Intel® Omni-Path Fabric Suite Fabric Manager GUI

User Guide

Rev. 14.0

October 2019
## Revision History


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Preface

This manual is part of the documentation set for the Intel® Omni-Path Fabric (Intel® OP Fabric), which is an end-to-end solution consisting of Intel® Omni-Path Host Fabric Interfaces (HFI), Intel® Omni-Path switches, and fabric management and development tools.

The Intel® OP Fabric delivers the next generation, High-Performance Computing (HPC) network solution that is designed to cost-effectively meet the growth, density, and reliability requirements of large-scale HPC clusters.

Both the Intel® OP Fabric and standard InfiniBand* (IB) are able to send Internet Protocol (IP) traffic over the fabric, or IPoFabric. In this document, however, it may also be referred to as IP over IB or IPoIB. From a software point of view, IPoFabric behaves the same way as IPoIB, and in fact uses an ib_ipoib driver to send IP traffic over the ib0/ib1 ports.

Intended Audience

The intended audience for the Intel® Omni-Path (Intel® OP) document set is network administrators and other qualified personnel.

Intel® Omni-Path Documentation Library

Intel® Omni-Path publications are available at the following URLs:

- Intel® Omni-Path Switches Installation, User, and Reference Guides
  http://www.intel.com/omnipath/SwitchPublications
- Intel® Omni-Path Software Installation, User, and Reference Guides (includes HFI documents)
  http://www.intel.com/omnipath/FabricSoftwarePublications
- Drivers and Software (including Release Notes)
  http://www.intel.com/omnipath/Downloads

Use the tasks listed in this table to find the corresponding Intel® Omni-Path document.

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<td>Using the Intel® OPA documentation set</td>
<td>Intel® Omni-Path Quick Start Guide</td>
<td>A roadmap to Intel's comprehensive library of publications describing all aspects of the product family. This document outlines the most basic steps for getting your Intel® Omni-Path Architecture (Intel® OPA) cluster installed and operational.</td>
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<tr>
<td>Setting up an Intel® OPA cluster</td>
<td>Intel® Omni-Path Setup Guide</td>
<td>Provides a high level overview of the steps required to stage a customer-based installation of the Intel® Omni-Path Fabric. Procedures and key reference documents, such as Intel® Omni-Path user guides and installation guides, are provided to clarify the process. Additional commands and best known methods are defined to facilitate the installation process and troubleshooting.</td>
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<td>Installing hardware</td>
<td>Intel® Omni-Path Fabric Switches Hardware Installation Guide</td>
<td>Describes the hardware installation and initial configuration tasks for the Intel® Omni-Path Switches 100 Series. This includes: Intel® Omni-Path Edge Switches 100 Series, 24 and 48-port configurable Edge switches, and Intel® Omni-Path Director Class Switches 100 Series.</td>
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<td>Intel® Omni-Path Host Fabric Interface Installation Guide</td>
<td>Contains instructions for installing the HFI in an Intel® OPA cluster.</td>
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<td>Installing host software</td>
<td>Intel® Omni-Path Software Installation Guide</td>
<td>Describes using a Text-based User Interface (TUI) to guide you through the installation process. You have the option of using command line interface (CLI) commands to perform the installation or install using the Linux* distribution software.</td>
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<td>Managing a switch using Chassis Viewer GUI</td>
<td>Intel® Omni-Path Fabric Switches GUI User Guide</td>
<td>Describes the graphical user interface (GUI) of the Intel® Omni-Path Fabric Chassis Viewer GUI. This document provides task-oriented procedures for configuring and managing the Intel® Omni-Path Switch family. Help: GUI embedded help files</td>
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<td>Managing a switch using the CLI</td>
<td>Intel® Omni-Path Switches Command Line Interface Reference Guide</td>
<td>Describes the command line interface (CLI) task information for the Intel® Omni-Path Switch family. Help: -help for each CLI</td>
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<td>Managing a fabric using FastFabric</td>
<td>Intel® Omni-Path Fabric Suite FastFabric User Guide</td>
<td>Provides instructions for using the set of fabric management tools designed to simplify and optimize common fabric management tasks. The management tools consist of Text-based User Interface (TUI) menus and command line interface (CLI) commands. Help: -help and man pages for each CLI. Also, all host CLI commands can be accessed as console help in the Fabric Manager GUI.</td>
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<td>Managing a fabric using Fabric Manager</td>
<td>Intel® Omni-Path Fabric Suite Fabric Manager User Guide</td>
<td>The Fabric Manager uses a well defined management protocol to communicate with management agents in every Intel® Omni-Path Host Fabric Interface (HFI) and switch. Through these interfaces the Fabric Manager is able to discover, configure, and monitor the fabric.</td>
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<td>Configuring and administering Intel® HFI and IPoIB driver Running MPI applications on Intel® OPA</td>
<td>Intel® Omni-Path Fabric Host Software User Guide</td>
<td>Describes how to set up and administer the Host Fabric Interface (HFI) after the software has been installed. The audience for this document includes cluster administrators and Message-Passing Interface (MPI) application programmers.</td>
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<td>Writing and running middleware that uses Intel® OPA</td>
<td>Intel® Performance Scaled Messaging 2 (PSM2) Programmer’s Guide</td>
<td>Provides a reference for programmers working with the Intel® PSM2 Application Programming Interface (API). The Performance Scaled Messaging 2 API (PSM2 API) is a low-level user-level communications interface.</td>
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<td>Optimizing system performance</td>
<td>Intel® Omni-Path Fabric Performance Tuning User Guide</td>
<td>Describes BIOS settings and parameters that have been shown to ensure best performance, or make performance more consistent, on Intel® Omni-Path Architecture. If you are interested in benchmarking the performance of your system, these tips may help you obtain better performance.</td>
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<td>Designing an IP or LNet router on Intel® OPA</td>
<td>Intel® Omni-Path IP and LNet Router Design Guide</td>
<td>Describes how to install, configure, and administer an IPoIB router solution (Linux* IP or LNet) for inter-operating between Intel® Omni-Path and a legacy InfiniBand* fabric.</td>
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<td>Building Containers for Intel® OPA fabrics</td>
<td>Building Containers for Intel® Omni-Path Fabrics using Docker* and Singularity* Application Note</td>
<td>Provides basic information for building and running Docker* and Singularity* containers on Linux*-based computer platforms that incorporate Intel® Omni-Path networking technology.</td>
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<td>Writing management applications that interface with Intel® OPA</td>
<td>Intel® Omni-Path Management API Programmer’s Guide</td>
<td>Contains a reference for programmers working with the Intel® Omni-Path Architecture Management (Intel OPAMGT) Application Programming Interface (API). The Intel OPAMGT API is a C-API permitting in-band and out-of-band queries of the FM’s Subnet Administrator and Performance Administrator.</td>
</tr>
<tr>
<td>Using NVMe* over Fabrics on Intel® OPA</td>
<td>Configuring Non-Volatile Memory Express* (NVMe*) over Fabrics on Intel® Omni-Path Architecture Application Note</td>
<td>Describes how to implement a simple Intel® Omni-Path Architecture-based point-to-point configuration with one target and one host server.</td>
</tr>
<tr>
<td>Learning about new release features, open issues, and resolved issues for a particular release</td>
<td>Intel® Omni-Path Fabric Software Release Notes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel® Omni-Path Fabric Manager GUI Release Notes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel® Omni-Path Fabric Switches Release Notes (includes managed and externally-managed switches)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel® Omni-Path Fabric Unified Extensible Firmware Interface (UEFI) Release Notes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel® Omni-Path Fabric Thermal Management Microchip (TMM) Release Notes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intel® Omni-Path Fabric Firmware Tools Release Notes</td>
<td></td>
</tr>
</tbody>
</table>

**How to Search the Intel® Omni-Path Documentation Set**

Many PDF readers, such as Adobe* Reader and Foxit* Reader, allow you to search across multiple PDFs in a folder.

Follow these steps:
1. Download and unzip all the Intel® Omni-Path PDFs into a single folder.
2. Open your PDF reader and use **CTRL-SHIFT-F** to open the Advanced Search window.
3. Select **All PDF documents in...**
4. Select **Browse for Location** in the dropdown menu and navigate to the folder containing the PDFs.
5. Enter the string you are looking for and click **Search**.

Use advanced features to further refine your search criteria. Refer to your PDF reader Help for details.

**Cluster Configurator for Intel® Omni-Path Fabric**


This tool generates sample cluster configurations based on key cluster attributes, including a side-by-side comparison of up to four cluster configurations. The tool also generates parts lists and cluster diagrams.

**Documentation Conventions**

The following conventions are standard for Intel® Omni-Path documentation:

- **Note:** provides additional information.
- **Caution:** indicates the presence of a hazard that has the potential of causing damage to data or equipment.
- **Warning:** indicates the presence of a hazard that has the potential of causing personal injury.
- Text in **blue** font indicates a hyperlink (jump) to a figure, table, or section in this guide. Links to websites are also shown in blue. For example:
  
  See **License Agreements** on page 14 for more information.

  For more information, visit [www.intel.com](http://www.intel.com).

- Text in **bold** font indicates user interface elements such as menu items, buttons, check boxes, key names, key strokes, or column headings. For example:
  
  Click the **Start** button, point to **Programs**, point to **Accessories**, and then click **Command Prompt**.

  Press **CTRL+P** and then press the **UP ARROW** key.

- Text in **Courier** font indicates a file name, directory path, or command line text. For example:

  Enter the following command: `sh ./install.bin`

- Text in **italics** indicates terms, emphasis, variables, or document titles. For example:

  **Refer to Intel® Omni-Path Fabric Software Installation Guide** for details.

  In this document, the term **chassis** refers to a managed switch.

Procedures and information may be marked with one of the following qualifications:

- **(Linux)** – Tasks are only applicable when Linux® is being used.
- **(Host)** – Tasks are only applicable when Intel® Omni-Path Fabric Host Software or Intel® Omni-Path Fabric Suite is being used on the hosts.
- **(Switch)** – Tasks are applicable only when Intel® Omni-Path Switches or Chassis are being used.
Best Practices

- Intel recommends that users update to the latest versions of Intel® Omni-Path firmware and software to obtain the most recent functional and security updates.
- To improve security, the administrator should log out users and disable multi-user logins prior to performing provisioning and similar tasks.

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This software is provided under one or more license agreements. Please refer to the license agreement(s) provided with the software for specific detail. Do not install or use the software until you have carefully read and agree to the terms and conditions of the license agreement(s). By loading or using the software, you agree to the terms of the license agreement(s). If you do not wish to so agree, do not install or use the software.

Technical Support

Technical support for Intel® Omni-Path products is available 24 hours a day, 365 days a year. Please contact Intel Customer Support or visit http://www.intel.com/omnipath/support for additional detail.
1.0 Introduction

Intel® Omni-Path Fabric Suite Fabric Manager GUI provides an intuitive, scalable dashboard and set of analysis tools for graphically monitoring fabric status and configuration. It is a user-friendly alternative to traditional command-line tools for day-to-day monitoring of fabric health.

For details about the other documents for the Intel® Omni-Path product line, refer to Intel® Omni-Path Documentation Library on page 10 of this document.

Figure 1. Fabric Manager GUI

Fabric Manager GUI can be run on a Linux* or Windows* desktop/laptop system with TCP/IP connectivity to the Intel® Omni-Path Fabric Suite Fabric Manager. Network connectivity to the Fabric Executive (FE) component of the Fabric Manager allows continuous, remote, “out of band” monitoring. If configured with alternate FE connection information, the Fabric Manager GUI automatically fails over to an alternative FE if the connection to the original is lost.

Fabric Manager GUI feature highlights include:

- The ability to monitor multiple fabric “subnets” simultaneously
- A dashboard summary of the state of the connected fabric
- An interactive way to visualize the fabric topology (see the following figure)
- A Pin Board that allows a user-selected set of GUI indicators to remain visible at all times
- Reliable “out-of-band” connectivity to the fabric over both secured and non-secured links
- Email and other alerts if user-selected events occur within the fabric
- Connectivity to the Fabric Manager’s console for access to the rich set of Intel® Omni-Path Fabric Suite FastFabric command-line tools
Connectivity to the Fabric Manager’s log file for troubleshooting purposes
- The ability to modify the configuration of the Fabric Manager

**Figure 2. Fabric Topology**

---

**1.1 Best Practices**

- Intel recommends that users update to the latest versions of Intel® Omni-Path firmware and software to obtain the most recent functional and security updates.
- To improve security, the administrator should log out users and disable multi-user logins prior to performing provisioning and similar tasks.

**1.2 Fabric Manager GUI Installation**

You can install the Intel® Omni-Path Fabric Suite on a Linux* or Windows* desktop/laptop system with TCP/IP connectivity to the Intel® Omni-Path Fabric Suite Fabric Manager.

See the *Intel® Omni-Path Fabric Software Installation Guide* for instructions on installing the Fabric Manager GUI.
2.0 Intel® Omni-Path Fabric Suite Fabric Manager GUI Setup Wizard

Setup Wizard guides a user to set up the Fabric Manager GUI, including the areas described below.

- Hosts
- Events
- Preferences

**Hosts**

To add a new subnet, click the button on the Hosts tab and provide the following attributes:

- Name – unique name of the subnet
- IP address or Host name – address used to connect with the FM, specifically the address used to connect to the FE
- Port number - the port number used to connect

To add a subnet, user name is not required. Even for the secure connection (when the Secure check box is checked), user name is not necessary.

For a secure connection, check the Secure check box and enter Key Store and Trust Store information. See the "SSL Key Creation for Fabric Manager GUI" appendix in the Intel® Omni-Path Fabric Suite Fabric Manager User Guide.

The Auto Connect checkbox must be selected to make the connection automatic.

**Events**

In the course of exploring a fabric, the Fabric Manager may send an event message to the Fabric Manager GUI to notify the user about an incident occurring on the network. The Events tab lists the classification and type of each event, and allows the user to select the severity level and action to take when an event is received.

Events are defined with the following attributes:

- Event Class – Subnet Event, Miscellaneous Event, etc.
- Event Type – Lost Connection with FE, Inactive Port, etc.
- Severity – Informational, Warning, Error, Critical
- Action – Set notification with an email, display, or both

All events have predefined default values, so you need to change only those events of interest.
User Preferences

On the Preferences tab, you define the following attributes:

Refresh Rate – the rate at which the UI is refreshed with the latest data from the Fabric Manager. In general, the Fabric Manager GUI Refresh Rate should be set to match or be slightly higher than the PM sweep rate. See the PM Sweeps section in the Intel® Omni-Path Fabric Suite Fabric Manager User Guide for more information.

Time Window – the duration of the sliding time window over which the number of active nodes and ports:

- Reported a Critical, Error, or Warning event type
- Was classified as a Worst Node based on its performance

In the following figure, a time window of 1 hour is defined. As time transpires the data collected prior to the time window is removed as new information is reported.

Figure 3. Time Window

Indicators for these values can be found on the Home and Performance pages as shown in the highlighted panels below.
Figure 4. Metrics Collected in Time Window

NOTE
This value must be larger than 10 * FM sweep rate.

# Worst Nodes – number of the worst nodes to display.

Email recipients – used to list recipients of email notifications for the subnet. See Setting up Email Notification on page 19 for more details.

2.1 Setting up Email Notification

The email notification feature allows a specified list of addresses to receive an email notification if a user-selected event occurs in the Fabric Manager GUI or in the fabric itself. Both the list of recipients and the list of events are specified on a per-subnet basis using the Configuration Setup Wizard: Configure menu > Setup Wizard (refer to Intel® Omni-Path Fabric Suite Fabric Manager GUI Setup Wizard on page 17). A single SMTP server is used to send messages for all defined subnets and is specified using the Email Settings dialog (Configure menu > Email setup).
Server Invalid/No Server Configured

The notification in the following figure is displayed any time the Fabric Manager GUI cannot connect to the specified SMTP server. This can be due to the Fabric Manager GUI host being offline (for example, no network connection), invalid SMTP settings, or SMTP settings left blank (with email notification enabled). If the dialog appears in response to an SMTP server settings test, you can dismiss the dialog and the SMTP settings can still be saved.

**Figure 5. Email Settings Error Dialog**

![Email Settings Error Dialog](image)

SMTP Configuration

A single SMTP server is used to send messages for all defined subnets and is specified using the Email Settings dialog (Configure menu > Email setup). To begin SMTP server configuration, click the **Enable Email Notifications** check box in the Email Settings dialog shown in the following figure.

**Figure 6. Enable Email Notification Selection**

![Enable Email Notification Selection](image)

You may enable/disable email notifications at any time but the SMTP settings may be edited only when email notifications have been enabled.

Enter the SMTP server address (for example, "mail.mydomain.com") in the **SMTP Host** field as shown in the following figure.
Figure 7. SMTP Host Selection

Enter a valid email address in the "Sender" field as shown in the following figure. This is the "from" address that will appear in all email notifications.

Figure 8. SMTP Sender Selection

SMTP Server Test

If the Fabric Manager GUI host has a working network connection, you can test the SMTP server settings if you choose to do so. Enter a valid email address for the recipient of the test notification message as shown in the following figure.
The **Test** button (shown in the following figure), can be used to send a test notification message to the specified recipient. After all settings in the dialog have been entered, the **Test** button becomes active. Click the button to send the message. If the Fabric Manager GUI is unable to connect to the SMTP server for any reason, the error notification dialog shown in Figure 5 on page 20 will be displayed. Note that you can still save the entered settings, if desired.

If the test is successful, the recipient receives the test message at the address specified. Note that the Fabric Manager GUI can provide feedback on server connection status only. It is possible for the Fabric Manager GUI to connect to a valid SMTP server without the test message being received. In this case, verify that the recipient address is correct and that any spam filter is set to pass the message.

**Save SMTP Settings**

To save SMTP settings, click **OK** as shown in the following figure.
Figure 11. **Save SMTP Settings**

To dismiss the Email Settings dialog without saving, click **Cancel**. To revert to the last saved settings, click **Reset**.

2.2 **Email Notification of Events**

**Select Events**

To send an email notification when a particular event occurs, Click **Select...** in the Actions column in the row of the desired event as shown in the following figure. Then click the **SEND_EMAIL** check box. An envelope icon will appear in the Actions column for all selected events.

Figure 12. **Email Notification Event Selection**

**Save Events**

To save the selected events, click the **Apply** button as shown in the following figure.
To specify a list of email notification recipients for the subnet, enter one, or more valid email addresses in the **Email recipients** field in the Preferences tab as shown in the following figure. Entries must be separated by a semi-colon.

Note that addresses are validated as they are entered. Addresses must be of the form `user@host.ext` where "ext" is a three character extension (e.g., "com"). A red border surrounds the field until a valid entry is completed.

If desired, a test notification message can be sent to all addresses in the recipients list. The Fabric Manager GUI host must have a working network connection and valid SMTP server settings must be configured prior to the test (refer to Setting up Email Notification on page 19). Click the **Test** button as shown in the following figure.
Figure 15. **Email Notification Test**

Save Recipients

To save the list of email recipients, click the **Apply** button as shown in the following figure.

Figure 16. **Save Email Recipients**
3.0 Fabric Manager GUI Window Navigation

The Fabric Manager GUI window is comprised of the following areas:

- **Menu Bar** on page 26
- **Tool Bar** on page 27
- **Main Panel** on page 27
- **Event Table** on page 27
- **Pin Board** on page 28

The following image shows the Fabric Manager GUI window with call-outs of the areas.

![Fabric Manager GUI Window](image)

3.1 Menu Bar

The Menu Bar supplies window and application specific menus that provide access to the following functions:

**Subnet** Menu

- Connect to a Subnet on page 27
- Close

**Configure** Menu

- Intel® Omni-Path Fabric Suite Fabric Manager GUI Setup Wizard on page 17
- Logging - In the Logging section, you set up the output destination, information level, and output format required for error logging.
• Email Setup - Set up SMTP server used in email notification.

Help Menu
• Online Help
• About

3.1.1 Connect to a Subnet

Subnets may be configured to connect to the fabric either automatically or manually. To connect a subnet automatically upon starting the Fabric Manager GUI, see Hosts on page 17.

To manually connect a subnet to the fabric:

From the menu bar, click Subnet, Connect To, and then the subnet.

NOTE
If a connection error is received, verify that the host name and port number are correct, and verify that the Fabric Executive is active.

3.2 Tool Bar

The tool bar contains the following buttons.

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://example.com" alt="Refresh" /></td>
<td>Refresh – Refreshes Fabric Manager GUI immediately with the latest data from the Fabric Manager or indicates that a data refresh is taking place.</td>
</tr>
<tr>
<td><img src="https://example.com" alt="Navigation" /></td>
<td>Navigation - Navigate to previous or next page and subpage displayed in Fabric Manager GUI.</td>
</tr>
</tbody>
</table>

3.3 Main Panel

The Main Panel contains the content for one of the following selected tabs:

• Home Tab on page 30
• Performance Tab on page 37
• Topology on page 59
• Admin Tab on page 65

3.4 Event Table

The Event Table displays the latest notices received from the Fabric Manager. By default this table is sorted by notice receive time, the time the Fabric Manager GUI receives a notice, in descending order and therefore shows the latest notice as the first row in the table. This table also shows each notice’s severity level with colored text, the source, and the description of the notice. This table is visible across all pages on the Home tab, and can be turned on/off by clicking the event summary panel on the pin board.
3.5 Pin Board

The Fabric Manager GUI provides a pin board at the right side of the main window (see the following figure) to monitor cards of interest. Click the pin button on a card’s title bar to make it instantly visible on the pin board, which allows you to monitor performance metrics while exploring other parts of the system. For example, the congestion trend card can be pinned to the pin board and it remains visible even when looking at the performance of a specific port. To remove cards from the pin board, click the button.

The Event Summary is the default pin card that shows the summary of events in a defined time window; it cannot be unpinned. Clicking the Event Summary card toggles the event panel at the bottom of the main window. Below it are user pin cards that are created by clicking the pin button on a card’s title bar. This board holds a maximum of eight pin cards. Each pin card is resizable by dragging the bottom edge. The following table summarizes the available operations on a pin card.
Table 1. Pin Board Options

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Info Icon]</td>
<td>displays information about this pin card, such as data type, data source, etc.</td>
</tr>
<tr>
<td>![Up Arrow Icon]</td>
<td>moves this pin card up</td>
</tr>
<tr>
<td>![Down Arrow Icon]</td>
<td>moves this pin card down</td>
</tr>
<tr>
<td>![Remove Pin Icon]</td>
<td>unpins this pin card</td>
</tr>
</tbody>
</table>

Figure 19. Pin Board Examples

The previous figure shows the default pin card displaying the summary of events in a defined time window by severity levels. Clicking on this card toggles the event table between visible and invisible states. By default, the Event Table is visible when the Home Page is selected and invisible when other pages are selected.
4.0 **Home Tab**

The Home tab provides the "big picture" of a fabric using two sections: Subnet Summary and Subnet Performance. See the topics below for details on each section of the Home tab.

- [Subnet Summary (Home)](#) on page 30
- [Subnet Performance](#) on page 33

4.1 **Subnet Summary (Home)**

This section of the Home tab summarizes what happened in the past. It includes the following panels:

- [Subnet Statistics](#) on page 30
- [Subnet Status](#) on page 31
- [Health Trend](#) on page 31
- [Worst Nodes](#) on page 33

4.1.1 **Subnet Statistics**

Subnet Statistics lists basic information about a subnet in the first column: Master SM name and its up time; Standby SMs' names; Summary of Links (number of internal switch links and host links); and Other ports (ports that are not in the subnet). The second and third columns show the statistical summary of nodes and ports separately. The top of each column displays the number of actives nodes/ports, followed by the numbers of no response and skipped nodes/ports, and then the distribution of device types (specifically Switch and HFI).

![Subnet Statistics Example](image)
4.1.2 Subnet Status

Subnet Status shows the current status of switches and HFIs. It tells a user that in the past time window (defined in setup wizard), how many switches/HFIs are under critical, error, warning, or normal status and are measured based on notices from the Fabric Manager. If one node has multiple notices within a time window, it is counted by the notice with the highest severity level. The map between notice and severity is customizable with the setup wizard. Choose either pie chart or bar chart with the icon on the right side of the title bar.

Figure 21. Subnet Status Example

4.1.3 Health Trend

Health Trend displays the health history of a subnet in an area chart.

Figure 22. Health Trend Example

The card shown in the previous figure displays the health history of a subnet in an area chart. On the chart is the current health score which is calculated with the following equation:

\[ Health \ Score = \sum_{j} (S_j \times W_j) \times 100 \]

where:
- \( S_j \) = the score for attribute \( j \)
- \( W_j \) = the weight for attribute \( j \)
The score for an attribute can be calculated using the following formula:

$$S_j = \frac{V_j}{\sum_j (B_j \times W_j)}$$

where:
- $V_j$ = the current value for attribute $j$
- $B_j$ = the current baseline for attribute $j$

Currently, the attributes, their source and their weight in the formula are as follows:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Source</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of switches</td>
<td>ImageInfo</td>
<td>Average number of active ports per switch + 1</td>
</tr>
<tr>
<td>Number of HFIs</td>
<td>ImageInfo, FabricInfo</td>
<td>Average number of active ports per HFI + 1</td>
</tr>
<tr>
<td>Number of Inter Switch Links</td>
<td>FabricInfo</td>
<td>3</td>
</tr>
<tr>
<td>Number of HFI links</td>
<td>FabricInfo</td>
<td>2</td>
</tr>
<tr>
<td>Number of Active Ports</td>
<td>ImageInfo</td>
<td>1</td>
</tr>
<tr>
<td>Number of Non-degraded Inter Switch Links</td>
<td>FabricInfo</td>
<td>3</td>
</tr>
<tr>
<td>Number of Non-degraded HFI links</td>
<td>FabricInfo</td>
<td>2</td>
</tr>
</tbody>
</table>

Weights represent the relative importance of one attribute against the others. For example, consider the small fabric in the following image: two 48-port switches connected by four ISLs and serving eight nodes. In this configuration, a switch down will have 5 times more impact in the health score than a HFI link down (switch weight = 4 node-ports + 4 ISLs + port 0 + 1 = 10 against weight HFI link = 2). However, the impact is even greater if you consider that a switch down may also affect other attributes. In this example, the health score goes down to 53% when you bring down one of the switches but only goes down to 93% when you bring down a HFI link. The end result is that even small changes in the fabric configuration are not diluted when the size of the fabric is big: in simulations with a fabric of over 8K nodes, a port being brought down is reflected with the non-perfect score of 99%. 
You can see the current values of each attribute and their baselines by hovering the mouse over the score; a tooltip appears to help you determine the source of a non-perfect score. The baseline values for each attribute are taken during initialization of the application and whenever the number of switches or HFIs increases in the fabric.

4.1.4 Worst Nodes

Worst Nodes lists the nodes with low health scores in a subnet as measured by a node's status. Normal, warning, error, and critical status levels have the scores of 100, 80, 30, and 10 respectively. Click on a worst node to display more information about the node and view performance, topology, and other data.

4.2 Subnet Performance

The Subnet Performance displays a statistical overview of the fabric to provide insight into the hot spots. It contains two groups of performance: Utilization and PM Counter Categories.

- Utilization Group on page 34
- PM Counter Categories Group on page 35

Refer to Intel® Omni-Path Fabric Suite Fabric Manager User Guide, in the section titled "Counter Classification" for more information on how Performance and "error" groups work, how thresholds are set, weights settings, adding PM groups, etc).
4.2.1 **Utilization Group**

The utilization group provides visual representation of a fabric's performance in terms of bandwidth and packet rate. Each metric is summarized by the following:

<table>
<thead>
<tr>
<th>Chart</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trend Chart</td>
<td>The historical values measured by all devices and all switches in a fabric, showing the trend and how switches contribute to the metric. The value represents the aggregated metric on all data traffic types: internal, send and transmit.</td>
</tr>
<tr>
<td>Top N Chart</td>
<td>The CURRENT top N worst ports measured by the selected metric. The parameter N can be changed with the Setup Wizard, or in this chart.</td>
</tr>
<tr>
<td>Histogram Chart</td>
<td>The CURRENT value distribution against ports, i.e., how many ports fall in a value range.</td>
</tr>
</tbody>
</table>

The combination of these charts provides mixed insights about the history, the present, and the global and local performance over the ports. On the bottom of the charts panel are the trend thumbnails of available metrics.

To bring the metric to the front, click on a thumbnail. To switch between the Top N and Histogram charts, use the drop-down menu on the title bar.

4.2.1.1 **Trend (Performance)**

The Trend chart shows the historical values measured by all devices and all switches in a fabric. The value represents the aggregated metric on all data traffic types: internal, external, send, and transmit (received). See General Summary (Performance) on page 39 for information about the different traffic types.

The second axis at the right side of the chart represents the number of no response ports within the fabric. If an issue happens when PA collects data, a mark at the top of the trend chart indicates that the data may be inaccurate. Move your mouse over the mark to display detailed information about the issue type and number of no response ports.

4.2.1.2 **Top N Chart**

The Top N chart shows the current top N worst ports measured by the selected metric. The parameter can be changed with the Setup Wizard, or in this chart.

The port labels on the left side are color coded with issue states. Move your mouse over a label to show a description of the state, indicated by the following colors:

- Dark Gray – no issue
- Blue – PMA ignore
- Yellow – PMA no response
- Red – Topology no response

Right-click a port to open a context menu to drill down to view this port's performance or topology.
The Histogram chart shows the current value distribution against ports, i.e., how many ports fall in a value range.

**PM Counter Categories Group**

The PM Counter Categories Group is similar to the Utilization Group except the following metrics are applied:

- Congestion
- SMA Congestion
- Integrity
- Bubble
- Security
- Routing

**Congestion**

These counters reflect possible errors that indicate traffic congestion in the fabric.

When congestion or a packet that has seen congestion is detected, one of these counters will be incremented and then depending on the issue reported, the packet will just have to wait or in an extreme case, it may be dropped.

**SMA Congestion**

These counters reflect congestion in the fabric specific to communication between the Subnet Manager and Subnet Manager Agents using the management VL (VL 15).

The category is calculated exactly as the Congestion category using the same weights and the correct VL15 utilization counters.
Integrity

These counters reflect errors in the Physical (PHY) and Link Layers, as well as errors in Firmware. The typical cause is a hardware problem such as a poor connection, marginal cable, incorrect length/model cable for signal rate, or damaged/broken hardware (for example, bad connectors).

When a bad packet is detected, one of these counters are incremented and the Link Layer discards the packet.

During the link training sequence, assorted errors may be observed. This is a normal part of the link training and clock synchronization process. Hence, errors observed as part of rebooting nodes or moving cables should not be considered a problem.

Bubble

These counters occur when an unexpected idle flit is transmitted or received. The term flit refers to a Flow Control Digit or Flit, the smallest unit of information on which flow control may be performed. Intel® Omni-Path Fabric packets are divided into flits of 64 bits for transmission across a link. The flit excludes any headers; the 64 bits is the payload size.

The transmit port will send idle flits until it can continue sending the rest of the packet. The category is calculated as follows:

1. The maximum value between the sum of the XmitWastedBW and XmitWaitData or the neighbor's PortRcvBubble.
2. Divide the previous value by the port's utilization to provide context.

Security

These counters reflect possible security problems in the fabric.

Security problems occur if a PKey or SLID violation occurs at the port during the ingress or egress of a packet.

Routing

These counters reflect possible routing issues. When a routing issue occurs, the offending packet is dropped.

A typical cause of this error is the routing to a wrong egress port or an improper Service Channel (SC) mapping.
5.0 Performance Tab

The Performance tab displays the detailed information about a subnet's performance. On the left of the page is a resource tree panel that organizes subnet devices by different categories which allows you to select resources. The main panel shows the performance of a selected resource and its content changes based on the type of resource selected.

See the topics below for details on each section of the Performance tab.
- Resource Tree on page 37
- Tree Search on page 38
- Summarized Performance on page 38
- Node Performance on page 41
- Port Performance on page 52

5.1 Resource Tree

The Resource Tree displays and organizes resources of the following types:
- **Device Type**: Organize resources by device types, Switch and HFI
- **PmPortGroups**: Organize resources by PM Port Groups
- **Virtual Fabric**: Organize resources by defined virtual fabric
Although the resources are organized differently in the Resource Tree, there are only three types of resources, as described below. Click a resource to display the performance information in the right panel.

- **Device Set**: A set of device nodes, such as a subnet, a device group, a virtual fabric, or a type of device
- **Device Node**: A fabric node that can be either a switch or HFI
- **Device Port**: A port in a fabric node

### 5.2 Tree Search

Tree Search enables you to search a node by name, node LID, or node GUID. The search results are displayed in a tree and selecting a node from the results tree populates the node from the Resource Tree.

### 5.3 Summarized Performance

Summarized performance shows aggregated performance on a set of device nodes. Similar to the Home tab, it includes two sections: Subnet Summary and General Performance.

- **Subnet Summary (Home)** on page 30
- **General Summary (Performance)** on page 39

#### 5.3.1 Subnet Summary (Performance)

The Subnet Summary section displays the following:

- **Statistics (Performance Subnet Summary)** on page 38
- **Events (Performance Subnet Summary)** on page 38

##### 5.3.1.1 Statistics (Performance Subnet Summary)

The Statistics section displays the basic information about a selected resource: the resource statistics summary, i.e., total number of active nodes/ports, their distribution against device types, and the number of ports not in the subnet.

##### 5.3.1.2 Events (Performance Subnet Summary)

The Event section displays past performance statistics based on recent events. The pie chart on the left summarizes the events distribution in a defined time window. This chart is very similar to the Status chart on Home tab, where nodes with informational or no events are categorized as normal nodes. Nodes without events are represented in gray. The bar chart on the right shows how the events distribute at each time point in the past.
5.3.2 General Summary (Performance)

This section is very similar to the Subnet Performance section on the Home tab. It organizes charts line-by-line to allow a user to look at the details of the charts. It also supports different data traffic types via the drop-down menu on the title bar.

The supported traffic types include:
- Internal - internal data traffic within a device set
- Send - data sent from a device set
- Transmit - data received from the outside
- External - the sum of send and transmit, i.e., the total data traffic with the outside
- All - the sum of internal, send, and transmit

The General Summary contains the following sections:
- Trend (Performance) on page 34
- Top N Chart on page 34
- Histogram on page 35
The combination of the Trend (Performance) on page 34, Top N Chart on page 34, and Histogram on page 35 charts provide mixed insights about the history, the present, and the global and local performance over the ports.

On the bottom of the charts panel are the trend thumbnails of available metrics. Click on a thumbnail to bring the metric to the front.

To zoom an area of the chart, choose one of these methods:

- Using your mouse, draw a rectangle on the chart where you want to zoom.
- OR
- Right-click over the rectangle and select Zoom In or Zoom Out, then choose Both Axes, Domain Axis, or Range Axis.

To return to the original scale after zooming in/out, click and drag the mouse upward.

### 5.3.2.1 Trend (Performance)

The Trend chart shows the historical values measured by all devices and all switches in a fabric. The value represents the aggregated metric on all data traffic types: internal, external, send, and transmit (received). See General Summary (Performance) on page 39 for information about the different traffic types.

The second axis at the right side of the chart represents the number of no response ports within the fabric. If an issue happens when PA collects data, a mark at the top of the trend chart indicates that the data may be inaccurate. Move your mouse over the mark to display detailed information about the issue type and number of no response ports.

### 5.3.2.2 Top N Chart

The Top N chart shows the current top N worst ports measured by the selected metric. The parameter can be changed with the Setup Wizard, or in this chart.

The port labels on the left side are color coded with issue states. Move your mouse over a label to show a description of the state, indicated by the following colors:

- Dark Gray – no issue
• Blue – PMA ignore
• Yellow – PMA no response
• Red – Topology no response

Right-click a port to open a context menu to drill down to view this port's performance or topology.

**Figure 29. Top N Example**

![Top N Example](image)

5.3.2.3 **Histogram**

The Histogram chart shows the *current* value distribution against ports, i.e., how many ports fall in a value range.

5.4 **Node Performance**

Node performance of a device node is displayed in three sections:

- Performance (Node) on page 41
- Connectivity (Node) on page 45
- Node Properties on page 48

5.4.1 **Performance (Node)**

The Performance section includes the following:

- Ports Table on page 42
- Received Data/Packets Rate on page 44
- Transmitted Data/Packets Rate on page 44
5.4.1.1 Ports Table

The Ports Table lists each port's performance data. A preview panel displays the historical traffic data of a selected port, such as received packets/data and transmitted packets/data. Data supporting the table and charts are the port counters belonging to the selected node. Use the button on the top-right corner of the ports table to select which port counters fields to display.

Table 2. Ports Table Data

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port #</td>
<td>Port number.</td>
</tr>
<tr>
<td>LinkQualityIndicator</td>
<td>This is a status indicator, similar to the signal strength bar display on a mobile phone, that enumerates link quality as a range of 0-5, with 5 being very good. Values in the lower part of the range may indicate hardware problems such as port, cable, etc. that surface as signal integrity issues, leading to performance and other problems.</td>
</tr>
<tr>
<td>RcvPktsRate</td>
<td>Receive Packets Rate in Packets per second (Pps).</td>
</tr>
<tr>
<td>RcvDataRate (MBps)</td>
<td>Receive Data Rate in Megabytes per second (MBps).</td>
</tr>
<tr>
<td>RcvData (MB)</td>
<td>Receive Data in Megabytes (MB).</td>
</tr>
<tr>
<td>RcvPktst</td>
<td>The total number of received fabric data packets.</td>
</tr>
<tr>
<td>MulticastRcvPktst</td>
<td>The total number of multicast and collective packets received.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>This counter includes all valid packets and all packets with a header up to and including the DLID, where the DLID is within the configured range for multicast or collectives. Packets within the configured multicast or collective address space are counted, even if later checks determine the packet is unroutable or exceeds the SwitchInfo.MulticastFDBCap, SwitchInfo.CollectiveFDBCap, configured SwitchInfo.MulticastFDBTop, or configured SwitchInfo.CollectiveFDBTop.</td>
</tr>
<tr>
<td>RcvErrors</td>
<td>This counter indicates the total number of packets containing an error that were received by the port, including physical errors and malformed packets. It may indicate possible misconfiguration of a port, either by the SM or (more likely) by user intervention (e.g., using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>RcvConstraintErrors</td>
<td>This counter is incremented when partition key or source LID violations are detected in a received packet, indicating a possible security issue or misconfiguration of device security settings.</td>
</tr>
<tr>
<td>RcvSwitchRelayErrors</td>
<td>This counter indicates the number of packets that were dropped due to internal routing errors. It is indicative of the possible misconfiguration of a switch by the SM.</td>
</tr>
<tr>
<td>RcvRemotePhysicalErrors</td>
<td>This counter indicates the number of downstream effects of signal integrity problems. It is indicative of an SI issue in the upstream path.</td>
</tr>
<tr>
<td>RcvFECN</td>
<td>When a device receives a packet with the FECN (Forward Explicit Congestion Notification) bit set to one, this counter is incremented.</td>
</tr>
<tr>
<td>RcvBECN</td>
<td>When a device receives a packet with the BECN (Backward Explicit Congestion Notification) bit set to one, this counter is incremented.</td>
</tr>
<tr>
<td>RcvBubble</td>
<td>This counter indicates the total number of &quot;flit times&quot; where one or more packets have started to be received, but the receiver received idle flits from the wire.</td>
</tr>
<tr>
<td>XmitPktsRate</td>
<td>Transmitted Packets Rate in Packets per second (Pps).</td>
</tr>
<tr>
<td>XmitDataRate (MBps)</td>
<td>Transmitted Data Rate in Megabytes per second (MBps).</td>
</tr>
<tr>
<td>XmitData (MB)</td>
<td>The total number of transmitted fabric data in Megabytes.</td>
</tr>
<tr>
<td>XmitPkts</td>
<td>The total number of fabric packets transmitted. This counter includes all fabric packet head flits transmitted with and without errors (such as PktBadHead).</td>
</tr>
<tr>
<td>MulticastXmitPkts</td>
<td>The total number of multicast and collective packets transmitted</td>
</tr>
</tbody>
</table>
| XmitDiscards           | The number of packets dropped due to one of the following errors:  
  • Switch lifetime Limit exceeded  
  • Switch head-of-queue lifetime limit exceeded  
  • Output port not in active state  
  • Packet length exceeded maximum fabric packet size for MTU for VL  
  • Flow control disabled and insufficient credits available  
  • SC2VL_t mapping invalid for given SC                                                                                                                                                                                                                                                                                      |
| XmitConstrainErrors    | This counter is incremented when partition key or source LID violations are detected in a packet attempting to be transmitted, indicating a possible security issue or misconfiguration of device security settings.                                                                                                                                                                                                                     |
| XmitWait               | This counter indicates the amount of time (in "flit times") any virtual lane had data but was unable to transmit (for reasons such as no credits available, or that the link was busy sending non-data packets such as link layer retraining or flow control).                                                                                                                                                    |
| XmitTimeCong           | This counter indicates the total number of "flit times" that the counter was in a congested state.                                                                                                                                                                                                                                                                                                                                 |
|                        | **continued...**                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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Performance Tab—Intel® Omni-Path Fabric Suite Fabric Manager GUI

October 2019

Doc. No.: H76471, Rev.: 14.0

Intel® Omni-Path Fabric Suite Fabric Manager GUI

User Guide

43
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmitWastedBW</td>
<td>This counter indicates the number of &quot;flit times&quot; where one or more packets have been started but the transmitters are forced to send idles due to bubbles.</td>
</tr>
<tr>
<td>XmitWaitData</td>
<td>This counter indicates the number of &quot;flit times&quot; where one or more packets have been started but interrupted due to bubbles in the ingress stream.</td>
</tr>
<tr>
<td>LocalLinkIntegrityErrors</td>
<td>This counter indicates the number of retries initiated by the link transfer layer. It may be indicative of low signal quality, or may be due to long or low quality cables.</td>
</tr>
<tr>
<td>FMConfigErrors</td>
<td>This counter indicates inconsistencies of low level SMA configuration on both sides of the link. It is indicative of the possible misconfiguration of a port, either by the SM, or (more likely) by user intervention (by using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>ExcessiveBufferOverruns</td>
<td>This counter, associated with credit management, indicates an input buffer overrun. It may indicate possible misconfiguration of a port, either by the SM or (more likely) by user intervention (e.g. using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>SwPortCongestion</td>
<td>This switch-only counter indicates the number of packets that were discarded as unable to transmit due to flow control issues.</td>
</tr>
<tr>
<td>MarkFECN</td>
<td>This counter indicates the total number of packets that were marked FECN by the transmitter due to congestion.</td>
</tr>
<tr>
<td>LinkErrorRecovery</td>
<td>This counter indicates the number of times the link has successfully completed the link error recovery process. If LQI is fluctuating toward low values AND this counter is increasing, it may be indicative of a bad link. Indication of a more severe signal quality problem.</td>
</tr>
<tr>
<td>LinkDowned</td>
<td>This counter indicates the total number of times the port has failed the link error recovery process and downed the link. A large number of occurrences of these events can cause disruptions to fabric traffic.</td>
</tr>
<tr>
<td>UncorrectableErrors</td>
<td>This counter indicates the number of uncorrectable internal device errors. It is indicative of a severe hardware defect or data corruption on the wire.</td>
</tr>
</tbody>
</table>

### 5.4.1.2 Performance (Charts)

Click the clock icon to choose the time option for the chart displays. Current show current values in a time window of 100*refreshRate. 1H, 2H, 6H and 24H show the history values in the last 1, 2, 6, or 24 hours respectively.

### 5.4.1.2.1 Received Data/Packets Rate

The chart displays received traffic data through the selected port in the ports table either in Data Rate in Byte per second (Bps) or in Packets Rate in Packet per second (Pps) by a user selection.

### 5.4.1.2.2 Transmitted Data/Packets Rate

The chart displays transmitted traffic data through the selected port in the ports table either in Data Rate in Byte per second (Bps) or in Packets Rate in Packet per second (Pps) by a user selection.
5.4.2 Connectivity (Node)

The Connectivity section summarizes each port's link status in a table. Each active port is followed by its neighboring port, and inactive ports are presented in gray. Data shown in the table are the port counters for each involved port and the table columns are configurable with the top-right corner button.

Figure 31. Connectivity Example

NOTE
If link speed and link width are displayed with red color, it indicates the following situations:

- Slow speed – active speed/width is lower than configured
- Configured slow speed – enabled speed is lower than supported
- Mismatched speed - active speed/width does not match neighboring port

Right-click on a port to open a menu to quickly jump to this port’s performance page or topology page.
Left-click on a Cable Info column to directly display cable information about this port.

The fields in the table below can be selected from the drop-down list at the upper-right corner of the section.

**Table 3. Connectivity Data**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node Name</td>
<td>Node Name is typically assigned by the system administrator based on the desired naming convention. It is typically the same or derived from the Linux hostname for the server. Once selected by the sysadmin, the value persists across OS reboot.</td>
</tr>
<tr>
<td>Node GUID</td>
<td>GUID of the HFI or Switch.</td>
</tr>
<tr>
<td>Port #</td>
<td>The link port number this SMP came on in.</td>
</tr>
<tr>
<td>Link State</td>
<td>Port State</td>
</tr>
<tr>
<td>Physical Link State</td>
<td>Physical Port State</td>
</tr>
</tbody>
</table>

*continued...*
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LinkQualityIndicator</td>
<td>This is a status indicator, similar to the signal strength bar display on a mobile phone, that enumerates link quality as a range of 0-5, with 5 being very good. Values in the lower part of the range may indicate hardware problems such as port, cable, etc. that surface as signal integrity issues, leading to performance and other problems.</td>
</tr>
<tr>
<td>Link Width</td>
<td>The possible values for link width: 1x, 2x, 3x, 4x.</td>
</tr>
<tr>
<td>Link Width Enabled</td>
<td>The set of link widths that the LNI protocol negotiates. The LNI protocol uses only LW.E to negotiate link width during LNI.</td>
</tr>
<tr>
<td>Link Width Supported</td>
<td>The link widths the port can negotiate to during LNI. In some implementations firmware/driver and/or local device settings may restrict this value further.</td>
</tr>
<tr>
<td>Active Link Speed</td>
<td>The link speed active value of this port.</td>
</tr>
<tr>
<td>Link Speed Enabled</td>
<td>The link speed enabled value of this port.</td>
</tr>
<tr>
<td>Link Speed Supported</td>
<td>The link speed supported value of this port.</td>
</tr>
<tr>
<td>RcvData (MB)</td>
<td>Receive Data Rate in Megabytes per second (MBps).</td>
</tr>
<tr>
<td>RcvPkts</td>
<td>The total number of received fabric data packets.</td>
</tr>
<tr>
<td>MulticastRcvPkts</td>
<td>The total number of multicast and collective packets received. This counter includes all valid packets and all packets with a header up to and including the DLID, where the DLID is within the configured range for multicast or collectives. Packets within the configured multicast or collective address space are counted, even if later checks determine the packet is unroutable or exceeds the SwitchInfo.MulticastFDBCap, SwitchInfo.CollectiveFDBCap, configured SwitchInfo.MulticastFDBTop or configured SwitchInfo.CollectiveFDBTop.</td>
</tr>
<tr>
<td>RcvErrors</td>
<td>This counter indicates the total number of packets containing an error that were received by the port, including physical errors and malformed packets. It may indicate possible misconfiguration of a port, either by the SM or (more likely) by user intervention (e.g., using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>RcvConstraintErrors</td>
<td>This counter is incremented when partition key or source LID violations are detected in a received packet, indicating a possible security issue or misconfiguration of device security settings.</td>
</tr>
<tr>
<td>RcvSwitchRelayErrors</td>
<td>This counter indicates the number of packets that were dropped due to internal routing errors. It is indicative of the possible misconfiguration of a switch by the SM.</td>
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<tr>
<td>RcvRemotePhysicalErrors</td>
<td>This counter indicates the number of downstream effects of signal integrity problems. It is indicative of an SI issue in the upstream path.</td>
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<tr>
<td>RcvFECN</td>
<td>When a device receives a packet with the FECN (Forward Explicit Congestion Notification) bit set to one, this counter is incremented.</td>
</tr>
<tr>
<td>RcvBECN</td>
<td>When a device receives a packet with the BECN (Backward Explicit Congestion Notification) bit set to one, this counter is incremented.</td>
</tr>
<tr>
<td>RcvBubble</td>
<td>This counter indicates the total number of “flit times” where one or more packets have started to be received, but the receiver received idle flits from the wire.</td>
</tr>
<tr>
<td>XmitData (MB)</td>
<td>The total number of transmitted fabric data in Megabytes.</td>
</tr>
<tr>
<td>XmitPkts</td>
<td>The total number of fabric packets transmitted. This counter includes all fabric packet head flits transmitted with and without errors (such as PktBadHead).</td>
</tr>
<tr>
<td>MulticastXmitPkts</td>
<td>The total number of multicast and collective packets transmitted</td>
</tr>
</tbody>
</table>

**continued...**
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmitDiscards</td>
<td>The number of packets dropped due to one of the following errors:</td>
</tr>
<tr>
<td></td>
<td>• Switch lifetime Limit exceeded</td>
</tr>
<tr>
<td></td>
<td>• Switch head-of-queue lifetime limit exceeded</td>
</tr>
<tr>
<td></td>
<td>• Output port not in active state</td>
</tr>
<tr>
<td></td>
<td>• Packet length exceeded maximum fabric packet size for MTU for VL</td>
</tr>
<tr>
<td></td>
<td>• Flow control disabled and insufficient credits available</td>
</tr>
<tr>
<td></td>
<td>• SC2VL_t mapping invalid for given SC</td>
</tr>
<tr>
<td>XmitConstrainErrors</td>
<td>This counter is incremented when partition key or source LID violations are detected in a packet attempting to be transmitted, indicating a possible security issue or misconfiguration of device security settings.</td>
</tr>
<tr>
<td>XmitWait</td>
<td>This counter indicates the amount of time (in &quot;flit times&quot;) any virtual lane had data but was unable to transmit (for reasons such as no credits available, or that the link was busy sending non-data packets such as link layer retraining or flow control).</td>
</tr>
<tr>
<td>XmitTimeCong</td>
<td>This counter indicates the total number of &quot;flit times&quot; that the counter was in a congested state.</td>
</tr>
<tr>
<td>XmitWastedBW</td>
<td>This counter indicates the number of &quot;flit times&quot; where one or more packets have been started but the transmitters are forced to send idles due to bubbles.</td>
</tr>
<tr>
<td>XmitWaitData</td>
<td>This counter indicates the number of &quot;flit times&quot; where one or more packets have been started but interrupted due to bubbles in the ingress stream.</td>
</tr>
<tr>
<td>LocalLinkIntegrityErrors</td>
<td>This counter indicates the number of retries initiated by the link transfer layer. It may be indicative of low signal quality, or may be due to long or low quality cables.</td>
</tr>
<tr>
<td>FMConfigErrors</td>
<td>This counter indicates inconsistencies of low level SMA configuration on both sides of the link. It is indicative of the possible misconfiguration of a port, either by the SM, or (more likely) by user intervention (by using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>ExcessiveBufferOverruns</td>
<td>This counter, associated with credit management, indicates an input buffer overrun. It may indicate possible misconfiguration of a port, either by the SM or (more likely) by user intervention (e.g., using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>SwPortCongestion</td>
<td>This switch-only counter indicates the number of packets that were discarded as unable to transmit due to flow control issues.</td>
</tr>
<tr>
<td>MarkFECN</td>
<td>This counter indicates the total number of packets that were marked FECN by the transmitter due to congestion.</td>
</tr>
<tr>
<td>LinkErrorRecovery</td>
<td>This counter indicates the number of times the link has successfully completed the link error recovery process. If LQI is fluctuating toward low values AND this counter is increasing, it may be indicative of a bad link. Indication of a more severe signal quality problem.</td>
</tr>
<tr>
<td>LinkDowned</td>
<td>This counter indicates the total number of times the port has failed the link error recovery process and downed the link. A large number of occurrences of these events can cause disruptions to fabric traffic.</td>
</tr>
<tr>
<td>UncorrectableErrors</td>
<td>This counter indicates the number of unrecoverable internal device errors. It is indicative of a severe hardware defect or data corruption on the wire.</td>
</tr>
</tbody>
</table>

### 5.4.3 Node Properties

The Node Properties section displays the properties for a selected node. The tool bar contains the following buttons:

- **Apply Options** – select which properties to display
- Show Border – turns on/off borders on property items
- Uniform Rows – turns on/off alternative row colors

**Figure 34. Node Properties Example**

![](image)

5.4.3.1 General Properties (Node Performance)

The General panel includes device information for a host or switch. This information is not editable by the user.

**Table 4. Device Information**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node State</td>
<td>The current state of the node.</td>
</tr>
<tr>
<td>LID</td>
<td>The Local Identifier (LID) is an address assigned at an Endpoint by the Fabric Manager, unique within the Fabric, used for forwarding Packets.</td>
</tr>
<tr>
<td>Node Name</td>
<td>Node Name is typically assigned by the system administrator based on the desired naming convention. It is typically the same or derived from the Linux hostname for the server. Once selected by the sysadmin, the value should persist across OS reboot.</td>
</tr>
<tr>
<td>Type</td>
<td>Node Type: UNKNOWN, HFI, SWITCH, ROUTER, OTHER.</td>
</tr>
<tr>
<td>Node GUID</td>
<td>GUID of the HFI or switch.</td>
</tr>
<tr>
<td>System Image GUID</td>
<td>GUID of system, same GUID for all OPA devices in a single system.</td>
</tr>
<tr>
<td>Partition Cap</td>
<td>Number of entries in the Partition Table for end ports.</td>
</tr>
<tr>
<td>Base Version</td>
<td>Supported MAD Base Version.</td>
</tr>
<tr>
<td>Sma Version</td>
<td>Supported Subnet Management Class (SMP) Version.</td>
</tr>
<tr>
<td>Device ID</td>
<td>Device ID information as assigned by device manufacturer.</td>
</tr>
<tr>
<td>Vendor ID</td>
<td>Device vendor, per IEEE.</td>
</tr>
<tr>
<td>Revision</td>
<td>Device revision, assigned by manufacturer.</td>
</tr>
</tbody>
</table>
Table 5. Port Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port GUID</td>
<td>The globally unique identifier (GUID) for the node.</td>
</tr>
<tr>
<td>Number of Ports</td>
<td>The number of ports on the node.</td>
</tr>
<tr>
<td>Port Number</td>
<td>The link port number this SMP came on in.</td>
</tr>
</tbody>
</table>

5.4.3.2 Switch Information (Properties)

Fabric management switch node information, including Switch Properties, Partition Key Enforcement and Forwarding Information.

Table 6. Switch Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Switch Port 0 Support</td>
<td>When set to true, indicates switch port 0 supports enhanced functions (TCA port). When set to false, indicates switch port 0 is a base switch port 0.</td>
</tr>
<tr>
<td>Life Time Value</td>
<td>Sets the time a packet can live in the switch.</td>
</tr>
<tr>
<td>Port State Change</td>
<td>It is set to one anytime the PortState component in the PortInfo of any ports transitions from Down to Initialize, Initialize to Down, Armed to Down, or Active to Down as a result of link state machine logic. Changes in Portstate resulting from SubnSet() do not change this bit. This bit is cleared by writing one, writing zero is ignored.</td>
</tr>
</tbody>
</table>

Table 7. Partition Key Enforcement

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Entries</td>
<td>Partition Enforcement Cap. It specifies the number of entries in the partition enforcement table per physical port. Zero indicates that partition enforcement is not supported by the switch.</td>
</tr>
<tr>
<td>Port Group Cap</td>
<td>The max size of the port group table.</td>
</tr>
<tr>
<td>Port Group Top</td>
<td>The current size of the port group table.</td>
</tr>
</tbody>
</table>

Table 8. Forwarding Information

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear FDB Cap</td>
<td>Number of entries supported in the Linear Unicast Forwarding Table (starting at LID=0x0000 going up). LinearFDBCap= 0 indicates that there is no Linear Forwarding Table.</td>
</tr>
<tr>
<td>Linear FDB Top</td>
<td>Indicates the top of the linear forwarding table. Packets received with unicast DLIDs greater than this value are discarded by the switch. A valid LinearFdbTop is less than LinearFdbCap. This component applies only to switches that implement linear forwarding tables and is ignored by switches that implement random forwarding tables.</td>
</tr>
<tr>
<td>Multicast FDB Cap</td>
<td>Number of entries supported in the Multicast Forwarding Table (starting at LID=0xC000 going up).</td>
</tr>
<tr>
<td>Multicast FDB Top</td>
<td>Indicates the upper bound of the range of the multicast forwarding table. Packets received with MLIDs greater than MulticastFDBTop are considered to be outside the range of the Multicast Forwarding Table. A valid MulticastFdbTop is less than MulticastFDBCap + 0xC000. This component applies only to switches that implement the optional multicast forwarding service. A switch shall ignore the continued...</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>MulticastFDBTop component if it has the value zero. The initial value for MulticastFDBTop shall be set to zero. A value of 0xBFFF means there are no MulticastForwardingTable entries.</td>
<td></td>
</tr>
<tr>
<td>Address Range Config Supported</td>
<td>A flag to indicate if address range for multicast and collectives can be configured.</td>
</tr>
</tbody>
</table>

### 5.4.3.3 Routing Information (Performance Properties)
Routing information for a switch, including IP Address, Routing Mode and Adaptive Routing.

#### Table 9. IP Address

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPV6 Address</td>
<td>IP Address to allow query of the IP address by which additional switch chassis management functions may be accessed.</td>
</tr>
<tr>
<td>IPV4 Address</td>
<td>IP Address to allow query of the IP address by which additional switch chassis management functions may be accessed.</td>
</tr>
</tbody>
</table>

#### Table 10. Routing Mode

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported</td>
<td>Supported routing mode. Routing mode enables alternate routing table modes</td>
</tr>
</tbody>
</table>

#### Table 11. Adaptive Routing

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>Enables/Disables Adaptive Routing.</td>
</tr>
<tr>
<td>Pause</td>
<td>Temporarily disables AR.</td>
</tr>
<tr>
<td>Lost Routes Only</td>
<td>Indicates that AR should only be done for failed links.</td>
</tr>
<tr>
<td>Frequency</td>
<td>Value expands to $2^F*64\text{ms}$.</td>
</tr>
<tr>
<td>Algorithm</td>
<td>(0 = \text{Random}, 1 = \text{Greedy}, 2 = \text{Random Greedy},)</td>
</tr>
</tbody>
</table>
| Threshold   | This is the threshold, above which, adaptive routing will trigger to start offloading DLIDs to alternate ports with no or low or no congestion. The thresholds are in terms of the distribution over the available buffering for a given port VL. Values 1-4 are considered high congestion at the current egress port. Values 5-7 are considered medium congestion. The weight values are as follows:  
  - 0 = use firmware default  
  - 1 = has consumed nearly all of the buffering(or Tags) for a VL (~100%)  
  - 2 = 90%  
  - 3 = 80% This is the default setting.  
  - 4 = 70%  
  - 5 = 65%  
  - 6 = 60%  
  - 7 = 55% |
5.4.3.4 Device Group

Device Group properties include information regarding the device groups that have been set up on a host or switch. This information is available for hosts and switches and is not editable by the user.

5.4.3.5 Multicast Forwarding

Multicast forwarding properties include information regarding the number of ports followed by the list of port numbers on a switch to which packets of a specific MLID value are forwarded. The MLID is the destination address for the packets, and packets sent to the MLID address will be sent to the ports listed for that MLID. This information is only available for switches and is not editable by the user.

5.4.3.6 Linear Forwarding

Linear forwarding properties include information regarding the port numbers on a switch to which packets of a specific LID value are forwarded. A port number of 255 indicates that the switch does not accept packets containing the specified LID. This information is only available for switches and is not editable by the user.

5.4.3.7 SC2SL Mapping Table

This mapping table converts the SC from a received packet back into the Service Level the SC is associated with.

5.5 Port Performance

Port performance of a device node is displayed in three sections:

- Performance
- Connectivity
- Properties
Performance Tab

The performance tab (shown above) includes two sections: Performance (Port) on page 53 and Counters. The performance section displays received and transmitted packets and data to facilitate comparison between received and transmitted data. The counters section displays unit and error counters for the selected port.

Connectivity Tab

This section displays the same content as the Connectivity (Node) on page 45.

Properties Tab

This section displays Port Performance properties. The Port Performance properties include Device Information, Link, Link Connection, Port Capability, Virtual Lane, Diagnostics, Partition Key Enforcement, Management, Flit Control, Port Error Actions, Miscellaneous, MTU by VL, HoQLife By VL, VL Stall Count By VL, QSFP Interpreted Cable Information, SC2VLT Mapping Table, SC2VLNT Mapping Table, and Link Down Error Log.

5.5.1 Performance (Port)

The performance subpage includes two sections: Performance and Counters. The performance section displays received and transmitted packets and data side-by-side with the same scale so you can compare received and transmitted data. The counters section displays utilization and error counters for the selected port.
5.5.1.1 Charts (Port Performance)

See Performance (Charts) on page 44.

5.5.1.2 Counters

The counters section displays receive, transmit, and other counters in the Port Counters card. When a counter field is selected from the card, the top-right chart displays history trend data for the selected field; the bottom-right card displays the description of the field. The descriptions are based on Appendix A Port Counters Overview. Field names can be slightly different.

Hide/Show Border – a toggle button that turns on/off borders on the display

Alternating/Uniform Rows – a toggle button that turns on/off alternate row colors on the display

5.5.1.2.1 Port Counters

This section displays the Receive and Transmit data shown below. Refer to Appendix A Port Counters Overview for more information.

Table 12. Receive Counters

<table>
<thead>
<tr>
<th>Data Displayed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RcvData</td>
<td>The total number of fabric packet flits received. This counter includes all fabric packet flits received with and without errors (such as PktBadTail). Only includes flits actually received in certain error situations, in which case only actual flits received are counted. In IB mode: The total number of data octets, divided by 4, received.</td>
</tr>
<tr>
<td>RcvPkts</td>
<td>The total number of fabric packets received. This counter includes all fabric packet head flits received with and without errors (such as PktBadHead).</td>
</tr>
<tr>
<td>MulticastRcvPkts</td>
<td>The total number of multicast and collective packets received. This counter includes all valid packets and all packets with a header up to and including the DLID, where the DLID is within the configured range for multicast or collectives. Packets within the configured multicast or collective address space are counted, even if later checks determine the packet is unroutable or exceeds the SwitchInfo.MulticastFDBCap, SwitchInfo.CollectiveFDBCap, configured SwitchInfo.MulticastFDBTop or configured SwitchInfo.CollectiveFDBTop.</td>
</tr>
<tr>
<td>RcvErrors</td>
<td>This counter indicates the total number of packets containing an error that were received by the port, including physical errors and malformed packets. It may indicate possible misconfiguration of a port, either by the SM or (more likely) by user intervention (e.g., using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>RcvConstraintErrors</td>
<td>This counter is incremented when partition key or source LID violations are detected in a received packet, indicating a possible security issue or misconfiguration of device security settings.</td>
</tr>
<tr>
<td>RcvSwitchRelayErrors</td>
<td>This counter indicates the number of packets that were dropped due to internal routing errors. It is indicative of the possible misconfiguration of a switch by the SM.</td>
</tr>
</tbody>
</table>

continued...
<table>
<thead>
<tr>
<th>Data Displayed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RcvRemotePhysicalErrors</td>
<td>This counter indicates the number of downstream effects of signal integrity problems. It is indicative of an SI issue in the upstream path.</td>
</tr>
<tr>
<td>RcvFECN</td>
<td>When a device receives a packet with the FECN (Forward Explicit Congestion Notification) bit set to one, this counter is incremented.</td>
</tr>
<tr>
<td>RcvBECN</td>
<td>When a device receives a packet with the BECN (Backward Explicit Congestion Notification) bit set to one, this counter is incremented.</td>
</tr>
<tr>
<td>RcvBubble</td>
<td>This counter indicates the total number of &quot;flit times&quot; where one or more packets have been started to be received, but receiver received idle flits from the wire.</td>
</tr>
</tbody>
</table>

**Table 13. Transmit Counters**

<table>
<thead>
<tr>
<th>Data Displayed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmitData</td>
<td>The total number of fabric packet flits transmitted. Does not include idle nor other LF command flits. This counter includes all fabric packet flits transmitted without and with errors (such as PktBadTail). Only includes flits actually transmitted (e.g., PktLen in header may exceed actual flits transmitted in certain error situations, in which case only actual flits transmitted are counted).</td>
</tr>
<tr>
<td>XmitPkts</td>
<td>The total number of fabric packets transmitted. This counter includes all fabric packet head flits transmitted with and without errors (such as PktBadHead).</td>
</tr>
<tr>
<td>MulticastXmitPkts</td>
<td>The total number of multicast and collective packets transmitted</td>
</tr>
<tr>
<td>Transmit Discards</td>
<td>The number of packets dropped due to one of the following errors:</td>
</tr>
<tr>
<td></td>
<td>• Switch lifetime Limit exceeded</td>
</tr>
<tr>
<td></td>
<td>• Switch head-of-queue lifetime limit exceeded</td>
</tr>
<tr>
<td></td>
<td>• Output port not in active state</td>
</tr>
<tr>
<td></td>
<td>• Packet length exceeded maximum fabric packet size for MTU for VL</td>
</tr>
<tr>
<td></td>
<td>• Flow control disabled and insufficient credits available</td>
</tr>
<tr>
<td></td>
<td>• SC2VL_t mapping invalid for given SC</td>
</tr>
<tr>
<td>XmitConstraintErrors</td>
<td>This counter is incremented when partition key or source LID violations are detected in a packet attempting to be transmitted, indicating a possible security issue or misconfiguration of device security settings.</td>
</tr>
<tr>
<td>XmitWait</td>
<td>This counter indicates the amount of time (in &quot;flit times&quot;) any virtual lane had data but was unable to transmit (for reasons such as no credits available, or that the link was busy sending non-data packets such as link layer retraining or flow control).</td>
</tr>
<tr>
<td>XmitTimeCong</td>
<td>This counter indicates the total number of &quot;flit times&quot; that the counter was in a congested state.</td>
</tr>
<tr>
<td>XmitWastedBW</td>
<td>This counter indicates the number of &quot;flit times&quot; where one or more packets have been started but the transmitters is forced to send idles due to bubbles.</td>
</tr>
<tr>
<td>XmitWaitData</td>
<td>This counter indicates the number of &quot;flit times&quot; where one or more packets have been started but interrupted due to bubbles in the ingress stream.</td>
</tr>
</tbody>
</table>
5.5.1.2.2 Other Counters

This section displays the data shown in the following table. Refer to Appendix A Port Counters Overview for more information.

Table 14. Other Counters

<table>
<thead>
<tr>
<th>Data Displayed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LocalLinkIntegrityErrors</td>
<td>This counter indicates the number of retries initiated by the link transfer layer. It may be indicative of low signal quality, or may be due to long or low quality cables.</td>
</tr>
<tr>
<td>FMConfigErrors</td>
<td>This counter indicates inconsistencies of low level SMA configuration on both sides of the link. It is indicative of the possible misconfiguration of a port, either by the SM or (more likely) by user intervention (by using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>ExcessiveBufferOverruns</td>
<td>This counter, associated with credit management, indicates an input buffer overrun. It may indicate possible misconfiguration of a port, either by the SM or (more likely) by user intervention (e.g., using a tool such as opaportconfig).</td>
</tr>
<tr>
<td>SwPortCongestion</td>
<td>This switch-only counter indicates the number of packets that were discarded as unable to transmit due to flow control issues.</td>
</tr>
<tr>
<td>MarkFECN</td>
<td>This counter indicates the total number of packets that were marked FECN by the transmitter due to congestion.</td>
</tr>
<tr>
<td>LinkErrorRecovery</td>
<td>This counter indicates the number of times the link has successfully completed the link error recovery process. If LQI is fluctuating toward low values AND this counter is increasing, it may be indicative of a bad link. Indication of a more severe signal quality problem.</td>
</tr>
<tr>
<td>LinkDowned</td>
<td>This counter indicates the total number of times the port has failed the link error recovery process and downed the link. A large number of occurrences of these events can cause disruptions to fabric traffic.</td>
</tr>
<tr>
<td>UncorrectableErrors</td>
<td>This counter indicates the number of unrecoverable internal device errors. It is indicative of a severe hardware defect or data corruption on the wire.</td>
</tr>
<tr>
<td>LinkQualityIndicator</td>
<td>This is a status indicator, similar to the signal strength bar display on a mobile phone, that enumerates link quality as a range of 0-5, with 5 being very good. Values in the lower part of the range may indicate hardware problems such as port, cable, etc. that surface as signal integrity issues, leading to performance and other problems.</td>
</tr>
</tbody>
</table>

5.5.2 Connectivity (Port Performance)

See Connectivity (Node) on page 45.

5.5.3 Port Properties

Port properties are not editable by the user.

To view the port properties:
1. From the main screen, click the Performance tab.
2. From the left resource panel, click the Device Types drop-down arrow to reveal the hierarchical view.
3. For any node, click + (plus sign) to expand the tree and select a port for a host or a switch.
4. Click the Properties tab.

5.5.3.1 Device Information (Performance Properties)
This panel displays general port information.

5.5.3.2 Link (Performance Properties)
This panel displays link information for this port.

5.5.3.3 Link Connection (Performance Properties)
This panel displays link connection information that includes the link connected to, neighbor mode, and port mode.

5.5.3.4 Port Capability
This panel displays the port capabilities that are supported for the current port.

5.5.3.5 Virtual Lane
This panel displays the information about the virtual lanes of the port.

5.5.3.6 Diagnostics (Performance)
This panel displays General diagnostic information for the current port.

5.5.3.7 Partition Key Enforcement
This panel displays the information about packet partition key enforcement for the current port. Choices are true, false or N/A (not applicable).

5.5.3.8 Management (Performance)
This panel displays subnet manager and management key information for the current port.

5.5.3.9 Flit Control (Performance)
This panel displays flit control information that includes the interleave and preemption.

5.5.3.10 Port Error Actions
This panel displays a port error action mask.

5.5.3.11 Miscellaneous (Performance Properties)
This panel displays miscellaneous information such as IP Address, Buffer Units and Subnet.
5.5.3.12 MTU By VL
This panel displays RW/HS-E Neighbor MTU values per VL.

5.5.3.13 HoQLife By VL
This panel displays the time a packet can live at the head of a VL queue.

5.5.3.14 VL Stall Count By VL
This panel displays the number of sequential packets dropped that causes the port to enter the VLStalled state.

5.5.3.15 QSFP Interpreted Cable Information
This panel displays QSFP port type cable information.

5.5.3.16 SC2VLT Mapping Table
This panel displays the Service Channel (SC) to Virtual Lane Transmit (VLT) mapping table.

5.5.3.17 SC2VLNT Mapping Table
This panel displays the Service Channel (SC) to Virtual Lane Non-transmit (VLNT) mapping table.

5.5.3.18 Link Down Error Log
This panel displays the Link Down Reason and Neighbor Link Down Reason in time that indicates the reason the port transitioned from Link states Init, Armed, Active to Down.
6.0 Topology

The Topology tab displays the topology for selected resources. On the left of the page is a resource tree panel that organizes subnet devices by different categories, which allows you to select resources. The main panel shows the topology of a selected resource and its content changes based on the type of selected resource.

The main panel displays the topology and related information. The left section showing the overall topology outline and selected resources corresponds to the topology of selected resources shown at the right. The bottom section displays detailed information for the currently selected resources and its contents change based on the type of resource selected.

![Topology Example](image)

See the topics below for details on each section of the Topology tab:

- **Resource Tree** on page 37
- **Outline** on page 60
- **Selected Resources** on page 60
- **Local Topology** on page 60
6.1 Resource Tree (Topology)

The Resource Tree panel is the same as on the Performance tab except that it allows multiple selections on resources with the same type, for example, multiple nodes, multiple ports or multiple device groups, virtual fabrics. However, when a user selects among different resource types, only one resource is allowed.

6.2 Outline

The Outline section shows the topology outline for a subnet, highlighting the selected resources. Use the **Enlarge** button at the bottom to open a pop up window of the topology outline for a closer look at the topology.

6.3 Selected Resources

This section displays the selected resources when you select multiple resources that cannot be shown on the same screen as the device tree panel.

6.4 Local Topology

This section displays a small and clear topology of selected resources for a closer look. Although it shows only local topology, it shares the same topology architecture as the outline graph to indicate how the local topology relates to the subnet topology overall.

Buttons at the top can be used to zoom in/out of the graph or fit the graph into the window. Each element shown on the local topology is clickable for a single selection. Hover the mouse over a device node to show the name of the node and to highlight its connections on the topology graph to see how it is connected.

**Figure 37. Local Topology Example**
The content of this panel depends upon the type of resources selected, as described in the topics linked below.

- **Device Node** on page 62
- **Links** on page 63
- **Routes** on page 63

### 6.4.1 Device Set (Topology)

Selection on a whole subnet is a special case of the device set selection. This panel shows the whole topology of the subnet.

**Figure 38. Device Set Example**

Selections on one or more device types, device groups, or virtual fabrics are also treated as a device set. This panel shows the topology among all involved devices, and each device is highlighted with a green border.
6.4.2 Device Node

When a device node is selected, this panel shows the connections of the node. The selected node is highlighted with a green border to distinguish it from its neighbors.
Detailed Information Panel

When a device node is selected this panel displays this node's properties and connectivity table, which is the same data represented with different views. For more detailed information see Connectivity (Node) on page 45 and Node Performance on page 41.

6.4.3 Links

When you select one or more ports, this panel shows and highlights each port's connection.

Figure 41. Links Example

Detailed Information Panel

When multiple ports are selected, this panel shows each port's connectivity table in a tabbed pane. Use the More button on the top-right corner to display additional links. When the number of links is less than 5, the button is disabled.

6.4.4 Routes

When multiple device nodes are selected, this panel shows the local topology of the selected nodes. It also highlights the routes among the nodes to show how they connect to each other.
Figure 42. Routes Example

When multiple device nodes are selected, this panel shows the pairwise route among the selected nodes in a tabbed pane. Each tab shows the route as a connectivity table (see Connectivity (Node) on page 45). It shows the whole path from one port to another and each port's performance data.
7.0 Admin Tab

The Admin tab provides tools to manage a subnet. The control panel on the left lists all available functions. The right side displays the corresponding content for a selected function.

The first time you select one of the icons on the control panel, you must enter a valid username and password to log in, which gives you access to the administrative features. After the initial login, admin features, there is no need to enter the credentials again.

The following functions are described in the linked topics:
- Applications Management on page 65
- Device Groups Management on page 67
- QOSGroups Management on page 67
- Virtual Fabrics Management on page 68
- Interactive Console on page 69
- Log View on page 72

Figure 43. Admin Tab

7.1 Applications Management

The left panel lists the application names with two buttons on the bottom that allow you to add or remove one application.
The right panel displays and allows you to edit the configuration of one application. An application’s configuration is made up of a set of attributes that are represented as attribute bars.

The **Click to add a new attribute** button allows you to select an attribute type from a drop-down list and specify values for the attribute. Use the **Save** and **Reset** buttons to save the new configuration or reset the configuration to original values.

Fabric Manager GUI validates the configuration before you save or remove an application, checking for duplicate names, invalid value ranges, for example a min value that is larger than the max value, and application references. An application with reference to others cannot be removed or renamed until you resolve any reference issues.

The **Deploy** button on the bottom-right corner deploys the applications to the master Subnet Manager in the following way:

1. Fabric Manager GUI makes a copy of current configuration file `opafm.xml` with a name such as `opafm.xml.<timestamp>.fv`.
2. Fabric Manager GUI maintains the number of backup files to 16 by removing older files.
3. Fabric Manager GUI replaces `opafm.xml` with the new configurations.

To see the new configurations take effect, restart and relaunch Fabric Manager GUI.

Some applications are predefined and they cannot be edited or removed. These applications are indicated with on the view only mode on the right panel.

When an `opafm.xml` was generated by a tool, the content will be uneditable. A message will show on the top of the editor panel to indicate that the content is read only and all Applications are shown on view only mode.
Device Groups Management

Device Groups management is similar to Applications management, but it has a different way to add or change an attribute. On the middle center is a resource selection panel that displays current resource selections and allows you to change them.

The **Devices** tab shows selected devices that can be described either by name or GUID. The **Select** tab shows the selection on special types of devices. The **Include** tab allows a Device Group to include another one.

QOSGroups Management

The QOSGroups Management user interface is similar to Applications Management. On the left panel, a check icon associated with a group name indicates that the QOS group is enabled. Before QOSGroups modifications are saved, Fabric Manager GUI validates that the Names and BaseSL entries are unique.

When you load an older version of opafm.xml that doesn't support QOS groups, a "QOSGroups are unavailable" message appears on the main panel.
Figure 47. QOSGroups Management

7.4 Virtual Fabrics Management

The figures below show the Virtual Fabrics Management user interface. It’s very similar to Applications Management. When you load an old version of opafm.xml that doesn’t support QOS groups, use the interface shown in the first figure to directly set QOS related parameters. When the loaded opafm.xml supports QOS Groups, use the interface shown in the second figure to specify the QOS Group for a Virtual Fabric.

Both interfaces have a similar configuration editor panel on the right side. Use this panel to specify basic administrator policies; for example, to enable one virtual fabric and specify whether it should provide security control and/or QOS control.

Please note that for QOS group, the QOS control box is grayed out because its value comes from QOS group. A user can not directly change it within the editor panel. The administrator policies attributes can be used only once and the used attribute is identified with an icon to indicate that it is not available.
7.5 Interactive Console

When you select the Console icon on the control panel (or the “+” tab) Fabric Manager GUI displays a new console screen where you must enter a username, password, host, and port (SSH uses port 22 by default). After logging in, the Interactive Console window changes as shown in the following figure.
Figure 50. Interactive Console

The Interactive Console provides:

- An Integrated Management Environment to allow a power user to manage a subnet via consoles within the Fabric Manager GUI.

- A Dynamic Online Help for CLI tools. It may be difficult for users to remember the arguments for a CLI tool. This special console monitors your actions and is able to automatically identify and show the corresponding help for the command as you are typing.

  For example, when you type `opare`, the console analyses the input, selects the `opareport` command, and then displays the help content for this command with arguments and their meanings. If you continue to type `opareport -o`, the panel scrolls to the available output types for argument `-o`.

The Interactive Console also manages consoles by tabs and each command can be issued either in the same console or a new console. Issuing commands in a new console enables you to compare results from similar commands by switching tabs.

To close a console, click the **x** icon on the tab. To log into a console, click the + icon (+).
Figure 51. Interactive Console Examples
7.6 Log View

The SM Log Viewer shown in the following figure shows the error log from the remote SM host. At the top of the page controls are provided to change the log text shown. A status line displays the file name, number of lines, number of matched search results, and range of lines in the file being viewed. The File Name field shows the path of the log file on the remote host. The tooltip to display the entire path is available for file paths that exceed the name field width. The main text portion of the window displays the lines of text taken from the log file (see Lines/Page below).

Figure 52. Log Viewer
Filters

Check boxes [ ] are used to filter lines of text containing SM, FM, FE, WARN, and ERROR. When a checkbox is selected, all lines containing the selected filter are displayed and highlighted in a different color; lines that do not contain the filtered text are not displayed.

Refresh

The Lines/Page control [#] allows you to select the number of lines to display on each page as the file is traversed. The Total Lines field shows the total number of lines in the log file and is updated as lines are added.

NOTE

After you enter or select a number of lines, click the [ ] to refresh the viewer with the new lines.

Search

The Search feature [ ] is accessible through the actions described below. The # Matches field below it indicates the number of search results found.

- Search Field
  - Click the search field to highlight text.
  - Double-clicking on the search field removes highlights from existing text and places a cursor at the end of the text.
  - Enter text to search for and then click [ ] to perform search.
  - Click [ ] to remove highlights from search results and to clear the search field.

- Marked Search
  - In the main text window, double-click on a word to highlight all instances of the word.
  - Selected word also appears in the search field.
  - Click [ ] to remove highlights from search results and to clear the search field.

- Selected Search
  - Copy/Paste
    1. While holding down the left mouse button, drag the mouse pointer across a word, phrase, line, or multiple lines to select the desired search entry.
    2. Right-click on the text area to display the context menu and select Copy.
    3. Right-click in the search field to display the context menu and select Paste.
    4. Click [ ] or press ENTER to perform search.
    5. Click [ ] to remove highlights from search results and to clear the search field.
NOTE
You can also use Ctrl+C to copy to the clipboard, and Ctrl+V to paste from the clipboard.

— Highlighting
1. While holding down the left mouse button, drag the mouse pointer across a word, phrase, line, or multiple lines to select the desired search entry.
2. Right-click on the text area to display the context menu and select Highlight to highlight all instances of the selected text.
3. Click to remove highlights from search results and to clear the search field.

Paging
The Paging control allows you to move backward and forward through the log file in line increments specified in the Lines/Page field. Highlighting of text imposed by the Filter, Highlight, or Search functions remains in effect as the page view changes. The Line Range field, located below the controls, shows the range of lines currently being viewed. This range remains unchanged if lines are filtered and show a subset of lines designated by Lines/Page or range.

Configuration
The Configuration control allows you to log out of the Log Viewer and redefine the host credentials and log file name. When the Configuration control is clicked the screen shown in the figure below is displayed. Two modes are available when logging into the Log Viewer:

• Auto Config – Only the user name and password fields are available and it is assumed that the Host, Port, and Log File path information is correct.
• Custom Config – In this mode, all fields are editable and the user must provide the necessary login information.

With this feature, the log on any host can be viewed regardless of the host to which the subnet window is connected.
Figure 53. Configuration Login Screen

![Configuration Login Screen](image)

**NOTE:** The ESM Syslog cannot be accessed directly from a switch.

8.0 Troubleshooting Guide

8.1 Overview

This troubleshooting guide is intended to provide assistance to system administrators and users to detect and correct system anomalies brought on by hardware failures or incorrect hardware/software configuration.

Assumptions

It is assumed that the user has some knowledge of High-Performance Computing (HPC) systems and is familiar with the following:

• The Intel® Omni-Path Fabric Suite FastFabric Tool Suite
• Navigation of the Linux command line
• Protocols: Secure Shell, Secure Copy, and Secure FTP (SFTP)
• General administration of a network cluster

About This Guide

This guide provides steps that can be taken to prevent or correct errors encountered when using the Fabric Manager GUI. It is not meant as an exhaustive troubleshooting guide for fabric-related anomalies but provides direction in correcting improper functioning of the Fabric Manager GUI.

Who Should Use This Guide

This guide is intended for system administrators responsible for the configuration and maintenance of HPC systems.

Typographical Conventions

The typographical conventions used throughout the Troubleshooting Guide are shown in the following table.

Table 15. Typographical Conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Indicates content describing anomalies and how to correct them.</td>
</tr>
<tr>
<td>Shaded block</td>
<td>Indicates a command typed at the command line.</td>
</tr>
<tr>
<td>Bold</td>
<td>Indicates key Fabric Manager GUI components such as menu options.</td>
</tr>
<tr>
<td>Square Brackets [ ]</td>
<td>Optional Items.</td>
</tr>
<tr>
<td>Angle Brackets &lt; &gt;</td>
<td>User-supplied values.</td>
</tr>
</tbody>
</table>
8.2 General Error Prevention

The number of errors encountered when using the Fabric Manager GUI can be minimized by adhering to a set of commonly ascribed best practices. While it is possible to encounter errors even when measured precautions have been observed, Intel highly recommends that these practices be used as a first line of defense against commonly known errors.

8.3 Best Practices

By following these best practices, many common errors can be averted.

- Keep an Ssh Terminal Open
  When running the Fabric Manager GUI, it is helpful to always have an Ssh Terminal available to verify host connectivity, analyze OPAFM configuration, use Intel® Omni-Path Fabric Suite FastFabric Tools to verify expected behavior, etc. Even if it is not possible to connect to the subnet, an Ssh session can still be opened using a CONSOLE feature under the ADMIN tab.

- Use the Online Help System
  The Fabric Manager GUI has an Online Help System that should be used as a guide to the proper use and understanding of features being explored. Click the on each panel to obtain specific information about that panel, or select ONLINE HELP from the HELP menu for information about setting up access to a subnet.

- Use the Fast Fabric Assistant
  The CONSOLE feature mentioned above has the additional ability of providing real-time help through the FastFabric Assistant, which provides command line syntax for commands in the Intel® Omni-Path Fabric Suite FastFabric Tool Suite.

- Take advantage of the SM Log
  The Fabric Manager GUI provides a window into the SM Log file where errors and other activities are logged by the Intel® Omni-Path Fabric Suite Fabric Manager. This can be an invaluable resource in detecting the root cause of errors encountered when running the Fabric Manager GUI. Under the ADMIN tab, select the LOGS tab and log into the host. Lines of text from the log file are provided beginning with the most recent 100 lines to a maximum of 1000 lines of text. Use the filters to narrow the text being displayed by device type, warnings, or errors.

8.4 Application Log

There are several application log files which, if configured, can provide much guidance in determine the root cause of system failures. These logs are located in different directories depending on whether it is installed under Windows or Linux.

The log files names are:
- fmgui.log
- hibernate.log
- opadbmgr.log
- opafecdriver.log

The paths for each OS are:
• Windows: C:\Users\<user_name>\AppData\Roaming\Intel\FabricManagerGUI\logs
• Linux: $HOME/.Intel/FabricManagerGUI/logs

Log file names and location are configurable in the logging configuration file at C:\Users\<user_name>\AppData\Roaming\Intel\FabricManagerGUI\logconfig.xml

8.5 Troubleshooting Q & A

In general, text fields throughout the Fabric Manager GUI provide real-time validation. If the type of information provided is not appropriate or left blank, the field is highlighted in light red with a red border as shown in the following example. Mouse-over the field to display a tool tip about how to provide the correct information.

Figure 54. Troubleshooting Example

Q1. Why does Fabric Manager GUI fail to connect to Fabric Manager?

A1. Diagnose the connection issue using the following steps.

1. Check whether the FE is configured properly. You can use the opasaquery tool with Out-of-band options from the IFS package to do this. This tool is an easy way to diagnose the connectivity to the FE without using Fabric Manager GUI. You can run the tool on the same server where the Fabric Manager and FE are running. If opasaquery fails, refer to the Intel® Omni-Path Fabric Suite Fabric Manager User Guide in the section "Controlling FM Startup" to configure and start FE properly. Ensure that IPV6 is enabled on the FM/FE host’s Ethernet Interface(s) because it is required by FE. However, in-band interfaces like the ib0 (IPoIB) network devices, do not require IPv6 to be enabled.
2. Check that the network is configured properly.
   If the opasaquery test in Step 1 works properly, there are issues with the network connectivity.
   a. Check the firewall to ensure that the FE port is reachable.
   b. If Step a. passes, the issue may be more complicated.
      i. If you are using both ipv4 and ipv6, try to focus on ipv4 only.
      ii. If you are using only ipv6, you might try looking at the Java system property "java.net.preferIPv4Stack" and see if it is set to "true". Check on the machine running the FM GUI first, look at JAVA_TOOL_OPTIONS or JAVA_OPTIONS settings. If not, perhaps your organization is enforcing this policy and you might try working with your system or network administrator to reach a resolution.

3. If you have verified that the Fabric Manager GUI machine can communicate with the FE port, then you should send the fmgui log file to Intel Fabric Manager GUI support.

Q2. Why is the number of active nodes/ports wrong on the Home screen?

A2. It is possible that the Fabric Manager GUI is configured to connect to the wrong host. Double-check the hostname/IP address to confirm the connection to the expected host.

Q3. On the HOME page, why does the MASTER SM field show the name of a different host than the one I am connected to?

A3. On the HOME page, notice that the name of the host you are connected to is shown in a number of places:
   • In the title bar at the top of the screen.
   • In the Subnet: field at the top of the SUBNET SUMMARY section.
   • Either in the MASTER SM or STANDBY SMs fields.

If you have connected to a Standby SM, the name in the MASTER SM field will be different from the name in the title bar and Subnet: field.
Q4. The Fabric Manager GUI fails to connect to a subnet after a long time and then displays an error message. How can I fix this?

A4. There are many reasons why a remote subnet fails to connect. The Fabric Manager GUI repeatedly attempts to connect to a subnet through the failover process. By traversing the list of subnet hosts, provided in the Subnet Wizard, the Fabric Manager GUI attempts to obtain a response from the Subnet Manager (SM) and subsequently the Performance Manager (PM). During the connection process the following dialog is displayed:

If no response is received from the SM, or if the SM responds but the PM does not, then the failover process has failed and the following dialog is displayed:
If this happens, then it is necessary to determine the root cause of the problem. Here are a few things to look at:

1. Check whether the host is reachable.
   
   Open an Ssh session using the CONSOLE feature under the ADMIN tab and then type the following command:

   ```
   ping <ip/hostname>
   ```

   If there is no response, determine the root cause and try again.

2. Check whether the FE is running.
   
   For more information about configuring the Fabric Manager to initialize the FE, refer to the Intel® Omni-Path Fabric Suite Fabric Manager User Guide in the section titled "Controlling FM Startup."

**Q5.** When I try to connect to a subnet I get an error indicating that the connection was forcibly closed by the remote host. What can I do?

**A5.** This error is displayed when an attempt is made to connect to a secure fabric without providing the necessary security certificates to establish the connection.

1. Follow the procedure in "SSL Key Creation for Fabric Manager GUI" appendix in the Intel Omni-Path Fabric Suite Fabric Manager User Guide.

2. Open the SETUP WIZARD under the CONFIGURE menu. Select the subnet to be configured and click on the SECURE checkbox as shown in the following figure. Use the file browser icons to locate the Key and Trust Store files, click APPLY, and then RUN.
3. Enter the password for the certificates on the new dialog to establish a connection to the remote host.

Q6. While trying to open an Ssh session to a remote host using the CONSOLE feature under the ADMIN tab, the following error was reported. Why?

`SSH_MSG_DISCONNECT: 2 Too many authentication failures for invaliduser`

A6. This error is displayed when:

- Invalid credentials are provided on the console login panel; check the credentials and try again.
- Invalid or valid credentials are provided, but the host is unreachable.
Q7. While trying to open an Ssh session to a remote host using the **CONSOLE** feature under the **ADMIN** tab, the following error was reported:

```
Unable to connect to remote host phgppriv22: java.net.ConnectException: Connection refused: connect
```

A7. This error is displayed when the Ssh port is incorrect. By default the Ssh port number is 22 unless specifically reconfigured by the system administrator.

Q8. In the Preferences Wizard I put an email recipient in the list and clicked on the Test button, but no email was sent.

A8. To send emails, the SMTP server must be running on the remote host. Then the Fabric Manager GUI must be configured to point to the SMTP server. Under the configure menu, select **Email Setup** and enter the SMTP Host, Port #, and Sender’s email address.

Q9. On the **LOGGING** window under the **CONFIGURATION** menu, how can I get more information about filling out the **OUTPUT FORMAT** field?

A9. Click on the Help 📖 icon to the right of the **OUTPUT FORMAT** field to display the formatting help window, which provides detailed information about the formatting symbols.
Appendix A Port Counters Overview

Each port in an Intel® Omni-Path Fabric maintains a set of port counters to indicate both traffic and error counts. These counters can be grouped into the categories described in this section. Each port stops incrementing when the max value is reached, irrespective of counter size. Most of the counters are 64-bits in size. Exceptions are noted.

A.1 Utilization

These counters reflect the normal utilization of the port and Virtual Lane when present.

Several of these counters are used during the calculation of Congestion, SMA Congestion, and the Bubble Categories. The Utilization metrics provide a way of giving some of the other counters context by comparing them to the amount of data or packets that were transmitted or received.

A.1.1 PortXmitData (TxD) and PortVLXmitData[n]

These counters indicate the total number of fabric packet flits transmitted. This does not include idle nor other LF command flits.

A.1.2 PortRcvData (RxD) and PortVLRcvData[n]

These counters indicate the total number of fabric packet flits received.

A.1.3 PortMulticastXmitPkts (MTxP)

This counter indicates the number of multicast and collective packets transmitted.

A.1.4 PortMulticastRcvPkts (MRxP)

This counter indicates the number of multicast and collective packets received.

A.2 Link Integrity

These counters reflect errors in the Physical (PHY) and Link Layers, as well as errors in firmware. In some cases, these errors are benign and can be ignored. However in other cases, excessive link integrity errors can indicate a hardware problem such as a poor connection, marginal cable, incorrect length/model cable for signal rate, or damaged/broken hardware, such as bad connectors.

When a bad packet is detected, one of these counters is incremented and the Link Layer may either discard or replay the packet.
During the link training sequence, assorted errors may be observed. This is a normal part of the link training and clock synchronization process. Hence, errors observed as part of rebooting nodes or moving cables should not be considered a problem.

The category is calculated as a weighted sum of the counters in the group. With the exception of ExcessiveBufferOverrunErrors, the counters in this group report on the receive side of the link. However, the counter can indicate a problem on either side of the link.

A.2.1 Link Quality Indicator (LQI)

This is a status indicator, similar to the signal strength bar display on a mobile phone, that enumerates link quality as a range of 0-5, with 5 being very good. Values in the lower part of the range may indicate hardware problems with components such as ports and cables that surface as signal integrity issues, leading to performance and other problems. The LQI gives you an instantaneous view of a link’s quality on every hardware port.

<table>
<thead>
<tr>
<th>Link Quality Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Working at or above preferred link quality, no action needed.</td>
</tr>
<tr>
<td>3</td>
<td>Working on low end of acceptable link quality, recommend corrective action on next maintenance window.</td>
</tr>
<tr>
<td>2</td>
<td>Working below acceptable link quality, recommend timely corrective action.</td>
</tr>
<tr>
<td>1</td>
<td>Working far below acceptable link quality, recommend immediate corrective action.</td>
</tr>
<tr>
<td>0</td>
<td>Link down</td>
</tr>
</tbody>
</table>

Note: Corrective action entails diagnosing the hardware (links/cables and ports/devices). For example: Are the cables bad or improperly placed? Is the HFI/switch responsive? Does rebooting the device/sever fix the issue?

A.2.2 LocalLinkIntegrityErrors (LLI) Counter

This counter indicates the number of retries initiated by a link transfer layer receiver. The retry rate is represented by the Link Quality Indicator. A link that is meeting performance requirements has a Link Quality of 5, which corresponds to 1000 or fewer replays per second.

A.2.3 PortRcvErrors (RxE) Counter

This counter indicates the total number of packets containing an error that were received by the port, including Link Layer protocol violations and malformed packets. It indicates possible misconfiguration of a port, either by the Subnet Manager (SM) or by user intervention. It can also indicate hardware issues or extremely poor link signal integrity.

A.2.4 ExcessiveBufferOverrunErrors (EBO) Counter

This counter, associated with credit management, indicates an input buffer overrun. It indicates possible misconfiguration of a port, either by the SM or by user intervention. It can also indicate hardware issues or extremely poor link signal integrity.
A.2.5  **LinkErrorRecovery (LER) Counter**

This counter indicates the number of times the link has successfully completed the link error recovery process.

Link Quality Indicator is the primary indicator for link quality to use. This counter is factored into the value reported for Link Quality Indicator. This counter may be non-zero for a properly functioning link.

A.2.6  **LinkDowned (LD) Counter**

This counter indicates the total number of times the port has failed the link error recovery process and downed the link. These events can cause disruptions to fabric traffic.

A.2.7  **UncorrectableErrors (Unc) Counter**

This counter indicates the number of unrecoverable device errors. This may indicate a defect in the reporting device.

A.2.8  **FMConfigErrors (FMC) Counter**

This counter reports inconsistent configurations of the low-level Subnet Management Agent (SMA) on either side of the link. It indicates possible misconfiguration of a port, either by the SM or by user intervention.

A.3  **Congestion**

These counters reflect possible errors that indicate traffic congestion in the fabric.

When congestion or a packet that has seen congestion is detected, one of these counters is incremented and then depending on the issue reported, the packet must wait. In an extreme case, the packet may time out and be dropped.

The category is calculated as a weighted sum of the counters in the context of the utilization counters. With the exception of PortRcvFECN, the counters are all reported on the transmit side of the link. In addition, PortRcvBECN is only taken if the local node is an HFI. However, the counter could indicate a problem on either side of the link.

A.3.1  **CongDiscards (CD) Counter**

**NOTE**

Formerly known as "SwPortCongestion".

This switch-only counter indicates the number of packets that were discarded as unable to transmit due to timeouts.

A.3.2  **PortRcvFECN (RxF) Counter**

When a device receives a packet with the Forward Explicit Congestion Notification (FECN) bit set to one, this counter is incremented.
A.3.3 **PortRcvBECN (RxB) Counter**
When a device receives a packet with the Backward Explicit Congestion Notification (BECN) bit set to one, this counter is incremented.

A.3.4 **PortMarkFECN (MkF) Counter**
This counter indicates the total number of packets that were marked Forward Explicit Congestion Notification (FECN) by the transmitter due to congestion.

A.3.5 **PortXmitTimeCong (TxTC) Counter**
This counter indicates the total number of *flit times* that the port was in a congested state for any data VL.

A.3.6 **PortXmitWait (TxW) Counter**
This counter indicates the amount of time (in *flit times*) any virtual lane had data but was unable to transmit due to no credits available.

A.4 **SMA Congestion**
These counters reflect congestion in the fabric specific to communication between the Subnet Manager and Subnet Manager Agents using the management VL (VL 15).

The category is calculated exactly as the Congestion category using the same weights and the correct VL15 utilization counters.

A.4.1 **PortVLXmitWait[15] (VLTxW[15]) Counter**
This counter behaves the same as PortXmitWait, but it is restricted to VL 15, which carries only SM traffic.

A.4.2 **VLCongDiscards[15] (VLCD[15]) Counter**

---

**NOTE**
Formerly known as "SwPortVLCongestion".

This counter behaves the same as CongDiscards, but it is restricted to VL 15, which carries only SM traffic.

A.4.3 **PortVLRcvFECN[15] (VLRxF[15]) Counter**
This counter behaves the same as PortRcvFECN, but it is restricted to VL 15, which carries only SM traffic.

A.4.4 **PortVLRcvBECN[15] (VLRxB[15]) Counter**
This counter behaves the same as PortRcvBECN, but it is restricted to VL 15, which carries only SM traffic.
A.4.5  **PortVLXmitTimeCong[15] (VLTxTC[15]) Counter**
This counter behaves the same as PortXmitTimeCong, but it is restricted to VL 15, which carries only SM traffic.

A.4.6  **PortVLMarkFECN[15] (VLMkF[15]) Counter**
This counter behaves the same as PortMarkFECN, but it is restricted to VL 15, which carries only SM traffic.

A.5  **Bubble**
These counters occur when an unexpected idle flit is transmitted or received.
The transmit port sends idle flits until it can continue sending the rest of the packet.
The category is calculated as follows:
1. The maximum value between the sum of the XmitWastedBW and XmitWaitData or the neighbor’s PortRcvBubble.
2. Then divide the previous value by the port’s utilization to provide context.

A.5.1  **PortXmitWastedBW (WBW) Counter**
This counter indicates the number of flit times where one or more packets have been started but the transmitters are forced to send idles due to bubbles in the ingress stream. Also, the VLs that have data to be sent are not permitted to preempt the currently transmitting VL.

A.5.2  **PortXmitWaitData (TxWD) Counter**
This counter indicates the number of flit times where one or more packets have been started but interrupted due to bubbles in the ingress stream.

A.5.3  **PortRcvBubble (RxBb) Counter**
This counter indicates the total number of flit times where one or more packets have started to be received, but the receiver received idle flits from the wire.

A.6  **Security**
These counters reflect possible security problems in the fabric.
Security problems can occur if a PKey or SLID violation occurs at the port during the ingress or egress of a packet.
The category is calculated as the sum of the neighbor’s PortRcvConstraintErrors and the local port’s PortXmitConstraintErrors.

A.6.1  **PortRcvConstraintErrors (RxCE)**
This counter is incremented when partition key or source LID violations are detected in a received packet, indicating a possible security issue or misconfiguration of device security settings.
A.6.2 **PortXmitConstraintErrors (TxCE)**

This counter is incremented when partition key violations are detected in a packet attempting to be transmitted, indicating a possible security issue or misconfiguration of device security settings.

A.7 **Routing**

These counters reflect possible routing issues. When a routing issue occurs, the offending packet is dropped.

A typical cause of this error is the routing to a wrong egress port or an improper Service Channel (SC) mapping. These errors can be a side effect of a port or device going down while traffic was still in flight to or through the given port or device.

A.7.1 **PortRcvSwitchRelayErrors (RxSR)**

This counter indicates the number of packets that were dropped due to internal routing errors. It indicates possible misconfiguration of a switch by the SM.

A.8 **Other**

These counters do not fit into any of the previous categories.

A.8.1 **PortRcvRemotePhysicalErrors (RxRP)**

This counter indicates the number of downstream effects of signal integrity (SI) problems. It indicates an SI issue in the upstream path.

This counter was not included as it does not directly indicate the link that had the issue, so it can be misleading.

A.8.2 **PortXmitDiscards (TxDC)**

This counter indicates the number of packets dropped due to several reasons including timeouts and improper packet lengths.

**NOTE**

This counter is a super set that includes Congestion Discards counter.