Intel® Omni-Path Host Fabric Interface

Installation Guide

April 2017

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Date	Revision	Description
April 2017	5.0	• Added a note regarding the use of the NVIDIA* GPUDirect* RDMA Linux* kernel to "Hardware Installation for HFI Without a PCI Express Riser" on page 16 • Added a Note with a pointer to upgrading HFI firmware to "2.0 Hardware Installation Checklist 9" on page 3
December 2016	4.0	• Added the section "Configurator" on page 6 • Added Figure 3, "Intel® Omni-Path Split PCI-E DuaL Port Host Fabric Interface" on page 14
May 2016	3.0	Document updated for Revision 3.0
February 2016	2.0	Document updated for Revision 2.0
November 2015	1.0	Document updated for Revision 1.0

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1.0   Introduction

This chapter describes the contents, intended audience, and organization of the *Intel®
Host Fabric Interface Installation Guide*.

The *Intel® Host Fabric Interface Installation Guide* contains instructions for installing
the HFI.

Note: This device has not been authorized as required by the rules of the Federal
Communications Commission. This device is not, and may not be, offered for sale or
lease, or sold or leased, until authorization is obtained.

1.1   Intended Audience

This installation guide is intended for administrators responsible for installing the Intel®
Omni-Path HFI in their Linux* cluster. Additional detailed information and instructions
for administering an Intel® cluster can be found in the *Intel® Omni-Path Host Software
User Guide*.

The *Intel® Host Fabric Interface Installation Guide* assumes that you are familiar with
the specific hardware that you plan to use. Before installing the HFI, you should have
basic knowledge of your host and target operating systems.

This document does not contain all the information you need to use basic Linux*
commands or to perform all system administration tasks. For this information, see the
software documentation you received with your system.

1.2   How this Guide is Organized

The *Intel® Host Fabric Interface Installation Guide* is organized into these sections:

- Chapter 1.0, "Introduction", contains an overview of the HFI and software,
  describes interoperability with other products, lists all related documentation, and
  provides Intel contact information.
- Chapter 2.0, "Hardware Installation Checklist", provides a high-level overview of
  the hardware installation procedures.
- Chapter 3.0, "Hardware Installation", includes instructions for installing the Intel®
  HFI.

1.3   Overview

The material in this documentation pertains to an OFED *cluster*. A cluster is defined as a
collection of nodes, each attached to a fabric through the Intel® interconnect. The
nodes are generally Linux*-based computers having multiple processors/cores. The
Intel® HFI utilizes Intel® Omni-Path switches and cabling.

A cluster requires fabric management. Here are several options:

- Use the Intel® Omni-Path Embedded Fabric Manager in one or more managed
  Omni-Path switches.
- Use a host-based subnet manager such as the Intel® Omni-Path Fabric Suite Fabric
  Manager, as a part of the Intel® Omni-Path Fabric Suite download.

1.4 Configurator

The Cluster Configurator for Intel® Omni-Path Fabrics is available at: http://www.intel.com/content/www/us/en/high-performance-computing-fabrics/omni-path-configurator.html.

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.

1.5 Documentation

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

- Intel® Omni-Path Switches Installation, User, and Reference Guides
  www.intel.com/omnipath/SwitchPublications

- Intel® Omni-Path Fabric Software Installation, User, and Reference Guides
  www.intel.com/omnipath/FabricSoftwarePublications

- Drivers and Software (including Release Notes)
  www.intel.com/omnipath/downloads

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

Table 1.   Intel® Omni-Path Documentation Library (Sheet 1 of 2)

Task	Document Title	Description
Key: Shading indicates the URL to use for accessing the particular document.		
• 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		
Setting up an Intel® OPA cluster	*Intel® Omni-Path Fabric Setup Guide*	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 BKMs are defined to facilitate the installation process and troubleshooting.
Installing Hardware	*Intel® Omni-Path Fabric Switches Hardware Installation Guide*	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.
	Intel® Omni-Path Host Fabric Interface Installation Guide	Contains instructions for installing the HFI in an Intel® OPA cluster. A cluster is defined as a collection of nodes, each attached to a fabric through the Intel® interconnect. The Intel® HFI utilizes Intel® Omni-Path switches and cabling.
Installing Software	*Intel® Omni-Path Fabric Software Installation Guide*	Describes using a Text 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 rpms individually.
Managing a switch using Chassis Viewer GUI	*Intel® Omni-Path Fabric Switches GUI User Guide*	Describes the Intel® Omni-Path Fabric Chassis Viewer graphical user interface (GUI). It provides task-oriented procedures for configuring and managing the Intel® Omni-Path Switch family. Help: GUI Online Help.

Table 1.   Intel® Omni-Path Documentation Library (Sheet 2 of 2)

Task	Document Title	Description
Managing a switch using the CLI	*Intel® Omni-Path Fabric Switches Command Line Interface Reference Guide*	Describes the command line interface (CLI) task information for the Intel® Omni-Path Switch family. Help: -help for each CLI.
Managing a fabric using FastFabric	*Intel® Omni-Path Fabric Suite FastFabric User Guide*	Provides instructions for using the set of fabric management tools designed to simplify and optimize common fabric management tasks. The management tools consist of TUI menus and command line interface (CLI) commands.
	Intel® Omni-Path Fabric Suite FastFabric Command Line Interface Reference Guide	Describes the command line interface (CLI) for the Intel® Omni-Path Fabric Suite FastFabric. Help: -help and man pages for each CLI. Also, all host CLI commands can be accessed as console help in the Fabric Manager GUI.
Managing a fabric using Fabric Manager	*Intel® Omni-Path Fabric Suite Fabric Manager User Guide*	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.
	Intel® Omni-Path Fabric Suite Fabric Manager GUI User Guide	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. Help: Fabric Manager GUI Online Help.
Configuring and administering Intel® HFI and IPoIB driver Running MPI applications on Intel® OPA	*Intel® Omni-Path Fabric Host Software User Guide*	Describes how to set up and administer the Host Fabric Interface (HFI) after the software has been installed. The audience for this document includes both cluster administrators and Message-Passing Interface (MPI) application programmers, who have different but overlapping interests in the details of the technology.
Writing and running middleware that uses Intel® OPA	*Intel® Performance Scaled Messaging 2 (PSM2) Programmer's Guide*	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.
Optimizing system performance	*Intel® Omni-Path Fabric Performance Tuning User Guide*	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.
Designing a storage router on Intel® OPA	*Intel® Omni-Path Storage Router Design Guide*	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.
Building a Lustre* Server using Intel® OPA	*Building Lustre* Servers with Intel® Omni-Path Architecture Application Note*	Describes the steps to build and test a Lustre* system (MGS, MDT, MDS, OSS, OST, client) from the HPDD master branch on a x86_64, RHEL*/CentOS* 7.1 machine.
Learning about new release features, open issues, and resolved issues for a particular release	*Intel® Omni-Path Fabric Software Release Notes*	
	Intel® Omni-Path Fabric Fabric Manager GUI Release Notes	
	Intel® Omni-Path Fabric Switches Release Notes (includes managed and externally-managed switches)	

1.6 Documentation Conventions

This guide uses the following documentation conventions:

- *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, and links to Web sites are also shown in blue. For example:
  - Table 2 lists problems related to the user interface and remote agent.
  - See "Installation Checklist" on page 6.
  - For more information, visit www.intel.com.
- Text in **bold** font indicates user interface elements such as a menu items, buttons, check boxes, or column headings. For example:
  - Click the **Start** button, point to **Programs**, point to **Accessories**, and then click **Command Prompt**.
  - Under **Notification Options**, select the **Warning Alarms** check box.
- Text in `Courier` font indicates a file name, directory path, or command line text. For example:
  - To return to the root directory from anywhere in the file structure: Type `cd /root` and press ENTER.
  - Enter the following command: `sh ./install.bin`
- Key names and key strokes are indicated with UPPERCASE:
  - Press CTRL+P.
  - Press the UP ARROW key.
- Text in *italics* indicates terms, emphasis, variables, or document titles. For example:
  - For a complete listing of license agreements, refer to the *Intel Software End User License Agreement*.
  - What are *shortcut keys*?
  - To enter the date type *mm/dd/yyyy* (where *mm* is the month, *dd* is the day, and *yyyy* is the year).
- Topic titles between quotation marks identify related topics either within this manual or in the online help throughout this document.

1.7 License Agreements

Refer to the *Intel Software End User License Agreement* for a complete listing of all license agreements affecting this product.

1.8 Technical Support

Technical Support for products under warranty is available during local standard working hours excluding Intel Observed Holidays. For customers with extended service, consult your plan for available hours. For Support information, contact your Intel representative.

2.0 Hardware Installation Checklist

This section provides an overview of the hardware installation procedures. Detailed steps are found in Chapter 3.0, "Hardware Installation".

The following steps summarize the basic hardware installation procedure:

1. Check that the HFI hardware is appropriate for your platform. See Table 2.

2. Check to see that you have the appropriate cables and switches, as described in "Cabling and Switches" on page 11.

3. Following the safety instructions in "Safety with Electricity" on page 11. Unpack the HFI ("Unpacking Information" on page 12) and verify the package contents.

4. Install the HFI by following the instructions in "Hardware Installation" on page 14.

5. Cable the HFI to the switch, as described in "Cabling the HFI to the Switch" on page 17. Check that all switches are configured.

6. Follow the steps in "Completing the Installation" on page 17 to finish the installation.

Note: For information on upgrading HFI firmware, please refer to the *Boot Server Upgrade* section of the *Intel® Omni-Path Fabric Software Installation Guide*.

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3.0 Hardware Installation

This section lists the requirements and provides instructions for installing the Intel® HFI. The components are collectively referred to as the *HFI* and the *riser card* in the remainder of this document.

3.1 Hardware Installation Requirements

This section lists hardware and software environment requirements for installing the HFI.

3.1.1 Hardware

The Intel® Omni-Path HFI is for use with UL listed computers. The following statement is true for the HFI:

> This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operations.

Table 2 displays the HFI and supported motherboards.

Table 2.   HFI Model and Related Platforms

Intel Model Number	Platform	Plugs Into
Intel® Omni-Path Host Fabric Interface	PCI Express systems	x8 PCI Express slot x16 PCI Express slot

If the installation of the HFI requires the use of a riser card. See Figure 3 for an illustration of a PCI Express (PCIe) slot in a typical motherboard.

The motherboard vendor is the optimal source for information about the layout and use of PCI Express-enabled expansion slots on supported motherboards.

3.1.1.1 Form Factors

The HFI is a standard PCI Express half-height, short-form factor, and can be used with either full-height or low-profile face plates.

3.1.2 Cabling and Switches

The HFI uses standard Quad Small Form-factor Pluggable (QSFP) copper cables. These cables can be passive copper or active copper. Contact Intel Sales or your authorized Reseller for a list of qualified cables.

For cabling instructions, see "Cabling the HFI to the Switch" on page 17.

3.2 Safety with Electricity

Observe these guidelines and safety precautions when working around computer hardware and electrical equipment:

- Locate the power source shutoff for the computer room or lab where you are working. This is where you will turn OFF the power in the event of an emergency or

accident. Never assume that power has been disconnected for a circuit; always check first.

- Do not wear loose clothing. Fasten your tie or scarf, remove jewelry, and roll up your sleeves. Wear safety glasses when working under any conditions that might be hazardous to your eyes.

- Shut down and disconnect the system's power supply from AC service before you begin work, to insure that standby power is not active. Power off all attached devices such as monitors, printers, and external components. Note that many motherboards and power supplies maintain standby power at all times. Inserting or removing components while standby is active can damage them.

- Use normal precautions to prevent electrostatic discharge, which can damage integrated circuits.

3.3 Unpacking Information

This section provides instructions for safely unpacking and handling the Intel® Omni-Path HFI. To avoid damaging the HFI, always take normal precautions to avoid electrostatic discharge.

3.3.1 Verify the Package Contents

The HFI should arrive in good condition. Before unpacking, check for any obvious damage to the packaging. If you find any damage to the packaging or to the contents, please notify your reseller immediately.

3.3.2 List of the Package Contents

The package contents for the HFI are:

- Intel® Omni-Path HFI
- Additional short bracket
- Additional standard bracket
- Readme First

Standard PCIe risers can be used. Risers are typically supplied by your system or motherboard vendor.

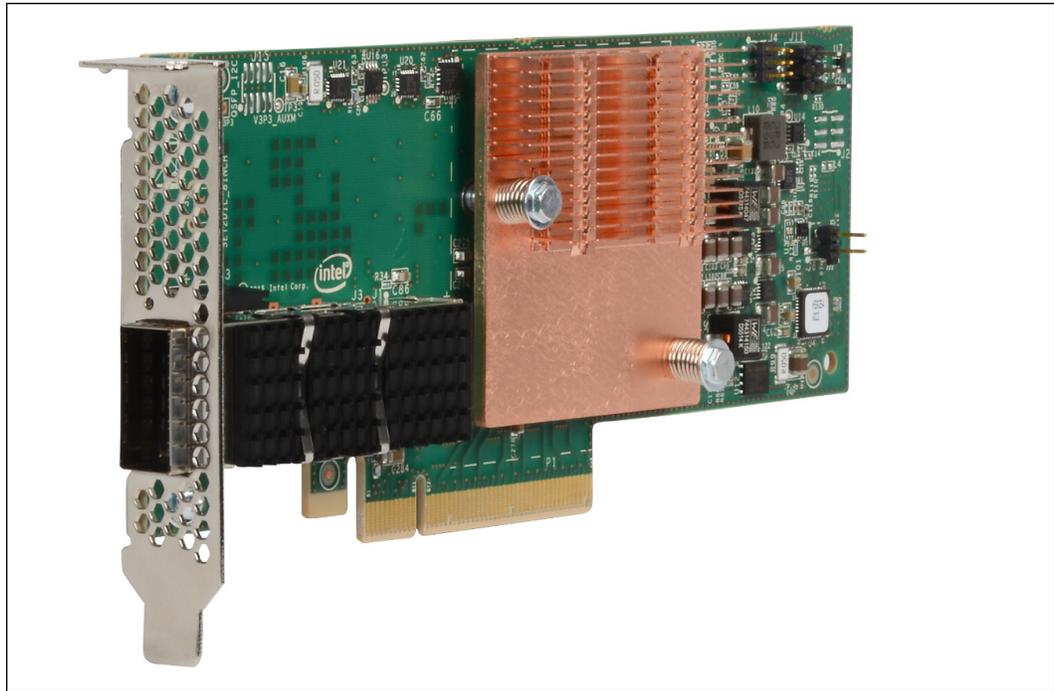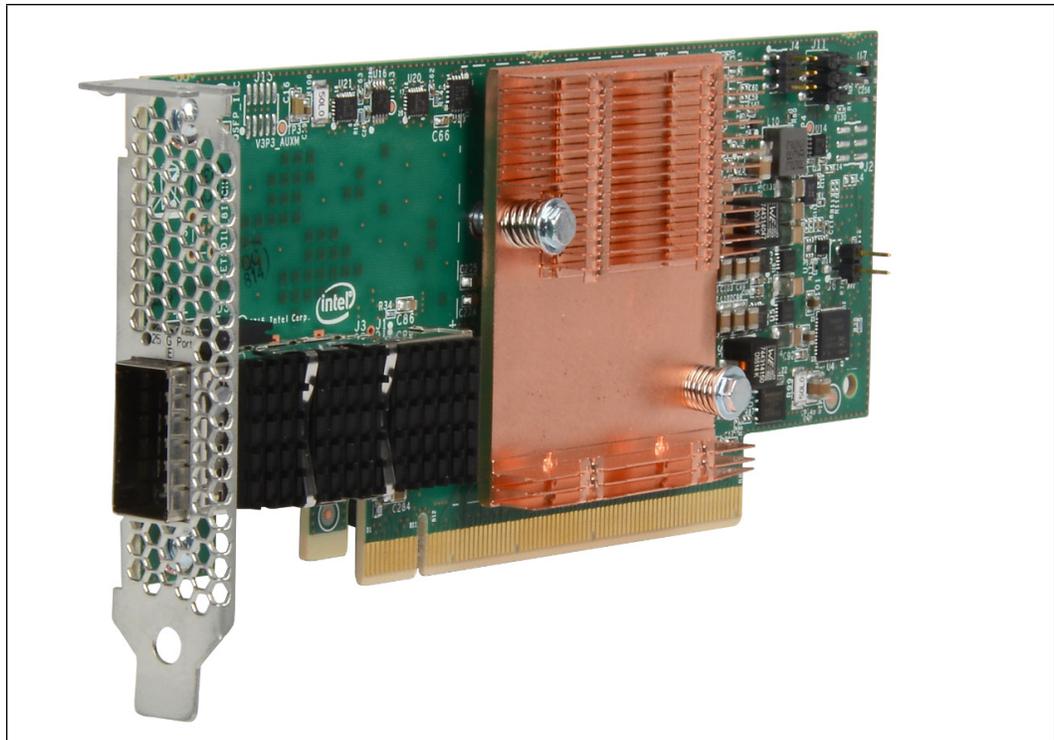**Figure 1.   Intel® Omni-Path Host Fabric Interface x8**

Figure 2.   Intel® Omni-Path Host Fabric Interface x16

3.3.3 Unpacking the HFI

Follow these steps when unpacking the HFI:

1. When unpacking, ground yourself before removing the Intel® HFI from the anti-static bag.

2. Grasping the Intel® HFI by its face plate, pull the HFI out of the anti-static bag. Handle the HFI only by its edges or the face plate. Do not allow the HFI or any of its components to touch any metal parts.

3. After checking for visual damage, store the HFI in its anti-static bag until you are ready to install.

3.4 Hardware Installation

This section contains hardware installation instructions for the HFI.

3.4.1 Hardware Installation for HFI with PCI Express Riser

Most installations will be in 1U and 2U chassis, which requires using a PCIe right angle riser card. This results in an installation of the HFI that is parallel to the motherboard.

A taller riser card can be used if necessary. The HFI can connect to any of the standard compatible PCI Express riser cards.

3.4.1.1 Installation Steps

Note: Change the server BIOS PCIe setting to **AUTO**. The Omni-Path HFI card will train itself to PCIe **GEN 3**. For details on changing server BIOS, refer your server vendor documentation.

To install the Intel® HFI with a PCIe riser card:

1. Shut down the power supply to the system into which you will install the Intel® HFI.

2. Take precautions to avoid electrostatic damage (ESD) to the cards by properly grounding yourself or touching the metal chassis to discharge static electricity before handling the cards.

3. Remove the cover screws and cover plate to expose the system's motherboard. For specific instructions on how to do this, follow the hardware documentation that came with your system.

4. Locate the PCIe slot on your motherboard. Note that the PCIe slot has two separate sections, with the smaller slot opening located towards the front (see Figure 3). These two sections correspond to the shorter and longer connector edges of the HFI and riser.

Figure 3.   PCIe Slot in a Typical Motherboard
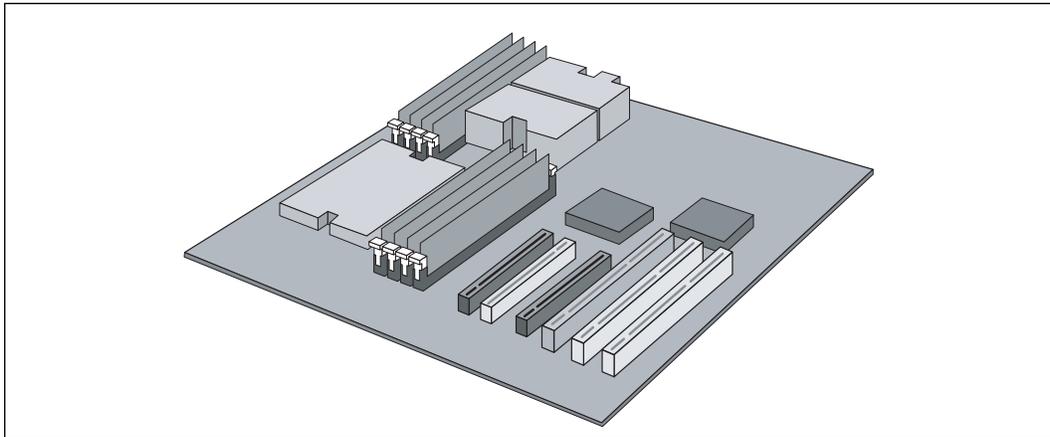
5. Determine if a blanking panel is installed in your chassis. If it is, remove it so that the InfiniBand* connector will be accessible. Refer to your system vendor instructions for how to remove the blanking panel.

6. Remove the Intel® HFI from the anti-static bag.

7. Locate the face plate on the connector edge of the card.

8. Connect the Intel® HFI and PCIe riser card together, forming the assembly that you will insert into your motherboard. First, visually line up the HFI slot connector edge with the edge connector of the PCIe riser card (see Figure 3).

9. Holding the Intel® HFI by its edges, carefully insert the card slot connector into the PCIe riser card edge connector, as show in Figure 3. The result is a combined L-shaped assembly of the PCIe riser card and Intel® HFI. This assembly is what you will insert into the PCIe slot on the motherboard in the next step.

10. Turn the assembly so that the riser card connector edge is facing the PCIe slot on the motherboard, and the face plate is toward the front of the chassis.

11. Holding this assembly above the motherboard at about a 45 degree angle, slowly lower it so that the connector on the face plate clears the blanking panel opening of the chassis from the inside. Slowly align the connector edge of the riser card with the PCIe slot of the motherboard. The short section of the connector must align with the short section of the slot.

12. Insert the riser assembly into the PCIe slot, ensuring good contact. The Intel® HFI should now be parallel to the motherboard and about one inch above it (see Figure 4).

Figure 4.   Assembled PCIe Host Fabric Interface with Riser
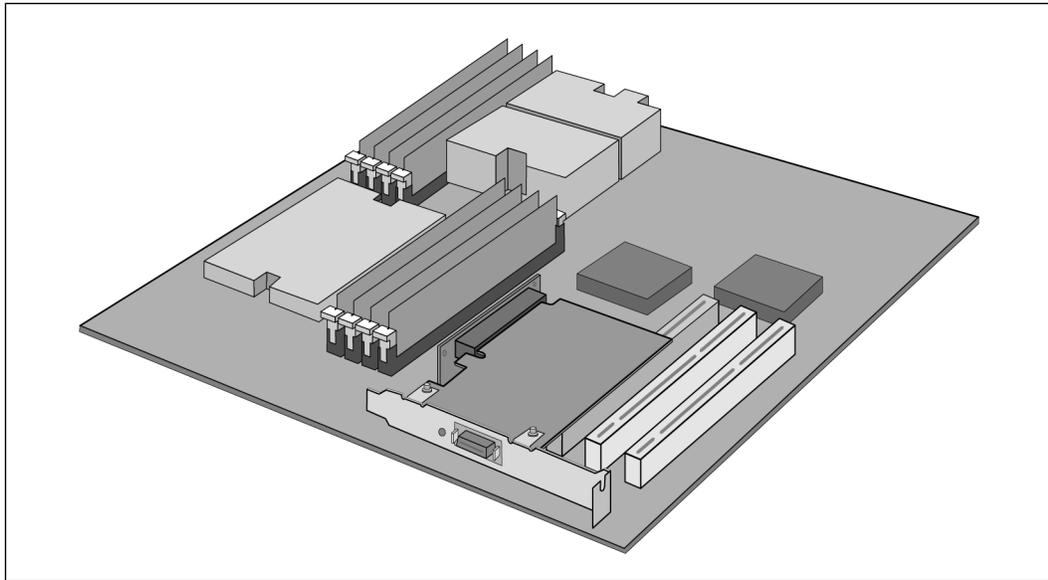
13. Secure the face plate to the chassis. The Intel® HFI has a screw hole on the side of the face plate that can be attached to the chassis with a retention screw. The securing method may vary depending on the chassis manufacturer. Refer to the system documentation for information about mounting details such as mounting holes, screws to secure the card, or other brackets.

The Intel® HFI with PCIe riser card is now installed. Next, install the cables as described in "Cabling the HFI to the Switch" on page 17. Then test your installation by powering up and verifying link status (see "Completing the Installation" on page 17).

3.4.2   Hardware Installation for HFI Without a PCI Express Riser

Note: If you intend to use the NVIDIA* GPUDirect* RDMA Linux* kernel feature provided within the Intel® Omni-Path Fabric Software stack, you need to choose a PCIe card on *the same root complex* that you intend to install (or have installed) an NVIDIA* TESLA* card.

GPUDirect* RDMA is a technology that enables a direct path for data exchange between a graphics processing unit (GPU) and a third-party peer device using standard features of PCI Express. For more information, see the NVIDIA* CUDA* toolkit documentation:

http://docs.nvidia.com/cuda/gpudirect-rdma/index.html

Installing the Intel® HFI without a PCI Express riser card requires a 3U or larger chassis.

To install the Intel® HFI without a riser card:

1. Shut down the power supply to the system where you will install the Intel® HFI.

2. Take precautions to avoid electrostatic discharge (ESD) damage to the cards by properly grounding yourself or touching the metal chassis to discharge static electricity before handling the cards.

3. If you are installing the Intel® HFI into a covered system, remove the cover screws and cover plate to expose the system's motherboard. For specific instructions on how to do this, follow the hardware documentation that came with your system.

4. Locate the PCIe slot on your motherboard.

5. Remove the Intel® HFI from the anti-static bag. Hold the card by the top horizontal section of the bracket, and the top rear corner of the card. Be careful not to touch any of the components on the printed circuit card.

6. Without fully inserting, gently align and rest the gold fingers of the HFI on top of the motherboard's PCIe slot.

7. Insert the card by pressing firmly and evenly on the top of the horizontal bracket and the top rear corner of the card simultaneously. The card should insert evenly into the slot. Be careful not to push, grab, or put pressure on any other part of the card, and avoid touching any of the components.

8. Secure the face plate to the chassis. The Intel® HFI has a screw hole on the side of the face plate that can be attached to the chassis with a retention screw. The securing method may vary depending on the chassis manufacturer. Refer to the system documentation for information about mounting details such as mounting holes, and screws to secure the card or other brackets.

Next, install the cables, as described in "Cabling the HFI to the Switch" on page 17. Then test your installation by powering up the system (see "Completing the Installation" on page 17).

3.5 Cabling the HFI to the Switch

Follow the recommendations of your cable vendor for cable management and proper bend radius.

To install the cable(s):

1. Check that you have removed the protector plugs (if any) from the cable connector ends.

2. Different vendor cables might have different latch mechanisms. Determine if your cable has a spring-loaded latch mechanism.

   • If your cable is spring-loaded, grasp the metal shell and pull on the plastic latch to release the cable. To insert, push and the cable snaps into place. You will hear a short "click" sound from the cable connector when it snaps in.

   • If your cable latch mechanism is not spring-loaded, push on the metal case, then push the plastic latch to lock the cable in place.

3. Connect the other end of the cable to a switch.

3.6 Completing the Installation

To complete the hardware installation:

1. Complete any other installation steps for other components.

2. Replace the cover plate and back panel.

3. Verify that the power cable is properly connected.

4. Turn on the power supply and boot the system normally.

5. Watch the LED indicator. The LEDs will flash only once, briefly, at power-up. The LED is functional only after the Omni-Path Fabric software has been installed, the driver has been loaded, and the system is connected to a switch.

Note: For information on upgrading HFI firmware, please refer to the *Boot Server Upgrade* section of the *Intel® Omni-Path Fabric Software Installation Guide*.

3.7 LED Link and Data Indicators

The LED functions are as follows:

- Link Down = Off
- Link Up Initialized = On solid green
- Link Up Active (No Traffic) = On solid green
- Link Up: Active (Slow Packet rate <10K/S) = BLINK: 384ms On, 384ms Off
- Link Up: Active (Fast Packet rate >10K/S) = BLINK: 128ms On, 128ms Off

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