRVBAS.

The first page of the PRTERRLOG command prompt looks similar to the following display:

```
                         Print Error Log (PRTERRLOG)

 Type choices, press Enter.

 Type of log data to list . . . .   *ALL           *ALL, *ALLSUM, *ANZLOG...
 Logical device . . . . . . . . .   *ALL           Name, *ALL
               + for more values    __________
 Resource name  . . . . . . . . .   __________     Name
               + for more values    __________
 Error log identifier . . . . . .   ________       Hexadecimal value
               + for more values    ________
 Output . . . . . . . . . . . . .   *PRINT         *PRINT, *OUTFILE
 Time period for log output:

   Beginning time . . . . . . . .   *AVAIL         Time, *AVAIL
   Beginning date . . . . . . . .   *CURRENT       Date, *CURRENT

   Ending time  . . . . . . . . .   *AVAIL         Time, *AVAIL
   Ending date  . . . . . . . . .   *CURRENT       Date, *CURRENT
 Print format . . . . . . . . . .   *CHAR          *CHAR, *HEX
                                                                    More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 5. PRTERRLOG Command Prompt

You can also view the error log by using the System Service Tool as described in Chapter 5, "Using System Service Tools" on page 71.

If the list produced with the Print Error Log command contains no hardware errors in lines, controllers, or IOPs, proceed with the next topic. Otherwise, contact your hardware service provider.

2.3 PTF Commands

This topic provides only part of the information about working with PTFs. For more information, see Chapter 4 in *AS/400 System Startup and Problem Handling*, SC41-4206.

Install the latest cumulative PTF package about every four months or at least twice a year. This is to ensure that your system has the latest level of code installed, and usually most of the so-called "performance PTFs" are included in the cumulative PTF packages.

IBM creates PTFs to correct problems or potential problems found within IBM licensed programs. PTFs may fix problems that appear to be hardware failures, or they may provide new or enhanced functions.

2.3.1 DSPPTF

The Display Program Temporary Fix (DSPPTF) command shows the program temporary fixes (PTFs) for a specified product.

To find out what level of code is running on the system, type the DSPPTF 5716999 command on any command line and you receive the "Display PTF Status" display. The first line displayed shows you the latest cumulative PTF package installed on your system.

2.3.2 SNDPTFORD

To find out what the latest PTF package is, enter the SNDPTFORD PTFID((SF98370)) command and press Enter. If you have a maintenance agreement with IBM, you receive a file that has information about:

- PTF packages available for Version 3 Release 7
- Installing the latest cumulative package
- Preventive service planning (PSP) information for installing the latest cumulative PTF package
- PSP information for installing Version 3 Release 7
- IBM frequently-asked questions about the AS/400 system
- Summary of the Version 3 Release 7 High Impact/Pervasive (HIPER) PTFs and PTFs that are in error (PE)
- Complete detailed list of the Version 3 Release 7 PTFs that are in error (PE)
- Complete detailed list of the Version 3 Release 7 High Impact/Pervasive (HIPER) problems
- Summary of the generally available Version 3 Release 7 PTFs

Enter the SNDPTFORD PTFID((SF97370)) command to obtain a listing that provides you with a convenient reference of the License Internal Code fixes and program temporary fixes (PTFs) that are available by IBM licensed program categories. This listing is updated regularly. You may choose to order a PTF/FIX that effects one of your IBM licensed programs.

Enter the SNDPTFORD PTFID((SF99370)) command to order the latest cumulative PTF package that is available in your country.

Information about the latest performance PTFs can also be obtained by reading item 130NC in HONE.

2.4 WRKSYSSTS Command

Observe and balance the **overall (system wide) performance** before focusing on a communications performance problem. The reason for this is that the communications performance is only a relatively small part of the overall performance. If the entire system is functioning poorly, there normally is no use trying to figure out what might be wrong with communications.

2.4.1 WRKSYSSTS

The Work with System Status display shows the current status of the system in real time. Use this display to observe the paging fault rates and job transitions. The indicators you need to pay special attention to (in order of priority) are:

1. Non database fault rates in the machine pool
2. Non database fault rates in all the other pools
3. Page rates in all the pools
4. Transition rates in all the pools

Note: When tuning the system, make sure that the machine pool is treated separately from the other pools.

Use the faulting guidelines in the *Work Management Guide* manual and Appendix I, "Guidelines for Interpreting Performance Data" on page 379 to determine the effects that faulting has on performance. The following examples may help you to understand the faulting guidelines:

- The response time of an interactive transaction is affected by any faults that occur during that transaction. Each fault adds from 10 to 30 milliseconds to the end-user's response time. For example, if the disk response time is 20 milliseconds and the transaction has five faults per transaction, add about 0.1 seconds to the total response time.
- Each fault consumes a certain amount of the CPU power: the more faults that occur, the more CPU is being consumed for unproductive work. In the following examples, processing the transactions consumes 70% of the CPU capability and the faulting rate is 100.
  - On a 9401 class (CPW close to 7) processor, these faults use CPU for 0.6 seconds.
  - On an 9402 model 2130 class (CPW close to 12) processor, these faults use CPU for 0.3 seconds.
  - On an 9406 530 class (CPW close to 132) processor, these faults use CPU for 0.02 seconds.

  If the faulting rate of your system is close to the poor end of the faulting guidelines tables, approximately 10% to 20% of the CPU is used for faulting. Adding main storage to reduce the faulting rate also lowers the CPU utilization, thus leaving more processing power available to handle more transactions.
- With the increasing faulting rate, the amount of disk I/O also increases. If you have only a few actuators, these faults can cause the disk utilizations to increase more rapidly than if you have many disk arms. As your disk arm (actuator) utilization increases, the time to process disk I/Os increases and the response times get longer.

While using the Work with System Status display to analyze a communication performance problem, concentrate on two storage pools:

***MACHINE pool**
: This is the pool in which the OS/400 jobs and microcode tasks run. Normally this is the pool that should have the rate of non-DB faults below 10 faults per second.

OTHER pool
: This is the pool in which the communications jobs are routed to. The shipped value for this is the *BASE pool. Investigate the subsystem descriptions for QCMN and QSERVER subsystems to see which storage pool is being used by the jobs and focus on that storage pool.

- What is the faulting rate in the *MACHINE pool? See Table 17 on page 379 for guidelines of non-database page faults in the storage pool. If the rate is not acceptable, see the map in Figure 7 on page 20.
- What is the faulting rate in the storage pool used for communications jobs?
- A rule of thumb for the initial **Activity Level Factor** used for the communications subsystem is 500K per activity level (for example, 4000K of memory and an activity level of 8 should provide adequate resources for **interactive** work). If 500K per activity level is not enough, add memory to the pool or decrease the activity level in the pool.

  Remember to provide enough activity levels in the pool where the communication jobs are running or you may experience a significant performance degradation. Please note that file transfer jobs require considerably more memory than interactive jobs so a rule of thumb for a **file transfer job** is a 2000K per transfer.
- If you have Client Access/400 users running critical file transfer functions, consider separating the transfer jobs to a storage pool of their own. Create a new storage pool for subsystem QCMN and direct the routing entry having the compare value QTFDWNLD to that pool. The following table describes the routing entries that you may work with to override the IBM supplied default values:

Table 2. IBM Supplied Program Routing Entry Compare Values for V3R7

Compare Value	Subsystem Description	Function
′QCNPCSUP ′	QBASE, QCMN	CLIENT ACCESS/400 SHARED FOLDERS 0, 1
′QCNTEDDM ′	QSYSWRK	DDM
′QHQTRGT ′	QBASE, QCMN	CLIENT ACCESS/400 REMOTE DATA QUEUE
′QLZPSERV ′	QBASE, QCMN	CLIENT ACCESS/400 LICENSE MANAGER (ORIGINAL CLIENTS)
′QMFRCVR ′	QBASE, QCMN	CLIENT ACCESS/400 MESSAGE SENDER
′QMFSNDR ′	QBASE, QCMN	CLIENT ACCESS/400 MESSAGE RECEIVER
′QNPSERVR ′	QBASE, QCMN	CLIENT ACCESS/400 NETWORK PRINT SERVER
′QOCEVOKE ′	QBASE, QCMN	CROSS-SYSTEM CALENDARING
′QOQSESRV ′	QBASE, QCMN	DIA VERSION 2 (Prestart Job Entry)
′QRQSRV ′	QBASE, QCMN	REMOTE SQL - DRDA
′QTFDWNLD ′	QBASE, QCMN	CLIENT ACCESS/ 400 FILE TRANSFER FACILITY
′QZDAINIT ′	QSERVER	DATABASE SERVERS (ODBC and Remote SQL)
′QZHQTRG ′	QBASE, QCMN	CLIENT ACCESS/400 REMOTE DATA QUEUE SERVER
′QZRCSRVR ′	QBASE, QCMN	CLIENT ACCESS/400 REMOTE COMMAND SERVER
′QZSCSRVR ′	QBASE, QSRV	CLIENT ACCESS/400 CENTRAL SERVER
′QVPPRINT ′	QBASE, QCMN	CLIENT ACCESS/ 400 VIRTUAL PRINT

```
                          Work with System Status                     SYSNM005
                                                             10/25/96  11:48:34
% CPU used . . . . . . . :        32.3    System ASP . . . . . . . :    11.80 G
Elapsed time . . . . . . : 6 00:22:59    % system ASP used  . . . :    77.0307
Jobs in system . . . . . :        5611    Total aux stg  . . . . . :    11.80 G
% perm addresses . . . . :        .007    Current unprotect used . :     315 M
% temp addresses . . . . :        .016    Maximum unprotect  . . . :     695 M
                                                                  5
Sys     Pool   Rsrv     Max  -----DB-----  ---Non-DB---  Act-    Wait-  Act-
Pool   Size K  Size K   Act  Fault  Pages  Fault  Pages  Wait    Inel   Inel
  1     59488 2 33980   +++     .0     .0 1 1.2    1.4    8.9     .0     .0
  2     73564       0    19     .2     .2     .4    1.2   12.3     .1     .0
  3       512       0     1     .0     .0     .0     .0     .0     .0     .0
  4    183352       0     5     .0     .1     .4    5.5   11.4     .0     .0
  5     12300       0     3     .0     .0     .0     .0     .0     .0     .0
  6     64000       0     8  4  .0     .0  3  .1     .2    1.4     .0     .0




                                                                        Bottom
===> ____________________________________________________________________________
F21=Select assistance level
```

Figure 6. The Preferred WRKSYSSTS Display

Notes:

1 This column is the most important column of this display. Because the machine pool contains objects used system-wide, page faulting in this pool affects **all** of the jobs in the system. Therefore, it is desirable to maintain a low page fault rate in this pool. **The only way to affect the paging in the machine pool is to adjust the size of the pool**.

See Table 17 on page 379 for guidelines of non-database page faults in the *MACHINE pool.

2 The rule of thumb for adjusting the **machine pool size** is to multiply the number in the ″Reserved Size″ field by one and a half.

3 This column represents the sum of non-database faults in all of the storage pools and this is the column you need to focus your attention on. The non database faults include program code (jobs′ work areas and variables, for example). To affect the faulting rate in the pool (except machine pool), you can change either the size or the activity level of the pool.

See Table 18 on page 379 and Table 19 on page 380 for guidelines about the amount of faults in storage pools.

4 This column represents the sum of database faults in all of the storage pools. Please remember that a system with no database faults is a ″dead″ system. This is because the data may be changed only when the data is in the main storage and if the data is **not** in the main storage, the system issues a fault. When no database pages are brought into the main storage, not a single piece of data is being changed and no work is done with the system.

Basically, a fault is an order to go and get a piece of data from a disk to main storage so that the data can be changed. Technically speaking, a page fault is a program notification that occurs when a page that is marked as not in main storage is referred to by an active program.

5 These last three columns (from left to right) represent the job's state transitions. When the pool size and activity level settings are in balance with each other, the ratio of columns (from left to right) should be 10 to one. Usually, when the pool size and activity level settings are correct for the workload, the transition rates fall within the guidelines.

A job running on the system is in one of the following states:

Active The job is in main storage and it is processing work that is requested by the application.

Wait The job needs to use a resource that is momentarily unavailable.

Ineligible The job has all of the resources required to do the processing, but it is waiting for a free activity level.

Wait-to-ineligible transitions need not be zero all of the time. When there is a momentary period of heavy usage, it may be better to let the jobs become ineligible to avoid excessive page fault rates or thrashing.

See Table 20 on page 380 for guidelines of the ratio of Wait-to-Ineligible/Active-to-Wait transitions.

6 The time frame of the observation period should be kept between five and 30 minutes. If the observation period is less than five minutes, the occasional peak loads tend to distract the rates of both faults and pages. On the other hand, if the time period is over 30 minutes, the important data may be lost because the counters holding the data may get wrapped.

2.4.2 Information About Activity Level Guidelines

Table 3. Activity Level

Resource Description	Where to Look	Compare With
Activity Level for *BASE and QSPL pool	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	Figures given in Chapter 14 in the *Work Management Guide*.
QINTER Activity Level	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	See Table 22 on page 380.

2.4.3 Information About Transition Guidelines

Table 4. W-I and A-W Ratio

Resource Description	Where to Look	Compare With
W-I/A-W	System Report: Storage Pool Utilization, WRKSYSSTS	See Table 20 on page 380.

2.4.4 Interactive Tuning Roadmap

Balancing your main memory and CPU utilization is accomplished by allocating the memory available and setting the activity levels in the storage pools. Refer to the *Work Management Guide* for the guidelines of both the memory and activity level settings.

Note: You have to repeat Step 4 through Step 7 for all of the other pools in your AS/400 system; Step 3 is for the *MACHINE pool only. Follow the road map during periods of high system′s activity because there is no use tuning the system when there is only a relatively light workload on the system. Make sure that system value QPFRADJ is set to zero before following the tuning road map.

```
                 Interactive AS/400 Tuning Roadmap

  1. Enter command WRKSYSSTS.
     Press PF21 to set assistance level to Intermediate.

  2. Wait 2-3 minutes and press PF5 to refresh.

  3. Does *MACHINE NDB faults meet the guidelines?
     a.  Yes ... Press PF10 and go to step 4.
     b.  No .... Adjust QMCHPOOL:
         1) -50K if fault rate = 0
         2) +50K if fault rate > 3.0
         3) Press PF10 to reset and go to step 2.

  4. Is the DB fault + NDB fault > 20 in any pool?
     a.  Yes ... Increase pool size by 50KB, press PF10 and repeat
                 Step 4 (repeat until all pools are less than 20).
     b.  No .... Go to step 5.

  5. Wait 2-5 minutes, press PF5.  Press PF21 to set the Assistance
     level to Advanced.
     Is the Wait to Ineligible state = 0?
     a.  Yes ... Reduce Activity level by 2, press PF10 to reset, and
                 repeat step 5.
     b.  No .... Go to step 6.

  6. Is the Active to Wait state 10x the activity level?
     a.  No ....System not heavily used or complex application mix,
                 go to step 4.
     b.  Yes ... Go to step 7.

  7. Is the sum of all fault rates for all pools within guidelines?
     a.  No .... Go to step 4.
     b.  Yes ... Go to step 8.

  8. Activity levels and pool sizes probably OK.  Continue monitoring
     WRKSYSSTS display regularly.
```

Figure 7. AS/400 Tuning Roadmap

2.5 WRKACTJOB Command

The Work with Active Jobs command measures system performance by measuring aspects such as the CPU usage and response time. The following examples show the different Work with Active Jobs displays.

To view the Work with Active Jobs display, type WRKACTJOB on any command line and press the Enter key. Press the PF21 key to show more jobs on one display as in the following example:

```
                          Work with Active Jobs                   SYSNM005
                                                        10/25/96  11:48:49
 CPU %:    3.4     Elapsed time:   00:22:42     Active jobs:   119
 Opt  Subsystem/Job  User         Type  CPU %  Function        Status
 __   QBATCH         QSYS         SBS      .0                   DEQW
 __   QCMN           QSYS         SBS      .0                   DEQW
 __     USERPC       COOK         EVK      .0  *  -PASSTHRU     EVTW
 __     USERPC       COOK         EVK      .0  *  -PASSTHRU     EVTW
 __     P23ARTYC     AS0219R      EVK      .0  *  -PASSTHRU     EVTW
 __     P23ARTYC     AS0219R      EVK      .0  *  -PASSTHRU     EVTW
 __   QCTL           QSYS         SBS      .0                   DEQW
 __     QJSCCPY      A960303A     BCH      .0  PGM-QSCCPY       DEQW
 __     QSYSSCD      QPGMR        BCH      .0  PGM-QEZSCNEP     EVTW
 __   QINTER         QSYS         SBS      .0                   DEQW
 __     USERPCF      USER         INT      .0  CMD-STRSST       DEQW
 __     USERPCI      USER         INT      .2  CMD-DSPLOG       DSPW
 __     QPADEV0006   A960303A     INT      .0  CMD-WRKSYSSTS    RUN
 __     QPADEV0016   A960303B     INT      .0  CMD-DSPMSG       DSPW
 __     QPADEV0017   A960303B     INT      .0  MNU-MAIN         DSPW
 __     QPADEV0021   A960303C     INT      .2  CMD-WRKQRY       DSPW
                                                                   More...
 ===> ____________________________________________________________________
 F21=Display instructions/keys
```

Figure 8. WRKACTJOB after Pressing PF21

More information is displayed after pressing the PF11 (Display elapsed data) key:

```
                             Work with Active Jobs                  SYSNM005
                                                           10/25/96  11:48:49
CPU %:    3.4     Elapsed time:   00:22:42     Active jobs:   119
Opt  Subsystem/Job  Type  Pool  Pty       CPU  Int     Rsp  AuxIO  CPU %
__   QBATCH         SBS     2    0         .6                   3     .0
__   QCMN           SBS     2    0        2.9                   1     .0
__     USERPC       EVK     2   20         .0                   0     .0
__     USERPC       EVK     2   20         .0                   0     .0
__     P23ARTYC     EVK     2   20         .1                   0     .0
__     P23ARTYC     EVK     2   20         .0                   0     .0
__   QCTL           SBS     2    0        1.0                   6     .0
__     QJSCCPY      BCH     2   10         .1                  78     .0
__     QSYSSCD      BCH     2   10         .3                   0     .0
__   QINTER         SBS     2    0        2.8                   0     .0
__     USERPCF      INT     4   20        2.7    0      .0      0     .0
__     USERPCI      INT     4   20       14.7  140      .2    428     .2
__     QPADEV0006   INT     4   20       15.6   19      .1    218     .0
__     QPADEV0016   INT     4   20       21.0    0      .0      0     .0
__     QPADEV0017   INT     4   20         .4    0      .0      0     .0
__     QPADEV0021   INT     4   20       17.8  160      .0    524     .2
                                                                    More...
===> ____________________________________________________________________________
F21=Display instructions/keys
```

Figure 9. WRKACTJOB after Pressing PF11

You may place the cursor on any column and arrange the display in a descending sequence, for example:

- CPU %
- Response time
- DISK I/O

```
                             Work with Active Jobs                  SYSNAM05
                                                           10/25/96  11:49:03
CPU %:    3.4     Elapsed time:   00:22:56     Active jobs:   119
Opt   Subsystem/Job Type  Pool  Pty       CPU  Int     Rsp  AuxIO  CPU %
__     USERPCI      INT     4   20       14.7  142      .2    431     .2
__     QPADEV0006   INT     4   20       15.8   21      .1    228     .0
__     QPADEV0021   INT     4   20       17.9  161      .0    524     .2
__     QPADEV0017   INT     4   20         .4    0      .0      0     .0
__     QPADEV0016   INT     4   20       21.0    0      .0      0     .0
__     USERPCF      INT     4   20        2.7    0      .0      0     .0
__     X2507        BCH     2   40        2.5                  25     .0
__     X2506        BCH     2   40         .0                   0     .0
__     TCPIPLOC     BCH     2   40         .0                   0     .0
__     TARGET2      BCH     2   40         .0                   0     .0
__     TARGET1      BCH     2   40         .0                   0     .0
__     SCPF         SYS     2   40       38.9                  24     .0
__     SYSTEM49     BCH     2   40         .1                   0     .0
__     SYSTEM40     BCH     2   40         .0                   0     .0
__     ARHIPPA3     BCH     2   40         .0                   0     .0
__     SYSTEM12     BCH     2   40         .0                   0     .0
                                                                    More...
===> ______________________________________________________________________
F21=Display instructions/keys
```

Figure 10. WRKACTJOB Sequenced by Response Time

Pay attention to the following subjects:

- Is a communications job consuming a relatively great deal of CPU?
- Are there any communications jobs creating lots of I/O?
  - If there is, display the job by entering a number five in front of the job and you receive the "Work with Job" display.
  - Are there many files opened?
  - Are there many logical files opened?
  - Can a similar task be done on a locally attached terminal?
  - Is the response time the same in both cases?
  - If it is, go and see what the application is doing.
  - Can the application itself be modified?

2.6 Using WRKDSKSTS

The Work with Disk Status display shows performance and status information about the disk units on the system. Type the WRKDSKSTS command on the command line and press the Enter key. The Work with Disk Status display is shown:

```
                              Work with Disk Status                    SYSNM005
                                                             10/25/96  11:49:17
Elapsed time:   00:00:00

               Size    %      I/O   Request    Read  Write    Read  Write    %
Unit  Type      (M)  Used     Rqs  Size (K)     Rqs   Rqs      (K)   (K)   Busy
   1  6606     1967  82.0      .0        .0      .0    .0       .0    .0      0
   1  6606     1967  82.0      .0        .0      .0    .0       .0    .0      0
   3  6606     1475  75.9      .0        .0      .0    .0       .0    .0      0
   4  6606     1475  76.0      .0        .0      .0    .0       .0    .0      0
   5  6606     1967  76.0      .0        .0      .0    .0       .0    .0      0
   6  6606     1967  76.0      .0        .0      .0    .0       .0    .0      0
   7  6606     1475  75.9      .0        .0      .0    .0       .0    .0      0
   8  6606     1475  76.0      .0        .0      .0    .0       .0    .0      0






                                                                         Bottom
Command
===> ____________________________________________________________________
F3=Exit   F5=Refresh   F12=Cancel   F24=More keys
```

Figure 11. The WRKDSKSTS Display

Note: Before observing disk status, have your system tuned according to either Figure 7 on page 20 or as described in Chapter 14 in the *Work Management Guide*.

When viewing the Work with Disk Status display, pay attention to the percent busy data that is actually the estimated percentage of time the disk unit is being used during the elapsed time. This estimate is based on:

- The number of I/O requests
- The amount of data transferred
- The performance characteristics of the type of disk unit

Each unit (actuator) should be less than 50% busy. An **actuator** is the device within an auxiliary storage device that moves the read and write heads. If each unit is between 50% and 70% busy, you may experience variable response times. In case all the units are more than 70% busy, the amount of actuators is inadequate for the workload in the system. If you have a well-tuned system with actuators exceeding the 50% busy guideline, increase the number of disk actuators.

It is possible to experience unacceptable performance even if only one actuator exceeds the 50% busy guideline. This usually happens when frequently-used data is placed on a single actuator. If this happens on your system, use the Performance Tools/400 licensed program to run the disk report to find out which data is frequently used. After identifying the data causing the bottleneck, you can save the data, delete the data, and restore the data to spread it across all of the actuators.

A batch job accessing the data can cause a short time period of an actuator exceeding the 50% guideline. If the data is not concentrated on a single actuator, you notice the high percentage of the utilization moving from one unit to another unit.

Note: Please remember that observation periods of less than five minutes usually do not provide reliable results.

To notice either improving or degrading trends in the disk performance, observe the historical data created from the regularly collected performance data.

2.7 WRKSYSACT Command

This command is a part of the Performance Tools/400 licensed program and is actually an enhancement of the Work with Active Jobs display. It is the only tool that shows both external jobs and internal tasks at the same time on the display. By default, the jobs are sequenced by CPU usage but you can also sequence the display by I/O.

- Are there any communications related modules consuming CPU?
- Are there any communications related modules consuming Disk?
  - If the answer is yes, contact your service provider to find out if there are any Program Temporary Fixes available for these modules.

Notice!

The performance statistics reported by this function represent activity that has occurred **since a previous collection**. This implementation may be different from other system functions that generally provide cumulative values until specifically reset.

If the Performance Tools/400 licensed program is installed on your system, enter the WRKSYSACT command on any command line to receive the following display:

```
                         Work with System Activity

Automatic refresh in seconds  . . . . . . . . . . . . . . . . . .   5
Elapsed time . . . . :   00:00:03       Overall CPU util . . :   2.6



Type options, press Enter.
  1=Monitor job   5=Work with job     1     2     3     4
                                                Total  Total
     Job or                                CPU   Sync  Async   PAG
Opt  Task        User        Number  Pty  Util   I/O    I/O   Fault
 _ 5 QPADEV0006  A960303A    060789    1    .9     0      0       0
 _   QPADEV0021  A960303C    060812   20    .5     0      0       0
 _   QTGTELNETS  QTCP        060229   20    .4     2      0       1
 _   QJSCCPY     A960303A    060839   10    .1     0      1       0
 _   VTMTS1                            0    .1     0      0       0
 _   IPR2050103                        0    .1     0      0       0
 _   SMP00006                          0    .1    15      0       0
 _   CFINT1                            0    .1     0      0       0
                                                                       Bottom
F3=Exit   F10=Update list 6 F11=View 2   F12=Cancel   F19=Automatic refresh
F24=More keys 7
```

Figure 12. WRKSYSACT Display View 1 is a Summary Display

Notes:

1 This column displays the run priority of the job.

2 This column displays the CPU utilization of the job.

3 This column displays the total amount of **synchronous** I/O the job is causing. Having a low amount of synchronous I/O is important because a job has to **wait** for the completion of the synchronous I/O operation before continuing.

4 This column displays the total amount of **asynchronous** I/O caused by the job. The amount of asynchronous I/O is of less importance than the amount of synchronous I/O because a job can continue processing immediately after requesting an asynchronous I/O. In a way, an asynchronous I/O is similar to a batch job; after having submitted it, you do not have to wait for its completion.

5 By entering ″1″ in this field, you can monitor this job **only** and by entering ″5″, you access the ″Work With Job″ display. You can monitor up to 20 jobs and tasks at a single time.

6 By pressing the PF11 key, you can select from three different displays: the summary, Synchronous I/O details, and Asynchronous I/O details.

7 Press the PF24 key for additional function keys to use. Press the PF14 key to display jobs only and exclude the information for tasks. Press the PF15 key to display tasks only and exclude the information for jobs. You can also use the PF16 key to display the jobs/tasks in a descending order of disk I/O operations.

```
                         Work with System Activity

 Automatic refresh in seconds  . . . . . . . . . . . . . . . . .   __5
 Elapsed time . . . . :   00:00:03       Overall CPU util . . :   2.6



 Type options, press Enter.
   1=Monitor job   5=Work with job
                                                   --------Synchronous---------
      Job or                                CPU     DB      DB    Non-DB  Non-DB
 Opt  Task         User         Number  Pty  Util   Read   Write   Read    Write
  _   QPADEV0006   A960303A     060789    1    .9      0       0       0       0
  _   QPADEV0021   A960303C     060812   20    .5      0       0       0       0
  _   QTGTELNETS   QTCP         060229   20    .4      0       0       2       0
  _   QJSCCPY      A960303A     060839   10    .1      0       0       0       0
  _   VTMTS1                              0    .1      0       0       0       0
  _   IPR2050103                          0    .1      0       0       0       0
  _   SMP00006                            0    .1      0       0       0      15
  _   CFINT1                              0    .1      0       0       0       0
                                                                          Bottom
 F3=Exit   F10=Update list   F11=View 3   F12=Cancel   F19=Automatic refresh
 F24=More keys
```

Figure 13. WRKSYSACT Display View 2, Details of Synchronous I/O

```
                         Work with System Activity

 Automatic refresh in seconds  . . . . . . . . . . . . . . . . .   __5
 Elapsed time . . . . :   00:00:03       Overall CPU util . . :   2.6



 Type options, press Enter.
   1=Monitor job   5=Work with job
                                                   --------Asynchronous--------
      Job or                                CPU     DB      DB    Non-DB  Non-DB
 Opt  Task         User         Number  Pty  Util   Read   Write   Read    Write
  _   QPADEV0006   A960303A     060789    1    .9      0       0       0       0
  _   QPADEV0021   A960303C     060812   20    .5      0       0       0       0
  _   QTGTELNETS   QTCP         060229   20    .4      0       0       0       0
  _   QJSCCPY      A960303A     060839   10    .1      0       1       0       0
  _   VTMTS1                              0    .1      0       0       0       0
  _   IPR2050103                          0    .1      0       0       0       0
  _   SMP00006                            0    .1      0       0       0       0
  _   CFINT1                              0    .1      0       0       0       0
                                                                          Bottom
 F3=Exit   F10=Update list   F11=View 1   F12=Cancel   F19=Automatic refresh
 F24=More keys
```

Figure 14. WRKSYSACT Display View 3, Details of Asynchronous I/O

Chapter 3. Using Performance Tools/400

Performance analysis is a method of investigating, measuring, and correcting deficiencies so that system performance meets the user′s expectations. The problem solving cycle should be similar to:

1. Understand the symptoms of the problem.
2. Use tools to measure and define the problem.
3. Isolate the cause.
4. Correct the problem.
5. Use tools to verify the correction.

Once the apparent cause (or causes) is isolated, you can propose a solution. The solution can be something simple such as tuning the storage pools, or a complex one that requires application recoding.

To achieve the optimum performance, you must understand the relationships between critical system resources and attempt to balance the use of the resources that are the CPU, the main storage, the disk units, and the communication lines. However, any improvement can only come through analyzing the critical resources and contention for both system and application objects.

3.1 System-Wide Problem Analysis

The ways to analyze the system-wide performance are:

- Using the CL commands as described in Chapter 2, "Using CL Commands to Find Performance Problems" on page 11.
- Using the Performance Tools/400 reports and displays as described in this chapter.

3.1.1 Advisor

The Advisor provides the easiest way of evaluating the performance data. It is a tool located between automatic system tuning and performance reports. You can either enter the Analyze Performance Data (ANZPFRDTA) command or choose option 10 on the PERFORM menu to start the advisor.

The Advisor uses data collected by the Performance Monitor to recommend performance tuning changes, and it can also point out other problems affecting system performance. You can use the Advisor to analyze the performance data collected from other systems.

The Advisor analyzes one member set of performance data at a time. Select the member that was collected when the performance problem occurred.

It is easy to find the right time interval to analyze by using the display histogram function. For example, if you need a time interval when the transactions had the longest response times, select the transaction response time option on the Display Histogram display. From the chart, select a time interval by moving the cursor to that interval, type 1, and press the Enter key. The Advisor analyzes the performance data collected during that particular interval and gives you recommendations and conclusions.

The Advisor analyzes performance data, including:

- Storage pool sizes
- Activity levels
- Disk and CPU utilization percentages
- Communications line utilization percentages and error rates
- IOP utilization percentages
- Unusual job activities such as exceptions or excessive use of system resources
- Interactive trace data (when collected)

Note!

To avoid causing a serious performance impact while running the Advisor interactively, start the advisor by entering the ANZPFRDTA command. Press the PF4 (prompt) key followed by the PF10 (additional parameters) key to change the value of the DATATYPE parameter from *ALL to *SAMPLE. If you need to analyze the trace data with Advisor, consider submitting the job or running it when your system has a light workload.

You can either select all of the intervals or a subset of the time intervals for analysis. You can run the Advisor either interactively or as a batch job. The output of using the Advisor is grouped under the following headings:

- Recommendations
- Conclusions
- Interval conclusions

All of the headings have information about:

- CPU utilization of high priority (with a run priority 20 or higher) jobs
- Performance analysis of interactive transactions by using the trace data collected with the performance monitor
- Main storage utilization and Wait-To-Ineligible versus Active-To-Wait ratio. This addresses page faulting and activity-level analysis.
- Disk utilization and other disk activities
- IOP utilization
- System impact of authority lookups
- System impact of exceptions
- Communication line utilization and error percentages

The Advisor does not:

- Make any recommendations for modifying specific programs to improve their performance.
- Analyze noninteractive trace data.

The recommendations may include changes to the system′s basic tuning values that can improve performance. They also may list problems that (when solved) can solve other performance problems.

The conclusions display lists conditions that may have affected performance during the data collection. Good examples of conclusions are:

- Thresholds reached
- Save and restore activities
- Communications line errors

You can use the conclusions that are not related to recommendations as guides for collecting more performance data or for adjusting the system.

The Advisor may suggest changes to pool sizes and activity levels. These changes are not made dynamically but only after the operator tells the advisor to make the changes or to ignore the recommendations. The tuning is done by pressing the PF9 key on the display recommendations display. Pool and activity level changes can be made to all of the main storage pools on the system.

The Advisor also suggests which report to run to get more information for your problem analysis. See the "Advisor" chapter of the *Performance Tools Guide*, SC41-4340, for detailed information.

3.1.2 Performance Graphics

Performance data collected by the performance monitor can also be displayed in a graphical format. The graphs can either be displayed interactively, or printed or plotted to hardcopy. The printing option of the graphs is recommended because the graphics on the paper are more descriptive. The best printouts are created by using an *IPDS printer. If you must use a conventional printer, please check the PAGESIZE parameter of the printer file QPPGGPH in the QPFR library.

You can enter the DSPPFRGPH command or the DSPHSTGPH command, or you may choose option 9 (Performance graphics) on the PERFORM menu. You have two types of performance graphics to choose from:

- Option 1. Display performance data graphics:

  Performance data graphs are graphs that:

  – Use select/omit criteria.
  – Are run against the original performance data.
  – Are used to show the performance during one data collection only.

- Option 2. Display historical data graphics:

  Historical data graphs are graphs that:

  – Use performance data from several collections.
  – Are useful when tracking performance trends.

The Display Historical Graph (DSPHSTGPH) command produces a graph from the historical data created by the Create Historical Data (CRTHSTDTA) command. The DSPHSTGPH command is intended to give you a historical perspective of the system performance in a graphical presentation.

You must run the Create Historical Data (CRTHSTDTA) command for each member that you want to include in the graph. If no historical data has been created for a member, it is not included in the graph unless you specify *YES on the CRTHSTDTA parameter of the DSPHSTGPH command. You can use the IBM-supplied format (in the QPFRDATA library) or you can create a format of your own.

3.1.3 Print Activity Report

The print activity report (PRTACTRPT) command creates a report using the performance data collected by the WRKSYSACT command.

You may produce two different reports:

Summary report
This prints out a report showing the top 10 list of:

- CPU intensive jobs and tasks
- I/O intensive jobs and tasks

Detailed report
This prints out either:

- Selected numbers of entries for each interval specified by the PERIOD parameter.
- The number of entries specified by the NBRJOBS parameter that are listed in the order specified by the SEQ parameter.

The following example shows a summary report:

```
                                               System Activity Report                                         10/22/96  12:45:18
                                                                                                                      Page    1
Member  . . . . :  QAITMON      Report Type . . . . :  SUMMARY     Version . . . . :     3    Started . . . . :  10/22/96  12:42:50
Library . . . . :  QPFRDATA                                        Release . . . . :   6.0    Stopped . . . . :  10/22/96  12:44:31
Order by CPU Utilization:
                                           Total  Total          -------Synchronous I/O-----    ------Asynchronous I/O------
Job or                               CPU   Sync  Async   PAG     DB    DB   Non-DB  Non-DB      DB    DB   Non-DB  Non-DB
 Task       User        Number  Pty  Util   I/O    I/O  Fault   Read Write   Read    Write     Read Write   Read    Write
----------  ----------  ------  ---  ----  -----  -----  -----  ----- -----  ------  ------    ----- -----  ------  ------
QPADEV0002  A960303A    059734   20   2.1    574    364    232      0     0     571       3        0     0     358       6
SMAI0004                          0   1.6      1      0      0      0     0       0       1        0     0       0       0
SMAI0007                          0   1.5      0      0      0      0     0       0       0        0     0       0       0
WRKSYSACT   A960303A    059747    1    .5      0      0      0      0     0       0       0        0     0       0       0
IOSTATSTAS  K                     0    .3      0      0      0      0     0       0       0        0     0       0       0
CFINT1                            0    .3      0      0      0      0     0       0       0        0     0       0       0
QBRMNET     QPGMR       059270   30    .2      0      0      0      0     0       0       0        0     0       0       0
QTGTELNETS  QTCP        059276   20    .1      0      0      0      0     0       0       0        0     0       0       0
IOP6512010  003                   0    .1      0      0      0      0     0       0       0        0     0       0       0
SMXCSPRVSR                        0    .0      0      0      0      0     0       0       0        0     0       0       0
Order by Total I/O:
                                           Total  Total          -------Synchronous I/O-----    ------Asynchronous I/O------
Job or                               CPU   Sync  Async   PAG     DB    DB   Non-DB  Non-DB      DB    DB   Non-DB  Non-DB
 Task       User        Number  Pty  Util   I/O    I/O  Fault   Read Write   Read    Write     Read Write   Read    Write
----------  ----------  ------  ---  ----  -----  -----  -----  ----- -----  ------  ------    ----- -----  ------  ------
QPADEV0002  A960303A    059734   20   2.1    574    364    232      0     0     571       3        0     0     358       6
QTGTELNETS  QTCP        059276   20    .1      0      0      0      0     0       0       0        0     0       0       0
WRKSYSACT   A960303A    059747    1    .5      0      0      0      0     0       0       0        0     0       0       0
SMAI0007                          0   1.5      0      0      0      0     0       0       0        0     0       0       0
SMAI0004                          0   1.6      1      0      0      0     0       0       1        0     0       0       0
QBRMNET     QPGMR       059270   30    .2      0      0      0      0     0       0       0        0     0       0       0
IOSTATSTAS  K                     0    .3      0      0      0      0     0       0       0        0     0       0       0
IPR0050103  --2619                0    .0      0      0      0      0     0       0       0        0     0       0       0
IOP9162010  001                   0    .0      0      0      0      0     0       0       0        0     0       0       0
VTMTS1                            0    .0      0      0      0      0     0       0       0        0     0       0       0
Job or Task       -- Job or task name
User              -- User profile associated with the job
Number            -- Job number
Pty               -- Job or task priority
CPU Util          -- Percent of CPU used by the job or task
Total Sync I/O    -- Total number of synchronous I/O operations
Total Async I/O   -- Total number of asynchronous I/O operations
PAG Fault         -- Number of faults involving the process access group
Synchronous I/O   --
  DB Read         -- Number of synchronous database reads
  DB Write        -- Number of synchronous database writes
  Non-DB Read     -- Number of synchronous non-database reads
  Non-DB Write    -- Number of synchronous non-database writes
Asynchronous I/O  --
  DB Read         -- Number of asynchronous database reads
  DB Write        -- Number of asynchronous database writes
  Non-DB Read     -- Number of asynchronous non-database reads
  Non-DB Write    -- Number of asynchronous non-database writes
```

Figure 15. An Example of PRTACTRPT Output

Notes:

The upper part of the list shows the jobs sequenced by the CPU utilization.

The lower part of the list shows the jobs sequenced by the disk I/O.

3.1.4 Performance Tools Reports

Printing performance reports extracts information from previously collected performance data. You can review the performance of specific jobs or transactions, or other performance elements. This can be done by choosing option 3 (print performance report) on the PERFORM menu. This leads you to the print performance report display. You may also issue any of the following commands:

PRTSYSRPT Print System Report

PRTCPTRPT Print Component Report

PRTTNSRPT Print Transaction Report

PRTLCKRPT Print Lock Report

PRTJOBRPT Print Job Interval Report

PRTPOLRPT Print Pool Report

PRTRSCRPT Print Resource Report

PRTTRCRPT Print Batch Job Trace Report

Each of these commands provides you with a different level of information. The following reports are produced from the **sample data** collected with the performance monitor:

- System report
- Component report
- Job report
- Pool report
- Resource report

If you collected **trace data** with the performance monitor, you can produce:

- Transaction report that can further be extended to:
  - Transaction detail report
  - Transition detail report
- Lock report
- Batch job trace report

In the early stages of problem determination, print only the first two reports (system report and component report). These help you to determine whether you need to analyze the problem in more detail or not.

The system report and the component report provide information to evaluate your system-wide performance. Pay attention to the following items:

- Average response time in the system report workload
- Number of transactions for total run time and per hour
- CPU percent for all levels of priority and also cumulative. The cumulative value up to and including priority 20 should not exceed 60 per cents provided no queries are run interactively.
- Number of database/non-database page faults in each storage pool

- Disk (percentage used and utilization of the actuators)
- Communication lines traffic and IOP utilization

3.1.4.1 System Report

In the system report, you find the basic set of information to compare against your predefined performance objectives and the guideline tables as shown in *Work Management Guide* manual.

- The system overview workload and resource utilization part shows you what the system workload is and what is the cost of processing the workload. The CPU utilization shows the percentage of processing unit time used by each job type. According to the guidelines, the total CPU utilization should not continuously exceed 81% (for four-way processors). See Table 16 on page 379 for other CPU categories.
- Check the percent of space in use and the utilization of disk on the utilization part of report; compare those values to Table 16 on page 379. Column ″ops per second″ and number of disk IOPs installed on the system show whether or not you are overdriving the IOPs. On a normal distribution of disk operations, each IOP′s average should be between 30 to 60 per second.
- Avg util and max util column on the communication part gives you the average and maximum percentage of the line capacity used during the measured interval. Compare those values to Table 16 on page 379.

If you find any discrepancies between the system performance report and the guidelines, go to the component report to find out whether you need to do a problem analysis on the system performance.

3.1.4.2 Component Report

The component report provides information about the same components as the system report but at a greater level of detail.

- Component interval activity shows the use of CPU, disk, and pools at selected time intervals. For example:
  - Is the transaction rate high in all the intervals?
  - Is the same disk unit suffering from high utilization during all of the intervals?
  - Which of the memory pools has the highest faulting rate?
- Job workload activity shows the activities of each job. You need to perform problem analysis on a particular job if you find that a job used most of the disk I/O operation (under column disk I/O) or CPU utilization (CPU util).
- In the pools storage activity part, you need to look at the columns DB faults and Non-DB faults. Compare those values to Table 18 on page 379 and Table 19 on page 380. Wait-to-ineligible need not be zero all of the time, but it must be less than .25 for good performance. See Table 20 on page 380 for the guidelines of activity level changes.
- Disk activity shows average disk activity per hour and the capacity of each disk. Batch processing may cause a high utilization of individual disk drives. Batch sequential processing can stay on one drive for some time. Interactive performance is not normally degraded if the batch jobs are running in a storage pool of their own. However, if there are many interactive jobs, a high disk utilization can indicate a performance problem.

- The database journal summary includes user journal and system journaling of access paths disk write counts. No guidelines are provided so you must record this information over time to determine any increase in the disk I/O as a result of journaling.

If you need more data on your current system performance before you decide to analyze, issue the WRKSYSACT command. Refer to Chapter 2, "Using CL Commands to Find Performance Problems" on page 11 for more information about that command.

Based on this information, you can decide if there is a problem with the overall performance of the system.

3.1.5 Memory Performance Displays and Reports

You cannot measure the amount of memory currently in use; you only can observe the amount of faults that **indirectly** tell you whether there is enough main storage or not. The tools used for finding out the memory performance are:

- The WRKSYSSTS command

  The Work with System Status display shows you in real time what the demand for main storage is. See Chapter 2, "Using CL Commands to Find Performance Problems" on page 11 for information about using this command.

- The DSPPFRDTA command

  The Display Performance Data command provides an interactive interface to the previously collected data given in the system, component, and interval reports.

- DSPACCGRP command and ANZACCGRP command

  These commands show for a job or a group of jobs:

  – The temporary storage used
  – Open files
  – File I/O counts
  – Active programs

  The Display command and Analyze Access Group command provide data on the size of the ″currently in use″ part of the PAG. The PAG size can be affected by reducing the number of active programs, the number of display and database files open, and the number of display formats and database buffers allocated for the files. See Section 3.4.2.1, "DSPACCGRP and ANZACCGRP" on page 51 for more information about displaying and analyzing the access groups.

3.1.5.1 Where to Find Information About Memory Usage

Table 5 (Page 1 of 2). Memory Utilization Information

Resource Description	Where to Look	Compare With
Machine pool NDB page fault	System Report: Storage Pool Utilization, WRKSYSSTS, Advisor	Table 17 on page 379
Sum of DB and NDB page faults for each pool	System Report: Storage Pool Utilization, WRKSYSSTS, Advisor	Table 18 on page 379

Table 5 (Page 2 of 2). Memory Utilization Information		
Resource Description	**Where to Look**	**Compare With**
Sum of DB and NDB page faults in all pools	System Report: Storage Pool Utilization, WRKSYSSTS, Advisor	Table 19 on page 380
Pool size By interval	Pool Report: Pool Activity	
The pool with the highest fault rate for each time interval	Component Report: Component Interval Activity	

3.1.6 CPU Performance Reports and Displays

- System report
- Component report
- Transaction report

  If the interactive utilization percentage of CPU is always more than 85, try modeling to see if a faster CPU can help.
- The WRKACTJOB command:

  This command allows you to determine:
  - What is the utilization percentage of CPU?
  - How much does each job use CPU, both in terms of percentage and for how long a time total?
- The WRKSYSACT command

3.1.7 A Brief Discussion About Program Exceptions Consuming CPU

Pre-V3R6 systems report a number of exceptions types by the performance tools Component Report and the Advisor. The reports showed the number of exceptions per second per interval that occurred; the Advisor shows the percent of the CPU used by exceptions in an interval. In addition, there are a set of charts that show the percent of the CPU used as a result of ″n″ number of exceptions by type per second.

From V3R6, some of the exceptions have been eliminated for one reason or another, and some of the exception CPU overhead has changed as a result of the machine implementation or the type of program in which they occur.

3.1.7.1 Program Exceptions

EAO These are gone from V3R6 as a result of the difference in PowerPC hardware addressing structure. Any data field or report that had them has been changed to indicate their absence. See Section 3.1.7.3, “Removal of Effective Address Overflow (EAO) Exceptions in V3R6” on page 36 for more details on why we used to have EAO exceptions and why now when we use PowerPC technology and 64-bit addressing, they no longer occur.

Size These are the result of an arithmetic operation in which the receiving field is too small for the result. They are an application programming problem and still occur.

The programs should be reviewed and changed to ensure that the proper receiver field specification is used or that the programming algorithm is doing the function in a manner to avoid size exceptions. Using Performance Monitor trace data and Transaction Report

(PRTTNSRPT RPTTYPE *TRSIT) may provide additional information about which programs are getting size exceptions.

Verify Verify exceptions occur when trying to resolve an as yet unresolved pointer.

This exception can occur on the RISC machine and is an application programming problem. The program should be changed to ensure that the variable used in a CALL instruction does not change from one use to the next. Use PEX STATS and PEX TRACE to find out where it is occurring.

Authority These can occur on the RISC machine and are the result of a system security setup mismatch.

The same rules apply to fixing these as on pre-V3R6 systems. Use authorization lists instead of group profiles and ensure that objects do not have private authorities on them that are less than the PUBLIC authority. For example, PUBAUT(*CHANGE) and QPGMR(*USE) causes authority checking to be done.

Decimal Data This can occur on PowerPC AS/400 systems. It is usually related to incorrect data specification in application data migrated from other systems, especially the System/36.

3.1.7.2 CPU Cost Variations

What has changed is the CPU cost for each exception. For the program exceptions that were tested (Authority, Size, Verify) that can occur on the RISC machine, the CPU costs varied depending on the type of program model used when the program was built.

There are three different options that affect the cost:

1. OPM (Original Program Model)
2. ILE with DFTACTGRP(*YES) where the activation group is not already created
3. ILE with DFTACTGRP(*NO)

The results of testing the different exceptions and program models showed inconsistent variations in the CPU/exception cost. For that reason, there are multiple costs shown in this document for each type of exception.

The challenge is to know what types of programs are generating the exceptions on the machine. The exception reporting mechanism does not discriminate between the types of programs so, in some cases, you have to make an intelligent guess about the possible severity of the problem.

The test results in Appendix I, "Guidelines for Interpreting Performance Data" on page 379 were generated by running each type of program on an AS/400 model 500-2142. There were two programs for each case, one that did not get the exception and one that did. The results were calculated by computing the difference between the two test cases, calculating the CPU time used per exception, and extrapolating the results to other PowerPC models using the ratio of the relative performance ratings between the measured system model and the other models.

3.1.7.3 Removal of Effective Address Overflow (EAO) Exceptions in V3R6

Effective Address Overflow exceptions on the S/38 and CISC AS/400 systems result from two different views of the six-byte address. This address really has two parts, the segment identifier that identifies a unique group of virtual addresses (called a segment or segment group) and an offset that identifies specific locations within the segment.

S/38 hardware was designed with the assumption that the system would use a larger number of smaller segments. Thus, the hardware treated the six-byte address as four bytes of segment identifier and two bytes of offset. This allows over one trillion segments each with a maximum size of 64KB. The software designers felt that the system needed a smaller number of larger segments and treated the address as three bytes of segment identifier and three bytes of offset that allows over 16 million segments each with a maximum size of 16MB.

The hardware detected any operation that spanned a 64K boundary and raised an Effective Address Overflow exception when this happened. According to the hardware′s view of the address, this was always a bad thing in that someone had tried to cross from their segment into what was potentially someone else′s segment. But due to the software design, this was generally not a problem. For example, a program could be storing a piece of data that crossed from the first 64K of a segment into the second 64K of the segment. (Note that the 16MB segment viewed by the software can contain up to 256 of the 64K ″hardware″ segments.) Thus, the software needed to look at EAO exceptions and decide if they were bad or not. Because IMPI operations cannot use operands spanning a 64K boundary, this handler also needed to look at the good exceptions and decompose the instruction into pieces that does not span a 64K boundary. For example, a Move Character operation might have a target operand of 10 bytes that spanned a 64K boundary. This move needs to be split into two Move Character operations, one to move the first part prior to the 64K boundary and one to move the second part after the 64K boundary. Needless to say, this software EAO exception handler could and did impact performance at times.

Because the AS/400 PowerPC hardware is a new design using eight-byte addresses, there is no longer a mismatch between the hardware and software views of the address. There is no longer any need for the software handler previously described and no corresponding performance impact. Hence, EAO exceptions are not reported for PowerPC AS/400 system.

3.1.7.4 Where to Find Information About CPU Usage

Table 6 (Page 1 of 2). CPU Utilization Information

Resource Description	Where to Look	Compare With
Interactive CPU	System Report: Resource Utilization Expansion, DSPPFRDTA, Transaction Report	Table 16 on page 379
CPU Queuing Multiplier	Transaction Report: Job Summary, System Summary Data, System Report	Table 34 on page 386
CPU Queuing Multiplier by Job Priority	System Report	
Total CPU usage by job type	System Report: Resource utilization expansion	

Table 6 (Page 2 of 2). CPU Utilization Information		
Resource Description	**Where to Look**	**Compare With**
Total CPU usage by individual jobs	Component report: Job Workload Activity,Transaction Report	
CPU utilization and seconds per job and system task	Transaction Report: Job Summary, System Summary Data	Historical Data
CPU Usage by Subsystem and Pool by Interval	Pool Report: Subsystem activity	Historical Data
Job Maximums of CPU, I/O, Transactions and Response Time by Pool	Pool Report: Subsystem Activity	
CPU Time by Job Per Interval	PRTACTRPT, Component Report	
CPU Time by LIC Task Per Interval	PRTACTRPT, Component Report	

Table 7. Information about Exceptions Consuming CPU		
Resource Description	**Where to Look**	**Compare With**
Authority Lookup	Component Report: Exception Occurrence Summary	Table 26 on page 382
Size (Arithmetic Overflow and Binary Overflow)	Component Report: Exception Occurrence Summary	Table 28 on page 383
Verify	Component Report: Exception Occurrence Summary	Table 31 on page 384
Note: Even though one exception consumes only a relatively small amount of CPU at a time, the cumulative effect of exceptions can add a significant workload to the CPU.		

3.1.8 Disk Performance Reports and Displays

- The system report shows you:
  - The disk I/O by job type (batch, system, interactive, pass-through, and so on)
  - The IOP utilization percentage
  - The ASP number and mirrored units
  - The disk unit size
  - The I/O rate per a disk unit
  - The disk IOP and device service time
- The component report shows you:
  - The synchronous and asynchronous disk I/O per second, displayed by interval.
  - The summary of the highest used device in the interval.
  - The synchronous and asynchronous disk I/O per job total.
  - The summary of database journal deposits (entries), bundle (blocks of deposits) writes for both user journaling and for system managed access path protection (SMAPP) support, system access path journal deposits and bundle writes, and access path recovery time estimates.
  - Per interval and by unit:

- The utilization percentage
- The size
- The number of overruns and underruns
- The seek activity

- Transaction report - summary report
  - Shows synchronous and asynchronous disk I/O per transaction per job
- Resource report
  - Shows you by interval:
    - The number of disk I/O per second
    - The number of reads and writes per second
    - The average amount of data transferred per disk I/O
    - The highest utilization and service time disk unit
    - The total disk space used
  - Shows per unit and interval:
    - The unit identification data per disk unit including:
      Bus
      IOP
      ASP
    - The number of reads and writes per second
    - The average data transfer size
    - The unit service time average
    - The IOP service time average
    - The average device I/O queue depth
- Pool report
  - Shows the highest number of disk I/O operations by a job running in a pool during an interval
- The WRKSYSACT command:
  - Shows the number of disk I/O operations by job and LIC task. These are further separated as synchronous and asynchronous operations.
- The WRKDSKSTS command:
  - The Work with Disk Status display shows performance and status information about the disk units on the system. It displays the:
    - Number of units currently on the system
    - Type of each disk unit
    - Size of disk space
    - Percentage of disk space used
    - I/O requests per second
    - Average size of the I/O requests
    - Average number of read and write requests
    - Average amount of data read and written
    - Percentage of time the disk is being used

3.1.8.1 Where to Find Information About Disk Performance

Table 8 (Page 1 of 2). Disk Utilization Information

Resource Description	Where to Look	Compare With
Disk Arm Utilization	System Report: Disk Utilization, WRKDSKSTS	Table 16 on page 379

Table 8 (Page 2 of 2). Disk Utilization Information		
Resource Description	**Where to Look**	**Compare With**
Disk IOP Utilization	Component Report: IOP Utilization	Table 16 on page 379
Disk Physical I/O per Transaction (Average)	System Report: Resource Utilization, Transaction Report	Table 35 on page 386
Disk Physical I/O per Transaction per Job.	Transaction Report: Job Summary	Table 35 on page 386
Synchronous and Asynchronous DB and NDB I/O per Job by Interval	Job Interval Report	Historical Data
Sync and Async Disk I/O per Job or LIC Task per Interval	PRTACTRPT	
Database journal deposits and bundle writes to user and system (SMAPP) journals	Component Report: Database Journal Summary	
Sync and Async Disk I/O by Subsystems and Pools by Interval	Pool Report: Subsystem activity	

Note:

Use the Write, Read, and Total Physical Disk I/O per transaction values shown in Table 35 on page 386 as a ″reasonability measure″. Verify that any job exceeding the values is performing the work required.

Note that any asynchronous disk I/O performed by the system QDBSRVnn jobs on behalf of a user job are not included in the job′s asynchronous I/O totals shown on performance reports.

See Table 36 on page 387 to find where the different types of job and disk I/O activities are counted in.

3.1.9 Communications Performance Data

The performance monitor can optionally collect remote response time data from 5494 remote controllers with Microcode Release 1.1 or later installed on the 5494. Communication IOP and line performance data is always collected.

If you have 5494 workstation controllers included in the data collection, you have information about:

- The number of active workstations on each controller
- The range of response times for the remote workstations
- The average response time for the remote workstations

The Performance Tools/400 system report and resource report list this 5494 response time data. Note that while entering the STRPFRMON command, you must set the RRSPTIME (remote response time) parameter value other than the default *NONE to have the response time data collected from the active 5494 controllers. A value of *SYS uses the same response time slots (0-1 seconds, and so on) as for the LRSPTIME (local response time) parameter.

- The component report shows you:
  - The workstation IOP utilization
  - The multifunction IOP utilizations
  - The twinaxial line utilization for local workstation IOPs

  It is possible to have either high local workstation IOP utilization and low twinaxial utilization **or** low local workstation IOP utilization and high twinaxial utilization. High IOP utilization can occur if there is heavy use of the text assist functions for an OV/400 editor. High twinaxial utilization can occur if there is a significant amount of high-speed printer output, Client Access/400 shared folder activities, or file transfer work going on.

- The system report shows you:
  - Both the average and peak line utilization over the report period
- The resource interval report shows communication line details per time interval selected.
- Resource Report:
  - Additional line utilization data by interval
  - Response time counts per ″response time buckets″ for local workstations and optionally for remote 5494-attached workstations
- Query:
  - The performance tools reports do not include all data or they show certain combinations of data. A common use of a query is to tie together more complex analysis structures such as jobs, pools, lines, and so on.
  - Display Performance Data (DSPPFRDTA) command:
    - Provides an interactive access to information contained in system, component, and resource reports.
  - Work with System Activity (WRKSYSACT) command:
    - LIC communication task activity (CPU, disk I/O, frequency)
  - QSYSOPR message queue:
    - Error failure, threshold, and communication job start and end messages are found in the system operators message queue.
  - QHST log:
    - Error failure, threshold, and communication job start and end messages are found in the history log.
  - Communication error log:
    - Communication errors are logged in the system error log regardless of Performance Monitor activity. Each entry is time stamped. Use the STRSST command to view the logged data. Assistance from your service provider in interpreting the log data is needed in most cases. See Chapter 5, "Using System Service Tools" on page 71 for information about using the service tools.

3.1.9.1 Where to Look for Information About Communications Performance

Table 9 (Page 1 of 2). Line and IOP Utilization Information

Resource Description	Where to Look	Compare With
Local WS IOP	Component Report: IOP Utilization	Table 16 on page 379
Multifunction IOP	Component Report: IOP Utilization	Table 16 on page 379
Communication IOP	Component Report: IOP Utilization	Table 16 on page 379

Table 9 (Page 2 of 2). Line and IOP Utilization Information		
Resource Description	**Where to Look**	**Compare With**
File Server IOP	Component Report: IOP Utilization	IOP reported is the one for exchanging data between the Integrated PC Server and AS/400 Disk. No guideline available at this time. Attached LAN lines are reported under remote lines, LAN lines. See Appendix F, "Integrated PC Server Query" on page 345 for information on cache read/write hit and 486 CPU utilization percentage guidelines.
Remote Lines, LAN Lines	System Report: Communication Summary, Resource Report	Table 16 on page 379
Communications I/O Count by Job Type	System Report: Resource Utilization	
Line Utilization and Activity (input/output)	System Report: Communications Summary	Historical Data
Communications Gets and Puts per Transaction by Job type	System Report: Resource Utilization Expansion	
Communication I/O Per Job	Component Report: Job Workload Activity	
Local and Remote Workstation Response Time Distribution	Component Report: Local Work Stations - Response Time Buckets	
Local and Remote Workstation Response Time Distribution By Interval	Resource Report: Local Workstation IOP Utilization and Remote Workstation Response Times	

3.1.10 Activity Level Performance Reports and Displays

- System report:
  - Displays Job State changes (movement in and out of activity level) per pool for the total collection period.
- Component report shows you:
  - Job State changes by pool summarized over selected time intervals.
- Pool report shows you:
  - Job State changes by subsystem and pool for each selected time interval.
  - Pool activity level for each interval. This may change during the time period due to operator action, an OEM automatic tuner, or the OS/400 automatic tuning through QPFRADJ. The value shown is the value at the time of the sample.
- The DSPPFRDTA command:
  - Provides interactive access to database including system, component, and pool interval report data.

- The WRKSYSSTS command
  - Provides real-time information on activity level usage and job state changes. See Chapter 2, “Using CL Commands to Find Performance Problems” on page 11 for information about using this command.

3.1.11 Comparing with Activity Level Guidelines

Table 10. Activity Level Information

Resource Description	Where to Look	Compare With
Activity Level for *BASE and Spooled Writer pool	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	Figures 14-8, 14-9, and 14-10 in the *Work Management Guide*, page 14-10.
QINTER Activity Level.	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	See Table 22 on page 380.

3.1.12 Comparing W-I and A-W Ratio Guidelines

Table 11. W to I and A to W Ratio Information

Resource Description	Where to Look	Compare With
W-I/A-W	System Report: Storage Pool Utilization, WRKSYSSTS	Table 20 on page 380

3.2 User Level Problem Analysis

The first step in determining a user level problem is to identify the affected user or users. The following questions are good examples of how to start the user level problem analysis:

- Are all of the users affected by poor performance or is there only a small, easily-defined group of users affected?
- What do these users have in common?
- Are they using the same application?
- Are they sharing the same (possibly small) memory pool?
- Is there only one user suffering from poor performance?
  - How does this user differ from the rest of the users?

After answering these questions, the solution is much closer.

User level problem analysis is done by:

- Using the WRKACTJOB command:

  For information about using this command, see Section 2.5, “WRKACTJOB Command” on page 21.
- Using the WRKSYSACT command:

  For information about using this command, see Section 2.7, “WRKSYSACT Command” on page 24.

- Using DSPPFRDTA command
- Analyzing Performance Tools/400 reports.

3.2.1 Print Job Summary Report

Find out if the user appears in the ″job statistics″ section of the ″job summary report″. Next look at the ″individual transaction statistics″ section to see what programs are used. Is this user the only one using this program? If no, is this user the only one with a performance problem? If all of the users of this program have problems with performance, see Section 3.3, “Application Level Problem Analysis” for more information.

Refer to the ″system summary data″ section, (″analysis by interactive response time″) to see how your response time objectives are met.

3.2.2 Print Transaction Summary Report

The transaction summary report provides you with information about response times, CPU utilization, and disk I/O by job. This report can be used for both user-level problem analysis and application-level problem analysis.

If the job summary section shows jobs that have high response times, high disk I/O activity, or high CPU utilization, use the transaction detail report to investigate further. However, **always print the summary report first** because both the transaction detail report and the transition report provide detailed information. By using the summary report, you can choose to print only the intervals or users that have performance problems instead of printing thousands of pages of irrelevant data.

3.3 Application Level Problem Analysis

Is there a problem with one application only?

Are there only some operations that are slow?

Application level analysis is based on the Performance Tools/400 reports.

See the ″Interactive Program Statistics″ section of Job Report for the top 10 programs with the highest resource utilization such as:

- CPU per transaction
- Disk I/O per transaction
- Response time per transaction
- Database reads/writes per transaction
- Non-database reads/writes per transaction

Compare this information with Table 35 on page 386 to see if values are acceptable.

Please note that values shown are guidelines only so you must verify that each transaction exceeding the values is performing the work required.

3.3.1 Charging Resource Utilization to Interactive Program

The Job Summary report, Individual Transaction Statistics, and Interactive Program Statistics data list several categories of performance metrics commonly referred as the 10 worst. Some of these metrics are the transactions with the longest CPU service time and transactions with the longest lock wait time. Each of these categories identifies a program that is charged with consuming that resource.

The program name listed is the program first doing a workstation output operation following the receipt of the workstation input. The receipt of the input is used to signal to the system the beginning of a transaction. In many application environments, this accurately reflects the program doing the work. On the other hand, in many application environments, the program *called by that program* actually consumes the system resource. Therefore, further analysis of the identified program (and programs it called) is required to find out what program really consumes the resources.

A good example of this kind of situation is the OS/400 User Interface Manager program appearing in the list showing the worst 10 programs. Frequently the QUIINMGR and QUIMNDRV are in this list even though these programs are almost never responsible for high consumption of a system resource. Usually, the functions and programs called from a menu display are the ones responsible for consuming the system resources. You need to choose one specific job and print the Transition Detail Report to see what is happening **below** the QUIxxxxx program falsely accused of stealing the systems resources.

One example of this false interpretation is doing a Send Network File command from any system menu. The SNDNETF function does no workstation I/O but it may lock the display station while copying a file to an internal space (on disk) for a later delivery done by SNADS functions. When the SNDNETF command completes its work, a user receives a message indicating the results and this message is written by QUIINMGR.

3.3.2 Print Transaction Summary Report

From the transaction report, you can select those programs that show a frequent high resource utilization. These programs should be analyzed in deeper detail using the other tools listed in Section 3.4, "Programmer Performance Utilities" to find out the cause of the problem.

3.3.3 Print Transaction Detail Report

If you need a more detailed problem analysis, print a transaction detail report by specifying RPTTYPE(*TNSACT) on the PRTTNSRPT command. The transaction report output has two parts:

- The details, which show data about every transaction in the job.
- The summary, which shows data about overall job operation.

If there are response times that are not acceptable compared to your objectives, read the report further.

The next section to look at is the job summary data and especially the synchronous disk I/O counts. If there are, for example, 200 DB Reads (database read operations) per transaction, the response times are surely unacceptable.

3.3.4 Print Transition Report

If you want to know all of the state changes within a transaction, run the Transaction report by specifying RPTTYPE(*TRSIT) on the PRTTNSRPT command.

Be Careful!

Remember to use the select/omit parameters or you receive several thousand pages of printout while adding a significant workload to your system.

The transition report is composed of two sections:

- Transition detail, which shows each state transition made by the job, for example, active-to-ineligible and transaction boundaries. For a brief discussion about transaction boundaries, see the index entry for trace points.
- Summary, which shows the same data as the summary output from the transaction report.

You may see in the transaction report (seize/lock conflict reports) that object ″ADDR 00000E00 0002IUSE″ is being held for a relatively long time. This refers to the internal object ″database file in use table″, which indicates frequent occurrences of one of the following conditions:

- File opens/closes
- File creates/deletes
- Clear physical file member
- Reorganize physical file member, and so on.

Since these functions have a significant impact on system and job performance, reduce their usage.

You may also see the I/O transaction boundaries in the transaction report. They indicate the trace points such as:

- SOTn
  - Start of a transaction
  - Start of the response time for that transaction
  - N represents various transaction types.
- SOR
  - Start of resource utilization time
- EORn
  - End of response time for the transaction
- EOTn
  - End of resource usage time
  - End of the transaction

See the *Performance Tools/400 Guide*, SC41-4340, for more details.

3.4 Programmer Performance Utilities

The tools described in this part are not meant to be used for all of the cases with performance problems. These tools are meant to be used only as a last resort if none of the other tools provide you with the information required.

Usually the data acquired by using these tools is used for tuning the application only. These tools normally provide a limited amount of data of the performance on the communications area.

3.4.1 OS/400 Utilities for Tracing a Job

The following OS/400 commands may be used to produce trace job information:

- STRSRVJOB

  The Start Service Job command starts the remote service operation for a specified job (other than the job issuing the command) so that other service commands can be entered to service the specified job. Any dump, debug, and trace commands can be run in that job until the service operation ends. The service operation continues until the End Service Job command is run.

  To use this command, you must be signed on as QPGMR, QSYSOPR, QSRV, or QSRVBAS, or have *ALLOBJ authority.

- ENDSRVJOB

  The End Service Job command ends the remote job service operation. This command stops the service operation that began when the Start Service Job command was entered.

  To use this command, you must be signed on as QPGMR, QSYSOPR, QSRV, or QSRVBAS, or have *ALLOBJ authority.

- TRCJOB

  The Trace Job command controls traces of Original Program Model (OPM) programs and Integrated Language Environment (ILE) procedure calls and returns that occur in the current job or in the job being serviced as a result of the Start Service Job command directed to that job. The command, which sets a trace on or off, can trace module flow, operating system data acquisition (including CL command traces), or both.

  Restrictions for using the TRCJOB command:

  1. The record format of the database output file must match the record format of the IBM-supplied output file QATRCJOB.
  2. The number of trace records processed between the start and end of the trace must not exceed one million.
  3. This command is shipped with public *EXCLUDE authority.

  The following user profiles are authorized to use this command: QPGMR, QSRV, QSRVBAS, QSYSOPR, and QRJE.

The following display is an example of starting a job trace:

```
                        Trace Job (TRCJOB)

Type choices, press Enter.

Trace option setting . . . . . . 1 *ON            *ON, *OFF, *END
Trace type . . . . . . . . . . .   *ALL           *ALL, *FLOW, *DATA
Maximum storage to use . . . . . 2 4096           1-16000 K
Trace full . . . . . . . . . . . 3 *WRAP          *WRAP, *STOPTRC
Program to call before trace . .   *NONE          Name, *NONE
  Library  . . . . . . . . . . .     __________   Name, *LIBL, *CURLIB
Select procedures to trace:      _
  Program  . . . . . . . . . . .   *ALL           Name, *ALL, *NONE
    Library  . . . . . . . . . .     __________   Name, *LIBL, *CURLIB
  Type . . . . . . . . . . . . .   _______        *PGM, *SRVPGM
               + for more values _
Output . . . . . . . . . . . . .   *PRINT         *PRINT, *OUTFILE
File to receive output . . . . .   __________     Name
  Library  . . . . . . . . . . .     *LIBL        Name, *LIBL, *CURLIB


                                                                 More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 16. How to Start a Job Trace

Notes:

1 When starting the trace, enter *ON and when ending the trace, enter *OFF.

2 Use the default setting of 4096K (4 megabytes). This size can handle about 14 000 trace records, which is sufficient in most cases.

3 Use the option *STOPTRC to stop the trace when the trace file is full of trace records; otherwise valuable data may be lost. If you enter option *WRAP, the oldest trace records are written over by new ones as they are collected.

The following printout is an example of output produced by using the OS/400 TRCJOB *OFF command:

```
 5716SS1 V3R6M0  950929                       AS/400 TRACE JOB INFORMATION                    10/31/96 24:13:24       PAGE    1
  TRACE TYPE  - *ALL     MAX STORAGE- 04096      EXIT PROGRAM-           *NONE
  RECORD COUNT- 000407   START TIME - 24:13:24   START DATE  - 10/31/96                JOB- 062603    /A960303A  /QPADEV0006
                                                                                       DB      NON-DB   PAGES     NUMBER
TIME          SEQNBR  FUNCTION  PROGRAM    LIBRARY     ENTRY EXIT  CALL LVL CPU TIME  READS   READS    WRITTEN   WAITS
10:03:09.626  000001  RETURN    QUICMD     QSYS        03FF  0678      05      0.002      0       0        0          0
10:03:09.630  000002  CALL      QMHRCVPM   QSYS        0001  001E       06     0.000      0       0        0          0
10:03:09.632  000003  RETURN    QUICMD     QSYS        0679  0311      05      0.000      0       0        0          0
10:03:09.633  000004  CALL      QMHFLTR    QSYS        0001  001A       06     0.000      0       0        0          0
10:03:09.633  000005  RETURN    QUICMD     QSYS        0311  0311      05      0.000      0       0        0          0
10:03:09.633  000006  RETURN    QUIMGFLW   QSYS        0499  0369    04        0.000      0       0        0          0
10:03:09.634  000007  CALL      QUIICHK    QSYS        0001  004D      05      0.000      0       0        0          0
10:03:09.635  000008  RETURN    QUIMGFLW   QSYS        036A  0388    04        0.000      0       0        0          0
10:03:09.636  000009  CALL      QUIEXFMT   QSYS        0001  03E5      05      0.000      0       0        0          0
10:03:09.636  000010  CALL      QMHRCVPM   QSYS        0001  001E       06     0.000      0       0        0          0
10:03:09.637  000011  RETURN    QUIEXFMT   QSYS        03E6  0072      05      0.000      0       0        0          0
10:03:09.637  000012  CALL      QUIOCNV    QSYS        0001  0082       06     0.000      0       0        0          0
10:03:09.638  000013  RETURN    QUIEXFMT   QSYS        0073  008C      05      0.000      0       0        0          0
10:03:09.638  000014  CALL      QUIINMGR   QSYS        0001  020A       06     0.000      0       0        0          0
10:03:09.640  000015  CALL      QWSPUDDS   QSYS        0001  08BC  07          0.000      0       0        0          0
10:03:09.640  000016  CALL      QWSMISC    QSYS        0001  003D   08         0.000      0       0        0          0
10:03:09.641  000017  DATA      FF         C67ED8C4E4C9F1F3F240404040D97EE4E2D9D9C3C44040404000   *F=QDUI132    R=USRRCD      *
10:03:09.642  000018  DATA      FF         D8D7C1C4C5E5F0F0F0F640C97E0000000000000000000000000   *QPADEV0006 I=               *
10:03:09.643  000019  RETURN    QWSPUDDS   QSYS        08BD  0661  07          0.000      0       0        0          0
10:03:09.644  000020  CALL      QWSRST     QSYS        0001  01E8   08         0.000      0       0        0          0
10:03:09.644  000021  CALL      QWSMISC    QSYS        0001  003D    09        0.000      0       0        0          0
10:03:09.644  000022  DATA      FF         C47ED8D7C1C4C5E5F0F0F0F640C67ED8C4E4C9F1F3F240404000   *D=QPADEV0006 F=QDUI132     *
10:03:09.645  000023  RETURN    QWSRST     QSYS        01E9  011A   08         0.000      0       0        0          0
10:03:09.645  000024  CALL      QT3REQIO   QSYS        0001  007F    09        0.000      0       0        0          0
10:03:09.645  000025  DATA      FF         E3F360C5D5E3D9E840400077000000000000000000000000003   *T3-ENTRY   Ï               *
10:03:09.645  000026  DATA      FF         D8D7C1C4C5E5F0F0F0F6000000000000000000C3F64000000000   *QPADEV0006          C6     *
10:03:09.645  000027  RETURN    QWSRST     QSYS        011B  0047   08         0.000      0       0        0          0
10:03:09.648  000028  RETURN    QWSPUDDS   QSYS        0662  0724  07          0.000      0       0        0          0
10:03:09.648  000029  XCTL      QWSGET     QSYS        0001  0569  07          0.000      0       0        0          0
10:03:09.649  000030  CALL      QWSMISC    QSYS        0001  003D   08         0.000      0       0        0          0
10:03:09.650  000031  RETURN    QWSGET     QSYS        056A  056F  07          0.000      0       0        0          0
10:03:09.650  000032  CALL      QT3REQIO   QSYS        0001  007F   08         0.024      0       0        0          1
10:03:09.650  000033  DATA      FF         E3F360C5D5E3D9E840400073000002870000123002800080002   *T3-ENTRY   Ë   g           *
10:03:09.651  000034  DATA      FF         D8D7C1C4C5E5F0F0F0F6000000000000000000C3F64000000000   *QPADEV0006          C6     *
10:03:09.651  000035  DATA      FF         E3F360D9C5D8C9D6404000000000000000000088000100070002   *T3-REQIO            h      *
10:03:13.545  000036  DATA      FF         E3F360C4C5D8E4C5E4C500000000000000000000000000020002   *T3-DEQUEUE                 *
10:03:13.546  000037  RETURN    QWSGET     QSYS        0570  057B  07          0.000      0       0        0          0
10:03:13.546  000038  CALL      QWSMISC    QSYS        0001  003D   08         0.000      0       0        0          0
10:03:13.547  000039  RETURN    QWSGET     QSYS        057C  0216  07          0.000      0       0        0          0
10:03:13.547  000040  RETURN    QUIINMGR   QSYS        020B  0102       06     0.000      0       0        0          0
10:03:13.548  000041  RETURN    QUIEXFMT   QSYS        008D  008D      05      0.000      0       0        0          0
10:03:13.548  000042  RETURN    QUIMGFLW   QSYS        0389  038C    04        0.000      0       0        0          0
10:03:13.549  000043  CALL      QUIACT     QSYS        0001  04DD      05      0.000      0       0        0          0
10:03:13.549  000044  CALL      QMHRMVPM   QSYS        0001  00A3       06     0.006      0       1        0          0
10:03:13.552  000045  RETURN    QUIACT     QSYS        04DE  016A      05      0.000      0       0        0          0
10:03:13.553  000046  RETURN    QUIMGFLW   QSYS        038D  055D    04        0.000      0       0        0          0
10:03:13.553  000047  CALL      QUIICHK    QSYS        0001  004D      05      0.000      0       0        0          0
10:03:13.554  000048  RETURN    QUIMGFLW   QSYS        055E  0498    04        0.000      0       0        0          0
10:03:13.554  000049  CALL      QUICMD     QSYS        0001  03FE      05      0.000      0       0        0          0
10:03:13.555  000050  CALL      QCADRV2    QSYS        0001  005E       06     0.000      0       0        0          0
```

Figure 17. An Example of Output Created with TRCJOB Command

Note: This is the first of the eight pages produced by tracing the Display Job command so please be careful when tracing a job. To avoid producing thousands of pages of printout, run the job trace for a short period of time only.

3.4.2 Performance Tools/400 Utilities for Tracing a Job

The performance tools provides some additional commands for gathering trace information:

- STRJOBTRC

  The Start Job Trace command starts the job tracing function to collect performance statistics for the specified job. After job tracing is started, a trace record is generated for every:

  – External (program) call and return
  – Exception
  – Message
  – Workstation wait in the job

  At least two (usually more) trace records are generated for every I/O statement (open, close, read, and write) in a high-level language program.

- ENDJOBTRC

  The End Job Trace command turns off the job tracing function. It also:

  – Saves all of the collected trace records in a database file.
  – Optionally produces reports.

  You may also use the Print Job Trace (PRTJOBTRC) command to produce reports from the same data.

Notice!

Tracing has a significant effect on the performance of the job being traced. It also affects the performance of the system in general, but to a lesser extent.

The following trace examples are produced by using the Start Job Trace (STRJOBTRC) command followed by End Job Trace (ENDJOBTRC) command.

```
                           End Job Trace (ENDJOBTRC)

Type choices, press Enter.

Output file member . . . . . . . MBR              QAJOBTRC
Output file library  . . . . . . LIB              QPFRDATA
Report type  . . . . . . . . . . RPTTYPE        1 *SUMMARY
Report title . . . . . . . . . . TITLE            _________________________
______
Starting sequence number . . . . STRSEQ           *FIRST
Ending sequence number . . . . . ENDSEQ           *LAST
Transaction ending program . . . ENDTNS           QT3REQIO
Transaction starting program . . STRTNS           QWSGET
Job name . . . . . . . . . . . . JOB              ENDJOBTRC
Job description  . . . . . . . . JOBD             QPFRJOBD
  Library  . . . . . . . . . . .                    *LIBL
```

Figure 18. ENDJOBTRC Command Prompt

Note:

1 By entering *SUMMARY, you submit two reports to be produced summarizing the job trace data by workstation transaction. One report shows primarily physical disk activity; its printer file is QPPTTRC1, and its page heading includes the text ″Trace Analysis Summary″. The other report concentrates on higher level activities such as database I/O and inter-program transfers of control; its printer file is QPPTTRC2, and its page heading includes the text ″Trace Analysis I/O Summary″.

Based on your needs, you may use either of the job tracing functions because they show a different kind of data. The OS/400 Job Trace shows the job flow and the trace obtained with the Performance Tools/400 shows the number of different disk I/O operations.

TRACE ANALYSIS SUMMARY 10/31/96

FILE-QAPTTRCJ LIBRARY-QPFRDATA MBR-QAJOBTRC JOB- QPADEV006 .A960303A .058608

			P H Y S I C A L I / O				
	SECONDS	CPU SECONDS	DB READS	NON-DB RDS	WRITES	WAITS	SEQUENCE
WAIT-ACT	34.193	.001					45
ACTIVE	.442	.245		2		3	145
WAIT-ACT	1.154	.001					150
ACTIVE	.319	.109		1		4	208
WAIT-ACT	10.354	.002					213
ACTIVE	.663	.410		3		3	441
WAIT-ACT	23.624	.002					446
ACTIVE	.480	.218		10		3	555
WAIT-ACT	17.752	.002					560
ACTIVE	.601	.388		2		3	779
WAIT-ACT	20.577	.001					784
ACTIVE	.619	.453		5		2	1046
WAIT-ACT	3.371						1051
ACTIVE	.536	.330		2		3	1247
WAIT-ACT	1.797	.001					1252
AVERAGE	.523	.309		4		3	7
TOTAL	3.660	2.162		25		21	

Figure 19. Trace Analysis Summary

TRACE ANALYSIS I/O SUMMARY 10/31/96

FILE-QAPTTRCJ LIBRARY-QPFRDATA MBR-QAJOBTRC JOB- QPADEV006 .A960303A .058608

			P R O G R A M	******* PROGRAM DATA BASE I/O *******									FULL		SHARE		SUBFILE		
	SECONDS	SEQNCE	NAME	CALL	INIT	GETDR	GETSQ	GETKY	GETM	PUT	PUTM	UDR	OPN	CLS	OPN	CLS	READS	WRITES	MSGS
WAIT-ACT	34.193	45																	
ACTIVE	.442	145											1						1
WAIT-ACT	1.154	150																	
ACTIVE	.319	208												1					
WAIT-ACT	10.354	213																	
ACTIVE	.663	441											1				1	12	1
WAIT-ACT	23.624	446																	
ACTIVE	.480	555															1	4	2
WAIT-ACT	17.752	560																	
ACTIVE	.601	779															1	12	
WAIT-ACT	20.577	784																	
ACTIVE	.619	1046															3	13	2
WAIT-ACT	3.371	1051																	
ACTIVE	.536	1247															2	12	1
WAIT-ACT	1.797	1252																	
AVERAGE	.523	7															1	8	1
TOTAL	3.660												2	1			8	53	7

Figure 20. Trace Analysis I/O Summary

The trace job outputs are used to determine the following information that can be used to analyze job performance:

- Programs called and calling sequence and frequency
- Wall clock time of the program call and return sequence
- CPU time used by each program
- The number of synchronous DB and NDB disk I/Os per program called
- The number of full and shared file opens
- Messages received by each program

Do not use the wall clock time (TIME heading) or CPU time (CPU TIME heading) to estimate the actual time used by each program. The implementation of a trace job inflates the real values to those shown in the trace job data. However, you can use the time values to identify **relative** differences among the programs listed.

Attention!

Be aware that tracing a job with hundreds of user program or procedure calls may have a significant impact on CPU utilization.

3.4.2.1 DSPACCGRP and ANZACCGRP

Analyzing Process Access Group activity is done by using these commands. Collect the data with the DSPACCGRP command and direct the output to a database file. The command lets you select jobs by generic job or user name, or by type (interactive or all).

Use the ANZACCGRP command to print a summary of the data in the file. For each job type, it shows:

- How many jobs exist
- The number of files that are in use in each job, and the amount of I/O done by the job
- What files are open in the system, what duplicate files a job may have, and the amount of I/O going on for each file
- The active programs within the jobs selected

Analyze job PAGs to see if savings can be made. Opening and closing seldom-used files each time they are used saves buffer space. In some cases, display files have many formats but a job uses only one or two. Placing these formats into a separate display file (for example, based on application function) can reduce PAG size. This reduces the number of disk I/O operations to read and write the PAG and saves space while the PAG is in memory. This is valuable on a system with limited main storage.

3.4.2.2 The Performance Explorer

If the tools introduced earlier in this chapter do not give you enough information, you might consider using the Performance Explorer. The Performance Explorer is a combination of Timing and Paging Statistics Tool and Sampled Access Monitor. The use of Performance Explorer is beyond the scope of this publication but if you have used either TPST or SAM earlier, you should have no problems with Performance Explorer. For detailed information about using the Performance Explorer, see the *AS/400 Performance Tools/400 Guide*, SC41-4340.

3.5 Performance Data Conversion

You can analyze performance data collected on a system running an earlier release of the OS/400 but the files must be converted before the current (V3R7) level of Performance Tools can use them.

This is done by running the Convert Performance Data (CVTPFRDTA) command against the down-level performance data.

The conversion may be done in the library in which the current data resides, or to a different library. If the conversion is done in the same library, the current data is replaced by the new data. If the conversion is done to a different library, the new data exists in the new library while the ″back level″ data continues to exist in the ″old″ library.

Note: To avoid the risk of destroying the old data if the command ends abnormally, convert the data into a different library (To library prompt (TOLIB parameter)), and later, delete the data from the old library (From library prompt (FROMLIB parameter)). Data conversion may affect the other transaction response times. You may consider submitting it during a low period of CPU utilization.

To be able to analyze performance data collected on a V3R2 level operating system you must specify either TGTRLS(V3R1M0) or TGTRLS(*PRV) when saving the performance data library.

Chapter 4. Using BEST/1 for Communications Performance Analysis and Capacity Planning

This chapter discusses using the BEST/1 function of the Performance Tools to analyze communications performance problems. The following major topics are covered in this chapter:

- V3R7 AS/400 capacity planning
- Creating a model for communications capacity planning analysis
- Using a model for communications capacity planning analysis
- Changing communications resources
- BEST/1 communications support for performance capacity analysis
- BEST/1 considerations when analyzing communications data

4.1 V3R7 BEST/1 Capacity Planning

Creating a model of the current system is the most common use of the capacity planning tool. Use the model to see how changing either the system configuration or the workload affects the performance. You may find out the affect on remote response time, line utilization, IOP utilization, CPU utilization, and other parameters.

The scenario of changing either hardware or workload and re-analyzing the data and viewing the results is discussed in this chapter.

If you are interested in seeing how the changes to your hardware configuration affect communications performance, you can do so by using the V3R7 BEST/1 Capacity Planning, which is a part of the Performance Tools/400 program product. If you are not familiar with BEST/1 Capacity Planning, it is highly recommended that you review the following manual:

- *AS/400 BEST/1 Capacity Planning Tool*, SC41-3341

4.1.1 When to Use BEST/1 for Communications Performance Analysis

Use BEST/1 modeling when the communications performance does not meet the predefined objectives or when you know that there are major changes coming to either the workload or the system configuration. For example, you can predict the impact to the system performance of adding 100 new users to the existing configuration. You can also see how replacing a 2626 IOP with a 6506 IOP affects either response times or the number of transactions getting done.

The first step in analyzing the communications performance data collected by using the Start Performance Monitor (STRPFRMON) CL command usually is to use the Advisor tool. See Chapter 3, "Using Performance Tools/400" on page 27 for information about using the advisor tool for communications performance analysis. By using BEST/1 with the real communications performance data, you can simulate **beforehand** what happens if you change, for example:

- The line speed of a communication line
- A communication IOP
- The CPU model

- The size of main storage
- DASD configuration

4.2 Creating a Model for Communications Analysis

The purpose of this section is to show you the steps of building a model using performance measurement data.

When building a model, choose a performance data member that represents a **normal workload** on the system. If you choose a member with only a few active jobs, the results you obtain may not help you in your search of the performance bottleneck. The heavier the workload in the performance data file member you choose to build the model from, the more usable the model is that you create.

If the created model can handle a workload significantly heavier than the one you have in real life, the system performance after the configuration changes should be acceptable in real life also. Usually, the results acquired by using the BEST/1 tool are accurate within five percent.

The following sections describe some of the displays associated with these steps. For a complete step-by-step demonstration, see the *AS/400 BEST/1 Capacity Planning Tool Guide*.

Enter the STRBEST command to start the BEST/1 modeling tool and from the *BEST/1 for the AS/400* menu, choose option 1 to work with models. The *Work with BEST/1 Models* menu is displayed. Enter option 1 to create a new model from performance data. Either use the default jobs classification or create your own job classifications as shown on the following pages.

4.2.1 Assigning Jobs to Workloads by Communications Line

BEST/1 enables you to assign jobs to workloads based on communications line or control unit options.

This enables models to be created that allow for workload changes according to remote locations. For example, you can use these options to predict what happens if:

- The amount of remote work station users increase or decrease.
- The business volumes on the remote end changes such as when:
  - A new branch is opened.
  - A competitive company is bought.

4.2.1.1 Specify Job Classification by Communication Line

Figure 21 on page 55 shows an example of the Specify Job Classification Category display. In this example, option 9 is used to group the jobs according to the communication line they are attached to.

```
                    Specify Job Classification Category

 Type choice, press Enter.

   Category . . . . . . . . . . . .   9            1=User ID
                                                   2=Job type
                                                   3=Job name
                                                   4=Account code
                                                   5=Job number
                                                   6=Subsystem
                                                   7=Pool
                                                 1 8=Control unit
                                                 2 9=Comm line
                                                   10=Functional area









 F3=Exit   F12=Cancel
```

Figure 21. Specify Job Classification Category Display

Notes:

1 When a control unit option is selected, all of the work that can be associated with a local station controller, a display station pass-through virtual controller, or a WAN controller is identified. All of the other work is assigned to a single workload.

2 When a communications line option is selected, all of the work that was not associated by the Performance Monitor with a communication line is assigned to only one workload.

4.2.1.2 Edit Job Classification

Figure 22 shows workloads and communications line pairs manually typed in. Only the communications lines that were active during performance data collection are shown. Press the PF9 key to get a list of communications lines from the previously gathered performance data.

```
                          Edit Job Classifications

 Enter workload names and category values which are assigned to each workload,
   press Enter.  Jobs with unassigned values become part of workload QDEFAULT.
   1            2
 Workload     Comm Line       Workload     Comm Line       Workload     Comm Line
 SDLC101      SC101           ________     _________       ________     _________
 SDLC102      SC102           ________     _________       ________     _________
 SDLC103      SC103           ________     _________       ________     _________
 TRNLAN       LINTRN          ________     _________       ________     _________
 X25A         LINX25A         ________     _________       ________     _________
 X25B         LINX25B         ________     _________       ________     _________
 QDEFAULT 3   _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
 ________     _________       ________     _________       ________     _________
                                                                           More...
 F3=Exit   F9=Display values from data   F12=Cancel
 To display values from performance data, press F9. 4
```

Figure 22. Edit Job Classifications Display

Notes:

1 and **2** show the workload assignments with activity from lines SC101, SC102, SC103, LINTRN, LINX25A, and LINX25B.

3 The remaining activity is assigned to workload QDEFAULT.

4 For easier assignment of workloads, press the PF9 (Display values from data) key to have BEST/1 query the QAPMJOBS file and show you a list of communications line names instead of trying to remember the names of communications lines.

4.2.1.3 Assign Jobs to Workloads

Figure 23 shows an example of the selection display after pressing the PF9 key in the Edit Job Classification display.

```
                              Assign Jobs to Workloads

 Workload . . . . . . . . . . . . . . . . .   __________ 1

 Type options, press Enter.  Unassigned jobs become part of workload QDEFAULT.
2 1=Assign to above workload   2=Unassign
                                       3             3          3
                                   Number of        CPU        I/O
 Opt  Workload    Comm Line    Transactions     Seconds      Count
  _     4                            38199     13501.999    1917862
  _   SDLC101     SC101               1515       295.622      48664
  _   SDLC102     SC102               1740       258.110      37562
  _   SDLC103     SC103                523        63.922       8156
  _   TRNLAN      LINTRN                 0        26.908       8428
  _   X25A        LINX25A                0         8.383       2464
  _   X25B        LINX25B               88        36.165       6255




                                         5                               Bottom
 F3=Exit   F12=Cancel       F15=Sort by workload      F16=Sort by comm line
 F17=Sort by transactions   F18=Sort by CPU seconds   F19=Sort by I/O count
```

Figure 23. Assign Jobs to Workloads

Notes:

1 Type a workload name and use option 1 or 2 beside the communications line to group work into workloads.

2 Use options 1 and 2 to assign or unassign the activity associated with the communications lines.

3 The Number of Transactions, CPU Seconds, and I/O Counts statistics provide you information about the activity on the line.

4 The first line shown under communications line names shows no communications line. This line represents all of the work that was not assigned to any of the communications lines. This *other* work can be assigned to only one workload, but it is preferable to let BEST/1 assign this work to the QDEFAULT workload to handle the *LIC (Licensed Internal Code) tasks properly. Leave this line unassigned.

5 You can have the workloads sorted after different factors by using the function keys shown on the bottom of the display.

4.2.2 Creating a Model

The actual creation of the model is submitted after the job classification scheme has been created. The create process accesses the performance data collected by the Performance Monitor and builds a model according to the specified job classifications.

4.3 Using a Model for Communications Analysis

Once the batch job creating the model has completed, you can work with the model to examine the results that can be viewed either as reports or graphs. Have the model analyzed and the calibration report viewed prior to any *What if...?* analysis.

The Analyzing of the model is done by selecting either option 5 (Analyze current model) or option 6 (Analyze current model and give recommendations) on the *Work with BEST/1 Models* menu.

4.3.1 Displaying Model Reports

Figure 24 shows an example of the Display Comm Resources Report display that shows the communications IOP utilization and the following information for each communications line resource:

- Utilization
- Response time per transaction
- Number of lines it represents
- Line speed of all the lines

```
                          Display Comm Resources Report
   1
Period:   Analysis                    4           5             6         7
   2                    3          Overhead    Rsp Time per    Nbr of    Line Speed
Resource               Util          Util       Trans (Sec)     Lines    (Kbit/sec)
CC01                    1.5
  LINTRN                0.4           0.0           0.01          1          4000.0
CC02                   65.2
  AE101                20.4           2.6           2.79          1             9.6
  JAIRO                 3.6           0.1           2.05          1             9.6
  LINSI                14.0           4.7           3.39          1             9.6
  LITECP1              26.7           4.7           3.21          1             9.6
  SC101                15.3           6.7           8.17          1             4.8
  SC102                16.8           6.2           7.36          1             4.8
CC03                   93.2
  FILIAL_CTR            0.0           0.0           0.00          1            19.2
  ITSC                  0.0           0.0           3.71          1             9.6
  OM104                 2.3           0.0           2.03          1             9.6
  SC103                 1.2           0.0           0.82          1             4.8
  LINX25A              19.0           0.6           1.18          1             9.6
                                                                            More...
F3=Exit   F10=Re-analyze      F12=Cancel   F15=Configuration menu
F17=Analyze multiple points   F18=Specify objectives    F24=More keys
```

Figure 24. Communications Resources Report

Notes:

1 The descriptive name of the analysis period (for example, a date).

2 The system-assigned or user-assigned name of the communications resource.

3 The predicted utilization of this line resource. For a communications IOP (such as the CC01 in this example), this is calculated from the number of frames processed and the service time per frame. For a line resource, this is calculated from the number of characters transferred and the line speed.

4 The line utilization that is due to overhead. For example, let′s assume that the line resource has a line overhead value of 10%. This means that for every 10 information bytes transferred, there is an extra overhead byte transferred. If the predicted line utilization (total) is 55%, the utilization due to overhead is 5%.

5 This represents the average predicted response time in seconds of the interactive transactions that contribute to the line traffic. The BEST/1 workload definitions indicate what portion of LAN or WAN transactions flow across each communications line. See Section 4.5.3, "Distribution of Characters Transferred Across Line Resources" on page 68 for more details. The workload report shows average WAN and LAN response times for an entire workload.

6 This field indicates the number of lines that the line resource represents. Adding or removing line resources is done by using the Work with Communications IOP Features display.

7 The line speeds for lines that are represented by the line resource. If this is an input field, type the line speed of your choice, or press PF4 to select from a list of line speeds. This line speed must be the actual speed of the connection. If the modems are communicating at 9.6Kbps, use 9.6Kbps as the AS/400 line speed (ignore what the AS/400 line description parameters show since they may not match the current situation).

4.3.2 Understanding Recommendations

If you choose option 6 to analyze the model and give recommendations, you may get suggestions for configuration changes. These changes are based on the internal tables containing values for resource utilization limits, so reading the recommendations is helpful when analyzing communications performance. Some of the recommended changes may be creating, changing, or deleting communications IOPs.

4.3.2.1 Display Recommendations

Figure 25 on page 60 shows an example of the Display Recommendations display that indicates both the components that were not meeting the desired objectives and the changes proposed to the current configuration to meet those objectives. This report contains two sections of information: exceptions and recommendations.

```
                         Display Recommendations

***** Analysis Exceptions ***** 1
Utilization of 65.22 for communications IOP CC02 exceeds objectives of 45.00
Utilization of 93.20 for communications IOP CC03 exceeds objectives of 45.00

***** Analysis Recommendations ***** 2
Move 3 Communication lines from IOP CC02 to CIOP1
Move 4 Communication lines from IOP CC03 to CIOP2
Create 1 communications IOP(s)
Move 1 communication lines from IOP CC02 to CC04
Move 1 communication lines from IOP CC03 to CC05





                                                                       Bottom
Performance estimates -- Press help to see disclaimer.
F3=Exit   F12=Cancel     F15=Configuration menu   F17=Analyze multiple points
F18=Specify objectives   F19=Work with workloads
```

Figure 25. Display Recommendations

Notes:

1 Exceptions are conditions that BEST/1 has identified as indicators of poor performance according to the objectives or guidelines.

2 Recommendations may suggest configuration changes to achieve the desired performance.

4.3.2.2 Exceptions

There are two basic types of exceptions related with communications performance:

- *Utilization of ... exceeds objectives ...*

  The predicted utilization of the identified hardware component has exceeded the guideline for that type of component.

- *... is saturated*

  The predicted utilization of the identified hardware component has exceeded 100%. This usually indicates a severe over-commitment of the hardware resource, which means that system was not capable of managing the workload.

4.3.2.3 Recommendations

If one or more exceptions have occurred, BEST/1 makes specific reconfiguration suggestions. These suggestions have one of two possible origins:

- Primary

  The reconfiguration is specifically indicated to remove one or more performance exception.

- Secondary

  Additional reconfiguration is required by AS/400 configuration requirements. For example, if the communications IOP utilization guideline is exceeded, BEST/1 probably recommended installation of a new communications IOP.

For communication lines, BEST/1 suggests increasing line speeds first. Then it suggests adding more lines to the configuration.

BEST/1 only recommends hardware reconfigurations that are both:

- Adequately or completely defined in the hardware table.
- Marked as currently available (Y).

4.3.2.4 How Communication Resources Utilizations are Predicted

BEST/1 uses the amount of:

- The total number of characters transferred
- Characters per transaction
- Transactions per function
- Functions per user

to calculate the utilization of communications resources for each workload.

Characters per transaction is the total of all characters transferred in and out. When communications lines are present, the number of characters is kept separately for each line. These are added across all workloads.

When building the workloads, BEST/1 assigns relative communication line activity to each workload based on the job′s CPU usage that has been assigned to each workload. Most interactive jobs indicate the communications line they are associated with, so this assignment is thought to be valid. Results in your environment may vary if you are using Client Access workstations attached to 5294 or 5394 remote workstation controllers.

WAN Controllers and LAN Controllers: Utilization of LAN and WAN controllers is determined by using the number of active jobs connected to LAN or WAN.

This method is based on the assumption that an average service time is representative and that the traffic is evenly spread among all the controllers of a particular type.

LAN and WAN IOPs: Use of LAN IOPs is determined by the attached communications lines. Each line′s contribution depends on the total LAN characters (determined previously for each workload), frame size, and IOP service time per frame. All the attached lines are added together to calculate the total percentage of the IOP utilization.

LAN IOP service time per frame is specific to each IOP. Line frame size is specific to each communications line.

Utilization for WAN IOPs is determined similarly by using the total WAN characters and number of WAN IOPs for WAN utilizations.

Communications Lines: Utilization of a LAN communications line is calculated by using the total LAN characters (determined previously to each workload), the line overhead, and the line speed.

Line overhead and line speed in kilobits per second is specific to each communications line. Utilization of WAN lines is determined similarly by using the total WAN characters per line.

Multifunction IOPs: The utilization of a multifunction IOP is determined by adding together the utilization for each type of activity. For example, the disk IOP utilization plus communications IOP utilization equals total MFIOP utilization.

4.4 Changing Communications Resources

This section shows some of the changes you can make to your model to meet your performance definitions. By changing some of the communications resources, you can ask *what-if...?* questions that help you with communications performance prediction.

Work with Communications Resources: Figure 26 shows an example of the Work with Communication Resources display. This display shows you all the communications IOPs and line resources in the current configuration for both LANs and WANs. Use this display to change the properties of communications resources.

For a communications IOP, you can change:

- Communications IOP feature
- Average service time

For a communications line, you can change:

- Number of lines the line represents
- Line speeds of all the lines

```
                        Work with Communications Resources

 Type options, press Enter.                     1
   2=Change   3=Copy   4=Delete   7=Rename   8=Create line resources
                                  4                          6          7
          2             3        Nbr of   5                  Line Speed  Pct Line
 Opt  Resource      Feature  Lines    Text                (Kbit/sec)  Overhead
  _   CC01          2626              LAN IOP
  _     LINTRN                    1   Comm line(s)            4000.0       2.0
  _   CC02          2623              WAN IOP
  _     AE101                     1   Comm line(s)               9.6      14.5
  _     JAIRO                     1   Comm line(s)               9.6       2.0
  _     LINSI                     1   Comm line(s)               9.6      50.4
  _     LITECP1                   1   Comm line(s)               9.6      21.3
  _     SC101                     1   Comm line(s)               9.6      78.5
  _     SC102                     1   Comm line(s)               4.8      57.7
  _   CC03          2623              WAN IOP
  _     FILIAL_CTR                1   Comm line(s)              19.2       2.0
  _     ITSC                      1   Comm line(s)               9.6       2.0
  _     LINX25A                   1   Comm line(s)               9.6       3.0
  _     OM104                     1   Comm line(s)               9.6       2.0
           8                                                             More...
 F3=Exit   F6=Create communications IOP   F12=Cancel
```

Figure 26. Changing Communications Resources

Notes:

1 The create line resources option allows you to create one or more line resources to attach to the current communications IOP.

2 This shows you the unique system-assigned or user-assigned name of the communications resource.

3 The communications IOP feature is shown on this column.

4 This field indicates the number of lines that the line resource represents. Adding or removing of the line resources is done through the Work with Communications IOP Features display.

5 A description of the communications resource. This can be a LAN IOP, a WAN IOP, or a communication line.

6 The line speed parameter for the lines that are represented by the line resource. If this is an input field, you can type the line speed of your choice, or press the PF4 key to select from a list of line speeds.

7 The amount of non-information bytes sent over a line resource is expressed as a percentage of the information bytes. For example, if 800 information bytes and 200 non-information bytes are transferred, the overhead is 25%. Depending on the type of line, non-information bytes can represent items such as protocol overhead or error retransmission. A high percentage of line overhead may indicate error conditions. By default, this value is set to 2% if the line utilization is 10% or less.

8 The create communications IOP function allows you to add a communication IOP into your configuration.

Multiple function IOPs are shown in this display as well as the Work with Disk Resources display because a multiple function IOP serves both as a disk IOP and as a communications IOP.

BEST/1 uses a LAN IOP called the 613L to represent a 6130 with LAN communications lines. The 6130 can support either WAN or LAN communications lines, but BEST/1 requires any communications IOP in the hardware table to be exclusively WAN or LAN. The hardware table includes a 6130 that supports WAN line speeds and a 613L that supports LAN line speeds.

When you create a model from performance data, the line speeds of the lines attached to a 6130 determine whether the IOP is listed as a 6130 or 613L.

LAN or WAN?

BEST/1 determines the communications IOP type by whether the minimum line speed supported by an IOP is less than 4MB.

- An IOP with a minimum line speed of 4MB or greater is considered LAN.
- An IOP with a minimum line speed of less than 4MB is considered WAN.

4.4.1 Example - Changing the IOP Type

The characteristics of the communications IOP usually affect the performance of the lines attached to the IOP. The higher capacity 2623 IOP provides better line performance than the lower capacity IOPs if any of these conditions are true:

- There is high throughput.
- The line has a high line speed.
- The IOP has many lines attached to it.
- Other lines on the IOP are highly utilized.
- There is high polling activity across the lines.

Change Communications IOP: Figure 27 shows an example of the Change Communications IOP display that allows you to change characteristics of the communications IOP. To change the communications IOP feature, select option 2 next to the element you want to change on the Work with Communications Resources display shown in Figure 26 on page 62.

```
                          Change Communications IOP

 IOP name 1 . . . . . . . :    CC02
 Text 2 . . . . . . . . . :   WAN IOP

 Type changes, press Enter.

3 Feature  . . . . . . . . . .    2623      F4 for list
4 Service Time . . . . . . . .    7.2       Msecs per frame










 F3=Exit   F4=Prompt   F12=Cancel
```

Figure 27. Changing IOP Type

Notes:

1 The name of the communications IOP resource

2 A description of the communications IOP resource. This can be:

- LAN (Local Area Network) IOP
- WAN (Wide Area Network) IOP

3 The communications IOP feature

4 The communications IOP average service time expressed in milliseconds per frame

4.5 BEST/1 Communications Support for Performance Analysis

BEST/1 communications support refers to modeling the way the users are connected to the system. For a communications performance analysis, look for users that are connected to the AS/400 system through:

- Local Area network (LAN)
- Wide Area Network (WAN)

A high utilization percentage of the communications line (LAN or WAN) surely affects response time. The purpose of this section is to describe the configuration displays that provide the communications support. These include the following displays:

- Create communications IOP feature.
- Create communications line resource.
- Specify Chars to communication line resources.

These three displays may be helpful if you have communications performance problems such as:

- There are IOPs with high utilization percentages.
- There are lines with high utilization percentages.
- You need to spread the workload evenly between IOP and line resources.

4.5.1 Creating a Communications IOP Feature

This section shows you an example of creating a communications IOP that you can add to your model to improve the performance. For example, if the analysis shows that there are IOPs with a high utilization percentage, you can see the estimated effect of adding a new IOP.

Create Communications IOP: Figure 28 on page 66 shows an example of the Create Communications IOP display that enables you to create a new communications IOP for your configuration. At the same time, you can also create communications lines and attach them to the new IOP.

You can add one or more communications lines to the current communications IOP with the average line speed specified in kilobits per second.

Fill in the necessary parameters for the communications IOP such as the feature number, service time, and the frame size. You also need to fill in information for the first line resource displayed such as the number of lines the line resource represents and whether the data is sent half or full duplex.

To create a communications IOP, press the PF6 key (Create Communications IOP) on the Work with Communications Resources display shown in Figure 26 on page 62.

You can also use the copy function on the Work with Communications Resources display shown in Figure 26 on page 62 to create an IOP.

```
                        Create Communications IOP

 Type changes, press Enter.  Line resources with 0 lines are not created.

1 IOP name . . . . . . . . . . .   CMB01
2 Feature  . . . . . . . . . . .   2619         F4 for list
3 Service time . . . . . . . . .   3.0          Msecs per frame
   4               5          6             7           8
   Line          Nbr of     Line Speed    Pct Line    Frame Size      9
   Resource       Lines     (Kbit/sec)    Overhead     (Bytes)      Duplex
   SC104            1        4000.0       20.0          256          *HALF







                                                                    Bottom
 Duplex: *HALF, *FULL
                      10
 F3=Exit   F4=Prompt   F6=Create line resource   F12=Cancel
```

Figure 28. Create Communications IOP

Notes:

1 The name of the communications IOP resource

2 The communications IOP feature

3 The communications IOP average service time expressed in milliseconds per frame

4 The name of the line resource. In the case of a model created from performance data, this name is system-defined. When you create (add) a communications IOP to a configuration, you provide the name.

5 This field indicates the number of lines that the line resource represents. Adding or removing line resources is done in the Work with Communications IOP Features display.

6 The line speed for lines that are represented by the line resource. If this is an input field, you can type the line speed of your choice, or press the PF4 key to select from a list of line speeds.

7 The amount of non-information bytes sent over a line resource given as a percentage of the information bytes. For example, if 800 information bytes and 200 non-information bytes are transferred, the overhead is 25%. Depending on the type of line, non-information bytes represent items such as protocol overhead or error retransmission. A high value for line overhead may indicate error conditions.

- For lines with less than 10% utilization, the default value of Pct Line Overhead is 2%.
- As the traffic on the line increases, the percentage value of Pct Line Overhead remains the same. Therefore, whether 800 or 8000 information bytes are transferred, if the value for Pct Line Overhead is set to 5%, it remains at 5%.

8 The size of the frame being processed by the communications line resource. For measured models, the frame size is determined by the average size of the information frame transferred across the line during the measurement interval.

9 This shows whether the line resource represents half duplex lines or full duplex lines. Half duplex lines can only send or receive data at any one time. Full duplex lines can both send and receive at the same time.

10 Press the PF6 key (Create line resource) to add line resources to this new communications IOP.

4.5.2 Creating a Communications Line Resource

This section is an example of creating a communications line. This helps you to remove a performance bottleneck if the line utilization percentage exceeds the guidelines.

Create Communications Lines: Figure 29 shows an example of the Create Communications Lines display that you can use to create a line resource and to specify its parameters. These include:

- Number of lines the line resource represents.
- Line speeds of all the lines. This is not a total speed, but a speed for each line.

Note: The fields shown in this display have already been described in Figure 28 on page 66.

To add lines to an **existing** communications IOP, select option 8 (Create line resources) on the Work with Communications Resources display shown in Figure 26 on page 62.

```
                          Create Communications Lines

 IOP name . . . . . . . . . . :   CMB01

 Type changes, press Enter.  Line resources with 0 lines are not created.

   Line           Nbr of     Line Speed     Pct Line     Frame Size
   Resource        Lines     (Kbit/sec)     Overhead       (Bytes)      Duplex
   SC104              1         4000.0        20.0            256        *HALF

                                                                        Bottom
 Duplex: *HALF, *FULL

 F3=Exit   F4=Prompt   F6=Create line resource   F12=Cancel
```

Figure 29. Create Communications Line Display

4.5.3 Distribution of Characters Transferred Across Line Resources

You may examine the distribution of transaction characters in a specific workload being transferred over the communications line resources to find out:

- The utilization of the line resource
- Whether you need to consider redistributing a part of the workload

Distribution is expressed as a relative count, not as a percentage. For example, if the relative count for line resource SC103 is 4.5 and for SC104 is 18, four times as many characters are being transferred across SC104. Note that line resource SC107 has a relative count of 67.5 that represents 15 times more characters being transferred than SC103.

Also notice that relative counts for LAN are not related to relative counts for WAN. The division of work between WAN and LAN is specified by the number of active jobs on the Objectives display.

Specify Chars to Comm Line Resources: Figure 30 shows an example of the Specify Chars to Comm Line Resources display that allows you to specify the relative counts and characters transferred for this workload across communications line resources.

You can access the Specify Chars to Communication Line Resources display by pressing the PF9 key on the Change or Create Workload display.

```
                    Specify Chars to Comm Line Resources

 Workload  . . . . . . . : 1 INTERACTIV

 Type changes, press Enter.
                                      4          5
      2                3          Nbr of    Line Speed          6
   Line Resource     Connect      Lines     (Kbit/sec)     Relative Count
    SC103              *WAN          1            4.8             4.5
    SC104              *WAN          1            4.8            18.5
    SC107              *WAN          1            4.8            65.0
    LINTRN             *LAN          1         4000.0           100.0
    LINX25A            *WAN          1            9.6             2.5
    LINX25B            *WAN          1            4.8             9.5







                                                                      Bottom
 F3=Exit      F10=Set relative counts to 1   F11=Show all line resources
 F12=Cancel   F17=Set relative counts to line capacity
```

Figure 30. Specify Chars to Comm Line Resources

Notes:

1 The name of the workload

2 The line resource that the workload is transferring characters across

3 The type of the line resource. The values are *LAN (Local Area Network) and *WAN (Wide Area Network). This value is determined by the minimum line speed supported by the communications IOP feature. LAN communications IOP features have a minimum line speed of 4MB. WAN communications IOP features have a maximum line speed of 4MB.

4 This field indicates the number of lines that the line resource represents. Adding or removing line resources is done from the Work with Communications IOP Features display.

5 This indicates the line speeds for lines that are represented by the line resource. If this is an input field, you can type the line speed of your choice. You may also press the PF4 key to select from a list of line speeds.

6 The relative number of characters transferred across this communications line resource. These are relative to each other; **they are not percentages**. Relative counts for WAN are calculated separate from the relative counts for LAN. For example, Figure 30 on page 68 shows all LAN traffic going across LINTRN and sixty five-hundreds of the WAN traffic going across SC107.

4.5.3.1 Communications Workload

BEST/1 creates two types of communications workloads to represent communications activity:

- For communications lines that have traffic but have no jobs associated, BEST/1 creates a workload named QCMN that represents traffic on those lines. QCMN workload contains no I/O activity and no CPU utilization.
- BEST/1 creates a communications workload for workloads that show non-interactive activity in a group but with no corresponding interactive activity in the same group. The name of the workload is your workload name plus the letters QLAN or QWAN (QL or QW if the name is too long). This workload contains only non-interactive activity. BEST/1 creates this workload because it cannot show non-interactive activity for that group in your original workload without showing corresponding interactive activity, which misrepresents the activity of your workload.

4.6 Comparing the Model Against the Measured Performance

After completing the changes to the model created, press the PF12 key until the Work with BEST/1 Model menu is displayed and re-analyze the model. On the Display Analysis Summary display, press the PF11 key to compare the results against the measured values.

Repeat the entire process described in this chapter until your performance objectives are met.

4.7 Considerations When Analyzing Communications Data with BEST/1

The following list contains communications related assumptions under which BEST/1 creates the model for analysis:

- All controllers are equally distributed across all communications lines for LAN and WAN.
- All LAN controllers have the same service time.
- All WAN workstation controllers have the same service time.

Please remember the following things when analyzing the model:

- Many times, communications activity caused by batch jobs is put in the special QCMN workload described in Section 4.5.3.1, "Communications Workload" on page 69. Use the copy function or the combine workloads function to properly associate communications activity with CPU and DASD activity.
- Client/Access users connected through 5294 or 5394 controllers are incorrectly assigned as local Client/Access jobs. Client/Access users attached through 5494, however, are correctly assigned.
- Total MFIOP utilization can only be determined by adding the predicted utilizations from the disk IOPs and Arms report with the predicted utilization on the Communications report.
- Assignment of relative counts of communications line activity to workloads is done based on job assignments to workloads and their relative CPU usage.
- LAN utilizations can only be calculated for workload that is actually being done with the AS/400 system. Other traffic on the LAN causes utilizations to be different from the predicted.
- Response times can only take into account the effect of the communications line that is attached to the AS/400 system. Any other connections beyond that line add additional response time.

Chapter 5. Using System Service Tools

The System Service Tools (SST) provides a relatively easy access to numerous logs that OS/400 constantly maintains. This chapter gives you some examples of how to use the system service tools but please remember that **incorrect use of this service tool can cause damage to data in the system**. Contact your service representative for assistance if you have even a slightest doubt about how to proceed.

5.1 Checking the Communications Hardware

The following displays give you an example of how to find information concerning communications error log data. Choose the option that is displayed on the input field. Sign on to the system with a user profile having the *SERVICE special authorities and enter the STRSST command on any command line. The following display is shown:

```
                        System Service Tools (SST)

   Select one of the following:

        1. Start a service tool
        2. Work with active service tools
        3. Work with disk units
        4. Work with diskette data recovery










   Selection
        1

   F3=Exit          F10=Command entry          F12=Cancel
```

Figure 31. The System Service Tools (SST) Display

System Service Tools (SST) lets you start service tools, work with active tools, and work with disk unit data. **Be aware:** Service tools should only be used under the direction of your service representative. The options you can select from this display are:

1. Start a service tool. The service tools are:
   - Product activity log
   - Trace Licensed Internal Code
   - Work with communications trace
   - Display/Alter/Dump
   - Work with LIC log
   - Main storage dump manager

- Hardware service manager

2. Select this option to:

   - Start a service tool.
   - Re-enter a service tool you left active.
   - End an active service tool.

   The status of a service tool is shown if the service tool is either active or ending.

3. Select this option to use tools that can be run for disk units. You can:

   - Display disk unit configuration.
   - Calculate disk configuration.
   - Work with the storage threshold of an Auxiliary Storage Pool (ASP).
   - Work with disk unit information.
   - Work with disk unit recovery.

4. This option is used to recover the data from a diskette containing read errors. Select this option to:

   - Read the contents of a diskette into the system.
   - Print reports about the data on the diskette.
   - Review the data on the diskette.
   - Change the data that has been read from the diskette.
   - Write the changed data back to another diskette.

   Use this option only when directed by your service representative.

Important!

Service Tools should only be used under direction of a service representative. Some of the tools allow changes in the data and LIC. These can cause unpredictable results.

The following example shows Start a Service Tool display:

```
                         Start a Service Tool

 Warning: Incorrect use of this service tool can cause damage
 to data in this system.  Contact your service representative
 for assistance.

 Select one of the following:

      1. Product activity log
      2. Trace Licensed Internal Code
      3. Work with communications trace
      4. Display/Alter/Dump
      5. Licensed Internal Code log
      6. Main storage dump manager
      7. Hardware service manager




 Selection
      1

 F3=Exit         F12=Cancel         F16=SST menu
```

Figure 32. The Start a Service Tool Display

The Start a Service Tool display lets you select a service tool to diagnose problems, for example, with the system Licensed Internal Code (LIC).

The options you can select from this display are:

1. This option displays or prints errors that have occurred (such as in disk and tape units, communications, and workstations). This option also lets you work with tape and diskette statistics.
2. This option shows a menu that lets you start or stop a trace of Licensed Internal Code (LIC). You can also display, dump, allocate, or clear the trace tables where the LIC is recorded.
3. This option lets you start or stop a trace of data on a communications line or network. Any traced data can be formatted and printed.
4. This option lets you display or change virtual storage data. You can dump the data to tape, diskette, or printer. You can also print data that was previously dumped to a tape or diskette. **USE THIS OPTION ONLY WHEN DIRECTED BY SERVICE REPRESENTATIVE!!**
5. This option lets you display LIC log information. You can dump the Licensed Internal Code log information to tape or diskette, or to a printer.
6. This option lets you display a main storage dump or copy the dump to tape or diskette, or to a printer.
7. This option lets you display, work with, and print the stored hardware resource information. Both logical and packaging hardware resources are displayed. This option also allows you to display, alter, trace, or dump input/output (I/O) processor Licensed Internal Code. I/O processors control the storage devices, workstations, and communication data links on the system.

Selecting option 1 provides you with the Product Activity Log display:

```
                         Product Activity Log

  Select one of the following:

       1. Analyze log
       2. Display or print by log ID
       3. Change log sizes
       4. Work with removable media lifetime statistics
       5. Display or print removable media session statistics
       6. Reference code description









  Selection
       1

  F3=Exit       F12=Cancel
```

Figure 33. The Product Activity Log Display

This display allows you to display or print product activity log entries, removable media statistic log entries, or to change the size of logs. The options you can select from this display are:

1. Select analyze log to display or print a summary of product activity entries. This summary is useful for analyzing intermittent and multiple error conditions.
2. Select this option to display or print data from the product activity log by log identifier. The log ID is a unique identifier that ties together all data related to a single error condition.
3. Select this option to verify or change the amount of storage on a disk unit used for product activity log data.
4. Select this option to display, print, or delete the statistical data logged for the lifetime use of a removable media.

   Lifetime is the total length of time one of these media allows information to be read from or written to it. When a removable media is deleted, please delete the entry from the log.
5. Select this option to display or print the statistical data logged for a session of a removable media.

   Session is the length of time one of these media is in position to be read from or written to (read/write heads are loaded).
6. Select this option to display or print the description of a reference code.

Select Option 1 on the Product Activity Log display. The Select Subsystem Data display is shown.

```
                        Select Subsystem Data

 Type choices, press Enter.

   Log . . . . . . . . . .  5          1=All logs
                                       2=Processor
                                       3=Magnetic media
                                       4=Local work station
                                       5=Communications
                                       6=Power
                                       7=Licensed program
                                       8=Licensed Internal Code


   From:
     Date . . . . . . . .   10/24/96   MM/DD/YY
     Time . . . . . . . .   11:51:44   HH:MM:SS


   To:
     Date . . . . . . . .   10/25/96   MM/DD/YY
     Time . . . . . . . .   11:51:44   HH:MM:SS

 F3=Exit            F5=Refresh          F12=Cancel
```

Figure 34. The Select Subsystem Data Display

This display allows you to select a subsystem log to work with and the time period you want to work in.

The options you can select from this display are:

1. Display or print all data in the product activity log.
2. Display or print processor log data.
3. Display or print magnetic media error log data, including data for disk and removable media devices.
4. Display or print local workstation log data. Local workstations are connected to the system by a method other than a local area network or a communications device.
5. Display or print communications log data including:
   - Communications I/O processors
   - I/O adapters
   - Ports
   - Lines
   - Controllers including devices connected with following protocols:
     – SDLC
     – ASYNC
     – BSC
     – X.25
     – IDLC
     – ISDN
     – Local Area Network
6. Display or print log data associated with the system power control network.
7. Display or print licensed program log data.

8. Display or print Licensed Internal Code (LIC) log data. LIC is the layered architecture below the machine interface (MI) and above the machine. LIC is a proprietary system design that carries out many functions such as:

   - Storage management
   - Pointers and addressing
   - Program management functions
   - Exception and event management
   - Data functions
   - I/O managers
   - Security

All of the selections lead you to the following display:

```
                     Select Analysis Report Options

  Type choices, press Enter.

    Report type . . . . . . . . . 1 1   1=Display analysis, 2=Display summary,
                                        3=Print options
    Optional entries to include:
      Informational . . . . . . . 2 Y   Y=Yes, N=No
      Statistic . . . . . . . . .   N   Y=Yes, N=No

    Reference code selection:
      Option  . . . . . . . . . . 3 1   1=Include, 2=Omit
      Reference codes
      *ALL________________________________________________   *ALL...

    Device selection:
      Option  . . . . . . . . . . 4 1   1=Types, 2=Resource names
      Device types or Resource names
      *ALL________________________________________________   *ALL...



  F3=Exit       F5=Refresh       F9=Sort by ...       F12=Cancel
```

Figure 35. The Select Report Type for Subsystem Display

This display allows you to choose the type of report, the detail report format you want, and the type of entries you want in the report.

1 The three different report options are:

1. This option provides you with a list of entries that match the selected search values. The fields displayed include:

   - System reference code that identifies a unique logging condition. The system reference code is made up of the first four digits of the translate table ID followed by the four digits of the reference code.
   - Date and time when the entry was logged
   - Error class
   - Resource name and resource type
   - Logical address that is the direct select address and unit address for the resource most closely related to the entry
   - Frame ID (the identifier assigned to the frame enclosure)
   - Card and device position

- Device name
- Component (the component ID of the program logging the entry)
- Code (the product library code for the program logging the entry)
- Description

2. This option provides you with a summary of log entries sorted by the option specified using the PF9=Sort by... function. The default is to sort by date. The number of entries that match the search values is displayed with each summary line.

3. This option prints a report based on the selected search values and sort value.

2 The optional entries to include are:

- Informational entries that are logged to provide information about the system (for example, vary ons and vary offs).

- Statistic entries are logged to record the volume statistics information for removable media. Usually the statistic entries contain no information about communications.

3 The reference code selection enables you to:

1. Include entries with certain reference codes only.

2. Omit entries with certain reference codes.

Type up to 10 reference codes separated by blanks or commas. Reference codes must be four hexadecimal numbers or you may use a wildcard (*). The wildcard represents all reference codes that match the hexadecimal numbers in front of the wildcard. For example, AA* represents all reference codes that begin with AA. There can be only one wildcard in each value and the wildcard must be the last character, although multiple values with wildcards may be used.

The default is to include all entries for all reference codes.

4 The device selection field enables you to:

1. Include entries for selected device types.

2. Include entries for devices with specific resource names.

Type up to 10 device types or resource names separated by blanks or commas. Device types must be four characters while the resource names are up to 10 characters. You may use wildcards (*) on both types and names. As with reference codes, only one wildcard per entry is allowed and the wildcard must be in the last position of the value (for example, 93*).

The default is to include all entries for all device types.

The combination of selections provides you with the Log Analysis Report display:

```
                          Log Analysis Report

 From  . . : 1 10/25/96  11:15:04      To . . : 1 11/11/96  14:04:12

 Type options, press Enter.
 2 5=Display report 3 6=Print report

      System                                      Resource      Resource
 Opt  Ref Code     Date      Time      Class  Name          Type
  5   B008170C     10/25/96  11:15:04  Perm   CHN01         2605
  _   B600FDC0     10/25/96  11:59:42  Temp   CMN02         2619
  _   B00156ED     10/25/96  17:42:58  Perm   CMN01         2612
  _   B00156ED     10/25/96  17:43:33  Perm   CMN01         2612
  _   B00156ED     10/25/96  17:43:49  Perm   CMN01         2612
  _   B600FDC0     10/28/96  09:06:05  Temp
  _   B600FDC0     10/28/96  09:06:05  Temp
  _   B0081701     10/28/96  09:06:05  Perm   CHN05         2605
  _   B0085002     10/28/96  09:06:05  Perm   CHN05         2605
  _   B600FDC0     10/28/96  09:12:03  Temp   CMN06         2605
  _   B600FDC0     10/28/96  09:12:04  Temp   CMN07         2605
                                                                  More...
  F3=Exit
4 F11=Alternate view                F12=Cancel
```

Figure 36. The Log Analysis Report Display

This display allows you to display or print error log entries for each resource listed. If you select to display reports of more than one resource entry, you cannot return to this display until all selected resource entries have been displayed. The PF12 key can only cancel the entry you are working on.

1 From and To (date and time). The information displayed is gathered between these times. The format is the same as the system date and time.

2 Use the display option to display the Detail Report for the selected entry.

3 Use the print option to print the Detail Report for the selected entry.

4 Using the PF11 key provides additional information about all of the entries in the log.

The following display is the Detailed Report for the previously selected entry. If you have selected to display more than one entry, PF12 does not return you to the Log Analysis Report display until all of the selected reference code entries have been displayed.

```
                    Display Detail Report for Resource

                                              Serial                 Resource
 Name             Type      Model       Number                 Name
 ITSOX2506        2605      002         10-***0C               CHN01

 Log ID  . . . . . . . . . :   01063217   Sequence . . . . . . . : 1   33472
 Date  . . . . . . . . . . :   10/25/96   Time . . . . . . . . . :   11:15:04
 Reference code  . . . . . : 2 170C       Secondary code . . . . : 3 00000000
 Table ID  . . . . . . . . : 4 B008F080   IPL source/state . . . : 5 B/3
 Protocol  . . . . . . . . : 6 X.25
 Class . . . . . . . . . . : 7 Permanent
 System Ref Code . . . . . :   B008170C
 Frame retry limit reached
 8




 Press Enter to continue.

 F3=Exit                                             F6=Hexadecimal report
 F9=Address Information          F10=Previous detail report       F12=Cancel
```

Figure 37. The Display Detail Report for Resource Display

The fields have the following meanings:

1 The Sequence field shows you the numbers (assigned to the entries in the error log) that indicate the sequence in which the errors occurred. The highest number is the most recent.

2 The Reference code. This is the code that your service representative asks you for because this shows you the hardware error code for the failing condition.

3 The Secondary code may show the failing condition (for example, IOP return code, processor step code, program return code, or major/minor code).

4 The Table ID. Your service representative may also ask the contents of this field because this identifies a group of reference codes.

5 This identifies the source of the IPL code being used at the time the entry was added and the state of the machine when the entry was added.

6 The protocol field shows you the protocol used for sending and receiving data between the resource and the system.

7 The Error class that identifies the type of the entry is one of the following:

- Permanent
- Statistics
- Temporary
- Threshold
- Buffered
- Recoverable

- Informational
- Vary on or vary off
- Machine check
- Qualified

8 The description is provided by the reference code translate table.

5.2 Working with Communications Traces

Communications Trace is a service function that allows data to be traced on a communications line, a network interface, or a network server. Once the data has been traced, it may be formatted and placed in a spooled file to be displayed or printed.

Communications Trace should be used when:

- Your problem analysis procedures do not give sufficient information about the problem.
- You suspect that a protocol violation is the problem.
- You suspect that line noise is the problem.
- The error messages indicate that there is an SNA BIND problem.

Interpreting the communications trace output requires detailed knowledge of the line protocols being used to correctly interpret the data generated. The information needed to interpret the trace is in the *SNA Formats*, GA27-3136. Whenever possible, start the communications trace before varying on the line to be traced. This gives you the most accurate sample of the line coming up.

5.2.1 Starting and Stopping the Trace

There are two ways to start a trace:

- Enter the Start Communications Trace (STRCMNTRC) CL command.
- Press PF6 on the Work with Communications Traces display accessed by using SST.

A communication trace continues until:

- The End Communications Trace (ENDCMNTRC) command is run.
- TRCFULL(*STOPTRC) is specified when starting the Trace and the buffer becomes full.
- The Communications Trace function of the SST is used to end the trace.
- A physical line problem causes the trace to end.

In this presentation, we are using the SST functions to trace a token-ring line called AN EXAMPLE. The Work with Communications Traces display is accessed by choosing option 3 on the Start a Service Tool menu displayed in Figure 32 on page 73. The following display is shown:

```
                    Work with Communications Traces

Type options, press Enter.
  2=Stop trace       4=Delete trace    6=Format and print trace
  7=Display message   8=Restart trace

      Configuration
Opt   Object          Type   Trace Description      Protocol   Trace Status

  (No active traces)











F3=Exit    F5=Refresh    1 F6=Start trace    F10=Change size
F11=Display buffer size    F12=Cancel
```

Figure 38. The Work with Communications Trace Display with No Trace Active

Start the trace:

1 Press PF6; the Start Trace display is shown:

```
                              Start Trace

Type choices, press Enter.

  Configuration object . . . . . . .   AN EXAMPLE

  Type   . . . . . . . . . . . . . .   1       1=Line, 2=Network interface
                                               3=Network server

  Trace description  . . . . . . . .   YOUR DESCRIPTION

  Buffer size  . . . . . . . . . . .   6 1     1=128K, 2=256K, 3=2048K
                                               4=4096K, 5=6144K, 6=8192K

  Stop on buffer full  . . . . . . .   N 2     Y=Yes, N=No

  Data direction   . . . . . . . . .   3 3     1=Sent, 2=Received, 3=Both

  Number of bytes to trace:
    Beginning bytes  . . . . . . . .   *CALC   Value, *CALC
    Ending bytes   . . . . . . . . .   *CALC   Value, *CALC

F3=Exit   F5=Refresh   F12=Cancel
```

Figure 39. The Start Trace Display

The descriptions of the fields are:

1 Buffer Size(K); this shows the size of the buffer allocated to capture data for this trace. The maximum value that can be specified is 8192K bytes.

Note: For network server description traces, the buffer size indicates the size of the buffer allocated for the formatted trace output.

2 Stop on buffer full (referred to later as Stop/Wrap) specifies whether the data captured by the trace should be overwritten after the specified buffer size is filled. ″Yes″ indicates that trace data is written to the buffer only until the buffer is filled. Later data is not traced. ″No″ indicates that later data is written over earlier data once the buffer is full. Data collected in the beginning of the trace is lost if the buffer wraps over.

3 Trace Direction determines whether to trace transmitted data, received data, or both.

After starting the trace, the Work with Communications Traces display is shown again as follows:

```
                     Work with Communications Traces

 Type options, press Enter.
   2=Stop trace        4=Delete trace    6=Format and print trace
   7=Display message   8=Restart trace

       Configuration
 Opt   Object           Type   Trace Description      Protocol   Trace Status
  2   1 AN EXAMPLE     2 LINE 3 YOUR DESCRIPTION     4 TRN      5 ACTIVE









 F3=Exit    F5=Refresh      F6=Start trace    F10=Change size
 F11=Display buffer size    F12=Cancel
```

Figure 40. The Work with Communications Trace Display with Active Trace

The options or the function keys available on this display are:

- Option 2 = Stop trace

  Select this option to stop a trace that is currently active or waiting for the line, network interface, or network server to be varied on.
- Option 4 = Delete trace

  Select this option to delete a trace that is currently stopped or has an error.
- Option 6 = Format trace data

  Select this option to show trace data formatting options.

  Note: The trace status must be STOPPED or ERROR **before** using this option. Use PF5 to update the display and view the current trace status. When formatting is complete, the trace data is placed in a spooled file named QPCSMPRT in the default output queue.

- Option 7 = Display message

  Select this option to show a message associated with a trace that has an error status.

- Option 8 = Restart trace

  Select this option to restart a trace. Selecting this option is equivalent to selecting option 4 (Delete trace) and pressing PF6 to start trace in succession. Restarting a trace starts the trace again using the options selected for the original trace.

  Note: The trace status must be STOPPED or ERROR to use this option.

- PF10 is used to change the maximum storage size for all traces.
- PF11 is used to view more information about a trace.

The fields shown on this display are:

1 Configuration object shows the name of the configuration object being traced.

2 Type shows the type of configuration object being traced.

3 Trace Description shows you the text description specified for this trace.

4 Protocol shows you the protocol used for sending and receiving data on the communications line, network interface, or network server. The protocol types are:

- Async (Asynchronous Communications)
- BSC (Binary Synchronous Communications)
- TRLAN (Token-Ring Network)
- X.25
- SDLC (Synchronous Data Link Control)
- Ethernet (CSMA/CD or DIX V2)
- IDLC (ISDN Data Link Control)
- ISDN (Integrated Services Digital Network)
- DDI (Distributed Data Interface)
- Frame Relay
- Wireless LAN
- NetBIOS (Network Basic Input Output System)

5 The status of the trace is one of the following statuses:

Active Trace data is being gathered.

Error An error occurred while the trace was gathering data (some data may have been gathered) or while the trace was being formatted.

Formatting The trace is being formatted.

Starting Trace is being started by another user. You cannot stop or delete this trace. Use the PF5 key to update the trace status.

Stopped The trace has stopped (it is not gathering data).

Stopping The trace is stopping.

Waiting The trace is waiting for the line, network interface, or network server to be varied on and is not gathering data.

If the status of the trace is WAITING and the line, network interface, or network server has not been varied on or the job has not been started, do the following steps:

1. Return to the SST Main Menu.
2. From the SST Main Menu, press PF10 to receive the Command Entry display.
3. Vary on the line, network interface, or network server and start the job.
4. Return to the SST Main Menu and choose the option to start a service function.
5. Select the Communications Traces service function.
6. The trace status should be shown as ACTIVE on the Work with Communications Traces display. Use PF5 to update the trace status.

If you chose the option to stop the trace when the buffer is full, use PF5 to update the trace status. When the trace buffer is full, the trace status changes to STOPPED.

5.2.2 Formatting the Trace Data

After the trace has been stopped, you must format the trace. Formatting is done by entering Option 6 on the Work with Communications Traces display and the following display is shown:

```
                           Format Trace Data

Configuration object  . . . . :   AN EXAMPLE
Type  . . . . . . . . . . . . :   LINE

Type choices, press Enter.

  Controller . . . . . . . . . . 1 *ALL          *ALL, name

  Data representation  . . . . . 2 3             1=ASCII, 2=EBCDIC, 3=*CALC

  Format SNA data only . . . . . 3 N             Y=Yes, N=No

  Format RR, RNR commands  . . . 4 N             Y=Yes, N=No

  Format TCP/IP data only  . . . 5 N             Y=Yes, N=No

  Format UI data only  . . . . . 6 N             Y=Yes, N=No

  Format MAC or SMT data only  . 7 N             Y=Yes, N=No

  Format Broadcast data  . . . . 8 Y             Y=Yes, N=No
F3=Exit     F5=Refresh      F12=Cancel
```

Figure 41. The Format Trace Data Display

The display-only fields on this display are:

- The configuration object that shows the name of the configuration object traced.
- The type that shows the type of configuration object traced.

The input fields on this display are:

1 Controller. This option is only valid for Async, X.25, SDLC, IDLC, and local area networks. You can select to format the data for a specific controller or for all controllers attached to the communications line at the time of the trace.

- To format the data for all controllers, type *ALL.
- To format the data for a specific controller, type the name of the controller.

2 Data representation. This option is not valid for BSC networks. This option determines whether the hexadecimal data is converted to ASCII or EBCDIC characters.

- Select *CALC (default) to have the system calculate how to format the displayable characters in the trace.
- Select ASCII to convert the hexadecimal data to displayable characters using ASCII conversion rules.
- Select EBCDIC to convert the hexadecimal data to displayable characters using EBCDIC conversion rules.

For example, hexadecimal 61 is a slash ('/') in EBCDIC but hexadecimal 61 is an "a" using ASCII conversion.

3 Format SNA data only. This option is only valid for local area networks, SDLC, X.25, and IDLC.

- Select Yes to format and spool SNA data only.
- Select No to format and spool line protocol data (SDLC, X.25, Ethernet, token-ring, DDI, and wireless). SNA data is spooled (shown in hexadecimal form) but is not formatted.

4 Format RR and RNR commands. This option is only valid for local area networks, SDLC, X.25, IDLC, and ISDN.

- Select Yes to format RR (Receiver Ready) and RNR (Receiver Not Ready) commands in addition to other data.
- Select No if you do not want RR and RNR commands formatted with other data.

5 Format TCP/IP data only. This option is only valid for local area networks and X.25.

- Select Yes to format and spool frames that contain Transmission Control Protocol/Internet Protocol (TCP/IP) data only.
- Select No to format and spool line protocol data (token-ring, Ethernet, X.25, or wireless) only.

6 Format UI data only. This option is only valid for local area networks. "Yes" can be specified for this option only if "No" was specified for the "Format SNA data only" option.

- Select Yes to format and spool Unnumbered Information (UI) data only.

- Select No to format and spool line protocol data (token-ring, Ethernet, DDI, or wireless) only.

7 Format MAC or SMT data only.

Note: Traces of token-ring lines attached to a network server description do not contain any MAC data; therefore, this option must be set to No.

This option is only valid for local area networks.

- Select Yes to format and spool only Medium Access Control (MAC) or Station Management (SMT) data.
- Select No to format and spool line protocol data (token-ring, Ethernet, DDI, or wireless) only.

8 Format broadcast data. This option is only valid for local area networks.

- Select Yes to include the broadcast data (frames received with destination MAC addresses of FFFFFFFFFFFF) in the formatted trace data.
- Select No to exclude the broadcast data from the trace.

Usually, the next step after having the trace data both collected and formatted is to send the data to somewhere else to be analyzed. You normally have three alternatives:

- Print out the spooled file and send the printout.
- Save the spooled trace data on tape or diskette and send them.
- Send the spooled file through communications lines.

To save the spooled trace data to tape or diskette:

1. Use the Create Physical File (CRTPF) command to create a file with a record length of 133 and a file type of *DATA.
2. Use the Copy Spooled File (CPYSPLF) command to copy the spooled file QPCSMPRT to the physical file created previously. **Set the CTLCHAR parameter to *FCFC on the CPYSPLF command**, or the person receiving the file is unable to print the file.
3. To copy to diskette, use the Copy To Diskette (CPYTODKT) command to copy from the physical file to file QDKT. To copy to tape, use the Copy To Tape (CPYTOTAP) command to copy from the physical file to file QTAPE.

To send the spooled trace data to another system:

Use the Send Network Spooled File (SNDNETSPLF) command to send the spooled file to another user on the SNADS network.

If the target system supports DDM:

1. Use the Create DDM File (CRTDDMF) command to create a DDM file.
2. Use the Copy Spooled File (CPYSPLF) command to copy the spooled file QPCSMPRT to the DDM file created in step 1 in the preceding list. Remember to specify CTLCHAR(*FCFC) on the Copy Spooled File command.

Chapter 6. Communications I/O Processor (IOP)

The communications I/O processor (IOP) is the major component within a communications subsystem. When configuring an AS/400 system with communications lines, it is important not to overload an IOP to avoid a possible system performance bottleneck.

This chapter handles the most important values that the performance manager collects for IOPs. It describes how you can use these values to identify IOP bottlenecks, where you can find these values, how they are related to each other, and what you can do to remove the bottlenecks. From a performance point of view, there are two types of IOPs for communications:

- Communications IOPs
- Multi-function IOPs

Performance data for communications IOPs is collected in the file *QAPMCIOP*. Performance data for multi-function IOPs is collected in the file *QAPMMIOP*. The field names described in this chapter start with *xx*. You should replace *xx* by *CI* to retrieve the field name used in the QAPMCIOP file. You should replace *xx* by *MI* to retrieve the field name used in the QAPMMIOP file.

In this chapter, references are made to performance reports and performance displays. Read Chapter 3, "Using Performance Tools/400" on page 27 to see how you can print these reports or reach these displays.

6.1 Important Fields in the IOP Performance Manager File

The important performance fields in the QAPMCIOP file are all related to IOP utilization.

6.1.1 IOP Utilization

IOP utilization is the percentage of elapsed time during which the IOP was utilized. IOP utilization is an important performance indicator. Exceeding the utilization threshold value may lead to unacceptable response times.

6.1.1.1 Using Performance Tools/400 to Display IOP Utilization

To view the IOP utilization, you can print:

- The component report
- The resource report

The component report has an IOP utilizations section that shows you the IOP utilization over the total report period (see Figure 42 on page 90). You can print the component report by using the PRTCPTRPT command.

```
                                                    Component Report                                         11/15/96 16:01:58
                                                    IOP Utilizations                                                 Page   17

Member  . . . : SAMPLE     Model/Serial  . : 510-2144/00-00000   Main storage . . :  384.0 MB  Started . . . . :  11/12/96 14:24:40
  Library . . : QPFRDATA   System name . . :          SYSNAM05   Version/Release  :    3/ 6.0  Stopped . . . . :  11/12/96 14:59:39

Communications                                 --- OPSTART Msg ---   --- KBytes Transmitted ---   Restart       BNA         Available
IOP's                      Utilization        Reverse      Normal       IOP          System       Queues      Received      Storage
--------------------       -----------        -------      ------    -----------   -----------    -------     --------     ---------
CC01          (2619)           4.6                  0       1,081            465           429          0            0     1,895,536
CC03          (2617)           4.4                  0       3,772          4,922           350          0            0     2,130,644
CC04          (2623)            .2                  0         195             14             7          0            0        43,744

DASD IOP's                 Utilization          Ops Per Sec
--------------------       -----------          -----------
SI03          (6512)            .0                        4

Multi-function
IOP's                      Utilization
--------------------       -----------
CMB01         (9162)           1.1

Local Work            Controller   -- OPSTART Msg --  KBytes Transmitted Restart      BNA      ----- Queue Average -----  Twinaxial
Station IOP's   Util      Name      Reverse    Normal    IOP     System   Queues    Received    Wait    Suspend   Active     Util
--------------  ----   ----------   -------    ------  -------  --------  -------   --------   ------   -------   ------  ---------
WS01   (916A)     .1                      0         7        0         0        0          0       .0        .0       .0        .0
```

Figure 42. Component Report - Communications IOP Utilization

The resource report has an IOP utilizations section that shows you the IOP utilization per interval. Figure 43 shows the component report for the communications IOP. Figure 44 on page 91 shows the component report for the multi-function IOP. You can print the resource report by using the PRTRSCRPT command.

```
                                                 Resource Interval Report                                    11/15/96 16:42:01
                                             Communications IOP Utilizations                                         Page   5

 Member  . . . : SAMPLE     Model/Serial  . : 510-2144/00-00000    Main storage  . . : 384.0 M   Started . . . : 11/12/96 14:24:40
   Library . . : QPFRDATA   System name . . :            SYSNAM05  Version/Release . :   3/6.0   Stopped . . . : 11/12/96 14:59:39

IOP Name/              Itv                        -- OPSTART Msg --    --- KBytes Transmitted ---    Restart    BNA      Avail Local
 (Model)               End       Utilization    Reverse     Normal        IOP            System      Queues   Received   Storage (K)
-----------------     -----      -----------    -------     ------     ----------      ----------    -------  --------   -----------
CC01       (2619)     14:29             4.5           0        169             65              58          0         0         1,851
                      14:34             4.6           0        152             69              67          0         0         1,851
                      14:39             5.0           0        367            111             174          0         0         1,851
                      14:44             4.4           0        146             63              69          0         0         1,851
                      14:49             4.3           0         75             51              19          0         0         1,851
                      14:54             4.5           0         89             51              25          0         0         1,851
                      14:59             4.6           0         83             55              17          0         0         1,851
CC03       (2617)     14:29             6.7           0      3,735          4,916             350          0         0         2,080
                      14:34             4.0           0          7              1               0          0         0         2,080
                      14:39             4.1           0          6              1               0          0         0         2,080
                      14:44             3.8           0          6              1               0          0         0         2,080
                      14:49             3.8           0          6              1               0          0         0         2,080
                      14:54             4.0           0          6              1               0          0         0         2,080
                      14:59             4.1           0          6              1               0          0         0         2,080
CC04       (2623)     14:29              .1           0         28              2               1          0         0            42
                      14:34              .2           0         28              2               1          0         0            42
                      14:39              .4           0         28              2               1          0         0            42
                      14:44              .1           0         27              2               1          0         0            42
                      14:49              .1           0         28              2               1          0         0            42
                      14:54              .3           0         28              2               1          0         0            42
                      14:59              .3           0         28              2               1          0         0            42
```

Figure 43. Resource Report - Communications IOP Utilization

```
                                          Resource Interval Report                                    11/15/96 16:42:01
                                       Multifunction IOP Utilizations                                         Page  19

 Member  . . . : SAMPLE     Model/Serial  . : 510-2144/00-00000    Main storage  . . : 384.0 M   Started . . . : 11/12/96 14:24:40
   Library . . : QPFRDATA   System name . . :           SYSNAM05  Version/Release . :   3/6.0   Stopped . . . : 11/12/96 14:59:39

IOP Name/              Itv
 (Model)               End       Utilization
-----------------     -----      -----------
CMB01      (9162)     14:29          1.2
                      14:34           .7
                      14:39           .4
                      14:44           .4
                      14:49          1.9
                      14:54          2.4
                      14:59           .7
```

Figure 44. Resource Report - Multifunction IOP Utilization

To relate the IOP information provided by the Component and Resource reports to particular communication line descriptions, you can use the System Report - Communication Summary. By selecting the line description you want, the System Report provides the IOP Resource Name, IOP Type and line name. Otherwise, it is not obvious which lines are associated with which IOPs from the component and resource reports alone.

Alternatively, you can enter the WRKHDWRSC (*CMN) command and use PF11 to display the addresses of the IOPs.

6.1.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file are related to the IOP utilization:

xxIDLC The idle loop count. The number of times the communication IOP ran an idle loop. This is done when the IOP has no work to perform.

xxIDLT The idle loop time. The time in hundredths of micro seconds to run the idle loop once.

xxKBYO Number of bytes transmitted from the IOP to the system. For communications, this includes inbound data from all lines on this IOP.

xxKBYI Number of bytes transmitted from the system to the IOP. For communications, this includes outbound data to all lines on this IOP.

xxRSTQ The number of times that the IOP sent a work request (OPSTART) to the system and the system queues to process the request were full.

xxBNAR The number of times that a system hardware buffer overrun occurred.

A non-zero value in the field xxRSTQ indicates that the IOP is sending requests and data to the system faster than the system can handle them. This value should be 0 or low.

A non-zero value in the field xxBNAR indicates that IOP work requests are being sent to the system faster than the hardware buffers are unloaded. This value should be 0 or low.

The IOP utilization is derived from the following equation:

*IOP utilization = (INTSEC - (xxIDLC * xxIDLT) / 10 ** 8) / INTSEC*

INTSEC is the elapsed interval seconds.

6.1.1.3 Where to Find the Performance Values

xxIDLC This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:

- Query the QAPMCIOP/QAPMMIOP file.

xxIDLT This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:

- Query the QAPMCIOP/QAPMMIOP file.

xxKBYO This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:

- Query the QAPMCIOP/QAPMMIOP file.
- Print the resource report (Communications IOP only).
- Print the component report (Communications IOP only).

xxKBYI This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:

- Query the QAPMCIOP/QAPMMIOP file.
- Print the resource report (Communications IOP only).
- Print the component report (Communications IOP only).

xxRSTQ This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:

- Query the QAPMCIOP/QAPMMIOP file.
- Print the resource report (Communications IOP only).
- Print the component report (Communications IOP only).

xxBNAR This is a field in the QAPMCIOP file. To determine the value of this field, you can:

- Query the QAPMCIOP/QAPMMIOP file.
- Print the resource report (Communications IOP only).
- Print the component report (Communications IOP only).

IOP utilization

This is a derived field. To determine the value of this field, you can:

- Print the resource report.
- Print the component report.

The component report shows you the IOP utilization over the total report period. The resource report shows you the IOP utilization per interval.

6.2 Communication IOP Recommendations

One of the most important factors affecting the overall communication performance on an AS/400 network is the performance of the communication Input/Output Processor (IOP). The communications workload should be distributed as evenly as possible across all available resources such as communication lines, IOP subsystems, and system buses.

We shall examine the following factors affecting IOP performance:

- Configuring communication lines
- Frame size
- IOP type
- IOP assist
- IOP utilization

6.2.1 Configuring Communication Lines

Care should be taken when configuring wide-area network communication lines because each IOP subsystem has a limit to the number of lines it can support based on factors such as line speed, protocol, frame size, and the number of X.25 virtual circuits. This limitation is mainly determined by the amount of storage on the IOP and is more important for the older IOPs that had less storage available. In addition to the storage used to hold operational microcode and protocol specific code, the following line configuration parameters require additional storage.

MAXFRAME Maximum frame size.

MAXOUT Maximum number of outstanding or unacknowledged frames.

MAXBUFFER
Maximum size of inbound and outbound data buffers or message size (used for BSC or ASYNC protocols).

MAXCTL Maximum number of controllers.

For detailed guidelines on configuring lines and communication subsystems, refer to the *Communications: Management Guide*, SC41-3406. Pay special attention to the section describing aggregate line speed and subsystem storage considerations.

These theoretical maximum configurations for each communications IOP may not provide the expected performance if there is some other bottleneck such as the CPU′s ability to support the communications workload, or if there are excessive errors on a particular line. Communications applications consume CPU resources to process data and support disk I/O as well as to process the communications software itself. Instead of thinking how many communication lines a given system can support, determine how many lines are required to support the expected workload, and find out which AS/400 model is capable of accommodating this load.

The configuration guidelines should be adhered to because seemingly minor configuration changes may lead to problems if the IOP is overloaded. Future changes to certain line description parameters such as MAXFRAME, MAXCTL, or MODULUS may result in insufficient IOP storage if they are increased beyond the default values.

The guidelines are more accurate for a large transfer environment because the utilization of the IOP is affected by the size of the frames being handled. In an interactive environment where many small frames are being transmitted to a large number of workstations per line, the IOP has to work considerably harder than for a large file transfer environment. This is particularly true for frames smaller than 256 bytes and can reduce the number of lines supported.

6.2.2 Frame Size

In general, the use of larger frames results in improved IOP performance and lower response times. This is because the time it takes the IOP to process a large frame is only slightly longer than that for a small frame. As the total number of frames is reduced by using large frames, so too is the total overhead associated with the processing of the frames. The IOP processing time is shorter, allowing it to handle other transactions and provide improved throughput. This is of particular significance in a LAN environment where the high media speed reduces the possibility of the line being a bottleneck. This is in contrast to a wide-area network communication line, where line speed is often the main cause of throughput and response time problems. The frames on a LAN arrive at the IOP at a much higher rate and if the frame size is not maximized, throughput may be dramatically reduced. The relatively error free transmission environment of a LAN aids the use of large frames as few re-transmissions are required. This is the main concern when using large frames on a *noisy* wide-area communication line, as re-transmissions reduces overall performance.

To correctly configure your lines for maximum frame sizes, you must change the MAXFRAME parameter on both the line and controller descriptions. This holds for TRLAN, ELAN, FDDI, Frame Relay, SDLC, and ISDN. For X.25, both the DFTPKTSIZE and MAXFRAME parameters must be increased.

6.2.3 IOP Type

The choice of a communication IOP is also of importance because the new high performance IOPs such as the 2623, 2619 (token-ring), 2617 (Ethernet) and 2666 offer superior performance compared to the older IOPs. These high performance IOPs have faster microprocessors and more memory. If the throughput of the IOP is unsatisfactory and it is not possible to offload some of the workload to other IOPs, it may be necessary to upgrade to one of these processors. It is especially important to use the higher performing IOPs for file serving and database serving and in environments where there are many communication I/Os per transaction.

The 2623 six-line communication IOP provides better performance than the older style processors in any of the following situations:

- There is a requirement for high X.25 throughput.
- The IOP has several lines attached to it.
- High speed lines are required.
- The lines are heavily utilized.
- There is a high amount of polling on the lines.

The 2666 high speed communications IOP supports high speed lines such as T1(1.544Mbps)/E1(2.048Mbps) and supports communication protocols such as SDLC, frame relay, and X.25.

Refer to Section 9.2.1, "IOP Utilization" on page 159, Section 8.4.1, "IOP Utilization" on page 143, and Section 7.10, "LAN IOPs" on page 122 for a more detailed comparison of IOP performance measurements.

6.2.4 IOP Assist

The new LAN IOPs (2617, 2619, 2618, 2665, 2668, and 2666) also support a function called IOP assist that allows APPC applications to send RUs and TCP/IP applications to send buffers to the IOP for processing, which reduces the CPU utilization for these tasks. When using WAN IOPs or the older types of LAN IOP, the time spent by the CPU processing frames decreased significantly as the frame size was increased. The IOP assist feature makes the CPU time far less dependent on frame size because much of the processing is offloaded to the IOP.

Note

Changing the RU size (MAXLENRU) in the APPN mode descriptions to a value other than *CALC may negate the IOP assist performance feature.

6.2.5 IOP Utilization

An essential step to obtaining good system level performance is to ensure that you do not exceed the recommended utilization limit of any system resource. Guidelines for IOP utilization figures are given in Appendix I, "Guidelines for Interpreting Performance Data" on page 379 for the following communication IOPs:

- Multifunction IOP
- Communication IOP (WAN)
- LAN IOP
- Integrated PC Server (Formerly referred to as FSIOP)

It is not possible to give a fixed percentage IOP utilization as a maximum recommended value as this depends on the nature of the communication workload at the time the utilization is measured. In the case of an SDLC line with several controllers attached and workstations in an ″active″ or ″varied on″ state, the IOP utilization may be as high as 80% without any real ″work″ being done by the remote workstations. This is due to the constant transmission of Receive Ready (RR) frames that are necessary to maintain the active links. This is referred to as ″polling″ and means that an IOP can appear busy even when no real work is being performed. For this reason, the IOP utilization value provided by AS/400 Performance Tools is only of value if you know that productive work was being done during a particular monitor interval. If you know that only RR activity was present during the interval, you need not be concerned by seeing a high utilization.

For interactive environments, you may still have acceptable performance with a utilization of up to 60%. This figure may be even higher if there is only a small number of concurrent users.

Similarly, when using multipoint lines, you should vary off any controllers that are turned off as the IOP wastes time polling them if they are left ″vary on pending″. This unnecessary polling increases IOP utilization and slows response time for other users. See Section 9.1.5, "Connect Poll Retries" on page 155 for a discussion of polling and the importance of line description polling parameters such as POLLPAUSE, which can be adjusted to limit the frequency of polling inactive stations.

The IOP utilization is also affected by error recovery and retries. If you are experiencing high utilization, check the System Service Tools (SST) error logs for the lines controlled by that IOP for errors. You can also change the error logging threshold level (THRESHOLD) to *MAX temporarily to have error messages posted to the QSYSOPR message queue.

Chapter 7. Local Area Network Performance Analysis

Local Area Network (LAN) support on the AS/400 system offers a flexible means of connection for token-ring and Ethernet network users at much higher transmission rates than are possible with conventional wide-area network communication lines. Yet in spite of the high bandwidth available, LANs also suffer from bottlenecks and poor performance. This chapter discusses some of the common reasons for poor performance on token-ring and Ethernet LANs and describes the key indicators of performance that are found in the OS/400 Performance Monitor database. This data can be analyzed using Performance Tools/400 or by running your own queries over these database files.

LAN performance is also dependent upon the applications and protocols being used, the hardware and software configurations of the LAN workstations, and the LANs physical topology. This chapter focuses on tuning the AS/400 system for optimum performance and does not cover these other variables.

7.1 LAN Performance Indicators in Performance Monitor Database

The following are the main LAN performance indicators that are analyzed using the information available in the OS/400 Performance Monitor database files.

- Line utilization
- LAN congestion
- Medium access control (MAC) errors
- Retransmissions
- Timeouts
- LAN overheads

7.2 Line Utilization

Line utilization measures the percentage of elapsed time during which the LAN was busy transferring data.

Operating the LAN at too high a line utilization results in poor response time and throughput due to excessive queuing time.

7.2.1 Using Performance Tools/400 to Display Line Utilization

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor.

The DSPPFRDTA command provides a combination of system, component, and resource report information. Press PF21 on the Display Performance Data display to view the Communication Line Detail display as shown in Figure 45 on page 98.

The line utilization for the sample interval selected is the value listed under the % Busy column heading.

```
                      Display Communications Line Detail

 Member . . . . . . . :   Q952290843      Elapsed time . . . . :   09:57:23
   Library  . . . . . :     QPFRDATA

 Type options, press Enter.

   5=Display remote jobs   7=Display communications interval data

          Line         Line        Line        Tns    Average     Job       %
 Option   ID           Type        Speed      Count   Response    Count     Busy
          OM102        SDLC          9.6        412       3.19        9      7.3
          OM105        SDLC          9.6       2145       1.84       22      8.6
          SI102        SDLC          9.6        219       3.22        7      6.2
          OM106        SDLC          9.6       1949       2.19       17     10.7
          ITSC         SDLC          9.6          0        .00        0      1.1
          OM104        SDLC          9.6       1300       1.99       13      9.2
          SC103        SDLC          4.8       2176       2.42       18     23.4
          LINTRN       TRLAN      4000.0        142        .00       44       .3
                                                                         Bottom

 F3=Exit   F12=Cancel   F15=Sort by line ID   F20=Sort by transactions
 F24=More keys
```

Figure 45. DSPPFRDTA - Communications Line Detail

Performance Tools/400 also provides the following reports that can be printed using PRTSYSRPT (Print System Report) and PRTRSCRPT (Print Resource Interval Report):

- System Report - Communication Summary shows average and peak line utilization over the total report period as in Figure 46.

```
                                                 System Report                                          9/06/93 16:39:00
                                             Communications Summary                                           Page 0004
                                              Sample System Report

Member  . . . : Q952290843   Model/Serial  . . :  E50/12-34567   Main storage . . :   64.0 M   Started  . . . . : 08/17/95 08:44:29
  Library . . : QPFRDATA     System name . . . :      CPD01      Version/Release  :   3/ 1.0   Stopped  . . . . : 08/17/95 18:43:21

     Bus/IOP/                           Line     Avg     Max    Active       Number       Average      ------ Bytes Per Second -----
       Line               Protocol      Speed    Util    Util   Devices   Transactions    Response      Received        Transmitted
--------------------      --------     -------   ----    ----   -------   ------------    --------     ---------        -----------
BUS 0  IOP 03 (2626)
  LINTRN                   TRLAN       4000.0      0       1       23              0          .0         1315.8             499.2
```

Figure 46. System Report - Communication Summary

- Resource Interval Report - Communications Line Detail shows the utilization calculated per sample interval as shown in Figure 47 on page 99.

```
                                                 Resource Interval Report                                   09/06/95 15:09:13
                                                Communications Line Detail                                          Page 108
                                               Sample Resource Interval Report

Member  . . . : Q952290843   Model/Serial  . . : E50/12-34567    Main storage  . . : 64.0 M      Started . . . : 08/17/95 08:44:29
  Library . . : QPFRDATA     System name . . . :        CPD01    Version/Release . :  3/1.0      Stopped . . . : 08/17/93 18:43:21

PROTOCOL = TRLAN (SORT BY INTERVAL)

                                                            ------- Congestion -------
         Bus/                          I Frames    I Frames   -- Local  --  -- Remote --            Rsp        Remote LAN
 Itv     IOP/       Line     Line     Trnsmitd    Recd        Not    Seq    Not    Seq     Frame   Timer    ---  Frames ---   MAC
 End     Line       Speed    Util     Per Sec     Per Sec     Ready  Error  Ready  Error   Retry   Ended    Trnsmitd   Recd   Errors
-----  ----------  -------  ------  ----------  ----------  -----  -----  -----  -----  -------  ------  --------   ----   ------
       BUS  0
       IOP   3
        (2626)
08:59  LINTRN       4000.0       0           1           1      0      1      0      0        0       8         0      0       86
09:14  LINTRN       4000.0       0           2           2      0      2      0      0        0      16         0      0      124
09:29  LINTRN       4000.0       0           1           2      0      3      0      0        0      20         0      0      151
09:44  LINTRN       4000.0       0           2           3      0      1      0      0        0      16         0      0      113
```

Figure 47. Resource Interval Report Showing Communication Line Details

Performance Tools also provides graphic support for line utilization and can show up to 16 lines on a single graph.

Note

If you are using TCP/IP in a LAN environment, the line utilization in the PT/400 output may not be correct because frames for TCP/IP traffic are not counted in the PT/400 report. If this is the case, you need to create your own query to measure the line utilization. For an example, please see Appendix B, "Local Area Network Queries" on page 239.

7.2.2 Performance Monitor Database Fields

The following fields can be found in the performance monitor database files QAPMECL and QAPMETH that contain token-ring network and Ethernet fields respectively.

QAPMECL - Token-Ring Network File:

ELICT Total number of characters transmitted in all I-frames

ELICR Total number of characters received in all I-frames

ELLSP Line speed expressed in bits per second

INTSEC The number of seconds since the last sample interval

ELLND Line description

QAPMSAP - SAP data File:

SCBXMT Total number of characters transmitted in UI-frames for this SAP

SCBRCV Total number of characters received in UI-frames for this SAP

SCLND Line description

SCSSAP The source SAP (SSAP) ID (for TCP/IP, it is AA.)

*LINE UTL(%) = ((ELICT+ELICR+SCBXMT+SCBRCV)*8*100) / (ELLSP * INTSEC)*

The factor of 8 in this equation is used to convert the number of characters (bytes) into the number of bits.

This line utilization may not represent a value that is quite accurate. First of all, LAN is a shared media and many stations may be using the same ring. AS/400 PT/400 collects bytes counts only from the AS/400 system or to the AS/400 system so that data between other stations are not collected. Second, only I-frames are counted for SNA traffic and we have no idea for other frames. If you observe poor performance in a LAN environment but the line utilization shows a low number (such as 10%), the IOP utilization may show a high figure.

QAPMETH - Ethernet Network File:

ETLICT Total number of characters transmitted in all I-frames

ETLICR Total number of characters received in all I-frames

ETLLSP Line speed expressed in bits per second

INTSEC The number of seconds since the last sample interval

ETLLND Line description

```
                         ((ETLICT + ETLICR + SCBXMT + SCBRCV) * 8 * 100)
LINE UTILIZATION (%) = -------------------------------------------------
                                    (ETLLSP * INTSEC)
```

This line utilization may not represent a value that is quite accurate. First of all, LAN is a shared media and many stations may be using the same bus. AS/400 PT/400 collects bytes counts only from the AS/400 system or to the AS/400 system so that data between other stations are not collected. Second, only I-frames are counted for SNA traffic and we have no idea for other frames. If you observe poor performance in a LAN environment but the line utilization shows a low number (such as 10%), the IOP utilization may show a high figure.

7.2.3 Recommendations

In order to achieve good performance in a token-ring environment, it is recommended that the line utilization should not exceed 50%. The figure is lower for the Ethernet environment. Studies have shown that the CSMA/CD protocol used on Ethernet networks optimizes throughput and response time under conditions of relatively low (less than 40%) bandwidth utilization.

In a large data transfer environment where there are a small number of interactive users contending for the line, a higher line utilization can still offer acceptable performance.

The relatively high transmission rates of LAN networks reduce the likelihood of the line utilization being a performance bottleneck. It is more common for the application code, the system communication code, or the performance of the CPU and LAN IOP to be the limiting factors on response time and throughput.

7.3 LAN Congestion

LAN adapter congestion is often a cause of performance degradation on token-rings and Ethernets. This section discusses some common performance indicators that identify LAN congestion.

7.3.1 Not Ready and Sequence Errors

When a link station is experiencing congestion due to overflow of the receive buffers, it signals the host using a Receive Not Ready frame. This usually indicates a slow-down or a temporary inability to receive additional information frames.

If a receiving station finds an error in frames, it signals the sending station using a Reject frame for retransmission. This is an indication that the information frames are being received out of sequence.

7.3.2 Using Performance Tools/400 to Display Congestion

LAN congestion errors can be analyzed using the DSPPFRDTA command as follows:

- Type DSPPFRDTA.
- Select performance member.
- Select time interval.
- Press PF21 for Display Communication Line Detail.
- Select the line you want to view with a ″7″ for Display Communication Interval Data.

The results are shown in Figure 48.

```
                     Display Communications Interval Data

 Line ID . . . . . . :   LINTRN         Member . . . . . . . :   Q952290843
 Line type  . . . . . :   TRLAN            Library  . . . . . :     QPFRDATA
 Line speed . . . . . :   4000.0         Elapsed time . . . . :   09:57:23
 Bus number . . . . . :   0
 IOP address  . . . . :   3

 Type options, press Enter.
   5=Display remote jobs

                                             ---------Congestion---------
                         I Frames  I Frames  Local  Local  Remote  Remote
         Itv        Line Trnsmitd    Recd     Not    Seq     Not     Seq
 Option  End        Util  Per Sec   Per Sec  Ready  Error   Ready   Error
         16:28:38     .2        1         1     0      1       0       0
         16:43:37     .2        7         4     0      3       0       0
         16:58:35     .3        2         2     0      0       0       0
         17:13:33     .3        2         2     0      1       0       0
         17:28:31     .3        1         2     0      0       0       0
                                                                      More...

 F3=Exit   F11=View2     F12=Cancel   F15=Sort by itv end
 F20=Sort by line util   F24=More keys
```

Figure 48. DSPPFRDTA - Display Communications Interval Data

This display shows the congestion error counters for each sample interval.

Local Not Ready
: These are the Receiver Not Ready frames transmitted by the host as a percentage of the Information Frames received by the host.

Local Sequence Error
These are the Reject frames transmitted by the LAN IOP as a percentage of the Information Frames received by the AS/400 system.

Remote not Ready
These are the Receiver Not Ready frames received by the AS/400 system as a percentage of the Information Frames transmitted by the LAN IOP.

Remote Sequence Error
These are the Reject frames received by the host as a percentage of the Information Frames transmitted by the host.

These same congestion error counters can be displayed using PRTRSCRPT (Print Resource Interval Report) as shown in Figure 47 on page 99.

7.3.3 Performance Monitor Database Fields

The following fields from the performance database files QAPMECL and QAPMETH are the most important indicators of LAN adapter congestion.

QAPMECL - Token-Ring Network File:

ELRFT Total number of Receiver-Not-Ready frames transmitted

ELRFR Total number of Receiver-Not-Ready frames received

ELRJFT Total number of Reject frames transmitted

ELRJFR Total number of Reject frames received

ELIFT Total number of I-frames transmitted

ELIFR Total number of I-frames received

EMRXC Receive Congestion. Frame was not received due to insufficient receive buffer.

EMIOA I/O adapter overrun. Adapter interrupt status queue overrun.

QAPMETH - Ethernet File:

ETLRFT Total number of Receiver-Not-Ready frames transmitted

ETLRFR Total number of Receiver-Not-Ready frames received

ETLRJFT Total number of Reject frames transmitted

ETLRJFR Total number of Reject frames received

ETLIFT Total number of I-frames transmitted

ETLIFR Total number of I-frames received

ETMROV Receiver overruns due to buffer shortage

ETLLBC Counts of the number of times the station entered a local busy substate

The congestion errors reported by Performance Tools/400 are derived from the preceding fields using the following equations:

*Local Not Ready (%) = (ELRFT*100)/ ELIFT*

*Local Sequence Error (%) = (ELRJFT*100)/ ELIFT*

*Remote Not Ready (%) = (ELRFR*100)/ ELIFT*

*Remote Sequence Error (%) = (ELRJFR*100)/ ELIFT*

If the local congestion values are high, it is an indication that the AS/400 IOP or system data buffers are not being emptied fast enough to cope with the received traffic.

If the remote congestion values are high, further investigation should be undertaken to determine which remote stations are experiencing the congestion. This is because these figures are gross values for the entire network that can mask individual station problems.

In this case, more detailed information for each workstation is found in the performance database files QAPMSTNL and QAPMSTNE that contain token-ring station and Ethernet station file entries respectively. The following fields are useful:

QAPMSTNL - Token-Ring Station File:

SLLND Token-ring line description

SLTYPE Resource type of the token-ring IOP

SLSTNN Name of reporting workstation

DTETIM Interval date (yy/mm/dd) and time (hh:mm:ss)

SLRNRX Number of Receiver-Not-Ready frames transmitted

SLRNRR Number of Receiver-Not-Ready frames received

SLREJT Number of Reject frames transmitted

SLREJR Number of Reject frames received

SLIXMT Total number of I-frames transmitted

SLIRCV Total number of I-frames received

SLLBCT Number of times station entered local busy substate

QAPMSTNE - Ethernet Station File:

STLND Ethernet line description

STTYPE Resource type of Ethernet IOP

STSTNN Name of reporting workstation

DTETIM Interval date (yy/mm/dd) and time (hh:mm:ss)

STRNRX Number of Receiver-Not-Ready frames transmitted

STRNRR Number of Receiver-Not-Ready frames received

STREJT Number of Reject frames transmitted

STREJR Number of Reject frames received

STIXMT Total number of I-frames transmitted

STIRCV Total number of I-frames received

STLBCT Number of times station entered local busy substate

7.3.4 Receive Congestion Errors on Token-Rings

Another useful indicator of LAN adapter congestion is the Receive Congestion error which is a Medium Access Control (MAC) error reported by token-ring devices only.

Receive congestion is one of the standard MAC errors reported to the functional address of Ring Error Monitor every two seconds and is a function of the token-ring architecture. There are many devices that can perform the function of a ring error monitor (for example, a LAN Network Manager station or a 3174).

Performance Tools/400 only displays the total number of MAC errors occurring on the network. This is discussed in Section 7.4, "Medium Access Control (MAC) Errors" on page 106. However, the following field in database file QAPMECL can be used as an indicator of congestion on the AS/400 token-ring I/O adapter.

EMRXC Receive congestion: The frame was not copied because no buffer was available.

There are no individual station counters for receive congestion errors in the database files. This makes it difficult to isolate the offending adapter. Often it is the case that a PC simply needs to be re-booted to clear a congestion problem as there can be a problem between the token-ring adapter drivers and the PC application. Even though there may be no application currently using the token-ring connectivity, as long as the PC is still powered on and connected to the LAN, the adapter still tries to process frames containing its MAC address or a broadcast frame.

7.3.5 Ethernet Collision Counters

Ethernet networks implement a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol. When a station has data to send, it first listens to the media to determine if data is currently being transmitted by another station. If not, the station begins to transmit while continuing to listen to detect whether the frames collide with other transmissions. If a collision does occur, the stations must ″back-off″ and cease transmitting for a random period of time. As this time period is different for each station, eventually one of them should be able to successfully transmit without further collisions. If a station encounters 16 unsuccessful transmission attempts, the frames are discarded and it is left to the higher level protocols to deal with the retransmission of that frame.

Clearly the more stations on any given Ethernet segment, the greater the number of collisions, and more retransmissions are needed. This leads to congestion of the available bandwidth and poor response times.

Performance Tools/400 does not display information regarding Ethernet collision statistics. However, the following database files do contain collision counters. There are no equivalent fields in the Ethernet station counter file QAPMSTNE so it is not possible to look at individual station statistics.

QAPMETH - Ethernet Statistics File:

ETMEXR Number of frames unsuccessfully transmitted more than 16 times and hence discarded due to excessive retries

ETMM1R Number of frames requiring more than one retry for successful transmission

ETM1R Number of frames requiring exactly one retry to transmit

ETMDCN This counts the number of times that transmission was deferred due to the media being busy

A high value for ETM1R does not necessarily correspond to a high collision rate on the Ethernet bus. This field is useful if you analyze the information together with the other fields and make a comparison on the success rate of transmission on the network.

7.3.6 Recommendations to Control Congestion

Invariably LAN congestion causes degraded network performance. However, there is no definitive approach to take to produce immediate results because of the many different components that affect congestion on a LAN. Some of these factors are:

- The characteristics of the application
- The amount of data sent
- The rate that the application can present and accept data
- The data blocking characteristics
- The LAN adapter type
- The processing unit model..
- The utilization of the line, adapter, and the CPU..
- The internal buffering capabilities..

Some improvements that can be taken to resolve congestion are:

- Install a higher performance LAN adapter.
- Use larger frame sizes to increase the throughput of the LAN.
- Use pacing for SNA sessions to limit the transmission rate to congested adapters. Pacing specifies the number of request units (RUs) that can be sent before an acknowledgement is required from the receiving device. Pacing is specified in the mode description and may be different for each session. This is discussed in further detail in Chapter 10, “SNA” on page 163.
- Increase the value of the LANRSPTMR parameter in the controller description. See Section 7.9.3, “LANRSPTMR and LANFRMRTY” on page 117. This reduces the number of times that a station solicits a response and lets it wait for the receiver′s LANACKTMR to expire causing it to send the needed response if the frame has arrived. LANRSPTMR should not exceed two seconds.
- Consider lowering the value of LANMAXOUT, which controls the rate of transmission of the transmitting station if you have the following situation. The transmitting station is using a faster adapter than the receiving station over a fast media and the transmitting station is receiving a high number of Receiver Not Ready frames or Reject frames.
- Consider changing the topology of your network by breaking it up into smaller segments using bridges or switched hubs. Careful network design is required to prevent creating bottlenecks with these new network components.
- Some of the congestion may be caused by bottlenecks in the CPU or the disks. In this case, refer to the *AS/400 Performance Management Version 3 Release 6*, GG24-4735, for tips on managing your system performance.

7.4 Medium Access Control (MAC) Errors

The number of Medium Access Control (MAC) errors is an important indication of frame transmission and reception errors and frame format recognition problems as well as frame validity-related errors.

MAC errors are those reported by each workstation to the functional address of the Ring Error Monitor (REM) that may or may not exist. Often a LAN has a dedicated station acting as a LAN Manager that performs the REM function. If not, the MAC errors may be interrogated by any device that uses this functional address including the AS/400 system.

MAC errors consist of ″soft errors″ that indicate an underlying problem with some component of the network but that are not severe enough to totally disrupt the LAN and ″hard errors″ such as Beacon frames that do indicate a major failure of the LAN.

These errors can also be described as either isolating or non-isolating, depending on whether the problem can be pinpointed to a particular station or pair of stations (called a fault domain).

The IBM Performance Tools/400 provides some tools that can help you retrieve the gross MAC error count, but this does not help in isolating the fault domain. In order to do so, you must use the data in the performance database files described later in this chapter. You can use the queries provided in Appendix B, “Local Area Network Queries” on page 239 to examine the appropriate fields.

7.4.1 Using Performance Tools/400 to Display MAC Errors

The total number of MAC errors per performance monitor time interval can be displayed using the following command.

Type DSPPFRDTA:

- Select performance member.
- Select time interval.
- Press the PF21 key for Display Communication Line Detail.
- Select the line you want to view with a ″7″ for Display Communication Interval Data.
- Press PF11 to view the MAC errors on the display. An example is shown in Figure 49 on page 107.

```
                    Display Communications Interval Data

Line ID . . . . . . :   LINTRN          Member . . . . . . . :   Q952290843
Line type . . . . . :   TRLAN             Library . . . . . :      QPFRDATA
Line speed . . . . . :   4000.0          Elapsed time . . . . :   09:57:23
Bus number . . . . . :   0
IOP address . . . . :   3

Type options, press Enter.
  5=Display remote jobs

                                   Response  -----Remote LAN------
        Itv        Line  Frame     Timer      Frames      Frames      MAC
Option  End        Util  Retry     Ended    Transmitted  Received    Errors
        08:59:29     .1      0         8         0           0          86
        09:14:25     .2      0        16         0           0         124
        09:29:24     .2      0        20         0           0         151
        09:44:22     .4      0        16         0           0         113
        09:59:20     .4      0         8         0           0         220
                                                                        More...
F3=Exit   F11=View1     F12=Cancel   F15=Sort by itv end
F20=Sort by line util   F24=More keys
```

Figure 49. DSPPFRDTA - Displaying MAC Errors

The total number of MAC errors for each time interval can also be printed using PRTSCRPT (Print Resource Interval Report) to generate the Communication Line Interval Report as shown in Figure 50.

```
                                         Resource Interval Report                                 09/06/95 15:09:13
                                        Communications Line Detail                                        Page 108
                                       Sample Resource Interval Report

Member  . . . : Q952290843   Model/Serial  . . : E50/12-34567    Main storage  . . : 64.0 M      Started . . . : 08/17/95 08:44:29
  Library . . : QPFRDATA     System name . . . :        CPD01    Version/Release . :  3/1.0      Stopped . . . : 08/17/95 18:43:21

PROTOCOL = TRLAN (SORT BY INTERVAL)

                                                       ------- Congestion -------
       Bus/                             I Frames    I Frames   -- Local  --  -- Remote --          Rsp       Remote LAN
 Itv     IOP/        Line      Line     Trnsmitd    Recd       Not    Seq    Not    Seq     Frame   Timer   ---  Frames ---   MAC
 End     Line        Speed     Util     Per Sec     Per Sec    Ready  Error  Ready  Error   Retry   Ended   Trnsmitd   Recd  Errors
-----  ----------  -------  ------  ----------  ----------  -----  -----  -----  -----  -------  ------  --------   ----  ------
       BUS  0
       IOP   3
        (2626)
08:59  LINTRN       4000.0       0           1           1      0      1      0      0        0       8         0      0      86
09:14  LINTRN       4000.0       0           2           2      0      2      0      0        0      16         0      0     124
09:29  LINTRN       4000.0       0           1           2      0      3      0      0        0      20         0      0     151
09:44  LINTRN       4000.0       0           2           3      0      1      0      0        0      16         0      0     113
```

Figure 50. Resource Interval Report Showing MAC Errors

7.4.2 Performance Monitor Database Fields

The following Performance Monitor database fields can be used to analyze MAC errors on both token-rings and Ethernets.

The query definition in Appendix B, "Local Area Network Queries" on page 239 shows you which fields constitute the total MAC error counts displayed by Performance Tools/400.

QAPMECL - Token-ring Network File:

EMFTR Total frames transmitted: This includes all LLC and MAC frames.

EMFRV Total frames received: This includes also all LLC and MAC frames.

EMLNE Line Error: Code violation of frame-check sequence error.

EMINE Internal Error: Adapter internal error.

EMBRE Burst Error: Burst of same polarity is detected by the physical unit after the starting delimiter of a frame or token.

EMAFE Address Recognized indicator or Frame Copied indicator Error: Physical control field-extension field error.

EMABT Abnormal Ending Delimiter: Abnormal ending delimiter transmitted because of internal error.

EMLST Lost Frame: Physical trailer timer ended while IOA is in transmit stripping state.

EMRXC Receive Congestion: Frame not copied because no buffer was available.

EMFCE Frame Copied Error: The frame with a specific destination address was copied by another adapter.

EMFQE Frequency Error: Adapter detected wrong frequency or data has been corrupted enough to prevent adapter from synchronizing on incoming data.

EMTKE Token Error: The adapter any token timer ended without detecting any frame or token.

EMANR Total number of frames with address not recognized error.

EMFNC Total number of frames with frame not copied error.

EMTSE Total number of adapter frame transmit or frame strip process errors.

EMSFT Soft Error: Total number of soft errors as reported by the adapter.

EMTBC Total number of Beacon frames transmitted.

QAPMETH - Ethernet Counter File:

ETLTFT Total number of SNA related frames transmitted.

ETLTFR Total number of SNA related frames received.

ETMIFM Inbound Frames Missed: A receive buffer error or a missed frame was detected by the IOA.

ETMCRE CRC Error: Checksum errors detected by the receiver.

ETMEXR More than 16 retries: Frame unsuccessfully transmitted due to excessive retries.

ETMOWC Out of Window Collisions: Collisions occurred after slot time of channel elapsed.

ETMALE Alignment Error: Inbound frame contained non-integer number of bytes and a CRC error.

ETMCRL Carrier Loss: Carrier input to the chipset on the IOA is false during Transmission.

ETMTDR Time-domain reflectometry: Counter used to approximate distance to a cable fault. This value is associated with the last occurrence of more than 16 retries.

ETMRBE Receive Buffer Errors: A silo overflow occurred upon receiving a frame.

ETMSPI Spurious Interrupts: An interrupt was received but could not be decoded into a recognizable interrupt.

ETMDIF Discarded Inbound Frames: Receiver discarded frame due to lack of AIF entries.

ETMROV Receive Overruns: Receiver has lost all or part of a incoming frame due to buffer shortage.

ETMMEE Memory Error: The chipset on the IOA is the bus master and did not receive a ready signal within 25.6 usecs of asserting the address on the DAL lines.

ETMIOV Interrupt Overrun: Interrupt not processed due to lack of status queue entries.

ETMTUN Transmit Underflow: Transmitter has truncated a message due to data late from memory.

ETMBBE Babble Errors: Also called Jabber errors. Transmitter exceeded maximum allowable time on Ethernet bus.

ETMSQE Signal Quality Error: Signal indicating the transmit is successfully complete did not arrive within two seconds of a successful transmission.

7.4.3 Recommendations

To analyze the number of MAC errors your LAN is experiencing, you should consider studying the percentage of LAN traffic due to MAC errors. An acceptable range is 0.1% to 1% for token-ring networks. Ethernets function with higher MAC error rates due to the amount of collisions. A MAC error percentage higher than 1% or 2% on a token-ring may require further investigation.

MAC error percentage can be calculated as follows:

```
                 Number of MAC errors                     * 100
-----------------------------------------------------
Number of MAC errors + total frames transmitted and received
```

The total number of MAC errors can be obtained from either the Display Performance Data display or the printed Resource Interval Report as shown previously. The total number of frames transmitted and received is calculated from the following performance database fields:

QAPMECL - Token-ring Network File:

EMFTR Total frames transmitted: This includes all LLC and MAC frames.

EMFRV Total frames received: This includes also all LLC and MAC frames.

QAPMETH - Ethernet Counter File:

ETLTFT Total number of SNA related frames transmitted

ETLTFR Total number of SNA related frames received

The threshold figure of 0.1% to 1% for MAC errors is only a rough guide. If your LAN performance is satisfactory and you are not losing sessions, you may choose to ignore these errors. Otherwise, you may want to investigate whether a hardware problem exists.

For more information on the nature and frequency of MAC errors occurring on your token-ring network, you can increase the value of the error logging level (TRNLOGLVL) in the line description to one of the following values:

***MIN** Reports only conditions indicating degraded performance.

***MED** Reports conditions indicating existing or potential degraded performance.

***MAX** Reports all errors.

Messages appear in the QSYSOPR message queue. The second level text explains the cause and possible actions you may take.

7.4.4 Token-Ring Network Errors

The token-ring network manager support is provided in OS/400 to assist you in monitoring a token-ring network and determining the source of problems on the ring. All ring error problems reported by the token-ring network manager are logged as messages to the history log (QHST), and some are also logged in the system operator message queue (QSYSOPR).

Sometimes a serious error can occur such as when an adapter is not receiving a normal signal due to a cable break. In such a situation, the network manager posts repeated messages to QSYSOPR and the QHST log. This is typically beaconing. Beaconing can affect performance on the LAN significantly. When this happens, you need to look into the QHST log and investigate the source of the problem.

7.5 Retransmissions

When receive congestion errors occur on any station adapter and information frames are not able to be processed, retransmission of those frames is necessary. Similarly, if high numbers of MAC errors are occurring, frames are being corrupted or lost and must be retransmitted. This leads to greater overall LAN utilization and longer queuing times for the other stations.

Performance monitor files provide statistics that you can use to calculate the retransmission rate:

QAPMSTNL - Token-ring Station File:

SLIREX Number of I-frames retransmitted

SLBREX Number of bytes retransmitted in I-frames

QAPMETH - Ethernet Counter File:

ETLFTR Number of times I-frame retransmission occurred

ETLBRT Number of bytes retransmitted in I-frames

QAPMSTNE - Ethernet Station File:

STIREX Number of I-frames retransmitted

STBREX Number of bytes retransmitted in I-frames

When significant numbers of frames are being retransmitted, it is recommended that you determine the rate of transmission from:

Total number of I-frames retransmitted / Total Elapsed Time

Total Elapsed Time is the total sampling period over which performance data is collected. A high rate of retransmissions warrants further investigation into the congestion counters discussed earlier.

7.6 Timeouts

Frequent timeouts experienced on the network are an indication that the timers controlling transmission and acknowledgements may not be properly set. For instance, if the remote station′s acknowledgement timer is set longer than the response timer of the local station, and the remote system does not have as much data to send to the remote station, the local response timer expires and may need to retransmit the frame again. This retransmission creates unnecessary traffic which may add to the congestion of a LAN.

The response timer (LANRSPTMR, also known as the T1 timer) begins when a frame is sent with the poll/final bit on. If the timer expires and an acknowledgement has not been received from the other system, a receiver ready (RR) is sent to solicit an acknowledgement. This timer is used to recover lost frames, and should not expire often. An acceptable level is for less than 3% of the frames transmitted to result in this timer expiring. Some amount of T1 expirations always occur. Powering off or disconnecting a PC may cause the T1 timer to end, which is no cause for concern. Other causes may need to be investigated. For example, transmission of frames across a bridge may cause the T1 timer to time out when the bridge becomes a bottleneck. This timer should not be set higher than two seconds.

The retry count (LANFRMRTY) is related to the response timer. The response timer sets the wait time before the sending system needs to solicit a response for a frame that was sent. LANFRMRTY, which is also known as the N2 counter, sets the number of times the system attempts to send a frame before it declares that a problem exists with the remote station.

7.6.1 Using Performance Tools/400 to Display Timeouts and Retries

The IBM Performance Tools/400 provides some tools that can help you retrieve the response timeouts and the retry count information.

The number of times the response timer T1 expired and the number of frame retries N2 can both be displayed using the following steps:

- Type DSPPFRDTA:
- Press PF21 for the Display Communication Line Detail display.
- Select the line you want to view with a ″7″ for Display Communication Interval Data.
- Press PF11 for View 2. This is shown in Figure 51 on page 112.

```
                    Display Communications Interval Data

Line ID . . . . . . :   LINTRN          Member . . . . . . . :   Q952290843
Line type  . . . . . :   TRLAN             Library  . . . . . :     QPFRDATA
Line speed . . . . . :   4000.0          Elapsed time . . . . :   09:57:23
Bus number . . . . . :   0
IOP address  . . . . :   3

Type options, press Enter.
  5=Display remote jobs

                                  Response  -----Remote LAN------
        Itv         Line  Frame    Timer      Frames      Frames      MAC
Option  End         Util  Retry    Ended    Transmitted  Received    Errors
        08:59:29     .1      0         8          0           0         86
        09:14:25     .2      0        16          0           0        124
        09:29:24     .2      0        20          0           0        151
        09:44:22     .4      0        16          0           0        113
        09:59:20     .4      0         8          0           0        220
                                                                       More...
F3=Exit   F11=View1     F12=Cancel   F15=Sort by itv end
F20=Sort by line util   F24=More keys
```

Figure 51. DSPPFRDTA - Displaying T1 and N2 Counters

The total number of T1 and N2 counts for each time interval can also be printed using PRTSCRPT (Print Resource Interval Report) to generate the Communication Line Interval Report as shown in Figure 52.

```
                                                   Resource Interval Report                                   09/06/95 15:09:13
                                                  Communications Line Detail                                          Page 108
                                                 Sample Resource Interval Report

Member  . . . : Q952290843   Model/Serial  . . : E50/12-34567    Main storage  . . : 64.0 M      Started . . . : 08/17/95 08:44:29
  Library . . : QPFRDATA     System name . . . :        CPD01    Version/Release . :  3/1.0      Stopped . . . : 08/17/95 18:43:21

PROTOCOL = TRLAN (SORT BY INTERVAL)

                                                           ------- Congestion -------
         Bus/                               I Frames    I Frames   -- Local  --   -- Remote --            Rsp         Remote LAN
 Itv     IOP/        Line      Line     Trnsmitd    Recd       Not    Seq    Not    Seq      Frame    Timer    ---  Frames ---   MAC
 End     Line        Speed     Util     Per Sec     Per Sec    Ready  Error  Ready  Error    Retry    Ended    Trnsmitd   Recd   Errors
-----  ----------  -------   ------   ----------  ----------  -----  -----  -----  -----  -------   ------   --------   ----   ------
       BUS  0
       IOP   3
        (2626)
08:59  LINTRN       4000.0        0            1           1      0      1      0      0        0        8          0      0       86
09:14  LINTRN       4000.0        0            2           2      0      2      0      0        0       16          0      0      124
09:29  LINTRN       4000.0        0            1           2      0      3      0      0        0       20          0      0      151
09:44  LINTRN       4000.0        0            2           3      0      1      0      0        0       16          0      0      113
```

Figure 52. Resource Interval Report Showing T1 and N2 Counters

7.6.2 Performance Monitor Database Fields

The performance monitor database file contains some statistics on T1 (LANRSPTMR) expiration and N2 (LANFRMRTY) retry counts that can be used to assess whether T1 and N2 have been appropriately set. These are shown in the following list:

QAPMECL - Token-ring Network File:

ELT1T The number of times the response timer T1 (LANRSPTMR) expired on the AS/400 system

ELN2R The number of times the AS/400 system has retried N2 (LANFRMRTY) times to contact a remote station without success

QAPMETH - Ethernet Network File:

ETLT1T The number of times the response timer T1 (LANRSPTMR) expired on the AS/400 system

ETLN2R The number of times the AS/400 system has retried N2 (LANFRMRTY) times to contact a remote station without success

If these counters indicate a high value, further investigation should be made by querying the station file to examine the values set for the response timer and retry count. The relevant station files are:

QAPMSTNL - Token-ring Station File:

SLT1TE T1 timer end count

SLN2RE N2 retries end count

QAPMSTNE - Ethernet Station File:

STT1TE T1 timer end count

STN2RE N2 retries end count

A high value in these fields may indicate a mismatch in values of the timers set for the local stations and the remote stations. Section 7.9.3, "LANRSPTMR and LANFRMRTY" on page 117 discusses these parameters in greater depth.

7.7 LAN Overheads

Generally LAN overhead tends to be less noticeable than for conventional communication lines because of the higher media speed. However, you should still expect to see some overhead on your LAN arising from the following conditions:

- MAC frames resulting from activities such as ring purging, neighbor notification, error detection, and reporting that occur only on token-rings.
- Disconnect frames that are sent by a link station to terminate a connection with a remote link station.
- Disconnect mode frames that are sent by the remote link station in response to the disconnect frames.
- Set Asynchronous Balanced Mode Extended (SABME) frames that are used by a link station to initiate data transfer with a remote link station.
- Frame Reject frames that are generated when there is an invalid or unsupported command in the control field, invalid information, length of the information field, or received sequence error in the control field.

If these overheads form a large percentage of the line traffic, especially on a station basis, you should investigating the cause as you may be experiencing unnecessary session drop-outs or corruption of information frames due to some physical problem with the LAN. An example has been provided in Appendix B, "Local Area Network Queries" on page 239 to show you how to analyze the overhead on a token-ring using a query called TRNUSAGE. This query uses the statistics in the Performance Monitor database files to provide the percentages of overhead frames to the total number of frames transmitted and received.

7.7.1 Performance Monitor Database Fields

The following database fields may be of use in analyzing session control overhead due to rejects, disconnects, and SABMEs.

QAPMECL - Token-Ring Network File:

ELFFT Number of Frame-Reject frames transmitted

ELFFR Number of Frame-Reject frames received

ELSFT Number of SABMEs transmitted

ELSFR Number of SABMEs received

ELDFT Number of Disconnect frames transmitted

ELDFR Number of Disconnect frames received

ELDMT Number of Disconnect Mode frames transmitted

ELDMR Number of Disconnect Mode frames received

QAPMSTNL - Token-Ring Station File:

SLFRMX Number of Frame-Reject frames transmitted

SLFRMR Number of Frame-Reject frames received

SLSABX Number of SABMEs transmitted

SLSABR Number of SABMEs received

SLDISX Number of Disconnect frames transmitted

SLDISR Number of Disconnect frames received

SLDMFX Number of Disconnect Mode frames transmitted

SLDMFR Number of Disconnect Mode frames received

QAPMETH - Ethernet Network File:

ETLFFT Number of Frame-Reject frames transmitted

ETLFFR Number of Frame-Reject frames received

ETLSFT Number of SABMEs transmitted

ETLSFR Number of SABMEs received

ETLDFT Number of Disconnect frames transmitted

ETLDFR Number of Disconnect frames received

ETLDMT Number of Disconnect Mode frames transmitted

ETLDMR Number of Disconnect Mode frames received

QAPMSTNE - Ethernet Station File:

STFRMX Number of Frame-Reject frames transmitted

STFRMR Number of Frame-Reject frames received

STSABX Number of SABMEs transmitted

STSABR Number of SABMEs received

STDISX Number of Disconnect frames transmitted

STDISR Number of Disconnect frames received

STDMFX Number of Disconnect Mode frames transmitted

STDMFR Number of Disconnect Mode frames received

7.8 LAN Queries

Some examples have been provided in Appendix B, “Local Area Network Queries” on page 239 to show you how you can write your own queries to generate reports that show some of the performance indicators discussed in this chapter as well as demonstrate how you can interrogate the data collected by the OS/400 Performance Monitor for further performance analysis. To write these queries, you need the product, Query/400. Examples have been provided for both token-ring LANs and Ethernet LANs. These queries cover the following areas:

1. Token-ring LAN Performance Indicators
2. Token-ring LAN MAC Error Counters
3. Token-ring LAN Overhead
4. Ethernet LAN Performance Indicators
5. Ethernet LAN MAC Error Counters

These queries generate reports that can help you assess your LAN performance and identify bottlenecks. Having determined what your bottlenecks are, you can make use of the recommendations discussed in the next section to tune your LAN performance.

7.9 LAN Performance Tuning Recommendations

In this section, we discuss in more detail recommendations for SNA environment to improve performance and address bottlenecks in your LAN network. We shall investigate the relationships between the LAN controller description tuning parameters and look at the performance characteristics of the different LAN IOPs and the effects of varying frame sizes.

7.9.1 LAN Controller Performance Parameters

All SNA controller descriptions used on local area networks have LANxxxxxx parameters that affect their performance. These are summarized in Table 12. In this section, we examine their relationships and look at recommended values to optimize LAN performance.

Table 12 (Page 1 of 2). Summary of LAN Controller Performance Parameters

Parameter	Short Term	Function
LANCNNTMR	CT1	Sets wait time for polling remote station during connection establishment.
LANCNNRTY	CN2	Sets number of poll retries sent to remote station during connection establishment.
LANRSPTMR	T1	Sets wait time for frame retransmission.

Table 12 (Page 2 of 2). Summary of LAN Controller Performance Parameters		
Parameter	**Short Term**	**Function**
LANFRMRTY	N2	Sets number of frame retransmission attempts.
LANACKTMR	T2	Sets wait time for acknowledgement to remote station.
LANACKFRQ	N3	Sets number of frames received before sending acknowledgement.
LANINACTMR	Ti	Sets wait time for requesting response from remote station.
LANMAXOUT	TW	Sets number of outstanding frames allowed before requesting acknowledgement from remote station.
LANWDWSTP	NW	Provides an alternative value equivalent to the LANMAXOUT parameter for use during periods of network congestion. The system provides an algorithm for returning the effective maximum outstanding frames value to that specified by the LANMAXOUT parameter as congestion subsides.
LANACCPTY		Sets priority of the station. Stations with higher priority have greater access to the token (used on token-ring only).
Notes: TW may be referred to as MAXOUT because TW is perceived as the MAXimum OUTstanding frames transmitted. Similarly, N3 may be referred to as MAXIN because it is perceived as the MAXimum INbound frames received before sending an acknowledgement to the originator of the frames.		

7.9.2 LANCNNTMR and LANCNNRTY

Both these values work together to define the frequency and persistence of polling the remote system or controller for the purpose of establishing a connection.

LANCNNTMR, which is in tenths of seconds, specifies how long to wait before sending an exchange identifier (XID) command or the Set Asynchronous Balanced Mode-Extended (SABME) command again.

LANCNNRTY specifies how often this polling occurs when the LANCNNTMR has ended. When the retry limit LANCNNRTY is reached and no response is received from the remote station, the following actions occur:

- The user is notified that contact with the remote station was unsuccessful.
- The system places the controller description in answer mode.
- If retry is the answer to the inquiry, the AS/400 system re-attempts the connection again.

The defaults of these parameters are usually sufficient for a non-bridged local area network. When the amount of network traffic is excessive, or the AS/400 LAN adapter becomes over-utilized, the connections may time out. In this case, the connection timer (LANCNNTMR) can be increased to allow the remote adapter to respond. LANCNNRTY may also be raised but we suggest that you raise the value of LANCNNTMR first and observe the results.

LANCNNRTY should not be raised unless LANCNNTMR is near its maximum value, or the adapter may generate unnecessary network traffic that only contributes to the original problem of not being able to connect. LANCNNRTY can be raised if the network is unreliable in the sense that frames have a reasonable chance of being dropped or if the remote adapter is dropping frames because of over-utilization.

In a bridged environment, the default connection parameters may not be sufficient to allow a normal connection because bridges generally introduce a delay in frame delivery, and if a bridge is congested, the frames are dropped. Therefore, both connection parameters can be incremented in a similar fashion as for a non-bridged environment. If there are a number of bridge hops between the local and remote stations, first increase the LANCNNTMR to give the frames and the acknowledgments time to cross the network. Observe the results. If frames are being dropped due to congestion of one or more bridges, the LANCNNRTY can be increased. Remember that by increasing LANCNNRTY, there is ultimately more traffic crossing the bridges, which may lead to further congestion.

7.9.3 LANRSPTMR and LANFRMRTY

The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters work together to determine how soon and how often a frame of data is transmitted again. Frames of data need to be transmitted again when one of the following conditions occur:

- A previous frame of data was lost or damaged.
- The remote station is too busy to receive and respond to the frame in time.
- The remote station is waiting to acknowledge the frame with an information frame of its own. This is affected by the LAN acknowledgement timer (LANACKTMR) parameter that is discussed later.

The LANRSPTMR parameter defines the time interval in tenths of seconds that the system waits before requesting a response for a frame that was sent.

The LANFRMRTY value specifies how many times the frame is transmitted again before the system notifies the user that an error occurred and the logical link to the remote station is disconnected.

The defaults for these parameters are intended for use on a single local area network. If a bridge is being used to communicate with a remote station on another local area network, you may want to consider increasing the values on both the local and remote systems because the bridge may slow down the line traffic enough to cause the timer to expire before the remote station is able to respond.

The value for each parameter should be chosen carefully. If LANRSPTMR is too small, the system solicits a response before the remote system has time to receive the frame and send the acknowledgement. If LANFRMRTY is too small, frames may be lost. A good value for LANFRMRTY is 10 or less.

7.9.4 LANACKTMR and LANACKFRQ

The LAN acknowledgement timer (LANACKTMR) and the LAN acknowledgement frequency (LANACKFRQ) parameters work together to determine how often an acknowledgement is sent to the remote station.

The LANACKTMR parameter specifies how long the system waits before sending an acknowledgement to a received frame. This allows the system, if it has any data to send to the remote controller, to use that frame to acknowledge the received frame.

Similarly, the LANACKFRQ parameter specifies the maximum number of frames the system can receive before acknowledgement is sent to the remote station independent of timers or any data to send. The system has a greater chance of sending a frame of data that includes an acknowledgement of the received frame if the LANACKFRQ value is large.

The LANACKTMR also serves a purpose if the LANMAXOUT at the sending system and LANACKFRQ on the receiving system are not set correctly. If the LANACKFRQ is set to three frames, for example, and LANMAXOUT is set to two frames, the LANACKTMR should expire in a reasonable time to cause a response to be sent. Since LANMAXOUT is less than the remote system′s LANACKFRQ, this count does not cause a response to be sent. Only two frames have been received so the LANACKFRQ value of three frames has not been reached. Therefore, a response is not sent until the LANACKTMR expires. The timer on the sending system, LANRSPTMR, should be greater than the LANACKTMR on the receiving system to give the receiver time to respond before being solicited for the response.

Small values for LANACKTMR may cause unnecessary acknowledgements to be sent, contributing to heavier LAN traffic. If your network has relatively high traffic, you may want to increase either or both values.

In most cases, where network traffic is not a problem and data tends to flow one way (as in a file transfer), large values may introduce unnecessary delay in sending acknowledgements and slow response times. If this is the case, a LANACKFRQ value of one is recommended.

The LAN acknowledgement values should also be carefully balanced with the response timer and maximum outstanding frame count of the remote station. The wrong values can result in timeouts and retransmissions, contributing to higher LAN traffic.

7.9.5 LANACKTMR and LANRSPTMR Relationship

Between two stations, LANRSPTMR sets the wait time before a response is solicited. LANACKTMR on the receiving station sets the wait time before a response is sent for the transmission. However, if acknowledgement frequency (LANACKFRQ of the remote station) is already set to 1, the response timer (LANRSPTMR) and the acknowledgement timer (LANACKTMR) should not expire unless a frame has been lost, in which case the Receive Ready (RR) response indicates by sequence number the last frame that was successfully received.

To determine which values to set for LANRSPTMR (T1) and LANACKTMR (T2), we need to consider a hypothetical case of a LAN with the two stations shown in Figure 53.

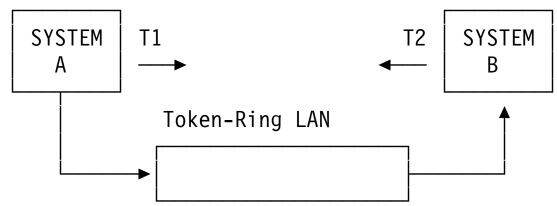

Figure 53. LANACKTMR and LANRSPTMR Relationship

The response timer of the transmitting station and the acknowledgement timer of the receiving station can be determined by:

LANRSPTMR > LANACKTMR + (2 * propagation delay)

The value, *(2 * propagation delay)* represents the time for two frames to travel the entire ring path as:

- The first path through the network is taken by the local station's transmitted frame.
- The second is taken by the remote station's acknowledgement frame as a response to the first frame.

The relatively high speed of a token-ring LAN makes this propagation delay negligible for a non-bridged environment resulting in the following guideline:

LANACKTMR <= LANRSPTMR /2

In a non-bridged environment, the AS/400 default settings of (*CALC) are sufficient to ensure that there are few T1 expirations.

These values may still hold for bridged LANs with up to a maximum of two bridges. However, in a bridged environment where the bridge becomes so congested that it becomes a bottleneck, the increase in propagation delay across the bridge may cause the T1 timer to expire. If this happens, you may start to lose connections. To counter this, the response timers and acknowledgement timers should be retuned.

To do this, you must first determine the propagation delay across the bridge. The communication trace tool can assist you in this process. This value can be used to determine the values of the timers based on the relationship we discussed earlier.

You probably need to increase the value of the response timer and the frame retry limit so that the retransmission period is extended. In addition, you may also need to adjust some parameters on the remote system. For example, you may want to decrease the value of the acknowledgement timer and reduce the acknowledgement frequency (LANACKFRQ) of the remote station. This ensures that the remote station sends its acknowledgement earlier after receiving a smaller amount of frames.

It is important that since both stations are transmitting and receiving frames, timers should be tuned on both stations.

7.9.6 LANACKFRQ and LANMAXOUT Relationship

LANMAXOUT on the local station specifies the number of frames that the local station sends to the remote station before waiting for an acknowledgement. LANACKFRQ on the remote station specifies how many frames the remote station receives before sending this acknowledgement.

If the remote station′s LANACKFRQ is set larger than the local station′s LANMAXOUT, the local station continuously waits for acknowledgement of the frames it has outstanding with the remote station before sending more frames. On the other hand, the remote station keeps waiting for more frames until its LANACKTMR expires. This certainly leads to poor performance.

For optimal performance, it is essential to specify appropriate values for LANMAXOUT and LAN acknowledgement frequency (LANACKFRQ) parameters on both the sending and receiving stations. If the wrong values are chosen, the LAN throughput may be reduced by up to 50% or worse if timeouts start to occur.

The LANACKFRQ parameter should be set to a value less than the remote station′s LANMAXOUT value. In practice, the following guideline is good:

```
LANACKFRQ (remote)  =  LANMAXOUT (local) /2
```

NEVER allow LANACKFRQ on one station to be greater than LANMAXOUT on the other station.

In general, leaving these parameters at the *CALC settings (LANACKFRQ=1 and LANMAXOUT=2) gives adequate performance for interactive environments. However, significant performance improvements can be made in large file transfer environments by increasing the LANMAXOUT value. This parameter is sensitive to the remote stations buffering and processing capabilities and can be made larger when transmitting to faster stations.

You may need to experiment with the LANMAXOUT parameter to get the best performance. If there is no significant improvement, the value should be changed back to *CALC. Consider the following guidelines:

- When using the new LAN IOPs (2626, 2636, 2619, 2617, and 6506), try using LANMAXOUT=6. If there is no improvement, reduce to LANMAXOUT=4 and test again. If there is still no improvement, return the value to *CALC(2).
- When using the older LAN IOPs (6130, 6034, 6134, and 2625), *CALC(2) probably gives the best performance. However, you may still try experimenting with a higher value.
- It is unlikely for performance to be improved by using values for LANMAXOUT greater than 7, and tests suggest that throughput can dramatically decrease if you use a value greater than 10.
- When communicating with a PS/2 smaller than a model 50 or equivalent, use *CALC(2) to avoid buffer overruns.
- When communicating with a PS/2 model 50 or above, you can experiment with LANMAXOUT=6 or 4; however, LANACKFRQ should be kept at *CALC(1).
- LANMAXOUT and LANACKFRQ should have the same value on the sending station as on the receiving station.

Note that in a mixed batch and interactive environment, a value of LANACKFRQ=*CALC(1) tends to favor the interactive traffic. If this value is increased, batch transfers may improve but at the expense of the interactive traffic.

7.9.7 LANINACTMR

The LAN inactivity timer (LANINACTMR) parameter is used to determine how long the system should wait before requesting a response from the remote station. This request is made to determine if the remote station is still on the ring or if the logical link is disconnected.

If the LANINACTMR value is set too small, unnecessary traffic is created. If it is set too large, the system may not determine that the logical link is inoperable as quickly as necessary. This timer is sensitive to whether the remote station is on the same local LAN segment or not. In a bridged environment, this value may need to be increased. If the value is set to 0 (that is, no timeout), you may not be informed if the logical link is inoperable until a data transfer attempt occurs.

Between two active communicating stations, the shortest time it takes for either station to detect that the remote station is not responding is equal to the following example:

```
LANINACTMR + ((LANFRMTRY + 1) * LANRSPTMR)
```

This value is important when both stations are communicating over a bridge. Bridges occasionally go into a temporary offline state before coming online again. If this is happening in your installation, it is recommended that you raise the LANINACTMR value to ensure a higher tolerance for your network. The LANINACTMR should be five to 10 times the value of LANRSPTMR.

7.9.8 LANWDWSTP

The LAN window step (LANWDWSTP) parameter provides a mechanism to aid in the reduction of network congestion. It does this by effectively reducing LANMAXOUT to one and slowly returning this value to the original LANMAXOUT value defined in the controller description. This allows the network congestion to subside faster than if the LANMAXOUT value was continually maintained.

If we call the temporary maximum outstanding frames value MAXOUTFRM, we can examine how this mechanism works.

When congestion occurs, the value of MAXOUTFRM is reduced from LANMAXOUT to one. This helps to reduce acknowledgement timeouts and retransmissions even though each frame must now be acknowledged. MAXOUTFRM is slowly raised in increments of one until it returns to the original value of LANMAXOUT set in the controller description. This incremental increase is controlled by the value set for LANWDWSTP. This parameter can be any value from one to 127. If, for example, LANWDWSTP=10, the remote station must successfully receive 10 frames before MAXOUTFRM can be incremented by one. This process continues until MAXOUTFRM is equal to LANMAXOUT.

If LANWDWSTP is set to *NONE, the number of outstanding frames is not reduced during network congestion.

7.9.9 LANACCPTY (Token-Ring Networks Only)

For a station on a token-ring to transmit a frame, it must first capture a free token to which it appends its data, converting the token into an information frame.

The free tokens on a ring contain three bits in their Access Control byte, which determines the priority of the token. A token with a high priority can only be used by a station authorized for equal or higher priority. In this way on heavily utilized rings, critical applications or workstations can be guaranteed greater access to the LAN. Of course, the token-ring architecture also ensures that enough low priority tokens circulate to service the other stations.

The priorities available are zero to three, with zero being the lowest priority. This is also the default value for LANACCPTY when creating controller descriptions. You should not change this value unless you are sure you need greater priority for a particular station. Changing priorities without caution can lead to serious performance degradation for the majority of users.

The LANACCPTY parameter is ignored for controllers attached to Ethernet LANs.

7.10 LAN IOPs

The relatively high bandwidth of local area networks reduces the likelihood that line utilization is a performance bottleneck. Response times are much more dependent upon the speed of the CPU and the IOP microprocessor.

Today there are several types of LAN IOP available, all with different performance characteristics. We shall examine their relative merits in this section. For a discussion of how to analyze the utilization of your IOP using Performance Monitor data, see Chapter 6, “Communications I/O Processor (IOP)” on page 89.

Upgrading to a higher performance LAN IOP provides significant increases in throughput and improved response times. However, it should also be noted that equal distribution of workload across the available IOPs is important, as is the distribution of those IOPs across the available busses on your system.

Generally, the different IOPs provide the same functions. The higher performing IOPs incorporate faster microprocessors and more memory to accommodate larger buffers and frame sizes. However, with higher performing IOPs, there exists a potential for overrun of slower performing IOPs. Symptoms include retransmissions and timeouts. This can be minimized or avoided by limiting the LANACKFRQ and LANMAXOUT parameters to one and two, respectively.

The following list shows LAN IOPs currently available in order of best performance.

Token-Ring IOPs:

1. 6506 IOP
   - Integrated PC Server, also known as File Serving Input Output Processor and FSIOP (TRLAN or ELAN)
   - The performance characteristics of this IOP when used for token-ring connectivity are similar to the 2619 IOP.

- Laboratory tests have measured throughput rates in excess of 14 Mbps for a single file transfer without database accesses. Actual LAN throughput realized by customers is less than the adapter capability as it is affected by many factors including system model and workload characteristics.
- This IOP also provides high performance file serving when using LAN Server/400 software.

2. 2619 IOP
   - 16/4 Mbps Token-Ring Network Adapter/HP
   - This adapter has similar performance to the 6506 Integrated PC Server and provides increased performance over the 2626 IOP (2626 is a CISC only IOP; it cannot be used with RISC machines).

Ethernet IOPs:

1. 6506 IOP
   - Integrated PC Server (TRLAN or ELAN)
   - The performance characteristics of this IOP when used for Ethernet connectivity are similar to the 2617 IOP.
   - This IOP also provides high performance file serving when using LAN Server/400 software.
2. 2617 IOP
   - 10 Mbps Ethernet/IEEE 802.3 Adapter/HP
   - This adapter is capable of six times the throughput possible of its predecessor. Laboratory measured throughput maximums are about 10 Mbps. This performance is seldom achievable in a production environment.
3. 2625 IOP and 6130 IOP with 2635 adapter
   - 10 Mbps Ethernet subsystem
   - Performance of both IOPs are equivalent.

Both the 2625 and 2635 Ethernet adapters discard inbound frames when they arrive at a rate in excess of 100 frames/sec (assuming a frame size of 1500 bytes). The 2617 adapter has been designed with more storage, which avoids this problem.

This possible discarding of frames should be kept in mind if you are using User Datagram Protocol (UDP) applications that use an unacknowledged delivery service.

If you are using TCP/IP or SNA applications, the higher level protocols should provide notification of discarded frames. However, if SNA sessions are dropping out because of discarded frames, you should attempt to reduce the amount of traffic flowing to the overloaded adapters or increase the maximum number of allowable retries using the LANFRMRTY parameter.

7.11 Frame Size

LAN throughput increases significantly as the frame size increases. For the LAN IOP, this translates into lower utilization as there are fewer frames to process. CPU utilization, however, is higher because the CPU has more data to process in each frame.

Generally, local area networks provide a relatively error-free environment. Data transmission is, therefore, more efficient if data is sent in the largest frames possible. This, coupled with the faster media speeds, results in significant improvement to the performance of the LAN.

7.11.1 Token-Ring Frame Sizes

When configuring token-ring lines on an AS/400 system, there are three places where you can define the maximum frame size (MAXFRAME) to be used. The effective MAXFRAME size is the smaller of the three.

- MAXFRAME in the line description
- MAXFRAME in the controller descriptions
- MAXFRAME parameter specified for each source service access point (SSAP) associated with the line

The largest value allowed for MAXFRAME varies depending on the type of token-ring IOP installed. You should select the largest value possible. This is usually *not* the default value for the line and controller descriptions. Table 13 lists these maximum frame sizes.

Table 13. Token-Ring Adapter and Largest MAXFRAME Value

	Largest MAXFRAME Value	
Resource Type	**Line Speed 16 Mbps**	**Line Speed 4 Mbps**
6506, 2619, 2626	16 393	4060
6134, 2636	8156	4060
6034, 6160	N/A	1994 (default)

Note: Type WRKHDWRSC *CMN to view the LAN Adapter type.

The largest value for MAXFRAME may not always be used in practice because the receiving IOP or intervening bridge/router or station may not be able to support this frame size. This does not cause any problem as the frame size is negotiated between the two stations at the time of session establishment. The smaller of the two frame sizes is selected. It is, therefore, important to remember to configure both the AS/400 system and the other stations when you increase the maximum frame size.

7.11.2 Ethernet Frame Sizes

In an Ethernet environment, the probability of collisions occurring is proportional to the following conditions:

- The number of stations
- Rate of transmission
- The length of the LAN
- The LAN utilization
- The IOP utilization

- The size and number of ″collision windows″

A collision window is the time during which a collision may occur. Its maximum value is the time required by a frame to travel between the two outermost stations on the Ethernet. On a 10 Mbps Ethernet, the collision window equals the one-way propagation delay (sum of all transmission delays) between the two contending stations.

While the size of the collision windows may be reduced by decreasing the frame size used by the adapters, this is not recommended since it increases the number of collision windows and also the overhead due to frame headers and trailers. Therefore, in an Ethernet environment, you should still use the maximum frame size for transmission.

Ethernet standards allow a maximum frame size of 1502 bytes. This size is only possible if you are using user-defined communications. Ordinarily, if you create an Ethernet line with the ETHSTD specified as *ALL or *IEEE8023, the maximum frame size is 1496 bytes. If you create an Ethernet line description with the ETHSTD specified as *ETHV2, the maximum frame size is 1493 bytes. The minimum frame size is 265 bytes. This is summarized in Table 14.

Table 14. Maximum Frame Size Based on ETHSTD Parameter

ETHSTD Parameter Value	**Frame Type**	**Maximum Frame Size**
*ALL	IEEE 802.3	1496
	Ethernet Version 2	1500
*IEEE8023	IEEE 802.3	1496
*ETHV2	Ethernet Version 2, SNA data	1493
	Ethernet Version 2, non-SNA data	1500

7.11.3 Bridge Frame Size Considerations

If a frame is being transmitted to a station that resides on a different LAN, the frame must be copied and transmitted again by a bridge. If the bridge is not configured to support a frame size as large as that configured on the token-ring or Ethernet line description, the frame is discarded. For SNA in the token-ring environment, the system originating the connection is informed of the frame size supported by the bridge if the bridge and frame are using source routing.

In the Ethernet environment, no indication of the unsupported frame size is received. This condition is only detected when a connection is being established with the remote system and a CPA57A1 message is sent to the QSYSOPR message queue.

If it is not possible to configure the bridge to support a larger frame size, the following parameters need to be changed to accommodate the frame size acceptable to the bridge:

- MAXFRAME parameter on the controller description
- SSAP MAXFRAME parameter on the line description
- MAXFRAME parameter on the line description (Token-ring networks only as Ethernets use the value specified for the ETHSTD parameter.)

Generally it is preferred that the MAXFRAME parameter on the controller description be changed first to minimize the impact on the rest of the network.

7.11.4 ETHSTD Parameter

The AS/400 system supports two Ethernet standards:

- Ethernet Version 2
- IEEE 802.3

If you choose to configure your Ethernet line with the ETHSTD specified as *ALL, the AS/400 system operates on both frame types simultaneously. You should configure your Ethernet line for the best performance based on your specific needs. For example, if your job requires a TCP/IP configuration that uses only the IEEE 802.3 Ethernet standard, but the line is configured to operate on both standards, all incoming Ethernet Version 2 frames are also processed. This unnecessary processing can cause performance problems.

7.11.5 Other Considerations

What we have discussed in this section covers recommendations for optimizing performance at the protocol level. Since you may want to run some form of application on your LAN network, there are other additional considerations for these environments.

For example, if you have application programs using SNA support and SNA parameters such as Request/Response Unit size (MAXLENRU), PACING and program output operations can have the same impact as the configuration parameters at the protocol level. You are advised to refer to Chapter 10, “SNA” on page 163 for a more detailed discussion of SNA parameters. If you are running CA/400 on your LAN, a useful guide for performance monitoring on your LAN is the redbook, *AS/400 Client/Server Performance using Windows 3.1 Client*, SG24-4526.

Chapter 8. X.25

X.25 is an alternative protocol to SDLC and is compatible with SNA. Some of the functions performed by SDLC for SNA are not supported by X.25. A layer called the logical link control exists between the SNA layers and the X.25 packet layer on a given virtual circuit. X.25 is capable of sending and receiving data simultaneously, which provides a significant performance advantage for those environments that are running multiple conversations over the same link (for example, pass-through between two AS/400 systems in both directions).

This chapter handles the most important values that the performance monitor collects for the X.25 protocol. It describes how you can use these values to identify bottlenecks in an X.25 environment, where you can find these values, how they are related to each other, and what you can do to solve the bottlenecks. Most of these values come from the *QAPMX25* performance tools database file that is generated when you run the Performance Monitor (see Chapter 1, “Tools Used for Finding Performance Problems” on page 1).

The performance values are related to the following three layers:

- High level data link control (HDLC)
- Packet level control (PLC)
- Logical link control (LLC)

The data link control layer defines the procedures for the connection, error free transfer of information, and disconnection between the DTE and the network DCE.

The packet layer defines the procedures necessary for establishing connections (virtual circuits) between DTEs, transferring information (in packets), and clearing connections.

Logical link control is the layer between the SNA layers and the X.25 packet layer on a given virtual circuit. It provides additional function required for SNA connections that is not available in X.25.

The following sections discuss the performance values related to these layers.

8.1 High Level Data Link Control (HDLC)

The data link control layer defines the procedures for the connection, error free transfer of information, and disconnection between the DTE and the network DCE. At the data link control layer, the information is transmitted between the two stations in data units called high-level data link control (HDLC) frames. Both the DTE and the network DCE are considered peer stations.

The following list contains the main HDLC communications performance indicators:

- Line utilization
- Line errors
- Congestion
- Data link resets

Some performance problems may be caused by errors at the HDLC layer. Errors related to the HDLC layer do not produce any cause or diagnostic codes. These errors must be isolated by using information provided in the QSYSOPR message queue.

8.1.1 Line Utilization

Line utilization is the percentage of elapsed time during which the line was utilized. Because X.25 is full duplex, line utilization should be determined for both directions. Line utilization is an important performance indicator. Exceeding the utilization threshold value may lead to unacceptable response times. For line speeds of 19 200 bits per second or less, most application programs can fully use the bandwidth of the line. The performance in this environment depends largely on the ability of the line to transfer data. For line speeds of greater than 19 200 bits per second, some application programs cannot fully use the bandwidth of the line. The performance in this environment depends much more on the performance of the application itself.

8.1.1.1 Using Performance Tools/400 to Display Line Utilization

Line utilization can be observed by using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 54 on page 129. The display shows you the line speed, the transmit, receive, and average line utilization. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. The transmit, receive, and average line utilization for the sample interval selected are the values listed in the Transmit/Receive/Average Line Util column heading.

```
                     Display Communications Interval Data

Line ID  . . . . . . :   LINX25       Member . . . . . . . :   Q953171314
Line type  . . . . . :   X.25           Library  . . . . . :     QPFRDATA
Line speed . . . . . :   9.6             Elapsed time . . . . :   09:58:09
Bus number . . . . . :   0
IOP address  . . . . :  10

Type options, press Enter.
  5=Display remote jobs

                  Transmit/             Pct              Pct
                  Receive/            I Frames          Frames
        Itv        Average   I Frames  Trnsmitd   Frames   Recd
Option  End       Line Util  Trnsmitd  in Error    Recd  in Error
  _     08:54:25  31/16/24      2274         0      4424        0
  _     09:09:23  42/61/52      4331         0      7841        0
  _     09:24:22  41/23/32      2817         0      5454        0
  _     09:39:19  40/21/31      2728         0      5239        0
  _     09:54:17  61/30/46      4022         0      7639        0
                                                                     More...
F3=Exit   F11=View2     F12=Cancel   F15=Sort by itv end
F20=Sort by line util   F24=More keys
```

Figure 54. Communications Interval Data (View 1) - X.25 Sample

Use the PRTSYSRPT command to print the System Report. The Communications Summary shows average and peak line utilization over the total report period shown in Figure 55.

```
                                                       System Report                                                 11/31/95 11:50:53
                                                   Communications Summary                                                   Page 0004
                                         Performance Data for X.25 Communications Analysis

Member  . . . : Q953171314   Model/Serial  . . :  D60/10-15181   Main storage . . :   80.0 M   Started  . . . . : 11/30/95 08:39:24
  Library . . : QPFRDATA     System name . . . :      SYSTEM1    Version/Release  :   3/ 1.0   Stopped  . . . . : 11/30/95 18:38:11

     Bus/IOP/                      Line     Avg     Max     Active       Number       Average     ------ Bytes Per Second -----
       Line              Protocol   Speed    Util    Util    Devices    Transactions    Response     Received          Transmitted
--------------------     --------  -------   ----    ----    -------    ------------    --------     ---------         -----------
BUS 0  IOP 10 (6130)
  LINX25                  X25          9.6     13      96        10              88        4.2         141.4              179.5


Bus/IOP/Line            --  Bus ID, IOP ID and model number, Line ID
Protocol                --  Line protocol (SDLC, ASYNC, BSC, X25, TRLAN, ELAN, IDLC)
Line Speed              --  Line speed (1000 bits per second)
                            (For IDLC this is the maximum over the measurement)
Avg Util                --  Average line utilization
Max Util                --  Maximum line utilization in all measurement intervals
Active Devices          --  Average number of active devices on the line
Number Transactions     --  Number of transactions
Average Response        --  Average system response (service) time (seconds)
Bytes /Sec Received     --  Average number of bytes received per second
Bytes /Sec Transmitted  --  Average number of bytes transmitted per second
```

Figure 55. Communications Summary - X.25 Sample

Use the PRTRSCRPT command to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval shown in Figure 56 on page 130.

```
                                              Resource Interval Report
                                             COMMUNICATIONS Line Detail

Member  . . . : Q953171314   Model/Serial  . . : D60/10-15181    Main storage
  Library . . : QPFRDATA     System name . . . :     SYSTEM1     Version/Relea
PROTOCOL = X.25 (SORT BY INTERVAL)
                             Transmit/                           Percent                             Percent
         Bus/                Receive/     Bytes        Total     I Frames     Bytes        Total     Frames   ------Reset------
 Itv      IOP/      Line      Average      Trnsmitd     I Frames  Trnsmitd     Recd         Frames   Recd     -----Packets-----
 End      Line      Speed     Line Util    Per Sec      Trnsmitd  In Error     Per Sec      Recd      In Err   Trnsmitd  Recd
-----  ----------  --------  -----------  ----------  ----------  ----------  ---------  --------  --------  --------  -------
       BUS  0
       IOP  10
        (6130)
13:20  X25LINE          9.6    13/01/07         160         216       0             0        14         0    42,800        0
13:25  X25LINE          9.6    11/00/05         132         156       0             0         8         0    31,100        0
13:30  X25LINE          9.6    16/02/09         196         250       0             0        28         0    49,500        0
```

Figure 56. Resource Interval Report - Communications Line Detail

8.1.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file QAPMX25 are related to the line utilization:

XHBRCV The number of bytes received including all bytes in frames that had any kind of error

XHBTRN The number of bytes transmitted including bytes transmitted again

XLLSP The speed of the line in bits per second (bps)

INTSEC Number of seconds since the last elapsed interval

The transmit line utilization is derived from the following equation:

```
Transmit line utilization = XHBTRN * 800 / (INTSEC * XLLSP)
```

The receive line utilization is derived from the following equation:

```
Receive line utilization = XHBRCV * 800 / (INTSEC * XLLSP)
```

The 800 is really (100 * 8) where 100 represents the result as a percentage, and 8 is the number of bits per byte (since line speed is bits per second).

Line utilization is calculated per interval, that is, the time you have specified on the INTERVAL parameter of the STRPFRMON command.

Appendix C, “X.25 Queries” on page 275 lists the sample queries (X25_ALL, X25_HDLC, and X25_JOB) to show the values previously mentioned.

8.1.1.3 Recommendations

- For interactive environments, keeping line utilization below 30% is recommended to maintain predictable and consistent response time.
- If you have batch jobs, such as file transfers running on that line, it is normal to have the line utilization above 50%. However, for interactive jobs, performance begins to degrade around 40% line utilization.
- If the percentage of errors is also high, the line utilization can be driven by lots of retransmission of data. Take the appropriate action to reduce line errors, (see Section 8.1.2, “Line Errors” on page 131).
- Line utilization can also be driven by running large file transfer type work (for example, running a query over large files). Besides affecting all genuine interactive users, it increases the response time for all interactive users on the same communications line.

- If you cannot isolate the large file transfer traffic such as rescheduling the jobs or applications, you need to use pacing to throttle the large file transfer work (low pacing value) and consider increasing the line speed to minimize the impact (see Chapter 10, "SNA" on page 163).

8.1.2 Line Errors

Line errors often result in frames being retransmitted. If the retransmission still results in bad frames, the application is notified and has to resend the entire record or multiple records. This may result in one RU (request unit) or a chain of RUs being transmitted again.

8.1.2.1 Using Performance Tools/400 to Display Line Error Information

Line error information can be displayed by using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the line error information.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 54 on page 129. The display shows you the number of information frames transmitted, the percent of information frames transmitted in error, the number of frames received, and the percent of frames received in error. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data.

Use the PRTRSCRPT command to print the Resource Interval Report. The Communications Line Detail shows you the number of Information frames transmitted, the Percent of Information frames transmitted in error, the number of frames received, and the percent of frames received in error per sample interval shown in Figure 56 on page 130.

8.1.2.2 Performance Monitor Database Fields

The performance monitor collects data about the number of:

- Frame retransmission
- Frames received in error
- Invalid frames received

A frame can be an information supervisory of unnumbered frames:

Information frames
I-frames are used to transfer user data. If there are no I-frames transmitted, you can conclude that the remote stations on that line are inactive. *Inactive* means that the stations connected to the controller are not doing any work even though the controller has been successfully varied on.

Supervisory frames
S-frames are used to perform link supervisory control functions such as acknowledge I-frames, request retransmission of I-frames, or request a temporary suspension of transmission of I-frames.

Unnumbered frames
U-frames are used to provide additional link control functions and contain no sequence numbers.

Frame retransmission is normally caused due to frames received in error and by link resets. To avoid communications performance problems, this number should be 0 or low. The following fields from the performance monitor can be used to determine the retransmission error rates:

XHFTRN Number of frames transmitted (I-frame, supervisory, and frames not numbered) excluding frames transmitted again

XHIFTR Number of I-frames transmitted excluding I-frames transmitted again

XHIFRT Number of I-frames transmitted again

XHFRT Number of I-frame, supervisory, and frames not numbered transmitted again

The percent of frames transmitted with errors is derived from the following equation:

```
Percent of frames transmitted with errors
= (XHFRT * 100) / (XHFRT + XHFTRN)
```

The percent of I-frames transmitted with errors is derived from the following equation:

```
Percent of I-frames transmitted with errors
= (XHIFRT * 100) / (XHIFRT + XHIFTR)
```

The following fields from the performance monitor can be used to determine the number or percent of frames received in error or that are not valid:

XHEFFR Error free frames received (I, S, and U)

XHFRIE The number of I-frames, S-frames, and U-frames received in error. There are three error possibilities:

- An S-frame or I-frame was received with an number count that is requesting retransmission of a frame.
- An I-frame was received with a number count that indicates that frames were missed.
- A frame was received with one of the following errors:
  - A frame check sequence error
  - An abnormal end
  - A receive overrun
  - A frame truncated error

XHIFR Frames received that are not valid: The number of not valid frames received. These are frames received with either:

- Short frame error: Frame is less than 32 bits.
- Residue error: Frame is not on a byte boundary.

The percent of frames received in error is derived from the following equation:

```
Percent of frames received in error
= ((XHIFR + XHFRIE) * 100) / (XHEFFR + XHIFR + XHFRIE)
```

Appendix C, “X.25 Queries” on page 275 lists the sample queries, X25_ALL and X25_HDLC, to show the values previously mentioned.

8.1.2.3 Recommendations

Receive and transmit errors can occur when the host system or remote device has an error or cannot process received data fast enough, see also Section 8.1.3, "Congestion" for congestion. Factors that can influence the performance because of retransmission are:

- Line quality
- Packet size
- Window size

Line quality: If the percentage of errors on a line is about 5% for a few intervals that had I-frames transmitted, check the local and remote connections. Ensure that all cables are properly shielded, that they are the correct cable type, and that all plug connections are secure. There should be no ribbon cables (flat, unshielded cables) anywhere between the system and the modem. Sometimes the errors can be caused by electrical ″noise″ or interference. If problems still occur, contact your line supplier to have the line tested. You might consider changing to a better quality line or modem. Normally, it is true that a non-switched line is a better quality line than a switched line.

Packet size: The AS/400 support for X.25 allows a range of packet sizes up to 4096 bytes. The packet size is specified using the DFTPKTSIZE parameter on the line and controller descriptions and the MAXPKTSIZE parameter on the line description. Larger packet sizes provide better performance. However, in case of an error-prone line, large packet sizes may not work well. The large packets have a higher probability for errors in this environment and take longer to transmit again.

Window size: The X.25 window size is similar to the maximum number of outstanding frames parameter used by SDLC and the token-ring networks. The maximum that this parameter can be set to depends on the MODULUS and DFTWDWSIZE parameters that are part of the line description. If MODULUS is set to 8, the largest size that DFTWDWSIZE can be set to is 7. If MODULUS is set to 128, the largest size that DFTWDWSIZE can be set to is 15. Usually, making this number as large as possible results in the best performance.

As with large packet sizes, a large window size may not work well for error-prone lines or networks.

8.1.3 Congestion

Local or remote congestion occurs when data is not processed fast enough either while sending or while receiving. Congestion results in transmitting receive-not-ready frames by the system that is congested, either the host or remote device.

8.1.3.1 Using Performance Tools/400 to Display Information About Congestion

Information about congestion can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the information about congestion.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 57 on page 134. The display shows you the percentage of Receive Not Ready frames transmitted and received. This display can be accessed from the Display Performance Data display by pressing

F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. Press F11=View 2 to see the second display. The percentage of Receive Not Ready frames transmitted and received for the sample interval selected are the values listed in the Local Not Rdy and Remote Not Rdy column headings respectively.

```
                     Display Communications Interval Data

 Line ID . . . . . . :   LINX25         Member . . . . . . . :   Q953171314
 Line type  . . . . . :   X.25            Library  . . . . . :     QPFRDATA
 Line speed . . . . . :   9.6            Elapsed time . . . . :   09:58:09
 Bus number . . . . . :   0
 IOP address  . . . . :  10

 Type options, press Enter.
   5=Display remote jobs

                   Transmit/  -Congestion--
                   Receive/   Local  Remote    Reset    Reset
         Itv        Average    Not     Not    Packets  Packets
 Option  End       Line Util   Rdy     Rdy   Trnsmitd    Recd
   _     08:54:25  31/16/24      0       0          0        0
   _     09:09:23  42/61/52      0       0          0        0
   _     09:24:22  41/23/32      0       0          0        0
   _     09:39:19  40/21/31      0       0          0        0
   _     09:54:17  61/30/46      0       0          0        0
                                                                    More...
 F3=Exit   F11=View1     F12=Cancel   F15=Sort by itv end
 F20=Sort by line util   F24=More keys
```

Figure 57. Communications Interval Data (View 2) - X.25 Sample

8.1.3.2 Performance Monitor Database Fields

The following fields in the performance monitor database file gives an indication of the congestion at the local or remote side:

XHRNRT Number of receive not ready supervisory frames transmitted (local congestion)

XHRNRR Number of receive not ready supervisory frames received (remote congestion)

Both values should be close to 0 in a well performing system. High congestion increases both CPU and IOP utilization and directly affects remote response time.

Important values that can be derived from these fields are:

Local Not Ready

Receive Not Ready frames transmitted by the AS/400 system as a percentage of all frames received by the host. A large number means the AS/400 data buffers are not emptied fast enough. The Local Not Ready value can be derived from the following equation:

```
Local Not Ready = XHRNRT / (XHEFFR + XHFRIE + XHIFR + XHRRFR + XHRNRR)
```

Remote Not Ready

Receive Not Ready frames received by the host as a percentage of the Information Frames transmitted by the host. A large number usually means X.25 network or the remote device data buffers are not emptied fast enough. The Remote Not Ready value can be derived from the following equation:

Remote Not Ready = XHRNRR / (XHIFTR + XHIFRT + XHRRFT + XHRNRT)

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL, X25_IOP, and X25_HDLC) to show the values previously mentioned.

8.1.3.3 Recommendations

Local Congestion: A remote system is sending data too fast for your AS/400 system to process. This is probably caused by some sort of bottleneck such as high CPU, disk, or IOP utilization. Another cause might be a low machine pool size. You can find more information about IOP in Section 8.4.1, "IOP Utilization" on page 143. For CPU, disk, and pool utilization, refer to *AS/400 Performance Management*, GG24-4735, or Appendix I, "Guidelines for Interpreting Performance Data" on page 379.

Remote Congestion: Another system or X.25 network receiving data from your AS/400 system cannot process the data fast enough and has sent out ″NOT READY″ messages. Check for possible bottlenecks on system or X.25 network receiving data from your AS/400 system. If the receiving system is an AS/400 system, the problem may also be a low machine pool size on that system.

8.1.4 Data Link Resets

Data link resets represents the number of times a Set Asynchronous Balance Mode (SABM) was received when the station was already in asynchronous balance mode during a measured period. This is caused due to a procedure error.

8.1.4.1 Using Performance Tools/400 to Display Data Link Resets

Performance tools do not create reports that show Data Link Reset values, nor can you use performance tools to display Data Link Reset values.

8.1.4.2 Performance Monitor Database Fields

Data link resets are indicated by the following field:

XHLNKR The number of times a set asynchronous balance mode (SABM) was received when the station was already in asynchronous balance mode

The performance monitor collects this number for each interval.

Appendix C, "X.25 Queries" on page 275 lists the sample queries, X25_ALL and X25_HDLC to show the values previously mentioned.

8.1.4.3 Recommendations

To avoid communications performance problems, this number should be zero or low. As this indication is caused by a procedure error, the line should be debugged. The link resets may be contributing to high line utilization. If the throughput or response time is unacceptable in your X.25 line, you may need to have the line or modem serviced; however, the amount of errors normally occurring changes depending on a number of variables such as the location and the quality and type of line.

Before servicing the lines, ensure that all cables are properly shielded, are IBM-supplied cables, and that all plug connections are secure. There should be no ribbon cables anywhere between the system and the modem.

8.2 Packet level Control (PLC)

The packet layer defines the procedures necessary for establishing connections (virtual circuits) between DTEs, transferring information (in packets), and clearing connections. The packet level protocol provides the multiplexing support for multiple virtual circuits for a given X.25 line. It should be noted that each virtual circuit competes for the total bandwidth available on the line to the network. As the number of active virtual circuits is increased, it is possible that the throughput on the individual virtual circuits will decrease.

The following list contains the main PLC communications performance indicators:

- Number of packets transmitted
- Congestion

Some performance problems may be caused by errors at the packet layer. The CCITT and SNA cause and diagnostic codes should help you understand why and where X.25 packet layer errors are occurring. SNA and CCITT codes are described in *X.25 Network Support*, SC41-3405. Cause and diagnostic codes can be retrieved by:

- Looking at the message help in the QSYSOPR message queue.

  When you use the DSPMSG QSYSOPR command, the first-level text of the message queue QSYSOPR is displayed. Move the cursor to a specified message and press the Help key to display the second-level text of the message. Also shown with the second-level text is the message ID, the error log ID, and other vital data. The X.25 cause and diagnostic codes are contained in the X.25-related error messages or in the error log.

- Taking a communications trace during an X.25 communications error. Cause and diagnostic codes are included in the data field of all CLEAR, RESET, RESTART REQUEST, or INDICATION, and DIAGNOSTIC packets are two bytes of data. The first byte of data is the cause code field, and the second byte of data is the diagnostic code field. It is also important to notice whether the AS/400 system has sent or received a packet containing cause or diagnostic codes. The meaning of the codes can be determined. How to take a communications trace is described in Chapter 5, “Using System Service Tools” on page 71.

8.2.1 Number of Packets Transmitted

This indicator represents the number of X.25 packets transmitted during a measured period.

8.2.1.1 Using Performance Tools/400 to Display Packets Transmitted

Performance tools do not create reports that show the number of packets transmitted, nor can you use performance tools to display the number of packets transmitted.

8.2.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file reflect the total number of packets transmitted:

XPTPT Total packets transmitted. Packets are created (disassembled) from the protocol data units (PDUs) that were created in the logical link control level.

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_PLC) to show the values previously mentioned.

8.2.1.3 Recommendations

The packet protocol creates an overhead in the transmission of user data. Because this overhead is constant, increasing the packet size to the limit allowed by the network improves performance without increasing the packet overhead.

8.2.2 Congestion

This indicator represents the number of X.25 receive-not-ready packets received during a measured period.

8.2.2.1 Using Performance Tools/400 to Display Information About Congestion

Performance tools do not create reports about congestion, nor can you use performance tools to display information about congestion.

8.2.2.2 Performance Monitor Database Fields

The following field in the performance monitor database file indicates PLC congestion:

XPRNR Receive-not-ready packets received

Receive-not-ready packets are sent due to a high network utilization.

Appendix C, "X.25 Queries" on page 275 lists the sample query (X25_ALL) to show the values previously mentioned.

8.2.2.3 Recommendations

The number of receive-not-ready packets received should be low. Look for network utilization (line, remote jobs, and IOP).

8.3 Logical Link Control (LLC)

Logical link control is the layer between the SNA layers and the X.25 packet layer on a given virtual circuit. It provides additional function required for SNA connections that is not available in X.25. The AS/400 system supports three LLC protocols:

- The qualified logical link control (QLLC)
- The enhanced logical link control (ELLC)
- The Logical Link Control-2 (LLC2)

The qualified logical link control (QLLC) protocol provides additional function required for SNA connections that is not available in X.25. QLLC has low protocol overhead; however, it provides no end-to-end (DTE-to-DTE) acknowledgment of logical link control protocol data units (LLC PDUs) carrying user data. QLLC provides an efficient logical link control when used in a reliable network.

The enhanced logical link control (ELLC) protocol performs the same base function as QLLC. In addition, it includes enhanced logical link error recovery procedures (using transparent recovery for recoverable failures), additional checksum protection, and sequencing (to guard against lost or duplicate data). The intent is to compensate for an unreliable network. This, however, is not without additional effects on *performance* that are caused by protocol overhead and by longer delays before failures are reported.

The logical link control-2 is used for Client Access/400 to give full SNA session support using X.3 network packet assembler/disassembler. The LLC2 needs longer protocol header bytes than QLLC and ELLC. In this document, we do not discuss LLC2.

The following list contains the main LLC communications performance indicators:

- Data units retransmitted and data units received in error
- LLC rejects
- LLC protocol data units discarded
- Number of time outs
- Checksum errors detected
- Number of reset indications from packet link control
- LLC congestion

Some performance problems may be caused by errors at the LLC layer. The CCITT and SNA cause and diagnostic code should help you understand why and where LLC layer errors are occurring. Cause and diagnostic codes can be retrieved by:

- Looking at the message help in the QSYSOPR message queue.

  When you use the DSPMSG QSYSOPR command, the first-level text of the message queue QSYSOPR is displayed. Move the cursor to a specified message and press the Help key to display the second-level text of the message. Also shown with the second-level text is the message ID, the error log ID, and other vital data. The X.25 cause and diagnostic codes are contained in the X.25-related error messages or in the error log.

- Taking a communications trace during an X.25 communications error. Cause and diagnostic codes are included in the data field of all CLEAR, RESET, RESTART REQUEST, or INDICATION, and DIAGNOSTIC packets are two bytes of data. The first byte of data is the cause code field, and the second byte of data is the diagnostic code field. It is also important to notice whether the AS/400 system has sent or received a packet containing cause or diagnostic codes. The meaning of the codes can be determined. How to take a communications trace is described in Chapter 5, “Using System Service Tools” on page 71.

8.3.1 Data Units Retransmitted and Data Units Received in Error

This indicator represents the number of data units retransmitted and data units received in error on the LLC level. Data unit retransmission occurs due to data units received in error.

8.3.1.1 Using Performance Tools/400 to Display Data Units Retransmitted or Received in Error

Performance tools do not create reports about the number of data units retransmitted or received in error, nor can you use performance tools to display the number of data units retransmitted or received in error.

8.3.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file reflect the number of data units transmitted and retransmitted:

XLITR The number of interface protocol data units transmitted

XLIRT The number of interface protocol data units retransmitted. This field is only valid for link protocol ELLC because Data PDUs are never retransmitted when link protocol QLLC is used.

From these values, the percent of data unit retransmission can be derived:

```
Percent of data units retransmitted = (XLIRT * 100) / XLITR
```

The following fields in the performance monitor database file reflect the number of data units received and data units received in error:

XLIRC Interface protocol data units received

XLIRE Interface protocol data units received in error (sequence). This field is only valid for link protocol ELLC.

From these values, the percent of data units received in error can be derived:

```
Percent of data units received in error = (XLIRE * 100) / XLIRC
```

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.1.3 Recommendations

To avoid communications performance problems, the percent of data units received in error should be low. The error can be caused by problems with the remote data terminal equipment (DTE) (for example, configuration, system problem, and resources). The number of retransmissions can be decreased by decreasing the LLC data unit size. Larger LLC protocol data unit sizes can improve performance; however, if frequent line errors occur, performance may be degraded by larger LLC protocol data units due to the greater likelihood that a data unit may encounter an error and need to be transmitted again. The LLC data unit size can be controlled through the MAXFRAME parameter found in both the primary line and controller description. For SNA communications, the MAXFRAME value represents the maximum logical link control data unit that can be sent or received on the line. For non-SNA communications, this value represents the maximum data packet sequence that can be sent or received. This value should not be confused with the high-level data link control (HDLC) frame size.

8.3.2 LLC Rejects

This indicator represents the number of X.25 LLC rejects during a measured period. LLC rejects only occur for SNA controllers utilizing the ELLC link protocol. LLC rejects indicates that something inside the X.25 network is losing or corrupting data. LLC rejects cause the retransmission of data and can cause poor performance.

8.3.2.1 Using Performance Tools/400 to Display LLC Rejects

Performance tools do not create reports about the number of LLC rejects, nor can you use performance tools to display the number of LLC rejects.

8.3.2.2 Performance Monitor Database Fields

The following fields in the performance monitor database file reflect the number LLC rejects transmitted and received:

XLLJT Number of LLC rejects transmitted

XLLJR Number of LLC rejects received

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.2.3 Recommendations

LLC rejects have a negative impact on performance because data is retransmitted. To avoid communications performance problems, these values should be low. The error can be caused by:

- Problems with the remote data terminal equipment (DTE)
- Configuration
- Other network resources

Look at the message help in the QSYSOPR message queue or take a communications trace during an X.25 communications error and inspect the cause and diagnostic codes to determine the source and cause of the error.

8.3.3 LLC Protocol Data Units Discarded

This indicator represents the number of LLC protocol units discarded.

8.3.3.1 Using Performance Tools/400 to Display LLC Protocol Data Units Discarded

Performance tools does not create reports about the number of LLC protocol data units discarded, nor can you use performance tools to display the number of LLC protocol data units discarded.

8.3.3.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number LLC protocol data units discarded:

XLRLD Number of received LLC protocol data units discarded

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.3.3 Recommendations

LLC protocol data units discarded are normally due to sequence errors (only for ELLC). See Section 8.3.1, "Data Units Retransmitted and Data Units Received in Error" on page 138 for recommendations.

8.3.4 Timeouts

This indicator represents the number of timeouts that occurred during a measured period.

8.3.4.1 Using Performance Tools/400 to Display Number of Timeouts

Performance tools does not create reports about the number of timeouts, nor can you use performance tools to display the number of timeouts.

8.3.4.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number of timeouts:

XLTO Number of timeouts

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.4.3 Recommendations

Timeouts can be caused by problems with the remote data terminal equipment (DTE) (for example, configuration, system problem, and resources). Or the AS/400 system′s timer values may be too small to receive responses from the remote system. Consider increasing the X.25 response timer (X25RSPTMR) or X.25 connection timer (X25CNNTMR) parameter in the controller description.

8.3.5 Checksum Errors Detected

This indicator represents the number of checksum errors detected during a measured period.

8.3.5.1 Using Performance Tools/400 to Display the Number of Checksum Errors

Performance tools does not create reports about the number of checksum errors, nor can you use performance tools to display the number of checksum errors.

8.3.5.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number of checksum errors detected:

XLCED Checksum errors detected This field is only valid for link protocol ELLC.

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.5.3 Recommendations

To avoid communications performance problems, the percent of data units received in error should be low; however, checksum errors should usually be recoverable using the ELLC protocol. The error is usually caused by problems with X.25 network corruption.

8.3.6 Number of Reset Indications from Packet Link Control

This indicator represents the number of reset indications from packet link control during a measured period.

8.3.6.1 Using Performance Tools/400 to Display the Number of Reset Indications

Performance tools do not create reports about the number of reset indications, nor can you use performance tools to display the number of reset indications.

8.3.6.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number of reset indications from packet link control:

XLRSI Number of reset indications from packet link control

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.6.3 Recommendations

A reset indication is issued when:

- A RESET packet arrives from the network.
- A RESTART packet was received or transmitted.
- The local PLC layer RESETs the virtual circuit due to a protocol error.

To determine if there are problems, you should check the cause and diagnostic code, (see Section 8.2, "Packet level Control (PLC)" on page 136).

8.3.7 LLC Congestion

This indicator represents the number of receive-not-ready frames received during a measured period.

8.3.7.1 Using Performance Tools/400 to Display Information About Congestion

Performance tools do not create reports about congestion, nor can you use performance tools to display information about congestion.

8.3.7.2 Performance Monitor Database Fields

The following field in the performance monitor database file indicates LLC congestion:

XLRNR LLC receive-not-ready frames received

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25_ALL and X25_LLC) to show the values previously mentioned.

8.3.7.3 Recommendations

Receive-not-ready frames are transmitted due a high system utilization, that is, the CPU is busy. To avoid problems, this number should be zero or low. Look for problems that are causing high CPU utilization.

8.4 Important Related Performance Manager Files

Related fields in other database files:

- IOP utilization
- Remote jobs

8.4.1 IOP Utilization

Each line is controlled by an IOP. The performance of a line may be affected by the IOP that controls the line. It is important not to overload an IOP to avoid a possible system performance bottleneck. See Chapter 6, “Communications I/O Processor (IOP)” on page 89 for more information about IOP performance.

8.4.1.1 Performance Monitor Database Fields

An important performance indicator for the IOP is the IOP utilization. How you calculate this value is described in Chapter 6, “Communications I/O Processor (IOP)” on page 89. To relate the line to the IOP, you need two files:

QAPMX25 Contains performance data about the line

QAPMCIOP Contains performance data about IOPs

Note: If the communications adapter is connected to a multifunction IOP, the QPAMMIOP file must be used instead of QAPMCIOP. Appendix C, “X.25 Queries” on page 275 lists sample queries for both kind of IOPs.

The IOP is identified in both files (QAPMHDLC and QAPMCIOP) by the field:

IOPRN IOP Resource Name

This field should be used to relate IOP information to the line.

Utilization of the IOP can be seen in the sample query X25_IOP in Appendix C, “X.25 Queries” on page 275.

8.4.1.2 Recommendations

Keep the IOP utilization within the guideline of 45%. Exceeding this threshold in a large transfer environment or with a small number of concurrent users may still offer acceptable performance. If the performance capabilities of a single IOP are exceeded, it is important to distribute the workload across several IOPs. Consider moving one of the high speed lines attached to this communications IOP card to another one. If you still have problems, consider changing to a newer communications IOP card if you are using an older one.

To decrease the IOP utilization, you should consider increasing the frame size. The use of large frames generally improves performance in terms of capacity for the communications IOP and in terms of system response time.

The amount of time that the IOP spends processing a large frame is only slightly more than the amount to process a smaller frame. Using larger frames to transfer a given message or block of data decreases the total number of frames required to complete the transfer. Therefore, the total amount of processing time required by the IOP is smaller allowing other transactions to more effectively utilize the IOP. Also, for environments using high speed media, the response time is generally better by using larger frames because the IOP and the CPU require less total processing time. In communications environments where errors are common, the use of smaller frame sizes may offer better performance by limiting the size of the retransmission. Having errors may also impact the number of communications lines that can run concurrently.

8.4.2 Remote Jobs

For a good understanding of the performance of a line, it is good to know which remote jobs are running on the communications line and which other resources they use.

8.4.2.1 Performance Monitor Database Fields

To relate the line to the remote jobs, you need two files:

QAPMX25 Contains performance data about the line

QAPMJOBS Contains performance data about jobs

In the file QAPMX25, a line is identified by the field:

XLLND The name of the X.25 line

To relate the job information to the line, you should use the following field in the QAPMJOBS file:

JBLND Name of the communications line the workstation and its controller are attached to

Important values in the QAPMJOBS file are:

JBRSP Total transaction time. This field has a value other than zero only if this is an interactive or a pass-through target job.

JBNTR Number of transactions. This field has a value other than zero only if this is an interactive or a pass-through target job.

JBCPU Processing unit time (in milliseconds) used

Important values that can be derived from the QAPMJOBS file are:

- The percentage of elapsed time during which the processing unit was utilized by the job:

  Percent CPU was utilized by the job = ((JBCPU / 1000) * 100) / INTSEC.

  The sample query X25_JOB in Appendix C, "X.25 Queries" on page 275 shows this utilization.

- The total number of remote jobs that are running on the X.25 line. You should add up all of the job entries, selecting by line name (JBLND).

- The total number of transactions performed by the jobs running on the X.25 line. You should add up the number of transactions (JBNTR) for each job running on the X.25 line.

- The average internal response time (in seconds) per transaction for each job:

  Avg response time for a job = (JBRSP / JBNTR).

  The sample query X25_JOB in Appendix C, "X.25 Queries" on page 275 shows this response time.

- The average internal response time (in seconds) per transaction for all jobs:

  Avg response time for all jobs = (Total transaction time / Total number of transactions). Look for periods of high utilization and correlate them with transaction rates and response times.

8.4.2.2 Recommendations

If there are high utilization and response times, but no increase in transaction load, there is a good chance that you are getting line errors. On the other hand, if the transaction load and line utilization increase and the response time is high, the system may be trying to handle more work than it has the capacity to do. In this case, the additional response time may be caused by queueing in a communications line, IOP, or control unit.

The CPU utilization for remote jobs is composed by other low-level performance communications indicators. However, the CPU utilization for remote jobs is lower when you use larger frame sizes.

Chapter 9. SDLC

Synchronous data link control (SDLC) is a commonly used AS/400 data link protocol. It is a polling protocol that is compatible with Systems Network Architecture (SNA). SDLC can be used over duplex or half duplex, switched, or non-switched lines. The line may be a point-to-point or a multi-point configuration.

This chapter handles the most important values that the performance manager collects for the SDLC protocol. It describes how you can use these values to identify bottlenecks in an SDLC environment, where you can find these values, how they are related to each other, and what you can do to solve the bottlenecks. Most of these values come from the *QAPMHDLC* performance tools database file which is generated when you run the Performance Monitor (see Section 1.2.2, "How to Collect Performance Data" on page 3). In this chapter, references are made to performance tools reports and performance tools displays. Read Chapter 3, "Using Performance Tools/400" on page 27 to see how you can print these reports or reach these displays.

9.1 Important Fields in the SDLC Performance Manager File

The following list contains the main SDLC communications performance indicators:

- Line utilization
- Line errors
- Congestion
- Data link resets
- Connect poll retries

9.1.1 Line Utilization

Line utilization is the percentage of elapsed time during which the line was utilized. Line utilization is an important performance indicator. Exceeding the utilization threshold value may lead to unacceptable response times. For line speeds of 19 200 bits per second or less, most application programs can fully use the bandwidth of the line. The performance in this environment depends largely on the ability of the line to transfer data. For line speeds of greater than 19 200 bits per second, some application programs cannot fully use the bandwidth of the line. The performance in this environment depends much more on the performance of the application itself.

9.1.1.1 Using Performance Tools/400 to Display Line Utilization

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 58 on page 148. The display shows you the line speed and line utilization. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications

Interval Data. The line utilization for the sample interval selected is listed in the "Line Util" column heading.

```
                      Display Communications Interval Data

 Line ID  . . . . . . :   LIN032         Member . . . . . . . :   Q953171314
 Line type  . . . . . :   SDLC             Library  . . . . . :     QPFRDATA
 Line speed . . . . . :   9.6            Elapsed time . . . . :   09:58:09
 Bus number . . . . . :   0
 IOP address  . . . . :   5

 Type options, press Enter.
   5=Display remote jobs

                                      Pct                 Pct
                                   I Frames             Frames
         Itv        Line  I Frames Trnsmitd   Frames     Recd
 Option  End        Util  Trnsmitd in Error    Recd   in Error
   _     08:54:04     .1         0        0       12       100
   _     09:09:23     .0         0        0        0         0
   _     09:24:22     .0         0        0        0         0
   _     09:39:19     .0         0        0        0         0
   _     09:54:17     .0         0        0        0         0
                                                                       More...
 F3=Exit   F11=View2     F12=Cancel   F15=Sort by itv end
 F20=Sort by line util   F24=More keys
```

Figure 58. Communications Interval Data - View 1

Use PRTSYSRPT to print the System Report. The Communications Summary shows average and peak line utilization over the total report period shown in Figure 59.

```
                                                    System Report                                         12/04/95 11:33:36
                                                Communications Summary                                            Page 0007
                                     Performance Data for SDLC Communications Analysis

Member  . . . : Q953171314   Model/Serial  . . :  D60/10-15181   Main storage . . :   80.0 M   Started  . . . . : 11/13/95 13:15:59
  Library . . : QPFRDATA     System name . . . :      SYSTEM1    Version/Release  :   3/ 1.0   Stopped  . . . . : 11/13/95 14:10:52

     Bus/IOP/                          Line      Avg     Max     Active       Number       Average      ------ Bytes Per Second -----
       Line              Protocol     Speed     Util    Util    Devices    Transactions    Response      Received        Transmitted
--------------------    --------    -------    ----    ----    -------    ------------    --------     ---------        -----------
BUS 0  IOP 05 (6130)
  LIN032                  SDLC          9.6      4      69        .7              88         4.2           16.6               37.7


Bus/IOP/Line            --  Bus ID, IOP ID and model number, Line ID
Protocol                --  Line protocol (SDLC, ASYNC, BSC, X25, TRLAN, ELAN, IDLC)
Line Speed              --  Line speed (1000 bits per second)
                            (For IDLC this is the maximum over the measurement)
Avg Util                --  Average line utilization
Max Util                --  Maximum line utilization in all measurement intervals
Active Devices          --  Average number of active devices on the line
Number Transactions     --  Number of transactions
Average Response        --  Average system response (service) time (seconds)
Bytes /Sec Received     --  Average number of bytes received per second
Bytes /Sec Transmitted  --  Average number of bytes transmitted per second
```

Figure 59. Communications Summary - SDLC

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval shown in Figure 60 on page 149.

```
                                              Resource Interval Report
                                            COMMUNICATIONS LINE Detail
                                               SDLC resource report
Member  . . . : Q953171314   Model/Serial  . . : D60/10-15181   Main storage  . . : 80.0 M      Started . . . : 11/13/95 13:15:59
 Library . . : QPFRDATA     System name . . . :     SYSNM001   Version/Release . :  3/1.0      Stopped . . . : 11/13/95 14:10:52
PROTOCOL = SDLC (SORT BY INTERVAL)
                                                              Percent                         Percent    Pct     -- Congestion ---
       Bus/                          Bytes       Total       I Frames   Bytes      Total      Frames     Poll     Local    Remote
 Itv    IOP/       Line     Line    Trnsmitd    I Frames    Trnsmitd   Recd       Frames     Received   Retry     Not      Not
 End    Line       Speed    Util    Per Sec     Trnsmitd    in Error   Per Sec    Recd       in Error   Time     Ready    Ready
----- ---------- -------- ------ ---------- ---------- ---------- -------- -------- ---------- ------- ------- -------
      BUS  0
      IOP   5
       (6130)
13:20 LIN032          9.6     10        102         82          0       21    2,118          0       8       0
13:25 LIN032          9.6      8         81         73          0       18    2,282          0       9       0
13:30 LIN032          9.6      6         69         76          0       13    1,163          0      13       0
13:35 LIN032          9.6      5         51         29          0       16    2,324          0       9       0
13:40 LIN032          9.6      2         16          0          0       16    2,426          0       9       0

F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 60. Resource Interval Report - Communications Line Detail

9.1.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file QAPMHDLC are related to the line utilization:

SHBRCV The number of bytes received including all bytes in frames that had any kind of error

SHBTRN The number of bytes transmitted including bytes transmitted again

SHLSP The speed of the line in bits per second (bps)

Line utilization is derived from the following equation:

```
Line utilization = (SHBRCV + SHBTRN) * 800 / (INTSEC * SHLSP)
```

The 800 is really (100 * 8) where 100 represents the result as a percentage, and 8 is the number of bits per byte (since line speed is bits per second). INTSEC indicates the number of seconds since the last elapsed interval. This is a field in the QAPMHDLC file.

To ensure that the AS/400 system provides accurate performance statistics, the LINESPEED parameter on the SDLC line definition should match the actual line speed. Line utilization is calculated per interval, that is, the time you have specified on the INTERVAL parameter of the STRPFRMON command.

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC_ALL, SDLC_IOP, SDLC_HDLC and SDLC_JOB) to show the values previously mentioned.

9.1.1.3 Recommendations

- For interactive environments, keeping line utilization below 30% is recommended to maintain predictable and consistent response time.
- If you have batch jobs such as file transfers running on that line, it is normal to have the line utilization above 50%. However, for interactive jobs, performance begins to degrade around 40% line utilization.
- If the percentage of errors is also high, the line utilization can be driven by a lot of retransmission of data. Take the appropriate action to reduce line errors (see Section 9.1.2, "Line Errors" on page 150).
- Line utilization can also be driven by running large file transfer type work (for example, running a query over huge files). Besides affecting all genuine

interactive users, it increases the response time for all interactive users on the same communications line.

- If you cannot isolate the large file transfer traffic such as rescheduling the jobs or applications, you need to use pacing to throttle the large file transfer work (low pacing value) and consider increasing the line speed to minimize the impact (see Chapter 10, "SNA" on page 163).

9.1.2 Line Errors

Line errors often result in frames being retransmitted. If the retransmission still results in bad frames, the application is notified and has to resend the entire record or multiple records. This may result in one RU (request unit) or a chain of RUs being transmitted again.

9.1.2.1 Using Performance Tools/400 to Display Line Error Information

Line error information can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the line error information.

Use DSPPFRDTA to access the Display Communications Interval Data display shown in Figure 58 on page 148. The display shows you the number of information frames transmitted, the percent of information frames transmitted in error, the number of frames received, and the percent of frames received in error. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data.

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows you the number of information frames transmitted, the percent of information frames transmitted in error, the number of frames received, and the percent of frames received in error per sample interval shown in Figure 60 on page 149.

9.1.2.2 Performance Monitor Database Fields

The performance monitor collects data about the number of:

- Frames retransmitted
- Frames received in error
- Invalid frames received

A frame can be an information, supervisory, or unnumbered frame:

Information frames
: I-frames are used to transfer user data. If there are no I-frames transmitted, you can conclude that the remote stations on that line are inactive. *Inactive* means that the stations connected to the controller are not doing any work even though the controller has been successfully varied on.

Supervisory frames
: S-frames are used to perform link supervisory control functions such as acknowledge I-frames, request retransmission of I-frames, or request a temporary suspension of transmission of I-frames.

Unnumbered frames
U-frames are used to provide additional link control functions and contain no sequence numbers.

A frame retransmission is normally caused due to frames received in errors and by link resets. To avoid communications performance problems, this number should be zero or low. The following fields from the performance monitor database file QAPMHDLC can be used to determine the retransmission error rates:

SHFTRN Number of frames transmitted (I, supervisory, and frames not numbered) excluding frames transmitted again

SHIFTR Number of I-frames transmitted excluding I-frames transmitted again

SHIFRT Number of I-frames transmitted again

SHFRT Number of I, supervisory, and frames not numbered transmitted again

The percent frames transmitted with errors is derived from the following equation:

```
Percent of frames transmitted with errors = (SHFRT * 100) / (SHFRT + SHFTRN)
```

The percent of I-frames transmitted with errors is derived from the following equation:

```
Percent of I-frames transmitted with errors = (SHIFRT * 100) / (SHIFRT + SHIFTR)
```

The following fields from the performance monitor database file QAPMHDLC can be used to determine the number or percent of frames received in error or that are not valid:

SHEFFR Error free frames received (I, S, and U)

SHFRIE The number of I, S, and U frames received in error. There are three error possibilities:

- An S or I-frame was received with an number count that is requesting retransmission of a frame.
- An I-frame was received with an number count that indicates that frames were missed.
- A frame was received with one of the following errors:
  - A frame check sequence error
  - An abnormal end
  - A receive overrun
  - A frame truncated error

SHIFR Frames received that are not valid: The number of not valid frames received. These are frames received with either:

- Short frame error: Frame is less than 32 bits.
- Residue error: Frame is not on a byte boundary.

The percent of frames received in error is derived from the following equation:

```
Percent of frames received in error
= ((SHIFR + SHFRIE) * 100) / (SHEFFR + SHIFR + SHFRIE)
```

Appendix A, “SDLC Queries” on page 227 lists the sample queries (SDLC_ALL and SDLC_HDLC) to show the values previously mentioned.

9.1.2.3 Recommendations

Receive and transmit errors can occur when the host system or remote device has an error or cannot process received data fast enough (see also Section 9.1.3, "Congestion" on page 153 for congestion). Check for messages in the QSYSOPR message. Factors that can influence the number of retransmissions are:

- Line quality
- Frame size
- Maximum outstanding frames
- Modem rate

Line quality: If the percentage of errors on a line is about 5% for a few intervals that had I-frames transmitted, check the local and remote connections. Ensure that all cables are properly shielded, are the correct cable type, and that all plug connections are secure. There should be no ribbon cables (flat, unshielded cables) anywhere between the system and the modem. Sometimes the errors can be caused by electrical ″noise″ or interference. If problems still occur, contact your line supplier to have the line tested. You might consider changing to a better quality line or modem. Normally, it is true that a non-switched line is a better quality line than a switched line.

Frame size is represented by the MAXFRAME parameter of the line and controller description. Larger frame sizes can improve performance; however, if frequent line errors occur, performance may be degraded by larger frame sizes due to the greater likelihood that a frame may encounter an error and need to be transmitted again. The frame size can be controlled through the MAXFRAME parameter found in both the primary line and controller description. The frame size used is usually based on the MAXFRAME parameter defined on the controller description. If you specify *LINKTYPE on the MAXFRAME parameter of the controller description, the frame size used is a frame size defined on the line description. Between two communicating stations, the maximum frame size used is based on the smaller of the MAXFRAME values of either station.

The maximum outstanding frames is represented by the MAXOUT parameter on the line description. The MAXOUT parameter determines the maximum number of frames that can be sent before the receiving station must send an acknowledgement. As for frame size, better performance can be realized with a large MAXOUT value. In case of an error-prone line, a large MAXOUT value impacts performance because of retransmission requirements. All frames that have not been acknowledged must be retransmitted. The maximum for this parameter depends on the modulus (MODULUS) and maximum outstanding frames (MAXOUT) parameters that are part of the line description. If the value for MODULUS is set to eight, the maximum value that MAXOUT can be set to is seven. If the MODULUS value is set to 128, the maximum value that MAXOUT can be set to is 28. The MODULUS value should usually be set to eight except in special situations such as networks using satellite links. If the MODULUS value is 128, the MAXOUT value must be greater than seven. In order to support a MODULUS value of 128, you should ensure that the remote system is capable of supporting such a size.

The modem rate indicates whether the modem you are using is being operated at its full rated speed (*FULL) or at an alternate or half speed (*HALF). If many errors occur at the modem′s higher transmission rate, errors and an associated retransmission can be reduced by selecting a slower data transmission rate for better overall performance. Modem data rate selection is valid only for *RS232V24 and must match the modem setting at the remote system.

9.1.3 Congestion

Local or remote congestion occurs when data is not processed fast enough either while sending or while receiving. Congestion results in transmitting receive-not-ready frames by the system that is congested, either the host or remote device.

9.1.3.1 Using Performance Tools/400 to Display Information about Congestion

Information about congestion can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the information about congestion.

Use DSPPFRDTA to access the Display Communications Interval Data display shown in Figure 61.

```
                     Display Communications Interval Data

 Line ID  . . . . . . :   LIN032         Member . . . . . . . :   Q953171314
 Line type  . . . . . :   SDLC             Library  . . . . . :     QPFRDATA
 Line speed . . . . . :   9.6            Elapsed time . . . . :   09:58:09
 Bus number . . . . . :   0
 IOP address  . . . . :   5

 Type options, press Enter.
   5=Display remote jobs

                          Pct   -Congestion--
                          Poll  Local  Remote
         Itv        Line  Retry  Not     Not
 Option  End        Util   Time  Rdy     Rdy
   _     08:54:04     .1    84     0       0
   _     09:09:23     .0    85     0       0
   _     09:24:22     .0    85     0       0
   _     09:39:19     .0    84     0       0
   _     09:54:17     .0    84     0       0
                                                                     More...
 F3=Exit   F11=View1     F12=Cancel   F15=Sort by itv end
 F20=Sort by line util   F24=More keys
```

Figure 61. Communications Interval Data - View 2

The display shows you the percentage of Receive Not Ready frames transmitted and received. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. Press F11=View 2 to see the second display. The percentage of Receive Not Ready frames transmitted and received for the sample interval selected are the values listed in the Local Not Rdy and Remote Not Rdy column headings respectively.

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows you the percentage of Receive Not Ready frames transmitted and received per sample interval shown in Figure 60 on page 149.

9.1.3.2 Performance Monitor Database Fields

The following fields in the performance monitor database file give an indication of the congestion at the local or remote side:

SHRNRT Number of receive not ready supervisory frames transmitted (local congestion)

SHRNRR Number of receive not ready supervisory frames received (remote congestion)

Both values should be close to zero in a well-performing system. High congestion increases both CPU and IOP utilization and directly affects remote response time.

Important values that can be derived from these fields are:

Local Not Ready
Receive Not Ready frames transmitted by the host as a percentage of all frames received by the host. A large number usually means the host IOP or system data buffers are not emptied fast enough. The Local Not Ready value can be derived from the following equation:

```
Local Not Ready = SHRNRT / (SHEFFR + SHFRIE + SHIFR + SHRRFR + SHRNRR)
```

Remote Not Ready
Receive Not Ready frames received by the host as a percentage of the information frames transmitted by the host. A large number usually means the remote device data buffers are not emptied fast enough. The Remote Not Ready value can be derived from the following equation:

```
Remote Not Ready = SHRNRR / (SHIFTR + SHIFRT + SHRRFT + SHRNRT)
```

Appendix A, “SDLC Queries” on page 227 lists the sample queries (SDLC_ALL, SDLC_IOP, and SDLC_HDLC) to show the values previously mentioned.

9.1.3.3 Recommendations

Local Congestion: A remote system is sending data too fast for your AS/400 system to process. This is probably caused by some sort of bottleneck such as high CPU, disk, or IOP utilization. Another cause might be a low machine pool size.

You can find more information about IOP in Section 9.2.1, “IOP Utilization” on page 159. For CPU, disk, and pool utilization, refer to the redbook *AS/400 Performance Management V3R1*, GG24-3723-02.

Remote Congestion: Another system receiving data from your AS/400 system cannot process the data fast enough and has sent out ″NOT READY″ messages. Check for possible bottlenecks on the system receiving data from your AS/400 system. This includes high CPU, IOP, or disk utilization. If the receiving system is an AS/400 system, the problem may also be a low machine pool size on that system.

9.1.4 Data Link Resets

Data link resets represents the number of times a set normal response mode (SNRM) was received when the station was already in normal response mode during a measured period. This is caused due to a procedure error.

9.1.4.1 Using Performance Tools/400 to Display Data Link Resets

Performance tools do not create reports that show Data Link Reset values, nor can you use performance tools to display Data Link Reset values.

9.1.4.2 Performance Monitor Database Fields

Data link resets are indicated by the following field:

SHLNKR The number of times a set normal response mode (SNRM) was received when the station was already in normal response mode

The performance monitor collects this number for each interval.

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC_ALL and SDLC_HDLC) to show the values previously mentioned.

9.1.4.3 Recommendations

To avoid communications performance problems, this number should be zero or low. As this indication is caused by a procedure error, the line should be debugged. Check for messages in the QSYSOPR message. The link resets may be contributing to high line utilization. If the throughput or response time is unacceptable in your SDLC line, you may need to have the line or modem serviced; however, the amount of errors normally occurring changes depending on a number of variables such as the location and the quality and type of line.

Before servicing the lines, ensure that all cables are properly shielded, are IBM-supplied cables, and that all plug connections are secure. There should be no ribbon cables anywhere between the system and the modem.

9.1.5 Connect Poll Retries

Connect poll retries causes a line unavailable for a certain time because the IOP waits for a workstation controller to respond to a poll. Controllers that are varied on (vary on pending) but powered off (normal disconnect mode) can cause this condition. A high percentage of poll retries for a multi-point line increases the response time for all active stations that are connected to the same line. Polling also contributes to line and IOP utilization.

9.1.5.1 Using Performance Tools/400 to Display Connect Poll Retries

Information about connect poll retries can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the information about connect poll retries.

Use DSPPFRDTA to access the Display Communications Interval Data display shown in Figure 61 on page 153. The display shows you the percentage of poll retry time. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. Press F11=View 2 to see the second display. The percentage of poll retry time for the sample interval selected is the value listed in the Pct Poll Retry Time column headings.

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows you the percentage of poll retry time per sample interval shown in Figure 60 on page 149.

9.1.5.2 Performance Monitor Database Fields

The following field in the performance monitor database file gives an indication of the connect poll retries:

SHCPT The length in time (in tenths of seconds) that the system waits for the response to a poll while in normal disconnect mode before polling the next station

An important value that can be derived from this field is the Percent Poll Retry Time, that is, the percent of the measured time interval when the line was unusable while the IOP waited for a workstation controller to respond to a poll. The Percent Poll Retry Time is derived from the following equation:

```
Percent Poll Retry Time = ((SHCPT * (SHFRT - SHIFRT)) * 100) / (INTSEC * 10).
```

SHCPT See preceding description

SHFRT Number of I, supervisory, and frames not numbered transmitted again

SHIFRT Number of I-frames transmitted again

INTSEC Elapsed interval seconds

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC_ALL and SDLC_HDLC) to show the values previously mentioned.

9.1.5.3 Recommendations

If there are intervals for multi-point lines that show a high percent poll retry time, you might want to increase the value for connect poll timer (CNNPOLLTMR parameter on line description) and decrease the NDM poll timer (NDMPOLLTMR parameter on controller description). You can also vary off those controllers until they are needed, if this is possible. The CNNPOLLTMR can effect response times for all controllers on the line. The CNNPOLLTMR controls how long the primary station waits after it polls a secondary controller and receives no response. While the primary station is waiting for a response, the line is idle, and the primary station cannot poll other stations on the line.

The connect poll retry (CNNPOLLRTY parameter on the controller description) is used in conjunction with the connect poll timer in normal disconnect mode and determines if the primary station should poll an offline, normal disconnect mode station periodically or if it should stop polling the controller after a limited number of polls. The system default value (*CALC) allows seven retries on a switched line and unlimited (*NOMAX) retries for a non-switched line.

The NDMPOLLTMR indicates how long the primary station must wait before sending a poll to a station in normal disconnect mode. While the timer is running, a controller that is offline is not polled even if its turn comes in the poll list. After the timer completes and the primary station finally reaches that station in the poll list, the station is polled. After the poll, the primary station waits for a response for the length of time specified by the connect poll timer.

Besides the parameters previously described, the idle timer (IDLTMR parameter) and frame retry (FRAMERTY parameter) affects response times due to idleness of the line.

The *IDLTMR* parameter determines how fast the line recovers after a temporary error. If an error occurs after a station is polled and no response (or no final frame of a response) is received, the primary station waits for the idle timer to end. This parameter is important if the line is noisy or has frequent temporary frame errors such as frame checks. Too low a value for the idle timer can cause unnecessary timeouts and responses to be transmitted again.

The *FRAMERTY* parameter is used in conjunction with the idle timer. The frame retry limit determines the number of times the primary station retries a transmission to a remote station if consecutive temporary errors such as idle timeouts occur. Between retries to a station, a primary station continues to cycle through its poll list, transmitting to other stations.

The frame retry limit should be large enough to allow the system to recover from temporary errors such as those caused by line noise. You should note that a large frame retry value can cause unnecessary delays in reporting permanent errors (such as inoperable remote system or link) and degrade performance for other stations while SDLC is busy retrying.

Other poll parameters that may effect the response time are:

POLLPAUSE
The poll pause parameter. This parameter in the line description tells the primary station how long it should delay after making one complete pass through the poll list before recycling through the poll list again. This parameter is only used when SDLC is not sending data to any station.

Usually small values are recommended. However, if there are a number of lines physically attached to the same communications controller, and some lines are experiencing performance problems, increasing the poll cycle pause timer may give other tasks in the controller more time to run. The more stations there are on a line, the lesser the effect that the poll cycle pause timer has on overall performance.

POLLLMT The poll limit parameter controls the number of additional polls SDLC sends to a station when that station responds with a number of frames equal to the maximum outstanding frames (MAXOUT) count. These additional polls determine if the remote controller has more frames to transmit that it was unable to do in its last transmission due to the MAXOUT limit. By polling the secondary station, the secondary station can send more frames to the primary station.

OUTLMT The out limit controls how many sequences of information frames SDLC sends to a remote station before polling other stations in the poll list.

FAIRPLLTMR
The fair poll timer. This timer can be specified for multi-point lines to prevent one station from tying up the line for long periods of time. FAIRPLLTMR specifies the maximum length of time that the

system sends data to one or more stations on the line before polling stations without pending output requests.

Lowering the fair poll timer makes polling more equitable by increasing the number of times every station is polled, but it degrades performance for busy stations and can increase the length of time it takes to send data. When some controllers are monopolizing the line at the expense of other controllers on the same line, lowering the fair poll timer may improve response time for other controllers. If possible, you may want to put the busy controller on a separate line to improve performance.

POLLPRTY The poll priority parameter controls the extra polls that are sent to a station in situations where a poll may be denied due to the following situations:

- When the primary station is only transmitting to other stations.
- When the fair poll timer completes.
- When the primary station is performing normal sequential polling.

When POLLPRTY is set to *YES, the priority station obtains an extra poll. During sequential polling, the setting of this parameter enables the priority station to be polled twice as often as non-priority stations. Therefore, POLLPRTY can be used to give better response to some stations.

This parameter should be used with caution. Designating a secondary station as a priority station is almost equivalent to another controller on the line. Non-priority stations may experience increased response time.

POLLRSPDLY
The poll response delay parameter. This parameter in the line description tells the secondary station how long to wait after it has been polled before it returns a response.

Normally the delay timer is be set to zero unless the following conditions apply:

- The modem requires this delay.
- The primary station cannot handle a fast response.
- There is some unique requirement.

Specifying a nonzero value increases the time all other controllers on a multi-point line must wait before being polled and should, therefore, be avoided if possible. The value of POLLRSPDLY along with the internal delays and the time needed for increasing must be less than the idle timer on the remote system.

9.2 Other Related Performance Monitor Files

The following performance indicators can be retrieved from other database files:

- IOP utilization
- Remote jobs

9.2.1 IOP Utilization

Each line is controlled by an IOP. The performance of a line may be affected by the IOP that controls the line. It is important not to overload an IOP to avoid a possible system performance bottleneck. Keep the IOP utilization within the guideline of 40%. See Chapter 6, "Communications I/O Processor (IOP)" on page 89 for more information about IOP performance.

9.2.1.1 Performance Monitor Database Fields

An important performance indicator for the IOP is the IOP utilization. How you calculate this value is described in Chapter 6, "Communications I/O Processor (IOP)" on page 89. To relate the line to the IOP, you need two files:

QAPMHDLC Contains performance data about the line

QAPMCIOP Contains performance data about IOPs

Note: If the communications adapter is connected to a multifunction IOP, the QPAMMIOP file must be used instead of QAPMCIOP. Appendix A, "SDLC Queries" on page 227 lists sample queries for both kind of IOPs.

The IOP is identified in both files (QAPMHDLC and QAPMCIOP) by the field:

IOPRN IOP Resource Name

This field should be used to relate IOP information to the line.

Appendix A, "SDLC Queries" on page 227 lists the sample query (SDLC_IOP) to show the values previously mentioned.

9.2.1.2 Recommendations

Keep the IOP utilization within the guideline of 40%. If the performance capabilities of a single IOP is exceeded, it is important to distribute the workload across several IOPs. Consider moving one of the high speed lines that is attached to this communications IOP card to another one. If you still have problems, consider changing to a newer communications IOP card if you are using an older one. The following factors can help you to decrease the IOP utilization:

- Polling
- Frame size

Polling contributes to the IOP utilization. A long polling delay requires less overhead then a shorter polling delay; however, a short polling delay gives better response time in an interactive environment. See Section 9.1.5, "Connect Poll Retries" on page 155 for more information.

The OS/400 support for SDLC can use a range of frame sizes up to 2057 bytes. Usually the larger the frame size used, the better the performance. Larger frame sizes reduces the number of frames that need to be transmitted. When fewer frames are transmitted, the overhead and line turnaround are reduced. This means that the CPU and communication IOP processes fewer frames. When this happens, CPU and IOP utilization are reduced correspondingly. In addition, you can expect a higher throughput, thereby making more efficient use of your communication line. The frame size can be controlled through the MAXFRAME parameter found in both the primary line and controller description (see also Section 9.1.2.3, "Recommendations" on page 152)

9.2.2 Remote Jobs

For a good understanding of the performance of a line, it is good to know which remote jobs are running on the communications line and which other resources they use.

9.2.2.1 Performance Monitor Database Fields

To relate the line to the remote jobs, you need two files:

QAPMHDLC Contains performance data about the line

QAPMJOBS Contains performance data about jobs

In the file QAPMHDLC, a line is identified by the field:

SHLND The name of the SDLC line

To relate the job information to the line, you should use the following field in the QAPMJOBS file:

JBLND Name of the communications line the workstation and its controller are attached to

Important values in the QAPMJOBS file are:

JBRSP Total transaction time. This field has a value other than zero only if this is an interactive or a pass-through target job.

JBNTR Number of transactions. This field has a value other than zero only if this is an interactive or a pass-through target job.

JBCPU Processing unit time (in milliseconds) used

Important values that can be derived from the QAPMJOBS file are:

- The percentage of elapsed time during which the processing unit was utilized by the job.

  Percent CPU was utilized by the job = ((JBCPU / 1000) * 100) / INTSEC.

- The total number of remote jobs that are running on the SDLC line. You should add up all of the job entries, selecting by line name (JBLND).
- The total number of transactions performed by the jobs running on the SDLC line. You should add up the number of transactions (JBNTR) for each job running on the SDLC line.
- The average internal response time (in seconds) per transaction for each job:

  Avg response time for a job = (JBRSP / JBNTR).

- The average internal response time (in seconds) per transaction for all jobs:

  Avg response time for all jobs = (Total transaction time / Total number of transactions). Look for periods of high utilization and correlate them with transaction rates and response times.

Appendix A, “SDLC Queries” on page 227 lists the sample queries (SDLC_ALL and SDLC_JOB) to show the values previously mentioned.

9.2.2.2 Recommendations

If there are high utilization and response times but no increase in the transaction load, there is a good chance that you are getting line errors. On the other hand, if the transaction load and line utilization increase and the response time is high, the system may be trying to handle more work than it has the capacity to do. In this case, the additional response time may be caused by queueing in a communications line, IOP, or control unit.

An important factor for the response time of interactive jobs that has not been discussed so far is the support of full duplex. This is represented by the DUPLEX parameter on the line description. Duplex support minimizes the modem turnaround time. This is the amount of time required for a station to stop receiving data and to begin transmitting data. Non-switched lines generally have little modem turnaround because they normally have four wires. Duplex support makes use of the two-way nature of four-wire lines so that one set of wires is always conditioned to receive while the other set of wires is always conditioned to transmit. Although data is never sent or received simultaneously with SDLC, there is almost no modem turnaround time with duplex support.

Typical times for turnaround depending on the modem and the quality of the line connection range from 0.1 second to 0.5 second (it may be less for newer modem models). This can be significant for interactive applications if a station alternates frequently between sending and receiving data for the same transaction. Large transfer applications can see some degradation because the application requires multiple transitions between sending data and receiving acknowledgements to ensure data integrity. Eliminating modem turnaround time brings some improvement to these applications.

Chapter 10. SNA

From a performance viewpoint, SNA protocol exists as a layer between what an application does to affect performance and the ″maximum performance capabilities″ controlled by line speed and line type protocols such as for local area networks and SDLC. SNA support affects primarily the communication between two programs or a program and a device whereas line type protocols primarily affect communication at the control unit level. User program I/O output operations are associated more closely to SNA capabilities than to communication type capabilities.

This chapter describes how you can use the SNA performance values and SNA traces to identify bottlenecks in an SNA environment, where you can find these values, how they are related to each other, and what you can do to solve the bottlenecks. Most of the performance values come from the *QAPMSNA* performance tools database file that is generated when you run the Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). The QAPMSNA file contains a record for each active controller (APPC or HOST).

10.1 Important Fields in the SNA Performance Monitor File

The following list contains the main SNA communications performance indicators:

- Number of connections established
- Number of sessions and brackets started and ended
- Session level pacing wait time
- Internal session level pacing
- Transmission queue wait time
- Line transmission time

The number of connections established records the frequency with which connections are established with the adjacent system. The other indicators record the *session* detail for each active APPC and host controller. The performance monitor collects data for each session type and session priority combination. The possible session types are:

- End-point
- Intermediate

End-point sessions may be established for the following device types:

APPC devices
Host devices
DHCF display devices
NRF display and printer devices

Intermediate sessions may be established for:

APPN intermediate traffic
SNA pass-through devices

Each session type can have traffic at any of four priorities:

1. Network priority

APPN
SNA change number of sessions (CNOS)
Alert support

2. High priority

   APPC devices
   APPN intermediate sessions

3. Medium priority

   APPC devices
   Host devices
   DHCF display devices
   NRF display and printer devices
   SNA pass-through devices
   APPN intermediate sessions

4. Low priority

   APPC devices
   APPN intermediate sessions

The session priority is determined by the transmission priority (TMSPTY) specified in the Class-of-Service (COS). The COS is determined by the mode description used. You should run interactive-type functions at *HIGH priority. Batch type functions should be configured to use *LOW priority.

In the following sections, each session traffic field name is prefixed by the characters ″tp″, where ″t″ is the session type (E=End Point, I=Intermediate) and ″p″ is the session priority (N=network, H=high, M=medium, L=low).

10.1.1 Number of Connections Established

The number of connections established indicates the frequency with which connections are established with the adjacent system. A connection is established with the adjacent system when the status of the controller description goes from varied off or vary on pending to varied on or active.

On a non-switched line, the connection is established after the line and controller description are varied on, assuming the adjacent system is ready to establish the connection. The non-switched connection remains until the controller is varied off, a non-recoverable line error occurs, or the adjacent system drops the connection.

On a switched line, the connection is not established until a communications program needs to use the connection (for example, the program acquires a session). The switched connection is usually dropped after the connection has been inactive (for example, all sessions are unbound) for a period of time.

10.1.1.1 Using Performance Tools

Performance tools do not create reports that show connection values, nor can you use performance tools for displaying connection values.

10.1.1.2 Performance Monitor Database Fields

SNLBU Indicates the number of connections that were established with the adjacent system in the time interval

This is a field in the QAPMSNA file. To examine the value of this field, you can run the sample queries (SNA_ALL and SNA_CON) listed in Appendix E, "SNA Queries" on page 311.

10.1.1.3 Recommendations

Establishment of communications uses significant resource on the AS/400 system. This additional resource may be seen in the QLUS function. For example, an environment with a large number of switched lines where the controllers are frequently connecting for a short time and then disconnecting may see increased resources used in the QLUS job.

In addition, establishing connections increases the number of RUs flowing in the network priority session. These additional network RUs increase:

- T2 station and line IOM CPU usage
- IOP utilization
- Line utilization

10.1.2 Number of Sessions and Brackets Started/Ended

A session is a logical connection between two network accessible units. A session starts when the positive response to an SNA bind command is sent or received. A session ends when an SNA unbind command is sent or received, or the session is abnormally ended (for example, the line fails).

The meaning of the number of brackets started and ended depends on the environment. In a non-APPC environment, the number of start and end brackets indicates the number of BIND and UNBIND commands. In an APPC environment, this counts the number of evokes/allocates and detach/deallocates. An APPC bracket is roughly equivalent to a conversation that is started when a program issues an ICF evoke operation or Common Programming Interface Communications (CPI-C) allocate verb and ends when a program issues an ICF detach operation or Common Programming Interface Communications (CPI-C) deallocate verb.

10.1.2.1 Using Performance Tools

Performance tools do not create reports about the number of sessions and conversations started and ended, nor can you use performance tools for displaying the number of sessions and conversations started and ended.

10.1.2.2 Performance Monitor Database Fields

tpNSS Indicates the number of sessions that are started

tpNSE Indicates the number of sessions that are ended

tpNBB Number of request units with begin bracket sent and received

tpNEB Number of request units with end bracket sent and received

To examine the value of these fields, you can run the sample queries (SNA_ALL and SNA_CON) listed in Appendix E, "SNA Queries" on page 311.

10.1.2.3 Recommendations

The session start and end fields may be examined if the overall session start/end count was high. These fields enable you to determine which controllers were connecting frequently to your system. Starting and ending sessions can cause significant system overhead, such as increase CPU usage in the T2 station IOM, line IOM, and QLUS task, plus increase in the line and IOP workloads. High CPU usage by the QLUS task may occur when a user-written APPC program uses the ″Change Number of Sessions″ function (CNOS). Re-writing APPC programs to avoid the CNOS function when the session was being closed can help to reduce CPU time. It is far more efficient to just UNBIND, avoiding CNOS altogether. Client Access/400 is an example of an APPC application that UNBINDs at session close rather than using CNOS.

10.1.3 Session Level Pacing Wait Time

Session-level pacing is a technique that allows a receiving session to control the rate at which it receives request units on the normal flow. It is used primarily to prevent a receiver with unprocessed requests from overloading because the sender can create requests faster than the receiver can process them. If the pacing factor is three, only three RUs can be sent and the session waits for a pacing response from the receiver. Session level pacing wait time indicates the amount of time that application data waits for a pacing response.

10.1.3.1 Using Performance Tools

Performance tools do not create reports that show session level pacing wait time values, nor can you use performance tools for displaying session level pacing wait time values.

10.1.3.2 Performance Monitor Database Fields

tpSPWT The cumulative wait time (in milliseconds) caused by session-level send messages. This wait time measures the amount of time application data was blocked (could not be sent) waiting for a pacing response to be received from the adjacent system.

tpSPNW Number of waits occurring for session-level send pacing. That is, the number of times application data was blocked (could not be sent) waiting for a pacing response to be received from the adjacent system.

tpSPPW Number of potential waits occurring for session-level send pacing. This is the worst case that can occur if the sending of application data was delayed waiting for every pacing response sent by the adjacent system.

tpSPWS The cumulative window size for session-level send pacing. Each time a pacing response is received from the adjacent system on a network priority session, this count is increased by window size specified by the pacing response.

Important values that can be derived from the session-level pacing fields are:

```
The average amount of time spent waiting for a pacing response
to be received = tpSPWT / tpSPNW.
```

To see this value, you can use the sample query (SNA_PAC1) listed in Appendix E, “SNA Queries” on page 311.

```
The percentage of times application data waited for a pacing
response to arrive = (tpSPNW * 100) / tpSPPW.
```

To see this value, you can use the sample query (SNA_PAC2) listed in Appendix E, "SNA Queries" on page 311.

```
The average pacing window size = tpSPWS / tpSPPW.
```

To see this value, you can use the sample query (SNA_PAC2) listed in Appendix E, "SNA Queries" on page 311.

10.1.3.3 Recommendations

If excessive waiting is caused by session-level pacing, the OUTPACING (local system) and INPACING (remote system) parameters in the mode description may need to be increased. When the AS/400 system is functioning as a dependent LU and communicating with a System/390 host, the pacing used is specified on the S/390 system. On the S/390 VTAM macros such as GROUP or LU, pacing is specified with the PACING parameter. You should keep in mind that, with respect to internal session level pacing, a large wait time may be desirable if batch is being throttled to allow interactive to run faster. You must know the environment to know if there is a problem. However, if the average pacing window size is seven or more and you have excessive waiting, you should check:

- The remote system; it may be slow in sending pacing responses.
- The line utilization
- If the line has errors

10.1.4 Internal Session Level Pacing

For APPN and APPC sessions that are adaptively paced, internal session-level pacing is used to limit the amount of bandwidth used by a particular session. It only controls internal flow and does not have any external line flows. A sending session is allowed to transmit a limited number of request units and is not allowed to transmit additional request units until a request unit is successfully delivered to the adjacent system.

10.1.4.1 Using Performance Tools

Performance tools do not create reports that show internal session level pacing values, nor can you use performance tools for displaying internal session level pacing values.

10.1.4.2 Performance Monitor Database Fields

tpIPWT The cumulative wait time for internal session-level pacing. That is, the number of times application data was blocked (could not be sent) waiting for data to be delivered to the adjacent system.

tpIPNW Number of waits occurring for internal session-level pacing. That is, the number of times application data was blocked (could not be sent) waiting for data to be delivered to the adjacent system.

An important value that can be derived from the internal session-level pacing fields is:

```
The average amount of time spent waiting because of internal
session-level pacing = tpIPWT / tpIPNW.
```

To see this value, you can use the sample query (SNA_IPAC) listed in Appendix E, "SNA Queries" on page 311.

10.1.4.3 Recommendations

In general, the following rules apply:

- Controllers carrying interactive-only traffic should see minimal pacing waits.
- Controllers carrying batch-only traffic should see minimal pacing waits.
- Controllers carrying a mix of interactive and batch traffic may see high pacing wait times. If the batch traffic is running at a different priority than the interactive traffic (this is desirable), it should be easy to determine if waiting is only occurring on the batch functions.

If excessive waiting is caused by internal session-level pacing and it is not desirable to limit the amount of bandwidth used, the OUTPACING and INPACING parameters in the mode description may need to be increased. These parameters are used to calculate the transmission limit. The limit used for a given session is (2*n)-1, where *n* is the INPACING or OUTPACING parameter. On a slow speed line, it may be necessary to configure a small limit for batch traffic and a larger limit for interactive traffic to ensure acceptable interactive response time.

10.1.5 Transmission Queue Wait Time

When a request unit has to be transmitted to a remote system, it is placed on a transmission priority queue. The amount of time a request unit has to wait in the transmission priority queue influences the response time of the corresponding communication job.

10.1.5.1 Using Performance Tools

Performance tools do not create reports that show transmission queue wait time values, nor can you use performance tools for displaying transmission wait time values.

10.1.5.2 Performance Monitor Database Fields

tpQNRE Number request/response units entering the transmission priority queue

tpQLRE Length of request/response units entering the transmission priority queue

tpQNRL Number of request/response units leaving the transmission priority queue. Normally this field matches tpQNRE.

tpQLRL Length of request/response units leaving the transmission priority queue. Normally this field matches tpQNRL.

tpQTRR Cumulative wait time in transmission priority queue

If the RUs stay in the transmission priority queue for a considerable amount of time, the values of the fields tpQNRE/tpQLRE may differ from the values of the fields tpQNRL/tpQLRL. RUs stay in the transmission priority queue, for example, when using a low speed line that has many sessions using the same controller.

Important values that can be derived from the transmission priority fields are:

```
The average length of a request unit entering the transmission
priority queue = tpQLRE / tpQNRE.
```

```
The average length of a request unit leaving the transmission priority
queue = tpQLRL / tpQNRL.

The average amount of time a request unit waited in a transmission
priority queue = tpQTRR / tpQNRL.
```

To see these values, you can use the sample query (SNA_TRQ) listed in Appendix E, "SNA Queries" on page 311.

10.1.5.3 Recommendations

Normally the wait times should be in the order of a few milliseconds. The average wait time for higher priority data should typically be less than lower priority data. If you notice excessive waiting in a transmission priority queue, you should check:

- The line utilization, especially if it is a low speed line
- The number of retransmissions on the line
- IOP utilization

Section 10.2.1, "Line Utilization" on page 171 describes how you can retrieve line performance information. The line protocol chapters contain a section that describes how you can retrieve IOP performance information for a given line.

10.1.6 Line Transmission Time

Line transmission time indicates the amount of time required to successfully transmit data to the adjacent system. This measurement period begins after the data leaves the transmission priority queue and ends when the data is successfully delivered to the adjacent system.

10.1.6.1 Using Performance Tools

Performance tools do not create reports that show line transmission values, nor can you use performance tools for displaying line transmission values.

10.1.6.2 Performance Monitor Database Fields

tpNRUD Number of request/response units delivered to the adjacent system. This field should be almost identical to the fields tpQNRL.

tpLRUD Length of request/response units delivered to the adjacent system. This field should be almost identical to the field tpQLRL.

tpTRUD Cumulative service time to deliver a request/response unit to the adjacent system

tpNRUR Number of request/response units received from the adjacent system

tpLRUR Length of request/response units received from the adjacent system

The tpQNRL/tpQLRL counts might be slightly higher than the tpLRUD/tpNRUD counts if the IOP stopped sending for five minutes or more.

Important values that can be derived from the line transmission fields are:

```
The average length of a delivered request unit = tpLRUD / tpNRUD.

The average amount of time to deliver a request unit =
tpTRUD / tpNRUD.

The average length of a received request unit = tpLRUR / tpNRUR.
```

To see these values, you can use the sample query (SNA_LIN) listed in Appendix E, "SNA Queries" on page 311.

10.1.6.3 Recommendations

The average amount of time to deliver a request unit gives a good indication of the real response time of the communications network. To determine the transmission time for the data being received, you should examine the performance data of the sending system. If you notice an excessive average amount of time to deliver a request, you should check:

- The line utilization, especially if it is a low speed line. The busier the line, the longer your RU has to queue before being transmitted. Line queuing time is part of the line delivery time.
- IOP utilization. Each RU sent has to be serviced by the IOP on both the sending system and the receiving system.

A contributor on the SNA level (the level as discussed in the beginning of this chapter) to line and IOP utilization is segmentation. Segmentation takes place when an RU does not fit into a frame. The RU is divided (segmented) across frames. How you can control the frame size is discussed in the line protocol chapters. You can control the RU size using the MAXLENRU parameter. To ensure an optimum length, the value *CALC is recommended. In this case, the system calculates the value to use.

For APPC/APPN devices, the Mode Description controls MAXLENRU values. For other device types such as 5250 displays, the AS/400 system defaults to a MAXLENRU based on the control unit MAXFRAME value supported. For other device types, such as Retail (4680) devices, MAXLENRU can be explicitly specified on the device description, although a default value is supported. In most cases, the default chosen by the system is the best value.

When the AS/400 system is functioning as a dependent LU and communicating with a System/390 host, the RU length used is specified on the S/390 system. On the S/390, RU send and receive lengths are specified in the log mode table through the MODEENT statement used for one or more LUs. Some VTAM applications such as CICS may override the VTAM MODEENT value. For example, the CICS Terminal Control Table (DFHTCT) entry for each LU can specify both send and receive RU values (RUSIZE and BUFFER).

Dependent LU support includes the AS/400 system running Remote Job Entry (RJEF), 3270 Device Emulation, Distributed System Node Executive (DSNX), and Distributed Host Command Facility (DHCF).

10.2 Important Related Performance Manager Files

The following performance indicators can be retrieved from other database files:

- Line utilization
- Communications jobs

10.2.1 Line Utilization

Each controller is attached to a line. The performance of the controller may be affected by the line to which it is attached. It is important not to overload the line to avoid a possible system performance bottleneck. You might read the appropriate line protocol chapter to determine what the utilization guideline is for a given line and what you can do to decrease the line utilization.

10.2.1.1 Using Performance Tools for Line Utilization

Read the appropriate line protocol chapter to determine how you can display the line utilization of a given line using performance tools.

10.2.1.2 Performance Monitor Database Fields

Information about the controller is contained in the file QAPMSNA. In this file, the attached line is identified by the following field:

SLINNM Name of the line description that is attached to the controller description

If *LOCAL is specified for the link type parameter on an APPC controller description, this field is blank.

To relate the controller to the attached line description, you need one of the following files, depending on the line protocol used:

QAPMECL Contains token-ring statistics. The field ELLND must match the field SLINNM.

QAPMETH Contains Ethernet statistics. The field that must match SLINNM is the field ETLLND.

QAPMHDLC Contains SDLC/HDLC statistics. The field SHLND must match the field SLINNM.

QAPMX25 Contains X25 statistics. The field XLLND must match the field SLINNM.

You can use the sample query (SNA_ALL or SNA_LIN) to show the values. The sample query is listed in Appendix E, “SNA Queries” on page 311. Refer also to the appropriate line protocol chapter to determine where you can find the line utilization.

10.2.1.3 Recommendations

In general, line utilization contributors are:

- Line speed
- Protocol overhead
- Error recovery
- Data sent and received

For the first three contributors, refer to the appropriate line protocol chapter on how you can decrease line utilization.

When you use APPC, the amount of data sent and received can be decreased using data compression. Data compression can be specified using the DTACPR network attribute. This value may be overridden by its corresponding parameter in a mode description. Data compression at the session level reduces the amount of data sent across a communications line. It can increase the throughput on slower lines. However, data compression also uses processing unit cycles. It can actually reduce throughput on fast lines, which can send the data faster than the processing unit can compress it. Data compression varies in its effectiveness depending on the content of the data. For example, data compression is more effective on text than on binary data. You can use APPC data compression between any two systems that support APPC and data compression, including APPC over TCP/IP configurations.

10.2.2 Communications Jobs

For a good understanding of the SNA performance, it is good to know which jobs are related to SNA and which resources they use. Communications jobs that are related to SNA are:

- T2 station IOM tasks
- Line IOM tasks
- The logical unit services

The T2 station IOM task provides services for the controller description. Each APPC and host controller has a unique T2 station I/O manager task. The task name is assigned when the controller goes into the VARIED ON or ACTIVE state. Hence, if a controller is varied off and later varied on, the station IOM task is different. The task name is of the form T2-xxxxxxx, where *xxxxxxx* are the first seven characters of the name of the controller description.

The line IOM tasks provides services for the line description. The task name is of the form xxxx-yyyyy, where *xxxx* is the line protocol (length varies), followed by *yyyyy*, that is, as many characters of the name of the line description that the whole character string fits into the 10-character field JBNAME in the database file QAPMJOBS. Also, the first character of the task type extender JBTTYE contains a character that is related to the communication protocol. Here are a few examples of protocols and task type extenders:

- LWS-yyyyyy (A) - Local workstation I/O manager
- ETH-yyyyyy (D) - Ethernet
- X25-yyyyyy (G) - X.25
- ISDN-yyyyy (J) - ISDN (D-channel)
- IDLC-yyyyy (L) - IDLC (ISDN B-channel)
- TRN-yyyyyy (3) - Token-ring
- SDLC-yyyyy (7) - SLDC

The logical unit services, identified by the job name QLUS, supports communications devices. QLUS handles the event handling for logical unit devices (communications devices) and also acts as the manager of communications devices.

10.2.2.1 Using Performance Tools

Job information can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1).

10.2.2.2 Performance Monitor Database Fields

To relate the controller to communications jobs, you need two files:

QAPMSNA Contains performance data about SNA

QAPMJOBS Contains performance data about jobs and tasks

In the file QAPMJOBS, the jobs and tasks are identified by the field:

JBNAME Name of the job/workstation

To relate the controller to the T2 station IOM task, the following field in the QAPMSNA file must match the value of the field JBNAME:

STSKNM T2 station I/O manager task name

To relate the controller to the line IOM task, the following field in the QAPMSNA file must match the value of the field JBNAME:

SLIOMT Line I/O manager task name

Because the JBNAME field in tha QAPMJOBS database file contains only the first few characters of the line/controller description name (as described in Section 10.2.2, "Communications Jobs" on page 172), and the fields STSKNM and SLIOMT in the database file QAPMSNA contain the first six characters of the T2 and line IOM task names, respectively, it is not always possible to find an exact match.

The QAPMJOBS file contains a record for the QLUS job. The JBNAME field for this record has the value QLUS.

10.2.2.3 Recommendations

You generally do not see significant CPU consumed by the station and line I/O tasks. The CPU used by the T2 task generally varies according to the number (not the size) of RUs processed.

It is possible that QLUS uses significant CPU resource. CPU utilization can be 2-10% if a large number of APPC device descriptions are varied on during the same short period of time. If QLUS CPU utilization is greater than 10% for some performance monitor interval or multiple time intervals, there is usually an APPC application design problem. One known cause is the short time span ending and starting hundreds of APPC conversations that includes the APPC verb equivalent to the Change Session Maximum command function. This high CPU usage may occur when a user-written APPC program uses the ″Change Number of Sessions″ function (CNOS).

10.3 SNA Traces

Sometimes communications performance problem determination tasks are easier if you can see the data that is sent and received using a trace. For SNA, you can use the following traces:

- Communications trace
- CPI communications trace
- ICF communications trace

The AS/400 system communications trace can be used to verify the amount of data going over a line, the time it takes for a response to be returned, and to check for abnormalities. Interpreting communications traces requires detailed knowledge of the line protocols being used. How you start and stop a communications trace is described in Chapter 5, "Using System Service Tools" on page 71. After you have taken a communications trace, you should print the trace. You probably want to view the listing from your terminal first so you can search for certain byte strings and let the system do the work for you. It is advised to print the trace data twice, one with the default option ″Format SNA data only = N″ and one with the option ″Format SNA data only = Y″. You need both because the default option (Format SNA data only = N) includes a timer, but the formatted SNA data is easier to read and understand. The timer is handy when trying to determine how long your system had to wait for a response from another system. For information about the data stream layout, refer to *Systems Network Architecture Formats*, GA27-3136.

A CPI or ICF communications trace may be useful if you have a performance problem with a specific CPI-C or ICF program. You can use the Trace Common Programming Interface (CPI) Communications (TRCCPIC) command to capture information about CPI-Communications calls that are being processed by your program. The trace information can be collected in a current job or in a job being serviced by a Start Service Job (STRSRVJOB) command.

You can use the Trace Intersystem Communications Function (TRCICF) command to trace communications information concerning the intersystem communications function (ICF) operations and functions that are used by a user program. The trace information can be collected in the current job or in the job being serviced by a Start Service Job (STRSRVJOB) command. The TRCICF command is similar to the TRCCPIC command. Detailed information concerning the TRCICF command and the output it creates is found in the *ICF Programming*, SC41-3442.

Chapter 11. TCP/IP Performance Investigation

TCP/IP is the protocol suite consisting of applications and transport layers. From a performance point of view, you may have to look at a broader range of the protocols. However, we are focusing on the transport layers in this document.

11.1 Performance Expectation

What do you expect when you use TCP/IP?

- A comparison to other systems such as OEM systems and other IBM platforms.
- A comparison to the documented values in the communications chapters of the *AS/400 Performance Capabilities Reference for PowerPC Technology*, ZC41-0607.

If you do not get similar performances compared to the values mentioned here, you may want to investigate your TCP/IP performance.

11.2 TCP/IP Overview

This section discusses performance related TCP/IP topics to give you a better understanding of performance implications. For complete TCP/IP information for the AS/400 system, please refer to the *TCP/IP Configuration and Reference*.

11.2.1 Data Format

The same as many other protocols, TCP/IP protocol suite uses several headers to describe the contents of a datagram. Apart from application-unique headers, major headers of TCP/IP are the IP header, UDP header, and TCP header.

The headers are added or removed as data goes through the corresponding protocol.

Let′s take a look at an example:

The following figure shows an example of this header encapsulation using FTP as the application and X.25 as the communication link. One thing we should mention is that FTP uses TCP for the transport layer.

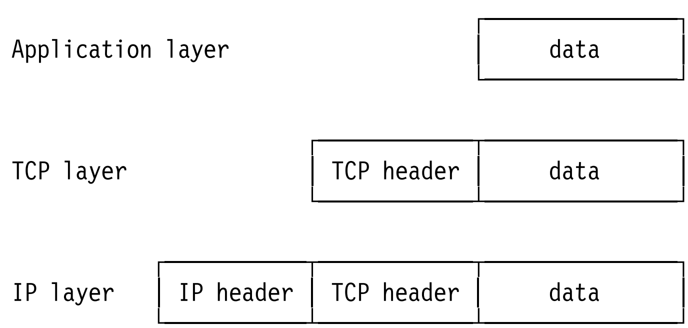

Figure 62. Encapsulation with Headers

When an application program (FTP is one of the examples) puts its data in the next layer of the protocol suites, the next layer (TCP) adds the TCP header. Usually the TCP header is 20 bytes in length. Then TCP puts the entire data in the next layer, IP. IP also adds its own IP header and sends it out to the communication link. The communication link may be a LAN or X.25. X.25, of course, adds its own X.25 header.

In our example, let′s assume that the packet size is 256 bytes and FTP sends 600 bytes data. The data including the headers is divided into multiple 256-byte packets to fit in the packet size. Each packet looks similar to the following diagram:

```
IP datagram    | IP header | TCP header |   data(600) |
               |   (20)    |   (20)     |             |

packet (1)   | packet header | IP header | TCP header |   data  |
             |               |   (20)    |   (20)     |  (216)  |

packet (2)   | packet header |    data(256)                     |

packet (3)   | packet header |    data(128)     |
```

Figure 63. Format of IP Datagram and Link

For more detail about the header formats, please refer to the manual, *TCP/IP Tutorial and Technical Overview*, GG24-3376.

Each packet is called an MTU (Maximum Transmission Unit) in TCP/IP terms. So the longer the packet size (MTU) is, the more efficient the throughput is. The AS/400 system determines its MTU size based on the buffer length parameter in the TCP/IP configuration. This is true for UDP also. For FTP, which uses TCP, the fixed length of 8192 bytes is used.

11.2.2 Flow Control

Since most applications use TCP rather than UDP, we can focus on TCP in this document for performance considerations.

To ensure a reliable data transmission, TCP uses a ″window″ to control the data flow. The ″window″ is the data length that a sender can send data through before receiving a confirmation from the receiving host.

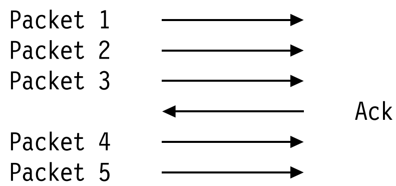

Figure 64. Windowing Technique

The figure shows how two host systems exchange data using the "window" technique. As you may notice, the longer the window size is, the better throughput you get. But the disadvantage of having a longer window size is that you may have poor throughput on a poor quality link. Because the window size is the unit of error recovery, once communication errors occur, you have to retransmit an entire window length.

11.2.3 Version 3 Performance Improvements

In addition to the major restructuring of TCP/IP for the AS/400 system, you can get better performance when you use the newer IOPs. From V3R1, some TCP/IP functions are put down below in IOPs, so that less overhead is needed. This is called a TCP/IP-assist function. Some TCP/IP-assist functions are:

- Checksum calculation
- Fragmentation and re-assembly of datagram
- Address resolution for ARP

These IOPs are #2617, #2619, #2618, #2665, #2666 (frame relay only), and #2668. As you may notice, these are all LAN-type shared media, which means when you use X.25 for TCP/IP, you cannot get better performance.

11.3 Performance Tool/400 Databases

Performance Tool/400 does not give you TCP/IP protocol-specific data, unlike SNA. SNA has its database files in the Performance Tool, but TCP/IP does not. Therefore, more details for TCP/IP are not available but you can use QAPMSAP and QAPMJOBS files for information about the TCP/IP.

11.3.1 QAPMSAP

The performance tool database QAPMSAP collects UI frame data and TCP/IP uses the UI frames. This data, however, as the DB file name implies, is only for LAN links. You cannot relate the numbers in the database fields to a specific TCP/IP application, or a port number from this database. So, if you have the LAN connection for TCP/IP and other protocols such as SNA, you can measure how much TCP/IP contributes to the line or IOP utilization by comparing the number of UI frames to other non-UI frames, which are collected in the file QAPMECL or QAPMETH on the same line.

The database fields in QAPMSAP are:

SCSSAP SAP address. TCP/IP uses the address AA.

SCLND Line description name

SCIRCV Total number of UI frames received at this SAP

SCIXMT Total number of UI frames transmitted through this SAP

SCBRCV Total number of bytes received at this SAP contained in UI frames

SCBXMT Total number of bytes transmitted through this SAP contained in UI frames

Please note that those UI bytes do not necessarily represent data bytes that your applications send or receive. There may be a chance to route IP data to other TCP/IP hosts and those data bytes are counted in the fields.

11.3.2 QAPMJOBS

QAPMJOBS collects performance data for each job. There are TCP/IP related fields in this database.

JBSKSC Number of sockets sent

JBSKRC Number of sockets received

JBSKBS Number of socket bytes sent

JBSKBR Number of socket bytes received

Those fields are related to a specific application using a socket interface so that you may be able to tell which application contributes to the resource utilization. But for those that do not use the socket interface such as TELNET or PASCAL APIs, these fields do not tell anything. If this is the case, you can collect the values in the fields of QAPMSAP.

11.4 Bottlenecks

Even though the Performance Tool/400 does not collect TCP/IP specific data, you can still use the Performance Tool to figure out if the bottleneck is with the line or IOP. Please refer to Chapter 6, “Communications I/O Processor (IOP)” on page 89 for IOP, Chapter 7, “Local Area Network Performance Analysis” on page 97 for LAN, and Chapter 8, “X.25” on page 127 for X.25 to find the utilizations.

These chapters at least give some idea which area you have to investigate in more detail.

11.5 Tools We Can Use for TCP/IP

Since Performance Tool/400 does not collect performance data for TCP/IP, we have to look at other areas.

- Error log

  Error log entries show which kind of errors have occurred in which lines to give you a rough idea about how many error recovery activities have taken place. But there is no absolute number to determine how many is too many.

  Entries with error log reference code ′7004′ means AS/400 TCP/IP discarded IP datagrams because of protocol errors such as checksum error and invalid destination address. The entries have IP, TCP, or UDP headers, so you can determine where they are sent and which port was used.

You need to specify ″Log protocol errors=*YES″ in the TCP/IP attribute to enable this error logging capability. But be aware that this causes a significant load on the IOP and CPU.

- Communication trace

  The communication trace gives you detailed activities on a line. You can find information regarding the contents of transmitted data, TCP/IP headers, and hand shaking activities. But the number of trace entries is quite large so use this tool only when you can identify which part of the trace entries may have useful information.

- Network Status

  AS/400 TCP/IP gives information about the status of TCP/IP routes, links, and connections on your local AS/400 system. The connection status function of the network status can be used to measure how many bytes are sent or received. Because those numbers are accumulated since TCP/IP was started or each TCP/IP application was started, it is not easy to correlate those numbers to the performance database′s numbers. That is, the performance data is collected in a sampling interval, but the network status data is collected from the time when TCP/IP or applications were started to the time when the network status command (NETSTAT CL command) is issued.

Chapter 12. Analyzing APPN Communications Performance

The AS/400 system provides a rich offering of network function with APPN. However, you should be aware of the APPN considerations that may affect the performance of your system and of your network. In this chapter, we examine the impact that intermediate session traffic has on your network nodes in order to understand the impact of configuration changes and network growth.

We look at the significant fields in the OS/400 Performance Monitor database that relate to APPN activity.

If you are experiencing poor response times or throughput, it is not necessarily due to APPN overhead and so you should conduct your normal performance analysis first and then focus on the issues discussed in this chapter once you determine for certain that the bottleneck is caused by APPN.

12.1 Advanced Peer-to-Peer Networking (APPN) Performance

When a node enters an APPN network, there are a number of things it must do to get started, particularly if it is a network node. First, it must establish control point sessions with its adjacent nodes to allow it to participate in the exchange of network control information.

Second, it must have its topology database updated to reflect the current state of the network. With the AS/400 system, it only receives an update of the changes that have occurred on the network since it was last present. If the network is unstable with many changes taking place, this results in a lot of data transfer and may take some time to complete. CPU and disk utilization may be significantly higher during this initial period. However, in a stable network, this process should not take long.

Third, any attached end nodes register their LU names with the network node server. The network node stores the LU names in a directory that is used to reply to search requests for those LU names from other network nodes.

The OS/400 Performance Monitor collects statistics regarding APPN activity on the network and stores it in a database file called QAPMAPPN. This chapter explains some of the relevant fields found in that file.

The QAPMAPPN file does not contain any data regarding CPU utilization or disk unit accesses associated with the tasks that perform APPN functions. This information is found in the performance monitor file QAPMJOBS. Similarly, QAPMAPPN does not contain session traffic data. The file, QAPMSNA, provides this data for each active controller description on the system, giving a breakdown of intermediate routing and session endpoint traffic.

An important reference to be used in conjunction with this chapter is Chapter 9 - Transaction Boundaries, in the *AS/400 Performance Tools/400*, SC41-4340. This publication contains details about APPN work activities and is not repeated here. However, this chapter follows the same layout as the APPN section of Chapter 9 in the AS/400 Performance Tools/400 Guide to allow you to combine the information easily. That publication and this chapter are arranged in the order of the fields in the QAPMAPPN file.

Before examining that data, there are some higher-level indicators of APPN performance that should be considered. One of them is the CPU utilization of the various tasks involved in processing APPN traffic. By understanding how much CPU is being used by the various tasks, you can focus on the high usage tasks and the fields in the QAPMAPPN file that explain the activities for those particular tasks.

12.1.1 APPN System Tasks

The following main tasks perform work for APPN. It is helpful if you gather baseline data during a normal workload for your installation so you know when the utilization for these tasks is unusually high.

QLUS System Logical Unit Services:

The functions performed by QLUS include:

- General management of APPC communications devices
- Initial processing of received start requests and routing to the appropriate subsystem monitor
- LU6.2 session management at vary on, vary off, for the Change Session Maximum (CHGSSNMAX) command function and for ending an APPC conversation

TRS Topology Routing Services:

This task is responsible for route selection, selecting a transmission group (controller description), and transmission priority based on the class of service definition. It is also responsible for maintaining the topology database on the local system.

CPPS Control Point Presentation Services:

This task handles all of the data transfer that occurs on the control point-to-control point (CP-CP) sessions for the various APPN transaction programs such as:

- Control point capabilities
- Topology database updates
- Directory services for search processing
- Registration/deletion

CPMGR Control Point Manager

DS Directory Services:

Sends asynchronous search requests and responses to other nodes on the network.

MSCP Machine Services Control Point

LOCMGR Location Manager

T2 Station I/O Manager
There is a T2 station I/O manager task for each active controller description with a name of the form T2-xxxxxxxxxx, where xxxxxxxxxxxx represents the name of the controller description.

The following approach may be used to analyze a possible APPN performance problem on your network:

1. First examine the overall system, disk, and communications performance using the Performance Monitor, Performance Tools, and Performance

Advisor (if you have them installed on your system). Look for performance bottlenecks such as high line, CPU, or disk utilization. It is most useful to have baseline data from a normal workload interval for comparison.

2. Determine how much of the system CPU is being used for the APPN tasks by using the queries in Appendix D, "Queries for APPN Tasks" on page 293. In general, the percentage of CPU used for these tasks should be low if the network is stable.

3. If you find unusually high CPU utilization for any of the various APPN tasks compared to baseline performance measurements, examine the specific fields in the QAPMAPPA database file described in the following section to help you understand the type of work being done.

   Pay particular attention to the CPU utilization for the CPPS task as this is responsible for handling all of the data on the CP-CP sessions and gives a good indication of the general overhead associated with the APPN functions.

4. Follow the recommendations provided for each APPN task to reduce the CPU utilization.

12.1.2 QLUS Task

This system job started by QSYSARB is responsible for, among other things, startup and termination of APPN sessions and CNOS task.

12.1.2.1 QLUS Task Recommendations

If the CPU utilization for QLUS is unusually high compared to baseline data that you have collected, you can decrease it by following these suggestions:

- It is not unusual to see a QLUS CPU utilization of 2-10% if a large number of APPC devices are varied on during the performance monitor measurement interval. If hundreds of APPC devices are varied on or Change Session Maximum (CHGSSNMAX) commands are issued over a short period of time, the utilization may be as high as 10-25%.

- If QLUS CPU utilization is consistently greater than 10% for several monitor intervals, you should look for an APPC application design problem such as remote systems repetitively issuing the API equivalent of CHGSSNMAX. For more information, refer to Section 10.6, APPC Programming Tips and Techniques in *AS/400 Performance Management Version 3 Release 6*, GG24-4735.

- The APPC controller description parameter NODETYPE should specify the correct node type for the remote system being described. If the remote system is an AS/400 system, you should use NETNODE or ENDNODE as the NODETYPE. Check the remote system node type by using the DSPNETA command on the remote system.

- If you do not really need APPN functions, you can change the controller description to APPN *NO. Consider this if the remote system does not need to access another system through this AS/400 system and through this controller description. Perhaps the remote system is a PC using Client Access/400 and only needs access to this AS/400 system. You can completely eliminate the use of APPN tasks by creating the controller with APPN *NO. If you do so, you need to manually create the device descriptions as auto-create does not work with APPN *NO.

- One option is to create the controller description with APPN *YES, but configure the NODETYPE as *LENNODE. This keeps the APPN control flow down to a minimum. Do this only if the remote system is a low-entry networking node (such as a PC without APPN support). Do not use *LENNODE to connect to another AS/400 node.

- When using SDLC, it is better to code one side of the session as primary and the other as secondary instead of letting it negotiate. Coding the parameter saves time at vary-on since negotiation does not need to be done. The line description and controller description parameter is called *data link role* (ROLE). The line description describes the local system and the controller description describes the remote system.
- QLUS is responsible for the creation and deletion of auto-created APPC device descriptions. System performance may be degraded if the number and frequency of these creations and deletions is excessive. Therefore, it may be better to increase the number of minutes specified for the *Auto-delete Device* parameter on the controller description or not delete them at all.

12.1.3 Topology Maintenance

Advanced Peer-to-Peer Networking (APPN) maintains a topology database on each AS/400 network node and end node. The topology database keeps information about links and nodes in the network. This is based on local network attributes and the status of controllers to adjacent systems, as well as on information received about network nodes and the links to other network nodes through topology database updates (TDUs). TDUs are transmitted between nodes through control point (CP) sessions.

A *transmission group* (TG) update occurs when a local controller′s status changes from *inactive* to *active*, or *active* to *inactive*. If the transmission group defines a connection between two network nodes, the local system issues a TDU. A single TDU may contain multiple TG updates blocked together. TDUs are distributed to every network node in the network using control point sessions.

If a change occurs in the network, for example, a link fails, the topology information is updated using TDUs. The task that performs this update is the Topology and Routing Services Task (TRS). The TRS task also handles the route selection in an APPN network based on the *class-of-service* (COS) selected by the user.

The CPU utilization for the TRS task should be fairly consistent. However, topology maintenance can account for high CPU utilization and disk I/O in complex or unstable networks. By unstable, we mean there are frequent activations and deactivations of transmission groups, or frequent line or system failures.

APPN network node support provides powerful routing facilities. However, network nodes may exhibit significant disk I/O in complex networks comprising of many nodes. The primary reason for this is that the TRS task may receive a large number of transmission group (TG) updates to process when end nodes are connecting and disconnecting. For each TG update, TRS has to perform eight to 10 operations to its internal topology index. Some of the overhead can be reduced by grouping nodes into smaller sub-networks with different network names, having fewer network nodes, and specifying APPN CP-CP Session Support = *No on end node controller descriptions.

12.1.3.1 Transmission Group Update

The following fields in the QAPMAPPN file refer to Transmission Group updates and are of interest when looking at TRS and CPPS activity. You can run queries over the file QAPMAPPN to examine the fields of interest.

INTNUM Interval number since the start of the performance monitor

DTETIM Interval date (yy/mm/dd) and time (hh:mm:ss)

INTSEC Elapsed interval time since the last sample interval.

(These three fields apply to all of the data fields in QAPMAPPN.)

ANTGU Total number of transmission group updates processed by this node during this monitor interval

ATTGU Cumulative time (msec) to process the TG updates

ANTGUM Number of TG updates resulting in one or more updates to the TDU buffer (network nodes only)

ANRATG Number of resources added to TDU buffer due to TG updates (network nodes only)

ANTSTG Number of TDUs sent as a result of buffering TG updates

ANNTTG Number of network nodes that had TDUs sent to them to inform them of the TG updates

If this number appears to be high, you may have a configuration problem that is causing updates to be sent to more nodes than is necessary. You may have configured nodes as network nodes when they could have been configured as end nodes.

12.1.3.2 Node Congestion

An APPN node is considered to be congested if 90% of the allowed intermediate sessions have been established. The status changes back to non-congested when this number drops down to 80% or less. A change in a node′s congestion status results in the issuing of a TDU by the local system. This is reflected in the amount of TRS and CPPS activity on the system. If you suspect a high TRS or CPPS utilization is resulting from congestion TDUs, examine the following fields in QAPMAPPN.

ANNCTC Total number of congestion transition changes in this interval

ATNCTC Cumulative time to process the congestion transition changes. This does not include the time it takes to send out the TDU.

ATRSNC Count of times TRS entered non-congested state

ATRSC Count of times TRS entered congested state

ATNCS Cumulative elapsed time (in msec) that the system has been in non-congested state

ATCS Cumulative elapsed time (in msec) that the system has been in congested state

ATSCP Number of TDUs sent as a result of node congestion transitions

ANTSCP How many network nodes were informed of the congestion state changes. This can be an indication of the network traffic created by these updates.

12.1.3.3 Topology Database Update Processing

Topology Database Updates (TDUs) affect the TRS and CPPS activity on network nodes only. TDUs are transmitted from network node to network node and may potentially be forwarded to all attached network nodes with which CP-CP sessions are established.

If TDUs are received too frequently, system performance may be degraded. If one particular network node is always receiving more TDUs than the others, a configuration problem may exist. This is evident from the field ANTRFN described in the following section. A distinction is made in the QAPMAPPN file records between updates made to the TDU buffer as a result of changes to old and new resources.

ANTDUP Number of TDUs received by this node:

If this number increases dramatically, there may be a failure in the network causing topology updates.

ANNRTD Number of new resources received in TDUs that cause addition to TDU buffer for forwarding

ANORTN Number of old resources received in TDUs that *do not* cause addition to the TDU buffer for forwarding

ANORTA Number of old resources received in TDUs that *do* cause addition to TDU buffer

ANTSRT Number of TDUs sent as a result of creating a TDU buffer from incoming TDUs

ANNTST Number of network nodes that had TDUs sent to them as a result of creating a TDU buffer from incoming TDUs

ACNTID Network ID of the node for which the most TDUs were received within the performance monitor interval

ACCPNM Control point name of the node for which the most TDUs were received within the performance monitor interval

ANTRFN Number of TDUs received by the node for which the most TDUs were received in the interval:

The two fields, ACNTID and ACCPNM, can be used to track the node most affected by the TDU updates. When many TDUs are received and the same node is always listed, this can indicate a configuration problem where a listed node has updates sent continuously.

12.1.3.4 Initial Topology Exchange Indications

An initial topology exchange is an examination of the resources in the intermediate routing portion of the topology database that occurs when control point sessions are established between two network nodes. TDUs are sent between these nodes to reflect any changes that have occurred with resources or any new information that has been received in TDUs.

The following fields reflect this initial topology exchange during CP-CP session establishment that affects TRS and CPPS activity on network nodes only.

ANITEP Total number of initial topology exchanges processed by this node due to a new CP-CP session establishment with another network node.

This is an indication of the work being done when the controller descriptions are varied on between network nodes with control point sessions.

ATPIE Cumulative time for processing the initial topology exchange TDUs

ANTECT Number of times the entire network node topology was transmitted during initial topology exchange due to it being the first exchange since a system IPL or a refresh of the topology database

ANTDE Total number of entries in the entire topology database:

This can be used to indicate the rate of growth of the network.

ANTERS Number of resources (nodes and TGs) added to the TDU buffer as a result of the initial topology exchange

ANTETS Number of TDUs sent as a result of initial topology exchange

12.1.3.5 Obsolete Topology Entry Removal

Every 24 hours, the topology database is examined and any entries that have not been updated in the last 15 days are deleted. Network nodes send a TDU every five days to prevent other nodes from deleting them from their database.

The following fields relate to Obsolete Topology Removal activity that affects TRS and CPPS activity:

ANGCP Number of times obsolete topology entries were removed from database

ATGCP Cumulative time to delete obsolete topology entries

ANTEDG Number of topology entries deleted due to cleanup:

These fields indicate the workload arising from the necessary cleanup of the local nodes topology database. You are able to see if the cleanup is working efficiently and how much overhead it creates.

12.1.3.6 Displaying APPN Information

Each time the DSPAPPNINF command is run to display APPN information with `INFTYPE = *TOPOLOGY`, the entire APPN topology database is examined. This can result in significant disk I/O for large networks.

The number of times this information is displayed is recorded in the following QAPMAPPN field:

ANDAII Number of times APPN information was displayed by using the DSPAPPINF command in the monitored time interval

12.1.3.7 Topology Maintenance Recommendations

If you see a high percentage of CPU being used for TRS, look for error messages indicating that a line is failing. This may be on your system or on another system in the network. Also verify that your lines are not being varied off and on needlessly. Any changes to the status of links in the network cause updates to the topology database.

12.1.4 Directory Services Registrations and Deletions

Each APPN end node makes registration and deletion requests to their network node server reflecting changes in their local location names. These requests may result from a configuration change or the activation or deactivation of a control point session.

The fields defined in the following list that are found in the QAPMAPPN file give a good indication of the amount of activity associated with these registrations and deletions per monitored time interval. In general, these requests do not adversely affect the performance of the network nodes as they are not forwarded on to every network node in the network.

ANRRP Total number of registration requests processed

ANNLRR Total number of locations registered; multiple locations may be registered by a single request.

ATPRR Cumulative time spent processing registrations

ANDRP Total number of deletion requests processed

ANLDDR Total number of locations deleted; multiple locations may be deleted by a single request.

ATPDR Cumulative time spent processing deletions

The APPN tasks involved with these registrations and deletions are DS and CPPS. We shall now examine in more detail the fields in QAPMAPPN that indicate the specific activity involved in performing these updates due to configuration changes and control point session activation.

12.1.5 Configuration Changes

Configuration changes affect the CPU utilization of APPN tasks. If you find high CPU utilization for the following tasks, examine the associated fields for unusually high activity.

12.1.5.1 Change Network Attributes

All of the APPN tasks are involved in processing a Change Network Attributes (CHGNETA) command. TRS sends out a TDU if the local node is a network node and the Route Addition Resistance (RAR) is changed.

If the local node type, local network ID, or local control point name is changed, the APPN directory and topology databases may be deleted. This may cause significant CPU utilization when the databases are rebuilt.

The tasks involved are: MSCP, TRS, DS, LOCMGR, CPMGR, and CPPS.

The following QAPMAPPN fields are useful in analyzing this activity:

ANCNAP Total number of CHGNETA requests processed

ATCNA Cumulative time to process CHGNETA requests

ANDDRC Number of times the directory database was deleted and re-created due to CHGNETA requests

ANTDRC Number of times the topology database was deleted and re-created due to CHGNETA requests

ANLRSC Number of location registrations sent due to CHGNETA requests

ANLDSC Number of location deletions sent due to CHGNETA requests

ANCART Number of times a node entry resource was added to a TDU buffer as a result of CHGNETA requests

ANTSTC Number of TDUs sent as a result of CHGNETA requests

ANNTSC Number of network nodes that received TDUs as a result of CHGNETA requests

12.1.5.2 APPN Local Location List Updates

These updates cause an addition or deletion to the APPN directory database. If the local system is an end node with a CP-CP session to a network node server, the update also initiates a registration or deletion request to the node server.

The APPN tasks involved in this activity are: LOCMGR, DS, CPPS, and CPMGR.

The following QAPMAPPN fields are useful in analyzing this activity:

ANLLUP Total number of local location list updates processed

ATLLUP Cumulative time to process the local location list updates

ANLRSL Number of location registration requests resulting from local location list updates

ANLDLL Number of location deletion requests resulting from local location list updates

12.1.5.3 APPN Remote Location List Updates

These cause a remote location to be added or deleted from the APPN directory database.

The APPN tasks involved in this activity are: LOCMGR and DS.

The following QAPMAPPN fields are useful in analyzing this activity:

ANRLUP Total number of remote location list updates processed

ATRLUP Cumulative time to process the remote location list updates

12.1.5.4 Mode Updates

These cause the control point manager (CPMGR) task to update its mode tables to reflect the addition, deletion, or update of a mode description.

The APPN task involved in this activity is CPMGR.

The following QAPMAPPN fields are useful in analyzing this activity:

ANMDUP Total number of mode description updates processed

ATMDUP Cumulative time to process the mode description updates

12.1.5.5 Class-of-Service (COS) Updates

These cause the control point manager (CPMGR) and topology routing services (TRS) tasks to update their class-of-service tables to reflect the addition, deletion, or update of a COS description.

The APPN tasks involved in this activity are: CPMGR and TRS.

The following QAPMAPPN fields are useful in analyzing this activity:

ANCSUP Total number of COS updates processed

ATCSUT Cumulative time to process the COS updates by the TRS task

ATCSUC Cumulative time to process the COS updates by the CPMGR task

12.1.6 Control Point Session Activation and Deactivation

Control point (CP) sessions are special APPN sessions used to transfer information between nodes in an APPN network. It takes some amount of CPU to set up and end a CP session.

Contention winner (locally controlled) CP-CP sessions are primarily used for sending data such as TDUs and directory searches. Contention loser (remotely controlled) CP-CP sessions are primarily used to receive control point data from other systems. If you see a high CPU percentage being used by the CPMGR or CPPS tasks, you can use the following fields in the QAPMAPPN file to determine if session activation and deactivation is excessive. The performance measurements also contain counts of the number of currently active CP-CP sessions that can help explain changes in resource utilization over different time intervals. Do not have more control point sessions than you need for connectivity and backup as every CP session between network nodes increases the amount of work performed by the CPMGR and CPPS tasks. For more information about the steps involved with session activation, see ″Session Setup Work Activity Details″ on page 9-14 of *AS/400 Performance Tools/400 Guide*, SC41-8084.

The APPN tasks involved in this activity are: CPMGR and CPPS.

The following QAPMAPPN fields are useful in analyzing this activity:

ANCSSA Number of contention winner CP-CP session setups attempted

ANCSSS Number of contention winner CP-CP session setups successful requests

ANLSAP Number of contention loser CP session activations processed

ATCCSA Cumulative time spent processing contention winner CP session activation

ANCST Number of contention winner CP-CP session ended

ATCST Cumulative time spent processing contention winner CP-CP session deactivation

ANLST Number of contention loser CP-CP session ended

ATLST Cumulative time for processing contention loser CP-CP session ended

ANCWSA Number of contention winner CP-CP sessions currently active

ANCLSA Number of contention loser CP-CP sessions currently active

12.1.7 Control Point Presentation Services (CPPS)

All of the data transfer occurring on the CP-CP sessions for the various APPN tasks is handled by the CPPS task. The QAPMAPPN fields discussed in this section give a good indication of the type of activities that the CPPS task is involved with. While this activity is absolutely essential in an APPN network, it may be an excessive CPU overhead if your network is not optimally configured. The performance measurements for CPPS should be one of the first things you check when investigating an APPN problem.

The query called APPNALL in Appendix D, “Queries for APPN Tasks” on page 293 shows you if you have a high CPU percentage for CPPS. You should run APPNJOINx queries before using the APPNALL query.

The performance data is grouped according to the following APPN transaction programs:

- Control Point (CP) Capabilities
- Topology Database Update
- Directory Services for Search Processing
- Registration and Deletion

12.1.7.1 Control Point (CP) Capabilities

This is used to send and receive CP capabilities to adjacent systems immediately after activating CP sessions. In general, this activity has only a slight affect on performance.

The following fields in file QAPMAPPN can be useful:

ANCDRR Number of data-received requests processed

ANCBDR Number of bytes of data received

ATCDRR Cumulative time spent processing the data-received requests

ANCSDR Number of send-data requests processed

ANCBDS Number of bytes of data sent

ATCSDR Cumulative time spent processing send-data requests

12.1.7.2 Topology Database Update

This is used to send TDUs on contention winner CP sessions and receive TDUs on contention loser CP sessions. TDUs can significantly affect performance for network nodes. If the CPPS measurements are higher than for other time intervals, check the topology maintenance data to determine the cause.

The following fields in file QAPMAPPN can be useful:

ANTDRR Number of data-received requests processed

ANTBDR Number of bytes of data received

ATTDRR Cumulative time spent processing the data-received requests

ANTSDR Number of send-data requests processed

ANTBDS Number of bytes of data sent

ATTSDR Cumulative time spent processing send-data requests

12.1.7.3 Directory Services for Search Processing

The Directory Services (DS) task sends and receives asynchronous search requests to other nodes on the network. This may have a significant effect on network node performance, but generally little effect on end nodes. If the CPPS measurements are unusually high, check the session setup performance measurements to determine the cause.

The following fields in file QAPMAPPN can be useful:

ANDDRR Number of data-received requests processed

ANDBDR Number of bytes of data received

ATDDRR Cumulative time spent processing the data-received requests

ANDSDR Number of send-data requests processed

ANDBDS Number of bytes of data sent

ATDSDR Cumulative time spent processing send-data requests

12.1.7.4 Registration and Deletion

This is used to send location registration and deletion requests from an end node to a network node server. In general, these requests should not significantly affect performance on either node. If the CPU utilization for CPPS or DS is unusually high as a result of registration and deletion requests, check the directory services registration and deletion requests measurements.

The following fields in file QAPMAPPN can be useful:

ANRDRR Number of data-received requests processed

ANRBDR Number of bytes of data received

ATRDRR Cumulative time spent processing the data-received requests

ANRSDR Number of send-data requests processed

ANRBDS Number of bytes of data sent

ATRSDR Cumulative time spent processing send-data requests

12.1.7.5 CPPS Recommendations

Check that there are one or two control point (CP) sessions between a network node and the network, but do not have more control point sessions than you need to provide connectivity and backup. Every control point session activated (controller description parameter CPSSN *YES configured) between network nodes increases the work of the CPPS task since it must update all of the network nodes to which there are CP sessions with any changes in the links or nodes in the network. You must have at least one CP session from a network node into the network, and you may want two for backup purposes. Do not, however, default all controller descriptions to CPSSN *YES without some thought to the mesh topology you are creating.

12.1.8 Session Setup Activities

Session setup activity, as with other APPN activities, varies with node type. Network nodes have to perform many more session setup functions than end nodes. The APPN tasks involved in session setup are primarily the following tasks:

- Location Manager
- T2 Station I/O Manager
- Directory Services
- Control Point Manager
- Topology Routing Services
- MSCP (for switched line)

These session setup tasks perform the following functions:

- Determine if an existing session may be used.
- Search the directory to find the system that owns the destination location.

- Determine the optimal route based on class-of-service.
- Activate switched links if needed.
- Select or create a new device.
- For remotely started sessions, receive binds for session setup requests.

Because the activities performed and resources used by the APPN control point tasks for session setup vary between network nodes and end nodes, the performance measurements in the QAPMAPPN file are divided into different work activities.

The following work activities are described together with a definition of when an activity yields a successful result.

1. Local system initiated sessions:

   Sessions started on the local system, including explicit session initiation requests by a user as well as internal session initiation requests.

   Success is when one or more device descriptions are returned to the operating system.

2. Receiver of search requests as an end node:

   The local system (an end node) receives a search request from its network node server.

   Success is when DS returns a positive response to the search request.

3. Network node performing search requests on behalf of an end node:

   The local node (a network node) has received a search request from a served end node that is initiating a session. The local system is responsible for searching for the target system and calculating a route to the destination control point.

   Success is when DS returns a positive response to the search request and routing information is supplied to the end node.

4. Intermediate node on a directed search request:

   The local system (a network node) has received a directed search request from another network node. The only functions that need to be performed in this case are forwarding the search request to the next hop of the route, and also forwarding the search response to the system that had sent the search to the local system.

   Success is when DS forwards the directed search on to the next hop, receives a positive response, and successfully returns the search response to the originating node.

5. Destination network node on a directed search:

   The local system (a network node) has received a directed search request from another network node. In this case, the local system is the target of the directed search because the location being searched for had at one time resided on the local system or an end node that was being served by the local system.

   Success is when DS returns a positive response to the search request.

6. Broadcast search received:

   Broadcast searches are processed only by network nodes. When the local system receives a broadcast search, it sends the search to all of the adjacent network nodes and determines if the location being searched for resides on the local system or on a served end node. Broadcast searches are the most costly search type from a performance point of view because of the number of nodes involved.

Success is when DS returns a positive response to the search request.

7. Network node processing a received search from a node in a different network (different net ID):

   This work activity tracks the number of searches processed that are started by systems in a different APPN network. Only the systems on the boundaries of the network maintain these measurements.

   Success is when DS returns a positive response to the search request.

8. Network node processing a received BIND from a node in the local network without routing information:

   The local system (a network node) is responsible for determining the control point that the target system resides on, calculating a route to the destination control point, and forwarding the BIND on to the next hop of the route.

   Success is when a positive response is returned indicating that the next hop has been determined and is active.

9. Network node processing a received BIND from a node in a different network without routing information.

10. Network node processing a received BIND from a node in the local network with routing information.

11. Network node processing a received BIND from a node in a different network with routing information:

    The fields in the QAPMAPPN file starting with buffer position 672 (ANWAP1) through to the end of the file are all concerned with session setup. The fields are grouped according to the last hexadecimal character of the field names that equals the number of the work activity previously listed.

    For example, the fields ending in ″1″ are measuring *local system initiated session setup*, and the fields ending in ″B″, which equals 11 in hexadecimal, are measuring a *network node processing a received BIND from a node in a different network with routing information*.

    This breakdown of the session setup activity into work activities helps to differentiate between the work performed by an end node and that done by a network node. This is seen from the following groupings by work activity.

    - Locally Initiated Session Setup is reflected in the performance measurements for work activity 1.
    - End Node Session Setup is reflected in the performance measurements for work activity 2.
    - Network Node Session Setup is reflected in the measurements for the remaining work activities 3 to B.

For each of these work activities, the file QAPMAPPN maintains a count of the number of activities processed and the number of activities that yielded a successful result. There is also a field giving the cumulative elapsed time spent to complete these activities. These fields are defined as follows where the last character ″X″ of the field names corresponds to the activity number ″1-B″ previously listed.

ANWAPX (X=1-B) Total number of work activities of this type processed

ATWASX (X=1-B) Total number of work activities yielding a successful result

ATWAPX (X=1-B) Cumulative time to complete work activities of this type

ASPSPX (X=1,8,9,A,B) Number of session setup requests that were pended because another setup was in progress for the same remote location name, local location name, and mode.

If this number is high, you may want to use preestablished sessions. This causes session setup to take place when the mode is started.

ASFNS1 Number of searches that failed due to no network services being available for the local end node.

If this occurs, check the network attributes (DSPNETA) and verify that the local system (end node) has a network node server defined. Perhaps an alternate server should be considered. Up to five servers may be defined for an end node. These are used starting with the first one in the list.

Recommendation: Run the query called APPNJOINx in Appendix D, "Queries for APPN Tasks" on page 293 to find the percentage of successful session setup work activities performed by your network node.

```
% Successful = (ATWASX / ANWAPX) * 100
```

If this shows less than 100%, you can examine the other fields in the QAPMAPPN file for greater detail. Refer to Appendix A of *AS/400 Work Management Version 3*, SC41-3306, for a description of all other performance fields in QAPMAPPN.

12.2 APPN Transmission Priority

This section looks at the performance considerations for mixing interactive session and large transfer transmissions on a single communication line. This has traditionally been a cause of poor interactive response time during periods of concurrent large transfer activity. The large transfer is capable of consuming the entire line bandwidth, causing severe queueing delays for the interactive users.

Prior to OS/400 Version 2 Release 1, the strategy to improve interactive response time was to ″hold back″ the throughput of the APPC large transfers by reducing the RU sizes and pacing values. Unfortunately, this also had the effect of reducing the throughput of the large transfer traffic.

For Version 2 Release 1 and later, enhancements were made to the APPN transmission priority to allow users to ″hold back″ the large transfers without such a severe throughput penalty.

These ″hold back″ options are not the default and require the following configuration changes to be made.

1. The interactive users and large transfer data should use different mode and class-of-service (COS) descriptions.
2. The MAXLENRU parameter, which determines the maximum amount of SNA data that can be sent in a single Request/Response Unit (RU), can be

decreased from *CALC to 256 for the large transfer mode description (MODD). Keep the interactive MAXLENRU parameter at a high value.

This reduces the average wait time for the interactive users to use the line because the large transfer frames queued up ahead are smaller in size. Large transfer throughput is reduced.

3. The OUTPACING parameter, which determines how many RUs can be exchanged before a response is required from the receiving station, can be decreased from seven to one for the large transfer mode. Keep the interactive OUTPACING parameter at a high value. description. This method can be used for systems prior to V2R1.

   This reduces the average wait time for the interactive users because there are fewer large transfer frames queued up ahead.

4. For configurations using APPN = *YES on the APPN controller descriptions, define a class-of-service description (COSD) with a transmission priority of *HIGH for the interactive COSD, and a priority of *LOW for the large transfer COSD.

   When poor response time is detected for frames with *HIGH priority, the APPN support restricts the throughput for lower priority frames by decreasing the number of allowed outstanding frames.

   Using APPN transmission priorities does not have much of an effect for versions prior to Version 2 release 1.

   Unlike reducing MAXLENRU and pacing values, using transmission priorities does not negatively impact large transfer performance when there is no interactive traffic.

In summary, for configurations with APPN = *NO, or prior to V2R1, the RU size and pacing values can be reduced to give better interactive response time with some performance degradation for the large transfer traffic.

For systems running V2R1 or later, the recommendation is to define different modes and classes-of-service for interactive and large transfer traffic, using *HIGH and *LOW priorities respectively. Interactive response times can be improved even more if large transfer RUs are reduced, but this is at the expense of large transfer throughput when there is no interactive traffic.

Chapter 13. AnyNet

AnyNet is a family of software products designed to make it easier for customers to choose the applications regardless of what protocol is used. AnyNet products implement the Multiprotocol Transport Networking (MPTN) architecture. The functions implemented with the AS/400 system are:

- APPC over TCP/IP
- Socket over SNA

This chapter discusses the performance considerations using AnyNet on the AS/400 system.

13.1 MPTN Architecture

Multiprotocol Transport Networking (MPTN) is an architecture developed by IBM. The objective of this architecture is to allow an application that uses a certain network protocol communicate with its partner application through a ″different network protocol″. This makes the application ″independent″ from the network. Traditionally, communication programs use APIs that are tied to the underlying network protocols. Such as FTP needs TCP/IP, the AS/400 system′s display pass-through needs SNA. MPTN frees the protocol bound limits so that any communication programs can run on any network protocols. Some examples are FTP running on an SNA network or display pass-through running on a TCP/IP network. Network protocols are completely transparent to the applications.

13.2 Types of MPTN Nodes

According to the MPTN architecture, there can be three kinds of nodes:

- **Native Node**: These nodes do not use/support of MPTN. This requires the attached node to implement all of the protocol stacks. A network of native nodes is called a ″Single Protocol Transport Network″ (SPTN). A pure SNA connection of two or more AS/400 systems is an example of SPTN.
- **MPTN Access Node**: This provides a semantic interface that allows an application to communicate with its partner through a different transport protocol. An MPTN access node can communicate with other access nodes or with an MPTN gateway. With this support, you can run FTP on SNA, for example.
- **MPTN Gateway**: This includes two functions:
  1. It connects a native node to an MPTN so that the native node can participate in the MPTN without the MPTN access node capability.
  2. It connects an SPTN to form an MPTN. In this configuration, you can connect an IP network to another IP network through an SNA network with the support of two gateways.

The AS/400 system provides MPTN access node functions but not an MPTN gateway.

13.2.1.1 Examples of MPTN/SPTN Network

Figure 65 shows possible connections using the MPTN capability.

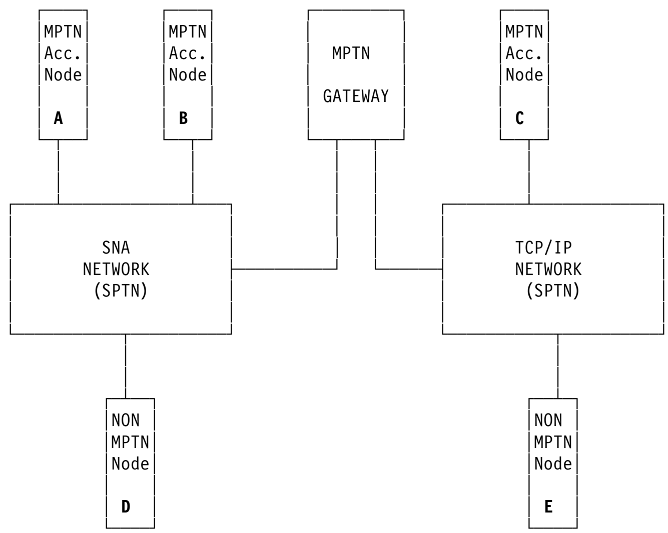

Figure 65. MPTN/SPTN Examples

- A socket program on System **A** can communicate with a socket application on System **B**. The socket information is delivered from one system to the other through the SNA Network.
- A CPI-C program on System **A** can communicate with System **D**. System D is a native node that does not support MPTN.
- A socket program on System **B** can communicate with System **E** through the **MPTN Gateway**. Notice that System E is a native NON-MPTN node.
- A CPI-C program on System **C** can communicate with System **D** through the **MPTN Gateway**. Notice that System D is a native NON-MPTN node.
- A socket program on System **B** can communicate with System **C** through the MPTN gateway. Notice that System C acts as a native node in this scenario.

13.2.2 AnyNet

AnyNet is a family of products that implements the MPTN architecture. AnyNet products are available for many operating systems: OS/400, OS2, MVS, and AIX. The AS/400 AnyNet support is part of the operating system.

13.2.3 AnyNet/400 Summary

- **Same communications APIs**: Two applications can use the same APIs to communicate with each other through a different transport layer.
- **Access Node functions**: The AS/400 system only provides access node function. It is not an MPTN Gateway. The AS/400 system can connect to an ″MPTN Gateway″ either ″natively″ or as an ″MPTN Access Node″.

- **Sockets over SNA**: Only sockets applications can be used with AnyNet. This means that the Telnet requester (which is not a socket application) cannot use AnyNet.
- **APPC over TCP/IP**: APPC applications can communicate with their partners using either ICF or CPI-C.

13.3 AnyNet Performance Considerations

The use of AnyNet implies CPU overhead since there is always a conversion, either from SNA to TCP/IP or vice versa. Both protocols have their strength and weakness, so depending on the scenario of your applications, behavior might be different from what was expected.

When the AnyNet function is used, several layers (operating system, License Internal Code, and IOPs) are involved. Fewer layers involved means less system overhead, thus it also means better performance; less CPU overhead means better performance. That is the reason why the native protocols provide better performance than AnyNet. Depending on the conversion required (APPC to TCP/IP or SOCKETS to SNA), there are different layers involved. The following picture is a rough flow of control of the AnyNet process (for simplicity, TCP/IP is represented as a single layer). Notice that for APPC over TCP/IP, there is one more layer than for Sockets over SNA.

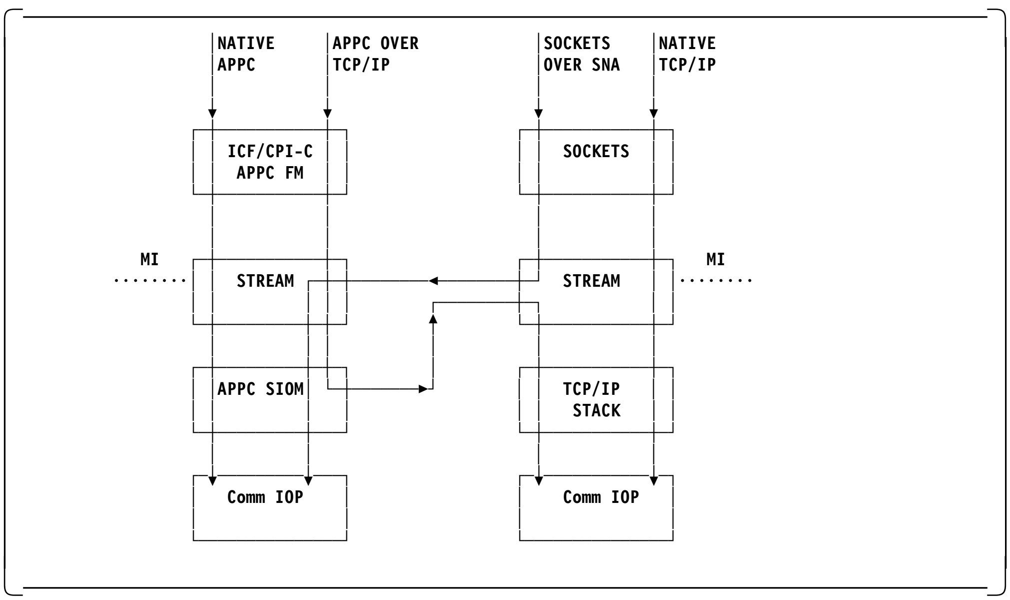

Figure 66. AnyNet System Layers

The AnyNet performance depends on the environment. There are four combinations with the APIs and protocols.

1. Native APPC
2. Native TCP/IP
3. Sockets over SNA
4. APPC over TCP/IP

Generally speaking, the AS/400 system′s SNA protocol is faster than TCP/IP protocols. Depending on the application data length and the frame size of the communication link, the performance varies.

There are many factors that influence the communications performance of both protocols:

- **RU size**: The use of *CALC for RU size in the MODE description provides an optimized RU size compatible with the frame size.
- **APPC buffering**: APPC provides buffering technique. Buffering means that when an application performs a ″write″, the data is not really sent but buffered for a later transmission. This allows the system to block the data and transmit the entire block together. This consideration is also true when using APPC over TCP/IP.
- **Sockets**: Only sockets applications can be used with AnyNet. In other words, it is not possible to use the PASCAL API with AnyNet. Sockets does not provide any blocking such as the APPC buffering. It is important to limit the number of send/receive operations when coding an application. This lack of buffering means that the data is really sent when the application performs a write.

13.3.1 Some Guidelines for Performance Analysis

Since AnyNet involves **SNA** and **TCP/IP**, the guidelines in the previous chapters of SNA and TCP/IP can be used. There are few considerations for better understanding of the performance data. This section covers the tools available to gather information when using AnyNet.

The system has a **dual** behavior when using AnyNet. For example, from an application point of view, it is a pure TCP/IP, but from the communications adapter, it is a pure SNA.

13.3.1.1 Sockets over SNA

When using sockets over SNA, Option 3 (TCP/IP connection STATUS) of the NETSTAT command shows the same information as for a native TCP/IP application. In other words, it is not possible to distinguish a pure TCP/IP application from Socket applications running over SNA.

```
                     Work with TCP/IP Connection Status
                                                           System:   SYSTEM05
Local internet address  . . . . . . . . . . . :   *ALL

Type options, press Enter.
  4=End   5=Display details

     Remote           Remote     Local
Opt  Address          Port       Port       Idle Time  State
     *                *          as-dtaq    147:51:04  Listen
     *                *          as-file    004:19:23  Listen
     *                *          as-netprt  022:46:25  Listen
     *                *          as-rmtcmd  000:06:28  Listen
     *                *          as-signon  000:07:14  Listen
     2.2.2.1          1179       ftp-data   000:00:00  Established
     2.2.2.1          1178       ftp-con >  000:00:03  Established
     9.5.93.142       1027       telnet     000:00:00  Established
     9.5.93.142       1029       telnet     000:03:43  Established
     9.5.93.155       1201       as-cent >  000:07:12  Established
     9.5.93.160       1028       as-cent >  000:13:38  Established
                                                                      More...
F5=Refresh   F11=Display byte counts   F13=Sort by column
F14=Display port numbers   F22=Display entire field   F24=More keys
```

Figure 67. Work with TCP/IP Connection Status

In Figure 67, the connection with remote IP address **2.2.2.1** uses Sockets over SNA. As you can see, there is no difference with a native TCP/IP connection.

Option 5 shows the details of the connection. This time the information provided differs from a native TCP connection. See Figure 68.

```
                       Display IPS Connection Status
                                                           System:   SYSTEM05

Connection identification:
  Remote host name  . . . . . . . . . :
    Remote internet address . . . . . :     2.2.2.1
    Remote port . . . . . . . . . . . :     1192
  Local host name . . . . . . . . . . :
    Local internet address  . . . . . :     2.2.2.5
    Local port  . . . . . . . . . . . :     ftp-data
  Associated user profile . . . . . . :   A960303C
Programming interface information:
  State . . . . . . . . . . . . . . . :   Established
  Connection open type  . . . . . . . :   Active
  Idle time . . . . . . . . . . . . . :   000:00:00.066
    Last activity date/time . . . . . :     11/14/96  14:50:14
Transmission information:
  Bytes out . . . . . . . . . . . . . :   0
  Bytes in  . . . . . . . . . . . . . :   163560

                                                                       Bottom
Press Enter to continue.
F3=Exit   F5=Refresh   F6=Print   F12=Cancel   F14=Display port numbers
F22=Display entire field
```

Figure 68. Display IPS Connection Status

The WRKCFGSTS *CTL command provides information about the status of the SNA connection.

```
                       Work with Configuration Status                SYSTEM05
                                                           11/13/96  17:05:17
Position to  . . . . .              Starting characters

Type options, press Enter.
  1=Vary on   2=Vary off   5=Work with job   8=Work with description
  9=Display mode status ...

Opt  Description      Status               -------------Job--------------
     ETHLINE          ACTIVE
       M05ETH         ACTIVE
         LLLLLL01     ACTIVE
           SNACKETS   ACTIVE/SOURCE        QPADEV0008  A960303C    064209



                                                                      Bottom
Parameters or command
===>
F3=Exit   F4=Prompt   F12=Cancel   F23=More options   F24=More keys
```

Figure 69. Work with Configuration Status

Performance Data: Here is where the **dual** behavior of AnyNet becomes evident.

QAPMSNA Contains performance data about SNA

QAPMJOBS Contains performance data about jobs

The **QAPMSNA** file shows information about the SNA side. In this case, the data is passed to the other systems as **SNA PIUs** (Path Information Unit). Those PIUs carry the imbedded TCP/IP data. From the point of view of this performance file, it is a pure SNA connection. Chapter 10, "SNA" on page 163 covers SNA performance in detail. All of the queries can be applied to Sockets over SNA. However, it is not possible to tell if the contents are APPC data or Socket data. By selecting the proper records, it is possible to gather information about PIUs that may transport TCP data. For example, the **SCTLNM** field is the controller description name. This field can be used to select the records that contain information about PIUs in which TCP data is transported. This same controller can be used for other SNA applications. For example, SNADS, DSPT, and DDM can be using the same controller at the same time with AnyNet. So a query shows information about all of the PIUs used by these applications including, of course, AnyNet.

The **QAPMJOBS** file shows performance data about jobs. From this file, it is possible to see if a job is using Sockets or not. So with the proper query, it is possible to gather information about applications that use sockets but it is not possible to know if AnyNet is being used. If a particular application is using Sockets over SNA, there is information about Sockets in this file, but no information about APPC PUTs or GETs (since that application does not use APPC). This file can provide information about applications that use sockets over SNA as well as information about native TCP/IP applications that also use Sockets.

The following hints can be used to isolate the desired information based on fields of QAPMJOBS.

- **JBSKSC** field: This is the number of socket sends. By selecting the records where this field is not zero, it shows all of the applications where there is Socket activity.
- **JBSKRC** field: This is number of Socket receives. The previous field considerations are valid here.
- **JBUSER** field: This is the job user identification. TCP server jobs use the QTCP user profile. QTCP can be used to identify the TCP server jobs. For the requester jobs, it is more difficult since it is necessary to know who originates the TCP requirements.

Appendix G, "AnyNet Queries" on page 351 provides sample queries.

13.3.1.2 APPC over TCP/IP

When using APPC over SNA, Option 3 (TCP/IP connection status) of the NETSTAT command shows information about the TCP session used to transport the imbedded SNA data. Before the connection is established, a special TCP server is "listening" on port "397". This port number is assigned to APPC over TCP/IP.

```
                        Work with TCP/IP Connection Status
                                                                    System:   SYSTEM05
 Local internet address  . . . . . . . . . . . :   *ALL

 Type options, press Enter.
   4=End   5=Display details

      Remote           Remote     Local
 Opt  Address          Port       Port       Idle Time  State
      *                *          as-dtaq    152:17:10  Listen
      *                *          as-file    008:45:29  Listen
      *                *          as-netprt  027:12:31  Listen
      *                *          as-rmtcmd  003:14:46  Listen
      *                *          as-signon  001:32:16  Listen
      2.2.2.1          ftp-con >  1147       002:23:38  Established
      3.3.3.1          APPCove >  1150       000:06:25  Established
      3.3.3.1          1190       APPCove >  000:06:23  Established
      9.5.93.142       1027       telnet     000:00:00  Established
      9.5.93.142       1029       telnet     000:09:43  Established
      9.5.93.161       1030       as-cent >  001:49:02  Established
                                                                           More...
 F5=Refresh   F11=Display byte counts   F13=Sort by column
 F14=Display port numbers   F22=Display entire field   F24=More keys
```

Figure 70. Work with TCP/IP Connection Status

The WRKCFGSTS *CTL command provides information about the SNA connection.

```
                         Work with Configuration Status               SYSTEM05
                                                            11/13/96  19:22:07
Position to  . . . . .                Starting characters

Type options, press Enter.
  1=Vary on   2=Vary off   5=Work with job   8=Work with description
  9=Display mode status ...

Opt  Description       Status                 -------------Job--------------

     ANYNETM01         ACTIVE
       M01             ACTIVE
         BLANK         ACTIVE/TARGET          M01         QUSER       064210
         #INTER        ACTIVE/SOURCE          QPADEV0004  A960303C    064275



                                                                         Bottom
Parameters or command
===>
F3=Exit   F4=Prompt   F12=Cancel   F23=More options   F24=More keys
```

Figure 71. Work with Configuration Status

Notice that there is no line associated to the APPC controller ANYNETM01 since this is an AnyNet connection. WRKCFGSTS provides the same information as in native SNA. In Figure 71, notice the active SNA applications using different MODES.

Performance Data: Again, the **dual** behavior of AnyNet is evident.

QAPMSNA Contains performance data about SNA

QAPMJOBS Contains performance data about jobs

The **QAPMSNA** file shows information about the SNA side. However, this time, the data is passed to the other system imbedded in IP datagrams. Again, all of the queries related to SNA can be applied. The **SCTLNM** field is the controller name. Using this field, the query shows information about those PIUs that are transmitted over TCP/IP. The information provided is the same as a native connection. The controller description specifies an ″AnyNet″ connection instead of using a regular line description. The queries provide information about those PIUs that are effectively delivered by AnyNet.

The **QAPMJOBS** file shows jobs performance data. From this field, it is possible to see if a job is using communications APIs or not. With the proper query, it is possible to gather information about applications that use APPC. However, it is not possible to know if AnyNet is being used. If a particular application is using APPC over TCP/IP, there is information about communications PUTs and GETs in this file but no information about Sockets PUTs or GETs (since the application we are investigating does not use Sockets). This file can provide information about applications that use APPC over TCP/IP as well as information about native APPC applications.

The following hints can be used to isolate the desired information based on fields of QAPMJOBS.

- **JBCPT** field: This is the number of communications puts. Bu selecting the records where this field is not zero, it shows all of the applications where there is SNA activity.
- **JBCGT** field: This is the number of communications puts. The previous field considerations are valid here.

Appendix G, “AnyNet Queries” on page 351 provides sample queries.

13.3.2 AnyNet Summary

- AnyNet is a mix of protocols. Any performance investigation must be based on the analysis of both protocols.
- AnyNet introduces CPU overhead so native protocols provide better performance.
- The performance when using AnyNet depends on the scenario.
- All of the systems using AnyNet should be analyzed. Bad performance of an AnyNet Gateway, for example, can lead to bad performance of the entire AnyNet Network.

Chapter 14. ISDN

An ISDN (Integrated Digital Services Network) provides a means to carry digital or digitized data over medium speed (64 kbps) channels. Data types include digitized voice, computer data, packet switched data, images, fax, remote signalling, and so on. Because ISDN is a digital network, there is no need to transform computer data to analog signals for transmission as was the case with traditional analog telephone networks. Moreover, separate channels are available for data transmission and for call signaling, such as call setup and breakdown. Permanent connections are also possible. ISDN is capable of duplex transmission. This provides higher throughput in those environments where multiple conversations are running over the same connection.

The current AS/400 implementation provides a basic rate interface (BRI). A basic rate interface consist of two 64 000 bps bearer (B) channels used for data transfer and a 16 000 bps D-channel (normally used for signaling). A direct high speed (T1 or E1) primary rate interface (PRI) is not available. It is also possible to connect an AS/400 system to a *passive bus* where up to up to eight devices share a basic rate interface. These devices contend for the use of the available B-channels, but only two B-channels may be used at any time. This configuration may not be available with some network providers.

ISDN has a layered architecture and complies with the lowest three levels of the seven layer Open Systems Interconnection (OSI) communications model. Recommendations for ISDN are defined by the Telecommunication Standardization Sector (ITU-T, formerly known as CCITT). These recommendations describe layer 1 through layer 3 for the D-channel and layer 1 for the B-channel. Thus, for layer 2 and layer 3 of the B-channel, different implementations are possible. On the AS/400 system, you can either use IDLC and SNA or LAP-B and X.25 for data transfer on the B-channel. Though the ITU-T recommendations allow the use of the D-channel for data transmission, this is not implemented on the AS/400 system at present. A simplified representation of the layered structure is shown in Figure 72 on page 208.

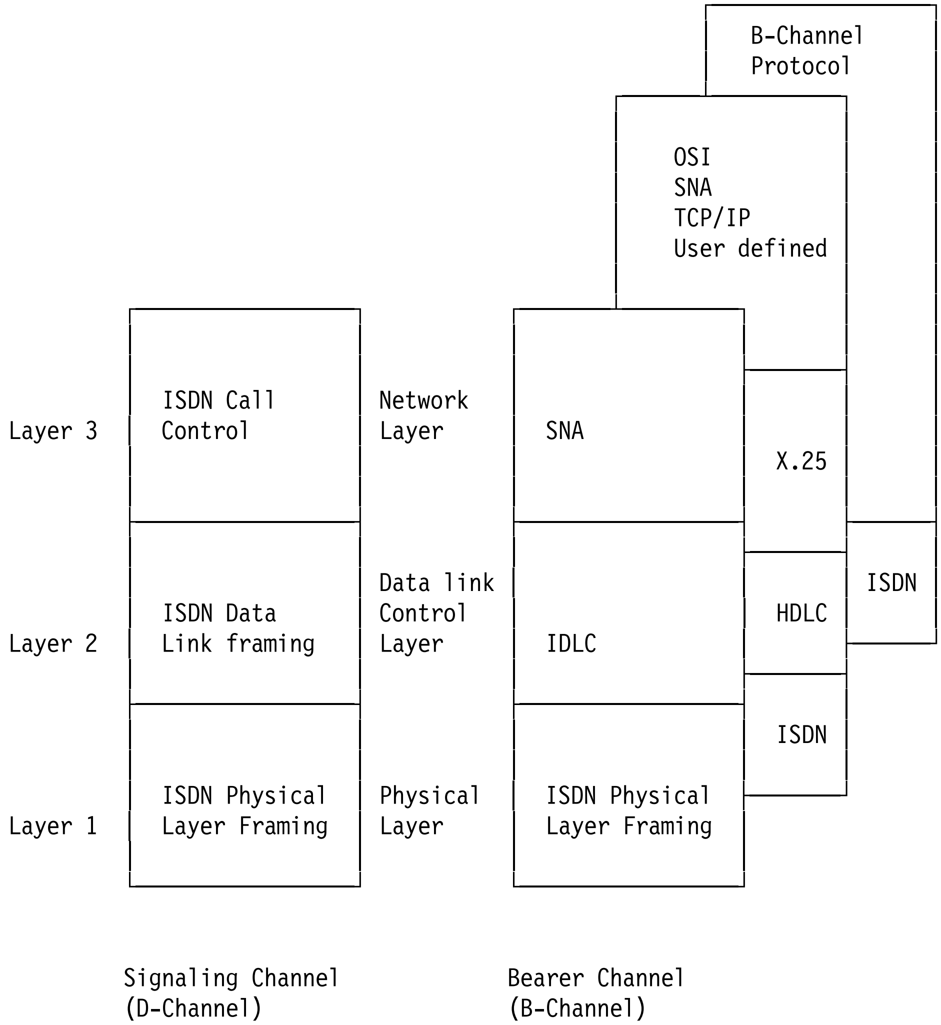

Figure 72. Examples of ISDN used with SNA or OSI

For a more detailed description of ISDN concepts and facilities, see the redbook *IBM AS/400 ISDN Connectivity* or the manuals *AS/400 ISDN Support*, *ISDN Data Link Control Architecture Reference*, and *ISDN Circuit Switched Signaling Control Architecture Reference*.

This chapter describes the most important data that the performance monitor collects for ISDN. Due to the different layer structure on the channels, you can find performance data in different database files. For the D-channel (or network interface), the data is collected in the *QAPMLAPD* file. The performance values are related to the following layers:

- Physical layer
- Data link layer
- Network layer

The physical layer (Layer 1) deals with the electrical, functional, and procedural characteristics of the connection over the physical medium. This layer is common for the B channel and D channel.

The data link layer (Layer 2, LAP-D on the D-channel) is responsible for the error-free transmission of frames on the physical connection.

The network layer (Layer 3, call control) establishes, maintains, and disconnects end-to-end connections (calls) for the B-channels into the ISDN. This function is also referred to as call control or signalling.

The QAPMLAPD database file also contains statistical fields or counters.

If you use IDLC protocol on the B-channel, you can find performance data for the B-channel usage in the *QAPMIDLC* database file. These are related to the data link layer (Layer 2, in this case, IDLC) on the B-channel. This file also contains statistics data.

If you use X.25 protocol on the B-channel, look for performance data in the *QAPMX25* database file.

For the layer structure and the performance data interpretation, refer to Chapter 8, "X.25" on page 127.

14.1 Link Access Protocol for D-Channel (LAP-D)

The data link control layer defines the procedures for the connection, error free transfer of information, and disconnection between two entities of Layer 3, call control (Q.931). At the data link control layer, the information uses HDLC framing.

The following list contains the main LAP-D communications performance indicators:

- Line utilization
- Line errors
- Frame errors
- Number of calls
- Number of call errors

Some performance problems may be caused by line errors (on the physical layer) or frame errors (on the data link control layer) as they require the re-transmission of frames. These can be isolated by reviewing the QSYSOPR message queue, the problem log, or the system error log.

14.1.1 Line Utilization (LAP-D)

Line utilization is the percentage of elapsed time during which information transfer took place on the line. Because ISDN is full duplex, line utilization should be determined for both directions. Usually, line utilization is an important performance indicator, but the utilization on LAP-D is something unique to ISDN. Because the D-channel is used only for call setup, the utilization of LAP-D shows those activities not representing user data transmission activities. High line utilization of this channel may mean lots of status messages or status enquiries. Then you may want to collect a communication trace to determine what causes this high utilization.

14.1.1.1 Performance Monitor Database Fields

The following fields in the performance monitor database file QAPMLAPD are related to the line utilization:

LSBRCV The total number of bytes received from the remote station. This includes no errors.

LSBTRN The total number of bytes transmitted including re-transmission bytes.

LDLSP The speed of the line in bits per second (bps)

INTSEC Number of seconds since the last elapsed interval

The transmit line utilization is derived from the following equation:

```
Transmit line utilization = LSBTRN * 8 * 100 / (INTSEC * LDLSP)
```

The receive line utilization is derived from the following equation:

```
Receive line utilization = LSBRCV * 8 * 100 / (INTSEC * LDLSP)
```

Since LSBRCV does not include bytes in error frames, this may show lower number when the line has errors. Before determining the utilization is high or low, it is good idea to see the error percentage of the line.

You have to multiply by eight to get the number of *bits* transmitted (because the line speed is given in *bits* per second and multiply by 100 to get the percent value instead of a fraction.

Line utilization is calculated per interval, that is, the time you specified on the INTERVAL parameter of the STRPFRMON command.

See Appendix H, "ISDN Queries" on page 361 for the sample queries (NWI_ALL and NWI_LAPD) to show the values previously mentioned.

14.1.1.2 Using Performance Tools/400 to Display Line Utilization (LAP-D)

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Display Communications Line Detail display shown in Figure 73 on page 211.

```
                      Display Communications Line Detail

Member . . . . . . . :   Q963121422      Elapsed time . . . . :   00:20:58
  Library  . . . . . :     QPFRDATA

Type options, press Enter.
  5=Display remote jobs   7=Display communications interval data

         Line         Line          Line        Tns     Average      Job       %
Option   ID           Type         Speed      Count    Response    Count    Busy
  _      ETHLINE      ELAN       10000.0          0         .00        0      .0
  _      TRNLINE      TRLAN       4000.0          0         .00        0      .0
  _      ITSOX2506P   X.25          64.0          0         .00        0    75.1
  _      ITSOX2507P   X.25          64.0          0         .00        0    75.1
  _      ITSOISDN06   IDLC          64.0          0         .00        0    73.4
  _      ITSOISDN07   IDLC          64.0          0         .00        0    73.4

                                                                          Bottom
F3=Exit   F12=Cancel   F13=Display network interface data
F15=Sort by line ID    F20=Sort by transactions   F24=More keys
```

Figure 73. Communications Line Detail

This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. The display shows you, among others, the line speed and the average line utilization. As you can see from the line speed, this is for the B-channel. You have to press F13 to display the network interface data shown in Figure 74.

```
                        Display Network Interface Data

Member . . . . . . . :   Q963121422      Elapsed time . . . . :   00:20:58
  Library  . . . . . :     QPFRDATA

Type options, press Enter.
  7=Display channel interval data

                                Transmit/              Percent              Percent
                                Receive/     Total     Frames      Total     Frames
        Network                  Average     Frames    Trnsmitd    Frames   Received
Option  Interface    Channel    Line Util   Trnsmitd     Again   Received   in Error
  _     ITSONWI06    B2         73/73/73        8991          0       8991          0
  _     ITSONWI07    B2         73/73/73        8991          0       8991          0
  _     ITSONWI06    D          00/00/00           0          0          0          0
  _     ITSONWI07    D          00/00/00           0          0          0          0

                                                                          Bottom
F3=Exit   F12=Cancel    F15=Sort by network interface   F16=Sort by channel
F20=Sort by line util   F24=More keys
```

Figure 74. Network Interface Data (View 1)

Use option 7=Display Channel Interval Data for the D-channel. The transmit, receive, and average line utilization for the sample interval selected are the values listed in the Transmit/Receive/Average Line Util column heading.

```
                        Display Channel Interval Data

Network Interface  . :   ITSONWI06      Member . . . . . . . :   Q962981049
Channel  . . . . . . :   D                Library  . . . . . :     QPFRDATA
Line speed . . . . . :   16.3           Elapsed time . . . . :   00:19:58
IOP name . . . . . . :   CC04

          Transmit/                                         Loss
          Receive/   -Outgoing Calls-  -Incoming Calls-      of
Itv        Average    Total   Percent   Total   Percent    Frame
End       Line Util   Calls  Rejected   Calls  Rejected  Alignment
10:54:28  00/00/00        0         0       0         0          0
10:59:28  00/00/00        0         0       0         0          0
11:04:28  00/00/00        0         0       0         0          0
11:09:28  00/00/00        0         0       0         0          0




                                                                   Bottom
Press Enter to continue.

F3=Exit   F11=View2   F12=Cancel   F24=More keys
```

Figure 75. Channel Interval Data (View 1) - D-Channel Sample

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval shown in Figure 75.

```
                                         Resource Interval Report                                     11/01/96 11:00:28
                                        Communications Line Detail                                           Page   7
                                        IDLCWDWSIZ(31) MAXFRAME(8192)
Member  . . . : Q962981049 Model/Serial  . : 510-2144/10-16CAD    Main storage  . . : 384.0 M   Started . . . : 10/24/96 10:49:28
  Library . . : QPFRDATA   System name . . :           SYSTEM01  Version/Release . :   3/6.0   Stopped . . . : 10/24/96 11:09:28
PROTOCOL = ISDN NETWORK INTERFACE (SORT BY INTERVAL)
      IOP              --Outgoing---  ---Incoming---  LAPD      LAPD Pct  LAPD     LAPD Pct
      Name/            ---Calls-----  ----Calls-----  Total     Frames    Total    Frames    Loss of    Local
 Itv   Network     Line          Pct            Pct   Frames    Trnsmitd  Frames   Recd      Frame      End Code    Collision
 End   Interface   Speed  Total  Retry  Total  Reject Trnsmitd  Again     Recd     in Error  Alignment  Violation   Detect
-----  ----------  -----  ------ -----  ------ ------ --------  --------  -------  --------  ---------  ---------   ---------
       CC04
        (2605)
10:54  ITSONWI06    16.3      0     0       0      0       60        0        60       0           0          0           0
10:54  ITSONWI07    16.3      0     0       0      0       60        0        60       0           0          0           0
10:59  ITSONWI06    16.3      0     0       0      0       60        0        60       0           0          0           0
10:59  ITSONWI07    16.3      0     0       0      0       60        0        60       0           0          0           0
11:04  ITSONWI06    16.3      0     0       0      0       60        0        60       0           0          0           0
11:04  ITSONWI07    16.3      0     0       0      0       60        0        60       0           0          0           0
11:09  ITSONWI06    16.3      0     0       0      0       58        0        58       0           0          0           0
11:09  ITSONWI07    16.3      0     0       0      0       58        0        58       0           0          0           0
Itv End                 -- End time of the data collection interval or time that vary
                           off occurred
IOP Name/               -- IOP resource name and model number, Network interface description
 Network Interface
Line Speed              -- Line speed (1000 bits per second)
Outgoing Calls Total    -- Number of outgoing call attempts
Outgoing Calls          -- Percent of outgoing calls that were rejected by the network
 Pct Retry
Incoming Calls Total    -- Number of incoming call attempts
Incoming Calls          -- Percent of incoming calls that were rejected
 Pct Reject
LAPD Total Frames       -- Number of frames transmitted (applies to D-channel only)
 Trnsmitd
LAPD Pct Frames         -- Percent frames re-transmitted due to error (applies to
 Trnsmitd Again            D-channel only)
LAPD Total Frames       -- Number of frames received (applies to D-channel only)
 Recd
LAPD Pct Frames         -- Percent frames received in error (applies to D-channel only)
 Recd in Error
Loss of Frame           -- Number of times a time period equivalent to two 48 bit frames
 Alignment                 elapsed without detecting valid pairs of line code violations
Local End Code          -- Number of unintended code violations detected by the TE
 Violation                 for frames received on the T interface
Collision Detect        -- Number of times that a transmitted frame corrupted by
                           another frame was detected
```

Figure 76. Resource Report - Communications Line Detail

14.1.2 Line Errors

Line errors result in frames being retransmitted. If the re-transmission still results in bad frames and the errors occur on the B-channel, the application is notified and eventually has to resend the entire record or multiple records. This may result in one RU (request unit) or a chain of RUs being transmitted again.

14.1.2.1 Performance Monitor Database Fields

The performance monitor collects data about physical line errors on the terminal equipment, network termination 1 (TE/NT1) interface. The following fields are related to physical line errors and affect the entire NWI, that is, not only D-channel but also B-channels.

LPLOFA Loss of frame alignment: Total number of times when a time period equivalent to two 48-bit frames has elapsed without receiving valid frames.

LPLECV Local end code violation: Counted by the TE to indicate unintended polarity violations (that are not framing bits) for frames received on the T interface.

LPDTSI Detected access transmission error in: The number of times the TE received an indication from the network termination type 1 (NT1) that a cyclic redundancy check (CRC) error has been detected by the NT1 across the NT1-LT (U) interface.

LPDTSO Detected access transmission error out: The number of times the TE received an indication from the NT1 that a CRC error has been detected by the NT1 across the U interface.

LPFECV Far end code violation: Counted by the TE to indicate unintended polarity violations detected by the NT1 for frames transmitted to the NT1 on the T interface.

LPES Errored seconds: Total number of seconds that had at least one DTSE-in or DTSE-out error.

LPSES Severely errored seconds: Total number of seconds that had more than three DTSE-in or DTSE-out errors.

LPCOL Collision detect: The number of times the TE detected that its transmitted frame has been corrupted by another TE attempting to use the same bus.

The sample queries (NWI_all and NWI_errors) in Appendix H, "ISDN Queries" on page 361 show you the previously mentioned fields. Note that the contents of the fields LPDTSI, LPDTSO, LPFECV, LPES, and LPSES are not included in the Performance Tools reports, so you have to run queries or develop your own programs to examine these types of line errors.

14.1.3 Using Performance Tools/400 to Display Line Error Information

Line error information can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the line error information.

Use the DSPPFRDTA command to access the Communications Line Detail display shown in Figure 73 on page 211. Press F13 to display Network Interface Data and use option 7=Display Channel Interval data (Figure 75 on page 212). You can see the times of Loss of Frame Alignment (LPLOFA) per interval.

Press F11 to access Channel Interval Data View 2.

```
                         Display Channel Interval Data

Network Interface  . :   ITSONWIO6       Member . . . . . . . :   Q962981049
Channel  . . . . . . :   D                 Library  . . . . . :     QPFRDATA
Line speed . . . . . :   16.3            Elapsed time . . . . :   00:19:58
IOP name . . . . . . :   CC04

                                                  Percent               Percent
            Local                         Total    Frames      Total     Frames
Itv       End Code   Collision   Frames   Trnsmitd    Frames    Received
End       Violation    Detect   Trnsmitd    Again    Received   in Error
10:54:28          0           0        60          0         60          0
10:59:28          0           0        60          0         60          0
11:04:28          0           0        60          0         60          0
11:09:28          0           0        58          0         58          0



                                                                      Bottom
Press Enter to continue.

F3=Exit   F11=View1   F12=Cancel   F24=More keys
```

Figure 77. Channel Interval Data (View 2) - D-Channel Sample

The display shows you the number of local end code violations (LPLECV) and the number of call collisions (LPCOL) per interval.

You can use the PRTRSCRPT command to print the Resource Interval Report. The Communications Line Detail section shows you the total number of frame alignment losses, local end code violations, and call collisions per sample interval shown in Figure 76 on page 213.

14.1.4 Frame Errors (LAP-D)

This is only for the D-channel and is only interesting, if the customer is having trouble making calls or also having similar problems on the B-channels.

The performance monitor collects data about the number of:

- Frame re-transmissions
- Frames received in error
- Invalid frames received

A frame can be an information, supervisory, or unnumbered information frame:

Information frames
: I-frames are used to transfer user data. If there are no I-frames transmitted, you can conclude that the remote stations on that line are inactive. *Inactive* means that the stations connected to the controller are not doing any work even though the controller has been successfully varied on.

Supervisory frames
: S-frames are used to perform link supervisory control functions such as acknowledge I-frames, request re-transmission of I-frames, or request a temporary suspension of transmission of I-frames.

Unnumbered information frames
UI-frames are used to provide additional link control functions and contain no sequence numbers.

Frame re-transmission is normally caused due to frames received in error and by link resets. To avoid communications performance problems, this number should be close to zero.

14.1.5 Performance Monitor Database Fields

The following fields in the database file QAPMLAPD from the performance monitor can be used to determine the re-transmission error rates:

LSFTRN Number of frames transmitted (information (I), unnumbered information (UI), and supervisory (S)). This includes frames retransmitted and frames sent on transmission stopped by transmit underrun.

LSFRT Number of frames retransmitted.

The percent of frames transmitted with errors is derived from the following equation:

```
Percent of frames transmitted with errors = (LSFRT * 100) / LSFTRN
```

The following fields from the performance monitor can be used to determine the number or percent of frames received in error or that are not valid:

LSFRCV Total number of frames received (information (I), unnumbered information (UI), and supervisory (S)). This includes no errors.

LLFRIE The total number of frames received in error. The individual error types are also counted in separate fields. Those fields are listed below.

LLCRCE The number of frames received that contained a cyclic redundancy check (CRC) error

LLSFE Short frame error. A short frame has fewer octets between its start and end flag than permitted.

LLORUN Receive overrun. The ISDN subsystem could not keep pace with incoming data because of local controller overload.

LLURUN Transmit underrun. The ISDN subsystem could not keep pace with outgoing data because of local controller overload.

LLABRT Frame abort. A frame was received with HDLC abort indicator.

LSSEQE Frame sequence error. A frame received with a sequence number indicating frames were lost.

The percent of frames received in error is derived from the following equation:

```
Percent of frames received in error = (LSFRIE * 100) / (LSFRCV + LSFRIE)
```

Appendix H, “ISDN Queries” on page 361 lists the sample queries (NWI_ALL and NWI_ERRORS) to show the values previously mentioned.

14.1.6 Using Performance Tools/400 to Display Frame Error Information

You can find frame error information in the Channel Interval Data (View 2) display shown in Figure 77 on page 215. Follow the steps described in Section 14.1.3, "Using Performance Tools/400 to Display Line Error Information" on page 214 to navigate through Performance Monitor displays.

You can also print the Resource Interval Report using the PRTRSCRPT command. The Communications Line Detail section lists the total number of LAPD frames transmitted, the percent of frames transmitted again, the total number of frames received, and the percent of frames received in error (Figure 76 on page 213).

14.1.7 Call Processing

Especially for short data transfers, a lengthy call processing may severely impact performance. Also, if a system needs a long time to process a call, either the ISDN or the calling system may time out. In most cases, these problems are caused by improper configuration.

14.1.7.1 Performance Monitor Database Fields

The following fields of the QAPMLAPD database file are related to ISDN call processing:

LQTOC Total number of outgoing call attempts. This includes outgoing SETUP messages requesting a packet switched connection (defined by CCITT Recommendation X.31).

LQROC The total number of outgoing calls that were rejected by the network. This includes outgoing SETUP messages for packet switched (X.31) connections.

LQTIC Total number of incoming call attempts. This includes incoming setup messages for packet switched connections (X.31).

LQRIC Total number of incoming calls that were rejected by the terminal equipment (TE). For a passive bus configuration, the call may have been intended for another TE that shares the passive bus. This count also includes rejected incoming SETUP messages for packet switched connections (X.31).

The sample queries (NWI_ALL and NWI_CALLS) in Appendix H, "ISDN Queries" on page 361 show you the previously mentioned fields.

14.1.8 Using Performance Monitor/400 to Display Call Information

Information about incoming and outgoing calls and call errors is included in the Channel Interval Data display. Please refer to Section 14.1.1.2, "Using Performance Tools/400 to Display Line Utilization (LAP-D)" on page 210 for information on how to access this display. A sample is shown in Figure 75 on page 212. You can also use the PRTRSCRPT command to print the Resource Interval report. The Communications Line Detail section lists the number of incoming and outgoing calls and the percent of incoming and outgoing calls rejected per interval. A sample report is shown in Figure 76 on page 213.

14.1.8.1 Recommendations

Normally, line utilization is not an issue for the D-channel because this is used only for call setup and call clearing.

However, the overall performance of a given data transfer may be degraded if the system needs a long time to establish the connection. Also, the call acceptance time may exceed that required by the network. If you see a non-zero value in Figure 75 on page 212 for the incoming calls that had been rejected, try to find out which lines were in *VARIED ON* status at that time and which connection lists were associated with them. Check if the LCLNBR, LCLSUBADR, RMTNBR, and RMTSUBADR parameters are correct.

For optimal performance, also check if there is only one unique entry in all connection lists for a given RMTNBR-LCLNBR pair. This reduces system search time for entries matching the incoming call. Do not use the value *ANY in the connection list entries. Likewise, after you have a working configuration, do not use the system-supplied default connection list QDCCNNLANY.

For outgoing calls that get rejected with cause code 31, check if all ISDN communication objects are in the appropriate state on the remote system.

14.2 ISDN Data Link Control (IDLC)

IDLC is IBM′s implementation of the CCITT recommendation for the Layer 2 protocol on the B channel. Because only the B-channel is used for actual data transfer, this is the most important field for performance investigation. On the other hand, because IDLC is a Layer 2 protocol, you cannot find any Layer 1-related information (physical line errors) here. As seen before, these are collected together with D-channel data.

The following list contains the main IDLC communications performance indicators:

- Line utilization (IDLC)
- Frame errors (IDLC)

14.2.1 Line Utilization (IDLC)

Line utilization is the percentage of elapsed time during which information transfer took place on the line. Because ISDN is full duplex, line utilization should be determined for both directions. Line utilization is an important performance indicator that requires special attention. Exceeding the guideline for line utilization may lead to unacceptable response times.

14.2.1.1 Using Performance Tools/400 to Display Line Utilization (IDLC)

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, “Tools Used for Finding Performance Problems” on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Communications Line Detail display shown in Figure 73 on page 211. The display shows you the line speed and the average line utilization for both transmit and receive in the column % Busy. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Press F13 to display the network interface data and use option 7=Display Channel Interval Data for the B-channel. The transmit, receive, and average line utilization for the sample intervals selected are listed in the Transmit/Receive/Average Line Util column heading.

```
                         Display Channel Interval Data

Network Interface  . :   ITSONWI06       Member . . . . . . . :   Q962981049
Channel  . . . . . . :   B2                Library  . . . . . :     QPFRDATA
Line speed . . . . . :   64.0            Elapsed time . . . . :   00:19:58
IOP name . . . . . . :   CC04

Type options, press Enter.
  5=Display remote jobs

                           Transmit/             Percent             Percent
                           Receive/    Total     Frames     Total    Frames
     Itv       Line         Average    Frames    Trnsmitd   Frames   Received
Opt  End       ID          Line Util  Trnsmitd    Again    Received  in Error
 _   10:54:28  ITSOISDN06  92/00/46      1347          0       1345         0
 _   10:59:28  ITSOISDN06  99/00/49      1450          0       1450         0
 _   11:04:28  ITSOISDN06  99/00/49      1454          0       1453         0
 _   11:09:28  ITSOISDN06  16/00/08       245          0        248         0


                                                                       Bottom
F3=Exit   F11=View2   F12=Cancel   F15=Sort by itv end   F19=Sort by line ID
F20=Sort by line util   F24=More keys
```

Figure 78. Channel Interval Data (View 1) - B-Channel Sample

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval as shown in Figure 78.

```
                                        Resource Interval Report                                  11/01/96 11:00:28
                                        Communications Line Detail                                        Page   9
                                        IDLCWDWSIZ(31) MAXFRAME(8192)
Member  . . . : Q962981049 Model/Serial  . : 510-2144/10-16CAD    Main storage  . . : 384.0 M   Started . . . : 10/24/96 10:49:28
  Library . . : QPFRDATA   System name . . :            SYSTEM01  Version/Release . :   3/6.0   Stopped . . . : 10/24/96 11:09:28
PROTOCOL = IDLC (SORT BY INTERVAL)
         IOP                    Transmit/           ---Frames----          ---Frames----
        Name/                   Receive/  Bytes     -Transmitted-  Bytes   --Received---  Receive                            Short
 Itv  Network    Line     Line  Average   Trnsmitd            Pct  Recd              Pct  CRC       Aborts   Sequence  Frame
 End  Interface  Descriptn Speed Line Util Per Sec  Total     Err  Per Sec  Total     Err  Errors    Recd     Error     Errors
----- ---------- ---------- ----- --------- -------- --------- --- ------- --------- --- -------  -------  --------  -------
        CC04
         (2605)
10:54 ITSONWI06  ITSOISDN06  64.0   92/00/46    7,364     1,347  0      29     1,345  0        0        0         0        0
10:54 ITSONWI07  ITSOISDN07  64.0   00/91/46       29     1,345  0   7,350     1,345  0        0        0         0        0
10:59 ITSONWI06  ITSOISDN06  64.0   99/00/49    7,937     1,450  0      30     1,450  0        0        0         0        0
10:59 ITSONWI07  ITSOISDN07  64.0   00/99/49       30     1,450  0   7,937     1,450  0        0        0         0        0
11:04 ITSONWI06  ITSOISDN06  64.0   99/00/49    7,948     1,454  0      31     1,453  0        0        0         0        0
11:04 ITSONWI07  ITSOISDN07  64.0   00/99/49       31     1,454  0   7,948     1,454  0        0        0         0        0
11:09 ITSONWI06  ITSOISDN06  64.0   16/00/08    1,328       245  0       5       248  0        0        0         0        0
11:09 ITSONWI07  ITSOISDN07  64.0   00/16/08        5       247  0   1,341       247  0        0        0         0        0
Itv End                -- End time of the data collection interval or time that vary
                          off occurred
IOP Name/              -- IOP resource name and model number, Network interface description
 Network Interface
Line Descriptn         -- Line Description
Line Speed             -- Line speed (1000 bits per second)
Transmit/Receive/      -- In full duplex mode, the percent of transmit line capacity
 Average Line Util        used, the percent of receive line capacity used, and
                          the average of transmit/receive capacity
Bytes Transmitd        -- Average number of bytes transmitted per second
 Per Sec
Frames Transmitted     -- Number of frames transmitted
 Total
Frames Transmitted     -- Percent frames re-transmitted due to error
 Pct Err
Bytes Recd Per Sec     -- Average number of bytes received per second
Frames Received Total  -- Number of frames received
Frames Received        -- Percent frames received in error
 Pct Err
Receive CRC Errors     -- Number of received frames that contained a CRC error
Aborts Recd            -- Number of frames received that contained HDLC
                          abort indicators
Sequence Error         -- Number of frames received that contained sequence errors
Short Frame Errors     -- Number of short frames received
```

Figure 79. Resource Report - Communications Line Detail

You can also print the system report with the PRTSYSRPT command, and analyze the Communications Summary section shown in Figure 81 on page 223. But be careful if you achieve an average line utilization approaching 50% (as in this example). ISDN lines are full duplex, so it can happen that one direction (transmit or receive) may be utilized nearly 100% while the other is utilized 0% giving an average near 50%. In these cases, always examine the Resource Interval report where you can see both directions separately.

```
                                              System Report                                       11/01/96 10:54:18
                                          Communications Summary                                          Page 0006
                                        IDLCWDWSIZ(31) MAXFRAME(8192)
Member  . . . : Q962981049 Model/Serial  . : 510-2144/10-16CAD   Main storage . . :  384.0 M   Started  . . . . : 10/24/96 10:49:28
  Library . . : QPFRDATA   System name . . :          SYSTEM01   Version/Release  :   3/ 6.0   Stopped  . . . . : 10/24/96 11:09:28
     IOP Name/                     Line      Avg     Max     Active       Number       Average      ------ Bytes Per Second -----
       Line            Protocol    Speed     Util    Util    Devices   Transactions    Response      Received        Transmitted
--------------------   --------   -------    ----    ----    -------   ------------    --------     ---------        -----------
CC04          (2623)
  ITSOISDN06            IDLC          64.0     38      49         0              0          .00          24.1             6147.4
  ITSOISDN07            IDLC          64.0     38      49         0              0          .00        6147.4               24.1
IOP Name/Line          --  IOP Resource name and model number, Line ID
Protocol               --  Line protocol (SDLC, ASYNC, BSC, X25, TRLAN, ELAN, IDLC, DDI, FRLY)
Line Speed             --  Line speed (1000 bits per second)
                           (For IDLC this is the maximum over the measurement)
Avg Util               --  Average line utilization
Max Util               --  Maximum line utilization in all measurement intervals
Active Devices         --  Average number of active devices on the line
Number Transactions    --  Number of transactions
Average Response       --  Average system response (service) time (seconds)
Bytes /Sec Received    --  Average number of bytes received per second
Bytes /Sec Transmitted --  Average number of bytes transmitted per second
```

Figure 80. Resource Report - Communications Line Detail

14.2.1.2 Performance Monitor Database Fields (IDLC)

The following fields in the performance monitor database file QAPMIDLC are related to the line utilization:

ISBRCV The total number of bytes received from the remote station. This includes no errors.

ISBTRN The total number of bytes transmitted including bytes transmitted again

ISLSP The speed of the line in bits per second (bps)

INTSEC Number of seconds since the last elapsed interval

The transmit line utilization is derived from the following equation:

```
Transmit line utilization = ISBTRN * 8 * 100 / (INTSEC * ISLSP)
```

The receive line utilization is derived from the following equation:

```
Receive line utilization = ISBRCV * 8 * 100 / (INTSEC * ISLSP)
```

You have to multiply by eight to get the number of *bits* transmitted (because the line speed is given in *bits* per second and multiply by 100 to get the percent value instead of a fraction.

Line utilization is calculated per interval, that is, the time you have specified on the INTERVAL parameter of the STRPFRMON command.

Appendix H, "ISDN Queries" on page 361 lists the sample queries (IDLC_ALL, and IDLC_UTIL) to show the values previously mentioned.

14.2.2 Line Errors (IDLC)

The Performance Monitor does not collect line error data for IDLC. Please see Section 14.1.2, "Line Errors" on page 213 for line errors occurring on the network interface.

14.2.3 Frame Errors (IDLC)

The performance monitor collects data in the QAPMIDLC file about the number of:

- Frame retransmissions
- Frames received in error
- Invalid frames received

Frame retransmission is normally caused due to frames received in error and by link resets. To avoid communications performance problems, this number should be zero or low. The following fields from the performance monitor can be used to determine the retransmission error rates:

ILCRCE The number of frames received that contained a cyclic redundancy check (CRC) error

ILSFE The number of short frames received. A short frame is a frame that has fewer octets between its start and end flags than is permitted.

ILORUN Receive overrun. The number of times the ISDN subsystem could not keep pace with incoming data because of local controller overload.

ILURUN Trasmit underrun. The number of times the ISDN subsystem could not keep pace with outgoing data because of local controller overload.

ILABRT The number of frames received that contained an HDLC abort indicator.

ISFTRN Number of frames transmitted (information (I), unnumbered information (UI), and supervisory (S)). This includes frames retransmitted and frames sent on transmission stopped by transmit underrun.

ISFRT Number of frames transmitted again

The percent of frames transmitted with errors is derived from the following equation:

```
Percent of frames transmitted with errors = (ISFRT * 100) / ISFTRN
```

The following fields from the performance monitor can be used to determine the number or percent of frames received in error or that are not valid:

ISFRCV Total number of frames received (information (I), unnumbered information (UI), and supervisory (S)). This includes no errors.

ILFRIE The total number of frames received in error. This is the sum of the following errors :

- Cyclic redundancy check (CRC) error (ILCRCE)
- Short frame error (ILSFE)
- Receive overrun (ILORUN)
- Transmit underrun (ILURUN)
- Frame abort (ILABRT)
- Frame sequence error (ISSEQE)

The percent of frames received in error is derived from the following equation:

```
Percent of frames received in error = (ILFRIE * 100) / (ISFRCV + ILFRIE)
```

Appendix H, “ISDN Queries” on page 361 lists the sample queries (IDLC_ALL and IDLC_UTIL) that show the values previously mentioned.

14.2.4 Using Performance Tools/400 to Display Frame Errors (IDLC)

Use DSPPFRDTA to access the Channel Interval Data display as described in Section 14.2.1.1, “Using Performance Tools/400 to Display Line Utilization (IDLC)” on page 218. This display shows you the total number of frames transmitted, the percent of frames transmitted again, the total number of frames received, and the percent of frames received in error. Please refer to Figure 78 on page 219.

Press F11 to view frame counters.

```
                         Display Channel Interval Data

 Network Interface  . :   ITSONWI06       Member . . . . . . . :   Q962981049
 Channel  . . . . . . :   B2                Library  . . . . . :     QPFRDATA
 Line speed . . . . . :   64.0            Elapsed time . . . . :   00:19:58
 IOP name . . . . . . :   CC04

 Type options, press Enter.
   5=Display remote jobs


                    Bytes    Bytes              Receive   Short
      Itv        Trnsmitd     Recd   Sequence     CRC     Frame  Aborts
 Opt  End         Per Sec  Per Sec     Error    Errors   Errors   Recd
  _   10:54:28     7364         29         0         0        0       0
  _   10:59:28     7937         30         0         0        0       0
  _   11:04:28     7948         31         0         0        0       0
  _   11:09:28     1328          5         0         0        0       0


                                                                         Bottom
 F3=Exit   F11=View1   F12=Cancel   F15=Sort by itv end   F19=Sort by line ID
 F20=Sort by line util   F24=More keys
```

Figure 81. Channel Interval Data (View 2) - B-Channel Sample

14.3 ISDN Used with X.25 (X.31)

There are two different methods to use X.25 on an ISDN: circuit mode and packet mode. In either mode, the ISDN may be accessed by switched or permanent channels. Some access methods may not be available from some network providers. Permanent ISDN channels, defined by the network subscription, are always ready to be used for X.25 communications.

14.3.1 Circuit Mode

- X.25 DTE-to-DTE (as defined in the ISO 8208 standard): The X.25 standards define procedures for the connection of one DTE directly to another DTE without actually using a packet-switched network. This type of connection requires that one of the DTEs provide a subset of the DCE functions. The procedure for the packet transfer is transparent to the ISDN. The D-channel provides call control to set up the connection for switched B-channels.
- X.31 case A: CCITT recommendation X.31 case A describes the use of an ISDN B-channel as a high-speed transportation medium. This establishes a connection between a DTE and a DCE. The D-channel provides the necessary call control to establish the connection. Again, once the B-channel connection is established, the packet transfer is transparent to the ISDN. Likewise, for the X.25 connection, the use of the ISDN is transparent.

14.3.2 Packet Mode

Recommendation X.31 Case B describes how an X.25 DTE can use ISDN packet services. For switched B-channels, the D-channel is used to set up an ISDN connection to a *packet handler* within the ISDN that routes packets through the ISDN much in the same way as an X.25 network.

14.3.3 Performance Monitor Database Fields

The Performance Monitor collects data about X.25 on an ISDN in the QAPMX25 database file. Please see Appendix C, "X.25 Queries" on page 275 for a detailed description about analyzing X.25 performance data.

14.4 Recommendations

> **Note**
>
> The AS/400 system is designed to connect to several types of ISDN networks. You can find the complete listing of networks in the *AS/400 ISDN Support* manual. Some changes described in this chapter may influence your network subscription parameters. Contact your network provider before making changes to the network interface description.

Receive and transmit errors can occur when the AS/400 system, the network, or the remote device have an error or cannot process received data fast enough (see also Section 8.1.3, "Congestion" on page 133 for congestion). Factors that can influence the performance because of a retransmission are:

- Line quality
- Frame size
- Window size
- Packet size (X.25 only)

Line quality: If the percentage of errors on a line is about 5% for a few intervals that had I-frames transmitted, check the local and remote connections. Ensure that all cables are properly shielded, that they are the correct cable type, and that all plug connections are secure. There should be no ribbon cables (flat, unshielded cables) anywhere between the system and the network termination (NT). Sometimes the errors can be caused by electrical ″noise″ or interference. If problems still occur, contact your line supplier to have the line tested. You might consider changing to a better quality line.

14.4.1 Frame Size

- AS/400 support for IDLC allows a range of frame sizes up to 8196 bytes. The frame size is specified with the MAXFRAME parameter in the line and controller descriptions. If you specify different values in the line and controller descriptions, the smaller value is used. In general, large frames provide better performance, especially with large file transfers. However, large frames do not perform well with error-prone lines due to longer retransmission times. Also, if a large frame is transmitted, the line is unavailable to any other transport so interactive sessions that normally use less amount of data might be adversely affected by batch file transfers, even if the right mode descriptions (MODD) and class-of-service (COS) are used.

  Maximum length of Request/Response Unit (RU): The maximum length of an SNA request/response unit (RU) can be specified with the MAXLENRU parameter in a mode description or in some device descriptions. If you specify *CALC on the MAXLENRU parameter, an SNA RU size is automatically selected that is compatible with the frame size. If you choose to set the value yourself, use an RU size that is slightly less than the frame size or a multiple of a frame size. The reason for this is that SNA adds an additional nine bytes of overhead (three bytes request/response header (RH), and six bytes transmission header (TH)). Therefore, a RU size should be chosen so that the RU size plus nine equals the frame size or a multiple of frame sizes. If you choose an RU size that is slightly greater than a multiple of frame sizes, this results in an extra short frame carrying only a small amount of data.

- For X.25, the frame size is also specified with the MAXFRAME parameter in the line and controller descriptions. The AS/400 supports frame sizes up to 4096 bytes. The considerations for the maximum length of a request/response units are similar to the IDLC case. If you use *CALC for the MAXLENRU parameter, the system selects an efficient size that is compatible with the packet size.

14.4.2 Window Size

- For IDLC, the window size is specified with the IDLCWDWSIZ parameter in the line and controller descriptions. The AS/400 support for IDLC allows a maximum window size of 31. As with large frame sizes, a large window size may not work well for error-prone networks.
- For X.25, the packet window size is a similar parameter. The maximum packet window size you can set depends on the MODULUS parameter of the line description. If you set MODULUS to eight, you can set the default window size (DFTWDWSIZE) to seven. If MODULUS is set to 128, DFTWDWSIZE can be set to 15. Usually (especially in an environment with large batch file transfers) a larger window size yields better performance. This parameter must match your X.25 subscription value.

14.4.3 Packet Size (X.25 Only)

- The packet size is specified using the DFTPKTSIZE parameter in the line and controller descriptions and the MAXPKTSIZE parameter in the line description. Larger packet sizes provide better performance. However, in case of an error-prone line, large packet sizes may not work well. The large packets have a higher probability for errors in this environment and take longer to transmit again. However, in general, it is preferable to use the largest packet size supported by the X.25 network. In conjunction with the packet size, if you specify *CALC for the MAXLENRU parameter, the system selects an efficient RU size. If you choose to set the value for this parameter yourself, select an RU size so that the RU size is a multiple of the packet size less the length of the SNA headers. The following SNA headers must be considered:

  – LLC header. If you use ELLC, the length of the ELLC header is six bytes. QLLC does not use an LLC header.

  – Transmission header (TH). The length of the TH is six bytes.

  – Request/response header (RH). The length of the RH is three bytes.

  Thus, for ELLC, use an RU size that is 15 bytes less than a multiple of the packet size and for QLLC, the RU size should be nine bytes less than a multiple of the packet size.

This parameter must match your X.25 subscription value.

In general, IDLC is expected to give better performance results in an error-free environment because of the larger frame and window sizes and because it adds less protocol overhead.

14.4.4 A Case Study

A series of tests were conducted at the ITSO to investigate the impact of the parameters previously described. The tests involved two 2605 adapters in the same 2623 communications IOP connected through a special loop wiring. One of the B-channels was used for a permanent IDLC connection, and an X.25 PVC was defined over the other permanent ISDN connection. A file of approximately 1.5MB was sent using these connections through SNA Distribution Services (SNADS) in one direction at one time.

The results are summarized in the following table:

Table 15. SNADS Transfer with Different Protocols

Protocol	Frame size	Packet size	Window size	Transfer time	IOP Utilization
IDLC	2048	N/A	7	181	5.8
IDLC	8192	N/A	31	180	2.3
X.25	1024	128	2	231	92.8
X.25	4096	4096	15	187	24.3

Appendix A. SDLC Queries

This section provides query definitions that can be used to examine SDLC environments. All of the queries use input from the OS/400 Performance Monitor run with the trace option. There are four queries defined:

- SDLC_ALL
- SDLC_HDLC
- SDLC_IOP
- SDLC_JOB

The SLDC_ALL query is simple. It shows you all of the values in the QAPMHDLC file. The only thing you have to define is the file name and member name that contains the performance data. The rest are defaults so it takes you only a few minutes to create the query.

The SLDC_HDLC query shows you the most important performance values for the SDLC environment.

The SDLC_IOP query shows you performance values of the IOP to which the line is connected.

The SDLC_JOB query shows you performance values of the JOBS that are running on the SDLC line.

A.1 SDLC_ALL

```
  Query . . . . . . . . . . . . . . . . . SDLC_ALL
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . All SDLC Performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMHDLC       QPFRDATA      SDLC          QAPMHDLR

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number
  DTETIM                                       Interval Date and Time
  INTSEC                                       Elapsed Interval Seconds
  IOPRN                                        IOP Resource Name
  SHTYPE                                       IOP Type
  SHLND                                        Line Description
  SHLSP                                        Line Speed
  SHBTRN                                       Bytes Transmitted
  SHBRCV                                       Bytes Received
  SHPRCL                                       Protocol
  SHFTRN                                       Frames Transmitted
  SHIFTR                                       I Frames Transmitted
  SHIFRT                                       I Frames Retransmitted
  SHFRT                                        Frames Retransmitted
  SHEFFR                                       Error Free Frames Received
  SHEFIR                                       Error Free I Frames Received
  SHFRIE                                       Frames Received in Error
  SHIFR                                        Invalid Frames Received
  SHRRFT                                       RR Frames Transmitted
  SHRRFR                                       RR Frames Received
  SHRNRT                                       RNR Frames Transmitted
  SHRNRR                                       RNR Frames Received
  SHLNKR                                       Link Resets
  SHCPT                                        Polling Wait Time
```

Figure 82. SDLC_ALL Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides

  Field           Summary    Column                                 Dec  Null        Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                  5    0
                                      Interval
                                      Number
  DTETIM                     2        Interval                 12
                                      Date
                                      Time
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
  IOPRN                      2        IOP                      10
                                      Resource
                                      Name
  SHTYPE                     2                                  4
                                      IOP
                                      Type
  SHLND                      2                                 10
                                      Line
                                      Description
  SHLSP                      2                                 11    0
                                      Line
                                      Speed
  SHBTRN                     2                                 11    0
                                      Bytes
                                      Transmitted
  SHBRCV                     2                                 11    0
                                      Bytes
                                      Received
  SHPRCL                     2                                  1
                                      Protocol
  SHFTRN                     2                                 11    0
                                      Frames
                                      Transmitted
  SHIFTR                     2                                 11    0
                                      I Frames
                                      Transmitted
  SHIFRT                     2                                 11    0
                                      I Frames
                                      Retransmitted
  SHFRT                      2                                 11    0
                                      Frames
                                      Retransmitted
  SHEFFR                     2        Error Free               11    0
                                      Frames
                                      Received
  SHEFIR                     2        Error Free               11    0
                                      I Frames
                                      Received
  SHFRIE                     2        Frames                   11    0
                                      Received
                                      in Error
  SHIFR                      2        Invalid                  11    0
                                      Frames
                                      Received
  SHRRFT                     2        RR                       11    0
                                      Frames
                                      Transmitted
  SHRRFR                     2        RR                       11    0
                                      Frames
                                      Received
  SHRNRT                     2        RNR                      11    0
                                      Frames
                                      Transmitted
  SHRNRR                     2        RNR                      11    0
                                      Frames
                                      Received
  SHLNKR                     2                                 11    0
                                      Link
                                      Resets
  SHCPT                      2        Polling                   3    0
                                      Wait
                                      Time
```

Figure 83. SDLC_ALL Query, Part 2

```
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 84. SDLC_ALL Query, Part 3

A.2 SDLC_HDLC

```
  Query . . . . . . . . . . . . . . . . . SDLC_HDLC
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . SDLC performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMHDLC       QPFRDATA      SDLC          QAPMHDLR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  LINEUTIL    (SHBRCV + SHBTRN) * 800 / INTSEC  Line Util                 4    1
              / SHLSP
  PCERRTR     (SHFRT * 100) / (SHFRT + SHFTRN)  Pct Frames                4    1
                                                Trnsmitd
                                                in Error
  PCIERRTR    (SHIFRT * 100) / (SHIFRT +        Pct I Frames              4    1
              SHIFTR)                           Trnsmitd
                                                in Error
  PCERRRCV    ((SHIFR + SHFRIE) * 100) /        Pct Frames                4    1
              (SHEFFR + SHIFR + SHFRIE)         Recd
                                                in Error
  PCPOLL      ((SHCPT * (SHFRT - SHIFRT)) *     Pct Poll                  4    1
              100) / (INTSEC * 10)              Retry
                                                Time
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
  LCLNOTR     SHRNRT / (SHEFFR + SHFRIE +       Local                     4    1
              SHIFR + SHRRFR + SHRNRR)          Not
                                                Ready
  RMTNOTR     SHRNRR / (SHIFTR + SHIFRT +       Remote                    4    1
              SHRRFT + SHRNRT)                  Not
                                                Ready

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SHLND           10        A           1      Line Description
  DATE
  TIME
  LINEUTIL
  PCERRTR
  PCIERRTR
  PCERRRCV
  PCPOLL
  LCLNOTR
  RMTNOTR
  SHLNKR                                       Link Resets
```

Figure 85. SDLC_HDLC Query, Part 1

```
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SHLND                      0                                 10
                                      Line
                                      Description
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  LINEUTIL        2 4        2        Line Util                 4    1
  PCERRTR         2 4        2        Pct Frames                4    1
                                      Trnsmitd
                                      in Error
  PCIERRTR        2 4        2        Pct I Frames              4    1
                                      Trnsmitd
                                      in Error
  PCERRRCV        2 4        2        Pct Frames                4    1
                                      Recd
                                      in Error
  PCPOLL          2 4        2        Pct Poll                  4    1
                                      Retry
                                      Time
  LCLNOTR         2 4        2        Local                     4    1
                                      Not
                                      Ready
  RMTNOTR         2 4        2        Remote                    4    1
                                      Not
                                      Ready
  SHLNKR          1          2                                 11    0         11    0
                                      Link
                                      Resets

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for line &SHLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 86. SDLC_HDLC Query, Part 2

A.3 SDLC_IOP

A.3.1 IOP Query for a Communications Processor

```
 Query . . . . . . . . . . . . . . . . . SDLC_IOP
   Library . . . . . . . . . . . . . . . ITSCID03
 Query text  . . . . . . . . . . . . . . SDLC and IOP related performance fields
 Query CCSID . . . . . . . . . . . . . .    37
 Query language id . . . . . . . . . . . ENU
 Query country id  . . . . . . . . . . . US
   *** . is the decimal separator character for this query ***
 Collating sequence  . . . . . . . . . . Hexadecimal

 Processing options
   Use rounding  . . . . . . . . . . . . Yes (default)
   Ignore decimal data errors  . . . . . No (default)
   Ignore substitution warnings  . . . . Yes
   Use collating for all compares  . . . Yes
 Special conditions
   *** All records selected by default ***

Selected files
 ID    File         Library      Member       Record Format
 T01   QAPMHDLC     QPFRDATA     SDLC         QAPMHDLR
 T02   QAPMCIOP     QPFRDATA     SDLC         QAPMCIOR

Join tests
 Type of join  . . . . . . . . . . . . . Matched records
 Field            Test             Field
 T01.INTNUM       EQ               T02.INTNUM
 T01.IOPRN        EQ               T02.IOPRN

Result fields
 Name       Expression                        Column Heading         Len  Dec

 LINEUTIL   (SHBTRN + SHBRCV) * 800 /         Line                     4    1
            T01.INTSEC / SHLSP                Util
 DATE       substr(T01.DTETIM,3,2) || '/' ||  Date
            substr(T01.DTETIM,5,2)
 TIME       substr(T01.DTETIM,7,2) || ':' ||  Time
            substr(T01.DTETIM,9,2)
 LCLNOTR    SHRNRT / (SHEFFR + SHFRIE +       Local                    4    1
            SHIFR + SHRRFR + SHRNRR)          Not
                                              Ready
 RMTNOTR    SHRNRR / (SHIFTR + SHIFRT +       Remote                   4    1
            SHRRFT + SHRNRT)                  Not
                                              Ready
 IOPUTIL    100 - ((CIIDLC * CIIDLT) /        Pct IOP                  4    1
            (1000000 * T02.INTSEC))           Util

Ordering of selected fields

 Field          Sort      Ascending/  Break  Field
 Name           Priority  Descending  Level  Text
 T01.INTNUM                                  Interval Number
 T01.IOPRN                            1      IOP Resource Name
 T01.SHTYPE                                  IOP Type
 T01.SHLND                            2      Line Description
 DATE
 TIME
 LINEUTIL
 IOPUTIL
 T01.SHBTRN                                  Bytes Transmitted
 T01.SHBRCV                                  Bytes Received
 LCLNOTR
 RMTNOTR
```

Figure 87. SDLC_IOP Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T01.INTNUM                 0                                  5    0
                                      Interval
                                      Number
  T01.IOPRN                  2        IOP                      10
                                      Resource
                                      Name
  T01.SHTYPE                 2                                  4
                                      IOP
                                      Type
  T01.SHLND                  2                                 10
                                      Line
                                      Description
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  LINEUTIL        2 4        2        Line                      4    1          4    1
                                      Util
  IOPUTIL         2 4        2        Pct IOP                   4    1          4    1
                                      Util
  T01.SHBTRN      1          2                                 11    0          8    0
                                      Bytes
                                      Transmitted
  T01.SHBRCV      1          2                                 11    0          8    0
                                      Bytes
                                      Received
  LCLNOTR         2 4        2        Local                     4    1          4    1
                                      Not
                                      Ready
  RMTNOTR         2 4        2        Remote                    4    1          4    1
                                      Not
                                      Ready
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    Yes
  2      No    No

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 88. SDLC_IOP Query, Part 2

A.3.2 IOP Query for MFIO Processor

```
  Query . . . . . . . . . . . . . . . . . SDLC_MIOP
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . SDLC and IOP related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMHDLC       QPFRDATA      SDLC          QAPMHDLR
  T02    QAPMMIOP       QPFRDATA      SDLC          QAPMMIOR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.INTNUM         EQ                T02.INTNUM
  T01.IOPRN          EQ                T02.IOPRN

Result fields
  Name        Expression                          Column Heading          Len  Dec
  LINEUTIL    (SHBTRN + SHBRCV) * 800 /           Line                      4    1
              T01.INTSEC / SHLSP                  Util
  DATE        substr(T01.DTETIM,3,2) || '/' ||    Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||    Time
              substr(T01.DTETIM,9,2)
  LCLNOTR     SHRNRT / (SHEFFR + SHFRIE +         Local                     4    1
              SHIFR + SHRRFR + SHRNRR)            Not
                                                  Ready
  RMTNOTR     SHRNRR / (SHIFTR + SHIFRT +         Remote                    4    1
              SHRRFT + SHRNRT)                    Not
                                                  Ready
  IOPUTIL     100 - ((MIIDLC * MIIDLT) /          Pct IOP                   4    1
              (1000000 * T02.INTSEC))             Util
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.INTNUM                                   Interval Number
  T01.IOPRN                             1      IOP Resource Name
  T01.SHTYPE                                   IOP Type
  T01.SHLND                             2      Line Description
  DATE
  TIME
  LINEUTIL
  IOPUTIL
  T01.SHBTRN                                   Bytes Transmitted
  T01.SHBRCV                                   Bytes Received
  LCLNOTR
  RMTNOTR
```

Figure 89. SDLC_MIOP Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                                 Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T01.INTNUM                 0                                  5    0
                                      Interval
                                      Number
  T01.IOPRN                  2        IOP                      10
                                      Resource
                                      Name
  T01.SHTYPE                 2                                  4
                                      IOP
                                      Type
  T01.SHLND                  2                                 10
                                      Line
                                      Description
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  LINEUTIL        2 4        2        Line                      4    1         4    1
                                      Util
  IOPUTIL         2 4        2        Pct IOP                   4    1         4    1
                                      Util
  T01.SHBTRN      1          2                                 11    0         8    0
                                      Bytes
                                      Transmitted
  T01.SHBRCV      1          2                                 11    0         8    0
                                      Bytes
                                      Received
  LCLNOTR         2 4        2        Local                     4    1         4    1
                                      Not
                                      Ready
  RMTNOTR         2 4        2        Remote                    4    1         4    1
                                      Not
                                      Ready
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    Yes
  2      No    No

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 90. SDLC_MIOP Query, Part 2

A.4 SDLC_JOB

```
  Query . . . . . . . . . . . . . . . . SDLC_JOB
    Library . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . SDLC and JOB related performance fields
  Query CCSID . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . No (default)
    Ignore substitution warnings  . . . Yes
    Use collating for all compares  . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMHDLC       QPFRDATA      SDLC          QAPMHDLR
  T02    QAPMJOBS       QPFRDATA      SDLC          QAPMJOBR

Join tests
  Type of join  . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.SHLND          EQ                T02.JBLND
  T01.INTNUM         EQ                T02.INTNUM

Result fields
  Name        Expression                         Column Heading          Len  Dec
  LINEUTIL    (SHBRCV + SHBTRN) * 800 /          Total                     4    1
              T01.INTSEC / SHLSP                 Line
                                                 Util
  DATE        substr(T01.DTETIM,3,2) || '/' ||   Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||   Time
              substr(T01.DTETIM,9,2)
  AVGJOBRSP   JBRSP / (JBNTR + 0000.1)           Job avg
                                                 response
                                                 time
  PCTCPU      ((JBCPU / 1000) * 100) /           Pct                       4    1
              T01.INTSEC                         CPU
                                                 Usage

Ordering of selected fields

  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.JBNAME      10        A           1      Job Name
  T02.JBUSER      20        A           1      Job User
  T02.JBNBR       30        A           1      Job Number
  T01.SHLND                                    Line Description
  T01.IOPRN                                    IOP Resource Name
  T01.SHTYPE                                   IOP Type
  DATE
  TIME
  AVGJOBRSP
  PCTCPU
  LINEUTIL
```

Figure 91. SDLC_JOB Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field            Summary    Column                                  Dec  Null       Dec  Numeric
  Name             Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T02.JBNAME                  0                                10
                                       Job
                                       Name
  T02.JBUSER                  2                                10
                                       Job
                                       User
  T02.JBNBR                   2                                 6
                                       Job
                                       Number
  T01.SHLND                   2                                10
                                       Line
                                       Description
  T01.IOPRN                   2        IOP                     10
                                       Resource
                                       Name
  T01.SHTYPE                  2                                 4
                                       IOP
                                       Type
  DATE                        2        Date                     5
  TIME                        2        Time                     5
  AVGJOBRSP        2 4        2        Job avg                 16    3
                                       response
                                       time
  PCTCPU           2 4        2        Pct                      4    1
                                       CPU
                                       Usage
  LINEUTIL                    2        Total                    4    1
                                       Line
                                       Util
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for job &JBNAME &JBUSER &JBNBR

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 152
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 92. SDLC_JOB Query, Part 2

Appendix B. Local Area Network Queries

This appendix contains query examples to help you measure your LAN performance. Queries for both token-ring networks and Ethernet networks are provided. These queries make use of the performance data collected by the OS/400 Performance Monitor. Basically, the files used in these queries are:

QAPMCIOP Communications Controller IOP Data File

QAPMECL Token-Ring Network/Statistics File

QAPMSTNL Token-Ring Station File

QAPMETH Ethernet Network/Statistics File

QAPMSTNE Ethernet Station File

B.1 Token-Ring LAN Query

Three examples of queries you can use to identify performance bottlenecks in token-ring LANs are discussed here:

1. TRNQRY

   This query, which prints the Token-Ring LAN Performance Indicators Report, shows you the values of the main performance indicators that were discussed in Chapter 6, "Communications I/O Processor (IOP)" on page 89. Use this report to compare with the threshold values of the performance indicators to obtain an overview of the performance on your token-ring LAN. The information that is provided in this report is shown in the following list:

   - Line utilization
   - IOP utilization
   - Overrun indicators
     - Local Not Ready
     - Local Sequence Error
     - Remote Not Ready
     - Remote Sequence Error
   - T1 Timers time-outs
   - MAC errors rate
   - Retransmission rate

   The query definition is shown in Section B.1.4, "Token-Ring LAN Performance Indicators Query" on page 244.

2. TRNMACQRYx (x = 1,2 and 3 representing Reports 1,2 and 3 respectively)

   This query prints three reports showing all of the MAC error counters contained in the Token-Ring Performance Data File. A high value in any of these counters should be investigated. The query definition is shown in Section B.1.5, "Token-Ring LAN MAC Error Counters Query" on page 248.

   Run query 1 and 2 in sequence starting from the query TRNQRY followed by the queries TRNMACQRYx. Alternatively, you can run both queries consecutively from a CL program. The detailed listing of this CL program is shown in Figure 95 on page 242. This program first generates the Token-Ring Performance Indicators Report and prints the detailed MAC Error Counters Report if the average MAC error rate exceeds 1% of the total frames transmitted and received.

The output of both queries is in Figure 93 on page 241 and Figure 94 on page 241.

3. TRNUSAGE

   This query analyzes the overhead generated in a token-ring LAN against the total frames transmitted and received in each time interval. The listing of this query definition is shown in Section B.1.6, "Token-Ring LAN Overhead Query" on page 254.

B.1.1 Sample Report Output

```
10/28/96  16:57:31                             Token-Ring LAN Performance Indicators Report                   PAGE    1

      IOP                        IOP        Line      Local Not Local Seq  Remote    Remote Seq T1 timer  MAC       Retransmission
      Resource   Line        Utilization Utilization  Ready     Error   Not Ready    Error   time-out Errors         Rate
      Name       Description    (%)         (%)        (%)       (%)       (%)         (%)    rate(%)   (%)
      CC01       TRNLINE1
                            Summary for : TRNLINE1
                            AVG   1.2          .0         .0        .0        .0         .0       2.7      .0               .0
                            MAX   1.5          .1         .0        .0        .0         .0      16.7      .0               .0

      CC02       TRNLINE2
                            Summary for : TRNLINE2
                            AVG   1.1          .1         .0        .0        .0         .0        .0      .0               .0
                            MAX   5.7         1.5         .0        .0        .0         .0        .0      .0               .0

      CC03       TRNLINE3
                            Summary for : TRNLINE3
                            AVG   3.9         1.7         .0        .0        .0         .0        .0      .0               .0
                            MAX   5.2         2.6         .0        .0        .0         .0        .0      .0               .0

      CC04       TRNLINE5
                            Summary for : TRNLINE5
                            AVG   2.2          .1         .0        .0        .0         .0       2.1      .0               .0
                            MAX   3.4          .2         .0        .0        .0         .0      13.6      .0               .0

                            Summary for all Token-ring LANs
                            AVG   1.5          .1         .0        .0        .0         .0       1.4      .0               .0
                            MAX   5.7         2.6         .0        .0        .0         .0      16.7      .0               .0

* * *  E N D  O F  R E P O R T  * * *
```

Figure 93. Sample Token-Ring LAN Performance Indicators Report

```
10/25/96  09:43:28                                        Token-Ring LAN MAC Errors Counters Report 3                  PAGE    1


IOP                 MAC    MAC                                                          IOA
Resource  Line      Err    Err       Unauth      Unauth      SOFR      Transmit     Status           Frames           Spurious
Name      Desc      Avg%   Max%      AP          MF          Error     Beacon       Overrun          Discarded        Interrupts

CC01      LINTRN     1.3    3.6
                           Summary for Token-ring: LINTRN
                           TOTAL          0           0           0           0           0               2,695                0

                           Summary for all Token-Ring LANs
                           TOTAL          0           0           0           0           0               2,695                0

* * *  E N D  O F  R E P O R T  * * *
```

Figure 94. Sample Token-Ring LAN MAC Error Counters Report

B.1.2 CL Program to Execute the Token-Ring LAN Queries

```
5763PW1 V3R1M0  940909                SEU SOURCE LISTING                           03/31/96 11:33:47               PAGE    1
SOURCE FILE . . . . . . .  MYLIB/QCLSRC
MEMBER  . . . . . . . . .  TOKENQRY
SEQNBR*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8 ...+... 9 ...+... 0
  100 /*********************************************************************/                           03/31/96
  400 /*                                                                   */                           03/31/96
  500 /* Program name : TOKENQRY                                           */                           03/31/96
  600 /* PURPOSE      : THIS CL PROGRAM WILL GENERATE A TOKEN RING         */                           03/31/96
  700 /*                LAN PERFORMANCE INDICATORS REPORT SHOWING          */                           03/31/96
  800 /*                - IOP UTILIZATION                                  */                           03/31/96
  900 /*                - LINE UTILIZATION                                 */                           03/31/96
 1000 /*                - IOA OVERRUN STATISTICS                           */                           03/31/96
 1100 /*                - T1 TIMER TIME-OUT RATE                           */                           03/31/96
 1200 /*                - MAC ERRORS                                       */                           03/31/96
 1500 /*                                                                   */                           03/31/96
 1600 /*                IF THE MAC ERRORS ARE SIGNIFICANT, A REPORT        */                           03/31/96
 1700 /*                SHOWING ALL THE MAC ERRORS WILL BE GENERATED       */                           03/31/96
 1900 /*                                                                   */                           03/31/96
 2000 /*********************************************************************/                           03/31/96
 2100      PGM  PARM(&MEM)                                                                              03/31/96
 2200 DCL &MEM *CHAR 10                                                                                 03/31/96
 2300 DCL &STRNG *CHAR 100 VALUE('RUNQRY QRY(MYLIB/SAPQRY) +                                            03/31/96
 2400                             QRYFILE((*RUNOPT/QAPMSAP MMMMMMMMMM))')                               03/31/96
 2500 DCL &STRNG2 *CHAR 200 VALUE('RUNQRY QRY(MYLIB/TRNQRY2) +                                          03/31/96
 2600                             QRYFILE((*RUNOPT/QAPMECL MMMMMMMMMM) +                                03/31/96
 2700                             (*RUNOPT/QAPMCIOP MMMMMMMMMM) +                                       03/31/96
 2800                             (*RUNOPT/*SAME))')                                                    03/31/96
 2900 DCL &STRNG3 *CHAR 200 VALUE('RUNQRY QRY(MYLIB/TRNQRY2) +                                          03/31/96
 3000                             QRYFILE((*RUNOPT/QAPMECL MMMMMMMMMM) +                                03/31/96
 3100                             (*RUNOPT/QAPMCIOP MMMMMMMMMM) +                                       03/31/96
 3200                             (*RUNOPT/*SAME)) +                                                    03/31/96
 3300                     OUTTYPE(*OUTFILE) OUTFILE(MYLIB/TRNPFRIND)')                                  03/31/96
 3400 DCL &STRNG4 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/TRNMACQRY1) +                                       03/31/96
 3500                             QRYFILE((*RUNOPT/*SAME) +                                             03/31/96
 3600                             (*RUNOPT/QAPMECL MMMMMMMMMM))')                                       03/31/96
 3700 DCL &STRNG5 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/TRNMACQRY2) +                                       03/31/96
 3800                             QRYFILE((*RUNOPT/*SAME) +                                             03/31/96
 3900                             (*RUNOPT/QAPMECL MMMMMMMMMM))')                                       03/31/96
 4000 DCL &STRNG6 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/TRNMACQRY3) +                                       03/31/96
 4100                             QRYFILE((*RUNOPT/*SAME) +                                             03/31/96
 4200                             (*RUNOPT/QAPMECL MMMMMMMMMM))')                                       03/31/96
 4300 DCLF FILE(MYLIB/TRNPFRIND)                                                                        03/31/96
 4400 /*  SETUP THE RUNQRY COMMAND STRING  */                                                           03/31/96
 4500 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                        03/31/96
 4600       CHGVAR     VAR(%SST(&STRNG 51 10)) VALUE(&MEM)                                              03/31/96
 4800 /*  RUNQRY QRY(MYLIB/SAPQRY)         */                                                           03/31/96
 5000       CALL PGM(QCMDEXC) PARM(&STRNG 100)                                                          03/31/96
 5100 /*  SETUP THE SECOND RUNQRY COMMAND STRING  */                                                    03/31/96
 5200 /*  SET MEMBER NAME FIELDS           */                                                           03/31/96
 5300       CHGVAR     VAR(%SST(&STRNG2 52 10)) VALUE(&MEM)                                             03/31/96
 5600       CHGVAR     VAR(%SST(&STRNG2 82 10)) VALUE(&MEM)                                             03/31/96
 5900 /*   RUNQRY QRY(MYLIB/TRNQRY)  */                                                                 03/31/96
 6000       CALL PGM(QCMDEXC) PARM(&STRNG2 200)                                                         03/31/96
 6100       DLTF FILE(MYLIB/TRNPFRIND)                                                                  03/31/96
 6200       MONMSG MSGID(CPF2105)                                                                       03/31/96
 5200 /*  SET MEMBER NAME FIELDS           */                                                           03/31/96
 6400       CHGVAR     VAR(%SST(&STRNG3 52 10)) VALUE(&MEM)                                             03/31/96
 6700       CHGVAR     VAR(%SST(&STRNG3 82 10)) VALUE(&MEM)                                             03/31/96
 7000 /*   RUNQRY QRY(MYLIB/TRNQRY)  OUTTYPE(*OUTFILE) OUTFILE(MYLIB/TRNPFR-                            03/31/96
 7100 IND) */                                                                                           03/31/96
 7200       CALL PGM(QCMDEXC) PARM(&STRNG3 200)                                                         03/31/96
 7300 START: RCVF                                                                                       03/31/96
 7500       MONMSG MSGID(CPF0864) EXEC(RETURN)                                                          03/31/96
 7600       IF COND(&MACERRRA02 *GT 0.01) THEN(DO)                                                      03/31/96
 7700 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                        03/31/96
 7800       CHGVAR     VAR(%SST(&STRNG4 71 10)) VALUE(&MEM)                                             03/31/96
 8100 /*   RUNQRY QRY(MYLIB/TRNMACQRY1)    */                                                           03/31/96
 8200       CALL PGM(QCMDEXC) PARM(&STRNG4 100)                                                         03/31/96
 8300 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                        03/31/96
 8400       CHGVAR     VAR(%SST(&STRNG5 71 10)) VALUE(&MEM)                                             03/31/96
 8700 /*   RUNQRY QRY(MYLIB/TRNMACQRY2)     */                                                          03/31/96
 8800       CALL PGM(QCMDEXC) PARM(&STRNG5 100)                                                         03/31/96
 8900 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                        03/31/96
 9000       CHGVAR     VAR(%SST(&STRNG6 71 10)) VALUE(&MEM)                                             03/31/96
 9300 /*   RUNQRY QRY(MYLIB/TRNMACQRY3)       */                                                        03/31/96
 9400       CALL PGM(QCMDEXC) PARM(&STRNG6 100)                                                         03/31/96
 9500       ENDDO                                                                                       03/31/96
 9600       ENDPGM                                                                                      03/31/96
                        * * * *  E N D  O F  S O U R C E  * * * *
```

Figure 95. Program to Generate the Token-Ring LAN Performance Report

B.1.3 Token-Ring LAN SAP Counter Query

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM05 10/28/96   17:29:55        Page    1
  Query . . . . . . . . . . . . . . . . . SAPQRY
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSAP        QPFRDATA      Q961981803    QAPMSAPR
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                1      Interval Number
  IOPRN                                 1      IOP Resource Name
  SCLND                                 1      Line Description
  SCIRCV                                       UIs Received
  SCIXMT                                       UIs Transmitted
  SCBRCV                                       UI Bytes Received
  SCBXMT                                       UI Bytes Transmitted
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0        Interval                 5    0
                                      Number
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  IOPRN                      2        IOP                     10
                                      Resource
                                      Name
  SCLND                      2        Line                    10
                                      Description
  SCIRCV          1          2        UIs                     11    0
                                      Received
  SCIXMT          1          2        UIs                     11    0
                                      Transmitted
  SCBRCV          1          2        UI Bytes                11    0
                                      Received
  SCBXMT          1          2        UI Bytes                11    0
                                      Transmitted
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . SAPTOTFILE
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Total number of UI frames per LIND
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .    83
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL          1     1              Character           BREAK LEVEL
    OVERFLOW          2     1              Character           OVERFLOW FLAG
    INTNUM            3     5    0         Zoned decimal       Interval Number
    IOPRN             8    10              Character           IOP Resource Name
    SCLND            18    10              Character           Line Description
    SCIRCV01         28    14    0         Zoned decimal       SCIRCV     TOTAL
    SCIXMT01         42    14    0         Zoned decimal       SCIXMT     TOTAL
    SCBRCV01         56    14    0         Zoned decimal       SCBRCV     TOTAL
    SCBXMT01         70    14    0         Zoned decimal       SCBXMT     TOTAL
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 96. Token-Ring LAN SAP Counter Report Query

B.1.4 Token-Ring LAN Performance Indicators Query

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM05 10/28/96   17:30:21        Page    1
  Query . . . . . . . . . . . . . . . . . TRNQRY2
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Token-Ring LAN Performance Indicators Report Query
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMECL        QPFRDATA      Q961981803    QAPMECLR
  T02    QAPMCIOP       QPFRDATA      Q961981803    QAPMCIOR
  T03    SAPTOTFILE     MYLIB         *FIRST        SAPTOTFILE
Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.IOPRN          EQ                T02.IOPRN
  T01.INTNUM         EQ                T02.INTNUM
  T01.INTNUM         EQ                T03.INTNUM
  T01.ELLND          EQ                T03.SCLND
```

Figure 97. Token-Ring LAN Performance Indicator Report Query, Part 1

```
                                  IBM Query/400                     10/28/96   17:30:21        Page    2
Result fields
  Name        Expression                        Column Heading          Len  Dec
  LINEUTIL    ((elict+elicr+scbrcv01+scbxmt01)     Line
              *8*100)/(ellsp*T01.intsec)        Utilization
                                                   (%)
Result fields (continued)
  Name        Expression                        Column Heading          Len  Dec
  IOPUTIL     (T02.intsec-(ciidlc*ciidlt)/         IOP
              100000000)/T02.intsec*100         Utilization
                                                   (%)             T
  TOTALFRAME  emftr+emfrv+0.001+                Total frames
              scixmt01+scircv01                 transmitted &
                                                received
  MAC_ERR01   emine+embre+emafe+emabt+emlst+    MAC errors1
              emrxc+emfce+emfqe+emtke+emdbe+
              emdpe
  TOTMAC_ERR  mac_err01+emanr+emfnc+emtse       Total MAC errors
              +emuap+emumf+emsft+emtbc+emioa+
              emfdc+emsin
  MACERRRATE  (TOTMAC_err/totalframe)*100        MAC
                                                errors
                                                 (%)
  LOCNRDY     (elrft*100)/(elift+0.001)         Local Not
                                                  Ready
                                                   (%)
  LOCSEQERR   (elrjft*100)/(elift+0.001)        Local Seq
                                                  Error
                                                   (%)
  RMTNRDY     (elrfr*100)/(elift+0.001)          Remote
                                                Not Ready
                                                  (%)
  RMTSEQERR   (elrjfr*100)/(elift+0.001)        Remote Seq
                                                   Error
                                                    (%)
  TIMEOUT     (elt1t*100)/(emftr+0.001)         T1 timer
                                                time-out
                                                rate(%)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.IOPRN                             1      IOP Resource Name
  T01.ELLND       10        A           1      Line Description
  IOPUTIL
  LINEUTIL
  LOCNRDY
  LOCSEQERR
  RMTNRDY
  RMTSEQERR
  TIMEOUT
  MACERRRATE
```

Figure 98. Token-Ring LAN Performance Indicator Report Query, Part 2

```
                                  IBM Query/400                      10/28/96   17:30:21        Page    3
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                                Dec  Null        Dec  Numeric
  Name             Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T01.IOPRN                   0        IOP                     10
                                       Resource
                                       Name
  T01.ELLND                   1                                10
                                       Line
                                       Description
  IOPUTIL          2 4        1           IOP                  28   2          4    1
                                       Utilization
                                          (%)
  LINEUTIL         2 4        1           Line                 22   2          4    1
                                       Utilization
                                          (%)
  LOCNRDY          2 4        1        Local Not               14   3          4    1
                                         Ready
                                          (%)
  LOCSEQERR        2 4        1        Local Seq               14   3          4    1
                                         Error
                                          (%)
  RMTNRDY          2 4        1         Remote                 14   3          4    1
                                       Not Ready
                                         (%)
  RMTSEQERR        2 4        1        Remote Seq              14   3          4    1
                                          Error
                                           (%)
  TIMEOUT          2 4        1        T1 timer                14   3          4    1
                                       time-out
                                       rate(%)
  MACERRRATE       2 4        1        MAC                     31   3          4    1
                                       Errors
                                        (%)
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Token-ring LANs
  1      No    No         Summary for : &t01.ellnd
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
```

Figure 99. Token-Ring LAN Performance Indicators Report Query, Part 3

```
                                IBM Query/400                    10/28/96   17:30:21        Page    4
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      Token-Ring LAN Performance Report Query
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      Token-Ring LAN Performance
    Page footing
Database file output
  File  . . . . . . . . . . . . . . . . . TRNPFRIND
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . .
  Print definition  . . . . . . . . . . . No

Output file record format
  Output record length  . . . . . . . . .    86
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL          1     1              Character           BREAK LEVEL
    OVERFLOW          2     1              Character           OVERFLOW FLAG
    IOPRN             3    10              Character           IOP Resource Name
    ELLND            13    10              Character           Line Description
    IOPUTIL02        23     4    1         Zoned decimal       IOPUTIL    AVG
    IOPUTIL04        27     4    1         Zoned decimal       IOPUTIL    MAX
    LINEUTIL02       31     4    1         Zoned decimal       LINEUTIL   AVG
    LINEUTIL04       35     4    1         Zoned decimal       LINEUTIL   MAX
    LOCNRDY02        39     4    1         Zoned decimal       LOCNRDY    AVG
    LOCNRDY04        43     4    1         Zoned decimal       LOCNRDY    MAX
    LOCSEQERO2       47     4    1         Zoned decimal       LOCSEQERR  AVG
    LOCSEQERO4       51     4    1         Zoned decimal       LOCSEQERR  MAX
    RMTNRDY02        55     4    1         Zoned decimal       RMTNRDY    AVG
    RMTNRDY04        59     4    1         Zoned decimal       RMTNRDY    MAX
    RMTSEQERO2       63     4    1         Zoned decimal       RMTSEQERR  AVG
    RMTSEQERO4       67     4    1         Zoned decimal       RMTSEQERR  MAX
    TIMEOUT02        71     4    1         Zoned decimal       TIMEOUT    AVG
    TIMEOUT04        75     4    1         Zoned decimal       TIMEOUT    MAX
    MACERRRA02       79     4    1         Zoned decimal       MACERRRATE AVG
    MACERRRA04       83     4    1         Zoned decimal       MACERRRATE MAX
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 100. Token-Ring LAN Performance Indicators Report Query, Part 4

B.1.5 Token-Ring LAN MAC Error Counters Query

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM05 10/28/96   17:30:34         Page    1
  Query . . . . . . . . . . . . . . . . . TRNMACQRY1
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Token-ring LAN MAC Error Counters Report 1
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File          Library       Member        Record Format
  T01    TRNPFRIND     MYLIB         *FIRST        TRNPFRIND
  T02    QAPMECL       QPFRDATA      Q961981803    QAPMECLR
Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.ELLND          EQ                T02.ELLND
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.IOPRN                             1      IOP Resource Name
  T01.ELLND       10        A           1      Line Description
  T01.MACERRRA02                        1      MACERRRATE AVG
  T01.MACERRRA04                        1      MACERRRATE MAX
  T02.EMINE                                    Internal Errors
  T02.EMBRE                                    Burst Error
  T02.EMAFE                                    ARI/FCI Error
```

Figure 101. Token-Ring LAN MAC Error Counters Report 1 Query, Part 1

```
                                  IBM Query/400                      10/28/96   17:30:34        Page    2
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.EMABT                                    Abort Delimiter
  T02.EMLST                                    Lost Frame
  T02.EMRXC                                    RX Congestion
  T02.EMFCE                                    Frame Copied Error

Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  T02.IOPRN                  0        IOP                     10
                                      Resource
                                      Name
  T01.ELLND                  1                                10
                                      Line
                                      Desc
  T01.MACERRRA02             1        MAC                      4    1
                                      Err
                                      Avg%
  T01.MACERRRA04             1        MAC                      4    1
                                      Err
                                      Max%
  T02.EMINE       1          1                                 5    0
                                      Internal
                                      Errors
  T02.EMBRE       1          1                                 5    0
                                      Burst
                                      Error
  T02.EMAFE       1          1                                 5    0
                                      ARI/FCI
                                      Error
  T02.EMABT       1          1                                 5    0
                                      Abort
                                      Delimiter
  T02.EMLST       1          1                                 5    0
                                      Lost
                                      Frame
  T02.EMRXC       1          1                                 5    0
                                      RX
                                      Congestion
  T02.EMFCE       1          1        Frame                    5    0
                                      Copied
                                      Error
```

Figure 102. Token-Ring LAN MAC Error Counters Report 1 Query, Part 2

```
                                  IBM Query/400                      10/28/96   17:30:34        Page    3
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Token-Ring LANs
  1      No    No         Summary for Token-ring: &T01.ELLND
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      MAC Error Counters Report
```

Figure 103. Token-Ring LAN MAC Error Counters Report 1 Query, Part 3

```
                                   IBM Query/400                    10/28/96   17:30:34        Page    4
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      MAC error counters
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 104. Token-Ring LAN MAC Error Counters Report 1 Query, Part 4

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM05 10/28/96   17:30:34        Page    1
  Query . . . . . . . . . . . . . . . . . TRNMACQRY2
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Token-ring LAN MAC Error Counters Report 2
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    TRNPFRIND      MYLIB         *FIRST        TRNPFRIND
  T02    QAPMECL        QPFRDATA      Q961981803    QAPMECLR
Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field             Test              Field
  T01.ELLND         EQ                T02.ELLND
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.IOPRN                             1      IOP Resource Name
  T01.ELLND       10        A           1      Line Description
  T01.MACERRRA02                        1      MACERRRATE AVG
  T01.MACERRRA04                        1      MACERRRATE MAX
  T02.EMFQE                                    Frequency Error
  T02.EMTKE                                    Token Error
  T02.EMDBE                                    Direct Memory Access Bus Error
```

Figure 105. Token-Ring LAN MAC Error Counters Report 2 Query, Part 1

```
                                 IBM Query/400                     10/28/96   17:30:34        Page    2
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.EMDPE                                    Direct Memory Access Parity Error
  T02.EMANR                                    Address Not Recognized
  T02.EMFNC                                    Frame Not Copied Error
  T02.EMTSE                                    Transmit Strip Error

Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  T02.IOPRN                  0        IOP                     10
                                      Resource
                                      Name
  T01.ELLND                  1                                10
                                      Line
                                      Desc
  T01.MACERRRA02             1        MAC                      4    1
                                      Err
                                      Avg%
  T01.MACERRRA04             1        MAC                      4    1
                                      Err
                                      Max%
  T02.EMFQE       1          1                                 5    0
                                      Frequency
                                      Error
  T02.EMTKE       1          1                                 5    0
                                      Token
                                      Error
  T02.EMDBE       1          1        Direct                   5    0
                                      Memory Access
                                      Bus Error
  T02.EMDPE       1          1        Direct                   5    0
                                      Memory Access
                                      Parity Error
  T02.EMANR       1          1        Address                  5    0
                                      Not
                                      Recognized
  T02.EMFNC       1          1        Frame                    5    0
                                      Not Copied
                                      Error
  T02.EMTSE       1          1        Transmit                 5    0
                                      Strip
                                      Error
```

Figure 106. Token-Ring LAN MAC Error Counters Report 2 Query, Part 2

```
                                 IBM Query/400                     10/28/96   17:30:34        Page    3
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Token-Ring LANs
  1      No    No         Summary for Token-ring: &T01.ELLND
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)

Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      MAC Error Counters Report
```

Figure 107. Token-Ring LAN MAC Error Counters Report 2 Query, Part 3

```
                                   IBM Query/400                     10/28/96   17:30:34        Page    4
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      MAC error counters
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 108. Token-Ring LAN MAC Error Counters Report 2 Query, Part 4

```
5716QU1  V3R6M0  950929           IBM Query/400            SYSTEM05 10/28/96   17:30:34        Page    1
  Query . . . . . . . . . . . . . . . . . TRNMACQRY3
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Token-ring LAN MAC Error Counters Report 3
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File          Library       Member        Record Format
  T01    TRNPFRIND     MYLIB         *FIRST        TRNPFRIND
  T02    QAPMECL       QPFRDATA      Q961981803    QAPMECLR
Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field             Test              Field
  T01.ELLND         EQ                T02.ELLND
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.IOPRN                             1      IOP Resource Name
  T01.ELLND       10        A           1      Line Description
  T01.MACERRRA02                        1      MACERRRATE AVG
  T01.MACERRRA04                        1      MACERRRATE MAX
  T02.EMUAP                                    Unauthorized AP
  T02.EMUMF                                    Unauthorized MF
  T02.EMSFT                                    SOFR Error
```

Figure 109. Token-Ring LAN MAC Error Counters Report 3 Query, Part 1

```
                                  IBM Query/400                     10/28/96   17:30:34        Page    2
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.EMTBC                                    Transmit Beacon
  T02.EMIOA                                    IOA Status Overrun
  T02.EMFDC                                    Frames Discarded
  T02.EMSIN                                    Spurious Interrupts
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  T02.IOPRN                  0        IOP                    10
                                      Resource
                                      Name
  T01.ELLND                  1                               10              8
                                      Line
                                      Desc
  T01.MACERRRA02             1        MAC                     4    1
                                      Err
                                      Avg%
  T01.MACERRRA04             1        MAC                     4    1
                                      Err
                                      Max%
  T02.EMUAP       1          1                                5    0
                                      Unauth
                                      AP
  T02.EMUMF       1          1                                5    0
                                      Unauth
                                      MF
  T02.EMSFT       1          1                                5    0
                                      SOFR
                                      Error
  T02.EMTBC       1          1                                5    0
                                      Transmit
                                      Beacon
  T02.EMIOA       1          1        IOA                     5    0
                                      Status
                                      Overrun
  T02.EMFDC       1          1                               11    0
                                      Frames
                                      Discarded
  T02.EMSIN       1          1                               11    0
                                      Spurious
                                      Interrupts
```

Figure 110. Token-Ring LAN MAC Error Counters Report 3 Query, Part 2

```
                                  IBM Query/400                     10/28/96   17:30:34        Page    3
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Token-Ring LANs
  1      No    No         Summary for Token-ring: &T01.ELLND
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)

Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      MAC Error Counters Report
```

Figure 111. Token-Ring LAN MAC Error Counters Report 3 Query, Part 3

```
                                 IBM Query/400                     10/28/96   17:30:34        Page    4
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      MAC error counters
    Page footing

             * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 112. Token-Ring LAN MAC Error Counters Report 3 Query, Part 4

B.1.6 Token-Ring LAN Overhead Query

```
5716QU1  V3R6M0  950929           IBM Query/400            SYSTEM05 10/28/96   17:32:14        Page    1
  Query . . . . . . . . . . . . . . . . . TRNUSAGE
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Token-Ring LAN Overhead Query
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMECL        QPFRDATA      Q961981803    QAPMECLR
Result fields
  Name        Expression                          Column Heading          Len  Dec
  LINEUTIL    ((elict+elicr)*8*100)/                 Line
              (ellsp*intsec)                      Utilization
                                                     (%)
  TOTALFRAME  emftr+emfrv+0.001                   Total frames
                                                  transmitted &
                                                  received
  MAC_ERR01   emine+embre+emafe+emabt+emlst+      MAC errors1
              emrxc+emfce+emfqe+emtke+emdbe+
              emdpe
  TOTMAC_ERR  mac_err01+emanr+emfnc+emtse         Total MAC errors
              +emuap+emumf+emsft+emtbc+emioa+
              emfdc+emsin
  MACERR      (TOTMAC_err/totalframe)*100          MAC                     31    4
                                                  errors
                                                   (%)
```

Figure 113. Token-Ring LAN Overhead Query, Part 1

```
                               IBM Query/400                     10/28/96   17:32:14        Page    2
Result fields (continued)
  Name        Expression                         Column Heading          Len  Dec
  RNR         (elrft+elrfr)*100/totalframe       Receive Not              15    4
                                                 Ready Frames
                                                    (%)
  REJ         (elrjft+elrjfr)*100/totalframe     Reject                   15    4
                                                 Frames
                                                   (%)
  FRREJ       (elfft+elffr)*100/totalframe       Frame-Rejects            15    4
                                                 Frames
                                                  (%)
  SABM        (elsft+elsfr)*100/totalframe       SABM                     15    4
                                                 Frames
                                                  (%)
  DISCNT      (eldft+eldfr)*100/totalframe       Disconnect               15    4
                                                 Frames
                                                  (%)
  DISCNTMODE  (eldmt+eldmr)*100/totalframe       Disconnect               15    4
                                                 Mode Frames
                                                  (%)
  MAC         (emmft+emmfr)*100/totalframe       MAC                      20    4
                                                 Frames
                                                  (%)
  ROUTE       (emrit+emrir)*100/totalframe       Routing                  15    4
                                                 Frames
                                                  (%)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  IOPRN                                 1      IOP Resource Name
  ELLND           10        A           1      Line Description
  INTNUM                                       Interval Number
  DTETIM                                       Interval Date and Time
  LINEUTIL
  TOTALFRAME
  MACERR
  RNR
  REJ
  FRREJ
  SABM
  DISCNT
  DISCNTMODE
  MAC
  ROUTE
```

Figure 114. Token-Ring LAN Overhead Query, Part 2

```
                                  IBM Query/400                      10/28/96   17:32:14         Page    3
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings       Len  Pos  Cap   Len  Pos  Editing
  IOPRN                      0        IOP                    10
                                      Resource
                                      Name
  ELLND                      1                               10
                                      Line
                                      Description
  INTNUM                     1                                5    0
                                      Interval
                                      Number
  DTETIM                     1        Interval               12
                                      Date
                                      Time
  LINEUTIL                   1           Line                18    2          7    2
                                      Utilization
                                         (%)
  TOTALFRAME                 1        Total frames           16    3         14    0
                                      transmitted &
                                      received
  MACERR                     1         MAC                   31    4          7    2
                                      errors
                                       (%)
  RNR                        1        Receive Not            15    4          5    2
                                      Ready Frames
                                         (%)
  REJ                        1        Reject                 15    4          5    2
                                      Frames
                                        (%)
  FRREJ                      1        Frame-Rejects          15    4          5    2
                                      Frames
                                       (%)
  SABM                       1        SABM                   15    4          5    2
                                      Frames
                                       (%)
  DISCNT                     1        Disconnect             15    4          5    2
                                      Frames
                                       (%)
  DISCNTMODE                 1        Disconnect             15    4          5    2
                                      Mode Frames
                                       (%)
  MAC                        1        MAC                    20    4          5    2
                                      Frames
                                       (%)
  ROUTE                      1        Routing                15    4          5    2
                                      Frames
                                       (%)
```

Figure 115. Token-Ring LAN Overhead Query, Part 3

```
                                  IBM Query/400                   10/28/96   17:32:14        Page    4
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Token-ring LANs
  1      No    No         Summary for : &t01.ellnd
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)

Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
      Token-Ring LAN Overhead Report
```

Figure 116. Token-Ring LAN Overhead Query, Part 4

```
                                  IBM Query/400                   10/28/96   17:32:14        Page    5
Page headings and footings
  Print standard page heading . . . . . . No
    Page heading
      Token-Ring LAN Overhead Report
    Page footing

Database file output
  File  . . . . . . . . . . . . . . . . . TRNUSAGE
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . .
  Print definition  . . . . . . . . . . . No

Output file record format
  Output record length  . . . . . . . . .   210
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    IOPRN             1    10              Character           IOP Resource Name
    ELLND            11    10              Character           Line Description
    INTNUM           21     5    0         Packed decimal      Interval Number
    DTETIM           24    12              Character           Interval Date and Time
    LINEUTIL         36    18    2         Packed decimal      ((elict+elicr)*8*100)/          (ellsp*intsec)
    TOTALFRAME       46    16    3         Packed decimal      emftr+emfrv+0.001
    MACERR           55    31    4         Zoned decimal       (TOTMAC_err/totalframe)*100
    RNR              86    15    4         Zoned decimal       (elrft+elrfr)*100/totalframe
    REJ             101    15    4         Zoned decimal       (elrjft+elrjfr)*100/totalframe
    FRREJ           116    15    4         Zoned decimal       (elfft+elffr)*100/totalframe
    SABM            131    15    4         Zoned decimal       (elsft+elsfr)*100/totalframe
    DISCNT          146    15    4         Zoned decimal       (eldft+eldfr)*100/totalframe
    DISCNTMODE      161    15    4         Zoned decimal       (eldmt+eldmr)*100/totalframe
    MAC             176    20    4         Zoned decimal       (emmft+emmfr)*100/totalframe
    ROUTE           196    15    4         Zoned decimal       (emrit+emrir)*100/totalframe
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 117. Token-Ring LAN Overhead Query, Part 5

B.2 Ethernet LAN Query

Two queries are provided in this section:

1. ELANQRY

   This query prints the main performance indicators that are often bottlenecks in an Ethernet LAN. Use the result of this query to compare with the threshold values of these indicators that has already been discussed in Chapter 6, “Communications I/O Processor (IOP)” on page 89 to obtain an evaluation of performance on your LAN. This query provides information on the following areas:

   - Line utilization
   - IOP utilization
   - Overrun indicators
     - Local Not Ready
     - Local Sequence Error
     - Remote Not Ready
     - Remote Sequence Error
   - T1 Timers time-outs
   - MAC errors rate
   - Retransmission rate

   The query definition is found in Section B.2.4, “Ethernet LAN Performance Indicator Report Query” on page 263.

2. ETHMACQRYx (x = 1,2 and 3 representing Reports 1,2 and 3 respectively)

   This query prints three reports showing all of the MAC error counters in the Ethernet performance data file. A high value in any of these counters should be investigated. The query definition is found in Section B.2.5, “Ethernet LAN MAC Error Counters Query” on page 267.

Run the queries in sequence starting from query ETHQRY followed by the queries, ETHMACQRYx. A CL program has been provided for you to execute this automatically. This is listed in Figure 120 on page 261. This program first generates the Ethernet LAN Performance Indicators Report and prints the detailed MAC Error Counters Report if the average MAC error rate exceeds 1% of the total frames transmitted and received.

The output of both queries is shown in Figure 118 on page 260 and Figure 119 on page 260.

Notes:

1. The MAC Error % column of the Ethernet LAN Performance Indicators Report counts the number of MAC errors different from that of the Advisor in the Performance Tools/400. These are due to two reasons:

   - Certain fields have been excluded from the total MAC error counts in the query definition because they represent more statistical counters rather than error counters. These fields are:

     ETMM1R More than 1 retry to transmit

ETM1R Exactly 1 retry to transmit

ETMDCN Deferred conditions due to a busy channel.

- The MAC error % calculation shown in the Advisor tends to cap the maximum percentage displayed at 100%. The query, ETHQRY, provides the actual results of the MAC error % calculation based on the formula defined in the query definition.

2. The report shows MAC error % of up to 10 significant places. A overflow of the figure is shown on the report as ′++++++++++′. This situation is unlikely to happen. If it does, consider modifying the field definition of the query, ETHQRY. Erase the length definition of the MAC Error % field, MACERRRATE, for both the result field definition and the report column formatting field definition. This allows Query/400 to decide on the length of the result field. Then run the query from the start again.

3. Take note of the Congestion statistics that are listed in the Ethernet MAC Error Counters report in the following columns:

   - More than 16 retries that count the number of frames unsuccessfully transmitted due to excessive retries.
   - Receive overruns due to receiver being unable to accept incoming frames.
   - More than one retry to transmit.
   - Exactly one retry to transmit.
   - Deferred conditions represent the number of times the adapter deferred transmission due to a busy channel.

   This should provide you with useful statistics about your Ethernet LAN congestion.

B.2.1 Sample Report Output

```
10/28/96  16:57:31                Ethernet LAN Performance Indicators Report               PAGE    1


IOP                 IOP    Line  Local   Local   Remote  Remote   T1-timer    Retrans           MAC
Resource  Line      Util   Util  Not Rdy Seq Err Not Rdy Seq Err  time-out     Rate            Error
Name      Desc      (%)    (%)   (%)       (%)     (%)     (%)     rate                         (%)

CC03      ETHLINE1
               Summary for Ethernet LAN: ETHLINE1
               AVG   6.8     .0      .0      .0      .0      .0     .2            .0         214.4
               MAX   8.2     .0      .0     1.1      .0      .0     .9            .0         431.7

               Summary for all Ethernet LANs
               AVG   6.8     .0      .0      .0      .0      .0     .2            .0         214.4
               MAX   8.2     .0      .0     1.1      .0      .0     .9            .0         431.7

* * *  E N D  O F  R E P O R T  * * *
```

Figure 118. Sample Ethernet LAN Performance Indicators Report

```
10/28/96  16:57:32                          Ethernet LAN MAC Error Counters Report 3                          PAGE    1


IOP                          MAC            MAC                               Signal   More Than   Exactly
Resource  Line               Err            Err    Transmit       Babble     Quality  1 Retry to  1 Retry to  Deferred
Name      Desc               Avg%           Max%   Underflow      Errors     Error    Transmit    Transmit    Conditions

CC03      ETHLINE1          214.4          431.7
                                            Summary for Ethernet: ETHLINE1
                                            TOTAL          0           0           0         307         286         957

                                            Summary for all Ethernet LANs
                                            TOTAL          0           0           0         307         286         957

* * *  E N D  O F  R E P O R T  * * *
```

Figure 119. Sample Ethernet LAN MAC Error Counters Report

B.2.2 CL Program to Execute the Ethernet LAN Queries

```
5738PW1 V2R2M0  920615                SEU SOURCE LISTING                          09/17/93 15:34:45              PAGE    1
5763PW1 V3R1M0  940909                SEU SOURCE LISTING                          03/31/96 11:30:22              PAGE    1
SOURCE FILE . . . . . . .  MYLIB/QCLSRC
MEMBER  . . . . . . . . .  ELANQRY
SEQNBR*...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7 ...+... 8 ...+... 9 ...+... 0
  100 /******************************************************************/                         03/29/96
  200 /*                                                                */                         03/29/96
  400 /*  PROGRAM NAME : ELANQRY                                        */                         03/29/96
  500 /*  PURPOSE      : THIS CL PROGRAM WILL GENERATE AN ETHERNET      */                         03/29/96
  600 /*                 LAN PERFORMANCE INDICATORS REPORT SHOWING      */                         03/29/96
  700 /*                 - IOP UTILIZATION                              */                         03/29/96
  800 /*                 - LINE UTILIZATION                             */                         03/29/96
  900 /*                 - IOA OVERRUN STATISTICS                       */                         03/29/96
 1000 /*                 - T1 TIMER TIME-OUT RATE                       */                         03/29/96
 1100 /*                 - MAC ERRORS                                   */                         03/29/96
 1200 /*                 - RETRANSMISSION RATE                          */                         03/29/96
 1300 /*                                                                */                         03/29/96
 1500 /*                 IF THE MAC ERRORS ARE SIGNIFICANT, A REPORT    */                         03/29/96
 1600 /*                 SHOWING ALL THE MAC ERRORS WILL BE GENERATED   */                         03/29/96
 1900 /*                                                                */                         03/29/96
 2000 /******************************************************************/                         03/29/96
 2100     PGM  PARM(&MEM)                                                                          03/29/96
 2200 DCL &MEM *CHAR 10                                                                            03/29/96
 2300 DCL &STRNG *CHAR 100 VALUE('RUNQRY QRY(MYLIB/SAPQRY) +                                       03/29/96
 2400                             QRYFILE((*RUNOPT/QAPMSAP MMMMMMMMMM))')                          03/29/96
 2500 DCL &STRNG2 *CHAR 200 VALUE('RUNQRY QRY(MYLIB/ETHQRY2) +                                     03/29/96
 2600                             QRYFILE((*RUNOPT/QAPMETH MMMMMMMMMM) +                           03/29/96
 2700                             (*RUNOPT/QAPMCIOP MMMMMMMMMM) +                                  03/29/96
 2800                             (*RUNOPT/*SAME))')                                               03/29/96
 2900 DCL &STRNG3 *CHAR 200 VALUE('RUNQRY QRY(MYLIB/ETHQRY2) +                                     03/29/96
 3000                             QRYFILE((*RUNOPT/QAPMETH MMMMMMMMMM) +                           03/29/96
 3100                             (*RUNOPT/QAPMCIOP MMMMMMMMMM) +                                  03/29/96
 3200                             (*RUNOPT/*SAME)) +                                               03/29/96
 3300                     OUTTYPE(*OUTFILE) OUTFILE(MYLIB/ETHPFRIND)')                             03/29/96
 3400 DCL &STRNG4 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/ETHMACQRY1) +                                  03/29/96
 3500                             QRYFILE((*RUNOPT/*SAME) +                                        03/29/96
 3600                             (*RUNOPT/QAPMETH MMMMMMMMMM))')                                  03/29/96
 3700 DCL &STRNG5 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/ETHMACQRY2) +                                  03/29/96
 3800                             QRYFILE((*RUNOPT/*SAME) +                                        03/29/96
 3900                             (*RUNOPT/QAPMETH MMMMMMMMMM))')                                  03/29/96
 4000 DCL &STRNG6 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/ETHMACQRY3) +                                  03/29/96
 4100                             QRYFILE((*RUNOPT/*SAME) +                                        03/29/96
 4200                             (*RUNOPT/QAPMETH MMMMMMMMMM))')                                  03/29/96
 4300 DCLF FILE(MYLIB/ETHPFRIND)                                                                   03/29/96
 4500 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                   03/29/96
 4600      CHGVAR     VAR(%SST(&STRNG 51 10)) VALUE(&MEM)                                          03/29/96
 4800 /*  RUNQRY QRY(MYLIB/SAPQRY)            */                                                   03/29/96
 5000      CALL PGM(QCMDEXC) PARM(&STRNG 100)                                                      03/29/96
 5100 /*  SETUP THE SECOND RUNQRY COMMAND STRING  */                                               03/29/96
 5300      CHGVAR     VAR(%SST(&STRNG2 52 10)) VALUE(&MEM)                                         03/29/96
 5500 /*  SET 2ND MEMBER NAME FIELD   */                                                           03/29/96
 5600      CHGVAR     VAR(%SST(&STRNG2 82 10)) VALUE(&MEM)                                         03/29/96
 5900 /*   RUNQRY QRY(MYLIB/ETHQRY2)  */                                                           03/29/96
 6000      CALL PGM(QCMDEXC) PARM(&STRNG2 200)                                                     03/29/96
 6100      DLTF FILE(MYLIB/ETHPFRIND)                                                              03/29/96
 6200      MONMSG MSGID(CPF2105)                                                                   03/29/96
 6300 /*  SET MEMBER NAME FIELDS              */                                                   03/29/96
 6400      CHGVAR     VAR(%SST(&STRNG3 52 10)) VALUE(&MEM)                                         03/29/96
 6700      CHGVAR     VAR(%SST(&STRNG3 82 10)) VALUE(&MEM)                                         03/29/96
 6900 /*  PUT THE OUTPUT IN THE FILE    */                                                         03/29/96
 7000 /*   RUNQRY QRY(MYLIB/ETHQRY)  OUTTYPE(*OUTFILE) OUTFILE(MYLIB/ETHPFR-                       03/29/96
 7100 IND) */                                                                                      03/29/96
 7200      CALL PGM(QCMDEXC) PARM(&STRNG3 200)                                                     03/29/96
 7300 START: RCVF                                                                                  03/29/96
 7500      MONMSG MSGID(CPF0864) EXEC(RETURN)                                                      03/29/96
 7600      IF COND(&MACERRRA02 *GT 0.01) THEN(DO)                                                  03/29/96
 7700 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                   03/29/96
 7800      CHGVAR     VAR(%SST(&STRNG4 71 10)) VALUE(&MEM)                                         03/29/96
 8100 /*   RUNQRY QRY(MYLIB/ETHMACQRY1)    */                                                      03/29/96
 8200      CALL PGM(QCMDEXC) PARM(&STRNG4 100)                                                     03/29/96
 8300 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                   03/29/96
 8400      CHGVAR     VAR(%SST(&STRNG5 71 10)) VALUE(&MEM)                                         03/29/96
 8700 /*   RUNQRY QRY(MYLIB/ETHMACQRY2)     */                                                     03/29/96
 8800      CALL PGM(QCMDEXC) PARM(&STRNG5 100)                                                     03/29/96
 8900 /*  PUT THE MEMBER NAME FROM THE PARAM  */                                                   03/29/96
 9000      CHGVAR     VAR(%SST(&STRNG6 71 10)) VALUE(&MEM)                                         03/29/96
 9300 /*   RUNQRY QRY(MYLIB/ETHMACQRY3)       */                                                   03/29/96
 9400      CALL PGM(QCMDEXC) PARM(&STRNG6 100)                                                     03/29/96
 9500      ENDDO                                                                                   03/29/96
 9600      ENDPGM                                                                                  03/29/96
                         * * * *  E N D  O F  S O U R C E  * * * *
```

Figure 120. Program to Generate the Ethernet LAN Performance Report

B.2.3 Ethernet LAN SAP Counter Query

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM05 10/28/96   17:29:55        Page    1
  Query . . . . . . . . . . . . . . . . . SAPQRY
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSAP        QPFRDATA      Q961981803    QAPMSAPR
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                1      Interval Number
  IOPRN                                 1      IOP Resource Name
  SCLND                                 1      Line Description
  SCIRCV                                       UIs Received
  SCIXMT                                       UIs Transmitted
  SCBRCV                                       UI Bytes Received
  SCBXMT                                       UI Bytes Transmitted
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0        Interval                  5    0
                                      Number
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  IOPRN                      2        IOP                      10
                                      Resource
                                      Name
  SCLND                      2        Line                     10
                                      Description
  SCIRCV          1          2        UIs                      11    0
                                      Received
  SCIXMT          1          2        UIs                      11    0
                                      Transmitted
  SCBRCV          1          2        UI Bytes                 11    0
                                      Received
  SCBXMT          1          2        UI Bytes                 11    0
                                      Transmitted
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . SAPTOTFILE
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Total number of UI frames per LIND
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .    83
  Field list:
    Field          Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL           1     1              Character           BREAK LEVEL
    OVERFLOW           2     1              Character           OVERFLOW FLAG
    INTNUM             3     5    0         Zoned decimal       Interval Number
    IOPRN              8    10              Character           IOP Resource Name
    SCLND             18    10              Character           Line Description
    SCIRCV01          28    14    0         Zoned decimal       SCIRCV     TOTAL
    SCIXMT01          42    14    0         Zoned decimal       SCIXMT     TOTAL
    SCBRCV01          56    14    0         Zoned decimal       SCBRCV     TOTAL
    SCBXMT01          70    14    0         Zoned decimal       SCBXMT     TOTAL
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 121. Ethernet LAN SAP Counter Report Query

B.2.4 Ethernet LAN Performance Indicator Report Query

```
5716QU1  V3R6M0  950929           IBM Query/400            SYSTEM05 10/28/96   17:31:34        Page    1
  Query . . . . . . . . . . . . . . . . . ETHQRY2
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Ethernet LAN Performance Indicators Report
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . No
    Ignore decimal data errors  . . . . . Yes
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMETH        QPFRDATA      Q961981803    QAPMETHR
  T02    QAPMCIOP       QPFRDATA      Q961981803    QAPMCIOR
  T03    SAPTOTFILE     MYLIB         *FIRST        SAPTOTFILE
Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.IOPRN          EQ                T02.IOPRN
  T01.INTNUM         EQ                T02.INTNUM
  T01.INTNUM         EQ                T03.INTNUM
  T01.ETLLND         EQ                T03.SCLND
Result fields
  Name        Expression                        Column Heading          Len  Dec
  LINEUTIL    ((etlict+etlicr+scbxmt01+            Line                   6    4
              scbrcv01)*8*100)/                 Utilization
              (etllsp*T01.intsec)                  (%)
  IOPUTIL     (T02.intsec-(ciidlc*ciidlt)/         IOP                    4    1
              100000000)/T02.intsec*100         Utilization
```

Figure 122. Ethernet LAN Performance Indicators Report Query, Part 1

```
                                   IBM Query/400                     10/28/96   17:31:34         Page    2
Result fields (continued)
  Name        Expression                          Column Heading         Len  Dec
  TOTALFRAME  etltft+etltfr+                      Total frames
              scixmt01+scircv01+0.001             transmitted &
                                                  received
  MAC_ERR01   etmifm+etmcre+etmexr+               MAC errors1
              etmowc+etmale+etmcrl+etmtdr+
              etmrbe+etmspi+etmdif
  TOTMAC_ERR  mac_err01+etmrov+etmmee+etmiov+     Total MAC errors
              etmtun+etmbbe+etmsqe
  MACERRRATE  (TOTMAC_err/totalframe)*100          MAC                    10    1
                                                  errors
                                                   (%)
  LOCNRDY     (etlrft*100)/(etlift+0.001)         Local Not                4    1
                                                    Ready
                                                     (%)
  LOCSEQERR   (etlrjt*100)/(etlift+0.001)         Local Seq                4    1
                                                    Error
                                                     (%)
  RMTNRDY     (etlrfr*100)/(etlift+0.001)          Remote                  4    1
                                                  Not Ready
                                                    (%)
  RMTSEQERR   (etlrjr*100)/(etlift+0.001)         Remote Seq               4    1
                                                     Error
                                                      (%)
  TIMEOUT     (etlt1t*100)/(etltft+0.001)         T1 timer                 4    1
                                                  time-out
                                                  rate(%)
  RETRANS     etlfrt/t01.intsec                   Retransmission           4    1
                                                        Rate
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.IOPRN                             1      IOP Resource Name
  T01.ETLLND      10        A           1      Line Description
  IOPUTIL
  LINEUTIL
  LOCNRDY
  LOCSEQERR
  RMTNRDY
  RMTSEQERR
  TIMEOUT
  RETRANS
  MACERRRATE
  TOTALFRAME
  MAC_ERR01
  TOTMAC_ERR
```

Figure 123. Ethernet LAN Performance Indicators Report Query, Part 2

```
                                   IBM Query/400                    10/28/96   17:31:34        Page    3
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                 Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T01.IOPRN                  0        IOP                      10
                                      Resource
                                      Name
  T01.ETLLND                 1                                 10                8
                                      Line
                                      Desc
  IOPUTIL         2 4        1        IOP                       4    1
                                      Util
                                      (%)
  LINEUTIL        2 4        1        Line                      6    4
                                      Util
                                      (%)
  LOCNRDY         2 4        1        Local                     4    1
                                      Not Rdy
                                      (%)
  LOCSEQERR       2 4        1        Local                     4    1
                                      Seq Err
                                       (%)
  RMTNRDY         2 4        1        Remote                    4    1
                                      Not Rdy
                                       (%)
  RMTSEQERR       2 4        1        Remote                    4    1
                                      Seq Err
                                       (%)
  TIMEOUT         2 4        1        T1                        4    1
                                      end
                                      rate
  RETRANS         2 4        1        Retrans                   4    1        10    1
                                       Rate
  MACERRRATE      2 4        1         MAC                     10    1        10    1
                                      Error
                                       (%)
  TOTALFRAME                 2        Total frames             20    3
                                      transmitted &
                                      received
  MAC_ERR01                  2        MAC errors1              14    0
  TOTMAC_ERR                 2        Total MAC errors         20    0
```

Figure 124. Ethernet LAN Performance Indicators Report Query, Part 3

```
                                   IBM Query/400                    10/28/96   17:31:34        Page    4
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Ethernet LANs
  1      No    No         Summary for Ethernet LAN: &T01.etllnd
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)

Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      Ethernet LAN Performance Indicators Report Query

Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      Ethernet LAN Performance Indicators Report
    Page footing
```

Figure 125. Ethernet LAN Performance Indicators Report Query, Part 4

```
                                  IBM Query/400                     10/28/96   17:31:34        Page    5
Database file output
  File  . . . . . . . . . . . . . . . . . ETHPFRIND
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . .
  Print definition  . . . . . . . . . . . No

Output file record format
  Output record length  . . . . . . . . .   120
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL          1     1              Character           BREAK LEVEL
    OVERFLOW          2     1              Character           OVERFLOW FLAG
    IOPRN             3    10              Character           IOP Resource Name
    ETLLND           13     8              Character           Line Description
    IOPUTIL02        21     4    1         Zoned decimal       IOPUTIL    AVG
    IOPUTIL04        25     4    1         Zoned decimal       IOPUTIL    MAX
    LINEUTIL02       29     6    4         Zoned decimal       LINEUTIL   AVG
    LINEUTIL04       35     6    4         Zoned decimal       LINEUTIL   MAX
    LOCNRDY02        41     4    1         Zoned decimal       LOCNRDY    AVG
    LOCNRDY04        45     4    1         Zoned decimal       LOCNRDY    MAX
    LOCSEQER02       49     4    1         Zoned decimal       LOCSEQERR  AVG
    LOCSEQER04       53     4    1         Zoned decimal       LOCSEQERR  MAX
    RMTNRDY02        57     4    1         Zoned decimal       RMTNRDY    AVG
    RMTNRDY04        61     4    1         Zoned decimal       RMTNRDY    MAX
    RMTSEQER02       65     4    1         Zoned decimal       RMTSEQERR  AVG
    RMTSEQER04       69     4    1         Zoned decimal       RMTSEQERR  MAX
    TIMEOUT02        73     4    1         Zoned decimal       TIMEOUT    AVG
    TIMEOUT04        77     4    1         Zoned decimal       TIMEOUT    MAX
    RETRANS02        81    10    1         Zoned decimal       RETRANS    AVG
    RETRANS04        91    10    1         Zoned decimal       RETRANS    MAX
    MACERRRA02      101    10    1         Zoned decimal       MACERRRATE AVG
    MACERRRA04      111    10    1         Zoned decimal       MACERRRATE MAX
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 126. Ethernet LAN Performance Indicators Report Query, Part 5

B.2.5 Ethernet LAN MAC Error Counters Query

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM05 10/28/96   17:31:48        Page    1
  Query . . . . . . . . . . . . . . . . . ETHMACQRY1
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Ethernet LAN MAC Error Counters Report 1
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    ETHPFRIND      MYLIB         ETHPFRIND     ETHPFRIND
  T02    QAPMETH        QPFRDATA      Q961981803    QAPMETHR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field             Test             Field
  T01.ETLLND        EQ               T02.ETLLND

Ordering of selected fields
  Field          Sort      Ascending/  Break  Field
  Name           Priority  Descending  Level  Text
  T01.IOPRN                            1      IOP Resource Name
  T01.ETLLND     10        A           1      Line Description
  T01.MACERRRA02                       1      MACERRRATE AVG
  T01.MACERRRA04                       1      MACERRRATE MAX
  T02.ETMIFM                                  Inbound Frames Missed
  T02.ETMCRE                                  CRC Error
  T02.ETMEXR                                  More Than 16 Retries
  T02.ETMOWC                                  Out of Window Collisions
  T02.ETMALE                                  Alignment Error
  T02.ETMCRL                                  Carrier Loss
```

Figure 127. Ethernet LAN MAC Error Counters Report 1 Query, Part 1

```
                              IBM Query/400                    10/28/96   17:31:48         Page    2

Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                                Dec  Null       Dec  Numeric
  Name             Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing

  T01.IOPRN                     0       IOP                     10
                                        Resource
                                        Name
  T01.ETLLND                    1                                8
                                        Line
                                        Desc
  T01.MACERRRA02                1       MAC                     10    1
                                        Err
                                        Avg%
  T01.MACERRRA04                1       MAC                     10    1
                                        Err
                                        Max%
  T02.ETMIFM       1            1       Inbound                  5    0
                                        Frames
                                        Missed
  T02.ETMCRE       1            1                                5    0
                                        CRC
                                        Error
  T02.ETMEXR       1            1                                5    0
                                        More Than
                                        16 Retries
  T02.ETMOWC       1            1       Out of                   5    0
                                        Window
                                        Collisions
  T02.ETMALE       1            1                                5    0
                                        Alignment
                                        Error
  T02.ETMCRL       1            1                                5    0
                                        Carrier
                                        Loss
```

Figure 128. Ethernet LAN MAC Error Counters Report 1 Query, Part 2

```
                              IBM Query/400                   3/31/96   11:30:00        Page    5


Selected output attributes

  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No


Printer Output

  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No


Printer Spooled Output

  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)


Cover Page

  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      Ethernet LAN MAC Error Counters Report 1


Page headings and footings

  Print standard page heading . . . . . . Yes

    Page heading
      Ethernet LAN MAC Error Counters Report 1

    Page footing

             * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 129. Ethernet LAN MAC Error Counters Report 1 Query, Part 3

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM05 10/28/96   17:31:48        Page    1

  Query . . . . . . . . . . . . . . . . . ETHMACQRY2
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Ethernet LAN MAC Error Counters Report 2
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member       Record Format
  T01    ETHPFRIND      MYLIB         ETHPFRIND    ETHPFRIND
  T02    QAPMETH        QPFRDATA      Q961981803   QAPMETHR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.ETLLND         EQ                T02.ETLLND

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.IOPRN                             1      IOP Resource Name
  T01.ETLLND      10        A           1      Line Description
  T01.MACERRRA02                        1      MACERRRATE AVG
  T01.MACERRRA04                        1      MACERRRATE MAX
  T02.ETMRBE                                   Receive Buffer Errors
  T02.ETMSPI                                   Spurious Interrupts
  T02.ETMDIF                                   Discarded Inbound Frames
  T02.ETMROV                                   Receive Overruns
  T02.ETMMEE                                   Memory Error
  T02.ETMIOV                                   Interrupt Overrun
```

Figure 130. Ethernet LAN MAC Error Counters Report 2 Query, Part 1

```
                              IBM Query/400                    10/28/96   17:31:48        Page    2

Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides

  Field           Summary    Column                                 Dec  Null        Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing

  T01.IOPRN                  0        IOP                     10
                                      Resource
                                      Name
  T01.ETLLND                 1                                 8
                                      Line
                                      Desc
  T01.MACERRRA02             1        MAC                     10    1
                                      Err
                                      Avg%
  T01.MACERRRA04             1        MAC                     10    1
                                      Err
                                      Max%
  T02.ETMRBE      1          1        Rec                      5    0
                                      Buffer
                                      Errors
  T02.ETMSPI      1          1                                 5    0
                                      Spurious
                                      Interrupts
  T02.ETMDIF      1          1        Discarded                5    0
                                      Inbound
                                      Frames
  T02.ETMROV      1          1                                 5    0
                                      Receive
                                      Overruns
  T02.ETMMEE      1          1                                 5    0
                                      Memory
                                      Error
  T02.ETMIOV      1          1                                 5    0
                                      Interrupt
                                      Overrun
```

Figure 131. Ethernet LAN MAC Error Counters Report 2 Query, Part 2

```
                              IBM Query/400                    10/28/96   17:31:48        Page    3

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Ethernet LANs
  1      No    No         Summary for Ethernet: &T01.ETLLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)

Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      Ethernet LAN MAC Error Counters Report 2

Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      Ethernet LAN MAC Error Counters Report 2
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 132. Ethernet LAN MAC Error Counters Report 2 Query, Part 3

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM05 10/28/96   17:31:48        Page    1

  Query . . . . . . . . . . . . . . . . . ETHMACQRY3
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . Ethernet LAN MAC Error Counters Report 3
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No

  Special conditions
    *** All records selected by default ***

Selected files
  ID     File          Library       Member        Record Format
  T01    ETHPFRIND     MYLIB         ETHPFRIND     ETHPFRIND
  T02    QAPMETH       QPFRDATA      Q961981803    QAPMETHR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.ETLLND         EQ                T02.ETLLND

Ordering of selected fields

  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text

  T01.IOPRN                             1      IOP Resource Name
  T01.ETLLND      10        A           1      Line Description
  T01.MACERRRA02                        1      MACERRRATE AVG
  T01.MACERRRA04                        1      MACERRRATE MAX
  T02.ETMTUN                                   Transmit Underflow
  T02.ETMBBE                                   Babble Errors
  T02.ETMSQE                                   Signal Quality Error
  T02.ETMM1R                                   More Than 1 Retry to Transmit
  T02.ETM1R                                    Exactly 1 Retry to Transmit
  T02.ETMDCN                                   Deferred Conditions
```

Figure 133. Ethernet LAN MAC Error Counters Report 3 Query, Part 1

```
                              IBM Query/400                   10/28/96   17:31:48        Page    2

Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides

  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing

  T01.IOPRN                  0        IOP                     10
                                      Resource
                                      Name
  T01.ETLLND                 1                                 8
                                      Line
                                      Desc
  T01.MACERRRA02             1        MAC                     10    1
                                      Err
                                      Avg%
  T01.MACERRRA04             1        MAC                     10    1
                                      Err
                                      Max%
  T02.ETMTUN      1          1                                 5    0
                                      Transmit
                                      Underflow
  T02.ETMBBE      1          1                                 5    0
                                      Babble
                                      Errors
  T02.ETMSQE      1          1        Signal                   5    0
                                      Quality
                                      Error
  T02.ETMM1R      1          1        More Than                5    0
                                      1 Retry to
                                      Transmit
  T02.ETM1R       1          1        Exactly                  5    0
                                      1 Retry to
                                      Transmit
  T02.ETMDCN      1          1                                 5    0
                                      Deferred
                                      Conditions
```

Figure 134. Ethernet LAN MAC Error Counters Report 3 Query, Part 2

```
                              IBM Query/400                   10/28/96   17:31:48        Page    3

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    No         Summary for all Ethernet LANs
  1      No    No         Summary for Ethernet: &T01.ETLLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)

Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      Ethernet LAN MAC Error Counters Report 3

Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      Ethernet LAN MAC Error Counters Report 3
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 135. Ethernet LAN MAC Error Counters Report 3 Query, Part 3

Appendix C. X.25 Queries

This appendix provides query definitions that can be used to examine X.25 environments. All of the queries use input from the OS/400 Performance Monitor and run with trace options. There are six queries defined:

- X25_ALL
- X25_HDLC
- X25_PLC
- X25_LLC
- X25_IOP
- X25_JOB

The X25_ALL query is simple. It shows you all of the values in the QAPMX25 file. The only thing you have to define is the file name and member name that contains the performance data. The rest are defaults so it takes you only a few minutes to create the query.

The X25_HDLC query shows you the most important performance values for the X25 environment on the HDLC level.

The X25_PLC query shows you the most important performance values for the X25 environment on the PLC level.

The X25_LLC query shows you the most important performance values for the X25 environment on the LLC level.

The X25_IOP query shows you performance values of the IOP to which the line is connected.

The X25_JOB query shows you performance values of the JOBS that are running on the X25 line.

C.1 X25_ALL

```
  Query . . . . . . . . . . . . . . . . . X25_ALL
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . All X.25 performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options

    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File          Library       Member        Record Format
  T01    QAPMX25       QPFRDATA      X25B          QAPMX25R

Ordering of selected fields

  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number
  DTETIM                                       Interval Date and Time
  INTSEC                                       Elapsed Interval Seconds
  IOPRN                                        IOP Resource Name
  XITYPE                                       IOP Type
  XLLND                                        Line Description
  XLLSP                                        Line Speed
  XHBTRN                                       Bytes Transmitted
  XHBRCV                                       Bytes Received
  XHPRCL                                       Protocol
  XHFTRN                                       Frames Transmitted
  XHIFTR                                       I Frames Transmitted
  XHIFRT                                       I Frames Retransmitted
  XHFRT                                        Frames Retransmitted
  XHEFFR                                       Error Free Frames Received
  XHEFIR                                       Error Free I Frames Received
  XHFRIE                                       Frames Received in Error
  XHIFR                                        Invalid Frames Received
  XHRRFT                                       RR Frames Transmitted
  XHRRFR                                       RR Frames Received
  XHRNRT                                       RNR Frames Transmitted
  XHRNRR                                       RNR Frames Received
  XHLNKR                                       Link Resets
  XLITR                                        IPDU Transmitted
  XLIRC                                        IPDU Received
  XLIRT                                        IPDU Retransmitted
  XLIRE                                        IPDU Received in Error
  XLLXTR                                       XID Transmitted
  XLXRC                                        XID Received
  XLTT                                         Tests Transmitted
  XLTR                                         Tests Received
  XLLJT                                        LLC Rejects Transmitted
  XLLJR                                        LLC Rejects Received
  XLRLD                                        Received LLC PDU Discarded
  XLTO                                         Timeouts
  XLCED                                        Checksum Errors Detected
  XLSRA                                        Successful Recovery Attempts
  XLRA                                         Recovery Attempts
  XLRSI                                        Reset Indications
  XLCLS                                        Close Station
  XLRNR                                        LLC RNR Received
  XPTPT                                        Total Packets Transmitted
  XPTPR                                        Total Packets Received
  XPDPT                                        Data Packets Transmitted
  XPDPR                                        Data Packets Received
  XPRPT                                        Reset Packets Transmitted
  XPROR                                        Reset Packets Received
  XPRNR                                        RNR Packets Received
```

Figure 136. X25_ALL Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides

  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                 5    0
                                      Interval
                                      Number
  DTETIM                     2        Interval                12
                                      Date
                                      Time
  INTSEC                     2        Elapsed                  7    0
                                      Interval
                                      Seconds
  IOPRN                      2        IOP                     10
                                      Resource
                                      Name
  XITYPE                     2                                 4
                                      IOP
                                      Type
  XLLND                      2                                10
                                      Line
                                      Description
  XLLSP                      2                                11    0
                                      Line
                                      Speed
  XHBTRN                     2                                11    0
                                      Bytes
                                      Transmitted
  XHBRCV                     2                                11    0
                                      Bytes
                                      Received
  XHPRCL                     2                                 1
                                      Protocol
  XHFTRN                     2                                11    0
                                      Frames
                                      Transmitted
  XHIFTR                     2                                11    0
                                      I Frames
                                      Transmitted
  XHIFRT                     2                                11    0
                                      I Frames
                                      Retransmitted
  XHFRT                      2                                11    0
                                      Frames
                                      Retransmitted
  XHEFFR                     2        Error Free              11    0
                                      Frames
                                      Received
  XHEFIR                     2        Error Free              11    0
                                      I Frames
                                      Received
  XHFRIE                     2        Frames                  11    0
                                      Received
                                      in Error
  XHIFR                      2        Invalid                 11    0
                                      Frames
                                      Received
  XHRRFT                     2        RR                      11    0
                                      Frames
                                      Transmitted
  XHRRFR                     2        RR                      11    0
                                      Frames
                                      Received
  XHRNRT                     2        RNR                     11    0
                                      Frames
                                      Transmitted
  XHRNRR                     2        RNR                     11    0
                                      Frames
                                      Received
  XHLNKR                     2                                11    0
                                      Link
                                      Resets
  XLITR                      2                                11    0
                                      IPDU
                                      Transmitted
  XLIRC                      2                                11    0
```

Figure 137. X25_ALL Query, Part 2

```
                                IPDU
                                Received
XLIRT              2                              11    0
                                IPDU
                                Retransmitted
XLIRE              2            IPDU              11    0
                                Received
                                in Error
XLLXTR             2                              11    0
                                XID
                                Transmitted
XLXRC              2                              11    0
                                XID
                                Received
XLTT               2                              11    0
                                Tests
                                Transmitted
XLTR               2                              11    0
                                Tests
                                Received
XLLJT              2            LLC               11    0
                                Rejects
                                Transmitted
XLLJR              2            LLC               11    0
                                Rejects
                                Received
XLRLD              2            Received          11    0
                                LLC PDU
                                Discarded
XLTO               2                              11    0
                                Timeouts
XLCED              2            Checksum          11    0
                                Errors
                                Detected
XLSRA              2            Successful        11    0
                                Recovery
                                Attempts
XLRA               2                              11    0
                                Recovery
                                Attempts
XLRSI              2                              11    0
                                Reset
                                Indications
XLCLS              2                              11    0
                                Close
                                Station
XLRNR              2            LLC               11    0
                                RNR
                                Received
XPTPT              2            Total             11    0
                                Packets
                                Transmitted
XPTPR              2            Total             11    0
                                Packets
                                Received
XPDPT              2            Data              11    0
                                Packets
                                Transmitted
XPDPR              2            Data              11    0
                                Packets
                                Received
XPRPT              2            Reset             11    0
                                Packets
                                Transmitted
XPROR              2            Reset             11    0
                                Packets
                                Received
XPRNR              2            RNR               11    0
                                Packets
                                Received
```

Figure 138. X25_ALL Query, Part 3

```
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 139. X25_ALL Query, Part 4

C.2 X25_HDLC

```
  Query . . . . . . . . . . . . . . . . . X25_HDLC
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . X.25 HDLC related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMX25        QPFRDATA      X25B          QAPMX25R

Result fields
  Name        Expression                        Column Heading         Len  Dec
  LINEUTILT   XHBTRN * 800 / INTSEC /XLLSP      Transmit                 4    1
                                                Line
                                                Util
  LINEUTILR   XHBRCV * 800 / INTSEC /XLLSP      Receive                  4    1
                                                line
                                                Util
  PCERRTR     (XHFRT * 100) / (XHFRT + XHFTRN)  Pct Frames               4    1
                                                Trnsmitd
                                                in Error
  PCIERRTR    (XHIFRT * 100) / (XHIFRT +        Pct I Frames             4    1
              XHIFTR)                           Trnsmitd
                                                in Error
  PCERRRCV    ((XHIFR + XHFRIE) * 100) /        Pct Frames               4    1
              (XHEFFR + XHIFR + XHFRIE)         Recd
                                                in Error
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
  LCLNOTR     XHRNRT / (XHEFFR + XHFRIE +       Local                    4    1
              XHIFR + XHRRFR + XHRNRR)          Not
                                                Ready
  RMTNOTR     XHRNRR / (XHIFTR + XHIFRT +       Remote                   4    1
              XHRRFT + XHRNRT)                  Not
                                                Ready

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  XLLND           10        A           1      Line Description
  IOPRN                                        IOP Resource Name
  DATE
  TIME
  LINEUTILT
  LINEUTILR
  PCERRTR
  PCIERRTR
  PCERRRCV
  LCLNOTR
  RMTNOTR
  XHLNKR                                       Link Resets
```

Figure 140. X25_HDLC Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  XLLND                      0                                 10
                                      Line
                                      Description
  IOPRN                      2        IOP                      10
                                      Resource
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  LINEUTILT       2 4        2        Transmit                  4    1
                                      Line
                                      Util
  LINEUTILR       2 4        2        Receive                   4    1
                                      line
                                      Util
  PCERRTR         2 4        2        Pct Frames                4    1
                                      Trnsmitd
                                      in Error
  PCIERRTR        2 4        2        Pct I Frames              4    1
                                      Trnsmitd
                                      in Error
  PCERRRCV        2 4        2        Pct Frames                4    1
                                      Recd
                                      in Error
  LCLNOTR         2 4        2        Local                     4    1
                                      Not
                                      Ready
  RMTNOTR         2 4        2        Remote                    4    1
                                      Not
                                      Ready
  XHLNKR                     2                                 11    0
                                      Link
                                      Resets

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for line &XLLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 141. X25_HDLC Query, Part 2

C.3 X25_PLC

```
  Query . . . . . . . . . . . . . . . . . X25_PLC
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . X.25 PLC related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMX25        QPFRDATA      X25B          QAPMX25R

Result fields
  Name        Expression                       Column Heading          Len  Dec
  DATE        substr(DTETIM,3,2) || '/' ||       Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||       Time
              substr(DTETIM,9,2)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  XLLND           10        A           1      Line Description
  DATE
  TIME
  XPTPT                                        Total Packets Transmitted
  XPRPT                                        Reset Packets Transmitted
  XPROR                                        Reset Packets Received
  XPRNR                                        RNR Packets Received

Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  XLLND                      0                                 10
                                      Line
                                      Description
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  XPTPT           1          2        Total                    11    0
                                      Packets
                                      Transmitted
  XPRPT           1          2        Reset                    11    0
                                      Packets
                                      Transmitted
  XPROR           1          2        Reset                    11    0
                                      Packets
                                      Received
  XPRNR           1          2        RNR                      11    0
                                      Packets
                                      Received
```

Figure 142. X25_PLC Query, Part 1

```
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for line &XLLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 143. X25_PLC Query, Part 2

C.4 X25_LLC

```
Query . . . . . . . . . . . . . . . . . X25_LLC
  Library . . . . . . . . . . . . . . . ITSCID03
Query text  . . . . . . . . . . . . . . X.25 LLC related performance fields
Query CCSID . . . . . . . . . . . . . .    37
Query language id . . . . . . . . . . . ENU
Query country id  . . . . . . . . . . . US
  *** . is the decimal separator character for this query ***
Collating sequence  . . . . . . . . . . Hexadecimal

Processing options
  Use rounding  . . . . . . . . . . . . Yes (default)
  Ignore decimal data errors  . . . . . No (default)
  Ignore substitution warnings  . . . . Yes
  Use collating for all compares  . . . Yes
Special conditions
  *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMX25        QPFRDATA      X25B          QAPMX25R

Result fields
  Name        Expression                         Column Heading          Len  Dec
  DATE        substr(DTETIM,3,2) || '/' ||       Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||       Time
              substr(DTETIM,9,2)
  PCTERRDUR   (XLIRE * 100) / XLIRC              Pct DU                    4    1
                                                 received
                                                 in Error
  PCTERRDUT   (XLIRT * 100) / XLITR              Pct DU                    4    1
                                                 Transmitted
                                                 in Error

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  XLLND           10        A           1      Line Description
  DATE
  TIME
  PCTERRDUT
  PCTERRDUR
  XLLJT                                        LLC Rejects Transmitted
  XLLJR                                        LLC Rejects Received
  XLRLD                                        Received LLC PDU Discarded
  XLTO                                         Timeouts
  XLCED                                        Checksum Errors Detected
  XLRSI                                        Reset Indications
  XLRNR                                        LLC RNR Received
```

Figure 144. X25_LLC Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  XLLND                      0                                10
                                      Line
                                      Description
  DATE                       2        Date                     5
  TIME                       2        Time                     5
  PCTERRDUT       2 4        2        Pct DU                   4    1
                                      Transmitted
                                      in Error
  PCTERRDUR       2 4        2        Pct DU                   4    1
                                      received
                                      in Error
  XLLJT           1          2        LLC                     11    0
                                      Rejects
                                      Transmitted
  XLLJR           1          2        LLC                     11    0
                                      Rejects
                                      Received
  XLRLD           1          2        Received                11    0
                                      LLC PDU
                                      Discarded
  XLTO            1          2                                11    0
                                      Timeouts
  XLCED           1          2        Checksum                11    0
                                      Errors
                                      Detected
  XLRSI           1          2                                11    0
                                      Reset
                                      Indications
  XLRNR           1          2        LLC                     11    0
                                      RNR
                                      Received

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for line &XLLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 145. X25_LLC Query, Part 2

C.5 X25_IOP

C.5.1 IOP Query for a Communications Processor

```
  Query . . . . . . . . . . . . . . . . . X25_IOP
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . X.25 and IOP related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMX25        QPFRDATA      X25B          QAPMX25R
  T02    QAPMCIOP       QPFRDATA      X25B          QAPMCIOR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field             Test              Field
  T01.INTNUM        EQ                T02.INTNUM
  T01.IOPRN         EQ                T02.IOPRN

Result fields
  Name        Expression                          Column Heading          Len  Dec
  DATE        substr(T01.DTETIM,3,2) || '/' ||    Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||    Time
              substr(T01.DTETIM,9,2)
  LCLNOTR     XHRNRT / (XHEFFR + XHFRIE +         Local                     4    1
              XHIFR + XHRRFR + XHRNRR)            Not
                                                  Ready
  RMTNOTR     XHRNRR / (XHIFTR + XHIFRT +         Remote                    4    1
              XHRRFT + XHRNRT)                    Not
                                                  Ready
  IOPUTIL     100 - ((CIIDLC * CIIDLT) /          Pct IOP                   4    1
              (1000000 * T02.INTSEC))             Util

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.IOPRN                                    IOP Resource Name
  T02.CITYPE      30        A           1      IOP Type
  T01.XLLND                                    Line Description
  DATE
  TIME
  IOPUTIL
  LCLNOTR
  RMTNOTR
  T01.XLITR                                    IPDU Transmitted
  T01.XLIRC                                    IPDU Received
```

Figure 146. X25_IOP Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T01.IOPRN                  0        IOP                      10
                                      Resource
                                      Name
  T02.CITYPE                 2                                  4
                                      IOP
                                      Type
  T01.XLLND                  2                                 10
                                      Line
                                      Description
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  IOPUTIL         2 4        2        Pct IOP                   4    1          4    1
                                      Util
  LCLNOTR         2 4        2        Local                     4    1          4    1
                                      Not
                                      Ready
  RMTNOTR         2 4        2        Remote                    4    1          4    1
                                      Not
                                      Ready
  T01.XLITR                  2                                 11    0
                                      IPDU
                                      Transmitted
  T01.XLIRC                  2                                 11    0
                                      IPDU
                                      Received

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    Yes
  2      No    No         Summary for line &T01.SHLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 147. X25_IOP Query, Part 2

C.5.2 IOP Query for MFIO Processor

```
  Query . . . . . . . . . . . . . . . . . X25_MIOP
    Library . . . . . . . . . . . . . . . ITSCID03
  Query text  . . . . . . . . . . . . . . X.25 and IOP related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***

Selected files
  ID     File          Library       Member        Record Format
  T01    QAPMX25       QPFRDATA      X25B          QAPMX25R
  T02    QAPMMIOP      QPFRDATA      X25B          QAPMMIOR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test             Field
  T01.INTNUM         EQ               T02.INTNUM
  T01.IOPRN          EQ               T02.IOPRN

Result fields
  Name        Expression                         Column Heading          Len  Dec
  DATE        substr(T01.DTETIM,3,2) || '/' ||   Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||   Time
              substr(T01.DTETIM,9,2)
  LCLNOTR     XHRNRT / (XHEFFR + XHFRIE +        Local                     4    1
              XHIFR + XHRRFR + XHRNRR)           Not
                                                 Ready
  RMTNOTR     XHRNRR / (XHIFTR + XHIFRT +        Remote                    4    1
              XHRRFT + XHRNRT)                   Not
                                                 Ready
  IOPUTIL     100 - ((mIIDLC * mIIDLT) /         Pct IOP                   4    1
              (1000000 * T02.INTSEC))            Util

Ordering of selected fields

  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.IOPRN                                    IOP Resource Name
  T01.XLLND                                    Line Description
  DATE
  TIME
  IOPUTIL
  LCLNOTR
  RMTNOTR
  T01.XLITR                                    IPDU Transmitted
  T01.XLIRC                                    IPDU Received
```

Figure 148. X25_MIOP Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                    Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  T01.IOPRN                  0        IOP                      10
                                      Resource
                                      Name
  T01.XLLND                  2                                 10
                                      Line
                                      Description
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  IOPUTIL         2 4        2        Pct IOP                   4    1          4    1
                                      Util
  LCLNOTR         2 4        2        Local                     4    1          4    1
                                      Not
                                      Ready
  RMTNOTR         2 4        2        Remote                    4    1          4    1
                                      Not
                                      Ready
  T01.XLITR                  2                                 11    0
                                      IPDU
                                      Transmitted
  T01.XLIRC                  2                                 11    0
                                      IPDU
                                      Received

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    Yes
  2      No    No         Summary for line &T01.SHLND

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 149. X25_MIOP Query, Part 2

C.6 X25_JOB

```
Query . . . . . . . . . . . . . . . . . X25_JOB
  Library . . . . . . . . . . . . . . . ITSCID03
Query text  . . . . . . . . . . . . . . X.25 and JOB related performance fields
Query CCSID . . . . . . . . . . . . . .    37
Query language id . . . . . . . . . . . ENU
Query country id  . . . . . . . . . . . US
  *** . is the decimal separator character for this query ***

Collating sequence  . . . . . . . . . . Hexadecimal
Processing options
  Use rounding  . . . . . . . . . . . . Yes (default)
  Ignore decimal data errors  . . . . . No (default)
  Ignore substitution warnings  . . . . Yes
  Use collating for all compares  . . . Yes
Special conditions
  *** All records selected by default ***

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMX25        QPFRDATA      X25B          QAPMX25R
  T02    QAPMJOBS       QPFRDATA      X25B          QAPMJOBR

Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field             Test             Field
  T01.XLLND         EQ               T02.JBLND
  T01.INTNUM        EQ               T02.INTNUM

Result fields
  Name        Expression                        Column Heading          Len  Dec
  LINEUTILT   XHBTRN * 800 / T01.INTSEC / XLLSP  Transmit                  4    1
                                                Line
                                                Util
  DATE        substr(T01.DTETIM,3,2) || '/' ||   Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||   Time
              substr(T01.DTETIM,9,2)
  AVGJOBRSP   JBRSP / (JBNTR + 0000.1)          Job avg
                                                response
                                                time
  PCTCPU      ((JBCPU / 1000) * 100) /          Pct                       4    1
              T01.INTSEC                        CPU
                                                Usage
  LINEUTILR   XHBRCV * 800 / T01.INTSEC /XLLSP   Receive
                                                line
                                                Util

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T02.JBNAME      10        A           1      Job Name
  T02.JBUSER      20        A           1      Job User
  T02.JBNBR       30        A           1      Job Number
  T01.XLLND                                    Line Description
  DATE
  TIME
  AVGJOBRSP
  PCTCPU
  LINEUTILT
  LINEUTILR
```

Figure 150. X25_JOB Query, Part 1

```
Report column formatting and summary functions

  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides

  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  TO2.JBNAME                 0                                10
                                      Job
                                      Name
  TO2.JBUSER                 2                                10
                                      Job
                                      User
  TO2.JBNBR                  2                                 6
                                      Job
                                      Number
  TO1.XLLND                  2                                10
                                      Line
                                      Description
  DATE                       2        Date                     5
  TIME                       2        Time                     5
  AVGJOBRSP       2 4        2        Job avg                 16    3
                                      response
                                      time
  PCTCPU          2 4        2        Pct                      4    1
                                      CPU
                                      Usage
  LINEUTILT                  2        Transmit                 4    1
                                      Line
                                      Util
  LINEUTILR                  2        Receive                 16    2
                                      line
                                      Util

Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for job &JBNAME &JBUSER &JBNBR

Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 152
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No

Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
```

Figure 151. X25_JOB Query, Part 2

Appendix D. Queries for APPN Tasks

Use Query to create your own reports.

- How much CPU does an intermediate APPN session use?
- This set of queries combines performance data to create reports of how much resource APPN tasks are using.

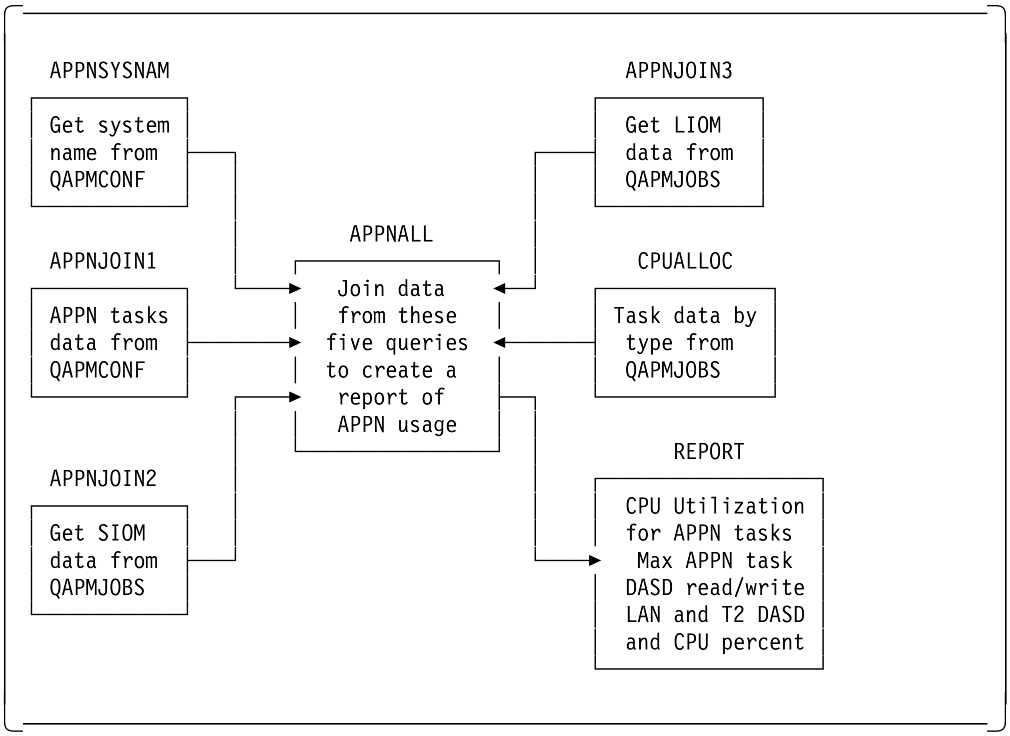

Figure 152. APPN Performance Communications Queries

These queries provide you with an example of creating your own report using the performance monitor data. A copy of each of these queries is provided for you in this appendix.

APPNSYSNAM Get system name from QAPMCONF config file.

APPNJOIN1 Selects APPN task info from QAPMJOBS and creates APPNTASK1 in file APPNTASKS.

APPNJOIN2 Selects T2 station IOM tasks from QAPMJOBS and creates T2TASK1 in file APPNTASKS.

APPNJOIN3 Selects TRN line IOM tasks from QAPMJOBS and creates LIOMTASK1 in file APPNTASKS.

CPUALLOC Processor usage by categories, creates member CPUALLOC in file of same name.

APPNALL Joins the T2TASK1, APPNTASK1, LIOMTASK1.

SYSNAME and CPUALLOC members for each interval collected. The result is a report of the CPU usage for all of the APPN activity.

Also provided are:

APPNDETAIL Selects APPN Tasks for Detail Resource Usage report.

APPNT2DTL Selects T2 station IOM task detail from QAPMJOBS and creates a report.

These queries can easily be altered to work on an SDLC line, for example, by changing the APPNJOIN3 query to select tasks whose names begin with #7 instead of #3 for TRN LAN.

The query called APPNDETAIL selects records with information on APPN tasks (CPMGR, LOCMGR, CPPS, DS, and TRS). You can just as easily select on DDM task names, SNADs task names, and others.

D.1 APPNSYSNAM Query (System Name - Input to Query APPNALL)

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11 25/96   10:33:07        Page    1
  Query . . . . . . . . . . . . . . . . . APPNSYSNAM
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMCONF       QPFRDATA      Q963121422    QAPMCONR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  INTNUM      1                                 Interval #
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           GKEY             EQ       ' S'
Ordering of selected fields
  Field          Sort      Ascending/  Break  Field
  Name           Priority  Descending  Level  Text
  INTNUM
  GKEY
  GDES
                                  IBM Query/400                    11/25/96   10:33:07        Page    2
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field          Summary    Column                               Dec  Null       Dec  Numeric
  Name           Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                    0        Interval #               1    0
  GKEY                      2        GKEY                     2
  GDES                      2        GDES                    10
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . SYSNAME
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . System name identifier
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .    13
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    INTNUM            1     1    0         Packed decimal      1
    GKEY              2     2              Character
    GDES              4    10              Character
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 153. APPNSYSNAM Query Definition

D.2 APPNJOIN1 Query (APPN Task - Join Input to Query APPNALL)

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/25/96   10:32:52        Page    1
  Query . . . . . . . . . . . . . . . . . APPNJOIN1
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMJOBS       QPFRDATA      Q963121422    QAPMJOBR
Result fields
  Name        Expression                        Column Heading         Len  Dec
  JBCPUSEC    jbcpu/1000                        cpu secs                 6    3
  JBCPUCENT   (jbcpusec/intsec)*100             cpu %                    5    3
  IOSUM       jbdbr+jbndb+jbwrt                 tot i/o                  7    0
  TOTOPSPSEC  iosum/intsec                      total dasd i/os          6    1
                                                  per second
  READPSEC    jbndb/intsec                      reads per second         6    1
  TIME        substr(dtetim,7,4)                time
  DATE        substr(dtetim,1,6)                date
  IOMSORT     substr(jbname,2,2)                iom type
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           JBNAME           LIST     'LMLOCMGR'
                                     'LCCPMGR'
                                     'LCCPPS'
                                     'LCDS'
                                     'LCTRS'
                                  IBM Query/400                    11/25/96   10:32:52        Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          10        A           1      Interval Number
  DATE
  TIME
  JBNAME                                       Job Name
  JBPOOL                                       Job Pool
  JBCPUCENT
  JBCPUSEC        20        D
  JBCPU                                        CPU Milliseconds
  JBNDB                                        Physical Non Database Reads
  JBWRT                                        Physical Writes
  READPSEC
  JBPRTY                                       Job Priority
  INTSEC                                       Elapsed Interval Seconds
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM          4          0                                 5    0
                                      Interval
                                      Number
  DATE            4          2        date                     6
  TIME            4          2        time                     4
  JBNAME          5          1                                10
                                      Job
                                      Name
  JBPOOL                     2                                 2
                                      Job
                                      Pool
  JBCPUCENT       1 4        2        cpu %                    5    3
  JBCPUSEC        1 4        1        cpu secs                 6    3
  JBCPU                      2                                11    0
                                      CPU
                                      Milliseconds
  JBNDB           1 4        1        Physical                11    0
                                      Non Database
                                      Reads
  JBWRT           1 4        1                                11    0
                                      Physical
                                      Writes
  READPSEC        1 4        2        reads per second         6    1
  JBPRTY                     2                                 3
                                      Job
                                      Priority
```

Figure 154. APPNJOIN1 Query Definition, Part 1

```
                                  IBM Query/400                     11/25/96   10:32:52        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                   Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . APPNTASKS
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . APPNTASK1
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . appn tasks - join input
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   122
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL          1     1              Character           BREAK LEVEL
    OVERFLOW          2     1              Character           OVERFLOW FLAG
    INTNUM            3     5    0         Zoned decimal       Interval Number
    INTNUM04          8     5    0         Zoned decimal       INTNUM     MAX
    DATE04           13     6              Character           DATE       MAX
                                  IBM Query/400                     11/25/96   10:32:52        Page    4
Output file record format (continued)
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    TIME04           19     4              Character           TIME       MAX
    JBNAME05         23     7    0         Zoned decimal       JBNAME     COUNT
    JBCPUCEN01       30     8    3         Zoned decimal       JBCPUCENT  TOTAL
    JBCPUCEN04       38     5    3         Zoned decimal       JBCPUCENT  MAX
    JBCPUSEC01       43     9    3         Zoned decimal       JBCPUSEC   TOTAL
    JBCPUSEC04       52     6    3         Zoned decimal       JBCPUSEC   MAX
    JBNDB01          58    14    0         Zoned decimal       JBNDB      TOTAL
    JBNDB04          72    11    0         Zoned decimal       JBNDB      MAX
    JBWRT01          83    14    0         Zoned decimal       JBWRT      TOTAL
    JBWRT04          97    11    0         Zoned decimal       JBWRT      MAX
    READPSEC01      108     9    1         Zoned decimal       READPSEC   TOTAL
    READPSEC04      117     6    1         Zoned decimal       READPSEC   MAX
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 155. APPNJOIN1 Query Definition, Part 2

D.3 APPNJOIN2 Query (T2 Station IOM - Join Input to Query APPNALL)

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/25/96   10:32:55        Page    1
  Query . . . . . . . . . . . . . . . . . APPNJOIN2
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMJOBS       QPFRDATA      Q963121422    QAPMJOBR
Result fields
  Name        Expression                         Column Heading         Len  Dec
  JBCPUSEC    jbcpu/1000                         cpu secs                 6    3
  JBCPUCENT   (jbcpusec/intsec)*100              cpu %                    5    3
  IOSUM       jbdbr+jbndb+jbwrt                  tot i/o                  7    0
  TOTOPSPSEC  iosum/intsec                       total dasd i/os          6    1
                                                   per second
  READPSEC    jbndb/intsec                       reads per second         6    1
  TIME        substr(dtetim,7,4)                 time
  DATE        substr(dtetim,1,6)                 date
  IOMSORT     substr(jbname,2,2)                 iom type
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           JBCPUSEC         GT       0
   AND     JBNAME           LIKE     'T2-%'
                                  IBM Query/400                     11/25/96   10:32:55        Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          10        A           1      Interval Number
  DATE
  TIME
  JBNAME                                       Job Name
  JBPOOL                                       Job Pool
  JBCPUCENT
  JBCPUSEC        20        D
  JBCPU                                        CPU Milliseconds
  JBNDB                                        Physical Non Database Reads
  JBWRT                                        Physical Writes
  READPSEC
  JBPRTY                                       Job Priority
  INTSEC                                       Elapsed Interval Seconds
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM          4          0                                 5    0
                                      Interval
                                      Number
  DATE            4          2        date                     6
  TIME            4          2        time                     4
  JBNAME          5          1                                10
                                      Job
                                      Name
  JBPOOL                     2                                 2
                                      Job
                                      Pool
  JBCPUCENT       1 4        2        cpu %                    5    3
  JBCPUSEC        1 4        1        cpu secs                 6    3
  JBCPU                      2                                11    0
                                      CPU
                                      Milliseconds
  JBNDB           1 4        1        Physical                11    0
                                      Non Database
                                      Reads
  JBWRT           1 4        1                                11    0
                                      Physical
                                      Writes
  READPSEC        1 4        2        reads per second         6    1
  JBPRTY                     2                                 3
                                      Job
                                      Priority
```

Figure 156. APPNJOIN2 Query Definition, Part 1

```
                                   IBM Query/400                    11/25/96   10:32:55        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . APPNTASKS
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . T2TASK1
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . t2 station iom tasks - join input
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   122
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL          1     1              Character           BREAK LEVEL
    OVERFLOW          2     1              Character           OVERFLOW FLAG
    INTNUM            3     5    0         Zoned decimal       Interval Number
    INTNUM04          8     5    0         Zoned decimal       INTNUM     MAX
    DATE04           13     6              Character           DATE       MAX
                                   IBM Query/400                    11/25/96   10:32:55        Page    4
Output file record format (continued)
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    TIME04           19     4              Character           TIME       MAX
    JBNAME05         23     7    0         Zoned decimal       JBNAME     COUNT
    JBCPUCEN01       30     8    3         Zoned decimal       JBCPUCENT  TOTAL
    JBCPUCEN04       38     5    3         Zoned decimal       JBCPUCENT  MAX
    JBCPUSEC01       43     9    3         Zoned decimal       JBCPUSEC   TOTAL
    JBCPUSEC04       52     6    3         Zoned decimal       JBCPUSEC   MAX
    JBNDB01          58    14    0         Zoned decimal       JBNDB      TOTAL
    JBNDB04          72    11    0         Zoned decimal       JBNDB      MAX
    JBWRT01          83    14    0         Zoned decimal       JBWRT      TOTAL
    JBWRT04          97    11    0         Zoned decimal       JBWRT      MAX
    READPSEC01      108     9    1         Zoned decimal       READPSEC   TOTAL
    READPSEC04      117     6    1         Zoned decimal       READPSEC   MAX
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 157. APPNJOIN2 Query Definition, Part 2

D.4 APPNJOIN3 Query (Token-Ring IOM - Join Input to Query APPNALL)

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM01 11/25/96   10:33:04         Page    1
  Query . . . . . . . . . . . . . . . . . APPNJOIN3
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . TRN IOM join input to query APPNALL
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMJOBS       QPFRDATA      Q963121422    QAPMJOBR
Result fields
  Name        Expression                          Column Heading          Len  Dec
  JBCPUSEC    jbcpu/1000                          cpu secs                  6    3
  JBCPUCENT   (jbcpusec/intsec)*100               cpu %                     5    3
  IOSUM       jbdbr+jbndb+jbwrt                   tot i/o                   7    0
  TOTOPSPSEC  iosum/intsec                        total dasd i/os           6    1
                                                    per second
  READPSEC    jbndb/intsec                        reads per second          6    1
  TIME        substr(dtetim,7,4)                  time
  DATE        substr(dtetim,1,6)                  date
  IOMSORT     substr(jbname,2,2)                  iom type
Select record tests
  AND/OR   Field             Test     Value (Field, Numbers, or 'Characters')
           JBCPUSEC          GT       0
   AND     JBNAME            LIKE     'TRN-%'
                                   IBM Query/400                     11/25/96   10:33:04         Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          10        A           1      Interval Number
  DATE
  TIME
  JBNAME                                       Job Name
  JBPOOL                                       Job Pool
  JBCPUCENT
  JBCPUSEC        20        D
  JBCPU                                        CPU Milliseconds
  JBNDB                                        Physical Non Database Reads
  JBWRT                                        Physical Writes
  READPSEC
  JBPRTY                                       Job Priority
  INTSEC                                       Elapsed Interval Seconds
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                            Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM          4          0                                 5    0
                                      Interval
                                      Number
  DATE            4          2        date                     6
  TIME            4          2        time                     4
  JBNAME          5          1                                10
                                      Job
                                      Name
  JBPOOL                     2                                 2
                                      Job
                                      Pool
  JBCPUCENT       1 4        2        cpu %                    5    3
  JBCPUSEC        1 4        1        cpu secs                 6    3
  JBCPU                      2                                11    0
                                      CPU
                                      Milliseconds
  JBNDB           1 4        1        Physical                11    0
                                      Non Database
                                      Reads
  JBWRT           1 4        1                                11    0
                                      Physical
                                      Writes
  READPSEC        1 4        2        reads per second         6    1
  JBPRTY                     2                                 3
                                      Job
                                      Priority
```

Figure 158. APPNJOIN3 Query Definition, Part 1

```
                                  IBM Query/400                      11/25/96   10:33:04        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Summary only
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . APPNTASKS
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . LIOMTASK1
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . line iom (trn) tasks - join input
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   122
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    BREAKLVL          1     1              Character           BREAK LEVEL
    OVERFLOW          2     1              Character           OVERFLOW FLAG
    INTNUM            3     5    0         Zoned decimal       Interval Number
    INTNUM04          8     5    0         Zoned decimal       INTNUM     MAX
    DATE04           13     6              Character           DATE       MAX
                                  IBM Query/400                      11/25/96   10:33:04        Page    4
Output file record format (continued)
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    TIME04           19     4              Character           TIME       MAX
    JBNAME05         23     7    0         Zoned decimal       JBNAME     COUNT
    JBCPUCEN01       30     8    3         Zoned decimal       JBCPUCENT  TOTAL
    JBCPUCEN04       38     5    3         Zoned decimal       JBCPUCENT  MAX
    JBCPUSEC01       43     9    3         Zoned decimal       JBCPUSEC   TOTAL
    JBCPUSEC04       52     6    3         Zoned decimal       JBCPUSEC   MAX
    JBNDB01          58    14    0         Zoned decimal       JBNDB      TOTAL
    JBNDB04          72    11    0         Zoned decimal       JBNDB      MAX
    JBWRT01          83    14    0         Zoned decimal       JBWRT      TOTAL
    JBWRT04          97    11    0         Zoned decimal       JBWRT      MAX
    READPSEC01      108     9    1         Zoned decimal       READPSEC   TOTAL
    READPSEC04      117     6    1         Zoned decimal       READPSEC   MAX
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 159. APPNJOIN3 Query Definition, Part 2

D.5 CPUALLOC Query (System Processor Usage by Categories)

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM01 11/25/96   10:33:11        Page    1
  Query . . . . . . . . . . . . . . . . . CPUALLOC
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . System processor usage by categories
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSYS        QPFRDATA      Q963121422    QAPMSYSR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  CPUTIL      ((syscpu+sycpu2+sycpu3+sycpu4)/    cpu %                     3    1
              1000)/intsec*100
  BTCHUTIL    ((sbcpu/1000)/intsec)*100         batch %                   3    1
  IAUTIL      ((sicpu/1000)/intsec)*100         I/A %                     3    1
  SYSSECS     (syscpu+sycpu2+sycpu3+sycpu4)/     total cpu secs            5    2
              1000
  DDMSECS     sdcpu/1000                        DDM secs                  5    2
  DDMUTIL     (ddmsecs/intsec)*100              DDM %                     3    1
  PCSECS      swcpu/1000                        CA/400 secs               5    2
  PCSUTIL     (pcsecs/intsec)*100               CA/400 %                  3    1
  PASSTHRU    spcpu/1000                        passthru secs             5    2
  PTHUTIL     (passthru/intsec)*100             passthru %                3    1
  MRTSECS     smcpu/1000                        MRT secs                  5    2
  MRTUTIL     (mrtsecs/intsec)*100              MRT %                     3    1
                                   IBM Query/400                     11/25/96   10:33:11        Page    2
Result fields (continued)
  Name        Expression                        Column Heading          Len  Dec
  S36ESECS    s6cpu/1000                        s/36e secs                5    2
  S36EUTIL    (s36esecs/intsec)*100             s/36e %                   3    1
  EVOKESECS   secpu/1000                        evoke secs                5    2
  EVOKEUTIL   (evokesecs/intsec)*100            evoke %                   3    1
  AUTOSECS    sacpu/1000                        auto start secs           5    2
  AUTOUTIL    (autosecs/intsec)*100             auto start %              3    1
  BATCHSECS   sbcpu/1000                        batch secs                5    2
  IASECS      sicpu/1000                        I/A secs                  5    2
  SPOOLSECS   sxcpu/1000                        spool secs                5    2
  SPOOLUTIL   (spoolsecs/intsec)*100            spool %                   3    1
  MCODESECS   shcpu/1000                        micro code secs           5    2
  MCODEUTIL   (mcodesecs/intsec)*100            micro code %              3    1
  TIMESTAMP   substr(dtetim,7,4)                time
  HOUR        substr(dtetim,1,2)                hour
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number
  TIMESTAMP
  SYSSECS
  CPUTIL
  MCODESECS
  MCODEUTIL
  BATCHSECS
  BTCHUTIL
  IASECS
  IAUTIL
  PCSECS
  PCSUTIL
  PASSTHRU
  PTHUTIL
  EVOKESECS
  EVOKEUTIL
  AUTOSECS
  AUTOUTIL
  SPOOLSECS
  SPOOLUTIL
  MRTSECS
  MRTUTIL
  DDMSECS
  DDMUTIL
  S36ESECS
  S36EUTIL
  HOUR
```

Figure 160. CPUALLOC Query Definition, Part 1

```
                             IBM Query/400                      11/25/96   10:33:11         Page    3
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                 5    0
                                      Interval
                                      Number
  TIMESTAMP                  2        time                     4
  SYSSECS                    2        total cpu secs           5    2
  CPUTIL          2          2        cpu %                    3    1
  MCODESECS                  2        micro code secs          5    2
  MCODEUTIL       2 3 4      2        micro code %             3    1
  BATCHSECS                  2        batch secs               5    2
  BTCHUTIL        2 3 4      2        batch %                  3    1
  IASECS                     2        I/A secs                 5    2
  IAUTIL          2 3 4      2        I/A %                    3    1
  PCSECS                     2        CA/400 secs              5    2
  PCSUTIL         2 3 4      2        CA/400 %                 3    1
  PASSTHRU                   2        passthru secs            5    2
  PTHUTIL         2 3 4      2        passthru %               3    1
  EVOKESECS                  2        evoke secs               5    2
  EVOKEUTIL       2 3 4      2        evoke %                  3    1
  AUTOSECS                   2        auto start secs          5    2
  AUTOUTIL        2 3 4      2        auto start %             3    1
  SPOOLSECS                  2        spool secs               5    2
  SPOOLUTIL       2 3 4      2        spool %                  3    1
  MRTSECS                    2        MRT secs                 5    2
  MRTUTIL         2 3 4      2        MRT %                    3    1
  DDMSECS                    2        DDM secs                 5    2
  DDMUTIL         2 3 4      2        DDM %                    3    1
  S36ESECS                   2        s/36e secs               5    2
  S36EUTIL        2 3 4      2        s/36e %                  3    1
  HOUR                       2        hour                     2
Selected output attributes
  Output type . . . . . . . . . . . . . . Database file
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
                             IBM Query/400                      11/25/96   10:33:11         Page    4
Database file output
  File  . . . . . . . . . . . . . . . . . CPUALLOC
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . CPUALLOC
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . cpu allocation input to join
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   105
  Field list:
    Field          Begin   Len  Dec    Null  Data Type           Text
    INTNUM             1     5    0          Packed decimal      Interval Number
    TIMESTAMP          4     4               Character           substr(dtetim,7,4)
    SYSSECS            8     5    2          Zoned decimal       (syscpu+sycpu2+sycpu3+sycpu4)/   1000
    CPUTIL            13     3    1          Zoned decimal       ((syscpu+sycpu2+sycpu3+sycpu4)/  1000)/intsec*100
    MCODESECS         16     5    2          Zoned decimal       shcpu/1000
    MCODEUTIL         21     3    1          Zoned decimal       (mcodesecs/intsec)*100
    BATCHSECS         24     5    2          Zoned decimal       sbcpu/1000
    BTCHUTIL          29     3    1          Zoned decimal       ((sbcpu/1000)/intsec)*100
    IASECS            32     5    2          Zoned decimal       sicpu/1000
    IAUTIL            37     3    1          Zoned decimal       ((sicpu/1000)/intsec)*100
    PCSECS            40     5    2          Zoned decimal       swcpu/1000
    PCSUTIL           45     3    1          Zoned decimal       (pcsecs/intsec)*100
    PASSTHRU          48     5    2          Zoned decimal       spcpu/1000
    PTHUTIL           53     3    1          Zoned decimal       (passthru/intsec)*100
    EVOKESECS         56     5    2          Zoned decimal       secpu/1000
    EVOKEUTIL         61     3    1          Zoned decimal       (evokesecs/intsec)*100
    AUTOSECS          64     5    2          Zoned decimal       sacpu/1000
    AUTOUTIL          69     3    1          Zoned decimal       (autosecs/intsec)*100
    SPOOLSECS         72     5    2          Zoned decimal       sxcpu/1000
    SPOOLUTIL         77     3    1          Zoned decimal       (spoolsecs/intsec)*100
    MRTSECS           80     5    2          Zoned decimal       smcpu/1000
    MRTUTIL           85     3    1          Zoned decimal       (mrtsecs/intsec)*100
    DDMSECS           88     5    2          Zoned decimal       sdcpu/1000
    DDMUTIL           93     3    1          Zoned decimal       (ddmsecs/intsec)*100
    S36ESECS          96     5    2          Zoned decimal       s6cpu/1000
    S36EUTIL         101     3    1          Zoned decimal       (s36esecs/intsec)*100
    HOUR             104     2               Character           substr(dtetim,1,2)
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 161. CPUALLOC Query Definition, Part 2

D.6 APPNALL Query (ASync Communications I/O Task Activity)

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/25/96   10:31:52        Page    1
  Query . . . . . . . . . . . . . . . . APPNALL
    Library . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . US
  Collating sequence  . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . No (default)
    Ignore substitution warnings  . . . Yes
    Use collating for all compares  . . Yes
Selected files
  ID     File          Library       Member        Record Format
  T01    APPNTASKS     MYLIB         T2TASK1       APPNTASKS
  T02    APPNTASKS     MYLIB         APPNTASK1     APPNTASKS
  T03    APPNTASKS     MYLIB         LIOMTASK1     APPNTASKS
  T04    SYSNAME       MYLIB         SYSNAME       SYSNAME
  T05    CPUALLOC      MYLIB         CPUALLOC      CPUALLOC
Join tests
  Type of join  . . . . . . . . . . . . Matched records
  Field             Test             Field
  T01.INTNUM        EQ               T02.INTNUM
  T01.INTNUM        EQ               T03.INTNUM
  T01.INTNUM        EQ               T04.INTNUM
  T01.INTNUM        EQ               T05.INTNUM
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
         T01.BREAKLVL      EQ       '1'
                                  IBM Query/400                     11/25/96   10:31:52        Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  T01.INTNUM                                   Interval Number
  T01.DATE04                                   DATE       MAX
  T01.TIME04                                   TIME       MAX
  T04.GDES
  T05.CPUTIL                                   ((syscpu+sycpu2+sycpu3+sycpu4)/  1000)/intsec*100
  T02.JBNAME05                                 JBNAME     COUNT
  T02.JBCPUCEN01                               JBCPUCENT  TOTAL
  T02.JBCPUCEN04                               JBCPUCENT  MAX
  T02.JBNDB01                                  JBNDB      TOTAL
  T02.JBWRT01                                  JBWRT      TOTAL
  T03.JBCPUCEN01                               JBCPUCENT  TOTAL
  T03.JBNDB01                                  JBNDB      TOTAL
  T03.JBWRT01                                  JBWRT      TOTAL
  T01.JBNAME05                                 JBNAME     COUNT
  T01.JBCPUCEN01                               JBCPUCENT  TOTAL
  T01.JBNDB01                                  JBNDB      TOTAL
  T01.JBWRT01                                  JBWRT      TOTAL
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings       Len  Pos  Cap   Len  Pos  Editing
  T01.INTNUM                 0                                5    0
                                    Interval
                                    Number
  T01.DATE04                 1      DATE                      6
                                    MAX
  T01.TIME04                 1      TIME                      4
                                    MAX
  T04.GDES                   1      GDES                     10
  T05.CPUTIL      2 4        2      cpu %                     3    1
  T02.JBNAME05               2      JBNAME                    7    0
                                    COUNT
  T02.JBCPUCEN01  2 4        2      JBCPUCENT                 8    3
                                    TOTAL
  T02.JBCPUCEN04             2      JBCPUCENT                 5    3
                                    MAX
  T02.JBNDB01                2      JBNDB                    14    0
                                    TOTAL
  T02.JBWRT01                2      JBWRT                    14    0
                                    TOTAL
  T03.JBCPUCEN01             2      JBCPUCENT                 8    3
                                    TOTAL
  T03.JBNDB01                2      JBNDB                    14    0
                                    TOTAL
```

Figure 162. APPNALL Query Definition, Part 1

```
                                  IBM Query/400                    11/25/96   10:31:52        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  T03.JBWRT01                2        JBWRT                   14    0
                                      TOTAL
  T01.JBNAME05               2        JBNAME                   7    0
                                      COUNT
  T01.JBCPUCEN01             2        JBCPUCENT                8    3
                                      TOTAL
  T01.JBNDB01                2        JBNDB                   14    0
                                      TOTAL
  T01.JBWRT01                2        JBWRT                   14    0
                                      TOTAL
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
                                  IBM Query/400                    11/25/96   10:31:52        Page    4
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      APPN,Async comm I/O task resource utilization summary
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
             * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 163. APPNALL Query Definition, Part 2

D.7 APPNDETAIL Query (APPN Tasks - Detailed Resource Usage)

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM01 11/25/96   10:32:48        Page    1
  Query . . . . . . . . . . . . . . . . . APPNDETAIL
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
Selected files
  ID     File          Library       Member        Record Format
  T01    QAPMJOBS      QPFRDATA      TEST1307      QAPMJOBR
Result fields
  Name        Expression                         Column Heading          Len  Dec
  JBCPUSEC    jbcpu/1000                         cpu secs                  6    3
  JBCPUCENT   (jbcpusec/intsec)*100              cpu %                     5    3
  IOSUM       jbdbr+jbndb+jbwrt                  tot i/o                   7    0
  TOTOPSPSEC  iosum/intsec                       total dasd i/os           6    1
                                                   per second
  READPSEC    jbndb/intsec                       reads per second          6    1
  TIME        substr(dtetim,7,4)                 time
  DATE        substr(dtetim,1,6)                 date
  IOMSORT     substr(jbname,2,2)                 iom type
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           JBCPUSEC         GT       0
   AND     JBNAME           LIST     'LMLOCMGR'
                                     'LCCPMGR'
                                     'LCCPS'
                                     'LCDS'
                                  IBM Query/400                     11/25/96   10:32:48        Page    2
Select record tests (continued)
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
                                     'LCTRS'
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          10        A           1      Interval Number
  DATE
  TIME
  JBNAME                                       Job Name
  JBPOOL                                       Job Pool
  JBCPUCENT
  JBCPUSEC        20        D
  JBCPU                                        CPU Milliseconds
  JBNDB                                        Physical Non Database Reads
  JBWRT                                        Physical Writes
  READPSEC
  JBPRTY                                       Job Priority
  INTSEC                                       Elapsed Interval Seconds
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM          4          0                                 5    0
                                      Interval
                                      Number
  DATE            4          2        date                     6
  TIME            4          2        time                     4
  JBNAME          5          1                                10
                                      Job
                                      Name
  JBPOOL                     2                                 2
                                      Job
                                      Pool
  JBCPUCENT       1 4        2        cpu %                    5    3
  JBCPUSEC        1 4        1        cpu secs                 6    3
  JBCPU                      2                                11    0
                                      CPU
                                      Milliseconds
  JBNDB           1 4        1        Physical                11    0
                                      Non Database
                                      Reads
```

Figure 164. APPNDETAIL Query Definition, Part 1

```
                               IBM Query/400                    11/25/96   10:32:48        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  JBWRT           1 4        1                                 11    0
                                      Physical
                                      Writes
  READPSEC        1 4        2        reads per second          6    1
  JBPRTY                     2                                  3
                                      Job
                                      Priority
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Display
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . APPNTASKS
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . APPNTASK1
  Data in file  . . . . . . . . . . . . . Replace member
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . appn tasks - join input
  Print definition  . . . . . . . . . . . No
                               IBM Query/400                    11/25/96   10:32:48        Page    4
Output file record format
  Output record length  . . . . . . . . .   67
  Field list:
    Field          Begin   Len  Dec   Null  Data Type            Text
    INTNUM             1     5    0         Packed decimal       Interval Number
    DATE               4     6              Character            substr(dtetim,1,6)
    TIME              10     4              Character            substr(dtetim,7,4)
    JBNAME            14    10              Character            Job Name
    JBPOOL            24     2              Character            Job Pool
    JBCPUCENT         26     5    3         Zoned decimal        (jbcpusec/intsec)*100
    JBCPUSEC          31     6    3         Zoned decimal        jbcpu/1000
    JBCPU             37    11    0         Packed decimal       CPU Milliseconds
    JBNDB             43    11    0         Packed decimal       Physical Non Database Reads
    JBWRT             49    11    0         Packed decimal       Physical Writes
    READPSEC          55     6    1         Zoned decimal        jbndb/intsec
    JBPRTY            61     3              Character            Job Priority
    INTSEC            64     7    0         Packed decimal       Elapsed Interval Seconds
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 165. APPNDETAIL Query Definition, Part 2

D.8 APPNT2DTL Query (T2 Station IOP Task Detail)

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM01 11/25/96   13:51:35         Page    1
  Query . . . . . . . . . . . . . . . . . APPNT2DTL
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMJOBS       QPFRDATA      Q963121422    QAPMJOBR
Result fields
  Name        Expression                         Column Heading          Len  Dec
  JBCPUSEC    jbcpu/1000                         cpu secs                  6    3
  JBCPUCENT   (jbcpusec/intsec)*100              cpu %                     5    3
  IOSUM       jbdbr+jbndb+jbwrt                  tot i/o                   7    0
  TOTOPSPSEC  iosum/intsec                       total dasd i/os           6    1
                                                   per second
  READPSEC    jbndb/intsec                       reads per second          6    1
  TIME        substr(dtetim,7,4)                 time
  DATE        substr(dtetim,1,6)                 date
  IOMSORT     substr(jbname,2,2)                 iom type
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           JBCPUSEC         GT       0
   AND     JBNAME           LIKE     'T2-%'
                                   IBM Query/400                     11/25/96   13:51:35         Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          10        A           1      Interval Number
  DATE
  TIME
  JBNAME                                       Job Name
  JBPOOL                                       Job Pool
  JBCPUCENT
  JBCPUSEC        20        D
  JBCPU                                        CPU Milliseconds
  JBNDB                                        Physical Non Database Reads
  JBWRT                                        Physical Writes
  READPSEC
  JBPRTY                                       Job Priority
  INTSEC                                       Elapsed Interval Seconds
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTNUM          4          0                                  5    0
                                      Interval
                                      Number
  DATE            4          2        date                      6
  TIME            4          2        time                      4
  JBNAME          5          1                                 10
                                      Job
                                      Name
  JBPOOL                     2                                  2
                                      Job
                                      Pool
  JBCPUCENT       1 4        2        cpu %                     5    3
  JBCPUSEC        1 4        1        cpu secs                  6    3
  JBCPU                      2                                 11    0
                                      CPU
                                      Milliseconds
  JBNDB           1 4        1        Physical                 11    0
                                      Non Database
                                      Reads
  JBWRT           1 4        1                                 11    0
                                      Physical
                                      Writes
  READPSEC        1 4        2        reads per second          6    1
  JBPRTY                     2                                  3
                                      Job
                                      Priority
```

Figure 166. APPNT2DTL Query Definition, Part 1

```
                                 IBM Query/400                     11/25/96   13:51:35        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                   Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Display
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Database file output
  File  . . . . . . . . . . . . . . . . . APPNTASKS
    Library . . . . . . . . . . . . . . . MYLIB
  Member  . . . . . . . . . . . . . . . . T2TASK1
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . t2 station iom tasks - join input
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .    67
  Field list:
    Field         Begin   Len  Dec   Null  Data Type            Text
    INTNUM            1     5    0         Packed decimal       Interval Number
    DATE              4     6              Character            substr(dtetim,1,6)
    TIME             10     4              Character            substr(dtetim,7,4)
    JBNAME           14    10              Character            Job Name
    JBPOOL           24     2              Character            Job Pool
                                 IBM Query/400                     11/25/96   13:51:35        Page    4
Output file record format (continued)
  Field list:
    Field         Begin   Len  Dec   Null  Data Type            Text
    JBCPUCENT        26     5    3         Zoned decimal        (jbcpusec/intsec)*100
    JBCPUSEC         31     6    3         Zoned decimal        jbcpu/1000
    JBCPU            37    11    0         Packed decimal       CPU Milliseconds
    JBNDB            43    11    0         Packed decimal       Physical Non Database Reads
    JBWRT            49    11    0         Packed decimal       Physical Writes
    READPSEC         55     6    1         Zoned decimal        jbndb/intsec
    JBPRTY           61     3              Character            Job Priority
    INTSEC           64     7    0         Packed decimal       Elapsed Interval Seconds
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 167. APPNT2DTL Query Definition, Part 2

Appendix E. SNA Queries

This appendix provides query definitions that can be used to examine SNA environments. All of the queries use input from the OS/400 Performance Monitor and run with trace options. There are eight queries defined:

- SNA_ALL
- SNA_CON
- SNA_IPAC
- SNA_PAC1
- SNA_PAC2
- SNA_PAC3
- SNA_LIN
- SNA_TRQ

The SNA_ALL query is simple. It shows you all of the values in the QAPMSNA file. The only thing you have to define is the file name and member name that contains the performance data. The rest are defaults so it takes you only a few minutes to create the query.

The SNA_CON query shows you the number of connections started and ended, the number of sessions started and ended, and the number of start and end brackets sent and received.

The SNA_IPAC query shows you the internal session level pacing wait time per session type/priority.

The SNA_PAC1 query shows you the average pacing response time per session type/priority.

The SNA_PAC2 query shows you the percent pacing wait per session type/priority.

The SNA_PAC3 query shows you the average pacing window size per session type/priority.

The SNA_LIN query shows you the line transmission time per session type/priority.

The SNA_TRQ query shows you the transmission queue wait time per session type/priority.

E.1 SNA_ALL

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/27/96   14:56:16        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_ALL
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . All SNA related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All fields selected by default ***
    *** All records selected by default ***
Selected files
  ID     File          Library      Member       Record Format
  T01    QAPMSNA       QPFRDATA     SNAOVERIP1   QAPMSNAR
Ordering of selected fields
  Field          Sort      Ascending/  Break  Field
  Name           Priority  Descending  Level  Text
  INTNUM                                      Interval Number
                                  IBM Query/400                    11/27/96   14:56:16        Page    2
Ordering of selected fields (continued)
  Field          Sort      Ascending/  Break  Field
  Name           Priority  Descending  Level  Text
  DTETIM                                      Interval Date and Time
  INTSEC                                      Elapsed Interval Seconds
  SCTLNM                                      Controller Description Name
  SLINNM                                      Line Description Name
  STSKNM                                      T2 Station I/O Manager Task Name
  SLIOMT                                      Line I/O Manager Task Name
  SACPNM                                      Adjacent CP Name
  SANWID                                      Adjacent Network ID
  SAPPN                                       APPN-Capable
  SCTYP                                       Controller Type
  SSMFS                                       Send Maximum Frame Size
  SRMFS                                       Receive Maximum Frame Size
  STLLBU                                      Date and Time of Most Recent Connection
  SNLBU                                       Connections Established with Remote System
  STACVO                                      Time for Auto-created/Varied On Devices
  SNACVO                                      Auto-created and/or Varied on Devices
  SNADD                                       Auto-deleted Devices
  SNWAIN                                      Messages Received by the T2 SIOM Task
  SNWAOU                                      Messages Sent by the T2 SIOM Task
  ENNSS                                       Network Priority Sessions Started
  ENNSE                                       Network Priority Sessions Ended
  ENNBB                                       N - Begin Bracket Request Units
  ENNEB                                       N - End Bracket Request Units
  ENSPWT                                      N - Session-level Send Pacing Wait Time
  ENSPNW                                      N - Session-level Send Pacing Waits
  ENSPPW                                      N - Session-level Send Pacing Potential Waits
  ENSPWS                                      N - Session-level Send Pacing Window Size
  ENIPWT                                      N - Internal Session-level Pacing Wait Time
  ENIPNW                                      N - Internal Session-level Pacing Waits
  ENQNRE                                      N - RUs Entering Transmission Queue
  ENQLRE                                      N - Length of RUs Entering Transmission Queue
  ENQNRL                                      N - RUs Leaving Transmission Queue
  ENQLRL                                      N - Length of RUs Leaving Transmission Queue
```

Figure 168. SNA_ALL Query Definition, Part 1

```
                                  IBM Query/400                     11/27/96   14:56:16        Page    3
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  ENQTRR                                       N - Transmission Queue Wait Time
  ENNRUD                                       N - RUs Delivered to Adjacent System
  ENLRUD                                       N - Length of RUs Delivered to Adjacent System
  ENTRUD                                       N - Service Time to Deliver RU to Adjacent System
  ENNRUR                                       N - RUs Received from Adjacent System
  ENLRUR                                       N - Length of RUs Received from Adjacent System
  EHNSS                                        High Priority Sessions Started
  EHNSE                                        High Priority Sessions Ended
  EHNBB                                        H - Begin Bracket Request Units
  EHNEB                                        H - End Bracket Request Units
  EHSPWT                                       H - Session-level Send Pacing Wait Time
  EHSPNW                                       H - Session-level Send Pacing Waits
  EHSPPW                                       H - Session-level Send Pacing Potential Waits
  EHSPWS                                       H - Session-level Send Pacing Window Size
  EHIPWT                                       H - Internal Session-level Pacing Wait Time
  EHIPNW                                       H - Internal Session-level Pacing Waits
  EHQNRE                                       H - RUs Entering Transmission Queue
  EHQLRE                                       H - Length of RUs Entering Transmission Queue
  EHQNRL                                       H - RUs Leaving Transmission Queue
  EHQLRL                                       H - Length of RUs Leaving Transmission Queue
  EHQTRR                                       H - Transmission Queue Wait Time
  EHNRUD                                       H - RUs Delivered to Adjacent System
  EHLRUD                                       H - Length of RUs Delivered to Adjacent System
  EHTRUD                                       H - Service Time to Deliver RU to Adjacent System
  EHNRUR                                       H - RUs Received from Adjacent System
  EHLRUR                                       H - Length of RUs Received from Adjacent System
  EMNSS                                        Medium Priority Sessions Started
  EMNSE                                        Medium Priority Sessions Ended
  EMNBB                                        M - Begin Bracket Request Units
  EMNEB                                        M - End Bracket Request Units
  EMSPWT                                       M - Session-level Send Pacing Wait Time
  EMSPNW                                       M - Session-level Send Pacing Waits
  EMSPPW                                       M - Session-level Send Pacing Potential Waits
                                  IBM Query/400                     11/27/96   14:56:16        Page    4
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  EMSPWS                                       M - Session-level Send Pacing Window Size
  EMIPWT                                       M - Internal Session-level Pacing Wait Time
  EMIPNW                                       M - Internal Session-level Pacing Waits
  EMQNRE                                       M - RUs Entering Transmission Queue
  EMQLRE                                       M - Length of RUs Entering Transmission Queue
  EMQNRL                                       M - RUs Leaving Transmission Queue
  EMQLRL                                       M - Length of RUs Leaving Transmission Queue
  EMQTRR                                       M - Transmission Queue Wait Time
  EMNRUD                                       M - RUs Delivered to Adjacent System
  EMLRUD                                       M - Length of RUs Delivered to Adjacent System
  EMTRUD                                       M - Service time to Deliver RU to Adjacent System
  EMNRUR                                       M - RUs Received from Adjacent System
  EMLRUR                                       M - Length of RUs Received from Adjacent System
  ELNSS                                        Low Priority Sessions Started
  ELNSE                                        Low Priority Sessions Ended
  ELNBB                                        L - Begin Bracket Request Units
  ELNEB                                        L - End Bracket Request Units
  ELSPWT                                       L - Session-level Send Pacing Wait Time
  ELSPNW                                       L - Session-level Send Pacing Waits
  ELSPPW                                       L - Session-level Send Pacing Potential Waits
  ELSPWS                                       L - Session-level Send Pacing Window Size
  ELIPWT                                       L - Internal Session-level Pacing Wait Time
  ELIPNW                                       L - Internal Session-level Pacing Waits
  ELQNRE                                       L - RUs Entering Transmission Queue
  ELQLRE                                       L - Length of RUs Entering Transmission Queue
  ELQNRL                                       L - RUs Leaving Transmission Queue
  ELQLRL                                       L - Length of RUs Leaving Transmission Queue
  ELQTRR                                       L - Transmission Queue Wait Time
  ELNRUD                                       L - RUs Delivered to Adjacent System
  ELLRUD                                       L - Length of RUs Delivered to Adjacent System
  ELTRUD                                       L - Service Time to Deliver RU to Adjacent System
  ELNRUR                                       L - RUs Received from Adjacent System
  ELLRUR                                       L - Length of RUs Received from Adjacent System
```

Figure 169. SNA_ALL Query Definition, Part 2

```
                                  IBM Query/400                    11/27/96  14:56:16        Page    5
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INNSS                                        Network Priority Sessions Started
  INNSE                                        Network Priority Sessions Ended
  INNBB                                        N - Begin Bracket Request Units
  INNEB                                        N - End Bracket Request Units
  INSPWT                                       N - Session-level Send Pacing Wait Time
  INSPNW                                       N - Session-level Send Pacing Waits
  INSPPW                                       N - Session-level Send Pacing Potential Waits
  INSPWS                                       N - Session-level Send Pacing Window Size
  INIPWT                                       N - Internal Session-level Pacing Wait Time
  INIPNW                                       N - Internal Session-level Pacing Waits
  INQNRE                                       N - RUs Entering Transmission Queue
  INQLRE                                       N - Length of RUs Entering Transmission Queue
  INQNRL                                       N - RUs Leaving Transmission Queue
  INQLRL                                       N - Length of RUs Leaving Transmission Queue
  INQTRR                                       N - Transmission Queue Wait Time
  INNRUD                                       N - RUs Delivered to Adjacent System
  INLRUD                                       N - Length of RUs Delivered to Adjacent System
  INTRUD                                       N - Service Time to Deliver RU to Adjacent System
  INNRUR                                       N - RUs Received from Adjacent System
  INLRUR                                       N - Length of RUs Received from Adjacent System
  IHNSS                                        High Priority Sessions Started
  IHNSE                                        High Priority Sessions Ended
  IHNBB                                        H - Begin Bracket Request Units
  IHNEB                                        H - End Bracket Request Units
  IHSPWT                                       H - Session-level Send Pacing Wait Time
  IHSPNW                                       H - Session-level Send Pacing Waits
  IHSPPW                                       H - Session-level Send Pacing Potential Waits
  IHSPWS                                       H - Session-level Send Pacing Window Size
  IHIPWT                                       H - Internal Session-level Pacing Wait Time
  IHIPNW                                       H - Internal Session-level Pacing Waits
  IHQNRE                                       H - RUs Entering Transmission Queue
  IHQLRE                                       H - Length of RUs Entering Transmission Queue
  IHQNRL                                       H - RUs Leaving Transmission Queue
                                  IBM Query/400                    11/27/96  14:56:16        Page    6
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  IHQLRL                                       H - Length of RUs Leaving Transmission Queue
  IHQTRR                                       H - Transmission Queue Wait Time
  IHNRUD                                       H - RUs Delivered to Adjacent System
  IHLRUD                                       H - Length of RUs Delivered to Adjacent System
  IHTRUD                                       H - Service Time to Deliver RU to Adjacent System
  IHNRUR                                       H - RUs Received from Adjacent System
  IHLRUR                                       H - Length of RUs Received from Adjacent System
  IMNSS                                        Medium Priority Sessions Started
  IMNSE                                        Medium Priority Sessions Ended
  IMNBB                                        M - Begin Bracket Request Units
  IMNEB                                        M - End Bracket Request Units
  IMSPWT                                       M - Session-level Send Pacing Wait Time
  IMSPNW                                       M - Session-level Send Pacing Waits
  IMSPPW                                       M - Session-level Send Pacing Potential Waits
  IMSPWS                                       M - Session-level Send Pacing Window Size
  IMIPWT                                       M - Internal Session-level Pacing Wait Time
  IMIPNW                                       M - Internal Session-level Pacing Waits
  IMQNRE                                       M - RUs Entering Transmission Queue
  IMQLRE                                       M - Length of RUs Entering Transmission Queue
  IMQNRL                                       M - RUs Leaving Transmission Queue
  IMQLRL                                       M - Length of RUs Leaving Transmission Queue
  IMQTRR                                       M - Transmission Queue Wait Time
  IMNRUD                                       M - RUs Delivered to Adjacent System
  IMLRUD                                       M - Length of RUs Delivered to Adjacent System
  IMTRUD                                       M - Service Time to Deliver RU to Adjacent System
  IMNRUR                                       M - RUs Received from Adjacent System
  IMLRUR                                       M - Length of RUs Received from Adjacent System
  ILNSS                                        Low Priority Sessions Started
  ILNSE                                        Low Priority Sessions Ended
  ILNBB                                        L - Begin Bracket Request Units
  ILNEB                                        L - End Bracket Request Units
  ILSPWT                                       L - Session-level Send Pacing Wait Time
  ILSPNW                                       L - Session-level Send Pacing Waits
```

Figure 170. SNA_ALL Query Definition, Part 3

```
                              IBM Query/400                    11/27/96   14:56:16        Page    7
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  ILSPPW                                       L - Session-level Send Pacing Potential Waits
  ILSPWS                                       L - Session-level Send Pacing Window Size
  ILIPWT                                       L - Internal Session-level Pacing Wait Time
  ILIPNW                                       L - Internal Session-level Pacing Waits
  ILQNRE                                       L - RUs Entering Transmission Queue
  ILQLRE                                       L - Length of RUs Entering Transmission Queue
  ILQNRL                                       L - RUs Leaving Transmission Queue
  ILQLRL                                       L - Length of RUs Leaving Transmission Queue
  ILQTRR                                       L - Transmission Queue Wait Time
  ILNRUD                                       L - RUs Delivered to Adjacent System
  ILLRUD                                       L - Length of RUs Delivered to Adjacent System
  ILTRUD                                       L - Service Time to Deliver RU to Adjacent System
  ILNRUR                                       L - RUs Received from Adjacent System
  ILLRUR                                       L - Length of RUs Received from Adjacent System
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                  5    0
                                      Interval
                                      Number
  DTETIM                     2        Interval                 12
                                      Date and Time
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
  SCTLNM                     2        Controller               10
                                      Description
                                      Name
                              IBM Query/400                    11/27/96   14:56:16        Page    8
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SLINNM                     2        Line                     10
                                      Description
                                      Name
  STSKNM                     2        T2 Station                6
                                      I/O Manager Task
                                      Name
  SLIOMT                     2        Line I/O                  6
                                      Manager Task Name
  SACPNM                     2        Adjacent                  8
                                      CP
                                      Name
  SANWID                     2        Adjacent                  8
                                      Network
                                      ID
  SAPPN                      2                                  1
                                      APPN-Capable
  SCTYP                      2                                  1
                                      Controller
                                      Type
  SSMFS                      2        Send                     11    0
                                      Maximum Frame Size
  SRMFS                      2        Receive                  11    0
                                      Maximum Frame Size
  STLLBU                     2        Date and                 12
                                      Time of Most Recent
                                      Connection
  SNLBU                      2        Connections              11    0
                                      Established with
                                      Remote System
  STACVO                     2        Time for                 11    0
                                      Auto-created/Varied
                                      On Devices
```

Figure 171. SNA_ALL Query Definition, Part 4

```
                                 IBM Query/400                      11/27/96   14:56:16         Page    9
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                            Dec  Null        Dec  Numeric
  Name             Functions  Spacing  Column Headings     Len  Pos  Cap   Len  Pos  Editing
  SNACVO                      2        Auto-created         11    0
                                       and/or Varied on
                                       Devices
  SNADD                       2                             11    0
                                       Auto-deleted
                                       Devices
  SNWAIN                      2        Messages             11    0
                                       Received by the
                                       T2 SIOM Task
  SNWAOU                      2        Messages             11    0
                                       Sent by the
                                       T2 SIOM Task
  ENNSS                       2        Network              11    0
                                       Priority Sessions
                                       Started
  ENNSE                       2        Network              11    0
                                       Priority Sessions
                                       Ended
  ENNBB                       2        N - Begin            11    0
                                       Bracket
                                       Request Units
  ENNEB                       2        N - End              11    0
                                       Bracket
                                       Request Units
  ENSPWT                      2        N - Session-level    11    0
                                       Send Pacing
                                       Wait Time
  ENSPNW                      2        N - Session-level    11    0
                                       Send Pacing
                                       Wait
  ENSPPW                      2        N - Session-level    11    0
                                       Send Pacing
                                       Potential Waits
                                 IBM Query/400                      11/27/96   14:56:16         Page   10
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                            Dec  Null        Dec  Numeric
  Name             Functions  Spacing  Column Headings     Len  Pos  Cap   Len  Pos  Editing
  ENSPWS                      2        N - Session-level    11    0
                                       Send Pacing
                                       Window Size
  ENIPWT                      2        N - Internal         11    0
                                       Session-level
                                       Pacing Wait Time
  ENIPNW                      2        N - Internal         11    0
                                       Session-level
                                       Pacing Waits
  ENQNRE                      2        N - RUs              11    0
                                       Entering
                                       Transmission Queue
  ENQLRE                      2        N - Length of        11    0
                                       RUs Entering
                                       Transmission Queue
  ENQNRL                      2        N - RUs              11    0
                                       Leaving Transmission
                                       Queue
  ENQLRL                      2        N - Length of        11    0
                                       RUs Leaving
                                       Transmission Queue
  ENQTRR                      2        N -                  11    0
                                       Transmission Queue
                                       Wait Time
  ENNRUD                      2        N - RUs              11    0
                                       Delivered to
                                       Adjacent System
  ENLRUD                      2        N - Length           11    0
                                       of RUs Delivered
                                       to Adjacent System
  ENTRUD                      2        N - Service Time     11    0
                                       to Deliver RU
                                       to Adjacent System
```

Figure 172. SNA_ALL Query Definition, Part 5

```
                           IBM Query/400                        11/27/96   14:56:16        Page   11
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings          Len  Pos  Cap   Len  Pos  Editing
  ENNRUR                     2        N - RUs                   11    0
                                      Received from
                                      Adjacent System
  ENLRUR                     2        N - Length of             11    0
                                      RUs Received
                                      from Adjacent System
  EHNSS                      2        High                      11    0
                                      Priority Sessions
                                      Started
  EHNSE                      2        High                      11    0
                                      Priority Sessions
                                      Ended
  EHNBB                      2        H - Begin                 11    0
                                      Bracket
                                      Request Units
  EHNEB                      2        H - End                   11    0
                                      Bracket
                                      Request Units
  EHSPWT                     2        H - Session-level         11    0
                                      Send Pacing
                                      Wait Time
  EHSPNW                     2        H - Session-level         11    0
                                      Send Pacing
                                      Waits
  EHSPPW                     2        H - Session-level         11    0
                                      Send Pacing
                                      Potential Waits
  EHSPWS                     2        H - Session-level         11    0
                                      Send Pacing
                                      Window Size
  EHIPWT                     2        H - Internal              11    0
                                      Session-level
                                      Pacing Wait Time
                           IBM Query/400                        11/27/96   14:56:16        Page   12
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings          Len  Pos  Cap   Len  Pos  Editing
  EHIPNW                     2        H - Internal              11    0
                                      Session-level
                                      Pacing Waits
  EHQNRE                     2        H - RUs                   11    0
                                      Entering
                                      Transmission Queue
  EHQLRE                     2        H - Length of             11    0
                                      RUs Entering
                                      Transmission Queue
  EHQNRL                     2        H - RUs                   11    0
                                      Leaving Transmission
                                      Queue
  EHQLRL                     2        H - Length                11    0
                                      of RUs Leaving
                                      Transmission Queue
  EHQTRR                     2        H -                       11    0
                                      Transmission Queue
                                      Wait Time
  EHNRUD                     2        H - RUs                   11    0
                                      Delivered to
                                      Adjacent System
  EHLRUD                     2        H - Length                11    0
                                      of RUs Delivered
                                      to Adjacent System
  EHTRUD                     2        H - Service Time          11    0
                                      to Deliver RU
                                      to Adjacent System
  EHNRUR                     2        H - RUs                   11    0
                                      Received from
                                      Adjacent System
  EHLRUR                     2        H - Length of             11    0
                                      RUs Received
                                      from Adjacent System
```

Figure 173. SNA_ALL Query Definition, Part 6

```
                                   IBM Query/400                      11/27/96   14:56:16         Page   13
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  EMNSS                      2        Medium                  11    0
                                      Priority Sessions
                                      Started
  EMNSE                      2        Medium                  11    0
                                      Priority Sessions
                                      Ended
  EMNBB                      2        M - Begin               11    0
                                      Bracket
                                      Request Units
  EMNEB                      2        M - End                 11    0
                                      Bracket
                                      Request Units
  EMSPWT                     2        M - Session-level       11    0
                                      Send Pacing
                                      Wait Time
  EMSPNW                     2        M - Session-level       11    0
                                      Send Pacing
                                      Waits
  EMSPPW                     2        M - Session-level       11    0
                                      Send Pacing
                                      Potential Waits
  EMSPWS                     2        M - Session-level       11    0
                                      Send Pacing
                                      Window Size
  EMIPWT                     2        M - Internal            11    0
                                      Session-level
                                      Pacing Wait Time
  EMIPNW                     2        M - Internal            11    0
                                      Session-level
                                      Pacing Waits
  EMQNRE                     2        M - RUs                 11    0
                                      Entering
                                      Transmission Queue
                                   IBM Query/400                      11/27/96   14:56:16         Page   14
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  EMQLRE                     2        M - Length of           11    0
                                      RUs Entering
                                      Transmission Queue
  EMQNRL                     2        M - RUs                 11    0
                                      Leaving Transmission
                                      Queue
  EMQLRL                     2        M - Length of           11    0
                                      RUs Leaving
                                      Transmission Queue
  EMQTRR                     2        M -                     11    0
                                      Transmission Queue
                                      Wait Time
  EMNRUD                     2        M - RUs                 11    0
                                      Delivered to
                                      Adjacent System
  EMLRUD                     2        M - Length of           11    0
                                      RUs Delivered
                                      to Adjacent System
  EMTRUD                     2        M - Service time        11    0
                                      to Deliver RU
                                      to Adjacent System
  EMNRUR                     2        M - RUs                 11    0
                                      Received from
                                      Adjacent System
  EMLRUR                     2        M - Length of           11    0
                                      RUs Received
                                      from Adjacent System
  ELNSS                      2        Low                     11    0
                                      Priority Sessions
                                      Started
  ELNSE                      2        Low                     11    0
                                      Priority Sessions
                                      Ended
```

Figure 174. SNA_ALL Query Definition, Part 7

```
                               IBM Query/400                   11/27/96   14:56:16        Page   15
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                 Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  ELNBB                        2      L - Begin                11    0
                                      Bracket
                                      Request Units
  ELNEB                        2      L - End                  11    0
                                      Bracket
                                      Request Units
  ELSPWT                       2      L - Session-level        11    0
                                      Send Pacing
                                      Wait Time
  ELSPNW                       2      L - Session-level        11    0
                                      Send Pacing
                                      Waits
  ELSPPW                       2      L - Session-level        11    0
                                      Send Pacing
                                      Potential Waits
  ELSPWS                       2      L - Session-level        11    0
                                      Send Pacing
                                      Window Size
  ELIPWT                       2      L - Internal             11    0
                                      Session-level
                                      Pacing Wait Time
  ELIPNW                       2      L - Internal             11    0
                                      Session-level
                                      Pacing Waits
  ELQNRE                       2      L - RUs                  11    0
                                      Entering
                                      Transmission Queue
  ELQLRE                       2      L - Length of            11    0
                                      RUs Entering
                                      Transmission Queue
  ELQNRL                       2      L - RUs                  11    0
                                      Leaving Transmission
                                      Queue
                               IBM Query/400                   11/27/96   14:56:16        Page   16
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                 Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  ELQLRL                       2      L - Length of            11    0
                                      RUs Leaving
                                      Transmission Queue
  ELQTRR                       2      L -                      11    0
                                      Transmission Queue
                                      Wait Time
  ELNRUD                       2      L - RUs                  11    0
                                      Delivered to
                                      Adjacent System
  ELLRUD                       2      L - Length of            11    0
                                      RUs Delivered
                                      to Adjacent System
  ELTRUD                       2      L - Service Time         11    0
                                      to deliver RU
                                      to Adjacent System
  ELNRUR                       2      L - RUs                  11    0
                                      Received from
                                      Adjacent System
  ELLRUR                       2      L - Length of            11    0
                                      RUs Received
                                      from Adjacent System
  INNSS                        2      Network                  11    0
                                      Priority Sessions
                                      Started
  INNSE                        2      Network                  11    0
                                      Priority Sessions
                                      Ended
  INNBB                        2      N - Begin                11    0
                                      Bracket
                                      Request Units
  INNEB                        2      N - End                  11    0
                                      Bracket
                                      Request Units
```

Figure 175. SNA_ALL Query Definition, Part 8

```
                                   IBM Query/400                      11/27/96   14:56:16         Page   17
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                                 Dec  Null        Dec  Numeric
  Name             Functions  Spacing  Column Headings          Len  Pos  Cap   Len  Pos  Editing
  INSPWT                      2        N - Session-level         11    0
                                       Send Pacing
                                       Wait Time
  INSPNW                      2        N - Session-level         11    0
                                       Send Pacing
                                       Waits
  INSPPW                      2        N - Session-level         11    0
                                       Send Pacing
                                       Potential Waits
  INSPWS                      2        N - Session-level         11    0
                                       Send Pacing
                                       Window Size
  INIPWT                      2        N - Internal              11    0
                                       Session-level
                                       Pacing Wait Time
  INIPNW                      2        N - Internal              11    0
                                       Session-level
                                       Pacing Waits
  INQNRE                      2        N - RUs                   11    0
                                       Entering
                                       Transmission Queue
  INQLRE                      2        N - Length of             11    0
                                       RUs Entering
                                       Transmission Queue
  INQNRL                      2        N - RUs                   11    0
                                       Leaving Transmission
                                       Queue
  INQLRL                      2        N - Length of             11    0
                                       RUs Leaving
                                       Transmission Queue
  INQTRR                      2        N -                       11    0
                                       Transmission Queue
                                       Wait Time
                                   IBM Query/400                      11/27/96   14:56:16         Page   18
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                                 Dec  Null        Dec  Numeric
  Name             Functions  Spacing  Column Headings          Len  Pos  Cap   Len  Pos  Editing
  INNRUD                      2        N - RUs                   11    0
                                       Delivered to
                                       Adjacent System
  INLRUD                      2        N - Length of             11    0
                                       RUs Delivered
                                       to Adjacent System
  INTRUD                      2        N - Service Time          11    0
                                       to Deliver RU
                                       to Adjacent System
  INNRUR                      2        N - RUs                   11    0
                                       Received from
                                       Adjacent System
  INLRUR                      2        N - Length of             11    0
                                       RUs Received
                                       from Adjacent System
  IHNSS                       2        High                      11    0
                                       Priority Sessions
                                       Started
  IHNSE                       2        High                      11    0
                                       Priority Sessions
                                       Ended
  IHNBB                       2        H - Begin                 11    0
                                       Bracket
                                       Request Units
  IHNEB                       2        H - End                   11    0
                                       Bracket
                                       Request Units
  IHSPWT                      2        H - Session-level         11    0
                                       Send Pacing
                                       Wait Time
  IHSPNW                      2        H - Session-level         11    0
                                       Send Pacing
                                       Waits
```

Figure 176. SNA_ALL Query Definition, Part 9

```
                                  IBM Query/400                   11/27/96   14:56:16        Page   19
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field            Summary    Column                                 Dec  Null       Dec  Numeric
  Name             Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  IHSPPW                      2        H - Session-level        11    0
                                       Send Pacing
                                       Potential Waits
  IHSPWS                      2        H - Session-level        11    0
                                       Send Pacing
                                       Window Size
  IHIPWT                      2        H - Internal             11    0
                                       Session-level
                                       Pacing Wait Time
  IHIPNW                      2        H - Internal             11    0
                                       Session-level
                                       Pacing Waits
  IHQNRE                      2        H - RUs                  11    0
                                       Entering
                                       Transmission Queue
  IHQLRE                      2        H - Length of            11    0
                                       RUs Entering
                                       Transmission Queue
  IHQNRL                      2        H - RUs                  11    0
                                       Leaving Transmission
                                       Queue
  IHQLRL                      2        H - Length of            11    0
                                       RUs Leaving
                                       Transmission Queue
  IHQTRR                      2        H -                      11    0
                                       Transmission Queue
                                       Wait Time
  IHNRUD                      2        H - RUs                  11    0
                                       Delivered to
                                       Adjacent System
  IHLRUD                      2        H - Length of            11    0
                                       RUs Delivered
                                       to Adjacent System
                                  IBM Query/400                   11/27/96   14:56:16        Page   20
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field            Summary    Column                                 Dec  Null       Dec  Numeric
  Name             Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  IHTRUD                      2        H - Service Time         11    0
                                       to Deliver RU
                                       to Adjacent System
  IHNRUR                      2        H - RUs                  11    0
                                       Received from
                                       Adjacent System
  IHLRUR                      2        H - Length of            11    0
                                       RUs Received
                                       from Adjacent System
  IMNSS                       2        Medium                   11    0
                                       Priority Sessions
                                       Started
  IMNSE                       2        Medium                   11    0
                                       Priority Sessions
                                       Ended
  IMNBB                       2        M - Begin                11    0
                                       Bracket
                                       Request Units
  IMNEB                       2        M - End                  11    0
                                       Bracket
                                       Request Units
  IMSPWT                      2        M - Session-level        11    0
                                       Send Pacing
                                       Wait Time
  IMSPNW                      2        M - Session-level        11    0
                                       Send Pacing
                                       Waits
  IMSPPW                      2        M - Session-level        11    0
                                       Send Pacing
                                       Potential Waits
  IMSPWS                      2        M - Session-level        11    0
                                       Send Pacing
                                       Window Size
```

Figure 177. SNA_ALL Query Definition, Part 10

```
                                  IBM Query/400                      11/27/96   14:56:16        Page   21
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  IMIPWT                     2        M - Internal            11    0
                                      Session-level
                                      Pacing Wait Time
  IMIPNW                     2        M - Internal            11    0
                                      Session-level
                                      Pacing Waits
  IMQNRE                     2        M - RUs                 11    0
                                      Entering
                                      Transmission Queue
  IMQLRE                     2        M - Length of           11    0
                                      RUs Entering
                                      Transmission Queue
  IMQNRL                     2        M - RUs                 11    0
                                      Leaving Transmission
                                      Queue
  IMQLRL                     2        M - Length of           11    0
                                      RUs Leaving
                                      Transmission Queue
  IMQTRR                     2        M -                     11    0
                                      Transmission Queue
                                      Wait Time
  IMNRUD                     2        M - RUs                 11    0
                                      Delivered to
                                      Adjacent System
  IMLRUD                     2        M - Length of           11    0
                                      RUs Delivered
                                      to Adjacent System
  IMTRUD                     2        M - Service TIme        11    0
                                      to Deliver RU
                                      to Adjacent System
  IMNRUR                     2        M - RUs                 11    0
                                      Received from
                                      Adjacent System
                                  IBM Query/400                      11/27/96   14:56:16        Page   22
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  IMLRUR                     2        M - Length of           11    0
                                      RUs Received
                                      from Adjacent System
  ILNSS                      2        Low                     11    0
                                      Priority Sessions
                                      Started
  ILNSE                      2        Low                     11    0
                                      Priority Sessions
                                      Ended
  ILNBB                      2        L - Begin               11    0
                                      Bracket
                                      Request Units
  ILNEB                      2        L - End                 11    0
                                      Bracket
                                      Request Units
  ILSPWT                     2        L - Session-level       11    0
                                      Send Pacing
                                      Wait Time
  ILSPNW                     2        L - Session-level       11    0
                                      Send Pacing
                                      Waits
  ILSPPW                     2        L - Session-level       11    0
                                      Send Pacing
                                      Potential Waits
  ILSPWS                     2        L - Session-level       11    0
                                      Send Pacing
                                      Window Size
  ILIPWT                     2        L - Internal            11    0
                                      Session-level
                                      Pacing Wait Time
  ILIPNW                     2        L - Internal            11    0
                                      Session-level
                                      Pacing Waits
```

Figure 178. SNA_ALL Query Definition, Part 11

```
                                   IBM Query/400                      11/27/96   14:56:16         Page   23
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null        Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  ILQNRE                     2        L - RUs                 11    0
                                      Entering
                                      Transmission Queue
  ILQLRE                     2        L - Length of           11    0
                                      RUs Entering
                                      Transmission Queue
  ILQNRL                     2        L - RUs                 11    0
                                      Leaving Transmission
                                      Queue
  ILQLRL                     2        L - Length of           11    0
                                      RUs Leaving
                                      Transmission Queue
  ILQTRR                     2        L -                     11    0
                                      Transmission Queue
                                      Wait Time
  ILNRUD                     2        L - RUs                 11    0
                                      Delivered to
                                      Adjacent System
  ILLRUD                     2        L - Length of           11    0
                                      RUs Delivered
                                      to Adjacent System
  ILTRUD                     2        L - Service Time        11    0
                                      to Deliver RU
                                      to Adjacent System
  ILNRUR                     2        L - RUs                 11    0
                                      Received from
                                      Adjacent System
  ILLRUR                     2        L - Length of           11    0
                                      RUs Received
                                      from Adjacent System
                                   IBM Query/400                      11/27/96   14:56:16         Page   24
Selected output attributes
  Output type . . . . . . . . . . . . . . Display
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 179. SNA_ALL Query Definition, Part 12

E.2 SNA_CON

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM01 11/27/96   15:05:41        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_CON
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA # of connections, sessions and start/end br.
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      SNAOVERIP1    QAPMSNAR
                                   IBM Query/400                     11/27/96   15:05:41        Page    2
Result fields
  Name        Expression                          Column Heading          Len  Dec
  SESSTR      (ennss+ehnss+emnss+elnss+           Total                     9    4
              innss+ihnss+imnss+ilnss)            Session
                                                  Start
  SESEND      (ennse+ehnse+emnse+elnse+           Total                     9    4
              innse+ihnse+imnse+ilnse)            Session
                                                  End
  BGNBRK      (ennbb+ehnbb+emnbb+elnbb+           Begin                     9    4
              innbb+ihnbb+imnbb+ilnbb)            Bracket
                                                  RUs
  ENDBRK      (enneb+ehneb+emneb+elneb+           End                       9    4
              inneb+ihneb+imneb+ilneb)            Bracket
                                                  RUs
  DATE        substr(DTETIM,3,2) || '/' ||        Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||        Time
              substr(DTETIM,9,2)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  DATE
  TIME
  SNLBU                                        Connections Established with Remote System
  SESSTR
  SESEND
  BGNBRK
  ENDBRK
                                   IBM Query/400                     11/27/96   15:05:41        Page    3
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                 Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     1        Cont                     10
                                      Desc
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  SNLBU           1          5        Connections              11    0
                                      Established with
                                      Remote System
  SESSTR          1          5        Total                     9    4          4    1
                                      Session
                                      Start
  SESEND          1          5        Total                     9    4          4    1
                                      Session
                                      End
  BGNBRK          1          5        Begin                     9    4          4    1
                                      Bracket
                                      RUs
  ENDBRK          1          5        End                       9    4          4    1
                                      Bracket
                                      RUs
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
```

Figure 180. SNA_CON Query Definition, Part 1

```
                               IBM Query/400                     11/27/96   15:05:41        Page    4
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  47 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
                               IBM Query/400                     11/27/96   15:05:41        Page    5
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      SES1: Session Summary - all SNA controllers
    Page footing
Database file output
  File  . . . . . . . . . . . . . . . . . SES1
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . session start/end, bracket bgn/end, connect str
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .    62
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    SCTLNM            1    10              Character           Controller Description Name
    DATE             11     5              Character           substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
    TIME             16     5              Character           substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
    SNLBU            21    11    0         Packed decimal      Connections Established with Remote System
    SESSTR           27     9    4         Zoned decimal       (ennss+ehnss+emnss+elnss+        innss+ihnss+imnss
                               IBM Query/400                     11/27/96   15:05:41        Page    6
Output file record format (continued)
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    SESEND           36     9    4         Zoned decimal       (ennse+ehnse+emnse+elnse+        innse+ihnse+imnse
    BGNBRK           45     9    4         Zoned decimal       (ennbb+ehnbb+emnbb+elnbb+        innbb+ihnbb+imnbb
    ENDBRK           54     9    4         Zoned decimal       (enneb+ehneb+emneb+elneb+        inneb+ihneb+imneb
             * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 181. SNA_CON Query Definition, Part 2

E.3 SNA_IPAC

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/27/96   15:05:59        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_IPAC
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA internal session level pacing wait time
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      SNAOVERIP1    QAPMSNAR
                                  IBM Query/400                    11/27/96   15:05:59        Page    2
Result fields
  Name        Expression                         Column Heading          Len  Dec
  ENIPCW      (enipwt/1000)/(enipnw+0.001)       EP NET
                                                 Int PAC
                                                 wait
  EHIPCW      (ehipwt/1000)/(ehipnw+0.001)       EP HIGH
                                                 Int PAC
                                                 wait
  EMIPCW      (emipwt/1000)/(emipnw+0.001)       EP MED
                                                 Int PAC
                                                 wait
  ELIPCW      (elipwt/1000)/(elipnw+0.001)       EP LOW
                                                 Int PAC
                                                 wait
  INIPCW      (inipwt/1000)/(inipnw+0.001)       IMN NET
                                                 Int PAC
                                                 wait
  IHIPCW      (ihipwt/1000)/(ihipnw+0.001)       IMN HIGH
                                                 Int PAC
                                                 wait
  IMIPCW      (imipwt/1000)/(imipnw+0.001)       IMN MED
                                                 Int PAC
                                                 wait
  ILIPCW      (ilipwt/1000)/(ilipnw+0.001)       IMN LOW
                                                 Int PAC
                                                 wait
  DATE        substr(DTETIM,3,2) || '/' ||       Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||       Time
              substr(DTETIM,9,2)
```

Figure 182. SNA_IPAC Query Definition, Part 1

```
                              IBM Query/400                    11/27/96   15:05:59        Page    3
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  DATE
  TIME
  ENIPCW
  EHIPCW
  EMIPCW
  ELIPCW
  INIPCW
  IHIPCW
  IMIPCW
  ILIPCW
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     0        Controller               10
                                      Description
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  ENIPCW          4          2        EP NET                   17    3
                                      Int PAC
                                      wait
  EHIPCW          4          2        EP HIGH                  17    3
                                      Int PAC
                                      wait
  EMIPCW          4          2        EP MED                   17    3
                                      Int PAC
                                      wait
                              IBM Query/400                    11/27/96   15:05:59        Page    4
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  ELIPCW          4          2        EP LOW                   17    3
                                      Int PAC
                                      wait
  INIPCW          4          2        IMN NET                  17    3
                                      Int PAC
                                      wait
  IHIPCW          4          2        IMN HIGH                 17    3
                                      Int PAC
                                      wait
  IMIPCW          4          2        IMN MED                  17    3
                                      Int PAC
                                      wait
  ILIPCW          4          2        IMN LOW                  17    3
                                      Int PAC
                                      wait
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
```

Figure 183. SNA_IPAC Query Definition, Part 2

```
                                  IBM Query/400                        11/27/96   15:05:59        Page    5
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                                  IBM Query/400                        11/27/96   15:05:59        Page    6
Database file output
  File  . . . . . . . . . . . . . . . . . SES2A
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Session Traffic - Part 1 of 2
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .    92
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    SCTLNM            1    10              Character           Controller Description Name
    DATE             11     5              Character           substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
    TIME             16     5              Character           substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
    ENIPCW           21    17    3         Packed decimal      (enipwt/1000)/(enipnw+0.001)
    EHIPCW           30    17    3         Packed decimal      (ehipwt/1000)/(ehipnw+0.001)
    EMIPCW           39    17    3         Packed decimal      (emipwt/1000)/(emipnw+0.001)
    ELIPCW           48    17    3         Packed decimal      (elipwt/1000)/(elipnw+0.001)
    INIPCW           57    17    3         Packed decimal      (inipwt/1000)/(inipnw+0.001)
    IHIPCW           66    17    3         Packed decimal      (ihipwt/1000)/(ihipnw+0.001)
    IMIPCW           75    17    3         Packed decimal      (imipwt/1000)/(imipnw+0.001)
    ILIPCW           84    17    3         Packed decimal      (ilipwt/1000)/(ilipnw+0.001)
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 184. SNA_IPAC Query Definition, Part 3

E.4 SNA_PAC1

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/27/96   15:06:12        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_PAC1
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA average pacing response time
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      TEST1307      QAPMSNAR
                                  IBM Query/400                    11/27/96   15:06:12        Page    2
Result fields
  Name        Expression                         Column Heading          Len  Dec
  ENAVWT      (enspwt/1000)/(enspnw+0.001)       EP NET
                                                 Pacing
                                                 Wait
  EHAVWT      (ehspwt/1000)/(ehspnw+0.001)       EP HIGH
                                                 Pacing
                                                 Wait
  EMAVWT      (emspwt/1000)/(emspnw+0.001)       EP MED
                                                 Pacing
                                                 Wait
  ELAVWT      (elspwt/1000)/(elspnw+0.001)       EP LOW
                                                 Pacing
                                                 Wait
  INAVWT      (inspwt/1000)/(inspnw+0.001)       INM NET
                                                 Pacing
                                                 Wait
  IHAVWT      (ihspwt/1000)/(ihspnw+0.001)       INM HIGH
                                                 Pacing
                                                 Wait
  IMAVWT      (imspwt/1000)/(imspnw+0.001)       INM MED
                                                 Pacing
                                                 Wait
  ILAVWT      (ilspwt/1000)/(ilspnw+0.001)       INM LOW
                                                 Pacing
                                                 Wait
  DATE        substr(DTETIM,3,2) || '/' ||       Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||       Time
              substr(DTETIM,9,2)
```

Figure 185. SNA_PAC1 Query Definition, Part 1

```
                                  IBM Query/400                      11/27/96   15:06:12         Page    3
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  DATE
  TIME
  ENAVWT
  EHAVWT
  EMAVWT
  ELAVWT
  INAVWT
  IHAVWT
  IMAVWT
  ILAVWT
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     0        Controller              10
                                      Description
                                      Name
  DATE                       2        Date                     5
  TIME                       2        Time                     5
  ENAVWT          4          2        EP NET                  17    3
                                      Pacing
                                      Wait
  EHAVWT          4          2        EP HIGH                 17    3
                                      Pacing
                                      Wait
  EMAVWT          4          2        EP MED                  17    3
                                      Pacing
                                      Wait
                                  IBM Query/400                      11/27/96   15:06:12         Page    4
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  ELAVWT          4          2        EP LOW                  17    3
                                      Pacing
                                      Wait
  INAVWT          4          2        INM NET                 17    3
                                      Pacing
                                      Wait
  IHAVWT          4          2        INM HIGH                17    3
                                      Pacing
                                      Wait
  IMAVWT          4          2        INM MED                 17    3
                                      Pacing
                                      Wait
  ILAVWT                     2        INM LOW                 17    3
                                      Pacing
                                      Wait
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
```

Figure 186. SNA_PAC1 Query Definition, Part 2

```
                              IBM Query/400                    11/27/96   15:06:12        Page    5
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                              IBM Query/400                    11/27/96   15:06:12        Page    6
Database file output
  File  . . . . . . . . . . . . . . . . . SES2A
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Session Traffic - Part 1 of 2
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   92
  Field list:
    Field         Begin   Len  Dec   Null  Data Type          Text
    SCTLNM            1    10              Character          Controller Description Name
    DATE             11     5              Character          substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
    TIME             16     5              Character          substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
    ENAVWT           21    17    3         Packed decimal     (enspwt/1000)/(enspnw+0.001)
    EHAVWT           30    17    3         Packed decimal     (ehspwt/1000)/(ehspnw+0.001)
    EMAVWT           39    17    3         Packed decimal     (emspwt/1000)/(emspnw+0.001)
    ELAVWT           48    17    3         Packed decimal     (elspwt/1000)/(elspnw+0.001)
    INAVWT           57    17    3         Packed decimal     (inspwt/1000)/(inspnw+0.001)
    IHAVWT           66    17    3         Packed decimal     (ihspwt/1000)/(ihspnw+0.001)
    IMAVWT           75    17    3         Packed decimal     (imspwt/1000)/(imspnw+0.001)
    ILAVWT           84    17    3         Packed decimal     (ilspwt/1000)/(ilspnw+0.001)
             * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 187. SNA_PAC1 Query Definition, Part 3

E.5 SNA_PAC2

```
5716QU1  V3R6M0  950929            IBM Query/400            SYSTEM01 11/27/96   16:50:25         Page    1
  Query . . . . . . . . . . . . . . . . . SNA_PAC2
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA percentage pacing wait
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      TEST1307      QAPMSNAR
                                   IBM Query/400                      11/27/96   16:50:25         Page    2
Result fields
  Name        Expression                          Column Heading          Len  Dec
  ENPCWT      (enspnw*100)/(ensppw+0.001)         EP NET
                                                  % time
                                                  PAC wt
  EHPCWT      (ehspnw*100)/(ehsppw+0.001)         EP HIGH
                                                  % time
                                                  PAC wt
  EMPCWT      (emspnw*100)/(emsppw+0.001)         EP MED
                                                  % time
                                                  PAC wt
  ELPCWT      (elspnw*100)/(elsppw+0.001)         EP LOW
                                                  % time
                                                  PAC wt
  INPCWT      (inspnw*100)/(insppw+0.001)         IMN NET
                                                  % time
                                                  PAC wt
  IHPCWT      (ihspnw*100)/(ihsppw+0.001)         IMN HIGH
                                                  % time
                                                  PAC wt
  IMPCWT      (imspnw*100)/(imsppw+0.001)         IMN MED
                                                  % time
                                                  PAC wt
  DATE        substr(DTETIM,3,2) || '/' ||        Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||        Time
              substr(DTETIM,9,2)
  ILPCWT      (ilspnw*100)/(ilsppw+0.001)         IMN LOW
                                                  % time
                                                  PAC wt
```

Figure 188. SNA_PAC2 Query Definition, Part 1

```
                                  IBM Query/400                     11/27/96   16:50:25        Page    3
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  DATE
  TIME
  ENPCWT
  EHPCWT
  EMPCWT
  ELPCWT
  INPCWT
  IHPCWT
  IMPCWT
  ILPCWT
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     0        Controller               10
                                      Description
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  ENPCWT                     2        EP NET                   20    3
                                      % time
                                      PAC wt
  EHPCWT                     2        EP HIGH                  20    3
                                      % time
                                      PAC wt
  EMPCWT                     2        EP MED                   20    3
                                      % time
                                      PAC wt
                                  IBM Query/400                     11/27/96   16:50:25        Page    4
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  ELPCWT                     2        EP LOW                   20    3
                                      % time
                                      PAC wt
  INPCWT                     2        IMN NET                  20    3
                                      % time
                                      PAC wt
  IHPCWT                     2        IMN HIGH                 20    3
                                      % time
                                      PAC wt
  IMPCWT                     2        IMN MED                  20    3
                                      % time
                                      PAC wt
  ILPCWT                     2        IMN LOW                  20    3
                                      % time
                                      PAC wt
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
```

Figure 189. SNA_PAC2 Query Definition, Part 2

```
                                  IBM Query/400                     11/27/96   16:50:25         Page    5
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                                  IBM Query/400                     11/27/96   16:50:25         Page    6
Database file output
  File  . . . . . . . . . . . . . . . . . SES2A
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Session Traffic - Part 1 of 2
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   108
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    SCTLNM            1    10              Character           Controller Description Name
    DATE             11     5              Character           substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
    TIME             16     5              Character           substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
    ENPCWT           21    20    3         Packed decimal      (enspnw*100)/(ensppw+0.001)
    EHPCWT           32    20    3         Packed decimal      (ehspnw*100)/(ehsppw+0.001)
    EMPCWT           43    20    3         Packed decimal      (emspnw*100)/(emsppw+0.001)
    ELPCWT           54    20    3         Packed decimal      (elspnw*100)/(elsppw+0.001)
    INPCWT           65    20    3         Packed decimal      (inspnw*100)/(insppw+0.001)
    IHPCWT           76    20    3         Packed decimal      (ihspnw*100)/(ihsppw+0.001)
    IMPCWT           87    20    3         Packed decimal      (imspnw*100)/(imsppw+0.001)
    ILPCWT           98    20    3         Packed decimal      (ilspnw*100)/(ilsppw+0.001)
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 190. SNA_PAC2 Query Definition, Part 3

E.6 SNA_PAC3

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/27/96   15:06:22        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_PAC3
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA average pacing window size
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      SNAOVERIP1    QAPMSNAR
                                  IBM Query/400                     11/27/96   15:06:22        Page    2
Result fields
  Name        Expression                        Column Heading          Len  Dec
  ENWNSZ      (enspws)/(ensppw+0.001)           EP NET
                                                PAC win
                                                size
  EHWNSZ      (ehspws)/(ehsppw+0.001)           EP HIGH
                                                PAC win
                                                size
  EMWNSZ      (emspws)/(emsppw+0.001)           EP MED
                                                PAC win
                                                size
  ELWNSZ      (elspws)/(elsppw+0.001)           EP LOW
                                                PAC win
                                                size
  INWNSZ      (inspws)/(insppw+0.001)           IMN NET
                                                PAC win
                                                size
  IHWNSZ      (ihspws)/(ihsppw+0.001)           IMN HIGH
                                                PAC win
                                                size
  IMWNSZ      (imspws)/(imsppw+0.001)           IMN MED
                                                PAC win
                                                size
  ILWNSZ      (ilspws)/(ilsppw+0.001)           IMN LOW
                                                PAC win
                                                size
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
```

Figure 191. SNA_PAC3 Query Definition, Part 1

```
                                IBM Query/400                    11/27/96   15:06:22        Page    3
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  DATE
  TIME
  ENWNSZ
  EHWNSZ
  EMWNSZ
  ELWNSZ
  INWNSZ
  IHWNSZ
  IMWNSZ
  ILWNSZ
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     0        Controller               10
                                      Description
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  ENWNSZ          4          2        EP NET                   17    3
                                      PAC win
                                      size
  EHWNSZ          4          2        EP HIGH                  17    3
                                      PAC win
                                      size
  EMWNSZ          4          2        EP MED                   17    3
                                      PAC win
                                      size
                                IBM Query/400                    11/27/96   15:06:22        Page    4
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  ELWNSZ          4          2        EP LOW                   17    3
                                      PAC win
                                      size
  INWNSZ          4          2        IMN NET                  17    3
                                      PAC win
                                      size
  IHWNSZ          4          2        IMN HIGH                 17    3
                                      PAC win
                                      size
  IMWNSZ          4          2        IMN MED                  17    3
                                      PAC win
                                      size
  ILWNSZ          4          2        IMN LOW                  17    3
                                      PAC win
                                      size
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
```

Figure 192. SNA_PAC3 Query Definition, Part 2

```
                             IBM Query/400                  11/27/96   15:06:22        Page    5
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                             IBM Query/400                  11/27/96   15:06:22        Page    6
Database file output
  File  . . . . . . . . . . . . . . . . . SES2A
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Session Traffic - Part 1 of 2
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   92
  Field list:
    Field         Begin   Len  Dec   Null  Data Type           Text
    SCTLNM            1    10              Character           Controller Description Name
    DATE             11     5              Character           substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
    TIME             16     5              Character           substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
    ENWNSZ           21    17    3         Packed decimal      (enspws)/(ensppw+0.001)
    EHWNSZ           30    17    3         Packed decimal      (ehspws)/(ehsppw+0.001)
    EMWNSZ           39    17    3         Packed decimal      (emspws)/(emsppw+0.001)
    ELWNSZ           48    17    3         Packed decimal      (elspws)/(elsppw+0.001)
    INWNSZ           57    17    3         Packed decimal      (inspws)/(insppw+0.001)
    IHWNSZ           66    17    3         Packed decimal      (ihspws)/(ihsppw+0.001)
    IMWNSZ           75    17    3         Packed decimal      (imspws)/(imsppw+0.001)
    ILWNSZ           84    17    3         Packed decimal      (ilspws)/(ilsppw+0.001)
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 193. SNA_PAC3 Query Definition, Part 3

E.7 SNA_LIN

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/27/96   15:06:34        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_LIN
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA line transmission time
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      SNAOVERIP1    QAPMSNAR
                                  IBM Query/400                    11/27/96   15:06:34        Page    2
Result fields
  Name        Expression                        Column Heading          Len  Dec
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
  TOTLRUD     enlrud + ehlrud + emlrud + ellrud  Total length RU
              + inlrud + ihlrud + imlrud +      delivered
              illrud
  TOTNRUD     ennrud + ehnrud + emnrud + elnrud  Total # RU
              + innrud + ihnrud + imnrud +      delivered
              ilnrud
  AVGRULEND   TOTLRUD / (TOTNRUD + 0.00001)     Avg RU
                                                length
                                                delivered
  TOTLRUR     enlrur + ehlrur + emlrur + ellrur  Total length RU
              + inlrur + ihlrur + imlrur +      received
              illrur
  TOTNRUR     ennrur + ehnrur + emnrur + elnrur  Total length RU
              + innrur + ihnrur + imnrur +      received
              ilnrur
  AVGRULENR   TOTLRUR / (TOTNRUR + 0.00001)     Avg RU
                                                length
                                                received
  ENLTTM      (entrud/1000)/(ennrud+0.001)      EN NET
                                                LT RU
                                                dlv tim
  EHLTTM      (ehtrud/1000)/(ehnrud+0.001)      EN HIGH
                                                LT RU
                                                dlv tim
  EMLTTM      (emtrud/1000)/(emnrud+0.001)      EN MED
                                                LT RU
                                                dlv tim
  ELLTTM      (eltrud/1000)/(elnrud+0.001)      EN LOW
                                                LT RU
                                                dlv tim
```

Figure 194. SNA_LIN Query Definition, Part 1

```
                                  IBM Query/400                      11/27/96   15:06:34         Page    3
Result fields (continued)
  Name        Expression                        Column Heading          Len  Dec
  INLTTM      (intrud/1000)/(innrud+0.001)       INM NET
                                                 LT RU
                                                 dlv tim
  IHLTTM      (ihtrud/1000)/(ihnrud+0.001)       INM HIGH
                                                 LT RU
                                                 dlv tim
  IMLTTM      (imtrud/1000)/(imnrud+0.001)       INM MED
                                                 LT RU
                                                 dlv tim
  ILLTTM      (iltrud/1000)/(ilnrud+0.001)       INM LOW
                                                 LT RU
                                                 dlv tim
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  SLINNM                                1      Line Description Name
  DATE
  TIME
  AVGRULEND
  AVGRULENR
  ENLTTM
  EHLTTM
  EMLTTM
  ELLTTM
  INLTTM
  IHLTTM
  IMLTTM
  ILLTTM
                                  IBM Query/400                      11/27/96   15:06:34         Page    4
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     0        Controller               10
                                      Description
                                      Name
  SLINNM                     2        Line                     10
                                      Description
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  AVGRULEND                  2        Avg RU                   28    5          18    1
                                      length
                                      delivered
  AVGRULENR                  2        Avg RU                   28    5          18    1
                                      length
                                      received
  ENLTTM          4          2        EN NET                   17    3
                                      LT RU
                                      dlv tim
  EHLTTM          4          2        EN HIGH                  17    3
                                      LT RU
                                      dlv tim
  EMLTTM          4          2        EN MED                   17    3
                                      LT RU
                                      dlv tim
  ELLTTM          4          2        EN LOW                   17    3
                                      LT RU
                                      dlv tim
  INLTTM          4          2        INM NET                  17    3
                                      LT RU
                                      dlv tim
  IHLTTM          4          2        INM HIGH                 17    3
                                      LT RU
                                      dlv tim
```

Figure 195. SNA_LIN Query Definition, Part 2

```
                                  IBM Query/400                      11/27/96   15:06:34        Page    5
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  IMLTTM          4          2        INM MED                 17    3
                                      LT RU
                                      dlv tim
  ILLTTM          4          2        INM LOW                 17    3
                                      LT RU
                                      dlv tim
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
                                  IBM Query/400                      11/27/96   15:06:34        Page    6
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                                  IBM Query/400                      11/27/96   15:06:34        Page    7
Database file output
  File  . . . . . . . . . . . . . . . . . SES2A
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Session Traffic - Part 1 of 2
  Print definition  . . . . . . . . . . . No
Output file record format
  Output record length  . . . . . . . . .   132
  Field list:
    Field          Begin   Len  Dec   Null  Data Type           Text
    SCTLNM             1    10              Character           Controller Description Name
    SLINNM            11    10              Character           Line Description Name
    DATE              21     5              Character           substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
    TIME              26     5              Character           substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
    AVGRULEND         31    28    5         Packed decimal      TOTLRUD / (TOTNRUD + 0.00001)
    AVGRULENR         46    28    5         Packed decimal      TOTLRUR / (TOTNRUR + 0.00001)
    ENLTTM            61    17    3         Packed decimal      (entrud/1000)/(ennrud+0.001)
    EHLTTM            70    17    3         Packed decimal      (ehtrud/1000)/(ehnrud+0.001)
    EMLTTM            79    17    3         Packed decimal      (emtrud/1000)/(emnrud+0.001)
    ELLTTM            88    17    3         Packed decimal      (eltrud/1000)/(elnrud+0.001)
    INLTTM            97    17    3         Packed decimal      (intrud/1000)/(innrud+0.001)
    IHLTTM           106    17    3         Packed decimal      (ihtrud/1000)/(ihnrud+0.001)
    IMLTTM           115    17    3         Packed decimal      (imtrud/1000)/(imnrud+0.001)
    ILLTTM           124    17    3         Packed decimal      (iltrud/1000)/(ilnrud+0.001)
                                  IBM Query/400                      11/27/96   15:06:34        Page    8
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 196. SNA_LIN Qoery Definition, Part 3

E.8 SNA_TRQ

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/27/96   15:06:39        Page    1
  Query . . . . . . . . . . . . . . . . . SNA_TRQ
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . SNA transmission queue wait time
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . .
  Query country id  . . . . . . . . . . .
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . No
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      SNAOVERIP1    QAPMSNAR
                                  IBM Query/400                     11/27/96   15:06:39        Page    2
Result fields
  Name        Expression                        Column Heading          Len  Dec
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
  ENTPQW      (enqtrr/1000)/(enqnrl+0.001)      EN NET
                                                TPQ RU
                                                avg wt
  EHTPQW      (ehqtrr/1000)/(ehqnrl+0.001)      EN HIGH
                                                TPQ RU
                                                avg wt
  EMTPQW      (emqtrr/1000)/(emqnrl+0.001)      EN MED
                                                TPQ RU
                                                avg wt
  ELTPQW      (elqtrr/1000)/(elqnrl+0.001)      EN LOW
                                                TPQ RU
                                                avg wt
  INTPQW      (inqtrr/1000)/(inqnrl+0.001)      INM NET
                                                TPQ RU
                                                avg wt
  IHTPQW      (ihqtrr/1000)/(ihqnrl+0.001)      INM HIGH
                                                TPQ RU
                                                avg wt
  IMTPQW      (imqtrr/1000)/(imqnrl+0.001)      INM MED
                                                TPQ RU
                                                avg wt
  ILTPQW      (ilqtrr/1000)/(ilqnrl+0.001)      INM LOW
                                                TPQ RU
                                                avg wt
  TOTQLRE     enqlre + ehqlre + emqlre + elqlre  Total length RU
              + inqlre + ihqlre + imqlre +      entering
              ilqlre
  TOTQNRE     enqnre + ehqnre + emqnre + elqnre  Total number RU
              + inqnre + ihqnre + imqnre +      entering
              ilqnre
                                  IBM Query/400                     11/27/96   15:06:39        Page    3
Result fields (continued)
  Name        Expression                        Column Heading          Len  Dec
  AVGRULENE   TOTQLRE / (TOTQNRE + 0.00001)     Avg RU
                                                length
                                                entering
  TOTQLRL     enqlrl + ehqlrl + emqlrl + elqlrl  Total length RU
              + inqlrl + ihqlrl + imqlrl +      leaving
              ilqlrl
  TOTQNRL     enqnrl + ehqnrl + emqnrl + elqnrl  Total number RU
              + inqnrl + ihqnrl + imqnrl +      leaving
              ilqnrl
  AVGRULENL   TOTQLRL / (TOTQNRL + 0.00001)     Avg RU
                                                length
                                                leaving
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  SCTLNM          10        A           1      Controller Description Name
  DATE
  TIME
  AVGRULENE
  AVGRULENL
  ENTPQW
  EHTPQW
  EMTPQW
  ELTPQW
  INTPQW
  IHTPQW
  IMTPQW
  ILTPQW
```

Figure 197. SNA_TRQ Query Definition, Part 1

```
                                   IBM Query/400                      11/27/96   15:06:39        Page    4
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  SCTLNM                     0        Controller               10
                                      Description
                                      Name
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  AVGRULENE                  2        Avg RU                   28    5         17    1
                                      length
                                      entering
  AVGRULENL                  2        Avg RU                   28    5         17    1
                                      length
                                      leaving
  ENTPQW                     2        EN NET                   17    3
                                      TPQ RU
                                      avg wt
  EHTPQW                     2        EN HIGH                  17    3
                                      TPQ RU
                                      avg wt
  EMTPQW                     2        EN MED                   17    3
                                      TPQ RU
                                      avg wt
  ELTPQW                     2        EN LOW                   17    3
                                      TPQ RU
                                      avg wt
  INTPQW                     2        INM NET                  17    3
                                      TPQ RU
                                      avg wt
  IHTPQW                     2        INM HIGH                 17    3
                                      TPQ RU
                                      avg wt
  IMTPQW                     2        INM MED                  17    3
                                      TPQ RU
                                      avg wt
                                   IBM Query/400                      11/27/96   15:06:39        Page    5
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  ILTPQW                     2        INM LOW                  17    3
                                      TPQ RU
                                      avg wt
Report breaks
  Break  New   Suspend   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  51 (default)
    Width . . . . . . . . . . . . . . . . 300
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
                                   IBM Query/400                      11/27/96   15:06:39        Page    6
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
Database file output
  File  . . . . . . . . . . . . . . . . . SES2A
    Library . . . . . . . . . . . . . . . COMMDTA
  Member  . . . . . . . . . . . . . . . . *FILE
  Data in file  . . . . . . . . . . . . . Replace file
  For a new file:
    Authority . . . . . . . . . . . . . . *LIBCRTAUT
    Text about
      the file  . . . . . . . . . . . . . Session Traffic - Part 1 of 2
  Print definition  . . . . . . . . . . . No
```

Figure 198. SNA_TRQ Query Definition, Part 2

```
                                  IBM Query/400                    11/27/96   15:06:39         Page    7
 Output file record format
   Output record length  . . . . . . . . .  122
   Field list:
     Field         Begin   Len  Dec   Null  Data Type           Text
     SCTLNM            1    10              Character           Controller Description Name
     DATE             11     5              Character           substr(DTETIM,3,2) || '/' ||     substr(DTETIM,5,2
     TIME             16     5              Character           substr(DTETIM,7,2) || ':' ||     substr(DTETIM,9,2
     AVGRULENE        21    28    5         Packed decimal      TOTQLRE / (TOTQNRE + 0.00001)
     AVGRULENL        36    28    5         Packed decimal      TOTQLRL / (TOTQNRL + 0.00001)
     ENTPQW           51    17    3         Packed decimal      (enqtrr/1000)/(enqnrl+0.001)
     EHTPQW           60    17    3         Packed decimal      (ehqtrr/1000)/(ehqnrl+0.001)
     EMTPQW           69    17    3         Packed decimal      (emqtrr/1000)/(emqnrl+0.001)
     ELTPQW           78    17    3         Packed decimal      (elqtrr/1000)/(elqnrl+0.001)
     INTPQW           87    17    3         Packed decimal      (inqtrr/1000)/(inqnrl+0.001)
     IHTPQW           96    17    3         Packed decimal      (ihqtrr/1000)/(ihqnrl+0.001)
     IMTPQW          105    17    3         Packed decimal      (imqtrr/1000)/(imqnrl+0.001)
     ILTPQW          114    17    3         Packed decimal      (ilqtrr/1000)/(ilqnrl+0.001)
             * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 199. SNA_TRQ Query Definition, Part 3

Appendix F. Integrated PC Server Query

F.1 Integrated PC Server Performance Monitor Data Queries

Figure 200 on page 346 shows the query definition when selecting ″HPFS data″ from Performance Monitor database file QAPMIOPD. Figure 201 on page 348 shows the query output for a specific collection of Integrated PC Server ″HPFS data″ from Performance Monitor database file QAPMIOPD. Refer to the *Work Management Guide* for field definitions. Field XIDTYP containing a ″3″ identifies HPFS data.

```
5763QU1  V3R1M0  940909           IBM Query/400           SYSNM116  3/13/95   16:53:36        Page    1
  Query . . . . . . . . . . . . . . . . . HPFSCOOK02
    Library . . . . . . . . . . . . . . . DJOHNSON
  Query text  . . . . . . . . . . . . . . HPFS386 Statistics- Cook 02
  Query CCSID . . . . . . . . . . . . . . 65535
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . No
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMIOPD       FSCITY2       CPUTEST2      QAPMIOXR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  TOTALREADS  XICT01 + XICT02                   Total #                  11    0
                                                READS
  CACHEHITRD  100 * XICT01 / (XICT01 + XICT02)  CACHE                     5    2
                                                HIT %
                                                READS
  TOTALWRITE  XICT03 + XICT04                   Total #                   7    0
                                                Writes
  CACHEHITWR  100 * XICT04 / (XICT03 + XICT04)  CACHE                     7    2
                                                HIT
                                                WRITE
Select record tests
  AND/OR   Field             Test     Value (Field, Numbers, or 'Characters')
           XIDTYP            EQ       '3'
   AND     XICT01            GT       0
   AND     XICT04            GT       0


                                  IBM Query/400                     3/13/95   16:53:36        Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number
  INTSEC                                       Elapsed Interval Seconds
  XIIOPA                                       IOP Bus Address
  XIDTYP                                       Type of data in record
  TOTALREADS
  CACHEHITRD
  TOTALWRITE
  CACHEHITWR
  XICT10                                       Counter 10
  XICT11                                       Counter 11
  XICT01                                       Counter 01
  XICT02                                       Counter 02
  XICT03                                       Counter 03
  XICT04                                       Counter 04
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0        Int                      5    0          1    0
                                      #
  INTSEC                     1        Int                      7    0          5    0
                                      Sec
  XIIOPA                     1        IOP                      3    0
                                      Bus
  XIDTYP                     1                                 1
                                      Data
                                      Type
```

Figure 200 (Part 1 of 2). QAPMIOPD File Query Definition - CACHE

```
  TOTALREADS     1          0        Total #              11    0
                                     READS
  CACHEHITRD     2          0        CACHE                 5    2           5    2
                                     HIT %
                                     READS
  TOTALWRITE     1          0        Total #               7    0
                                     Writes
  CACHEHITWR     2          0        CACHE                 7    2           7    2
                                     HIT %
                                     WRITE
  XICT10         2          0        Files                11    0           6    0
                                     Opened
  XICT11         2          0        Files                11    0           6    0
                                     Closed
  XICT01         1          0        Read Reqs            11    0          11    0
                                     frm CACHE


                                  IBM Query/400                      3/13/95   16:53:36         Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null        Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  XICT02         1          0        Read Reqs            11    0
                                     from DISK
  XICT03         1          0        Write reqs           11    0
                                     from DISK
  XICT04         1          0        Write Reqs           11    0
                                     LAZY
                                     Written
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . Yes
    Wrapping width  . . . . . . . . . . . 168
    Record on one page  . . . . . . . . . No

Printer Output
  Printer device  . . . . . . . . . . . . PRT03
  Report size
    Length  . . . . . . . . . . . . . . .  66
    Width . . . . . . . . . . . . . . . . 166
  Report start line . . . . . . . . . . .   6
  Report end line . . . . . . . . . . . .  60
  Report line spacing . . . . . . . . . . Double space
  Print definition  . . . . . . . . . . . Yes

Printer Spooled Output
  Spool the output  . . . . . . . . . . . Yes
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . Yes

Cover Page
  Print cover page  . . . . . . . . . . . Yes
    Cover page title
      8 Users LAN Server/400 - QAPMIOPD(HPFS) Read, Write Cache, File Open/Close


                                  IBM Query/400                      3/13/95   16:53:36         Page    4
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
      LAN Server/400: HPFS Cache Statistics and File Open/Close
    Page footing
```

Figure 200 (Part 2 of 2). QAPMIOPD File Query Definition - CACHE

```
8 Users LAN Server/400 - QAPMIOPD(HPFS) Read, Write Cache, File Open/Close
      QUERY NAME . . . . . HPFSCOOK02
      LIBRARY NAME . . . . DJOHNSON
      FILE         LIBRARY      MEMBER       FORMAT
      QAPMIOPD     FSCITY2      CPUTEST2     QAPMIOXR
      DATE . . . . . . . . 03/13/95
      TIME . . . . . . . . 16:53:37
                 HPFS386 Statistics- Cook 02
```

03/13/95 16:53:37 LAN Server/400: HPFS Cache Statistics and File Open/Close PAGE 1

Int #	Int Sec	IOP Bus	Data Type	Total # READS	CACHE HIT % READS	Total # Writes	CACHE HIT % WRITE	Files Opened	Files Closed	Read Reqs frm CACHE	Read Reqs from DISK	Write reqs from DISK	Write Reqs LAZY Written
1	301	2	3	95,347	87.41	6,933	100.00	995	975	83,351	11,996	0	6,933
2	298	2	3	232,309	95.12	3,136	100.00	3,969	3,974	220,981	11,328	0	3,136
3	298	2	3	222,045	93.72	7,537	99.98	3,980	3,995	208,117	13,928	1	7,536
			FINAL TOTALS										
			TOTAL	549,701		17,606				512,449	37,252	1	17,605
			AVG		92.08		99.99	2,981	2,981				

* * * E N D O F R E P O R T * * *

Figure 201. QAPMIOPD File Query Report - CACHE

Figure 202 on page 349 shows the query definition when selecting ″CPU data″ from Performance Monitor database file QAPMIOPD. Figure 203 on page 350 shows the query output for a specific collection of Integrated PC Server ″CPU data″ from Performance Monitor database file QAPMIOPD. Refer to the *Work Management Guide* for field definitions. Field XIDTYP containing a ″2″ identifies Integrated PC Server CPU data.

```
5763QU1  V3R1M0  940909           IBM Query/400           SYSNM116  3/22/95   13:59:07        Page    1
  Query . . . . . . . . . . . . . . . . . CPU486COOK
    Library . . . . . . . . . . . . . . . DJOHNSON
  Query text  . . . . . . . . . . . . . . FSIOP 486 CPU Utilizationt Statistics
  Query CCSID . . . . . . . . . . . . . . 65535
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal

  Processing options
    Use rounding  . . . . . . . . . . . . No
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMIOPD       FSCITY2       BAP8WS64MB    QAPMIOXR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  CPU486INT   ((XICT01 / 1000) / INTSEC) * 100  486 CPU %                 7    1
                                                Utilization
  XICT01SECS  XICT01 / 1000                     486 CPU                   7    1
                                                Seconds
Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           XIDTYP           EQ       '2'
   AND     XICT01           NE       0
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number


                                   IBM Query/400                     3/22/95   13:59:07        Page    2
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  XIIOPA                                       IOP Bus Address
  XIDTYP                                       Type of data in record
  XITYPE                                       IOP Type
  INTSEC                                       Elapsed Interval Seconds
  XICT01SECS
  CPU486INT
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                             Dec  Null        Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0        Int                      5    0          1    0
                                      #
  XIIOPA                     1        IOP                      3    0
                                      Bus
  XIDTYP                     1        Data                     1
                                      Type
                                      (OS/2)
  XITYPE                     2        IOP                      4
                                      Type
  INTSEC          1          1        Interval                 7    0          5    0
                                      Seconds
  XICT01SECS      1          2        486 CPU                  7    1
                                      Seconds
  CPU486INT       2          2            486 CPU              7    1          4    1
                                        Utilization
                                            (%)
```

Figure 202 (Part 1 of 2). QAPMIOPD File Query Definition - CPU

```
 Selected output attributes
   Output type . . . . . . . . . . . . . . Printer
   Form of output  . . . . . . . . . . . . Detail
   Line wrapping . . . . . . . . . . . . . No


                                  IBM Query/400                      3/22/95   13:59:07         Page    3
 Printer Output
   Printer device  . . . . . . . . . . . . *PRINT
   Report size
     Length  . . . . . . . . . . . . . . .  66
     Width . . . . . . . . . . . . . . . . 132
   Report start line . . . . . . . . . . .   6
   Report end line . . . . . . . . . . . .  60
   Report line spacing . . . . . . . . . . Triple space
   Print definition  . . . . . . . . . . . Yes

 Printer Spooled Output
   Spool the output  . . . . . . . . . . . Yes
   Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
   Copies  . . . . . . . . . . . . . . . .   1
   Hold  . . . . . . . . . . . . . . . . . Yes

 Cover Page
   Print cover page  . . . . . . . . . . . Yes
     Cover page title
       8 Users Interconnected - FSIOP CPU

 Page headings and footings
   Print standard page heading . . . . . . Yes
     Page heading
       8 Interconnected LAN Server/400 Clients - FSIOP CPU
     Page footing
```

Figure 202 (Part 2 of 2). QAPMIOPD File Query Definition - CPU

```
                                                 8 Users Interconnected - FSIOP CPU
                                         QUERY NAME . . . . . CPU486COOK
                                         LIBRARY NAME . . . . DJOHNSON
                                         FILE         LIBRARY      MEMBER       FORMAT
                                         QAPMIOPD     FSCITY2      BAP8WS64MB   QAPMIOXR
                                         DATE . . . . . . . . 03/22/95
                                         TIME . . . . . . . . 13:59:07
                                               FSIOP 486 CPU Utilizationt Statistics


03/22/95  13:59:07  8 Interconnected LAN Server/400 Clients - FSIOP CPU  PAGE    1
Int IOP  Data    IOP    Interval         486 CPU       486 CPU
#   Bus  Type    Type   Seconds          Seconds     Utilization
         (OS/2)                                           (%)
 1    2    2     6506        298            93.8        31.4
 2    2    2     6506        296           131.4        44.4
 3    2    2     6506        299           120.6        40.3
 4    2    2     6506        197            47.1        23.9
                FINAL TOTALS
                TOTAL      1,090           392.9
                AVG                                     35.0
* * *  E N D  O F  R E P O R T  * * *
```

Figure 203. QAPMIOPD File Query Report - CPU

Appendix G. AnyNet Queries

This section contains query examples to help you measure the AnyNet performance. There is no consolidated information about AnyNet. The performance investigation for AnyNet is done by gathering both SNA and TCP/IP (Sockets) information.

G.1 Sockets over SNA Queries

The files QAPMSNA and QAPMJOBS are used.

This is the main field used to select records from QAPMSNA file:

SCTLNM Controller Description Name

These are the main fields used to select records from QAPMJOBS file:

JBSKSC Number of Socket Sends

JBSKRC Number of Socket Receives

Refer to Chapter 13, "AnyNet" on page 197 for a more detailed explanation.

G.1.1 SNA Query

```
  Query . . . . . . . . . . . . . . . . . SNA_ALL
    Library . . . . . . . . . . . . . . . ANYNET
  Query text  . . . . . . . . . . . . . . All the SNA data for a particular Ctl. Description
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***

  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMSNA        QPFRDATA      IPOVERSNA2    QAPMSNAR

Result fields
  Name        Expression                         Column Heading          Len  Dec
  DATE        substr(DTETIM,3,2) || '/' ||       Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||       Time
              substr(DTETIM,9,2)

Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           SCTLNM           EQ       'MO5ETH'
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number
  DATE
  TIME
  INTNUM                                       Interval Number
  INTSEC                                       Elapsed Interval Seconds
  SCTLNM                                       Controller Description Name
  SLINNM                                       Line Description Name
  STSKNM                                       T2 Station I/O Manager Task Name
  SLIOMT                                       Line I/O Manager Task Name
  .
  .
  .
  .
  .
The rest of the query as SNA_ALL in Appendix E.
```

Figure 204. SNA_ALL Query for One Specific Controller Description

G.1.2 Sockets Jobs Query

```
  Query . . . . . . . . . . . . . . . . . SOCK_JOB
    Library . . . . . . . . . . . . . . . ANYNET
  Query text  . . . . . . . . . . . . . . Selects Jobs where there is socket activity
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***

  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes

Selected files
  ID     File          Library       Member       Record Format
  T01    QAPMJOBS      QPFRDATA      PUREIP       QAPMJOBR

Result fields
  Name       Expression                         Column Heading         Len  Dec
  DATE       substr(DTETIM,3,2) || '/' ||       Date
             substr(DTETIM,5,2)
  TIME       substr(DTETIM,7,2) || ':' ||       Time
             substr(DTETIM,9,2)

Select record tests
  AND/OR   Field           Test     Value (Field, Numbers, or 'Characters')
           JBSKSC          NE       0
   OR      JBSKRC          NE       0

Ordering of selected fields
  Field          Sort      Ascending/  Break  Field
  Name           Priority  Descending  Level  Text
  INTNUM                                      Interval Number
  DATE
  TIME
  INTSEC                                      Elapsed Interval Seconds
  JBSKSC                                      Number of Socket Sends
  JBSKRC                                      Number of Socket Receives
  JBSSYS                                      Subsystem Name
  JBSLIB                                      Library Name
  JBNAME                                      Job Name
  JBUSER                                      Job User
  JBNBR                                       Job Number
  JBACCO                                      Job Accounting Code
  JBTYPE                                      Job Type
  JBSTYP                                      Job Subtype
  JBTTYP                                      Task type
  JBTTYE                                      Task type extender
  JBFLAG                                      Job Flag
  JBS36E                                      S/36 Environment
  JBPOOL                                      Job Pool
  JBPRTY                                      Job Priority
  JBCPU                                       CPU Milliseconds
  JBRSP                                       Total Response Seconds
  JBSLC                                       Timeslice in Milliseconds
  JBNTR                                       Interactive Transactions
  JBDBR                                       Physical Database Reads
  JBNDB                                       Physical Non Database Reads
  JBWRT                                       Physical Writes
  JBAW                                        Active to Wait Transitions
  JBWI                                        Wait to Ineligible Transitions
  JBAI                                        Active to Ineligible Transitions
  JBPLN                                       Lines to be Printed
  JBPPG                                       Pages to be Printed
  JBPFL                                       Files to be Printed
  JBLWT                                       Logical Database Writes
  JBLRD                                       Logical Database Reads
  JBDBU                                       Miscellaneous Database Operations
  JBCPT                                       Communications Puts
  JBCGT                                       Communications Gets
  JBSPD                                       Job Suspend Time
  JBRRT                                       Job Reroute Time
  JBLND                                       Line Description
  JBCUD                                       Control Unit Description
  JB2LND                                      Secondary Line Description
  JB2CUD                                      Secondary Control Unit
  JBNDW                                       Synchronous Non Database Writes
  JBDBW                                       Synchronous Database Writes
  JBANDW                                      Asynchronous Non Database Writes
  JBADBW                                      Asynchronous Database Writes
  JBANDR                                      Asynchronous Non Database Reads
  JBADBR                                      Asynchronous Database Reads
```

Figure 205. SOCK_JOB Query, Part 1

```
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  JBPW                                         Permanent Writes
  JBPAGF                                       PAG Faults
  JBOBIN                                       Binary Overflows
  JBODEC                                       Decimal Overflows
  JBOFLP                                       Floating Point Overflows
  JBIPF                                        I/O Pending Faults
  JBWIO                                        Waits For Asynchronous I/O
  JBIRN                                        IOP Resource Name
  JBDRN                                        Device Resource Name
  JBPORT                                       Workstation Port Number
  JBSTN                                        Workstation Station Number
  JBPTSF                                       Pass-Through Source Flag
  JBPTTF                                       Pass-Through Target Flag
  JBEAF                                        Emulation Active Flag
  JBPCSF                                       Client Access/400 Application Flag
  JBDDMF                                       Target DDM Job Flag
  JBMRTF                                       MRT Flag
  JBROUT                                       Routing Entry Index
  JBAIQT                                       Total Application Input Queuing Time
  JBNAIQ                                       Application Queuing Transactions
  JBRUT                                        Total Resource Usage Time
  JBNRU                                        Resource Usage Transactions
  JBQT                                         Total Queuing Time to Enter the MRT
  JBMMT                                        Total Time Spent at MRTMAX
  JBNEQT                                       Number of Entries Into the MRT
  JBPUTN                                       Number of Puts
  JBPUTA                                       Amount of Data Sent
  JBGETN                                       Number of Gets
  JBGETA                                       Amount of Data Received
  JBPGIN                                       Number of Intervals Between First Put and CD
  JBPGIL                                       Total Time Spent Between First Put and CD
  JBGGIL                                       Total Time Spent Between First Gets
  JBRTI                                        Number of REQIOs to Transmit Data
  JBRRI                                        Number of REQIOs to Receive Data
  JBSZWT                                       Total Seize/Wait Time in Milliseconds
  JBSKBS                                       Number of Socket Bytes Sent
  JBSKBR                                       Number of Socket Bytes Received
  JBXRFR                                       Stream file reads
  JBXRFW                                       Stream file writes
  JBXSLR                                       File system symbolic link reads
  JBXDYR                                       File system directory reads
  JBDLCH                                       File system lookup cache hits
  JBDLCM                                       File system  lookup cache misses
  JBSJNM                                       Submitter's job name
  JBSJUS                                       Submitter's job user
  JBSJNB                                       Submitter's job number
```

Figure 206. SOCK_JOB Query, Part 2

```
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                  5    0
                                      Interval
                                      Number
  DTETIM                     2        Interval                 12
                                      Date
                                      Time
  INTSEC                     2        Elapsed                   7    0
                                      Interval
                                      Seconds
  JBSKSC                     2                                 11    0
                                      Socket
                                      Sends
  JBSKRC                     2                                 11    0
                                      Socket
                                      Receives
  JBSSYS                     2                                 10
                                      Subsystem
                                      Name
  JBSLIB                     2                                 10
                                      Library
                                      Name
  JBNAME                     2                                 10
                                      Job
                                      Name
```

Figure 207. SOCK_JOB Query, Part 3

```
JBUSER                    2                                 10
                                   Job
                                   User
JBNBR                     2                                  6
                                   Job
                                   Number
JBACCO                    2        Job                      15
                                   Accounting
                                   Code
JBTYPE                    2                                  1
                                   Job
                                   Type
JBSTYP                    2                                  1
                                   Job
                                   Subtype
JBTTYP                    2                                  2
                                   Task
                                   Type
JBTTYE                    2        Task                      2
                                   Type
                                   Extender
JBFLAG                    2                                  2
                                   Job
                                   Flag
JBS36E                    2                                  1
                                   S/36
                                   Environment
JBPOOL                    2                                  2
                                   Job
                                   Pool
JBPRTY                    2                                  3
                                   Job
                                   Priority
JBCPU                     2                                 11    0
                                   CPU
                                   Milliseconds
JBRSP                     2        Total                    15    3
                                   Response
                                   Seconds
JBSLC                     2        Timeslice                11    0
                                   in
                                   Milliseconds
JBNTR                     2                                 11    0
                                   Interactive
                                   Transactions
JBDBR                     2        Physical                 11    0
                                   Database
                                   Reads
JBNDB                     2        Physical                 11    0
                                   Non Database
                                   Reads
JBWRT                     2                                 11    0
                                   Physical
                                   Writes
JBAW                      2        Active                   11    0
                                   to Wait
                                   Transitions
JBWI                      2        Wait to                  11    0
                                   Ineligible
                                   Transitions
JBAI                      2        Active to                11    0
                                   Ineligible
                                   Transitions
JBPLN                     2        Lines                    11    0
                                   to be
                                   Printed
JBPPG                     2        Pages                    11    0
                                   to be
                                   Printed
JBPFL                     2        Files                    11    0
                                   to be
                                   Printed
JBLWT                     2        Logical                  11    0
                                   Database
                                   Writes
JBLRD                     2        Logical                  11    0
                                   Database
                                   Reads
JBDBU                     2        Miscellaneous            11    0
                                   Database
                                   Operations
JBCPT                     2                                 11    0
                                   Communications
                                   Puts
```

Figure 208. SOCK_JOB Query, Part 4

JBCGT	2	Communications Gets	11	0
JBSPD	2	Job Suspend Time	11	0
JBRRT	2	Job Reroute Time	11	0
JBLND	2	Line Description	10	
JBCUD	2	Control Unit Description	10	
JB2LND	2	Secondary Line Description	10	
JB2CUD	2	Secondary Control Unit	10	
JBNDW	2	Synchronous Non Database Writes	11	0
JBDBW	2	Synchronous Database Writes	11	0
JBANDW	2	Asynchronous Non Database Writes	11	0
JBADBW	2	Asynchronous Database Writes	11	0
JBANDR	2	Asynchronous Non Database Reads	11	0
JBADBR	2	Asynchronous Database Reads	11	0
JBPW	2	Permanent Writes	11	0
JBPAGF	2	PAG Faults	11	0
JBOBIN	2	Binary Overflows	11	0
JBODEC	2	Decimal Overflows	11	0
JBOFLP	2	Floating Point Overflows	11	0
JBIPF	2	I/O Pending Faults	11	0
JBWIO	2	Waits For Asynchronous I/O	11	0
JBIRN	2	IOP Resource Name	10	
JBDRN	2	Device Resource Name	10	
JBPORT	2	Workstation Port Number	3	0
JBSTN	2	Workstation Station Number	3	0
JBPTSF	2	Pass-Through Source Flag	1	0
JBPTTF	2	Pass-Through Target Flag	1	0
JBEAF	2	Emulation Active Flag	1	0
JBPCSF	2	CA4 Application Flag	1	0

Figure 209. SOCK_JOB Query, Part 5

JBDDMF	2	Target DDM Job Flag	1	0
JBMRTF	2	MRT Flag	1	0
JBROUT	2	Routing Entry Index	5	0
JBAIQT	2	Total Application Input Queuing Time	11	0
JBNAIQ	2	Application Queuing Transactions	11	0
JBRUT	2	Total Resource Usage Time	11	0
JBNRU	2	Resource Usage Transactions	11	0
JBQT	2	Total Queuing Time to Enter the MRT	11	0
JBMMT	2	Total Time Spent at MRTMAX	11	0
JBNEQT	2	Number of Entries Into the MRT	11	0
JBPUTN	2	Number of Puts	11	0
JBPUTA	2	Amount of Data Sent	11	0
JBGETN	2	Number of Gets	11	0
JBGETA	2	Amount of Data Received	11	0
JBPGIN	2	Number of Intervals From First Put to CD	11	0
JBPGIL	2	Time From First Put to CD	11	0
JBGGIL	2	Total Time Spent Between First Gets	11	0
JBRTI	2	Number of REQIOs to Transmit Data	11	0
JBRRI	2	Number of REQIOs to Receive Data	11	0
JBSZWT	2	Total Seize/Wait Time	11	0
JBSKBS	2	Socket Bytes Sent	11	0
JBSKBR	2	Socket Bytes Received	11	0
JBXRFR	2	Stream File Reads	11	0
JBXRFW	2	Stream File Writes	11	0
JBXSLR	2	File System Symbolic Link Reads	11	0
JBXDYR	2	File System Directory Reads	11	0
JBDLCH	2	File System Lookup Cache Hits	11	0

Figure 210. SOCK_JOB Query, Part 6

```
  JBDLCM                    2        File System           11    0
                                     Lookup
                                     Cache Misses
  JBSJNM                    2        Submitter             10
                                     Job
                                     Name
  JBSJUS                    2        Submitter             10
                                     Job
                                     User
  JBSJNB                    2        Submitter              6
                                     Job

Selected output attributes
  Output type . . . . . . . . . . . . . . Display
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
```

Figure 211. SOCK_JOB Query, Part 7

G.2 APPC over TCP/IP Queries

The QAPMSNA and QAPMJOBS files are used.

This is the main field used to select records from QAPMSNA file:

SCTLNM Controller Description Name

These are the main fields used to select records from QAPMJOBS file:

JBCPT Number of Socket Sends

JBCGT Number of Socket Receives

Refer to Chapter 13, "AnyNet" on page 197 for a more detailed explanation.

G.2.1 SNA Query

The same SNA Query listed in the previous section of this chapter can be used for APPC over TCP/IP.

G.2.2 APPC Jobs Query

```
  Query . . . . . . . . . . . . . . . . . SNA_JOB
    Library . . . . . . . . . . . . . . . ANYNET
  Query text  . . . . . . . . . . . . .
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***

  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes

Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMJOBS       QPFRDATA      SNAOVERIP1    QAPMJOBR

Result fields
  Name        Expression                        Column Heading          Len  Dec
  DATE        substr(DTETIM,7,2) || ':' ||       Date
              substr(DTETIM,9,2)
  TIME        substr(DTETIM,7,2) || ':' ||       Time
              substr(DTETIM,9,2)

Select record tests
  AND/OR   Field            Test     Value (Field, Numbers, or 'Characters')
           JBCPT            NE       0
   OR      JBCGT            NE       0

Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM                                       Interval Number
  DATE
  TIME
  INTSEC                                       Elapsed Interval Seconds
  JBSSYS                                       Subsystem Name
  JBSLIB                                       Library Name
  JBNAME                                       Job Name
  JBUSER                                       Job User
  JBNBR                                        Job Number
  .
  .
  .
  .
  Follows the same as Sockets Jobs Query (SOCK_JOB) in this same chapter.
```

Figure 212. SNA_JOB Query

Appendix H. ISDN Queries

This appendix provides query definitions that can be used to examine X.25 environments. All of the queries use input from the OS/400 Performance Monitor and run with trace options. There are eight queries defined:

- NWI_ALL
- NWI_CALLS
- NWI_ERRORS
- NWI_IOP
- NWI_LAPD
- IDLC-ALL
- IDLC-IOP
- IDLC-UTIL

The NWI_ALL and IDLC_ALL queries are simple. They show you all of the values in the QAPMLAPD and QAPMIDLC files, respectively. The only thing you have to define is the file name and member name that contains the performance data. Most of the rest are defaults so it takes you only a few minutes to create these queries. Please note that there are several fields in the QAPMIDLC file so the print lines are longer than the maximum line length permitted by Query/400 (378 characters); therefore, the print lines in the IDLC_ALL query are wrapped. Other queries might also have longer lines than your printer can handle so check the maximum print position (MPP) allowed by your printer and adjust the line length in the queries accordingly.

The NWI_CALLS query shows you the number of incoming and outgoing calls and call errors.

The NWI_ERRORS query shows you the D-channel utilization and the physical errors on the network interface.

The NWI_IOP query shows you the IOP utilization by the network interface.

The NWI_LAPD query shows you the most important performance values of the D-channel usage.

The IDLC_IOP query shows you the IOP utilization by the network interface.

The IDLC_UTIL query shows you the most important performance values of the B-channel usage.

H.1 NWI_ALL

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:10:03        Page    1
  Query . . . . . . . . . . . . . . . . . NWI_ALL
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . All NWI performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMLAPD       QPFRDATA      Q962981049    QAPMLPDR
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          20        A                  Interval number
  DTETIM                                       Interval date and time: yymmddhhmmss
  INTSEC                                       Elapsed interval seconds
  IOPRN                                        IOP Resource Name
  LDIOP                                        Reserved
  LDTYPE                                       IOP Type
  LDNWI           10        A           1      Network interface description
  LDLSP                                        Line speed: in bits per second
  LDPRCL                                       Protocol: always D-ISDN D channel data
  LPLOFA                                       Loss of frame alignment
  LPLECV                                       Local end code violation
  LPDTSI                                       Detected access transmission error in
  LPDTSO                                       Detected access transmission error out
  LPFECV                                       Far end code violation
  LPES                                         Errored seconds
  LPSES                                        Severely errored seconds
  LPCOL                                        Collision detect
                                  IBM Query/400                    11/17/96   20:10:03        Page    2
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  LLCRCE                                       Receive CRC errors
  LLSFE                                        Short frame errors
  LLORUN                                       Receive overrun
  LLURUN                                       Transmit underrun
  LLABRT                                       Aborts received
  LLFRIE                                       Frames received in error
  LSFRT                                        Retransmitted frames
  LSSEQE                                       Sequence errors
  LSFTRN                                       Frames transmitted
  LSFRCV                                       Frames received
  LSBTRN                                       Bytes transmitted
  LSBRCV                                       Bytes received
  LQTOC                                        Total outgoing calls
  LQROC                                        Retry for outgoing calls
  LQTIC                                        Total incoming calls
  LQRIC                                        Retry for incoming calls
  LDCHLS1                                      S1 maintenance channel: 0-not active, 1-active
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                 5    0
                                      Interval
                                      Number
  DTETIM                     2        Interval                12
                                      Date
                                      and time
  INTSEC                     2        Elapsed                  7    0
                                      Interval
                                      Seconds
  IOPRN                      2        IOP                     10
                                      Resource
                                      Name
  LDIOP                      2                                 1
                                      Reserved
  LDTYPE                     2                                 4
                                      IOP
                                      Type
  LDNWI                      2        Network                 10
                                      Interface
                                      Description
  LDLSP                      2                                11    0
                                      Line
                                      Speed
```

Figure 213. NWI_ALL Query Definition, Part 1

```
                                  IBM Query/400                    11/17/96   20:10:03        Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  LDPRCL                     2                                  1
                                      Protocol
  LPLOFA                     2        Loss of                  11    0
                                      Frame
                                      Alignment
  LPLECV                     2        Local                    11    0
                                      End code
                                      Violation
  LPDTSI                     2        Detected access          11    0
                                      Transmission
                                      Error in
  LPDTSO                     2        Detected Access          11    0
                                      Transmission
                                      Error out
  LPFECV                     2        Far                      11    0
                                      End code
                                      Violation
  LPES                       2                                  5    0
                                      Errored
                                      Seconds
  LPSES                      2        Severely                  5    0
                                      Errored
                                      Seconds
  LPCOL                      2                                 11    0
                                      Collision
                                      Detect
  LLCRCE                     2        Receive                  11    0
                                      CRC
                                      Errors
  LLSFE                      2        Short                    11    0
                                      Frame
                                      Errors
  LLORUN                     2                                 11    0
                                      Receive
                                      Overrun
  LLURUN                     2                                 11    0
                                      Transmit
                                      Underrun
  LLABRT                     2                                 11    0
                                      Aborts
                                      Received
  LLFRIE                     2        Frames                   11    0
                                      Received
                                      in error
  LSFRT                      2                                 11    0
                                      Retransmitted
                                      Frames
                                  IBM Query/400                    11/17/96   20:10:03        Page    4
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                               Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  LSSEQE                     2                                 11    0
                                      Sequence
                                      Errors
  LSFTRN                     2                                 11    0
                                      Frames
                                      Transmitted
  LSFRCV                     2                                 11    0
                                      Frames
                                      Received
  LSBTRN                     2                                 11    0
                                      Bytes
                                      Transmitted
  LSBRCV                     2                                 11    0
                                      Bytes
                                      Received
  LQTOC                      2        Total                    11    0
                                      Outgoing
                                      Calls
  LQROC                      2        Retry for                11    0
                                      Outgoing
                                      Calls
  LQTIC                      2        Total                    11    0
                                      Incoming
                                      Calls
  LQRIC                      2        Retry for                11    0
                                      Incoming
                                      Calls
  LDCHLS1                    2        S1                        1    0
                                      Maintenance
                                      Channel
```

Figure 214. NWI_ALL Query Definition, Part 2

```
                                  IBM Query/400                     11/17/96   20:10:03        Page    5
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . Yes
    Wrapping width  . . . . . . . . . . . 378
    Record on one page  . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 378
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 215. NWI_ALL Query Definition, Part 3

H.2 NWI_CALLS

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:16:02        Page    1
  Query . . . . . . . . . . . . . . . . . NWI_CALLS
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . ISDN call related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMLAPD       QPFRDATA      Q963121422    QAPMLPDR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  PCTRETRYI   (LQRIC * 100) / LQTIC             Pct Incoming              4    1
                                                Calls
                                                Retried
  PCTRETRYO   (LQROC * 100) / LQTOC             Pct Outgoing              4    1
                                                Calls
                                                Retried
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
                                  IBM Query/400                    11/17/96   20:16:02        Page    2
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  LDNWI           10        A           1      Network interface description
  DATE            20        A
  TIME            30        A
  LQTOC                                        Total outgoing calls
  LQROC                                        Retry for outgoing calls
  PCTRETRYO
  LQTIC                                        Total incoming calls
  LQRIC                                        Retry for incoming calls
  PCTRETRYI
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  LDNWI                      0        Network                 10
                                      Interface
                                      Description
  DATE                       2        Date                     5
  TIME                       2        Time                     5
  LQTOC           2 4        2        Total                   11    0
                                      Outgoing
                                      Calls
  LQROC           2 4        2        Retry for               11    0
                                      Outgoing
                                      Calls
  PCTRETRYO       2 4        2        Pct Outgoing             4    1
                                      Calls
                                      Retried
  LQTIC           2 4        2        Total                   11    0
                                      Incoming
                                      Calls
  LQRIC           2 4        2        Retry for               11    0
                                      Incoming
                                      Calls
  PCTRETRYI       2 4        2        Pct Incoming             4    1
                                      Calls
                                      Retried
```

Figure 216. NWI_CALLS Query Definition, Part 1

```
                                  IBM Query/400                     11/17/96   20:16:02         Page    3
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for network interface &ldnwi
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                                  IBM Query/400                     11/17/96   20:16:02         Page    4
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 217. NWI_CALLS Query Definition, Part 2

H.3 NWI_ERRORS

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:16:27        Page    1
  Query . . . . . . . . . . . . . . . . . NWI_ERRORS
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . ISDN NWI error related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMLAPD       MYLIB         Q963121422    QAPMLPDR
Result fields
  Name        Expression                       Column Heading         Len  Dec
  LINEUTILT   (LSBTRN * 800) / INTSEC /LDLSP    Trn                      4    1
                                               Line
                                               Util
  LINEUTILR   (LSBRCV * 800) / INTSEC /LDLSP    Rcv                      4    1
                                               line
                                               Util
  PCERRTR     (LLFRIE * 100) / (LSFRCV +        Pct Frames               4    1
              LLFRIE)                          Transmitted
                                               in Error
  PCERRRCV    (LLFRIE * 100) / LSFRCV           Pct Frames               4    1
                                               Received
                                               in Error
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
                                  IBM Query/400                    11/17/96   20:16:27        Page    2
Result fields (continued)
  Name        Expression                       Column Heading         Len  Dec
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  LDNWI           10        A           1      Network interface description
  DATE            20        A
  TIME            30        A
  LINEUTILT
  LINEUTILR
  PCERRTR
  PCERRRCV
  LPLOFA                                       Loss of frame alignment
  LPLECV                                       Local end code violation
  LPDTSI                                       Detected access transmission error in
  LPDTSO                                       Detected access transmission error out
  LPFECV                                       Far end code violation
  LPES                                         Errored seconds
  LPSES                                        Severely errored seconds
  LPCOL                                        Collision detect
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  LDNWI                      0        Network                 10
                                      Interface
                                      Descr
  DATE                       2        Date                     5
  TIME                       2        Time                     5
  LINEUTILT       2 4        2        Trn                      4    1
                                      Line
                                      Util
  LINEUTILR       2 4        2        Rcv                      4    1
                                      line
                                      Util
  PCERRTR         2 4        2        Pct Frm                  4    1
                                      Trnd
                                      in Err
  PCERRRCV        2 4        2        Pct Frm                  4    1
                                      Rcv
                                      in Err
```

Figure 218. NWI_ERRORS Query Definition, Part 1

```
                                  IBM Query/400                      11/17/96   20:16:27         Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field            Summary    Column                                 Dec  Null        Dec  Numeric
  Name             Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  LPLOFA                      2        Loss of                  11    0
                                       Frame
                                       Alignment
  LPLECV                      2        Local                    11    0
                                       End code
                                       Violation
  LPDTSI                      2        Detect Acc               11    0
                                       Transm
                                       Error In
  LPDTSO                      2        Detect Acc               11    0
                                       Transm
                                       Error Out
  LPFECV                      2        Far                      11    0
                                       End code
                                       Violation
  LPES                        2        Errd                      5    0
                                       Secs
  LPSES                       2        Svr                       5    0
                                       Errd
                                       Secs
  LPCOL                       2        Collision                11    0
                                       Detect
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for NWI &ldnwi
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
                                  IBM Query/400                      11/17/96   20:16:27         Page    4
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 178
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
               * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 219. NWI_ERRORS Query Definition, Part 2

H.4 NWI_IOP

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:16:55        Page    1
  Query . . . . . . . . . . . . . . . . NWI_IOP
    Library . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . NWI and IOP related performance fields
  Query CCSID . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . No (default)
    Ignore substitution warnings  . . . Yes
    Use collating for all compares  . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMLAPD       QPFRDATA      Q963121422    QAPMLPDR
  T02    QAPMCIOP       QPFRDATA      Q963121422    QAPMCIOR
Join tests
  Type of join  . . . . . . . . . . . . Matched records
  Field             Test              Field
  T01.INTNUM        EQ                T02.INTNUM
  T01.IOPRN         EQ                T02.IOPRN
Result fields
  Name        Expression                         Column Heading          Len  Dec
  DATE        substr(T01.DTETIM,3,2) || '/' ||   Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||   Time
              substr(T01.DTETIM,9,2)
                                  IBM Query/400                    11/17/96   20:16:55        Page    2
Result fields (continued)
  Name        Expression                         Column Heading          Len  Dec
  IOPUTIL     100 - ((CIIDLC * CIIDLT) /         Pct IOP                   4    1
              (1000000 * T02.INTSEC))            Util
  IOPNAME     T01.IOPRN                          IOP Name
  NWINAME     T01.LDNWI                          Network
                                                 Interface
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  IOPNAME         10        A           1
  T02.CITYPE                                   IOP Type
  NWINAME         20        A           2
  DATE
  TIME
  IOPUTIL
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  IOPNAME                    0        IOP Name                 10
  T02.CITYPE                 2        IOP                       4
                                      Type
  NWINAME                    2        Network                  10
                                      Interface
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  IOPUTIL         2 4        2        Pct IOP                   4    1          4    1
                                      Util
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for IOP &iopname
  2      No    No         Summary for NWI &nwiname
```

Figure 220. NWI_IOP Query Definition, Part 1

```
                                   IBM Query/400                    11/17/96   20:16:55        Page    3
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 221. NWI_IOP Query Definition, Part 2

H.5 NWI_LAPD

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   21:16:45        Page    1
  Query . . . . . . . . . . . . . . . . . NWI_LAPD
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . ISDN NWI related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMLAPD       QPFRDATA      Q963121422    QAPMLPDR
Result fields
  Name        Expression                        Column Heading          Len  Dec
  LINEUTILT   (LSBTRN * 800) / INTSEC /LDLSP    Transmit                  4    1
                                                Line
                                                Util
  LINEUTILR   (LSBRCV * 800) / INTSEC /LDLSP    Receive                   4    1
                                                line
                                                Util
  PCERRTR     (LlFRIE * 100) / (LSFRCV +        Pct Frames                4    1
              LLFRIE)                           Trnsmitd
                                                in Error
  PCERRRCV    (LLFRIE * 100) / LSFRCV           Pct Frames                4    1
                                                Recd
                                                in Error
  DATE        substr(DTETIM,3,2) || '/' ||      Date
              substr(DTETIM,5,2)
                                  IBM Query/400                    11/17/96   21:16:45        Page    2
Result fields (continued)
  Name        Expression                        Column Heading          Len  Dec
  TIME        substr(DTETIM,7,2) || ':' ||      Time
              substr(DTETIM,9,2)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  LDNWI           10        A           1      Network interface description
  DATE            20        A
  TIME            30        A
  LINEUTILT
  LSBTRN                                       Bytes transmitted
  LSFTRN                                       Frames transmitted
  PCERRTR
  LINEUTILR
  LSBRCV                                       Bytes received
  LSFRCV                                       Frames received
  PCERRRCV
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  LDNWI                      0        Network                  10
                                      Interface
                                      Descr
  DATE                       2        Date                      5
  TIME                       2        Time                      5
  LINEUTILT       2 4        2        Trn                       4    1
                                      Line
                                      Util
  LSBTRN                     2                                 11    0
                                      Bytes
                                      Transmtd
  LSFTRN                     2                                 11    0
                                      Frames
                                      Transmtd
  PCERRTR         2 4        2        Pct Frm                   4    1
                                      Trnd
                                      in Err
  LINEUTILR       2 4        2        Rcv                       4    1
                                      line
                                      Util
```

Figure 222. NWI_LAPD Query Definition, Part 1

```
                                  IBM Query/400                     11/17/96   21:16:45         Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                                  Dec  Null        Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  LSBRCV                     2                                 11    0
                                      Bytes
                                      Rcvd
  LSFRCV                     2                                 11    0
                                      Frames
                                      Rcvd
  PCERRRCV        2 4        2        Pct Frm                   4    1
                                      Rcvd
                                      in Err
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for NWI &ldnwi
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
                                  IBM Query/400                     11/17/96   21:16:45         Page    4
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 223. NWI_LAPD Query Definition, Part 2

H.6 IDLC_ALL

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:17:43        Page    1
  Query . . . . . . . . . . . . . . . . IDLC_ALL
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . All NWI performance fields
  Query CCSID . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . US
  Collating sequence  . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMIDLC       QPFRDATA      Q962981049    QAPMIDLR
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  INTNUM          20        A                  Interval number
  DTETIM                                       Interval date and time: yymmddhhmmss
  INTSEC                                       Elapsed interval seconds
  IOPRN                                        IOP Resource Name
  ISTYPE                                       IOP Type
  ISLND           10        A                  Line description
  ISNWI                                        Network interface description
  ISLSP                                        Line speed: in bits per second
  ISPRCL                                       Protocol: always I-IDLC
  ILCRCE                                       Receive CRC errors
  ILSFE                                        Short frame errors
  ILORUN                                       Receive overrun
  ILURUN                                       Transmit underrun
  ILABRT                                       Aborts received
  ILFRIE                                       Frames received in error
  ISFRT                                        Retransmitted frames
  ISSEQE                                       Sequence errors
                                   IBM Query/400                    11/17/96   20:17:43        Page    2
Ordering of selected fields (continued)
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  ISFTRN                                       Frames transmitted
  ISFRCV                                       Frames received
  ISBTRN                                       Bytes transmitted
  ISBRCV                                       Bytes received
  ISB1                                         B1 channel
  ISB2                                         B2 channel
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count          Overrides
  Field           Summary    Column                                Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap   Len  Pos  Editing
  INTNUM                     0                                  5    0
                                      Itv
                                      Nbr
  DTETIM                     2        Interval                 12
                                      Date
                                      and time
  INTSEC                     2        Elapsed                   7    0
                                      Itv
                                      Seconds
  IOPRN                      2        IOP                      10
                                      Resource
                                      Name
  ISTYPE                     2                                  4
                                      IOP
                                      Type
  ISLND                      2                                 10
                                      Line
                                      Descr
  ISNWI                      2        Network                  10
                                      Interf
                                      Descr
  ISLSP                      2                                 11    0
                                      Line
                                      Speed
  ISPRCL                     2                                  1
                                      Prot
  ILCRCE                     2        Receive                  11    0
                                      CRC
                                      Errors
  ILSFE                      2        Short                    11    0
                                      Frame
                                      Errors
```

Figure 224. IDLC_ALL Query Definition, Part 1

```
                                 IBM Query/400                      11/17/96   20:17:43         Page    3
Report column formatting and summary functions (continued)
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings         Len  Pos  Cap    Len  Pos  Editing
  ILORUN                     2                                 11    0
                                      Receive
                                      Overrun
  ILURUN                     2                                 11    0
                                      Transmit
                                      Underrun
  ILABRT                     2                                 11    0
                                      Aborts
                                      Received
  ILFRIE                     2        Frames                   11    0
                                      Received
                                      In error
  ISFRT                      2                                 11    0
                                      Retransmtd
                                      Frames
  ISSEQE                     2                                 11    0
                                      Sequence
                                      Errors
  ISFTRN                     2                                 11    0
                                      Frames
                                      Transmtd
  ISFRCV                     2                                 11    0
                                      Frames
                                      Received
  ISBTRN                     2                                 11    0
                                      Bytes
                                      Transmtd
  ISBRCV                     2                                 11    0
                                      Bytes
                                      Received
  ISB1                       2                                  1    0
                                      B1
                                      Ch
  ISB2                       2                                  1    0
                                      B2
                                      Ch
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
                                 IBM Query/400                      11/17/96   20:17:43         Page    4
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 312
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 225. IDLC_ALL Query Definition, Part 2

H.7 IDLC_IOP

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:18:06        Page    1
  Query . . . . . . . . . . . . . . . . . IDLC_IOP
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . NWI and IOP related performance fields
  Query CCSID . . . . . . . . . . . . . .     37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMIDLC       QPFRDATA      Q963121422    QAPMIDLR
  T02    QAPMCIOP       QPFRDATA      Q963121422    QAPMCIOR
Join tests
  Type of join  . . . . . . . . . . . . . Matched records
  Field              Test              Field
  T01.INTNUM         EQ                T02.INTNUM
  T01.IOPRN          EQ                T02.IOPRN
Result fields
  Name        Expression                         Column Heading          Len  Dec
  DATE        substr(T01.DTETIM,3,2) || '/' ||   Date
              substr(T01.DTETIM,5,2)
  TIME        substr(T01.DTETIM,7,2) || ':' ||   Time
              substr(T01.DTETIM,9,2)
                                  IBM Query/400                    11/17/96   20:18:06        Page    2
Result fields (continued)
  Name        Expression                         Column Heading          Len  Dec
  IOPUTIL     100 - ((CIIDLC * CIIDLT) /         Pct IOP                   4    1
              (1000000 * T02.INTSEC))            Util
  IOPNAME     T01.IOPRN                          IOP Name
  NWINAME     T01.ISNWI                          Network
                                                 Interface
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  IOPNAME         10        A           1
  T02.CITYPE                                   IOP Type
  NWINAME         20        A           2
  DATE
  TIME
  IOPUTIL
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                             Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  IOPNAME                    0        IOP Name                10
  T02.CITYPE                 2        IOP                      4
                                      Type
  NWINAME                    2        Network                 10
                                      Interface
  DATE                       2        Date                     5
  TIME                       2        Time                     5
  IOPUTIL         2 4        2        Pct IOP                  4    1          4    1
                                      Util
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for IOP &iopname
  2      No    No         Summary for NWI &nwiname
                                  IBM Query/400                    11/17/96   20:18:06        Page    3
```

Figure 226. IDLC_IOP Query Definition, Part 1

```
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 227. IDLC_IOP Query Definition, Part 2

H.8 IDLC_UTIL

```
5716QU1  V3R6M0  950929           IBM Query/400           SYSTEM01 11/17/96   20:18:29        Page    1
  Query . . . . . . . . . . . . . . . . . IDLC_UTIL
    Library . . . . . . . . . . . . . . . MYLIB
  Query text  . . . . . . . . . . . . . . ISDN NWI related performance fields
  Query CCSID . . . . . . . . . . . . . .    37
  Query language id . . . . . . . . . . . ENU
  Query country id  . . . . . . . . . . . US
    *** . is the decimal separator character for this query ***
  Collating sequence  . . . . . . . . . . Hexadecimal
  Processing options
    Use rounding  . . . . . . . . . . . . Yes (default)
    Ignore decimal data errors  . . . . . No (default)
    Ignore substitution warnings  . . . . Yes
    Use collating for all compares  . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
  ID     File           Library       Member        Record Format
  T01    QAPMIDLC       QPFRDATA      Q963121422    QAPMIDLR
Result fields
  Name        Expression                      Column Heading          Len  Dec
  LINEUTILT   (ISBTRN * 800) / INTSEC /ISLSP     Transmit                  4    1
                                              Line
                                              Util
  LINEUTILR   (ISBRCV * 800) / INTSEC /ISLSP     Receive                   4    1
                                              line
                                              Util
  PCERRTR     (ILFRIE * 100) / (ISFRCV +      Pct Frames                4    1
              ILFRIE)                         Trnsmitd
                                              in Error
  PCERRRCV    (ILFRIE * 100) / ISFRCV         Pct Frames                4    1
                                              Recd
                                              in Error
  DATE        substr(DTETIM,3,2) || '/' ||    Date
              substr(DTETIM,5,2)
                                  IBM Query/400                    11/17/96   20:18:29        Page    2
Result fields (continued)
  Name        Expression                      Column Heading          Len  Dec
  TIME        substr(DTETIM,7,2) || ':' ||    Time
              substr(DTETIM,9,2)
Ordering of selected fields
  Field           Sort      Ascending/  Break  Field
  Name            Priority  Descending  Level  Text
  DATE            20        A
  TIME            30        A
  LINEUTILT
  LINEUTILR
  ISFTRN                                       Frames transmitted
  PCERRTR
  ISFRCV                                       Frames received
  PCERRRCV
Report column formatting and summary functions
  Summary functions:  1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count           Overrides
  Field           Summary    Column                              Dec  Null       Dec  Numeric
  Name            Functions  Spacing  Column Headings        Len  Pos  Cap   Len  Pos  Editing
  DATE                       0        Date                     5
  TIME                       2        Time                     5
  LINEUTILT       2 4        2        Transmit                 4    1
                                      Line
                                      Util
  LINEUTILR       2 4        2        Receive                  4    1
                                      line
                                      Util
  ISFTRN                     2                                11    0
                                      Frames
                                      Transmitted
  PCERRTR         2 4        2        Pct Frames               4    1
                                      Trnsmitd
                                      in Error
  ISFRCV                     2                                11    0
                                      Frames
                                      Received
  PCERRRCV        2 4        2        Pct Frames               4    1
                                      Recd
                                      in Error
```

Figure 228. IDLC_UTIL Query Definition, Part 1

```
                                  IBM Query/400                    11/17/96   20:18:29        Page    3
Report breaks
  Break  New   Suppress   Break
  Level  Page  Summaries  Text
  0      No    Yes
  1      No    No         Summary for NWI &ldnwi
Selected output attributes
  Output type . . . . . . . . . . . . . . Printer
  Form of output  . . . . . . . . . . . . Detail
  Line wrapping . . . . . . . . . . . . . No
Printer Output
  Printer device  . . . . . . . . . . . . *PRINT
  Report size
    Length  . . . . . . . . . . . . . . .  66 (default)
    Width . . . . . . . . . . . . . . . . 132
  Report start line . . . . . . . . . . .   6 (default)
  Report end line . . . . . . . . . . . .  60 (default)
  Report line spacing . . . . . . . . . . Single space
  Print definition  . . . . . . . . . . . No
Printer Spooled Output
  Spool the output  . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Form type . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
  Copies  . . . . . . . . . . . . . . . .   1
  Hold  . . . . . . . . . . . . . . . . . (Defaults to value in print file, QPQUPRFIL)
Cover Page
  Print cover page  . . . . . . . . . . . No
    Cover page title
Page headings and footings
  Print standard page heading . . . . . . Yes
    Page heading
    Page footing
                                  IBM Query/400                    11/17/96   20:18:29        Page    4
                   * * * * *   E N D   O F   Q U E R Y   P R I N T   * * * * *
```

Figure 229. IDLC_UTIL Query Definition, Part 2

Appendix I. Guidelines for Interpreting Performance Data

Table 16. Resource Utilization Guidelines

Resource Description	Good	Acceptable	Poor
CPU 1 Processor (1)	<0.70	0.70-0.80	0.80<
CPU 2 Processors (1)	<0.76	0.76-0.83 (2)	0.83< (2)
CPU 3 Processors (1)	<0.79	0.79-0.85 (2)	0.85< (2)
CPU 4 Processors (1)	<0.81	0.81-0.86 (2)	0.86< (2)
DISK ARM	<0.40	0.40-0.50	0.50<
DISK IOP	<0.60	0.70	0.80<
IOP Local	<0.25	0.35	0.40<
IOP Multifunction	<0.35	0.45	0.50<
IOP Communications	<0.35	0.45	0.50<
IOP Lan (Interactive)	<0.35	0.40	0.50<
LINE Remote (Interactive)	<0.30	0.35	0.40<
FSIOP Read/Write Cache Hit (3)	>0.90	0.90	0.90<
FSIOP OS/2 CPU Utilization (3)	<0.80	0.80	0.80<

Note:

1. This refers to CPU utilization of jobs whose priorities are equal to or higher than the interactive job priorities.
2. In a multiple processor environment, the guidelines are more sensitive to exceeding the values specified in the ″good″ column.
3. You need to query the file QAPMIOPD to obtain these values. See the index entry for *Integrated PC Server* for sample queries.

Table 17. Machine Pool, Non-Database Page Faults

Main Storage Size	Good	Acceptable	Poor
All Systems	<10	10-15	15<

Table 18. Sum of Database and Non-Database Page Faults for Each Pool

Model	Good	Acceptable	Poor
9402 mod400 2130 2131 2132 2133	<50	50-100	100<
9406 mod500 2140 2141	<50	50-100	100<
9406 mod510 2144, 9406 mod530 2150, 50S 2121	<150	150-300	300<
9406 mod530 2151 2152 2153, 53S 2154 2155 2156	<200	200-325	325<

Table 19. Sum of Database and Non-Database Page Faults in All Pools

Model	Good	Acceptable	Poor
9402 mod400 2130 2131 2132 2133	<75	75-125	125<
9406 mod500 2140 2141	<75	75-125	125<
9406 mod500 2142 2143, 40S 2110, 50S 2120	<150	150-350	350<
9406 mod510 2144, 9406 mod530 2150, 50S 2121	<300	300-600	600<
9406 mod530 2151 2152 2153, 53S 2154 2155 2156	<400	400-650	650<

Table 20. Ratio of Wait-to-Ineligible/Active-to-Wait

Good	Acceptable	Poor
<.1	.1-.25	.25<

*Table 21. Initial Settings for Pool Size and Activity Level When QBATCH Jobs are Running in *BASE*

Main Storage Size (MB)	*Base Pool size (KB)/ Activity Level	*Interact Pool Size (KB)/Activity Level
<96	18340/9	42800/21
128	25930/9	60503/20
256	61690/21	14394/48
288	68170/13	159063/32
480	121810/24	284223/57
512	127990/17	298643/62
768	199510/26	465523/62
800	205450/18	479383/43
1024<	268030/24	625403/57

Note: When investigating server models, use the opposite values for the (*BASE) and (*INTERACT).

For example, for 1024MB, use initial setting 625403/57 for *BASE and initial setting 268030/24 for *INTERACT

Table 22. QINTER Activity Level Factor

Main Storage Size (MB)	Activity Level Factor (KB)
< 96	2000
128 - 256	3000
288 - 480	5000
512 - 768	7500
800 - 1024	11000
1024 <	15000

Table 23. QSPL Pool Sizes and Activity Levels for Advanced Function Printers

Number of Writers	Initial Size (KB)	Activity Levels
1	1500	1
2	1700	2
3	1900	3
4	2100	4
4 <	2300	5

Note: If extensive use of AFP page segments and overlays are used, set the storage pool to 4MB (4000KB).

Table 24. QSPL Pool Sizes and Activity Levels for Non-Advanced Function Printers

Number of Writers	Initial Size (KB)	Activity Level
1	256	1
2	256	2
3	256	3
4	292	4
4 <	352	5

Table 25. Batch Job Storage Guidelines

Batch Job Type	Initial Storage (KB)	Comments
Short-Running Production	1250	May run in 800KB; may require as much as 1750KB
Long-Running Production	2500	May run in 1250KB; may require as much as 3500KB
Compiles	16000	May run in 12000KB; runs better in 32000KB
Reformat (Sort)	2000	Smaller sorts may run in 1500KB; larger sorts may use 3000KB
Queries	2000	Small queries run in 1500KB; larger queries may use up to 4000KB
Save/Restore	2000	Some SAVE operations run in 1000KB; others may need 6000KB for maximum throughput.

*Table 26. Authority Lookup Exceptions versus CPU % Cost - ILE DFTAG(*NO) or OPM*

Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
25	13	9	6	5	9	6	4	2	2	1	1	1	0
50	26	17	12	9	17	12	9	5	4	3	2	1	1
100	52	34	24	18	34	24	17	10	7	6	5	3	2
300			71	56		71	52	30	22	18	14	9	6
500				92			86	50	37	30	23	15	10
700								70	52	42	32	21	14
1000								99	74	59	45	29	19
2000											90	59	39
3000												88	58
4000													77
5000													97
6000													

*Table 27. Authority Lookup Exceptions vs. CPU % Cost - ILE DFTAG(*YES) (with *CALLER AG in Called Program)*

Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
5	87	58	40	31	58	40	29	17	12	10	8	5	3
10			80	62		80	58	34	25	20	15	10	7
15				94			87	50	37	30	23	15	10
20								67	50	40	31	20	13
25								84	62	50	38	25	16
30									75	60	46	30	20
35									87	70	53	35	23
40									99	80	61	40	26
45										90	69	45	29
50											76	50	33
100												99	65
150													98

Table 28. Size Exceptions versus CPU % Cost - OPM													
Exceptions per second	**2130**	**2131**	**2132**	**2133**	**2140**	**2141**	**2142**	**2143**	**2144**	**2150**	**2151**	**2152**	**2153**
10	26	17	12	9	17	12	9	5	4	3	2	1	1
20	52	34	24	18	34	24	17	10	7	6	5	3	2
30	77	52	35	28	52	35	26	15	11	9	7	4	3
40		69	47	37	69	47	34	20	15	12	9	6	4
50		86	59	46	86	59	43	25	18	15	11	7	5
100				92			86	50	37	30	23	15	10
200								99	74	60	45	29	19
300										89	68	44	29
400											90	59	39
500												74	48
600												88	58
700													68
800													77
900													87
1000													97

Table 29. Size Exceptions versus CPU % Cost - ILE DFTAG(*YES)													
Exceptions per second	**2130**	**2131**	**2132**	**2133**	**2140**	**2141**	**2142**	**2143**	**2144**	**2150**	**2151**	**2152**	**2153**
1000	15	9	7	5	10	7	5	3	2	2	1	1	1
2000	30	20	14	11	20	14	10	6	4	3	3	2	1
3000	44	30	20	16	30	20	15	9	6	5	4	3	2
4000	59	39	27	21	39	27	20	11	8	7	5	3	2
5000	74	49	34	27	49	34	25	14	11	9	6	4	3
10000		99	68	53	99	68	49	29	21	17	13	8	6
15000				80			74	43	32	26	19	13	8
20000							99	57	42	34	26	17	11
25000								71	53	43	32	21	14
30000								86	63	51	39	25	17
35000								100	74	60	45	30	19
40000									85	68	52	34	22
45000									95	77	58	38	25
50000										85	65	42	28
55000										94	71	46	31

Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
1000	11	7	5	4	7	5	4	2	2	1	1	1	0
2000	22	15	10	8	15	10	7	4	3	3	2	1	1
3000	34	22	15	12	22	15	11	6	5	4	3	2	1
4000	45	30	21	16	30	21	15	9	6	5	4	3	2
5000	56	37	26	20	37	26	19	11	8	6	5	3	2
10000		75	51	40	75	51	37	22	16	13	10	6	4
15000			77	60		77	56	32	24	19	15	10	6
20000				80			75	43	32	26	20	13	8
25000							93	54	40	32	25	16	10
30000								65	48	39	29	19	13
35000								76	56	45	34	22	15
40000								86	64	52	39	26	17
45000								97	72	58	44	29	19
50000									80	65	49	32	21
55000									88	71	54	35	23

*Table 30. Size Exceptions versus CPU % Cost - ILE DFTAG(*NO)*

Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
25	13	9	6	5	9	6	4	3	2	2	1	1	0
50	26	17	12	9	17	12	9	5	4	3	2	1	1
100	52	35	24	19	35	24	17	10	7	6	5	3	2
300			72	56		72	52	30	22	18	14	9	6
500				93			87	50	37	30	23	15	10
700								70	52	42	32	21	14
900								90	67	54	41	27	18
1000									74	60	46	30	20
2000											91	59	39
3000												89	59
4000													78
5000													98

Table 31. Verify Exceptions versus CPU % Cost - OPM

*Table 32. Verify Exceptions versus CPU % Cost - ILE DFTAG(*YES)*													
Exceptions per second	**2130**	**2131**	**2132**	**2133**	**2140**	**2141**	**2142**	**2143**	**2144**	**2150**	**2151**	**2152**	**2153**
25	13	8	6	5	8	6	4	2	2	1	1	1	0
50	25	17	12	9	17	12	8	5	4	3	2	1	1
100	50	34	23	18	34	23	17	10	7	6	4	3	2
300			70	54		69	50	29	22	17	13	9	6
500				90			84	49	36	29	22	14	9
700								68	50	41	31	20	13
900								88	65	52	40	26	17
1000								97	72	58	44	29	19
2000											88	58	38
3000												86	57
4000													76
5000													94

*Table 33. Verify Exceptions versus CPU % Cost - ILE DFTAG(*NO)*													
Exceptions per second	**2130**	**2131**	**2132**	**2133**	**2140**	**2141**	**2142**	**2143**	**2144**	**2150**	**2151**	**2152**	**2153**
25	13	9	6	5	9	6	4	2	2	2	1	1	0
50	26	17	12	9	17	12	9	5	4	3	2	1	1
100	52	34	24	18	34	24	17	10	7	6	5	3	2
300			71	55		71	52	30	22	18	14	9	6
500				92			86	50	37	30	23	15	10
700								70	52	42	32	21	14
900								89	66	54	41	26	17
1000								99	74	59	45	29	19
2000											90	59	39
3000												88	58
4000													77
5000													97

Table 34. Queuing Multiplier Based on CPU Utilization				
u%	**QM (1 Processor)**	**QM (2 Processors)**	**QM (3 Processors)**	**QM (4 Processors)**
70	3.33	1.96	1.52	1.32
75	4.00	2.29	1.73	1.46
80	5.00	2.78	2.05	1.69
85	6.66	3.60	2.59	2.09
90	10.00	5.26	3.69	2.91
95	20.00	10.25	7.01	5.39
Note: As the Queuing Multiplier increases above 4, performance problems with the resource (CPU) should be expected. This is a conservative guideline as multi-processors can deliver acceptable performance with higher Queuing Multiplier values. PRTTNSRPT - Job Summary report shows CPU Queuing Multiplier.				

The contents of Table 35 should be viewed as ″indicators″ that the associated job must be analyzed for the reasonability of the work being done. For example, a job may be updating two sets of similar database data. This can cause the count of physical I/Os to be high. If this double updating is actually required, exceeding the database I/O guidelines must be accepted.

Table 35. Disk Physical I/O per Transaction Guidelines		
Type of Synchronous I/O	**Number of I/Os - Internal Disk(*)**	**Number of I/Os - 9337(*)**
DB Reads	20 or less	25 or less
DB Writes	10 or less	13 or less
Total I/O	50 or less	65 or less
Note: (*) Depending on your data access patterns, the 9337 DASD read ahead buffers and the 6501, 6530, and 6502 disk controller write cache support may support higher disk I/O rates satisfactorily.		

Table 36. Job Activity and Disk I/O Cross Reference Chart				
Job Activity	**Physical I/O Type**	**Logical I/O Type**	**Fault Type**	**I/O Counted In:**
Read a record randomly	S-DBR	Read	DB	Job
Read a record sequentially	A-DBR	Read		Job
Search access path	S-DBR	Other	DB	Job
Re-page a record	S-DBR		DB	Job
Update a record	A-DBW	Other		Job
Add a record	A-DBW	Write		Job
Delete a record	A-DBW	Other		Job
Update a record (Force Write Rat > 0)	S-DBW	Other		Job
Add a record (FWR > 0)	S-DBW	Write		Job
Delete a record (FWR > 0)	S-DBW	Other		Job
Open a file	S-NDBR		NDB	Job
Close a file	S-DBW			Job
Journaling	S-NDBW			Job
Get a user program	S-NDBR		NDB	Job
Re-page a user program	S-NDBR		NDB	Job
Get a system (LIC) program	S-NDBR			Job
Read the PAG	S-NDBR		NDB if purge is *NO	Job
Re-page the PAG	S-NDBR		NDB	Job
Write the PAG	S-NDBW			Job (PURGE(*YES) only)
Read a data area/data queue	S-NDBR		NDB	Job
Read a subfile	S-NDBR		NDB	Job
Modify a source member using SEU	S-NDBR		NDB	Job
Display messages	S-NDBR		NDB	Job
PCS File Transfer to AS/400	S-NDBR/ S-DBW		NDB	PCS
PCS File Transfer from AS/400	S-NDBR		NDB	PCS
PCS Shared Folders	S-NDBW/ A-NDBW			System

The contents of Table 37 includes average disk service time, internal lab batch benchmark run time, and Ops/Sec/GB guideline values that can be used as a reference when considering upgrading to newer disk configurations and manually modeling batch job run time based on disk I/O operations.

Using BEST/1 is still recommended for capacity planning, although you have to do additional calculations for estimating batch job run time. The table is an excerpt from the *Performance Capabilities Reference* manual.

Table 37. Disk Service, Batch Run Time, Ops per Second per GB

Disk Model and IOP	**GB of Storage per Arm**	**Typical Service Time**	**Batch Runtime (Hrs)**	**Batch Non-RAID Ops/Sec per GB**	**Batch RAID Ops/Sec per GB**
9337-010 with 6500	.542	19.0	5.6	39	NA
9337-015 with 6500	.542	15.0	5.2	49	NA
9337-020 with 6500	.970	19.0	5.6	22	NA
9337-025 with 6500	.970	16.6	5.2	25	NA
9337-040 with 6500	1.967	17.1	5.2	12	NA
9337-110 with 6500	.407	19.0	7.8	NA	23
9337-115 with 6500	.407	15.0	7.2	NA	30
9337-120 with 6500	.728	19.0	7.8	NA	13
9337-125 with 6500	.728	16.6	7.2	NA	15
9337-140 with 6500	1.475	17.1	7.2	NA	07
9337-210 with 6501	.542	12.1	4.3	51	38
9337-215 with 6501	.542	09.5	4.0	66	49
9337-220 with 6501	.970	12.1	4.3	29	21
9337-225 with 6501	.970	10.7	4.0	33	24
9337-240 with 6501	1.967	11.0	4.0	16	12
9337-420 with 6501	.970	10.0	3.8	38	34
9337-440 with 6501	1.967	08.6	3.5	22	20
9337-480 with 6501	4.194	08.9	3.6	10	09
320MB with 6530	.320	17.7	5.8	71	NA
400MB with 6530	.400	16.6	5.7	60	NA
988MB with 6530	.988	15.6	5.4	26	NA
6602 with 6530	1.031	13.5	4.4	29	NA
6603 with 6530	1.967	14.0	4.4	15	NA
6606 with 6530	1.967	11.5	4.0	18	NA
6607 with 6530	4.194	11.9	4.0	08	NA
320MB with 6502	.320	17.7	5.8	71	NA
400MB with 6502	.400	16.6	5.7	60	NA
988MB with 6502	.988	15.6	5.4	26	NA
6602 with 6502	1.031	10.1	3.9	34	28
6603 with 6502	1.967	10.5	3.9	17	14
6606 with 6502	1.967	08.7	3.6	21	17
6607 with 6502	4.194	09.0	3.6	09	08
2800	.320	19.5	5.9	64	NA
2801	.988	16.8	5.3	24	NA
2802	1.031	13.5	5.0	29	NA

Note:

- NA indicates "not applicable" as under the RAID heading where disk configurations do not support RAID-5.
- The preceding figures are averages with the disks at approximately 40% busy.

  The preceding values were derived from a Rochester lab unique batch application and do not include all test results. The *Performance Capabilities Reference* manual contains the complete test results.
- Note that the 6502 (internal) and 6501 (external IOP) have 2MB and 4MB write caches which enable a significant number of application output operations to be performed per physical I/O operation.
- For both the 9337-4xx and the 6606 and 6607 disk, the non-RAID-5 and RAID-5 physical disk I/O guidelines are close to each other.
- The service times shown are in milliseconds for non-RAID-5 configurations. When RAID-5 is used, add 2 milliseconds to service time for a reasonable approximation.

Appendix J. Special Notices

This publication provides an explanation to enable a better understanding of AS/400 communications and networking performance. It is also intended to help customers, IBM system engineers, and IBM business partners who want to tune the IBM AS/400 system to improve communications performance. The information in this publication is not intended as the specification of any programming interfaces that are provided by the AS/400 Performance Tools, 5716-PT1, or the AS/400 Query/400, 5716-QU1. See the PUBLICATIONS section of the IBM Programming Announcement for the AS/400 Performance Tools, 5716-PT1, and AS/400 Query/400, 5716-QU1 for more information about which publications are considered to be product documentation.

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Appendix K. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

K.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see “How to Get ITSO Redbooks” on page 393.

- *AS/400 Client/Server Performance using the Windows Client*, SG24-4526-01
- *AS/400 Performance Management V3R6/V3R7*, SG24-4735

K.2 Redbooks on CD-ROMs

Redbooks are also available on CD-ROMs. **Order a subscription** and receive updates 2-4 times a year at significant savings.

CD-ROM Title	Subscription Number	Collection Kit Number
System/390 Redbooks Collection	SBOF-7201	SK2T-2177
Networking and Systems Management Redbooks Collection	SBOF-7370	SK2T-6022
Transaction Processing and Data Management Redbook	SBOF-7240	SK2T-8038
AS/400 Redbooks Collection	SBOF-7270	SK2T-2849
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Application Development Redbooks Collection	SBOF-7290	SK2T-8037
Personal Systems Redbooks Collection	SBOF-7250	SK2T-8042

K.3 Other Publications

These publications are also relevant as further information sources.

- *AS/400 Work Management Guide*, SC41-4306
- *AS/400 Performance Tools/400*, SC41-3340
- *Query/400 User's Guide*, SC41-9614-02
- *AS/400 BEST/1 Capacity Planning Tool*, SC41-3341
- *AS/400 LAN and Frame Relay Suppot*, SC41-3404
- *AS/400 Communications Management*, SC41-3406
- *AS/400 ISDN Suppot*, SC41-4403
- *ISDN Data Link Control Architecture Reference*, SC31-6826
- *ISDN Circuit Switched Signaling Control Architecture Reference*, SC31-6827

The following publication is an internal use only document. Only IBM systems engineers and business partners are authorized to obtain this document. The SE and business partner are responsible for determining what information from this document may be shared with a specific customer.

- *AS/400 Programming: Version 3 Release 1 Performance Capabilities Reference*, ZC41-8166

This document contains internal laboratory performance test results that are helpful in setting reasonable expectations and understanding the relationship between system resources and certain system parameter values.

This manual also lists OS/400 and many licensed program module names. The *System Support Diagnostic Aids (Volume 1)*, LY44-0597 (available to IBM licensed customers only), lists Licensed Internal Code (LIC) tasks.

How to Get ITSO Redbooks

This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

This information was current at the time of publication, but is continually subject to change. The latest information may be found at http://www.redbooks.ibm.com.

How IBM Employees Can Get ITSO Redbooks

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- **GOPHER link to the Internet** - type GOPHER.WTSCPOK.ITSO.IBM.COM
- **Tools disks**

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  ```
  TOOLS SENDTO EHONE4 TOOLS2 REDPRINT GET SG24xxxx PACKAGE
  TOOLS SENDTO CANVM2 TOOLS REDPRINT GET SG24xxxx PACKAGE (Canadian users only)
  ```

  To get BookManager BOOKs of redbooks, type the following command:

  ```
  TOOLCAT REDBOOKS
  ```

  To get lists of redbooks, type one of the following commands:

  ```
  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET ITSOCAT TXT
  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET LISTSERV PACKAGE
  ```

  To register for information on workshops, residencies, and redbooks, type the following command:

  ```
  TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ITSOREGI 1998
  ```

  For a list of product area specialists in the ITSO: type the following command:

  ```
  TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ORGCARD PACKAGE
  ```

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