Mellanox MLNX-OS® User Manual for *IBM 90Y3474*

Rev 1.6.6

Software Version 3.3.3706

www.mellanox.com

NOTE:
THIS HARDWARE, SOFTWARE OR TEST SUITE PRODUCT (“PRODUCT(S)”) AND ITS RELATED DOCUMENTATION ARE PROVIDED BY MELLANOX TECHNOLOGIES “AS-IS” WITH ALL FAULTS OF ANY KIND AND SOLELY FOR THE PURPOSE OF AIDING THE CUSTOMER IN TESTING APPLICATIONS THAT USE THE PRODUCTS IN DESIGNATED SOLUTIONS. THE CUSTOMER'S MANUFACTURING TEST ENVIRONMENT HAS NOT MET THE STANDARDS SET BY MELLANOX TECHNOLOGIES TO FULLY QUALIFY THE PRODUCTO(S) AND/OR THE SYSTEM USING IT. THEREFORE, MELLANOX TECHNOLOGIES CANNOT AND DOES NOT GUARANTEE OR WARRANT THAT THE PRODUCTS WILL OPERATE WITH THE HIGHEST QUALITY. ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT ARE DISCLAIMED. IN NO EVENT SHALL MELLANOX BE LIABLE TO CUSTOMER OR ANY THIRD PARTIES FOR ANY DIRECT, INDIRECT, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES OF ANY KIND (INCLUDING, BUT NOT LIMITED TO, PAYMENT FOR PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY FROM THE USE OF THE PRODUCT(S) AND RELATED DOCUMENTATION EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Mellanox Technologies
350 Oakmead Parkway Suite 100
Sunnyvale, CA 94085
U.S.A.
www.mellanox.com
Tel: (408) 970-3400
Fax: (408) 970-3403

Mellanox Technologies, Ltd.
Beit Mellanox
PO Box 586 Yokneam 20692
Israel
www.mellanox.com
Tel: +972 (0)74 723 7200
Fax: +972 (0)4 959 3245

Table of Contents

Document Revision History

Table 1 - Document Revision History - Ethernet

Document Revision	Date	Changes
Rev. 1.6.6	Apr. 2013	Added Section 4.1.5, “In-Band Management,” on page 33. Added Section 4.8.1.4, “Traps and Events Mapping,” on page 51. Updated Section 5.5, “Spanning Tree,” on page 60.
Rev. 1.6.4	Mar 2013	Added Section 5.10, “Port Mirroring,” on page 70. Added Section 5.11, “sFlow,” on page 76.
Rev. 1.5.4	Sep. 2012	Updated Section 4.2.4, “Downgrading MLNX-OS Software,” on page 38.
Rev 1.5.2	June 2012	Updated Section 4.8.1, “SNMP,” on page 48.
Rev 1.5.1	May 2012	Added Section 5.7, “Link Layer Discovery Protocol (LLDP),” on page 64.
Rev 1.5	May 2012	Initial document.

About this Manual

This manual provides general information concerning the scope and organization of this User's Manual.

Intended Audience

This manual is intended for network administrators who are responsible for configuring and managing Mellanox Technologies' SwitchX based Switch Platforms.

Related Documentation

The following table lists the documents referenced in this *User's Manual.*

Table 2 - Reference Documents

Document Name	Description
InfiniBand Architecture Specification, Vol. 1, Release 1.2.1	The InfiniBand Architecture Specification that is provided by IBTA.
Switch Installation Guide	Each Mellanox Technologies' switch platform is shipped with an Installation Guide document to bring-up and initialize the switch platform.
System Hardware User Manual	This document contains hardware descriptions, LED assignments and hardware specifications among other things.
Switch Product Release Notes	Please look up the relevant SwitchX®-based switch system/series release note file
MLNX-OS® Command Reference Guide	Command Reference Guide for MLNX-OS listing all of the commands available through MLNX-OS with explanations and examples.

All of these documents can be found on the Mellanox website. They are available either through the product pages or through the support page with a login and password.

Glossary

Table 3 - Glossary

AAA	Authentication, Authorization, and Accounting. Authentication - verifies user credentials (username and password). Authorization - grants or refuses privileges to a user/client for accessing specific services. Accounting - tracks network resources consumption by users.
ARP	Address Resolution Protocol. A protocol that translates IP addresses into MAC addresses for communication over a local area network (LAN).
CLI	Command Line Interface. A user interface in which you type commands at the prompt
DCB	Data Center Bridging
DCBX	DCBX protocol is an extension of the Link Layer Discovery Protocol (LLDP). DCBX end points exchange request and acknowledgment messages. For flexibility, parameters are coded in a type-length-value (TLV) format.
DHCP	The Dynamic Host Configuration Protocol (DHCP) is an automatic configuration protocol used on IP networks.
DNS	Domain Name System. A hierarchical naming system for devices in a computer network
ETS	ETS provides a common management framework for assignment of bandwidth to traffic classes.
FTP/TFTP/sFTP	File Transfer Protocol (FTP) is a standard network protocol used to transfer files from one host to another over a TCP-based network, such as the Internet.
Gateway	A network node that interfaces with another network using a different network protocol
HA (High Availability)	A system design protocol that provides redundancy of system components, thus enables overcoming single or multiple failures in minimal downtime
Host	A computer platform executing an Operating System which may control one or more network adapters
LACP	Link Aggregation Control Protocol (LACP) provides a method to control the bundling of several physical ports together to form a single logical channel. LACP allows a network device to negotiate an automatic bundling of links by sending LACP packets to the peer (directly connected device that also implements LACP).
LDAP	The Lightweight Directory Access Protocol is an application protocol for reading and editing directories over an IP network.
MAC	A Media Access Control address (MAC address) is a unique identifier assigned to network interfaces for communications on the physical network segment. MAC addresses are used for numerous network technologies and most IEEE 802 network technologies including Ethernet.

Table 3 - Glossary

MTU (Maximum Transfer Unit)	The maximum size of a packet payload (not including headers) that can be sent /received from a port
Network Adapter	A hardware device that allows for communication between computers in a network
PFC/FC	Priority Based Flow Control applies pause functionality to traffic classes OR classes of service on the Ethernet link.
RADIUS	Remote Authentication Dial In User Service. A networking protocol that enables AAA centralized management for computers to connect and use a network service.
RDMA (Remote Direct Memory Access)	Accessing memory in a remote side without involvement of the remote CPU
RSTP	Rapid Spanning Tree Protocol. A spanning-tree protocol used to prevent loops in bridge configurations. RSTP is not aware of VLANs and blocks ports at the physical level.
SA (Subnet Administrator)	The interface for querying and manipulating subnet management data
SCP	Secure Copy or SCP is a means of securely transferring computer files between a local and a remote host or between two remote hosts. It is based on the Secure Shell (SSH) protocol.
SNMP	Simple Network Management Protocol. A network protocol for the management of a network and the monitoring of network devices and their functions
NTP	Network Time Protocol. A protocol for synchronizing computer clocks in a network
SSH	Secure Shell. A protocol (program) for securely logging in to and running programs on remote machines across a network. The program authenticates access to the remote machine and encrypts the transferred information through the connection.
syslog	A standard for forwarding log messages in an IP network
TACACS+	Terminal Access Controller Access-Control System Plus. A networking protocol that enables access to a network of devices via one or more centralized servers. TACACS+ provides separate AAA services.
XML Gateway	Extensible Markup Language Gateway. Provides an XML request-response protocol for setting and retrieving HW management information.

1 Introduction

Mellanox® Operating System (MLNX-OS®) enables the management and configuration of Mellanox Technologies' SwitchX® silicon based switch platforms. MLNX-OS supports the Virtual Protocol Interconnect (VPI) technology which enables it to be used for both Ethernet and InfiniBand technology providing the user with greater flexibility.

MLNX-OS provides a full suite of management options, including support for Mellanox's Unified Fabric Manager® (UFM), SNMP V1,2,3, and web user interface. In addition, it incorporates a familiar industry-standard CLI, which enables administrators to easily configure and manage the system.

1.1 MLNX-OS Features

Table 4 - General System Features

Feature	Description
Software Management	• Dual software image • Software and firmware updates
File management	• FTP • TFTP • SCP
Logging	• Event history log • SysLog support
Management Interface	• DHCP/Zeroconf • IPv6
Chassis Management	• Monitoring environmental controls
Network Management Interfaces	• SNMP v1,v2c,v3 • REST interfaces (XML Gateway)
Security	• SSH • Telnet • RADIUS • TACACS+
Date and Time	• NTP
Cables & Transceivers	• Transceiver info
Virtual Port Interconnect® (VPI)	• Ethernet • InfiniBand

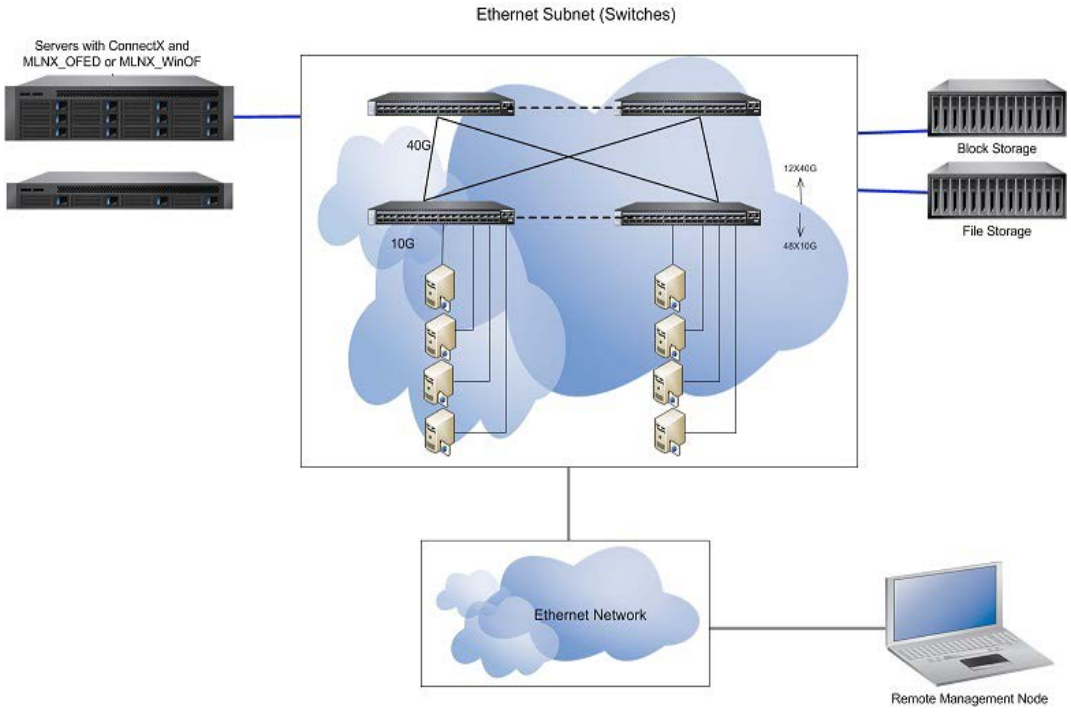
Table 5 - Ethernet Features

Feature	Description
General	• Jumbo Frames (9K) • ACL - 24K rules (permit/deny) • Breakout cables

Table 5 - Ethernet Features

Feature	Description
Ethernet support	• 48K Unicast MAC addresses • VLAN (802.1Q) - 4K • LAG/LACP (802.3ad), 16 links per LAG (36 LAGs) • Rapid Spanning Tree (802.1w) • Flow control (802.3x) • IGMP snooping v1,2 • LLDP • ETS (802.1Qaz) • PFC (802.1Qbb)
IP routing	• VLAN interface • ECMP • OSPF

Figure 1: Managing an Ethernet Fabric Using MLNX-OS



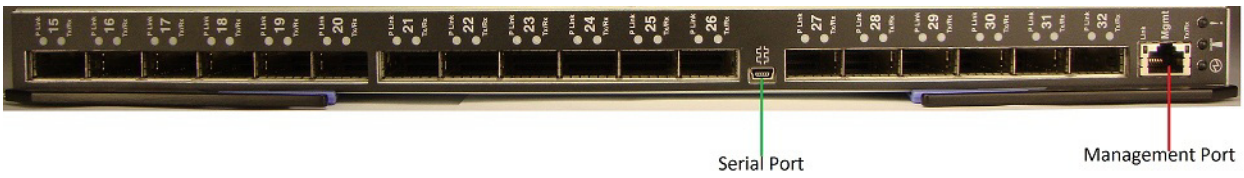
2 Getting Started

The procedures described in this chapter assume that you have already installed and powered on your switch according to the instructions in the *Hardware Installation Guide*, which was shipped with the product.

2.1 Configuring the Switch for the First Time

Step 1. Connect the host PC to the console (mini USB) port of the switch system using the supplied cable.

Figure 2: Console Ports



No remote IP connection is available at this stage via the external management port. The internal management port can be accessed currently by the chassis management.

Step 2. Configure a serial terminal with the settings described below.

Table 6 - Serial Terminal Program Configuration

Parameter	Setting
Baud Rate	9600
Data bits	8
Stop bits	1
Parity	None
Flow Control	None

Step 3. Login as *admin* and use *admin* as password.

2.2 Starting the Command Line (CLI)

Step 1. Set up an Ethernet connection between the switch and a local network machine using a standard RJ-45 connector.

Step 2. Start a remote secured shell (SSH) to the switch using the command “ssh -l <username> <switch ip address>.”

```
rem_mach1 >  ssh -l <username> <ip address>

Mellanox MLNX-OS Switch Management

Last login: Thu Apr 28 11:24:13 2011 from 192.168.10.1
Mellanox Switch

switch >
```

Step 3. Login to the switch (default username is *admin*, password *admin*)

Step 4. Once you get the prompt, you are ready to use the system. Refer to *MLNX-OS Command Reference Guide* for additional information on the CLI commands.

2.3 Starting the Web Interface

➢ ***To start a WebUI connection to the switch platform:***

Step 1. Set up an Ethernet connection between the switch and a local network machine using a standard RJ-45 connector.

Step 2. Open a web browser – Internet Explorer 7.0 Chrome or Mozilla Firefox 3.0.

Note: Make sure the screen resolution is set to 1024*768 or higher.

Step 3. Type in the IP address of the switch or its DNS name in the format: http://<switch_IP_address>.

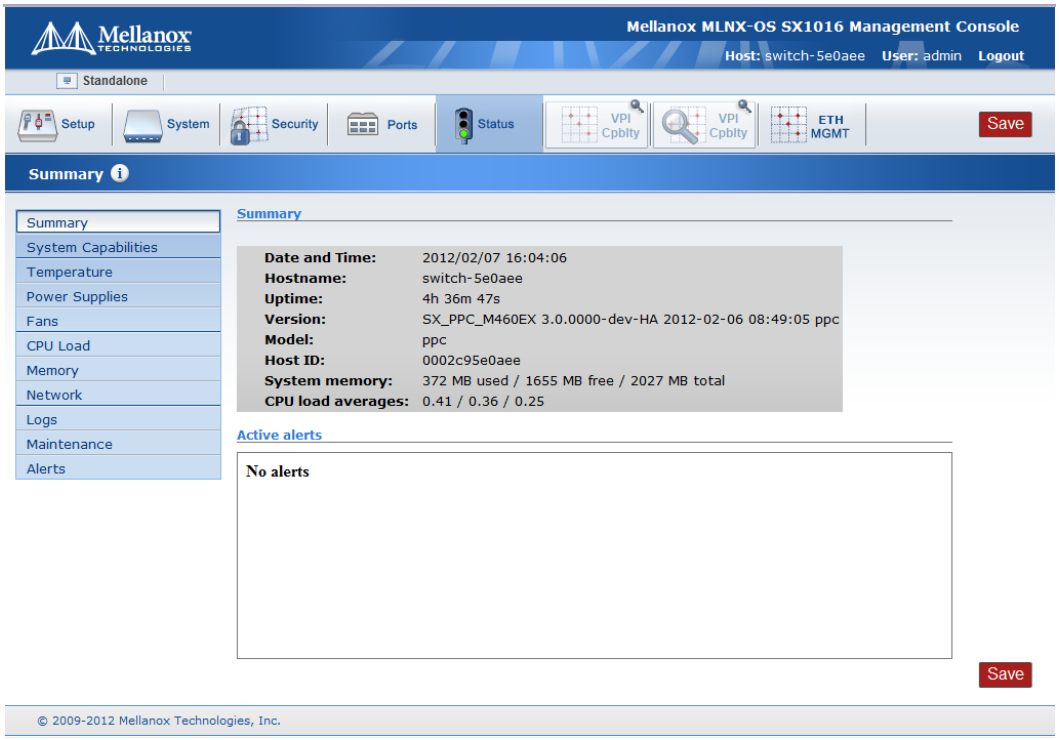
Step 4. Login to the switch (default user name is *admin*, password *admin*).

The following figure shows an example of the login window for remote management of the switch.

Figure 3: MLNX-OS Login Window

After you log in to MLNX-OS, a (default) status summary window will be displayed containing the following information:

Figure 4: Display After Login



2.4 Licenses

MLNX-OS software package can be extended with premium features. Installing a license allows you to access the specified premium features.

This section is relevant only to switch systems with an internal management capability.

The following licenses are offered with MLNX-OS software:

Table 7 - MLNX-OS Licenses

OPN	Valid on product	Description
LIC-FDR10	SX1035/SX1036	InfiniBand FDR-10 SW license for Ethernet Switches
LIC-1035-L2	SX1035	Full Ethernet L2
LIC-6018-L2	SX6018	Full Ethernet L2
LIC-6036-L2	SX6036F/T	Full Ethernet L2
LIC-1016-L3	SX1016	Full Ethernet L3
LIC-1035-L3	SX1035	Full Ethernet L2 + L3
LIC-1036-L3	SX1036	Full Ethernet L3
LIC-1024-L3	SX1024	Full Ethernet L2 + L3
LIC-6036-L3	SX6036F/T	Full Ethernet L2 + L3
LIC-1024-56E	SX1024	Ethernet 56GE
LIC-1036-56E	SX1036	Ethernet 56GE
LIC-6036F-56GE	SX6036F	Ethernet 56GE
LIC-fabric-inspector	SX6036F/T / SX65XX	InfiniBand fabric inspector monitoring and health.
LIC-1036-GW	SX1036	L3 Ethernet + Gateway software license for Mellanox 1036 Series Ethernet Switch
LIC-6036-GW	SX6036	Full Ethernet L2 + L3 + Gateway software license for Mellanox 6036 Series Switch

If your switch system includes one or more internal management modules, then to activate extended MLNX-OS features you must install the license that was purchased along with the switch system.

2.4.1 Installing MLNX-OS® License (CLI)

➢ ***To install an MLNX-OS license via CLI:***

Step 1. Login as *admin* and change to *Config* mode.

```
switch > enable
switch # config terminal
```

Step 2. Install the license using the key. Run:

```
switch (config) # license install <license key>
```

Step 3. Display the installed license(s) using the following command.

```
switch (config) # show licenses
License 1: <license key>
Feature: EFM_SX
Valid: yes
Active: yes
switch (config) #
```

Make sure that the “Valid” and “Active” fields both indicate “yes”.

Step 4. Save the configuration to complete the license installation. Run:

```
switch (config) # configuration write
```

If you do not save the installation session, you will lose the license at the next system start up.

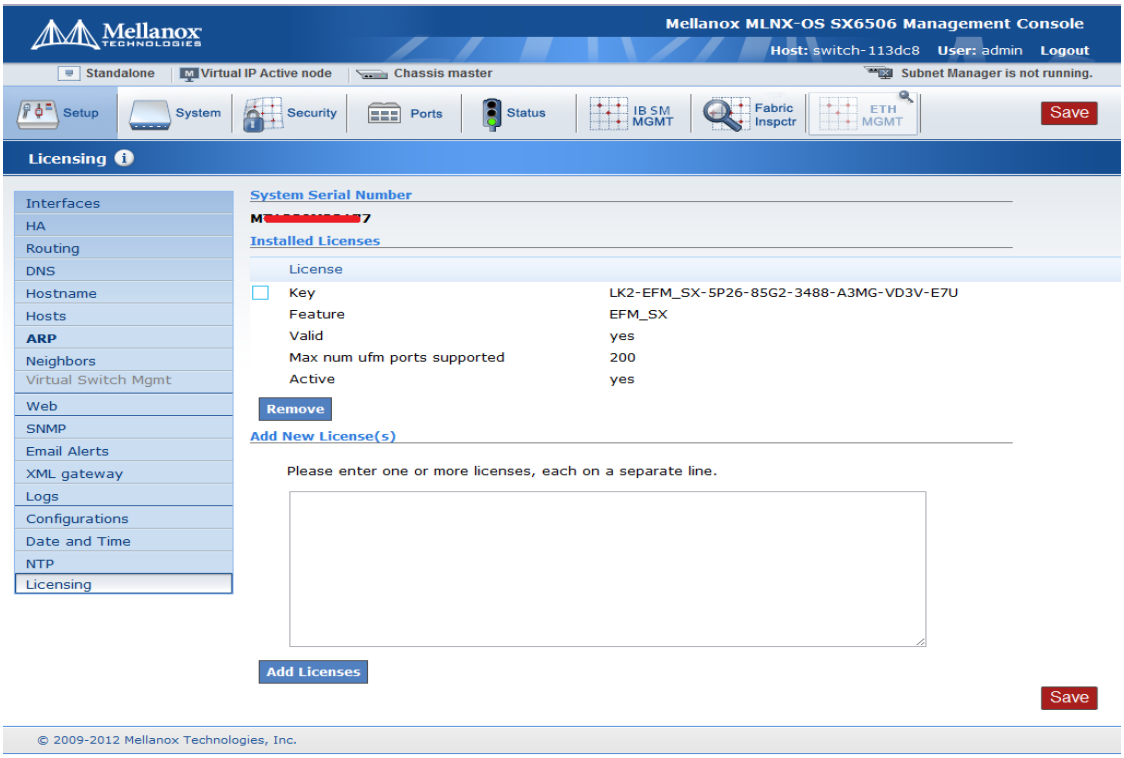
2.4.2 Installing MLNX-OS License (Web)

➢ ***To install an MLNX-OS license via CLI:***

Step 1. Log in as *admin*.

Step 2. Click the **Setup** tab and then **Licensing** in the left side navigation pane.

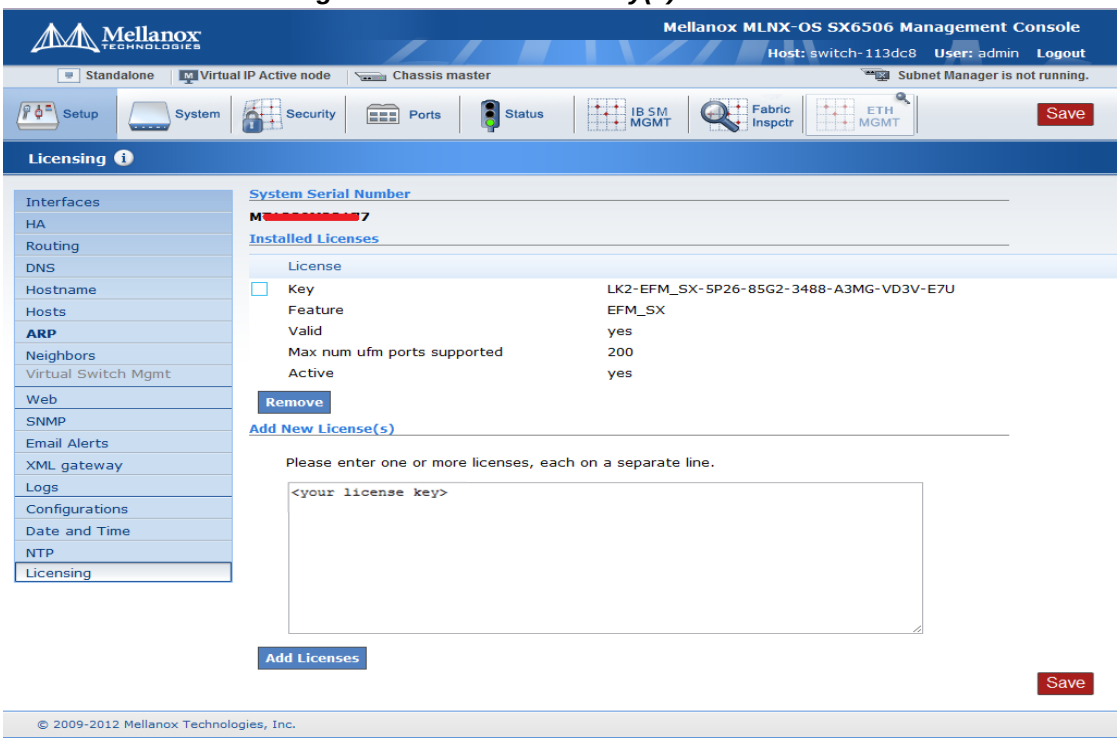
Figure 5: No Licenses Installed



Step 3. Enter your license key(s) in the text box. If you have more than one license, please enter each license in a separate line. Click “Add Licenses” after entering the last license key to install them.

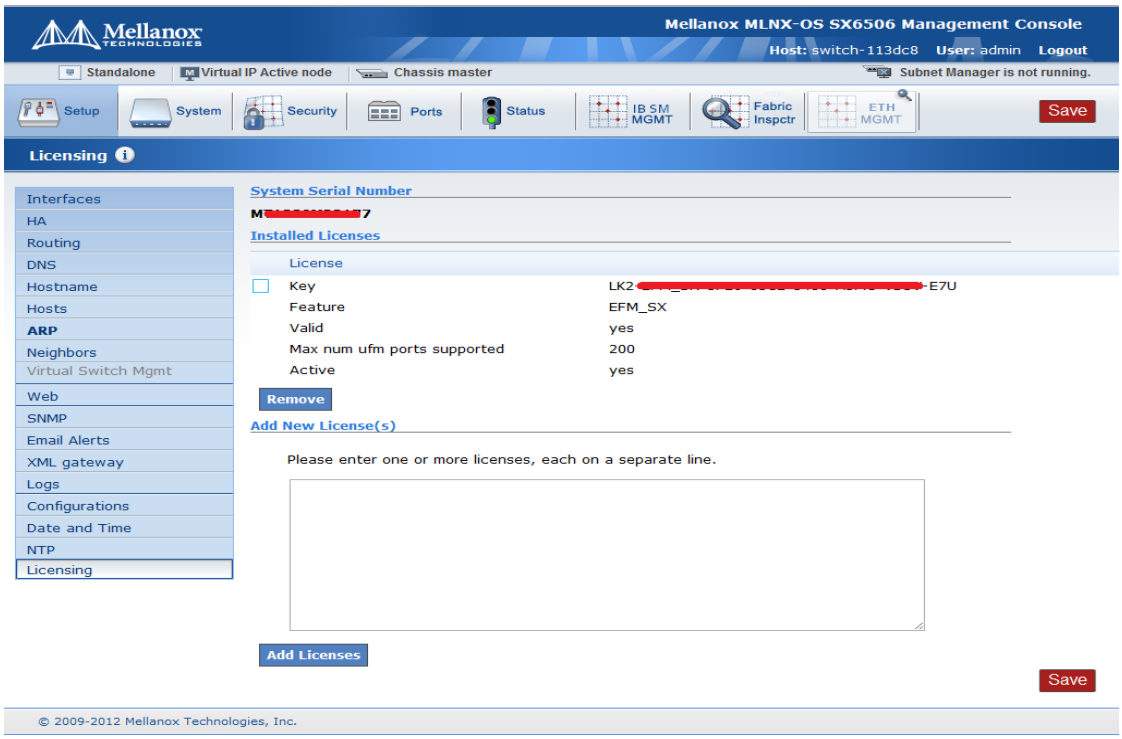
If you wish to add another license key in the future, you can simply enter it in the text box and click “Add Licenses” to install it.

Figure 6: Enter Licence Key(s) in Text Box



All installed licenses should now be displayed.

Figure 7: Installed License



Step 4. Save the configuration to complete the license installation.

If you do not save the installation session, you will lose the installed licenses at the next system boot.

2.4.3 Retrieving a Lost License Key

In case of a lost MLNX-OS® license key, contact your authorized Mellanox reseller and provide the switch's *chassis serial number.*

➢ ***To obtain the switch's chassis serial number:***

Step 1. Login to the switch.

Step 2. Retrieve the switch's *chassis serial number* using the command "show inventory".

```
switch (config) # show inventory
================================================================================
Module               Type                Part number          Serial Number

================================================================================
CHASSIS              SX1035              MSX6036F-1BFR        MT1121X02692
MGMT                 SX1035              MSX6036F-1BFR        MT1121X02692
FAN                  SXX0XX_FAN          MSX60-FF             MT1121X02722
PS1                  SXX0XX_PS           N/A                  N/A
CPU                  CPU                 SA000103             MT1120X01027
switch (config) #
```

Step 3. Send your Mellanox reseller the following information to obtain the license key:

- The chassis serial number
- The type of license you need to retrieve. Refer to "MLNX-OS Licenses" on page 15.

Step 4. Once you receive the license key, you can install the license as described in the sections above.

3 User Interfaces

3.1 Command Line Interface (CLI)

MLNX-OS® is equipped with an industry-standard CLI. The CLI is accessed through SSH or Telnet sessions, or directly via the console port on the front panel (if it exists).

Refer to the *MLNX-OS Command Reference Guide* for complete set of commands, syntax and examples.

3.1.1 CLI Modes

The CLI can be in one of following modes, and each mode makes available a certain group (or level) of commands for execution. The different CLI configuration modes are:

Table 8 - CLI Modes and Config Context

Mode/Context	Description
Standard	When the CLI is launched, it begins in Standard mode. This is the most restrictive mode and only has commands to query a restricted set of state information. Users cannot take any actions that directly affect the system, nor can they change any configuration.
Enable	The `enable` command moves the user to Enable mode. This mode offers commands to view all state information and take actions like rebooting the system, but it does not allow any configurations to be changed. Its commands are a superset of those in Standard mode.
Config	The `configure terminal` command moves the user from Enable mode to Config mode. Config mode is allowed only for user accounts in the “admin” role (or capabilities). This mode has a full unrestricted set of commands to view anything, take any action, and change any configuration. Its commands are a superset of those in Enable mode. To return to Enable mode, enter `exit` or `no configure`. Note that moving directly from/to Standard mode to/from Config mode is not possible.
Config Interface Management	Configuration mode for management interface mgmt0, mgmt1 and loopback.
Config interface ethernet	Configuration mode for Ethernet interface.
Config Interface Port Channel	Configuration mode for Port channel (LAG).
Config Vlan	Configuration mode for VLAN.
Any Command Mode	Several commands such as “show” can be applied within any context.

3.1.2 Syntax Conventions

To help you identify the parts of a CLI command, this section explains conventions of presenting the syntax of commands.

Table 9 - Syntax Conventions

Syntax Convention	Description	Example
< > Angled brackets	Indicate a value/variable that must be replaced.	<1...65535> or <switch interface>
[ ] Square brackets	Enclose optional parameters. However, only one parameter out of the list of parameters listed can be used. The user cannot have a combination of the parameters unless stated otherwise.	[destination-ip | destination-port | destination-mac]
{ } Braces	Enclose alternatives or variables that are required for the parameter in square brackets.	[mode {active | on | passive}]
| Vertical bars	Identify mutually exclusive choices.	active | on | passive

Do not type the angled or square brackets, vertical bar, or braces in command lines. This guide uses these symbols only to show the types of entries.

CLI commands and options are in lowercase and are case-sensitive.

For example, when you enter the `enable` command, enter it all in lowercase. It cannot be ENABLE or Enable. Text entries you create are also case-sensitive.

3.1.3 Getting Help

You may request context-sensitive help at any time by pressing “?” on the command line. This will show a list of choices for the word you are on, or a list of top-level commands if you have not typed anything yet.

For example, if you are in Standard mode and you type “?” at the command line, then you will get the following list of available commands.

```
switch > ?
cli             Configure CLI shell options
enable          Enter enable mode
exit            Log out of the CLI
help            View description of the interactive help system
no              Negate or clear certain configuration options
```

```
show             Display system configuration or statistics
slogin           Log into another system securely using ssh
switch           Configure switch on system
telnet           Log into another system using telnet
terminal         Set terminal parameters
traceroute       Trace the route packets take to a destination
switch-11a596 [standalone: master] >
```

If you type a legal string and then you press "?" *without* a space character before it, then you will either get a description of the command that you have typed so far or the possible command/ parameter completions. If you press "?" *after* a space character and "<cr>" is shown, this means that what you have entered so far is a complete command, and that you may press Enter (carriage return) to execute it.

Try the following to get started:

```
?
show ?
show c?
show clock?
show clock ?
show interfaces ?     (from enable mode)
```

You can also enter "help" to view a description of the interactive help system.

Note also that the CLI supports command and/or parameter tab-completions and their shortened forms. For example, you can enter "en" instead of the "enable" command, or "cli cl" instead of "cli clear-history". In case of ambiguity (more than one completion option is available, that is), then you can hit double tabs to obtain the disambiguation options. Thus, if you are in Enable mode and wish to learn which commands start with the letter "c", type "c" and click twice on the tab key to get the following:

```
switch # c<tab>
clear       cli       configure
switch # c
```

(There are three commands that start with the letter "c": `clear`, `cli` and `configure`.)

3.1.4 Prompt and Response Conventions

The prompt always begins with the hostname of the system. What follows depends on what command mode the user is in. To demonstrate by example, assuming the machine name is "`switch`", the prompts for each of the modes are:

```
switch >              (Standard mode)
switch #              (Enable mode)
switch (config) #     (Config mode)
```

The following session shows how to move between command modes: \

```
switch >                                    (You start in Standard mode)
switch > enable                             (Move to Enable mode)
switch #                                    (You are in Enable mode)
switch # configure terminal                       (Move to Config mode)
switch (config) #                           (You are in Config mode)
switch (config) # exit                      (Exit Config mode)
switch #                                    (You are back in Enable mode)
switch # disable                            (Exit Enable mode)
switch >                                    (You are back in Standard mode)
```

Commands entered do not print any response and simply show the command prompt after you press <Enter>.

If an error is encountered in executing a command, the response will begin with “%”, followed by some text describing the error.

3.1.5 Using the “no” Form

Several Config mode commands offer the negation form using the keyword “no”. This no form can be used to disable a function, to cancel certain command parameters or options, or to reset a parameter value to its default. To re-enable a function or to set cancelled command parameters or options, enter the command without the “no” keyword (with parameter values if necessary).

The following example performs the following:

1. Displays the current CLI session options.
2. Disables auto-logout.
3. Displays the new CLI session options (auto-logout is disabled).
4. Re-enables auto-logout (after 15 minutes).
5. Displays the final CLI session options (auto-logout is enabled)

```
// 1. Display the current CLI session options
switch (config) # show cli
CLI current session settings:
  Maximum line size:        8192
  Terminal width:           157 columns
  Terminal length:          60 rows
  Terminal type:            xterm
  Auto-logout:              15 minutes
  Paging:                   enabled
  Progress tracking:        enabled
  Prefix modes:             enabled
  ...
// 2. Disable auto-logout
switch (config) # no cli session auto-logout
// 3. Display the new CLI session options
switch-1 [standalone: master] (config) # show cli
CLI current session settings:
  Maximum line size:        8192
  Terminal width:           157 columns
```

```
  Terminal length:          60 rows
  Terminal type:            xterm
  Auto-logout:              disabled
  Paging:                   enabled
  Progress tracking:        enabled
  Prefix modes:             enabled
  ...
// 4. Re-enable auto-logout after 15 minutes
switch (config) # cli session auto-logout 15
// 5. Display the final CLI session options
switch (config) # show cli
CLI current session settings:
  Maximum line size:        8192
  Terminal width:           157 columns
  Terminal length:          60 rows
  Terminal type:            xterm
  Auto-logout:              15 minutes
  Paging:                   enabled
  Progress tracking:        enabled
  Prefix modes:             enabled
  ...
```

3.1.6 Parameter Key

This section provides a key to the meaning and format of all of the angle-bracketed parameters in all the commands that are listed in this document.

Table 10 - Angled Brackets Parameter Description

Parameter	Description
<domain>	A domain name, e.g. “mellanox.com”.
<hostname>	A hostname, e.g. “`switch-1`”.
<ifname>	An interface name, e.g. “mgmt0”, “mgmt1”, “lo” (loopback), etc.
<index>	A number to be associated with aliased (secondary) IP addresses.
<IP address>	An IPv4 address, e.g. “192.168.0.1”.
<log level>	A syslog logging severity level. Possible values, from least to most severe, are: “debug”, “info”, “notice”, “warning”, “error”, “crit”, “alert”, “emerg”.
<GUID>	Globally Unique Identifier. A number that uniquely identifies a device or component.
<MAC address>	A MAC address. The segments may be 8 bits or 16 bits at a time, and may be delimited by “:” or “.”. So you could say “11:22:33:44:55:66”, “1122:3344:5566”, “11.22.33.44.55.66”, or “1122.3344.5566”.
<netmask>	A netmask (e.g. “255.255.255.0”) or mask length prefixed with a slash (e.g. “/24”). These two express the same information in different formats.

Table 10 - Angled Brackets Parameter Description

Parameter	Description
<network prefix>	An IPv4 network prefix specifying a network. Used in conjunction with a net-mask to determine which bits are significant. e.g. “192.168.0.0”.
<regular expression>	An extended regular expression as defined by the “grep” in the man page. (The value you provide here is passed on to “grep -E”.)
<node id>	ID of a node belonging to a cluster. This is a numerical value greater than zero.
<cluster id>	A string specifying the name of a cluster.
<port>	TCP/UDP port number.
<TCP port>	A TCP port number in the full allowable range [0...65535].
<URL>	A normal URL, using any protocol that wget supports, including http, https, ftp, sftp, and tftp; or a pseudo-URL specifying an scp file transfer. The scp pseudo-URL format is scp://username:password@hostname/path/filename. Note that the path is an absolute path. Paths relative to the user's home directory are not currently supported. The implementation of ftp does not support authentication, so use scp or sftp for that. Note also that if you omit the “:password” part, you may be prompted for the password in a follow up prompt, where you can type it securely (without the characters being echoed). This prompt will occur if the “cli default prompt empty-password” setting is true; otherwise, the CLI will assume you do not want any password. If you include the “:” character, this will be taken as an explicit declaration that the password is empty, and you will not be prompted in any case.

3.2 Web Interface

MLNX-OS® package equipped with web interface which is a web GUI that accept input and provide output by generating webpages which can be viewed by the user using a web browser.

The following web browsers are supported

- Internet Explorer 8.0 or higher
- Chrome 18 or higher
- Mozilla Firefox 12 or higher
- Safari 5 or higher

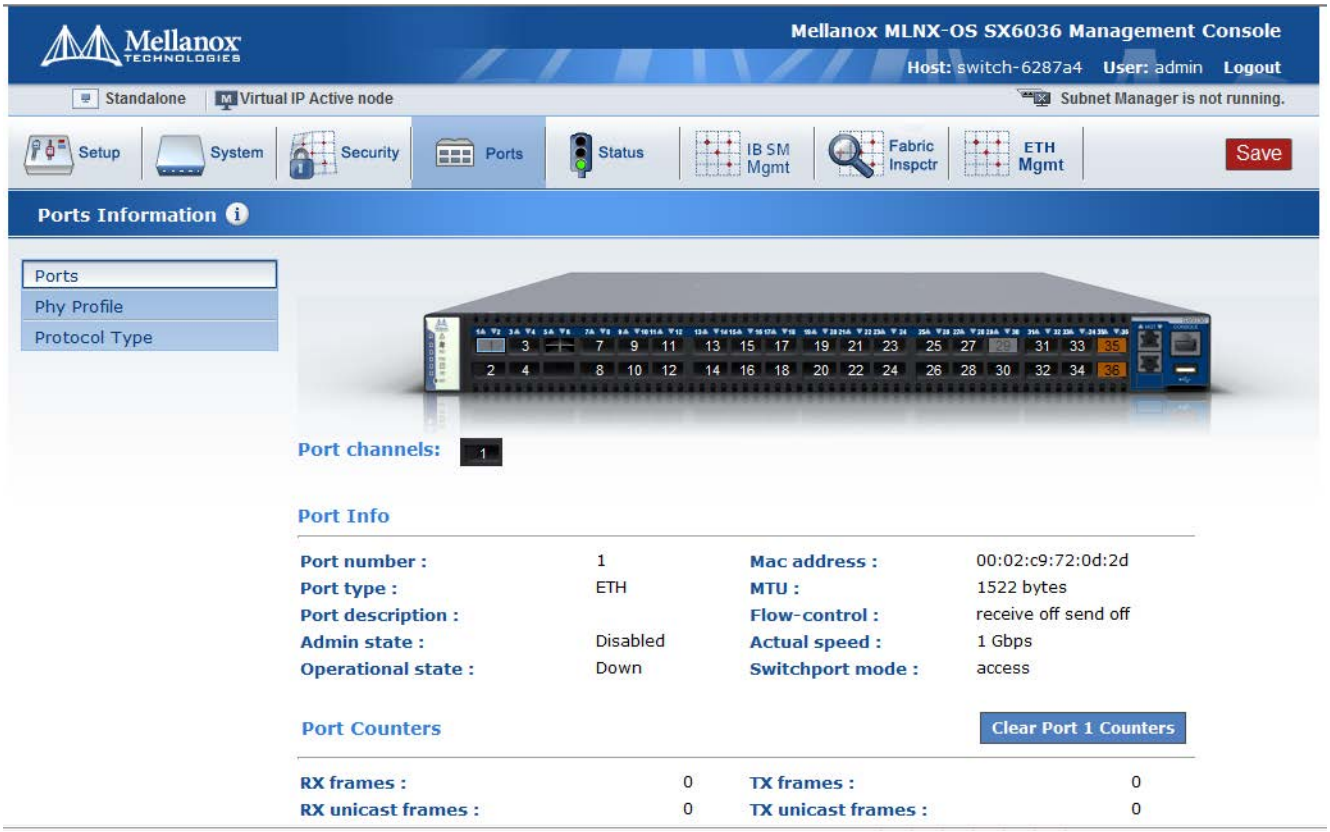
The web interface makes available the following perspective tabs:

- Setup
- System
- Security
- Ports
- Status
- IB SM Management
- Fabric Inspector

- Ethernet Management

Make sure to save your changes before switching between menus or sub-menus. Click the "Save" button to the right of "*Save Changes?*".

Figure 8: WebUI



3.2.1 Setup Menu

The **Setup** menu makes available the following submenus (listed in order of appearance from top to bottom):

Table 11 - Setup Submenus

Submenu Title	Description
Interfaces	Used to obtain the status of, configure, or disable interfaces to the InfiniBand fabric. Thus, you can: set or clear the IP address and netmask of an interface; enable DHCP to dynamically assign the IP address and netmask; and set interface attributes such as MTU, speed, duplex, etc.
HA	Not functional.

Table 11 - Setup Submenus

Submenu Title	Description
Routing	Used to set, remove or display the default gateway, and the static and dynamic routes.
Hostname	Used to set or modify the hostname. Used to set or delete static hosts. **Note:** Changing hostname stamps a new HTTPS certificate.
DNS	Used to set, remove, modify or display static and dynamic name servers.
Login Messages	Used to edit the login messages: Message of the Day (MOTD), Remote Login message, and Local Login message.
ARP	Used to add static and dynamic ARP entries, and to clear the dynamic ARP cache.
IPSec	Used to configure IPSec feature.
Neighbors	Used to display IPv6 neighbor discovery protocol.
Virtual Switch Mgmt	Used to set the system profile.
Web	Used to configure Web user interface and proxy settings.
SNMP	Used to configure SNMP attributes, SNMP admin user, and trap sinks.
Email Alerts	Used to define the destination of email alerts and the recipients to be notified.
XML gateway	Provides an XML request-response protocol to get and set hardware management information.
Logs	Used to set up system log files, remote log sinks, and log formats.
Configurations	Used to manage, activate, save, and import MLNX-OS SwitchX configuration files, and to execute CLI commands.
Date and Time	Used to set the date, time, and time zone of the switch system.
NTP	Used to set NTP (Network Time Protocol) and NTP servers.
Licensing	Used to manage MLNX-OS licenses.

3.2.2 System Menu

The **System** menu makes available the following sub-menus (listed in order of appearance from top to bottom):

Table 12 - System Submenus

Submenu Title	Description
Modules	Displays a graphic illustration of the system modules. By moving the mouse over the ports in the front view, a pop-up caption is displayed to indicate the status of the port. The port state (active/down) is differentiated by a color scheme (green for active, gray/black for down). By moving the mouse over the rear view, a pop-up caption is displayed to indicate the leaf part information.

Table 12 - System Submenus

Submenu Title	Description
Inventory	Displays a table with the following information about the system modules: module name, type, serial number, ordering part number and Asic firmware version.
Power Management	Displays a table with the following information about the system power supplies: power supply name, power, voltage level, current consumption, and status. A total power summary table is also displayed providing the power used, the power capacity, and the power available.
MLNX-OS Upgrade	Displays the installed MLNX-OS images (and the active partition), to upload a new image, and to install a new image.
Reboot	Used to reboot the system. Make sure that you save your configuration prior to clicking reboot.

3.2.3 Security Menu

The **Security** menu makes available the following sub-menus (listed in order of appearance from top to bottom):

Table 13 - Security Submenus

Submenu Title	Description
Users	Used to manage (setting up, removing, modifying) user accounts.
Admin Password	Used to modify the system administrator password.
SSH	Used to display and generate host keys.
AAA	Used to configure AAA (Authentication, Authorization, and Accounting) security services such as authentication methods and authorization.
Login Attempts	Used to manage login attempts
RADIUS	Used to manage Radius client.
TACACS+	Used to manage TACACS+ client.
LDAP	Used to manage LDAP client.
Certificate	Used to manage certificates.

3.2.4 Ports Menu

The Ports menu displays the port state and enables some configuration attributes of a selected port. It also enables modification of the port configuration. A graphical display of traffic over time (last hour or last day) through the port is also available.

Table 14 - Ports Submenus

Submenu Title	Description
Ports	Manages port attributes, counters, transceiver info and displays a graphical counters histogram.

Table 14 - Ports Submenus

Submenu Title	Description
Phy Profile	Provides the ability to manage phy profiles.
Protocol type	Manages the link protocol type

3.2.5 Status Menu

The **Status** menu makes available the following sub-menus (listed in order of appearance from top to bottom):

Table 15 - Status Submenus

Submenu Title	Description
Summary	Displays general information about the switch system and the MLNX-OS image, including: current date and time, hostname, uptime of system, system memory, CPU load averages, etc.
Profile and Capabilities	Displays general information about the switch system capabilities such as the enabled profiles (e.g IB/ETH) and their corresponding values.
Temperature	Provides a graphical display of the switch module sensors' temperature levels over time (1 hour). It is possible to display either the temperature level of one module's sensor or the temperature levels of all the module sensors' together.
Power Supplies	Provides a graphical display of one of the switch's power supplies voltage level over time (1 hour).
Fans	Provides a graphical display of fan speeds over time (1 hour). The display is per fan unit within a fan module.
CPU Load	Provides a graphical display of the management CPU load over time (1 hour).
Memory	Provides a graphical display of memory utilization over time (1 day).
Network	Provides a graphical display of network usage (transmitted and received packets) over time (1 day). It also provides per interface statistics.
Logs	Displays the system log messages. It is possible to display either the currently saved system log or a continuous system log.
Maintenance	Used to perform specific maintenance operations automatically on a predefined schedule.
Alerts	Used to display a list of the recent health alerts and enables the user to configure health settings.

3.2.6 IB SM Mgmt

The IB SM MGMT menu is not supported in Ethernet systems.

The **IB SM Mgmt** menu makes available the following sub-menus (listed in order of appearance from top to bottom):

Table 16 - IB SM Mgmt Submenus

Submenu Title	Description
Summary	Displays the local Subnet Manager (SM) status (running time, failures, etc).
Base SM	Used to manage basic SM configuration (enabling SM, priority level, and restoring initial configuration).
Advanced SM	Used to manage basic SM configuration (enabling SM, priority level, and restoring initial configuration).
Expert SM	Used to configure security and GUID based prefixes (m_key, sm_key, sa_key, etc), and to manage special SM attributes that should not be changed except by expert users of the Subnet Manager who understand the risks of manipulating these attributes.
Compute nodes	Used to add compute nodes using network adapter port GUIDs.
Root nodes	Used to add root nodes using switch GUIDs.
Partitions	Manages partition keys (sets removes or displays the partition keys).
Basic Qos	Used to configure basic QoS attributes such as default QoS settings, and VL arbitration low and high entries. It is also used to display and manage SL to VL mappings.

3.2.7 Fabric Inspector

The Fabric Inspctr menu is not applicable when the switch profile is not InfiniBand.

The Fabric Inspctr menu requires a license (LIC-fabric-inspector)

The **Fabric Inspctr** menu makes available the following sub-menus (listed in order of appearance from top to bottom):

Table 17 - Fabric Inspctr Submenus

Submenu Title	Description
Summary	Displays a fabric status summary, including the time of last fabric update, what systems are in the fabric, what InfiniBand devices are identified, etc.
IB Systems	Displays information about all identified InfiniBand systems in the fabric (adapters, switches, etc).
IB Nodes	Displays information about InfiniBand nodes in the fabric. It is possible to filter display by the type of InfiniBand node (HCA adapter, switch, etc).
IB Ports	Displays all active InfiniBand ports in the fabric. It is possible to filter display by the type of InfiniBand port (HCA port, switch port, switch management port, etc), by the port rate (speed or width), by the Subnet Manager status on the node, by node traffic, etc.
Connections	Displays all active connections in the fabric. It is possible to filter display by the link type (switch to switch, switch to HCA, etc) and by the link rate (speed or width).
System Names	Allows the mapping of System Names to GUIDs to ease system identification.

3.2.8 ETH Mgmt

The Eth Mgmt menu is not applicable when the switch profile is not ethernet.

The **ETH Mgmt** menu makes available the following sub-menus (listed in order of appearance from top to bottom):

Table 18 - ETH Mgmt Submenus

Submenu Title	Description
Spanning Tree	Used for configuring and monitoring spanning tree protocol.
MAC Table	Used for configuring static mac addresses in the switch, and displaying the mac address table.
Link Aggregation	Used for configuring and monitoring aggregated Ethernet links (LAG) as well as configuring LACP.
VLAN	Used for managing the switch VLAN table.
IGMP Snooping	Used for managing IGMP snooping in the switch.
ACL	Used for managing Access Control in the switch.

4 System Management

4.1 Management Interface

4.1.1 Configuring Management Interfaces with Static IP Addresses

If your switch system was set during initialization to obtain dynamic IP addresses through DHCP and you wish to switch to static assignments, perform the following steps:

Step 1. Change to Config mode. Run:

```
switch >
switch > enable
switch # configure terminal
```

Step 2. Disable setting IP addresses using the DHCP using the following command:

```
switch (config) # no interface <ifname> dhcp
```

Step 3. Define your interfaces statically using the following command:

```
switch (config) # interface <ifname> ip address <IP address> <netmask>
```

For further definitions of the interface, please refer to *Mellanox MLNX-OS® Command Reference Guide*.

4.1.2 Configuring IPv6 Address on the Management Interface

Step 1. Enable IPv6 on this interface.

```
switch (config) # interface mgmt0 ipv6 enable
```

Step 2. Set the IPv6 address to be configured automatically.

```
switch (config) # interface mgmt0 ipv6 address autoconfig
```

Step 3. Verify the IPv6 address is configured correctly.

```
switch (config) # show interfaces mgmt0 brief
```

4.1.3 Dynamic Host Configuration Protocol (DHCP)

DHCP is used for automatic retrieval of management IP addresses.

For all other systems (and software versions) DHCP is disabled by default.

If a user connects through SSH, runs the wizard and turns off DHCP, the connection is immediately terminated as the management interface loses its IP address.

```
<localhost># ssh admin@192.168.10.101
Mellanox MLNX-OS Switch Management
Password:
Mellanox Switch
Mellanox configuration wizard
Do you want to use the wizard for initial configuration? yes
Step 1: Hostname? [switch-6287a4]
Step 2: Use DHCP on mgmt0 interface? [yes] no
<localhost>#
```

In such case the serial connection should be used.

4.1.4 Default Gateway

In order to configure manually the default gateway, use the “ip route” command, with “0.0.0.0” as prefix and mask. The next-hop address must be within the range of one of the IP interfaces on the system.

```
switch (config)# ip route 0.0.0.0 0.0.0.0 10.209.0.2
switch (config)# show ip route
Destination       Mask             Gateway          Interface   Source
default           0.0.0.0          10.209.0.2       mgmt0       static
10.209.0.0        255.255.254.0    0.0.0.0          mgmt0       direct
switch (config)#
```

4.1.5 In-Band Management

In-band management is a management path passing through the data ports. In-band management can be created over one of the VLANs in the systems.

The in-band management feature does not require any license. However, it works only for system profiles VPI and Ethernet. It cannot be enabled with IP Routing or IP Proxy-ARP.

➢ ***To set an in-band management channel:***

Step 1. Create a VLAN. Run:

```
switch (config) # vlan 10
switch (config vlan 10) #
```

Step 2. Create a VLAN interface. Run:

```
switch (config) # interface vlan 10 create
```

Step 3. Enter the VLAN interface configuration mode and configure L3 attributes. Run:

```
switch (config) # interface vlan10
switch (config interface vlan10)#ip address 10.10.10.10 /24
```

Step 4. (Optional) Verify in-band management configuration. Run:

```
switch (config) # show interfaces vlan10
Interface vlan10 status:
   Comment:
   Admin up:           yes
   Link up:            yes
   DHCP running:       no
   IP address:         10.10.10.10
   Netmask:            255.255.255.0
   IPv6 enabled:       no
   Speed:              N/A
   Duplex:             N/A
   Interface type:     ethernet
   Interface source:   vlan
   MTU:                1500
   HW address:         00:02:C9:7E:24:E8

   RX bytes:           0                   TX bytes:       250
   RX packets:         0                   TX packets:     3
   RX mcast packets:   0                   TX discards:    0
   RX discards:        0                   TX errors:      0
   RX errors:          0                   TX overruns:    0
   RX overruns:        0                   TX carrier:     0
   RX frame:           0                   TX collisions:  0
                                           TX queue len:   0
switch (config) #
```

4.2 Software Management

4.2.1 Upgrading MLNX-OS Software - Preconditions

Prior to upgrading MLNX-OS software from version 3.2.0100 and lower, please remove any old configuration from your system.

To remove old configuration:

Step 1. Clear your system of any old configuration. Run from CMM:

```
system:switch[2]> clear -cnfg
OK
system:switch[2]>
```

Step 2. Follow the steps described in Section 4.2.2, “Upgrading MLNX-OS® Software,” on page 34.

4.2.2 Upgrading MLNX-OS® Software

To upgrade MLNX-OS software on your system, perform the following steps:

Step 1. Change to Config mode.

```
switch > enable
switch # configure terminal
switch (config) #
```

Step 2. Obtain the previously available image (.img file). You *must* delete this image in the next step to make room for fetching the new image.

```
switch (config) # show images
Installed images:

  Partition 1:
  SX_PPC_M460EX SX_3.3.3130 2013-03-20 21:32:25 ppc

  Partition 2:
  SX_PPC_M460EX SX_3.3.3130 2013-03-20 21:32:25 ppc

Images available to be installed:

  image-PPC_M460EX-SX_3.3.3256.img
  SX_PPC_M460EX SX_3.3.3256 2013-03-20 21:32:25 ppc

Serve image files via HTTP/HTTPS: no

No image install currently in progress.

Boot manager password is set.

No image install currently in progress.

Require trusted signature in image being installed: yes (default)
switch (config) #
```

Step 3. Delete the old image that is listed under `Images available to be installed` prior to fetching the new image. Use the command `image delete` for this purpose.

```
switch (config) # image delete image-PPC_M460EX-SX_3.0.1224.img
switch (config) #
```

Step 4. Fetch the new software image.

```
switch (config) # image fetch scp://username:password@192.168.10.125/var/www/html/
<image_name>
Password (if required): ******
100.0%[################################################## ###############]
switch (config) #
```

Step 5. Display the available images.

To recover from image corruption (e.g., due to power interruption), there are two installed images on the system. See the commands:

`image boot next`

`image boot location`.

```
switch (config) # show images
Installed images:
  Partition 1:
  SX <old ver> 2013-04-28 16:02:50

  Partition 2:
  SX <new ver> 2013-04-28 16:52:50

Images available to be installed:
  new_image.img
  SX <new ver> 2013-04-28 16:52:50

Serve image files via HTTP/HTTPS: no

No image install currently in progress.

Boot manager password is set.

No image install currently in progress.

Require trusted signature in image being installed: yes (default)
switch (config) #
```

Step 6. Install the new image.

```
switch (config) # image install <image_name>
Step 1 of 4: Verify Image
 100.0%  [##############################################################]
Step 2 of 4: Uncompress Image
 100.0%  [##############################################################]
Step 3 of 4: Create Filesystems
 100.0%  [##############################################################]
Step 4 of 4: Extract Image
 100.0%  [##############################################################]
switch (config) #
```

CPU utilization may go up to 100% during image upgrade.

Step 7. Have the new image activate during the next boot. Run:

```
switch (config) # image boot next
```

Step 8. Run `show images` to review your images. Run:

```
switch (config) # show images
Images available to be installed:
```

```
  new_image.img
  SX <new ver> 2011-04-28 16:52:50

Installed images:
  Partition 1:
  SX <old ver> 2011-04-28 16:02:50

  Partition 2:
  SX <new ver> 2011-04-28 16:52:50

Last boot partition: 1
Next boot partition: 2

No boot manager password is set.
switch (config) #
```

Step 9. Save current configuration. Run:

```
switch (config) # configuration write
switch (config)#
```

Step 10. Reboot the switch to run the new image. Run:

```
switch (config) # reload
Configuration has been modified; save first? [yes] yes
Configuration changes saved.
Rebooting...
switch (config)#
```

After software reboot, the software upgrade will also automatically upgrade the firmware version.

On SX65XX systems with dual management, the software must be upgraded on both the Master and the Slave units.

In order to upgrade the system on dual management system refer to Section 4.2.2, “Upgrading MLNX-OS® Software,” on page 34.

When performing upgrade from the WebUI, make sure that the image you are trying to upgrade to is not located already in the system (i.e. fetched from the CLI).

4.2.3 Deleting Unused Images

➢ ***To delete unused images:***

Step 1. Enter Config mode. Run:

```
switch >
switch > enable
switch # configure terminal
```

Step 2. Get a list of the unused images. Run

```
switch (config) # show images
Images available to be installed:
  image-PPC_M460EX-SX_3.1.1224.img
  SX-OS_PPC_M460EX SX_3.1.1224 2011-04-28 12:29:48 ppc
Installed images:
Partition 1:
SX-OS_PPC_M460EX 3.1.0000-dev-HA 2011-04-10 12:02:49 ppc
Partition 2:
SX-OS_PPC_M460EX 3.1.0000-dev-HA 2011-04-10 12:02:49 ppc

Last boot partition: 1
Next boot partition: 1
Boot manager password is set.
No image install currently in progress.
Require trusted signature in image being installed: yes
switch (config) #
```

Step 3. Delete the unused images. Run:

```
switch config) # image delete image-PPC_M460EX-SX_3.0.1224.img
switch (config) #
```

For further information, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.2.4 Downgrading MLNX-OS Software

Prior to downgrading software, please make sure the following prerequisites are met:

Step 1. Log into your switch via the CLI using the console port.

Step 2. Backup your configuration according to the following steps:

1. Change to Config mode. Run:

```
switch-112094 [standalone: master] > enable
switch-112094 [standalone: master] # configure terminal
switch-112094 [standalone: master] (config) #
```

2. Disable paging of CLI output. Run:

```
switch-112094 [standalone: master] (config) # no cli default paging enable
```

3. Display commands to recreate current running configuration. Run:

```
switch-112094 [standalone: master] (config) # show running-config
```

4. Copy the output to a text file.

4.2.4.1 Downloading Image

Step 1. Log into the system to obtain the serial number. Run:

```
switch-112094 [standalone: master] (config) # show inventory
```

Step 2. Download the requested MLNX-OS version from the following link:

http://support.mellanox.com/SupportWeb/

Step 3. Enter your username and password when prompted.

Step 4. Log into the switch via the CLI using the console port.

Step 5. Change to Config mode. Run:

```
switch > enable
switch # configure terminal
switch (config) #
```

Step 6. Delete all previous images from the `Images available to be installed` prior to fetching the new image. Run:

```
switch (config) # image delete image-EFM_PPC_M405EX-ppc-m405ex 20090531-190132.img
```

Step 7. Fetch the requested software image. Run:

```
switch (config) # image fetch scp://username:password@192.168.10.125/var/www/html/
<image_name>
100.0%[################################################## ###############]
```

4.2.4.2 Downgrading Image

The procedure below assumes that booting and running is done from Partition 1 and the downgrade procedure is performed on Partition 2.

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Show all image files on the system. Run:

```
switch (config) # show images
Images available to be installed:
new_image.img
<downgrade version> 2010-09-19 16:52:50
Installed images:
```

```
Partition 1:
<current version> 2010-09-19 03:46:25
Partition 2:
<current version> 2010-09-19 03:46:25
Last boot partition: 1
Next boot partition: 1
No boot manager password is set.
switch (config) #
```

Step 4. Install the MLNX-OS image. Run:

```
switch (config) # image install <image_name>
Step 1 of 4: Verify Image
100.0% [####################################################################]
Step 2 of 4: Uncompress Image
100.0% [####################################################################]
Step 3 of 4: Create Filesystems
100.0% [####################################################################]
Step 4 of 4: Extract Image
100.0% [####################################################################]
switch (config) #
```

Step 5. Show all image files on the system. Run:

```
switch (config) # show images
Images available to be installed:
new_image.img
 <downgrade version> 2010-09-19 16:52:50
Installed images:
Partition 1:
 <current version> 2010-09-19 03:46:25
Partition 2:
 <downgrade version> 2010-09-19 16:52:50
Last boot partition: 1
Next boot partition: 2
No boot manager password is set.
switch (config) #
```

Step 6. Set the boot location to be the other partition (next). Run:

```
switch (config) # image boot next
```

There are two installed images on the system. Therefore, if one of the images gets corrupted (due to power interruption, for example), in the next reboot the image will go up from the second partition.

In case you are downloading to an older software version which has never been run yet on the switch, use the following command sequence as well:

switch (config) # no boot next fallback-reboot enable

switch (config) # configuration write

Step 7. Reload the switch. Run:

```
switch (config) # reload
```

4.2.4.3 Switching to Partition with Older Software Version

The system saves a backup configuration file when upgrading from an older software version to a newer one. If the system returns to the older software partition, it uses this backup configuration file. Note that all configuration changes done with the new software are lost when returning to the older software version.

There are 2 instances where the backup configuration file does not exist:

- The user has run “reset factory” command, which clears all configuration files in the system
- The user has run “configuration switch-to” to a configuration file with different name then the backup file

Also note that the configuration file becomes empty if the switch is downgraded to a software version which has never been installed yet.

To allow switching partition to the older software version, in these cases above, follow the steps below:

Step 1. Run the command:

```
switch (config)# no boot next fallback-reboot enable
```

Step 2. Set the boot partition. Run:

```
switch (config)# image boot next
```

Step 3. Save the configuration. Run:

```
switch (config)# configuration write
```

Step 4. Reload the system. Run:

```
switch (config)# reload
```

4.2.5 Upgrading System Firmware

Each MLNX-OS software package version has a default switch firmware version. When you update the MLNX-OS software to a new version, an automatic firmware update process will be attempted by MLNX-OS. This process is described below.

4.2.5.1 After Updating MLNX-OS Software

Upon rebooting your switch system after updating the MLNX-OS software, MLNX-OS software will first compare its default firmware version with the currently programmed firmware versions on all the switch modules (leafs and spines on director-class switches, or simply the switch card on edge switch systems).

If one or more of the switch modules is programmed with a firmware version other than the default version, then MLNX-OS will automatically attempt to burn the default firmware version instead.

If a firmware update takes place, then the login process will be delayed for a few minutes.

To verify that the firmware update was successful, login to MLNX-OS and run the command "show asic-version" (can be run in any mode). This command lists all of the switch modules along with their firmware versions. Make sure that all the firmware versions are the same and match the default firmware version. If the firmware update failed for one or more modules, then the following warning is displayed.

```
Warning: Some of the subsystems are not updated with default FW <ver>.
```

If you detect a firmware version mismatch for one or more modules of the switch system, please contact your assigned Mellanox Technologies field application engineer.

4.2.5.2 Importing Firmware and Changing the Default Firmware

To perform an automatic firmware update by MLNX-OS for a different switch firmware version without changing the MLNX-OS version, import the firmware package as described below. MLNX-OS sets it as the new default firmware and performs the firmware update automatically as described in the previous subsections.

Default Firmware Change on Standalone Systems

Step 1. Import the firmware image (.tgz file). Run:

```
 switch (config) # image fetch
 switch (config) # image default-chip-fw fw-SX-rel-9_1_2090.tgz
 Default Firmware 9.1.2090 updated. Please save configuration and reboot for new FW to
take effect.
 switch (config) #
```

Step 2. Save the configuration. Run:

```
 switch (config) # configuration write
 switch (config) #
```

Step 3. Reboot the system to enable auto update.

4.3 File Management

4.3.1 Saving a Configuration File

To save the current configuration to the active configuration file, you can either use the `configuration write` command (requires running in Config mode) or the `write memory` command (requires running in Enable mode).

- To save the configuration to the active configuration file, run:

```
switch (config) # configuration write
```

- To save the configuration to a user-specified file without making the new file the active configuration file, run:

```
switch (config) # configuration write to myconf no-switch
```

- To save the configuration to a user-specified file and make the new file the active configuration file, run:

```
switch (config) # configuration write to myconf
```

- To display the available configuration files and the active file, run:

```
switch (config) # show configuration files
initial
myconf (active)
switch (config) #
```

For further information, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.3.2 Loading a Configuration File

By default, or after a system reset, the system loads the default "initial" configuration file.

➢ ***To load a different configuration file and make it the active configuration:***

```
switch [standalone: master] >
switch [standalone: master] > enable
switch [standalone: master] # configure terminal
switch [standalone: master] (config) # configuration switch-to myconfig
switch [standalone: master] (config) #
```

For further information, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.3.3 Restoring Factory Default Configuration on a Switch System (Single Management Module)

In cases where the system configuration becomes corrupted it is suggested that you restore the factory default configuration.

Step 1. Connect to the IBM chassis manager and move into the correct Switch blade context.

Step 2. Run the command "`clear -cnfg`" (for more assistance, please refer to the IBM CMM User Manual).

Step 3. Wait for the switch blade to reboot itself twice.

It might take a few minutes between one reboot and the other. Please avoid using the system during that time.

For further information, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.4 Remote Logging

4.4.1 Configuring Remote Syslog to “info” Level

➢ ***To configure remote syslog to send syslog messages to a remote syslog server:***

Step 1. Enter Config mode. Run:

```
switch >
switch > enable
switch # configure terminal
```

Step 2. Set remote syslog server. Run

```
switch (config) # logging <IP address>
```

Step 3. Set the minimum severity of the log level to `info`. Run:

```
switch (config) # logging <IP address> trap info
```

Step 4. Override the log levels on a per-class basis. Run:

```
switch (config) # logging <IP address> trap override class <class name>
```

For further information, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.5 Event Notifications

4.5.1 E-mail Notifications

➢ ***To configure MLNX-OS to send you emails for all configured events and failures:***

Step 1. Enter to Config mode. Run:

```
switch >
switch > enable
switch # configure terminal
```

Step 2. Set your mailhub to the IP address to be your mail client’s server – for example, Microsoft Outlook exchange server.

```
switch (config) # email mailhub 10.0.X.X
```

Step 3. Add your email address for notifications.

```
switch (config) # email notify recipient <email address>
```

Step 4. Have the system send you a test email.

```
switch # email send-test

The last command should generate the following email:
-----Original Message-----
From: Admin User [mailto:do-not-reply@switch.]
Sent: Sunday, May 01, 2011 11:17 AM
To: <name>
Subject: System event on switch: Test email for event notification

==== System information:
Hostname: switch
```

```
Version:  <version> 2011-05-01 14:56:31
          ...
Date:     2011/05/01 08:17:29
Uptime:   17h 8m 28.060s

This is a test email.
==== Done.
```

For further information, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.6 Diagnostics

Switch Power On Self Test As the switch powers on, it begins the Power On Self Test (POST), a series of tests as part of its power-up procedure to ensure that the switch functions properly. During the POST, the switch logs any errors encountered. Some POST errors are critical, others are not.

The updated POST diagnostic code will be stored inside the "POST Diagnostic Register".

Table 19 lists the POST return codes and their meanings.

Table 19 - POST Return Codes

Return Code	Severity	Meaning	POST Section
0x5	Critical	System initialization failure.	Standard POST
0x10	Critical	Failure connecting to the main management process.	Standard POST
0x15	Critical	VPD initialization failure.	Standard POST
0x20	Critical	CPLD initialization failure.	Standard POST
0x25	Critical	Default IP configuration failure.	Standard POST
0x30	Critical	Temperature sensors failure.	Extended POST
0x35	Critical	Voltage sensors failure.	Extended POST
0x40	Critical	RAM memory failure.	Full POST
0x45	Critical	NAND memory failure.	Full POST
0x80	Non Critical	Incorrect firmware version.	Standard POST
0xff	Non Critical	POST ended successfully	Standard POST

4.6.1 Retrieving Return Codes when Executing Remote Commands

- ***To stop the CLI and set the system to send return errors if some commands fail, perform the following:***

Step 1. Connect to the system from the host SSH.

Step 2. Add the `-h` parameter after the `cli` (as shown in the example below) to notify the system to halt on failure and pass through the exit code.

```
ssh <username>@<hostname> cli -h '"enable" "show interfaces brief"'
```

4.7 User Management and Security

4.7.1 Authentication, Authorization and Accounting (AAA)

AAA is a term describing a framework for intelligently controlling access to computer resources, enforcing policies, auditing usage, and providing the information necessary to bill for services. These combined processes are considered important for effective network management and security. The AAA feature allows you to verify the identity of, grant access to, and track the actions of users managing the MLNX-OS switch. The MLNX-OS switch supports Remote Access Dial-In User Service (RADIUS) or Terminal Access Controller Access Control device Plus (TACACS+) protocols.

- **Authentication** - authentication provides the initial method of identifying each individual user, typically by entering a valid username and password before access is granted. The AAA server compares a user's authentication credentials with the user credentials stored in a database. If the credentials match, the user is granted access to the network or devices. If the credentials do not match, authentication fails and network access is denied.
- **Authorization** - following the authentication, a user must gain authorization for performing certain tasks. After logging into a system, for instance, the user may try to issue commands. The authorization process determines whether the user has the authority to issue such commands. Simply put, authorization is the process of enforcing policies: determining what types or qualities of activities, resources, or services a user is permitted. Usually, authorization occurs within the context of authentication. Once you have authenticated a user, they may be authorized for different types of access or activity.
- **Accounting** - the last level is accounting, which measures the resources a user consumes during access. This includes the amount of system time or the amount of data a user has sent and/or received during a session. Accounting is carried out by logging of session statistics and usage information, and is used for authorization control, billing, trend analysis, resource utilization, and capacity planning activities.

Authentication, authorization, and accounting services are often provided by a dedicated AAA server, a program that performs these functions. Network access servers interface with AAA servers using the Remote Authentication Dial-In User Service (RADIUS) protocol.

For information on the AAA commands, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.7.1.1 RADIUS

RADIUS (Remote Authentication Dial-In User Service), widely used in network environments, is a client/server protocol and software that enables remote access servers to communicate with a central server to authenticate dial-in users and authorize their access to the requested system or service. It is commonly used for embedded network devices such as routers, modem servers, switches and so on. RADIUS is currently the de-facto standard for remote authentication. It is prevalent in both new and legacy systems.

It is used for several reasons:

- RADIUS facilitates centralized user administration
- RADIUS consistently provides some level of protection against an active attacker

For information on the RADIUS commands, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.7.1.2 TACACS+

TACACS (Terminal Access Controller Access Control System), widely used in network environments, is a client/server protocol that enables remote access servers to communicate with a central server to authenticate dial-in users and authorize their access to the requested system or service. It is commonly used for providing NAS (Network Access Security). NAS ensures secure access from remotely connected users. TACACS implements the TACACS Client and provides the AAA (Authentication, Authorization and Accounting) functionalities.

TACACS is used for several reasons:

- Facilitates centralized user administration
- Uses TCP for transport to ensure reliable delivery
- Supports inbound authentication, outbound authentication and change password request for the authentication service
- Provides some level of protection against an active attacker

For information on the TACACS+ commands, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.7.1.3 LDAP

LDAP (Lightweight Directory Access Protocol) is an authentication protocol that allows a remote access server to forward a user's logon password to an authentication server to determine whether access can be allowed to a given system. LDAP is based on a client/server model. The switch acts as a client to the LDAP server. A remote user (the remote administrator) interacts only with the switch, not the back-end server and database.

LDAP authentication consists of the following components:

- A protocol with a frame format that utilizes TCP over IP
- A centralized server that stores all the user authorization information
- A client: in this case, the switch

Each entry in the LDAP server is referenced by its Distinguished Name (DN). The DN consists of the user-account name concatenated with the LDAP domain name. If the user-account name is John, the following is an example DN:

```
uid=John,ou=people,dc=domain,dc=com
```

For information on the LDAP commands, please refer to *Mellanox MLNX-OS Command Reference Guide*.

4.7.2 Secure Shell (SSH)

4.7.2.1 Adding a Host and Providing an SSH Key

➢ ***To add entries to the global known-hosts configuration file and its SSH value, perform the following steps:***

Step 1. Change to Config mode Run:

```
switch [standalone: master] > enable
```

```
switch [standalone: master] # configure terminal
switch [standalone: master] (config) #
```

Step 2. Add an entry to the global known-hosts configuration file and its SSH value. Run:

```
switch [standalone: master] (config) # ssh client global known-host "myserver ssh-rsa
AAAAB3NzaC1yc2EAAAABIwAAAIEAsXeklqc8T0EN2mnMcVcfhueaRYzIVqt4rVsrERIjmlJh4mkYYIa8hGGikNa+
t5xw2dRrNxnHYLK51bUsSG1ZNwZT1Dpme3pAZeMY7G4ZMgGIW9xOuaXgAA3eBeoUjFdi6+1BqchWk0nTb+gMfI/
MK/heQNns7AtTrvqg/O5ryIc="
switch [standalone: master] (config) #
```

Step 3. Verify what keys exist in the host. Run:

```
switch [standalone: master] (config) # show ssh client
SSH client Strict Hostkey Checking: ask

SSH Global Known Hosts:
    Entry 1: myserver
          Finger Print: d5:d7:be:d7:6c:b1:e4:16:df:61:25:2f:b1:53:a1:06

No SSH user identities configured.

No SSH authorized keys configured.

switch [standalone: master] (config) #
```

4.7.3 User Accounts

There are two user account types: *admin* and *monitor*. As *admin*, the user is privileged to execute all the available operations. As *monitor*, the user can execute operations that display system configuration and status, or set terminal settings.

Table 20 - User Roles (Accounts) and Default Passwords

User Role	Default Password
admin	admin
monitor	monitor

4.8 Network Management Interfaces

4.8.1 SNMP

Simple Network Management Protocol (SNMP), is a network protocol for the management of a network and the monitoring of network devices and their functions. SNMP supports asynchronous event (trap) notifications and queries.

MLNX-OS supports:

- SNMP versions v1, v2c and v3
- SNMP trap notifications
- Standard MIBs
- Mellanox private MIBs
- EHCM MIB

4.8.1.1 Standard MIBs

Table 21 - Standard MIBs – Textual Conventions and Conformance MIBs

MIB	Standard	Comments
INET-ADDRESS-MIB	RFC-4001	
SNMPV2-CONF		
SNMPV2-TC	RFC 2579	
SNMPV2-TM	RFC 3417	
SNMP-USM-AES-MIB	RFC 3826	
IANA-LANGUAGE-MIB	RFC 2591	
IANA-RTPROTO-MIB	RFC 2932	
IANAifType-MIB		
IANA-ADDRESS-FAMILY-NUMBERS-MIB		

Table 22 - Standard MIBs – Structure, Management Interface and General SNMP

MIB	Standard	Comments
SNMPv2-MIB	RFC 3418	
SNMP-FRAMEWORK-MIB	RFC 2571	
SNMP-VIEW-BASED-SM-MIB	RFC 3414	
SNMP-VIEW-BASED-ACM-MIB	RFC 3415	
SNMP-MPD-MIB	RFC 2572	
IP-MIB	RFC 4293	Management interface
TCP-MIB	RFC 4022	Management interface
UDP-MIB	RFC 4113	Management interface
IP-FORWARD-MIB	RFC 4292	Management interface
HOST-RESOURCES-MIB, HOST-RESOURCES-TYPE	RFC 2790	Management interface

Table 23 - Standard MIBs – Chassis and Switch

MIB	Standard	Comments
RFC1213-MIB	RFC 1213	

Table 23 - Standard MIBs – Chassis and Switch

MIB	Standard	Comments
IF-MIB	RFC 2863	ifXTable only supported.
ENTITY-MIB	RFC 4133	
ENTITY-SENSOR-MIB	RFC 3433	Fan and temperature sensors
ENTITY-STATE-MIB	RFC 4268	Fan and temperature states
Bridge MIB	RFC 4188	dot1dTpFdbGroup and dot1dStaticGroup are not supported in this MIB, it is supported as a part of Q-Bridge-MIB. This MIB is not relevant to InfiniBand.
Q-Bridge MIB	RFC 4363	The following SNMP groups are not supported: • qBridgeVlanStatisticsGroup, • qBridgeVlanStatisticsOverflowGroup , • qBridgeVlanHCStatisticsGroup, • qBridgeLearningConstraintsGroup. The following SNMP tables are not supported: • dot1qTpFdbTable (dynamic UC MAC addresses) • dot1qTpGroupTable (dynamic MC MAC addresses) • dot1qForwardAllTable (GMRP) • dot1qForwardUnregisteredTable (GMRP) • dot1qVlanCurrentTable (GVRP) This MIB is not relevant to InfiniBand.
RSTP-MIB	RFC 4318	This MIB is not relevant to InfiniBand.
LLDP-MIB	802.1AB-2005	This MIB is not relevant to InfiniBand.

4.8.1.2 Private MIB

Table 24 - Private MIBs Supported

MIB	Comments
MELLANOX-SMI-MIB	Mellanox Private MIB main structure (no objects)
MELLANOX-PRODUCTS-MIB	List of OID - per managed system (sysObjID)
MELLANOX-IF-VPI-MIB	IfTable Extensions
MELLANOX-EFM-MIB	Deprecated MIB (based on Mellanox-MIB) Traps definitions are supported.

Mellanox private MIBs can be downloaded from the Mellanox Support webpage.

4.8.1.3 Mellanox Private Traps

The following private traps are supported by MLNX-OS

Table 25 - SNMP Traps

Trap	Action Required
asicChipDown	Reboot the system.
asicOverTempReset	Check Fans and environmental temperature.
asicOverTemp	Check Fans and environmental temperature.
lowPower	Add/connect power supplies.
internalBusError	N/A
procCrash	Generate SysDump and contact Mellanox support.
cpuUtilHigh	N/A
procUnexpectedExit	Generate SysDump and contact Mellanox support.
diskSpaceLow	Clean images and sysDump files using the commands “image delete” and “file debug-dump delete”.
systemHealthStatus	Refer to Health Status table.
lowPowerRecover	N/A
insufficientFans	Check Fans and environmental conditions.
insufficientFansRecover	N/A
insufficientPower	Add/connect power supplies, or change power mode using the command “power redundancy mode”.
insufficientPowerRecover	N/A

For additional information refer to MELLANOX-EFM-MIB.

4.8.1.4 Traps and Events Mapping

The following table maps the CLI supported events to SNMP traps.

Table 26 - Supported Traps and Events

Event Description	CLI Event	MIB OID	Comments
ASIC (chip) down	asic-chip-down	Mellanox-EFM-MIB: asicChipDown	Not supported
CPU utilization has risen too high	cpu-util-high	Mellanox-EFM-MIB: cpuUtilHigh	
File system free space has fallen too low	disk-space-low	Mellanox-EFM-MIB: diskSpaceLow	

Table 26 - Supported Traps and Events

Event Description	CLI Event	MIB OID	Comments
Health module status changed	health-module-status	Mellanox-EFM-MIB: systemHealthStatus	
Insufficient amount of fans in system	insufficient-fans	Mellanox-EFM-MIB: insufficientFans	
Insufficient amount of fans in system recovered	insufficient-fans-recover	Mellanox-EFM-MIB: insufficientFansRecover	
Insufficient power supply	insufficient-power	Mellanox-EFM-MIB: insufficientPower	
An interface's link state has changed to DOWN	interface-down	RFC1213: linkdown (SNMPv1)	Supported for Ethernet and management interfaces
An interface's link state has changed to UP	interface-up	RFC1213: linkup (SNMPv1)	Supported for Ethernet and management interfaces
Internal bus (I^2C) error	internal-bus-error	Mellanox-EFM-MIB: internalBusError	
A process in the system is detected as hung	liveness-failure	Not implemented	
Low power supply	low-power	Mellanox-EFM-MIB: lowPower	
Low power supply recover	low-power-recover	Mellanox-EFM-MIB: lowPowerRecover	
Local bridge became a root bridge	new_root	Bridge-MIB: newRoot	Supported for Ethernet
Paging activity has risen too high	paging-high	N/A	Not supported
Power redundancy mismatch	power-redundancy-mismatch	Mellanox-EFM-MIB: powerRedundancyMismatch	Supported for SX65XX only systems
A process in the system has crashed	process-crash	Mellanox-EFM-MIB: procCrash	
A process in the system unexpectedly exited	process-exit	Mellanox-EFM-MIB: procUnexpectedExit	
An SNMPv3 request has failed authentication	snmp-authtrap	Not implemented	
Topology change triggered by a local bridge	topology_change	Bridge-MIB: topologyChange	Supported for Ethernet

Table 26 - Supported Traps and Events

Event Description	CLI Event	MIB OID	Comments
Unexpected system shut-down	unexpected-shutdown	Mellanox-EFM-MIB: unexpectedShutdown	
Send a testing event	To send, use the CLI command: `snmp-server notify send-test`	testTrap	
Reset occurred due to over-heating of ASIC	N/A	Mellanox-EFM-MIB: asicOverTempReset	Not supported
Temperature is too high	temperature-too-high	Mellanox-EFM-MIB: asicOverTemp	

4.8.1.5 Configuring SNMP

➢ ***To set up the SNMP:***

Step 1. Activate the SNMP server on the MLNX-OS switch (in configure mode) using the following commands:

Community strings are case sensitive.

```
switch (config) # snmp-server enable
switch (config) # snmp-server enable notify
switch (config) # snmp-server community public ro
switch (config) # snmp-server contact "contact name"
switch (config) # snmp-server host <host IP address> traps version 2c public
switch (config) # snmp-server location "location name"
switch (config) # snmp-server user admin v3 enable
switch (config) # snmp-server user admin v3 prompt auth md5 priv des
```

4.8.1.6 Configuring an SNMPv3 User

➢ ***To configure SNMP V3 user:***

Step 1. Configure the user using the command:

```
 switch (config) # snmp-server user [role] v3 prompt auth <hash type> priv <privacy
type>
```

where

- user role - `admin`
- auth type - `md5` or `sha`
- priv type - `des` or `aes-128`

Step 2. Enter authentication password and its confirmation.

Step 3. Enter privacy password and its confirmation.

```
switch (config) # snmp-server user admin v3 prompt auth md5 priv des
Auth password: ********
      Confirm: ********
Privacy password: ********
         Confirm: ********
switch (config) #
```

To retrieve the system table, run the following SNMP command:

```
snmpwalk -v3 -l authPriv -a MD5 -u admin -A  "<Authentication password>" -x DES -X
"<privacy password>" <system ip> SNMPv2-MIB::system
```

4.8.1.7 Configuring an SNMP notifications

➢ ***To set up the SNMP Notification (traps or informs) follow the next steps***

Step 1. Make sure SNMP and SNMP notification are enable. Run:

```
switch (config) # snmp-server enable
switch (config) # snmp-server enable notify
switch (config) #
```

Step 2. Configure SNMP host with the desired arguments (IP Address, SNMP version, authentication methods). More than one host can be configured. Each host may have different attributes. Run:

```
switch (config) # snmp-server host 10.134.47.3 traps version 3 user my-username auth
sha my-password
switch (config) #
```

Step 3. Verify the SNMP host configuration. Run:

```
switch (config) # show snmp host
Notifications enabled:           yes
Default notification community:  public
Default notification port:       162

Notification sinks:

   10.134.47.3
      Enabled:                yes
      Port:                   162 (default)
      Notification type:      SNMP v3 trap
      Username:               my-username
      Authentication type:    sha
      Privacy type:           aes-128
      Authentication password: (set)
      Privacy password:       (set)

switch (config) #
```

Step 4. Verify the list of traps and informs being sent to out of the system. Run :

```
switch (config) # show snmp events
Events for which traps will be sent:
  asic-chip-down: ASIC (Chip) Down
  cpu-util-high: CPU utilization has risen too high
  disk-space-low: Filesystem free space has fallen too low
  health-module-status: Health module Status
  insufficient-fans: Insufficient amount of fans in system
  insufficient-fans-recover: Insufficient amount of fans in system recovered
  insufficient-power: Insufficient power supply
  interface-down: An interface's link state has changed to down
  interface-up: An interface's link state has changed to up
  internal-bus-error: Internal bus (I2C) Error
  liveness-failure: A process in the system was detected as hung
  low-power: Low power supply
  low-power-recover: Low power supply Recover
  new_root: local bridge became a root bridge
  paging-high: Paging activity has risen too high
  power-redundancy-mismatch: Power redundancy mismatch
  process-crash: A process in the system has crashed
  process-exit: A process in the system unexpectedly exited
  snmp-authtrap: An SNMP v3 request has failed authentication
  topology_change: local bridge trigerred a topology change
  unexpected-shutdown: Unexpected system shutdown
switch (config) #
```

4.8.2 MLNX-OS XML API

MLNX-OS XML API is an additional option to manage the system (besides SNMP). The XML gateway provides an XML request-response protocol that can be used by end-user tools to get and set management information on the appliance. The service can be accessed over HTTP or HTTPS, and then it uses the existing web authentication mechanism. It can also be accessed over SSH, and then it uses the existing CLI authentication mechanism. XML Gateway - Management information base.

For further information please contact Mellanox support.

5 Ethernet Switching

5.1 Interface

Interface Ethernet have the following physical set of configurable parameters

- Admin state – enabling or disabling the interface.
- Flow control – admin state per direction (send or receive)
- MTU (Maximum Transmission Unit) – (1518-9216 bytes)
- Speed – 1/10/40/56GbE (depends on the interface type and system)
- Description – user defined string
- Module-type – the type of the module plugged in the interface

5.2 Link Aggregation Group (LAG)

Link Aggregation protocol describes a network operation in which several same speed links are combined into a single logical entity with the accumulated bandwidth of the originating ports. LAG groups exchange Lag Aggregation Control Protocol (LACP) packets in order to align the functionality between both endpoints of the LAG. To equally send traffic on all LAG links, the switch uses a hash function which can use a set of attributes as key to the hash function.

As many as 16 physical ports can be aggregated on a single port-channel.

5.2.1 Configuring Static Link Aggregation Group (LAG)

➢ ***To configure a static LAG:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a port-channel entity. Run:

```
switch (config) # interface port-channel 1
switch (config interface port-channel 1) #
```

Step 4. Change back to config mode.

```
switch (config interface port-channel 1) # exit
switch (config) #
```

Step 5. Enable LACP in the switch. Run:

```
switch (config) # lacp
switch (config) #
```

Step 6. Add a physical port to the port-channel. Run:

```
switch (config interface ethernet 1/4) # channel-group 1 mode on
switch (config interface ethernet 1/4) #
```

If the physical port is operationally up, this port will be an active member of the aggregation. Consequently, it will be able to convey traffic.

5.2.2 Configuring Link Aggregation Control Protocol (LACP)

➢ ***To configure LACP:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a port-channel entity. Run:

```
switch (config) # interface port-channel 1
switch (config interface port-channel 1) #
```

Step 4. Change back to config mode. Run:

```
switch (config interface port-channel 1) # exit
switch (config) #
```

Step 5. Enable LACP in the switch. Run:

```
switch (config) # lacp
switch (config) #
```

Step 6. Add a physical port to the port-channel. Run:

```
switch (config interface ethernet 1/4) # channel-group 1 mode active/passive
switch (config interface ethernet 1/4) #
```

5.3 VLANs

A Virtual Local Area Network (VLAN) is an L2 segment of the network which defines a broadcast domain and is identified by a tag added to all Ethernet frames running within the domain. This tag is called a VLAN ID (VID) and can take a value of 1-4094.

Each port can have a switch mode of either:

- Access – Access port is a port connected to a host. It can accept only untagged frames, and assigns them a default configured VLAN (Port VLAN ID). On egress, traffic sent from the access port is untagged.
- Access-dcb – This mode is Mellanox specific that receives ingress untagged traffic but sends egress priority tag (VLAN ID = 0)
- Hybrid – Hybrid port is a port connected to either switches or hosts. It can receive both tagged and untagged frames and assigns untagged frames a default configured VLAN (Port VLAN ID). It receives tagged frames with VLANs of which the port is a member (these VLANs' names are allowed). On egress, traffic of allowed VLANs sent from the Hybrid port is sent tagged, while traffic sent with PVID is untagged.

- Trunk – Trunk port is a port connecting 2 switches. It accepts only tagged frames with VLANs of which the port is a member. On egress, traffic sent from the Trunk port is tagged. By default, a Trunk port is, automatically, a member on all current VLANs.

5.3.1 Configuring Access Mode and Assigning Port VLAN ID (PVID)

➢ ***To configure Access mode and assign PVID to interfaces:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a VLAN. Run:

```
switch (config) # vlan 6
switch (config vlan 6) #
```

Step 4. Change back to config mode. Run:

```
switch (config vlan 6) # exit
switch (config) #
```

Step 5. Enter the interface context. Run:

```
switch (config) # interface ethernet 1/36
switch (config interface ethernet 1/36) #
```

Step 6. From within the interface context, configure the interface mode to Access. Run:

```
switch (config interface ethernet 1/36) # switchport mode access
switch (config interface ethernet 1/36) #
```

Step 7. From within the interface context, configure the Access VLAN membership. Run:

```
switch (config interface ethernet 1/36) # switchport access vlan 6
switch (config interface ethernet 1/36) #
```

Step 8. Change back to config mode. Run:

```
switch (config interface ethernet 1/36) # exit
switch (config) #
```

5.3.2 Configuring Hybrid Mode and Assigning Port VLAN ID (PVID)

➢ ***To configure Hybrid mode and assign PVID to interfaces:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a VLAN. Run:

```
switch (config) # vlan 6
switch (config vlan 6) #
```

Step 4. Change back to config mode. Run:

```
switch (config vlan 6) # exit
switch (config) #
```

Step 5. Enter the interface context. Run:

```
switch (config) # interface ethernet 1/36
switch (config interface ethernet 1/36) #
```

Step 6. From within the interface context, configure the interface mode to Access. Run:

```
switch (config interface ethernet 1/36) # switchport mode hybrid
switch (config interface ethernet 1/36) #
```

Step 7. From within the interface context, configure the Access VLAN membership. Run:

```
switch (config interface ethernet 1/36) # switchport hybrid vlan 6
switch (config interface ethernet 1/36) #
```

Step 8. Change to config mode again. Run:

```
switch (config interface ethernet 1/36) # exit
switch (config) #
```

5.3.3 Configuring Trunk Mode VLAN Membership

➢ ***To configure Trunk mode VLAN membership:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a VLAN. Run:

```
switch (config) # vlan 10
switch (config vlan 10) #
```

Step 4. Change back to config mode. Run:

```
switch (config vlan 10) # exit
switch (config) #
```

Step 5. Enter the interface context. Run:

```
switch [standalone: master] (config) # interface ethernet 1/35
switch [standalone: master] (config interface ethernet 1/35) #
```

Step 6. From within the interface context, configure the interface mode to Trunk. Run:

```
switch [standalone: master] (config interface ethernet 1/35) # switchport mode trunk
switch [standalone: master] (config interface ethernet 1/35) #
```

5.3.4 Configuring Hybrid Mode VLAN Membership

➢ ***To configure Hybrid mode VLAN membership:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a VLAN. Run:

```
switch (config) # vlan 10
switch (config vlan 10) #
```

Step 4. Change back to config mode. Run:

```
switch (config vlan 10) # exit
switch (config) #
```

Step 5. Enter the interface context. Run:

```
switch (config) # interface ethernet 1/35
switch (config interface ethernet 1/35) #
```

Step 6. From within the interface context, configure the interface mode to Hybrid. Run:

```
switch (config interface ethernet 1/35) # switchport mode hybrid
switch (config interface ethernet 1/35) #
```

Step 7. From within the interface context, configure the allowed VLAN membership. Run:

```
switch (config interface ethernet 1/35) # switchport hybrid allowed-vlan add 10
switch (config interface ethernet 1/35) #
```

Step 8. Change to config mode again. Run:

```
switch (config interface ethernet 1/35) # exit
switch (config) #
```

5.4 MAC Address Table

5.4.1 Configuring Unicast Static MAC Address

You can configure static MAC addresses for unicast traffic. This feature improves security and reduces unknown unicast flooding.

➢ ***To configure Unicast Static MAC address:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Run the command `mac-address-table static unicast <destination mac address> vlan <vlan identifier(1-4094)> interface ethernet <slot>/ <port>`.

```
switch (config) # mac-address-table static unicast 00:11:22:33:44:55 vlan 1 interface
ethernet 0/1
```

5.5 Spanning Tree

The operation of Rapid Spanning Tree Protocol (RSTP) provides for rapid recovery of connectivity following the failure of a bridge/bridge port or a LAN. The RSTP component avoids this delay by calculating an alternate root port, and immediately switching over to the alternate port if the root port becomes unavailable. Thus, using RSTP, the switch immediately brings the alternate port to forwarding state, without the delays caused by the listening and learning states. The RSTP component conforms to IEEE standard 802.1D 2004.

RSTP enhancements is a set of functions added to increase the volume of RSTP in Mellanox switches. It adds a set of capabilities related to the behavior of ports in different segments of the network. For example: the required behavior of a port connected to a non-switch entity, such as

host, is to converge quickly, while the required behavior of a port connected to a switch entity is to converge based on the RSTP parameters.

Additionally, it adds security issues on a port and switch basis, allowing the operator to determine the state and role of a port or the entire switch should an abnormal event occur. For example: If a port is configured to be root-guard, the operator will not allow it to become a root-port under any circumstances, regardless of any BPDU that will have been received on the port.

5.5.1 Port Priority and Cost

When two ports on a switch are part of a loop, the STP port priority and port path cost configuration determine which port on the switch is put in the forwarding state and which port is put in the blocking state.

To configure port priority use the following command:

```
switch (config interface etherent <inf>)# spanning-tree port-priority <0-240>
```

To configure port path cost use the following command:

```
switch (config interface etherent <inf>)# spanning-tree cost <1-200000000>
```

5.5.2 Port Type

Port type has the following configuration options:

- **edge –** is not assumed to be converged by the RSTP learning/forwarding mechanism. It converges to forwarding quickly.

It is recommended to configure the port type for all ports connected to hosts as edge ports.

- **normal –** is assumed to be connected to a switch, thus it tries to be converged by the RSTP learning/forwarding. However, if it does not receive any BPDUs, it is operationally moved to be edge.
- **network –** is assumed to be connected to a switch. If it does not receive any BPDUs, it is moved to discarding state.

Each of these configuration options is mutually exclusive.

Port type is configured using the command spanning-tree port type. It may be applied globally on the switch (Config) level, which configures all switch interfaces. Another option is to configure ports individually by entering the interface's configuration mode.

- Global configuration:

```
switch (config)# spanning-tree port type {edge , normal , network} default
```

- Interface configuration:

```
switch (config interface etherent <inf>)# spanning-tree port type {edge , normal, network}
```

5.5.3 BPDU Filter

Using BPDU filter prevents the CPU from sending/receiving BPDUs on specific ports.

BPDU filtering is configured per interface. When configured, the port does not send any BPDUs and drops all BPDUs that it receives. To configure BPDU filter, use the following command:

```
switch (config interface etherent <inf>)# spanning-tree bpdufilter {enable , disable}
```

Configuring BPDU filtering on a port connected to a switch can cause bridging loops because the port filters any BPDU it receives and goes to forwarding state.

5.5.4 Loop Guard

Loop guard is a feature that prevents loops in the network.

When a blocking port in a redundant topology transitions to the forwarding state (accidentally), an STP loop occurs. This happens when BPDUs are no longer received by one of the ports in a physically redundant topology.

Loop guard is useful in switched networks where devices are connected point-to-point. A designated bridge cannot disappear unless it sends an inferior BPDU or brings the link down on a point-to-point connection.

The loop guard configuration is only allowed on “network” port type.

If loop guard is enabled and the port does not receive BPDUs, the port is put into an inconsistent state (blocking) until the port starts to receive BPDUs again. A port in the inconsistent state does not transmit BPDUs. If BPDUs are received again, loop guard alters its inconsistent state condition. STP converges to a stable topology without the failed link or bridge after loop guard isolates the failure.

Disabling loop guard moves all loop-inconsistent ports to listening state.

To configure loop guard use the following command:

```
switch (config interface etherent <inf>)# spanning-tree guard loop
```

5.5.5 Root Guard

Configuring root guard on a port prevents that port from becoming a root port. A port put in root-inconsistent (blocked) state if an STP convergence is triggered by a BPDU that makes that port a root port. The port is unblocked after the port stops sending BPDUs.

To configure loop guard use the following command:

```
switch (config interface etherent <inf>)# spanning-tree guard root
```

5.6 IGMP Snooping

The Internet Group Multicast Protocol (IGMP) is a communications protocol used by hosts and adjacent routers on IP networks to establish multicast group memberships. The host joins a mul-

ticast-group by sending a join request message towards the network router, and responds to queries sent from the network router by dispatching a join report.

A given port can be either manually configured to be a router-port or it can be dynamically manifested when having received a query, hence, the network router is connected to this port. All IGMP Snooping Control packets received from hosts (joins / leaves) are forwarded to the router-port, and the router-port will update its multicast-group data-base accordingly. Each dynamically learnt multicast group will be added to all of the router-ports on the switch.

As many as 5K multicast groups can be created on the switch.

5.6.1 Configuring IGMP Snooping

You can configure IGMP snooping to establish multicast group memberships.

➢ ***To configure IGMP snooping:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable IGMP snooping globally. Run:

```
switch (config) # ip igmp snooping
switch (config) #
```

Step 4. Enable IGMP snooping on a VLAN. Run:

```
switch (config) # vlan 2
switch (config vlan 2) # ip igmp snooping
```

5.6.2 Defining a Multicast Router Port on a VLAN

You can define a Multicast Router (MRouter) port on a VLAN in one of the following methods:

➢ ***To change the Interface Switchport to Trunk:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable IGMP snooping globally. Run:

```
switch (config) # ip igmp snooping
switch (config) #
```

Step 4. Change the interface switchport mode of the port (the interface is member of VLAN 1 by default). Run:

```
switch (config) # interface ethernet 1/1
switch (config interface ethernet 1/1) # switchport mode trunk
```

Step 5. Change back to config mode. Run:

```
switch (config interface ethernet 1/1) # exit
switch (config) #
```

Step 6. Define the MRouter port on the VLAN. Run:

```
switch (config) # vlan 2
switch (config vlan 2) # ip igmp mrouter interface ethernet 1/1
switch (config vlan 2) #
```

➢ ***To change the Interface Switchport to Hybrid:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable IGMP snooping globally. Run:

```
switch (config) # ip igmp snooping
switch (config) #
```

Step 4. Create a VLAN. Run:

```
switch (config) # vlan 200
switch (config vlan 200) #
```

Step 5. Change back to config mode. Run:

```
switch (config vlan 200) # exit
switch (config) #
```

Step 6. Change the interface switchport mode of the port (the interface is member of VLAN 1 by default). Run:

```
switch (config) # interface ethernet 1/36
switch (config interface ethernet 1/36) # switchport mode hybrid
```

Step 7. Attach the VLAN to the port's interface. Run:

```
switch (config interface ethernet 1/36) # switchport mode hybrid allowed-vlan 200
switch (config interface ethernet 1/36) #
```

Step 8. Change to config mode again. Run:

```
switch (config interface ethernet 1/36) # exit
switch (config) #
```

Step 9. Define the MRouter port on the VLAN. Run:

```
switch (config) # vlan 200
switch (config vlan 200) # ip igmp mrouter interface ethernet 1/36
switch (config vlan 200) #
```

5.7 Link Layer Discovery Protocol (LLDP)

The Link Layer Discovery Protocol (LLDP) is a vendor-neutral Link Layer protocol in the Internet Protocol Suite used by network devices for advertising their identity, capabilities, and neighbors on a IEEE 802 LAN. The protocol is formally defined in IEEE 802.1AB.

5.7.1 Configuring LLDP

➢ ***To configure the LLDP on the switch:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable LLDP globally on the switch. Run:

```
switch (config) # lldp
switch (config) #
```

Step 4. Enable LLDP per interface. Run:

```
switch (config interface ethernet 1/1) # lldp receive
switch (config interface ethernet 1/1) # lldp transmit
```

Step 5. Show LLDP local information. Run:

```
switch (config) # show lldp local

LLDP is Enabled

Local global configuration
Chassis sub type: macAddress (4)
Chassis id: 00:11:22:33:44:55
System Name: "switch-111111"
System Description: my-system-description
Supported capabilities: B
Supported capabilities enabled: B
```

Step 6. Show LLDP remote information. Run:

```
switch (config)# show lldp interfaces ethernet 1/1 remote

Ethernet 1/1
Remote Index: 1
Remote chassis id: 00:11:22:33:44:55 ; chassis id subtype: mac
Remote port-id: ethenret 1/2; port id subtype: local
Remote port description: ethernet 1/2
Remote system name: remote-system
Remote system description: remote-system-description
Remote system capabilities supported: B ; B
```

5.8 Quality of Service (QoS)

5.8.1 Priority Flow Control and Link Level Flow Control

Priority Flow Control (PFC) provides an enhancement to the existing pause mechanism in Ethernet. The current Ethernet pause option stops all traffic on a link. PFC creates eight separate virtual links on the physical link and allows any of these links to be paused and restarted independently, enabling the network to create a no-drop class of service for an individual virtual link. PFC has 8 possible priorities (3 bits in VLAN header). Each priority can be mapped to one of 4 possible queues in the ingress.

The PFC software offers the following features:

- Provides per-priority enabling or disabling of flow control

- Transmits PFC-PAUSE frames when the receive threshold for a particular traffic class is reached
- Provides the management capability for an administrator to configure the flow control properties on each port of the switch
- Keeps flow control disabled for all priorities on all ports by default
- Allows an administrator to enable or disable flow control per port and per priority level
- Supports flow control only on physical ports, not on logical interfaces such as tunnels or interfaces defined by sharing a physical port in multiple virtual switch contexts
- Uses the configured threshold values to set up the queue buffer spaces accordingly in the datapath
- Provides hardware abstraction layer callouts for the following:
  - Enabling or disabling of flow control on each port for each priority
  - Configuring the queue depth for each priority on each port
- Supports MIB defined in the 802.1Qbb standard and a proprietary MIB for management
- Provides trace logs for execution upon error conditions and for any event notifications from the hardware or datapath. These trace logs are a useful aid in troubleshooting.
- Allows the administrator to configure the minimum and maximum threshold values for flow control. These configurations are applied globally on all ports and priorities.

Priority Based Flow Control (PFC) provides an enhancement to the existing pause flow control mechanism as described in 802.1X.

➢ ***To enable PFC globally:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable PFC globally on the switch. Run:

```
switch (config) # dcb priority-flow-control enable
This action might cause traffic loss while shutting down a port with priority-flow-con-
trol mode on
Type 'yes' to confirm  enable pfc globally: yes
```

➢ ***To enable PFC per priority:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable PFC globally on the switch. Run:

```
switch (config) # dcb priority-flow-control enable
# dcb priority-flow-control enable
This action might cause traffic loss while shutting down a port with priority-flow-con-
trol mode on
Type 'yes' to confirm  enable pfc globally: yes
switch (config) #
```

Step 4. Choose the desirable priority you want to enable using the command `dcb priority-flow-control priority <pri[0..7]> enable`.

```
switch (config) # dcb priority-flow-control priority 5 enable
```

➢ ***To enable PFC per interface:***

Step 1. Log in as admin.

Step 2. Change to config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Enable PFC globally on the switch. Run:

```
switch (config) # dcb priority-flow-control enable
```

Step 4. Choose the desirable priority you want to enable using the command `dcb priority-flow-control priority <pri[0..7]> enable`

```
switch (config) # dcb priority-flow-control 5 enable
```

Step 5. Change to Interface mode. Run:

```
switch (config) #
switch (config) # interface ethernet 1/1
switch (config interface ethernet 1/1) #
```

Step 6. Enable PFC for the specific interface:

```
switch (config interface ethernet 1/1) # dcb priority-flow-control mode on
```

5.8.2 Enhanced Transmission Selection (ETS)

Enhanced Transmission Selection (ETS) provides a common management framework for assignment of bandwidth to traffic classes, for weighted round robin (WRR) scheduling. If a traffic class does not use all the bandwidth allocated to it, other traffic classes can use that available bandwidth. This allows optimal utilization of the network capacity while prioritizing and providing the necessary resources.

The ETS feature has the following attributes:

- ETS global admin:
  - Enable (default) – scheduling mode is WRR according to the configured bandwidth-per-traffic class
  - Disable – scheduling mode is Strict Priority (SP)
- Bandwidth percentage for each traffic class: By default each traffic class gets an equal share

The default mapping of priority to traffic classes (per interface) is as follows:

- Priority 0,1 mapped to tc 0
- Priority 2,3 mapped to tc 1
- Priority 4,5 mapped to tc 2
- Priority 6,7 mapped to tc 3

ETS is enabled by default (scheduling is WRR).

➢ ***To set the scheduling mode to Strict Priority:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Run the command `dcb ets disable`.

```
switch (config) # no dcb ets enable
```

➢ ***To configure the WRR bandwidth percentage:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Make sure ETS feature is enabled. Run:

```
switch (config) # dcb ets enable
```

Step 4. Choose the WRR bandwidth rate and distribution.

By default the WRR distribution function is equal 25% per TC. Changing the WRR bandwidth rate will cause a change in the distribution function, for example if you wish to schedule more traffic on TC-0, TC-1, TC-2 while reducing the amount of traffic sent on TC-3, run the command `dcb ets tc bandwidth`.

```
switch (config) # dcb ets tc bandwidth 30 30 30 10
# show dcb ets

ETS enabled

TC        Bandwidth
--------------------------
0         30%
1         30%
2         30%
3         10%

Number of Traffic Class: 4
switch (config) #
```

Traffic class priorities are <0-3>, where 0 is the lowest and 3 is the highest.

The sum of all traffic class bandwidth value (in percentage) should be 100, otherwise the command will fail.

Step 5. Run the command `show dcb ets` to verify the configuration.

```
switch (config) # show dcb ets
ETS enabled

TC        Bandwidth
-------------------------
0         30%
1         30%
2         10%
3         30%

Number of Traffic Class: 4
switch (config) #
```

5.9 Access Control List

An Access Control List (ACL) is a list of permissions attached to an object, to filter or match switches packets. When the pattern is matched at the hardware lookup engine, a specified action (e.g. permit/deny) is applied. The rule fields represent flow characteristics such as source and destination addresses, protocol and VLAN ID.

ACL support currently allows actions of *permit* or *deny* rules, and supports only ingress direction. ACL search pattern can be taken from either L2 or L3 fields, e.g L2/L3 source and destination addresses, protocol, VLAN ID and priority or TCP port.

5.9.1 Configuring Access Control List

Access Control List (ACL) is configured by the user and is applied to a port once the ACL search engine matches search criteria with a received packet.

➢ ***To configure ACL:***

Step 1. Log in as admin.

Step 2. Enter config mode. Run:

```
switch > enable
switch # configure terminal
```

Step 3. Create a MAC / IPv4 ACL (access-list) entity.

```
switch (config) mac access-list mac-acl
switch (config mac access-list mac-acl) #
```

Step 4. Add a MAC / IP rules to the appropriate access-list.

```
switch (config mac access-list mac-acl)seq-number 10 deny 0a:0a:0a:0a:0a:0a mask
ff:ff:ff:ff:ff:ff any vlan 6 cos 2 protocol 80
switch (config mac access-list mac-acl) #
```

Step 5. Bind the created access-list to an interface (slot/port or port-channel).

```
switch (config)
switch (config) # interface ethernet 1/1
switch (config interface ethernet 1/1) # mac port access-group mac-acl
```

5.9.2 ACL Actions

An ACL action is a set of actions can be activated in case the packet hits the ACL rule.

➢ ***To modify the VLAN tag of the egress traffic as part of the ACL "permit" rule:***

Step 1. Create access-list action profile:

a.Create an action access-list profile using the command `access-list action <action-profile-name>`

b.Add rule to map a VLAN using the command `vlan-map <vlan-id>` within the action profile configuration mode

Step 2. Create an access-list and bind the action rule:

a.Create an access-list profile using the command `ipv4/mac access-list`

b.Add access list rule using the command `deny/permit (action <action profile name>)`

Step 3. Bind the access-list to an interface using the command `ipv4/mac port access-group`

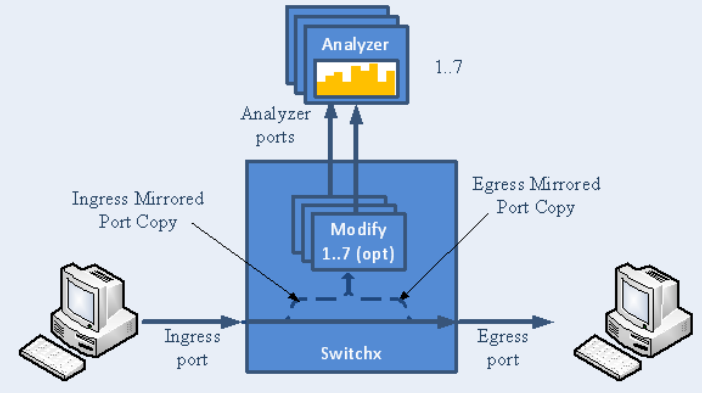
```
Create an action profile and add vlan mapping action:
switch (config)#access-list action my-action
switch (config access-list action my-action) # vlan-map 20
switch (config access-list action my-action) #exit

Create an access list and bind rules:
switch (config)# mac access-list my-list
switch (config mac access-list my-list)# permit any any action my-action
switch (config mac access-list my-list)# exit

Bind an access-list to a port:
Switch (config)# interface ethernet 1/1
Switch (config interface ethernet 1/1)# mac port access-group my-list
```

5.10 Port Mirroring

Port mirroring enables data plane monitoring functionality which allows the user to send an entire traffic stream for testing. Port mirroring sends a copy of packets of a port's traffic stream, called "mirrored port", into an analyzer port. Port mirroring is used for network monitoring. It can be used for intrusion detection, security breaches, latency analysis, capacity and performance matters, and protocol analysis.

Figure 9 provides an overview of the mirroring functionality.

Figure 9: Overview of Mirroring Functionality

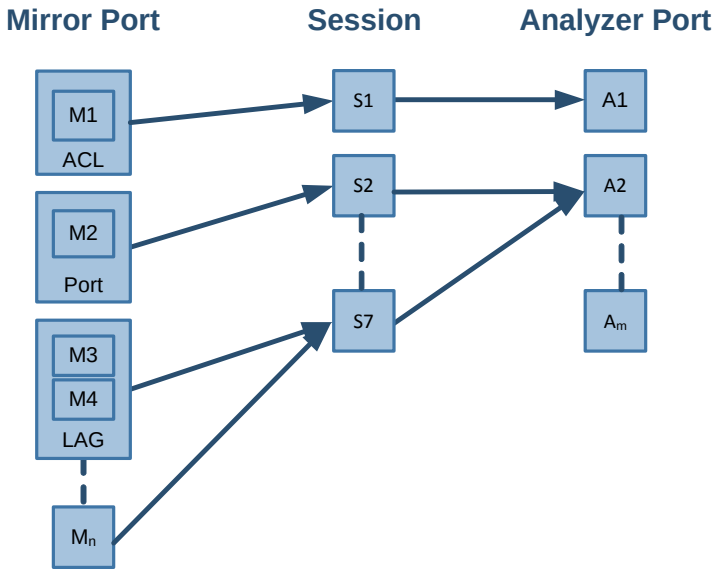


There is no limitation on the number of mirroring sources and more than a single source can be mapped to a single analyzer destination.

5.10.1 Mirroring Sessions

Port mirroring is performed by configuring mirroring sessions. A session is an association of a mirror port (or more) and an analyzer port.

Figure 10: Mirror to Analyzer Mapping



A mirroring session is a monitoring configuration mode that has the following parameters:

Table 27 - Mirroring Parameters

Parameter	Description	Access
Source interface(s)	List of source interfaces to be mirrored.	RW
Destination interface	A single analyzer port through which all mirrored traffic egress.	RW
Header format	The format and encapsulation of the mirrored traffic when sent to analyzer.	RW
Truncation	Enabling truncation segments each mirrored packet to 64 bytes.	RW
Congestion control	Controls the behavior of the source port when destination port is congested.	RW
Admin state	Administrative state of the monitoring session.	RW

5.10.1.1 Source Interface

The source interface (mirror port) refers to the interface from which the traffic is monitored. Port mirroring does not affect the switching of the original traffic. The traffic is simply duplicated and sent to the analyzer port. Traffic in any direction (either ingress, egress or both) can be mirrored.

There is no limitation on the number of the source interfaces mapped to a mirroring session.

Ingress and egress traffic flows of a specific source interface can be mapped to two different sessions.

LAG

The source interface can be a physical interface or a LAG.

Port mirroring can be configured on a LAG interface but not on a LAG member. When a port is added to a mirrored LAG it inherits the LAG's mirror configuration. However, if port mirroring configuration is set on a port, that configuration must be removed prior to adding the port to a LAG interface.

When a port is removed from a LAG, the mirror property is switched off for that port.

Control Protocols

All control protocols captured on the mirror port are forwarded to the analyzer port in addition to their normal treatment. For example LACP, STP, and LLDP are forwarded to the analyzer port in addition to their normal treatment by the CPU.

Exceptions to the behavior above are the packets that are being handled by the MAC layer, such as pause frames.

5.10.1.2 Destination Interface

The destination interface is an analyzer port is one to which mirrored traffic is sent. The mirrored packets, are duplicated, optionally modified and sent to the analyzer port. The SwitchX® platform supports up to 7 analyzer ports where any mirror port can be mapped to any analyzer port and more than a single mirror port can be mapped to a single analyzer port.

Packets can be forwarded to any destination using the command `destination interface`.

The analyzer port supports status and statistics as any other port.

LAG

The destination interface cannot be a member of LAG when the header format is local.

Control Protocols

The destination interface may also operate in part as a standard port, receiving and sending out non-mirrored traffic. When the header format is configured as a local port, ingress control protocol packets that are received by the local analyzer port get discarded.

Advanced MTU Considerations

The analyzer port, like its counterparts, is subject to MTU configuration. It does not send packets longer than configured.

When the analyzer port sends encapsulated traffic, the analyzer traffic has additional headers and therefore longer frame. The MTU must be configured to support the additional length, otherwise, the packet is truncated to the configured MTU.

The system on the receiving end of the analyzer port must be set to handle the egress traffic. If it is not, it might discard it and indicate this in its statistics (packet too long).

5.10.1.3 Header Format

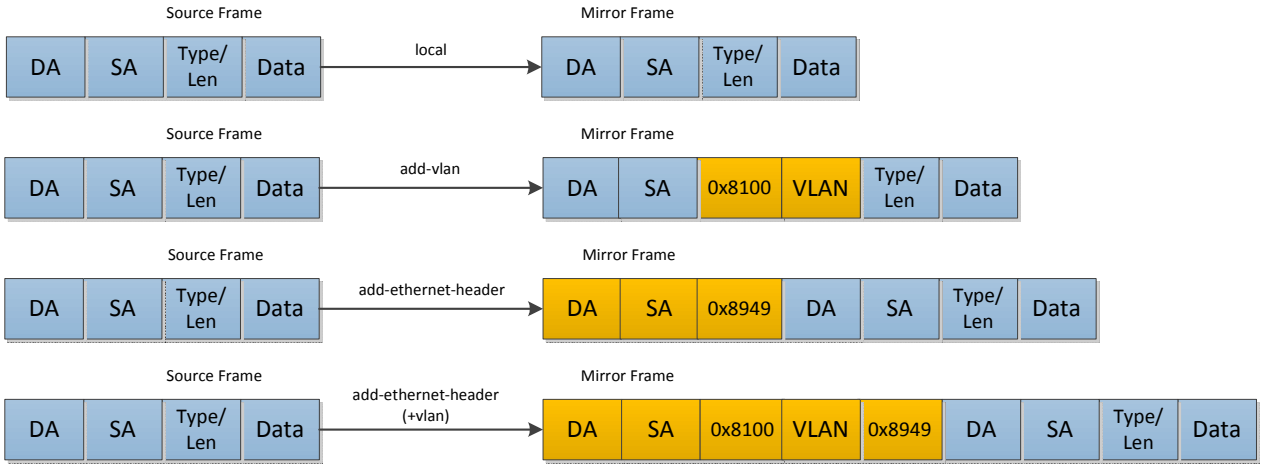
Ingress traffic from the source interface can be manipulated in several ways depending on the network layout using the command `header-format`.

If the analyzer system is directly connected to the destination interface, then the only parameters that can be configured on the port are the MTU, speed and port based flow control. Priority flow control is not supported is this case. However, if the analyzer system is indirectly connected to the destination interface, there are two options for switching the mirrored data to the analyzer system:

- A VLAN tag may be added to the Ethernet header of the mirrored traffic
- An Ethernet header can be added with include a new destination address and VLAN tag

It must be taken into account that adding headers increases packet size.

Figure 11: Header Format Options



5.10.1.4 Congestion Control

The destination ports might receive pause frames that lead to congestion in the switch port. In addition, too much traffic directed to the analyzer port (for example 40GbE mirror port is directed into 10G analyzer port) might also lead to congestion.

In case of congestion:

- When best effort mode is enabled on the analyzer port, SwitchX drops excessive traffic headed to the analyzer port using tail drop mechanism, however, the regular data (mirrored data heading to its original port) does not suffer from a delay or drops due to the analyzer port congestion.
- When the best effort mode on the analyzer port is disabled, the SwitchX does not drop the excessive traffic. This might lead to buffer exhaustion and data path packet loss.

The default behavior in congestion situations is to drop any excessive frames that may clog the system.

ETS, PFC and FC configurations do not apply to the destination port.

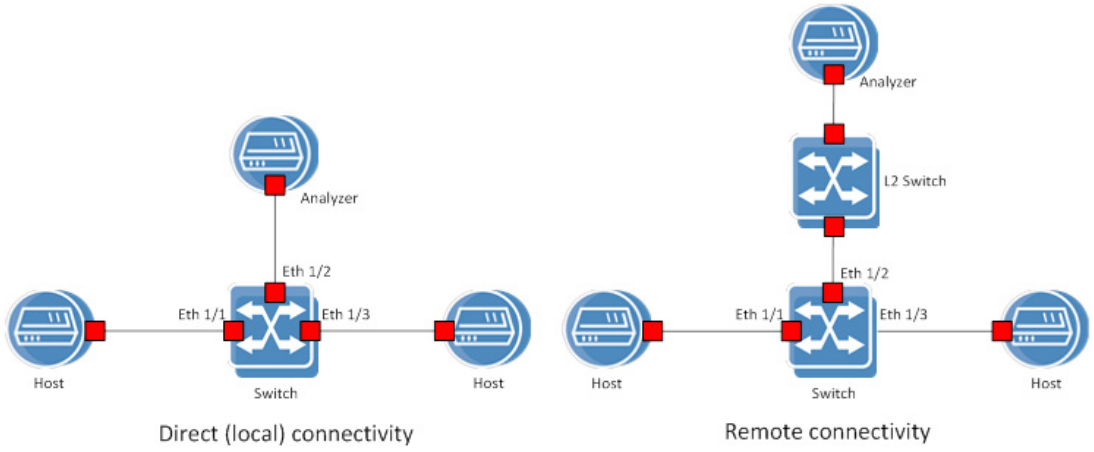
5.10.1.5 Truncation

When enabled, the system can truncate the mirrored packets into smaller 64-byte packets (default) which is enough to capture the packets' L2 and L3 headers.

5.10.2 Configuring Mirroring Sessions

Figure 12 presents two network scenarios with direct and remote connectivity to the analyzer equipment. Direct connectivity is when the analyzer is connected to the analyzer port of the switch. In this case there is no need for adding an L2 header to the mirrored traffic. Remote connectivity is when the analyzer is indirectly connected to the analyzer port of the switch. In this situation, adding an L2 header may be necessary depending on the network's setup.

Figure 12: Mirroring Session



➢ ***To configure a mirroring session:***

Step 1. Create a session. Run:

```
switch (config) # monitor session 1
```

This command enters a monitor session configuration mode. Upon first implementation the command also creates the session.

Step 2. Add source interface(s). Run:

```
switch (config monitor session 1) # add source interface ethernet 1/1 direction both
```

Step 3. Add destination interface. Run:

```
switch (config monitor session 1) # destination interface ethernet 1/2
```

Step 4. (Optional) Set header format. Run:

```
switch (config monitor session 1) # header-format add-ethernet-header destination-mac
00:0d:ec:f1:a9:c8 add-vlan 10 priority 5 traffic-class 2
```

For remote connectivity use the header formats `add-vlan` or `add-ethernet-header`. For local connectivity, use `local`.

Step 5. (Optional) Truncate the mirrored traffic to 64-byte packets. Run:

```
switch (config monitor session 1) # truncate
```

Step 6. (Optional) Set congestion control. Run:

```
switch (config monitor session 1) # congestion pause-excessive-frames
```

The default for this command is to drop excessive frames. The `pause-excessive-frames` option uses flow control to regulate the traffic from the source interfaces.

If the option `pause-excessive-frame` is selected, make sure that flow control is enabled on **all** source interfaces on the ingress direction of the monitoring session using the command `flowcontrol` in the interface configuration mode.

Step 7. Enable the session. Run:

```
switch (config monitor session 1) # no shutdown
```

5.10.3 Verifying Mirroring Sessions

➢ ***To verify the attributes of a specific mirroring session:***

```
switch (config) # show monitor session 1
Admin: Enable
Status: Up
Truncate: Enable
Destination interface: eth1/2
Congestion type: pause-excessive-frames
Header format: add-ethernet-header
                 - traffic class 2
                 - vlan 10
                 - priority 5
                 - destination-mac 00:0d:ec:f1:a9:c8
```

```
Source interfaces
Interface  direction
-----------------------
eth1/1     both
```

➢ ***To verify the attributes of running mirroring sessions:***

```
switch (config) # show monitor session summary
Session  Admin        Status     Mode       Destination    Source
1        Enable       Up         add-eth    eth1/2         eth1/1(b)
2        Disable      Down       add-vlan   eth1/2         eth1/8(i), po1(e)
3        Enable       Up         add-eth    eth1/5         eth1/18(e)
7        Disable      Down       local
```

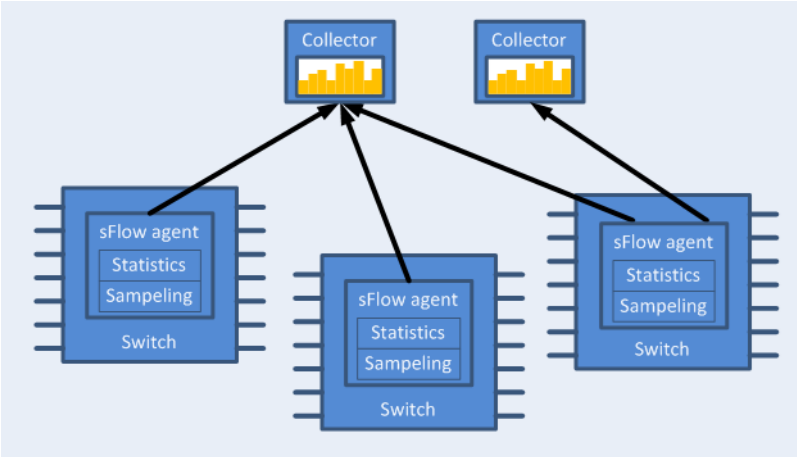
5.11 sFlow

sFlow (ver. 5) is a procedure for statistical monitoring of traffic in networks. MLNX-OS supports an sFlow sampling mechanism (agent), which includes collecting traffic samples and data from counters. The sFlow datagrams are then sent to a central collector.

The sampling mechanism must ensure that any packet going into the system has an equal chance of being sampled, irrespective of the flow to which it belongs. The sampling mechanism provides the collector with periodical information on the amount (and load) of traffic per interface by loading the counter samples into sFlow datagrams.

The sFlow packets are encapsulated and sent in UDP over IP. The UDP port number that is used is the standard 6343 by default.

Figure 13: sFlow Functionality Overview



5.11.1 Flow Samples

The sFlow agent samples the data path packet based.

Truncation and sampling rate are the two parameters that influence the flow samples. In case of congestion the flow samples can be truncated to a predefined size before it is being assigned to the CPU. The truncation can be set to any value between 64 to 256 bytes with the default being 128 bytes. Furthermore, the sampling rate may also be adjust as required.

5.11.2 Statistical Samples

The sFlow agent samples interface counters time based. Polling interval is configurable to any value between 5-3600 seconds with the default being 20 seconds.

The following statistics are gathered by the CPU:

Table 28 - List of Statistical Counters

Counter	Description
Total packets	The number of packets that pass through sFlow-enabled ports.
Number of flow samples	The number of packets that are captured by the sampling mechanism.
Number of statistic samples	The number of statistical samples.
Number of discarded samples	The number of samples that were discarded.
Number of datagrams	The number of datagrams that were sent to the collector.

5.11.3 sFlow Datagrams

The sFlow datagrams contain flow samples and statistical samples.

The sFlow mechanism uses IP protocol, therefore if the packet length is more than the interface MTU, it becomes fragmented by the IP stack. The MTU may also be set manually to anything in the range of 200-9216 bytes. The default is 1400 bytes.

5.11.4 Sampled Interfaces

sFlow must be enabled on physical or LAG interfaces that require sampling. When adding a port to a LAG, sFlow must be disabled on the port. If a port with enabled sFlow is configured to be added to a LAG, the configuration is rejected. Removing a port from a LAG disables sFlow on the port regardless of the LAG's sFlow status.

5.11.5 Configuring sFlow

➢ ***To configure the sFlow agent:***

Step 1. Unlock the sFlow commands. Run:

```
switch (config) # protocol sflow
```

Step 2. Enable sFlow on the system. Run:

```
switch (config) # sflow enable
```

Step 3. Enter sFlow configuration mode. Run:

```
switch (config) # sflow
switch (config sflow) #
```

Step 4. Set the central collector's IP. Run:

```
switch (config sflow) # collector-ip 10.10.10.10
```

Step 5. Set the agent-ip used in the sFlow header. Run:

```
switch (config sflow) # agent-ip 20.20.20.20
```

Step 6. (Optional) Set the sampling rate of the mechanism. Run:

```
switch (config sflow) # sampling-rate 16000
```

This means that one every 16000 packet gets collected for sampling.

Step 7. (Optional) Set the maximum size of the data path sample. Run:

```
switch (config sflow) # max-sample-size 156
```

Step 8. (Optional) Set the frequency in which counters are polled. Run:

```
switch (config sflow) # counter-poll-interval 19
```

Step 9. (Optional) Set the maximum size of the datagrams sent to the central collector. Run:

```
switch (config sflow) # max-datagram-size 1500
```

Step 10. Enable the sFlow agent on the desired interfaces. Run:

```
switch (config interface ethernet 1/1)# sflow enable
switch (config interface port-channel 1)# sflow enable
```

5.11.6 Verifying sFlow

➢ ***To verify the attributes of the sFlow agent:***

```
switch (config)# show sflow

sflow protocol enabled
sflow enabled
sampling-rate 16000
max-sampled-size 156
counter-poll-interval 19
max-datagram-size 1500
collector-ip 10.10.10.10
collector-port 6343
agent-ip 20.20.20.20

Interfaces
Ethernet: eth1/1
Port-channel: po1

Statistics:
Total Packets: 2000
Number of flow samples: 1200
Number of samples discarded: 0
Number of statistic samples: 800
Number of datagrams: 300
```