VMware vFabric Postgres Standard Edition User Guide

vFabric Postgres Standard Edition 1.0

vFabric Data Director 1.0

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About This Book

The *VMware vFabric Postgres Standard Edition User Guide* provides information about using vPostgres databases with VMware® vFabric™ Data Director, including getting started with application development for Data Director, VMware customizations to the Postgres relational database, Postgres SQL for Data Director, using Postgres client tools, connecting to Data Director, and unsupported Postgres features.

Intended Audience

This book is intended for anyone who wants to develop applications that take advantage of the Data Director DBaaS platform. The information in this book is written for experienced DBAs and application developers who are familiar with administering, using, and developing applications for, Postgres databases.

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Introduction to VMware vFabric Postgres

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VMware vFabric Postgres (vPostgres) is an ACID-compliant, ANSI-SQL-compliant transactional, relational database designed for the virtual environment and optimized for vSphere. It is based on the Postgres open-source relational database and is compatible with Postgres SQL (psql) and the PostgreSQL tools and client drivers. Its features include elastic database memory, database-aware high availability, and automated optimal database configuration.

You can create, run, and manage vPostgres databases using the Data Director administration UI, or use client tools to connect to vPostgres databases, load data, run scripts, perform backups, and run applications.

This documentation focuses on using the client database tools to interact with vPostgres. The following assumptions apply to using this documentation.

- vFabric Data Director is installed and running.
- You know how to connect to Data Director and are familiar with the UI.
- You are familiar with Postgres and psql.
- Your database server is running.
- You are familiar with JDBC and/or ODBC, and programming languages such as Java.

VMware Customizations for Postgres 2

vFabric Postgres contains enhancements and customizations for Data Director, discussed in this chapter.

Differences Between vFabric Postgres and Postgres Databases

vFabric Postgres databases integrate VMware virtualization technology. This section describes the differences between standard Postgres databases and vPostgres databases.

You can use the following methods to deploy vPostgres databases.

- Use the vPostgres databases RPM or an installer (Linux only). Using an RPM or installer is an embedded vPostgres deployment. This method installs only vPostgres and its related clients and tools.
- Use vFabric Data Director. Data Director provides the platform that deploys vPostgres virtual machines.

The behavior of vPostgres embedded deployments is closest to the standard Postgres database behavior.

vFabric Postgres Enhancements

The following are vPostgres enhancements to the standard Postgres database.

Elastic Database Memory

Elastic database memory enables vPostgres to run with graceful performance degradation under heavy over-commitment of memory. vPostgres participates in memory resource management with the vSphere guest operating system and vSphere Hypervisor to achieve elastic database memory.

vPostgres monitors requests for memory from vSphere Hypervisor as well as swap activity within the vSphere guest operating system. When Hypervisor or the guest operating system need more memory, the vPostgres buffer manager shrinks the database buffer pool to make memory available. When more memory becomes available, the buffer manager increases the amount of memory dedicated to the buffer pool.

Elastic database memory is enabled by default.

Tuning

vPostgres has higher default values for many critical settings compared with standard Postgres databases, including the settings for shared_buffers, checkpoint_segments, and wal_buffers. The higher default values improve out-of-the-box vPostgres performance with a slight tradeoff in disk space and memory usage. The result is that users of embedded vPostgres databases can more easily tune the database for their workload.

Checksums

vPostgres performs checksums on each write operation to tables or indexes. Performing checksums on each write ensures that when vPostgres retrieves data, that data is clean.

Checksums are enabled by default.

Checkpoints

When you configure checkpoint intervals, you must choose between lower crash recovery time (by using frequent checkpoints) and higher performance (by using less frequent checkpoints). Solving the trade-off problem in the virtualized world is complex because resources alloted to the database virtual machine vary dynamically. vPostgres allows you to configure the required crash-recovery Service Level Agreement (SLA), and tunes the checkpoint parameters dynamically as it monitors performance.

Checkpoint tuning is enabled by default.

Data Director Deployed vPostgres Differences

The following enhancements apply to vPostgres databases deployed using Data Director.

Simplified Configuration

To configure Data Director deployed vPostgres databases, users select a database configuration template, and then customize settings such as name, storage allocation, database owner account, and backup template. Data Director updates the `postgresql.conf` file's tunable parameters.

No Superuser Admin Privileges

Each Data Director database user has only database administrator rights. This means that tools that require superuser privileges, such as COPY FROM, COPY To, and tools that operate on the system catalog, will not work.

No In-line psql Editing

`Psql` does not provide editing help. To provide the ability to edit `psql` in-line, download the stock PostgreSQL `psql` client tool and re-link it with the vPostgres `libpq`.

No pg_dumpall

The `pg_dumpall` tool requires superuser privileges, and does not work with Data Director deployed vPostgres databases.

No CREATE/DROP Database Privileges

Data Director users have privileges only within the database. You cannot use database client tools to create or drop databases. Use the Data Director UI to create and drop databases.

Object Naming

Database names must use alphanumeric characters, underline ('_') or hyphen ('-').

There are no restrictions on object names beyond the standard Postgres object name requirements.

Connection String Format

Data Director uses its DB Name Server virtual machine to route database connections to Data Director deployed vPostgres databases. The connection string has the following format.

```
{UUID}.DBNameService_IP_Address
```

You can obtain the connection string from the Data Director UI, or you can construct the connection string if you know the UUID and DB Name Server host name.

See Chapter 3, “Connecting to vPostgres Databases,” on page 16 for more information.

Getting Started with VMware vFabric Postgres 3

You interact with vFabric Postgres databases (vPostgres databases) using the Postgres based client database tools. The vPostgres client tools enable you to connect to vPostgres databases using the following methods.

- Embedded. Install the vPostgres client tools on your system using RPMs (Linux) or .exe's (Windows).
- Data Director deployed vPostgres databases. Create and manage vPostgres databases using the Data Director Web UI.

This chapter includes the following topics.

About the vPostgres Client Tools

The vPostgres client tools are based upon the Postgres client database tools and are customized for vPostgres. Versions are provided for Linux x86, 32-bit and 64-bit, and for Windows x86, 32-bit and 64-bit.

The following vPostgres client database tools are included in the vPostgres client tools package.

- pg_config. Prints the current vPostgres installation's configuration parameters.
- pg_dump. Backs up vPostgres databases.
- pg_restore. Restores vPostgres databases from archives created by pg_dump.
- psql. The command line-based front end to PostgreSQL.

The vPostgres installer package for Windows includes ODBC and JDBC drivers for vPostgres.

The Linux RPM includes ODBC drivers for vPostgres. The Linux ODBC driver requires unixODBC-2.2.14 or greater.

The vPostgres client tools ship with the following libraries.

- libpq.so (Linux) or libpq.dll (Windows). The C API to PostgreSQL. Libpq is the underlying engine for several PostgreSQL APIs such as those written for C++, Perl, Python, Tcl, and ECPG.
- psqlodbcw.so (Linux) or psqlodbc35w.dll (Windows). The ODBC driver for PostgreSQL.

The provided vPostgres libraries are customized for use with vPostgres databases. Use the provided libraries rather than the standard Postgres libraries. To ensure that you link with the correct libraries, do one of the following.

- If you intend to keep the standard Postgres libraries on your system, ensure that your LD_LIBRARY_PATH environment variable specifies the location of the vPostgres libraries first.
- Remove the standard Postgres libraries and ensure that your LD_LIBRARY_PATH environment variable points to the vPostgres libraries' location on your system.

Install the vPostgres Client Tools

Download the appropriate client tools package for your platform from the VMware download site, `http://www.vmware.com/go/download-datadirector.`

- Windows client tools packages are available for 32-bit and 64-bit systems.
- Linux client tools packages are available for 32-bit and 64-bit systems as follows
  - A JDBC package in ZIP format. The JDBC package provides the JDBC driver and sample code.
  - Client RPMs for 32-bit and 64-bit systems. The client RPMs provide platform-appropriate binaries, ODBC driver, and libraries.
  - Client development RPMs for 32-bit and 64-bit systems. The client development RPMs provide platform-appropriate include files for application development.

If you plan to write code, download the client RPM as well as the client development RPM.

The client tools packages have names similar to the following.

```
VMware-vPostgres-[client | client-devel]-<identifier>-<platform>.[exe | rpm]
```

The <identifier> string identifies the client tools version and build, <platform> is x64 or x86, and [exe | rpm] is the Windows or Linux installer.

Install the client development RPM only if you plan to compile an application to link with libpq. The client development RPM is not needed if you are relinking the libraries dynamically.

- On Linux, run the RPM package using the following command.

  ```
  rpm -ivh <pathToClientRpms> # If you are upgrading, use the -Uvh option
  ```

  Where <pathToClientRpms> is the full pathname of the RPM package location on your system. The default installed location is `/opt/vmware/vpostgres/1.0`.

- On Windows, double-click the .exe file to start the installer. After you accept the license agreement and confirm the install location, installation proceeds. The default installed location is `\Program Files\VMware\vPostgres\1.0\`. If you install the x86 vPostgres client tools on a Windows 64-bit system, the Windows installer places the client tools in `\Program Files (x86)\VMware\vPostgres\1.0\`.

Ensure that your PATH environment variable includes the location of your vPostgres client tools. For example:

```
C:\Program Files\VMware\vPostgres\1.0\bin
```

Locating x86 vPostgres Client Tools Registry Information on a 64-Bit Windows System

If you install both the x86 and 64-bit vPostgres client tools on the same 64-bit Windows system, you can locate the registry information for the x86 client tools as follows.

1 Open a console window.

2 At the prompt, type **`regedit`**.

3 Go to `HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\VMware, Inc.\vPostgres\1.0`.

The InstallPath registry key is similar to `C:\Program Files (x86)\VMware\vPostgres\1.0\`.

Adding an x86 vPostgres ODBC Data Source on a 64-Bit Windows System

If you install both the x86 and 64-bit vPostgres client tools on the same 64-bit Windows system, you add an x86 ODBC data source as follows.

1 In Explorer, go to `C:\Windows\SysWOW64\`

2 Double-click Odbcad32.exe.

The ODBC Data Sources Administrator wizard starts.

3 Click the **System DSN** tab.

4 Click the **Add** button.

5 Click the VMware vPosgres PostgreSQL Unicode 32bit data source.

6 Click **Finish**.

About the vPostgres Client Drivers

The vPostgres client tools package includes a JDBC driver and an ODBC driver customized for vPostgres. Use the vPostgres JDBC or ODBC drivers to connect to Data Director rather than the standard Postgres drivers, and ensure that you set client encoding to UTF-8.

The Windows installer places the JDBC driver in the following location.

```
C:\Program Files\VMware\vPostgres\1.0\JDBC
```

On Linux systems, the installation process places the JDBC driver in the following location.

```
/opt/vmware/vpostgres/1.0/JDBC
```

The Samples directory contains a simple Java example and README file that show how to connect to Data Director using JDBC.

The vPostgres installation process installs the vPostgres ODBC driver. To verify the Windows ODBC driver installation, go to Start > Administrative Tools > Data Sources (ODBC), and click the Drivers tab. The VMware vPostgres ODBC driver appears in the list of installed ODBC drivers.

Using the JDBC Driver

Suppose that you have an application that uses the JDBC driver to access a database. If you install the application as `/usr/local/lib/myapp.jar` and the PostgreSQL JDBC driver as `/usr/local/pgsql/share/java/postgresql.jar`, you run the application as follows.

```
export CLASSPATH=/usr/local/lib/myapp.jar:/usr/local/pgsql/share/java/postgresql.jar:.
java MyApp
```

Relinking Existing Applications Using libpq

Relinking on Linux Systems

The Linux RPM installation process adds the vPostgres `libpq` to the Linux search path, placing the vPostgres `libpq` path before the standard Postgres `libpq` path. You can also issue the following commands.

```
$ export LD_LIBRARY_PATH=/opt/vmware/vpostgres/1.0/lib-public
$ mypgapp
```

Refer to `/opt/vmware/vpostgres/1.0/share/libpq-doc/README.vpostgres-libpq` for more information about using the Linux vPostgres libpq.

Relinking on Windows Systems

The Windows client tools installation provides development components in the `C:\Program Files\VMware\vPostgres\1.0\dev` folder.

- `C:\Program Files\VMware\vPostgres\1.0\dev\lib` contains the libraries libpgport.lib and libpq.lib.

- `C:\Program Files\VMware\vPostgres\1.0\dev\include` contains the libpq header files.

On Windows clients, copy the libpq and other libraries into the directory of the application binaries.

Connecting to vPostgres Databases

Data Director uses its DB Name Server virtual machine to route database connections to Data Director-deployed vPostgres databases. The connection string has the following format.

```
{UUID}.DBNameService_IP_Address
```

The curly brackets, {}, are part of the connection string and denote the UUID.

You can obtain the connection string from the Data Director UI, or you can construct the connection string if you know the UUID and DB Name Server host name.

Obtain the connection string from the Data Director UI.

1 Log in to your Data Director organization as a user with database privileges.

2 Go to your database group and click the database name.

The database connection string appears in the **Connection String** field. The connection string includes JDBC connection information, similar to the following.

```
jdbc:postgresql://{UUID}.<DB Name Service IP or FQDN>/<db name>?user=<user ID>
```

- `{UUID}` is the database UUID enclosed in curly brackets, {}.
- `<DB Name Service IP or FQDN>` is either the IP address of the Data Director DB Name Service network or the fully-qualified domain name.
- `<db name>` is the name of the vPostgres database to connect to.
- `<user ID>` is the user ID to log in to the vPostgres database.
- Copy the connection string and paste it into the right place in your application.

How you use the connection string depends upon how you connect to vPostgres databases. For example:

- If you use a tool such as pgAdmin, copy the `{UUID}.<DB Name Service IP or FQDN>` part of the connection string to specify the host, and note the user ID to specify the user name in the pgAdmin server connection properties.
- If you use JDBC, paste the entire connection string into the jdbc.url field in your jdbc.properties file.

Connecting to a vPostgres Database With pgAdmin

The pgAdmin client tool is not necessary for connecting to vPostgres databases. The Data Director UI includes everything you need to manage your vPostgres databases graphically. The instructions for using pgAdmin are included for completeness.

If you do not have pgAdmin installed, download the pgAdmin appropriate for your platform from the Postgres site and install it. See the Postgres site for information.

To use the Postgres pgAdmin tool to connect to vPostgres databases, pgAdmin must use the Data Director `libpq`.

The Windows pgAdmin tool works only with Windows 32-bit systems. If you run Windows 64-bit, install the 32-bit versions of the vPostgres client tools. The installer places the 32-bit tools in the C:\Program Files (x86) tree.

Before you begin, obtain the following information.

- The vPostgres connection string. See "Connecting to vPostgres Databases" on page 16.

- The Data Director DB Name Service IP address. You can get the IP address from the Data Director vApp in vSphere Client. Contact your administrator if you need help.

  a Login to vSphere Client as an administrator.

  b Locate your Data Director vApp in the **Hosts and Clusters** list, and expand the vApp.

  c Click **DB Name Server** to select it, and click the **Summary** tab.

  d The IP address is listed in the General pane.

  Ask your system administrator for help if you do not have access to the Data Director Web UI or to the vSphere Client.

1 Ensure that pgAdmin uses the vPostgres `libpq` on Windows.

  a Copy the `C:\Program Files\pgAdmin III\<version>` directory to `C:\Program Files\pgAdmin III\<version>-vPostgres`, where <version> is the pgAdmin version number, for example, 1.14.

  b Copy all the files in your `C:\Program Files\VMware\vPostgres\1.0\bin` directory to `C:\Program Files\pgAdmin III\<version>-vPostgres`.

2 Start pgAdmin from the `C:\Program Files\pgAdmin III\<version>-vPostgres` directory.

3 Select **File** > **Add Server**.

4 Enter values for the following properties.

  - Name. Enter a meaningful name for the server, such as Data Director.
  - Host. Enter the `{UUID}.[DB Name Service IP or FQDN]` part of the vPostgres connection string.
  - Leave the default values for Port, Service, and Maintenance DB.
  - Username. Enter the database user name. This is usually the database owner user ID.
  - Password. Enter the database user name's password. You can optionally store the password, but note that pgAdmin stores the password in plain text format.
  - (Optional) Enter a color to denote this server in the object browser and in diagrams.
  - (Optional) Enter a server group in which to place this server, or accept the default.

5 Click the **Advanced** tab, and type the DB Name Service IP address in the **Host** text box.

6 Click **OK**.

PgAdmin connects to the vPostgres database.

Connect to a vPostgres Database with JDBC

The JDBC connection string has the following format.

```
jdbc:postgresql://{UUID}.<host name>/<RDB name>?user=<user name>
```

The curly brackets, {}, are part of the connection string and denote the UUID.

For example, suppose that your vPostgres database, myDB, is deployed on the host w1-devtest-22.dev.mycorp.com. If theUUID is d35f7ab1-d70e-4d98-c121-122f68e4ab60 and the user name is dbowner, the JDBC connection string is as follows.

```
jdbc:postgresql://{d35f7ab1-d70e-4d98-c121-122f68e4ab60}.w1-devtest-22.dev.mycorp.com/mydb?user=dbowner
```

Connect to a vPostgres Database With psql

The psql connection string has the following format.

```
psql -h {UUID}.<DB Name Service IP> -p 5432 -d <DB name> -U <db user name>
```

You connect to a database using `psql`. The database has the UUID 1234-5678-9012-3456, the DB Name Service port is 5432, the IP address for the DB Name Server is 10.0.0.1, the database name is myDB, and the database user name is dbuser. The `psql` command is as follows.

```
$ psql –h {1234–5678–9012–3456}.10.0.0.1 –p 5432 –d myDB –U dbuser
```

Psql connects to myDB and prompts for the password, and logs you in. You can enter `psql` commands as usual.

Loading Data Into vPostgres Databases Using psql \COPY

Use the `psql` command \COPY (back slash-COPY) to load data into vPostgres databases rather than the `psql` COPY FROM or COPY TO command. The COPY FROM (or TO) command must run on the server with superuser privileges and cannot load data into remote clients such as vPostgres. The \COPY FROM and \COPY TO commands use the client session to read and write from local files, support relative paths, and use the `psql` communication layer to load data to, or from, the server.

For example, the following `psql` command loads data from a text file, shelterlists.txt, into the vPostgres database table shelters in the schema rescues.

```
\copy rescues.shelters from ‘C:\shelterslists.txt’;
```

Querying vPostgres Databases

After you connect to a vPostgres database, you can query the database. For example, using `psql`, connect to the database and type the `psql` command at the database prompt.

You can run SQL script files using the `psql` command-line option `–f <SQL script filename>`, where <SQL script filename> contains a series of SQL commands. Psql reads the file, runs the SQL commands, and exits.

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