Getting Started with Alveo Data Center Accelerator Cards

UG1301 (v1.8) February 5, 2021

XILINX.

Revision History

The following table shows the revision history for this document.

Section	Revision Summary
02/05/2021 Version 1.8	
General	Updated example output logs to reflect Alveo U250-2RP platform.
Chapter 1: Introduction	Updated platform information and introduced DFX terminology.
XRT and Deployment Platform Installation Procedures on RedHat and CentOS	Updated installation steps, as well as added an additional step to program the shell partition.
XRT and Deployment Package Installation Procedures on Ubuntu	Updated installation steps, as well as added an additional step to program the shell partition.
Appendix B: Creating a Vault Repository for CentOS	Clarified description.
11/24/2020 Version 1.7	
Chapter 1: Introduction	Updated platform information.
Card Features	Added network interface information, updated electrical design power, as well as HBM and DDR4.
Minimum System Requirements	Updated operating system.
Card Interfaces and Details	Clarified description.
XRT and Deployment Platform Installation Procedures on RedHat and CentOS	Updated installation steps for the Alveo U200 and U250 cards.
XRT and Deployment Package Installation Procedures on Ubuntu	
Running lspci	Updated output log.
Running xbmgmt flash --scan	Updated description.
Running xbmgmt partition	Added section.
xbutil validate	Updated description and removed note about XRT installation on Ubuntu.
Upgrade	Updated to reflect 2020.2 XRT.
Downgrade	
Upgrade	
Downgrade	
Upgrade from 2018.2 to 2018.3 in RedHat and CentOS	Removed sections.
Downgrade from 2018.3 to 2018.2 in RedHat and CentOS	
Upgrade from 2018.x to 2019.1 in RedHat and CentOS	
Downgrade from 2019.1 to 2018.x in RedHat and CentOS	
Upgrade from 2018.2 to 2018.3 in Ubuntu	
Downgrade from 2018.3 to 2018.2 in Ubuntu	
Upgrade from 2018.x to 2019.1 in Ubuntu	
Downgrade from 2019.1 to 2018.x in Ubuntu	
Generating the xbmgmt flash --update Command	

Section	Revision Summary
Appendix C: Reverting the Card to Factory Image	Clarified description.
Appendix D: Obtaining xbmgmt Command Options	Added appendix.
08/18/2020 Version 1.6	
Card Features	Updated information.
XRT and Deployment Package Installation Procedures on Ubuntu	Added a link to Xilinx Answer Record 75294.
xbutil validate	Added a note about installing XRT on Ubuntu.
Appendix E: Regulatory and Compliance Information	Added appendix.
06/03/2020 Version 1.5	
Chapter 1: Introduction	Updated the information.
Card Features	Added new section.
xbutil validate	Updated information about specifying `-d`.
12/18/2019 Version 1.4	
XRT and Deployment Package Installation Procedures on Ubuntu	Added a note about XRT installation.
Chapter 7: Troubleshooting	Updated information about installing packages on RedHat and CentOS.
Known Issues	Added a known issue.
10/31/2019 Version 2019.2	
General	Updated to the Vitis™ unified software platform throughout. Updated outputs throughout document.
Qualified Servers	Provided the web link to the qualified servers.
Chapter 4: Installing the Deployment Software	Replaced `xbutil` command with the new `xbmgmt` command for card flashing. Updated output logs.
Known Issues	Added a known issue.
XRT and Deployment Platform Installation Procedures on RedHat and CentOS	Replaced `xbutil` command with the new `xbmgmt` command for card flashing. Updated output logs.
XRT and Deployment Package Installation Procedures on Ubuntu	
Running xbmgmt flash --scan	Replaced `xbutil` command with the new `xbmgmt` command when scanning card. Updated output logs.
Appendix A: Changing XRT and Target Platform Versions	Replaced `xbutil` command with the new `xbmgmt` command for card flashing. Updated output logs.
Appendix C: Reverting the Card to Factory Image	Added new appendix.
07/23/2019 Version 2019.1	
Upgrade from 2018.x to 2019.1 in RedHat and CentOS	Corrected answer record links
Upgrade from 2018.2 to 2018.3 in RedHat and CentOS	
Upgrade from 2018.2 to 2018.3 in Ubuntu	
Downgrade from 2018.3 to 2018.2 in Ubuntu	
Upgrade from 2018.x to 2019.1 in Ubuntu	
Downgrade from 2018.3 to 2018.2 in RedHat and CentOS	
Chapter 1: Introduction	

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Section	Revision Summary
06/27/2019 Version 2019.1	
Qualified Servers	Updated server requirements.
06/24/2019 Version 2019.1	
General	Added support for Alveo U280 production card.
Appendix A: Changing XRT and Target Platform Versions	Updated upgrade and downgrade steps.
06/05/2019 Version 2019.1	
General	Updated outputs throughout document.
Qualified Servers	Updated table of validated servers.
Card Interfaces and Details	Added information on status LEDs.
Installing the Card	Added image of an installed Alveo card.
Chapter 4: Installing the Deployment Software	Updated installation, upgrade, and downgrade flows for 2019.1 release.
Chapter 6: Next Steps	Added information on additional development resources.
Chapter 7: Troubleshooting	Updated troubleshooting and known issues.
02/12/2019 Version 1.3	
General	Added support for Alveo U280 ES card.
Modifying the Installation on RedHat and CentOS, Modifying the Installation on Ubuntu	Updated instructions on upgrading and downgrading XRT and the deployment shell.
Generating the xbmgmt flash --update Command	Updated instructions.
01/23/2019 Version 1.2	
XRT and Deployment Platform Installation Procedures on RedHat and CentOS, XRT and Deployment Package Installation Procedures on Ubuntu	Updated instructions on running xbutil flash.
Generating the xbmgmt flash --update Command	Added new information on how to generate the options needed to run xbutil flash.
12/21/2018 Version 1.1	
Minimum System Requirements	Updated system requirements.
XRT and Deployment Platform Installation Procedures on RedHat and CentOS	Updated installation flow.
Modifying the Installation on RedHat and CentOS	Added new information on upgrading and downgrading deployment software.
Modifying the Installation on Ubuntu	Added new information on upgrading and downgrading deployment software.
Known Issues	Updated known issues.
Appendix B: Creating a Vault Repository for CentOS	Added new appendix.
10/02/2018 Version 1.0	
Initial Xilinx release.	N/A

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Introduction

This document provides hardware and software installation procedures for the U250 and the following two-stage Dynamic Function eXchange (DFX-2RP) Xilinx® Alveo™ data center accelerator card platform, initially supported by 2020.2 XRT. For more information, see Dynamic Function Exchange for more information on DFX platforms.

- xilinx_u250_gen3x16_xdma_3_1_202020_1

Installation procedures for the U200 and U280, as well as all other platforms on the U250 Alveo data center accelerator cards, must follow the instructions in v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

The Alveo U200/U250/U280 data center accelerator cards are PCIe® Gen3 x16 compliant featuring the Xilinx Virtex® UltraScale+™ technology. These cards accelerate compute-intensive applications such as machine learning, data analytics, video processing, and more. The Alveo U200/U250/U280 data center accelerator cards are available in passive and active cooling configurations.

Different system configurations are available for running, developing, and debugging applications on your Alveo accelerator cards:

- **Running Applications:** To configure a system to run accelerated applications, install an Alveo card into a system as described in Chapter 3: Card Installation Procedures along with the required deployment software to support running applications as described in Chapter 4: Installing the Deployment Software.

- **Developing Applications:** To develop FPGA accelerated applications, it is necessary to install both the deployment software and the development software. Development software installation, described in Chapter 6: Next Steps, consists of installing both a development target platform and the Vitis™ environment. This configuration does not have an Alveo card installed and is used for development along with debugging in emulation modes.

- **Running, Developing, and Debugging Applications:** By installing the Alveo card along with both the deployment and development software on a single machine, you can configure a system for developing and running accelerated applications. With the card installed, developers can debug applications in both emulation modes and on the hardware.

Card Features

Features of the production Alveo U200/U250/U280 data center accelerator cards are listed in the following table.

Table 1: **Alveo U200/U250/U280 Features**

Card Component	U200	U250	U280
FPGA	UltraScale+ XCU200-2FSGD2104E	UltraScale+ XCU250-2LFIGD2104E	UltraScale+ XCU280-L2FSVH2892E
DDR4	64 gigabyte (GB) 4x DDR4 16 GB		32 gigabyte (GB) 2x DDR4 16 GB
	2400 mega-transfers per second (MT/s), on 64-bit ECC DIMM		
HBM	–	–	8 GB, 32-pseudo channels
Configuration Options	1 gigabit (Gb) Quad Serial Peripheral Interface (SPI) flash memory		
	Micro-USB JTAG configuration port		
PCIe	16-lane PCI Express		
	PCIe Integrated Endpoint block connectivity		
	Gen1, 2, or 3 up to x16		Gen1, 2, or 3 up to x16 Gen4 x8
Network Interface	2x QSFP28	2x QSFP28	2x QSFP28
I2C Bus	✓	✓	✓
Status LEDs	✓	✓	✓
Power Management	Power management with system management bus (SMBus) voltage, current, and temperature monitoring		
Electrical Design Power	65W PCIe slot functional with PCIe slot power only		
	140W PCIe slot functional with 110A max V_{CCINT} current PCIe slot power and 6-pin PCIe AUX power cable connected		
	215W PCIe slot functional with 160A max V_{CCINT} current PCIe slot power and 8-pin PCIe AUX power cable connected[1]		
Flash Memory	Onboard reprogrammable flash configuration memory		
UART	UART access through the USB port		
Configuration	UltraScale+ device configurable over USB/JTAG and Quad SPI configuration flash memory		

Notes:
1. Vitis unified software platform based applications are only designed to run with electrical design power at 215W.

Minimum System Requirements

The minimum system requirements for running the Alveo™ U200/U250/U280 Data Center accelerator cards are listed in the following table.

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Table 2: **Minimum System Requirements**

Component	Requirement
Motherboard	PCI Express® 3.0-compatible with one dual-width x16 slot.
System Power Supply	225W via PCI Express Slot connection and 8-pin PCI Express Auxiliary Power cable.
Operating System	Linux, 64-bit: • Ubuntu 16.04, 18.04, 20.04 • CentOS 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2 • RHEL 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2
System Memory	For deployment installations, a minimum of 16 GB plus application memory requirements is required. For development installations, a minimum of 64 GB of system memory is required, but 80 GB is recommended.
Internet Connection	Required for downloading drivers and utilities.
Hard disk space	Satisfy the minimum system requirements for your operating system.
Licensing	None required for application deployment. For the application development environment, see *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393).

For additional specifications and details on the acceptable environmental conditions, see *Alveo U200 and U250 Data Center Accelerator Cards Data Sheet* (DS962) and *Alveo U280 Data Center Accelerator Cards Data Sheet* (DS963).

Qualified Servers

A list of servers on which Alveo cards are fully qualified on can be found here: https://www.xilinx.com/products/boards-and-kits/alveo/qualified-servers.html.

Accelerator Card Overview

Card Interfaces and Details

Alveo™ cards are available in both passive and active cooling configurations; see Passive and Active Cooling Cards. The interfaces of each are identical, except the fan included on active cooled cards. The card includes the following interfaces.

- A PCI Express® x16 card connector.

- A PCI Express auxiliary power connector. This 8-pin connector is shown in Figure 5 and is not compatible with an ATX12V/EPS12V power cable source.

- Two QSFP28 interfaces. Currently these interfaces are not supported by the deployment platform.

- A micro-USB connector for maintenance purposes.

- A fan for the active cooled card configuration.

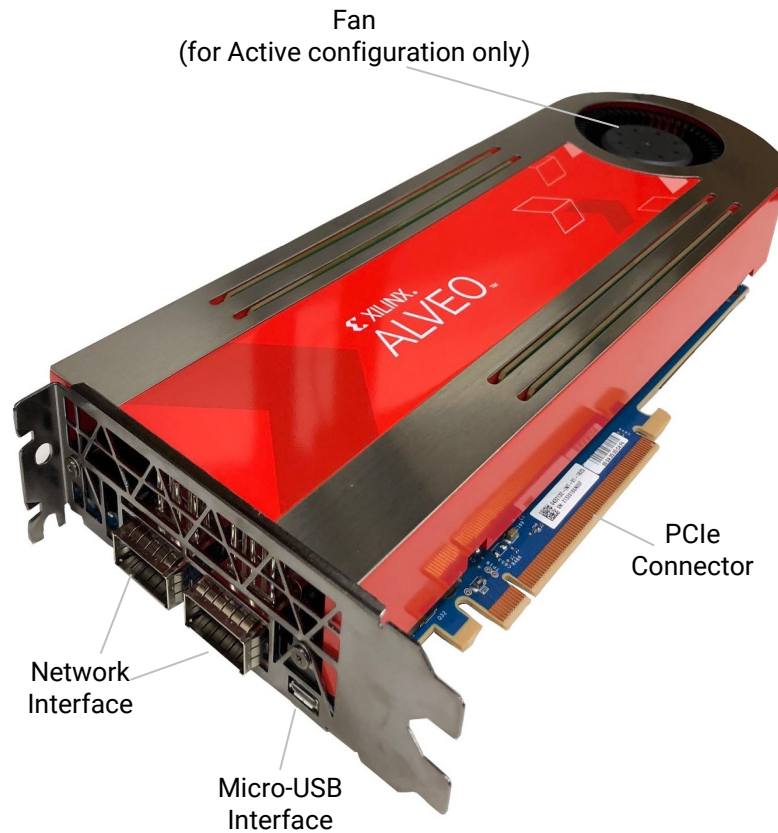⚠ **WARNING!** *Hazardous moving parts. Keep away from fan blades.*

⚠ **ATTENTION!** *Pièces mobiles peuvent etre dangereuses. Éloignez-vous des lames du ventilateur.*

⚠ **WARNUNG!** *Gefährliche bewegliche Teile. Halten sie sich von Lüfterflügeln fern.*

Figure 1: **Alveo Card Features**

Note: On the Alveo U280 card, the micro-USB is located on the opposite end of the card between the PCB board and the enclosure.

Passive and Active Cooling Cards

Alveo™ cards are available in both active and passive cooling configurations, as shown in the following figures. The passive cooling card is designed to be installed into a data center server, where controlled air flow provides direct cooling. The active cooling card is designed to be installed into a PC environment where the air flow is uncontrolled; consequently, this configuration includes a heat sink and fan enclosure cover to provide appropriate cooling.

For card specifications, dimensions, list of card features, and block diagram see *Alveo U200 and U250 Data Center Accelerator Cards Data Sheet* (DS962) and *Alveo U280 Data Center Accelerator Cards Data Sheet* (DS963).

Figure 2: **Active Cooled Card Configuration**

Figure 3: **Passive Cooled Card Configuration**

Card Installation Procedures

To reduce the risk of fire, electric shock, or injury, always follow basic safety precautions.

⚠ **CAUTION!** *You must always use an ESD strap or other antistatic device when handling hardware.*

⚠ **ATTENTION!** *Il est fortement recommandé d'utiliser un bracelet ESD ou autres dispositifs antistatiques.*

⚠ **VORSICHT!** *Beim Umgang mit Hardware müssen sie immer ein Erdungs Armband oder ein anderes antistatisches Gerät verwenden.*

Safety Instructions

Safety Information

To ensure your personal safety and the safety of your equipment:

- Keep your work area and the computer/server clean and clear of debris.
- Before opening the computer/system cover, unplug the power cord.

Dispositif de Sécurité

Pour assurer votre sécurité personnelle et la sécurité de votre équipement:

- Maintenez votre zone de travail et l'ordinateur/serveur propre et dégagé de débris.
- Avant d'ouvrir le capot de l'ordinateur/système, débranchez le cordon d'alimentation.

Sicherheitsinformation

Um ihre persönliche Sicherheit und die Sicherheit ihrer Ausrüstung zu gewährleisten:

- Halten sie ihren Arbeitsbereich und den Computer / Server sauber und frei von Ablagerungen.
- Ziehen sie vor dem Öffnen der Computer / Systemabdeckung das Netzkabel ab.

Electrostatic Discharge Caution

Electrostatic discharge (ESD) can damage electronic components when they are improperly handled, and can result in total or intermittent failures. Always follow ESD-prevention procedures when removing and replacing components.

To prevent ESD damage:

- Use an ESD wrist or ankle strap and ensure that it makes skin contact. Connect the equipment end of the strap to an unpainted metal surface on the chassis.

- Avoid touching the card against your clothing. The wrist strap protects components from ESD on the body only.

- Handle the card by its bracket or edges only. Avoid touching the printed circuit board or the connectors.

- Put the card down only on an antistatic surface such as the bag supplied in your kit.

- If you are returning the card to Xilinx Product Support, place it back in its antistatic bag immediately.

Attention aux Décharge Électrostatique (ESD)

L'ESD peut endommager les composants électroniques lorsqu'ils sont mal manipulés, et peut entraîner des défaillances totales ou intermittentes. Suivez toujours les procédures de prévention contre les ESD lors du retrait et remplacement des composants.

Pour prévenir les dommages dus aux ESD:

- Utilisez une sangle de poignet ou de cheville anti-ESD et assurez-vous qu'elle est en contact avec la peau. Branchez l'extrémité du cable de la sangle à une surface métallique non peinte du châssis et a la masse.

- Évitez de mettre en contact la carte de circuit imprimé ou les connecteurs avec vos vêtements. La sangle de poignet protège la carte ou connecteurs contre les ESD du corps seulement.

- Manipulez la carte uniquement par son support ou par ses bords. Évitez de toucher la carte de circuit imprimé ou les connecteurs.

- Ne posez la carte de circuit imprimé ou les connecteurs que sur une surface antistatique telle que le sac anti-statique fourni avec la carte.

- Si vous retournez la carte a Xilinx, remettez-la dans son sac antistatique immédiatement.

Vorsicht Elektrostatische Entladung

Elektrostatische Entladung (ESD) kann elektronische Bauteile beschädigen, wenn sie unsachgemäß behandelt werden, und es kann zu totalen oder zeitweiligen Ausfällen kommen. Befolgen sie beim Entfernen und Austauschen von Komponenten stets die ESD-Schutzmaßnahmen.

So verhindern sie ESD-Schäden:

- Verwenden sie einen ESD-Handgelenk-oder Knöchelriemen und stellen sie sicher, dass er Hautkontakt hat. Verbinden sie das Ende des Riemens mit einer unlackierten Metalloberfläche am Gehäuse.

- Berühren sie die Karte nicht mit ihrer Kleidung. Der Riemen schützt Komponenten nur vor ESD am Körper.

- Fassen sie die Karte nur an der Halterung oder an den Kanten an. Berühren sie nicht die Leiterplatte oder die Anschlüsse.

- Legen sie die Karte nur auf einer antistatischen Oberfläche ab, z.B. dem antistatischen Beutel der mit dem Kit mitgeliefert wurde.

- Wenn sie die Karte an den Xilinx Product Support zurücksenden, legen Sie sie bitte sofort wieder in den antistatischen Beutel.

Before You Begin

IMPORTANT! *Alveo™ cards are delicate and sensitive electronic devices; equipment is to be installed by a qualified technician only. This equipment is intended for installation in a Restricted Access Location.*

IMPORTANT! *Les cartes Alveo™ sont des appareils électronique sensibles et fragiles; l'équipement doit être installé par un technicien certifié seulement. Cet équipement est destiné à être installé dans un lieu d'accès restreint.*

WICHTIG! *Die Karten Alveo™ sind sensible und empfindliche elektronische Geräte. Das Gerät darf nur von einem qualifizierten Techniker installiert werden. Dieses Gerät ist für die Installation an einem Ort mit begrenztem Zugang vorgesehen.*

- Verify that the minimum card space is available to install your card. Card specifications and dimensions can be found in *Alveo U200 and U250 Data Center Accelerator Cards Data Sheet* (DS962) and *Alveo U280 Data Center Accelerator Cards Data Sheet* (DS963).

- Check for card compatibility with the system. Also check for proper system requirements such as power, bus type, and physical dimensions to support the card.

- Ensure that appropriate PCIe Auxiliary Power source is available, and not an ATX12V/EPS12V power source.

Installing the Card

IMPORTANT! *Do not unplug the Alveo™ AUX power connector while in the power-up state (hot-plug is not allowed).*

> ⭐ **IMPORTANT!** *Ne débranchez pas le connecteur auxiliaire d'alimentation des cartes Alveo™ pendant qu'elles sont sous-tension ("hot-plug" n'est pas autorisé).*

> ⭐ **WICHTIG!** *Trennen Sie den Alveo™-Stromanschluss-Stecker nicht im eingeschalteten Zustand (Hot-Plug ist nicht zulässig).*

The following procedure is a guide for the Xilinx® Alveo™ data center accelerator card installation. Consult your computer documentation for additional information.

If you encounter any issues during installation, see Chapter 7: Troubleshooting and Known Issues. Also see AR-71752 for additional known issues.

1. Host power supply must be disconnected.

2. For enclosed computers, open your computer by removing the casing.

3. If necessary, remove the two adjacent PCIe® slot covers corresponding to the PCIe x16 slot in which you are installing the Alveo card.

4. Plug the Alveo card in the PCIe x16 slot on the motherboard.

5. Connect the AUX power connector to the Alveo card, ensure the plug is mechanically fixed (with the click).

> ⭐ **IMPORTANT!** *Operation of the Alveo cards only with AUX power connector is not allowed.*

> ⭐ **IMPORTANT!** *Le fonctionnement des cartes Alveo uniquement avec le connecteur auxiliaire n'est pas autorisé.*

> ⭐ **WICHTIG!** *Der Betrieb von Alveo-Karten nur mit AUX Connector ist nicht zulässig.*

The Alveo card has an 8-pin female PCIe AUX power connector. Depending on your server or computer, an additional PCI Express auxiliary power cable or adapter may be needed. Consult your computer documentation for additional information.

For actively cooled cards, connect the power cable to the AUX power connector at top of the card as shown in the following figure.

Figure 4: **Connecting the Power Cable to Actively Cooled Cards**

For passively cooled cards, connect the power cable to the AUX power connector at the side of the card as shown in the following figure.

Figure 5: **Connecting the Power Cable to Passively Cooled Cards**
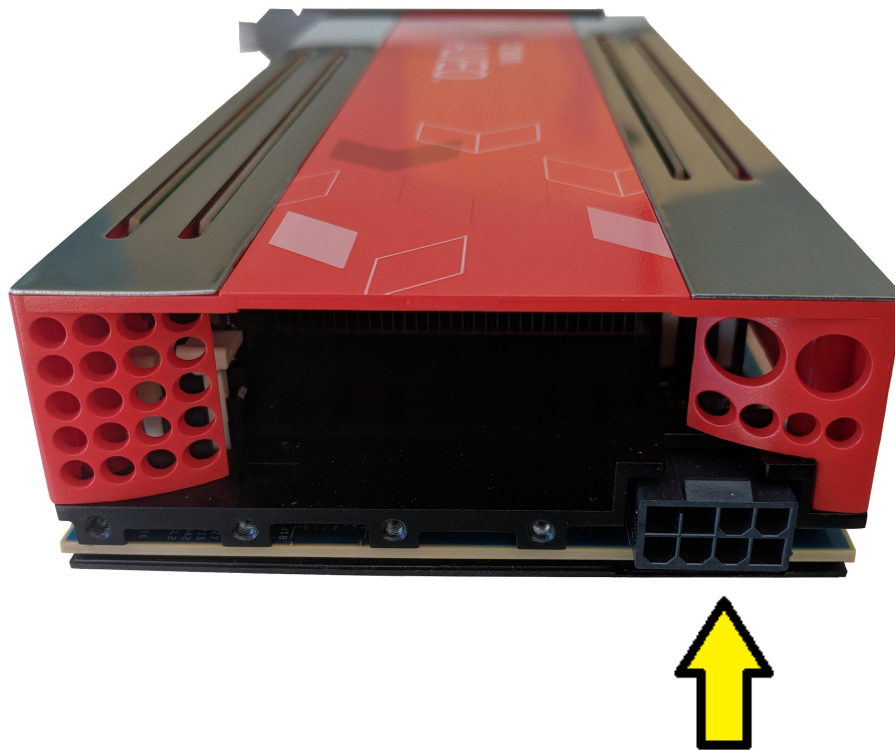
> ⚠️ **WARNING!** *Alveo cards are not compatible with an ATX12V/EPS12V power source. Do not force connection to a CPU (ATX12V/EPS12V) power source. This will damage the Alveo card and void the warranty.*

> ⚠️ **ATTENTION!** *Les cartes Alveo ne sont pas compatibles avec une source d'alimentation ATX12V / EPS12V. Ne forcez pas la connexion à une source d'alimentation CPU (ATX12V / EPS12V). Cela endommagerait la carte Alveo et annulerait la garantie.*

> ⚠️ **WARNUNG!** *Alveo-Karten sind nicht mit einer ATX12V / EPS12V-Stromquelle kompatibel. Erzwingen Sie keine Verbindung zu einer CPU-Stromquelle (ATX12V / EPS12V). Dadurch wird die Alveo-Karte beschädigt und die Garantie erlischt.*

The power-supply can have an 8-pin or a 6-pin power connector configuration. Some power supplies label this cable *PCIe Auxiliary Power* or *VGA*. These connector configurations are not pin compatible with other power source types. Do not force a connection to any power source other than PCIe Auxiliary Power.

> ⭐ **IMPORTANT!** *Only 140W of power is available with the 6-pin connector (65 Watts from PCIe connector with 12V source, and 75 Watts from the 6-pin AUX connector). 215W is available with the 8-pin connector (65 Watts from PCIe connector 12V source, and 150 Watts from the 8-pin AUX connector).*

> ⭐ **IMPORTANT!** *La puissance de 140W est uniquement disponibles avec le connecteur 6-broches (65 Watts à partir de la source du connecteur PCIe 12V et 75 watts à partir du connecteur AUX à 6-broches). 215W est disponible avec le connecteur à 8-broches (65 watts à partir de la source du connecteur PCIe 12V et 150 Watts à partir du connecteur 8-broches).*

> ⭐ **WICHTIG!** *Mit dem 6-Pin-Anschluss stehen nur 140W zur Verfügung (65 Watt vom PCIe-Anschluss mit 12 V-Quelle und 75 Watt vom 6-Pin-Anschluss). 215W ist mit dem 8-Pin-Anschluss erhältlich (65 Watt von 12V-PCIe-Anschluss und 150 Watt vom 8-Pin-Anschluss).*

The following example shows a successfully installed active configuration Alveo card.

Figure 6: **Installed Alveo Card**
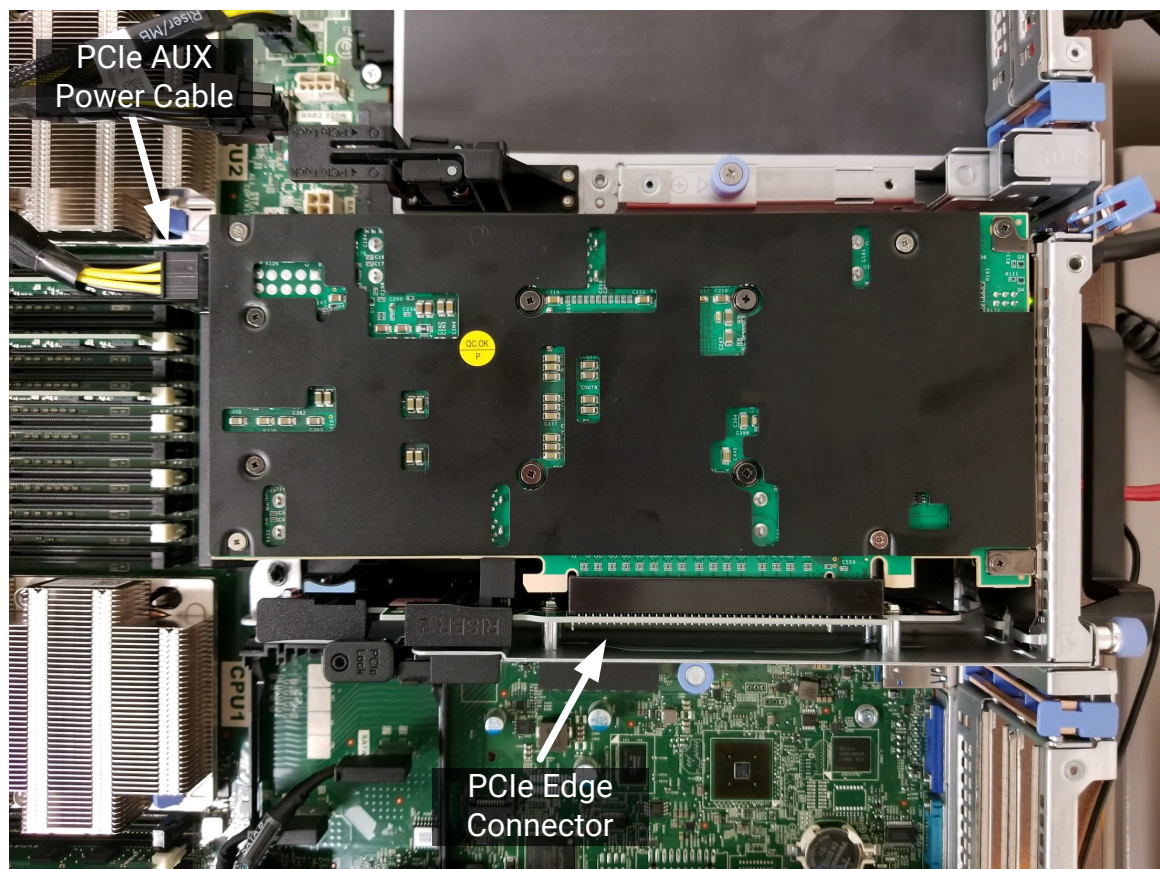
6. If you previously removed the computer casing, re-install the casing.

7. Connect the power cord and turn on the computer.

> ⚠ **WARNING!** *Do not power-on a passively cooled card without adequate forced airflow across the card with proper airflow direction, otherwise the card can be damaged. For more information, see Alveo U200 and U250 Data Center Accelerator Cards Data Sheet (DS962) and Alveo U280 Data Center Accelerator Cards Data Sheet (DS963).*

8. To verify that the device has been installed correctly, enter the following Linux command in the terminal:

```
$ sudo lspci -vd 10ee:
```

If the card is successfully installed and found by the operating system, a message similar to the one below will be displayed.

This is a sample output for an installed Alveo U250 card:

```
65:00.0 Processing accelerators: Xilinx Corporation Device 5004
        Subsystem: Xilinx Corporation Device 000e
        Flags: bus master, fast devsel, latency 0, NUMA node 0
        Memory at 380072000000 (64-bit, prefetchable) [size=32M]
        Memory at 380074040000 (64-bit, prefetchable) [size=256K]
        Capabilities: [40] Power Management version 3
        Capabilities: [60] MSI-X: Enable+ Count=32 Masked-
        Capabilities: [70] Express Endpoint, MSI 00
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [1c0] #19
        Capabilities: [400] Access Control Services
        Capabilities: [410] #15
        Capabilities: [480] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
        Kernel driver in use: xclmgmt
        Kernel modules: xclmgmt
```

Note: If this card has previously been installed, the `lspci` output will be similar to the one shown in Running lspci.

If you do not see a message similar to either of these, see Chapter 7: Troubleshooting.

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Installing the Deployment Software

This chapter details the procedures for installing deployment software on RedHat/CentOS and Ubuntu operating systems. All software installations use standard Linux RPM and Linux DEB packages and require root access.

The deployment software consists of the following software packages:

- **Xilinx® runtime (XRT):** XRT provides the libraries and drivers for an application to run on Alveo™ cards.

- **Deployment platform:** The deployment platform provides the firmware needed to run pre-compiled applications. It cannot be used to compile or create new applications. To create new applications, install the development software detailed in Chapter 6: Next Steps. While you can also install the development software on a machine with an installed card, doing so is not necessary to run applications.

For platform features and details, see *Alveo Data Center Accelerator Card Platforms User Guide* (UG1120).

If you encounter any issues during installation, see Chapter 7: Troubleshooting and Known Issues. See Xilinx Answer Record 71752 for additional known issues.

> **IMPORTANT!** *Root access is required for all software and firmware installations.*

> **IMPORTANT!** *L'accès Root est requis pour toutes les installations logicielles et firmware.*

> **WICHTIG!** *Root-Zugriff ist für alle Software- und Firmware-Installationen erforderlich.*

XRT and Deployment Platform Installation Procedures on RedHat and CentOS

Use the following steps to download and install the XRT and DFX-2RP deployment platforms. DFX-2RP platforms consist of base and shell partitions. For more information, see Dynamic Function Exchange in XRT Documentation.

For details on upgrading or downgrading the XRT and deployment platform, see Appendix A: Changing XRT and Target Platform Versions.

1. XRT installation requires Extra Packages for Enterprise Linux (EPEL) and a related repository. If not already installed, install EPEL on your system by following the steps provided here.

2. Run the following two commands to install kernel headers and kernel development packages. Ensure that `uname` is surrounded by backticks (`` ` ``) and not single quotes (`'`):

```
$ sudo yum install kernel-headers-`uname -r`
$ sudo yum install kernel-devel-`uname -r`
```

   Note: If these `yum` commands fail because they cannot find packages matching your kernel version, set up a Vault repository. For more information, see Appendix B: Creating a Vault Repository for CentOS.

3. After the previous command completes, reboot your machine.

4. Download both the XRT and deployment platform installation packages associated with your card from the **Getting Started** tab on the Alveo U250 Product Page.

   Note: For the U280 Alveo data center accelerator card, follow the instructions in v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

5. Install the XRT installation package by running the following command from within the directory where the XRT installation packages reside.

```
$ sudo yum install ./xrt*.rpm
```

   This will install the XRT and its necessary dependencies. Follow the instructions when prompted throughout the installation.

6. Extract the deployment platform installation packages into a single directory and from within the directory run the following command to install the deployment packages.

```
$ sudo yum install ./xilinx*.rpm
```

   After installing the deployment platform you will see the following message.

```
Partition package installed successfully.
Please flash card manually by running below command:

$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name> --
card <card_bdf>
```

   Alternatively, you can install the five deployment platform installation packages individually. If this is the case, install them in the following order.

   - Satellite controller firmware

   - Card management firmware

   - Base partition firmware

   - Platform validation

   - Shell partition firmware

7. Flash the base firmware to the Alveo card using the command displayed in the output of the previous step. It has the following format.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name> --card <card_bdf>
```

The following command, described in Appendix D: Obtaining xbmgmt Command Options, can be used for obtaining the `base_name` and `card_bdf` command options.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --scan
```

8. You will be asked to confirm the update, as follows. Type **y** and press the **Enter** key.

```
Status: shell needs updating
Current shell: <current_base_partition_name>
Shell to be flashed: <base_partition_to_be_flashed>
Are you sure you wish to proceed? [y/n]:
```

Flashing will take up to 10 minutes.

> **IMPORTANT!** *Do not enter **Ctrl + c** in the terminal while the firmware is flashing as this can cause the card to become inoperable.*

> **IMPORTANT!** *N'entrez pas **Ctrl + c** dans le terminal lorsque le micrologiciel clignote, car cela pourrait rendre la carte inutilisable.*

> **WICHTIG!** *Geben Sie im Terminal nicht **Strg + c** ein, während die Firmware blinkt, da dies dazu führen kann, dass die Karte nicht mehr funktioniert.*

Successfully flashing a new card results in a message similar to the following. If the command returns `Card Not Found`, perform a cold reboot, and retry. Otherwise, see Chapter 7: Troubleshooting.

```
Updating shell on card[0000:65:00.0]
Bitstream guard installed on flash @0x1002000
Persisted 542227 bytes of meta data to flash 0 @0x7f7b9c1
Extracting bitstream from MCS data:
...........................
Extracted 27367156 bytes from bitstream @0x1002000
Writing bitstream to flash 0:
...........................
Bitstream guard removed from flash
Successfully flashed Card[0000:65:00.0]

1 Card(s) flashed successfully.
Cold reboot machine to load the new image on card(s).
```

If the card is up-to-date, you will see a message similar to the following.

```
Status: shell is up-to-date
Card(s) up-to-date and do not need to be flashed.
```

9. Cold boot your machine to load the new base firmware image on the FPGA.

> **IMPORTANT!** *Be sure to fully power OFF the machine and then power it ON again. The image will not boot from flash if the machine is only rebooted.*

> ⭐ **IMPORTANT!** *Assurez-vous d'éteindre complètement la machine, puis de la rallumer. L'image flash ne démarrera pas si la machine n'est pas redémarrée.*

> ⭐ **WICHTIG!** *Schalten Sie das Gerät vollständig aus und wieder ein. Das Image startet nicht von Flash, wenn der Computer nur neu gestartet wird.*

10. Flash the Satellite Controller (SC) firmware to the Alveo card using the same command to flash the base firmware. It has the following format:

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name>  --card <card_bdf>
```

See Appendix D: Obtaining xbmgmt Command Options for obtaining the command options.

You will be asked to confirm the update, as follows. Type **y** and press the **Enter** key.

```
Status: SC needs updating
Current SC: <current_sc_version>
SC to be flashed: <sc_version_to_be_flashed>
Are you sure you wish to proceed? [y/n]: y
```

Flashing will take up to 5 minutes.

Successfully flashing the SC results in a message similar to the following. No reboot is necessary.

```
Updating SC firmware on card[0000:65:00.0]
Stopping user function...
.....................................
Successfully flashed Card[0000:65:00.0]

1 Card(s) flashed successfully.
```

If the card is up-to-date, you will see a message similar to the following.

```
Status: shell is up-to-date
Card(s) up-to-date and do not need to be flashed.
```

11. Program the shell partition using the following command.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --program --name <shell_name> --card <card_bdf>
```

Use the following command, described in Appendix D: Obtaining xbmgmt Command Options, for obtaining the `card_bdf` and `shell_name` options.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --scan
```

After programming the shell, an output similar to the following example will be displayed.

```
Programming PLP on Card [0000:65:00.0]...
Partition file: /opt/xilinx/firmware/u250/gen3x16/xdma-shell/
partition.xsabin
Program successfully
```

After the shell partition is programmed, it is not necessary to reprogram it unless the system is warm or cold rebooted.

> ⭐ **IMPORTANT!** *Prior to running an application on DFX-2RP platform, it is necessary to first program the shell partition on the card or the application will fail to detect the shell and will not run. See Xilinx Answer Record 71915 for details.*

The installation for deployment is now complete.

Related Information

Card Bring-Up and Validation

XRT and Deployment Package Installation Procedures on Ubuntu

Use the following steps to download and install the XRT and DFX-2RP deployment platforms. DFX-2RP platforms consist of base and shell partitions. For more information, see Dynamic Function Exchange in XRT Documentation.

For details on upgrading or downgrading the XRT and deployment package, see Appendix A: Changing XRT and Target Platform Versions.

1. Download both the XRT and deployment installation packages associated with your card from the **Getting Started** tab on the Alveo U250 Product Page.

   Note: For the U280 Alveo data center accelerator card, follow the instructions in v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

2. Install the XRT installation package by running the following command from within the directory where the XRT installation packages reside.

   ```
   $ sudo apt install ./xrt*.deb
   ```

   This will install the XRT along with any necessary dependencies. Follow the instructions when prompted throughout the installation.

3. Extract the deployment platform installation packages into a single directory and from within the directory run the following command to install the deployment packages.

   ```
   $ sudo apt install ./xilinx*.deb
   ```

   After installing the deployment platform you will see the following message.

   ```
   Partition package installed successfully.
   Please flash card manually by running below command:

   $ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name> --
   card <card_bdf>
   ```

Alternatively, you can install the five deployment platform installation packages individually. If this is the case, install them in the following order.

- Satellite controller firmware

- Card management firmware

- Base partition firmware

- Platform validation

- Shell partition firmware

4. Flash the base firmware to the Alveo card using the command displayed in the output of the previous step. It has the following format.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name> --card <card_bdf>
```

The following command, described in Appendix D: Obtaining xbmgmt Command Options, can be used for obtaining the `base_name` and `card_bdf` command options.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --scan
```

5. You will be asked to confirm the update, as follows. Type **y** and press the **Enter** key.

```
Status: shell needs updating
Current shell: <current_base_partition_name>
Shell to be flashed: <base_partition_to_be_flashed>
Are you sure you wish to proceed? [y/n]:
```

Flashing will take up to 10 minutes.

⭐ **IMPORTANT!** *Do not enter **Ctrl + c** in the terminal while the firmware is flashing as this can cause the card to become inoperable.*

⭐ **IMPORTANT!** *N'entrez pas **Ctrl + c** dans le terminal lorsque le micrologiciel clignote, car cela pourrait rendre la carte inutilisable.*

⭐ **WICHTIG!** *Geben Sie im Terminal nicht **Strg + c** ein, während die Firmware blinkt, da dies dazu führen kann, dass die Karte nicht mehr funktioniert.*

Successfully flashing a new card results in a message similar to the one shown below. If the command returns `Card Not Found`, perform a cold reboot, and retry. Otherwise, see Chapter 7: Troubleshooting.

```
Updating shell on card[0000:65:00.0]
Bitstream guard installed on flash @0x1002000
Persisted 542227 bytes of meta data to flash 0 @0x7f7b9c1
Extracting bitstream from MCS data:
...........................
Extracted 27367156 bytes from bitstream @0x1002000
Writing bitstream to flash 0:
...........................
```

```
Bitstream guard removed from flash
Successfully flashed Card[0000:65:00.0]

1 Card(s) flashed successfully.
Cold reboot machine to load the new image on card(s).
```

If the card is up-to-date, you will see a message similar to the following.

```
Status: shell is up-to-date
Card(s) up-to-date and do not need to be flashed.
```

6. Cold boot your machine to load the new base firmware image on the FPGA.

> **IMPORTANT!** *Be sure to fully power OFF the machine and then power it ON again. The image will not boot from flash if the machine is only rebooted.*

> **IMPORTANT!** *Assurez-vous d'éteindre complètement la machine, puis de la rallumer. L'image flash ne démarrera pas si la machine n'est pas redémarrée.*

> **WICHTIG!** *Schalten Sie das Gerät vollständig aus und wieder ein. Das Image startet nicht von Flash, wenn der Computer nur neu gestartet wird.*

7. Flash the Satellite Controller (SC) firmware to the Alveo card using the same command to flash the base firmware. It has the following format:

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name> --card <card_bdf>
```

See Appendix D: Obtaining xbmgmt Command Options for obtaining the command options.

You will be asked to confirm the update, as follows Type **y** and press the **Enter** key.

```
Status: SC needs updating
Current SC: <current_sc_version>
SC to be flashed: <sc_version_to_be_flashed>
Are you sure you wish to proceed? [y/n]: y
```

Flashing will take up to 5 minutes.

Successfully flashing the SC results in a message similar to the one shown below. No reboot is necessary.

```
Updating SC firmware on card[0000:65:00.0]
Stopping user function...
.......................................
Successfully flashed Card[0000:65:00.0]

1 Card(s) flashed successfully.
```

If the card is up-to-date, you will see a message similar to the following.

```
Status: shell is up-to-date
Card(s) up-to-date and do not need to be flashed.
```

8. Program the shell partition using the following command.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --program --name <shell_name> --card <card_bdf>
```

Send Feedback

Use the following command, described in Appendix D: Obtaining xbmgmt Command Options, for obtaining the `card_bdf` and `shell_name` options.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --scan
```

After programming the shell, an output similar to the following example will be displayed.

```
Programming PLP on Card [0000:65:00.0]...
Partition file: /opt/xilinx/firmware/u250/gen3x16/xdma-shell/
partition.xsabin
Program successfully
```

After the shell partition is programmed, it is not necessary to reprogram it unless the system is warm or cold rebooted.

⭐ **IMPORTANT!** *Prior to running an application on DFX-2RP platform, it is necessary to first program the shell partition on the card or the application will fail to detect the shell and will not run. See Xilinx Answer Record 71915 for details.*

The installation for deployment is now complete.

Related Information

Card Bring-Up and Validation

Card Bring-Up and Validation

After installing the XRT and deployment platform, the card installation can be verified using the following commands, which are explained in more detail below.

- `lspci`
- `xbmgmt flash`
- `xbmgmt partition`
- `xbutil validate`

The `lspci` Linux command is used to confirm the card, is seen by the OS, as was done when installing the card.

The additional commands use the `xbmgmt` and `xbutil` utilities included during the XRT package installation. These utilities include multiple commands to validate and identify the installed card(s) and report additional card details including memory, PCIe®, platform name, and system information. See *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393) for a detailed list of commands.

Set the environment to use the utilities by running the following command. Note that the command is dependent on the command shell you are using.

Use the following command in csh shell:

```
$ source /opt/xilinx/xrt/setup.csh
```

Use the following command in bash shell:

```
$ source /opt/xilinx/xrt/setup.sh
```

Running lspci

1. Enter the following command:

```
$ sudo lspci -vd 10ee:
```

2. If the card is successfully installed and found by the operating system, you will see a message similar to the following. Note that for each card, there will be two physical functions found: one for management and one for user. See https://xilinx.github.io/XRT/master/html/platforms.html for additional details.

```
65:00.0 Processing accelerators: Xilinx Corporation Device 5004
        Subsystem: Xilinx Corporation Device 000e
        Flags: bus master, fast devsel, latency 0, NUMA node 0
        Memory at 380072000000 (64-bit, prefetchable) [size=32M]
        Memory at 380074040000 (64-bit, prefetchable) [size=256K]
        Capabilities: [40] Power Management version 3
        Capabilities: [60] MSI-X: Enable+ Count=32 Masked-
        Capabilities: [70] Express Endpoint, MSI 00
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [1c0] #19
        Capabilities: [400] Access Control Services
        Capabilities: [410] #15
        Capabilities: [480] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
        Kernel driver in use: xclmgmt
        Kernel modules: xclmgmt

65:00.1 Processing accelerators: Xilinx Corporation Device 5005
        Subsystem: Xilinx Corporation Device 000e
        Flags: bus master, fast devsel, latency 0, IRQ 64, NUMA node 0
        Memory at 380070000000 (64-bit, prefetchable) [size=32M]
        Memory at 380074000000 (64-bit, prefetchable) [size=256K]
        Memory at 380060000000 (64-bit, prefetchable) [size=256M]
        Capabilities: [40] Power Management version 3
        Capabilities: [60] MSI-X: Enable+ Count=32 Masked-
        Capabilities: [70] Express Endpoint, MSI 00
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [400] Access Control Services
        Capabilities: [410] #15
        Capabilities: [480] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
        Kernel driver in use: xocl
        Kernel modules: xocl
```

Running xbmgmt flash --scan

Use the `xbmgmt flash --scan` command to display and confirm the card's flashed base firmware version and additional card details, including the card Bus:Device:Function (BDF).

1. Enter the following command:

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --scan
```

For each card in the server, you will see an output similar to the following example.

```
Card [0000:65:00.0]
    Card type:          u250
    Flash type:         SPI
    Flashable partition running on FPGA:
        xilinx_u250_gen3x16_base_3,[ID=0x48810c9d17860ef5],[SC=4.6.6]
    Flashable partitions installed in system:
        xilinx_u250_gen3x16_base_3,[ID=0x48810c9d17860ef5],[SC=4.6.6]
```

The name of the base partition, ID, and SC firmware version running on the FPGA are found under `Flashable partition running on FPGA` while the ones installed in the system are found under `Flashable partitions installed in system`.

In this example, the BDF is `0000:65:00.0`, the base partition on the FPGA and system are identical (`xilinx_u250_gen3x16_base_3`), the ID is `0x48810c9d17860ef5` and the SC version is `4.6.6`.

2. Confirm the base partition under `Flashable partition running on FPGA` is identical to the that under `Flashable partitions installed in system`.

   If these versions do not match, perform a cold reboot, and retry.

Running xbmgmt partition

The `xbmgmt partition` command for Dynamic Function eXchange platforms supporting two reconfigurable partitions (DFX-2RP) provides options to display the base and shell firmware versions running on the card, as well as program the shell firmware.

1. Display the base firmware running on the card by entering the following command.

   ```
   $ sudo /opt/xilinx/xrt/bin/xbmgmt partition --scan
   ```

   For each card in the server, you will see an output similar to the following example.

   ```
   Card [0000:65:00.0]
       Partitions running on FPGA:
           xilinx_u250_gen3x16_base_3
               logic-uuid:
               48810c9d17860ef53e9e529e8b14ce39
               interface-uuid:
               695718ec21a232e45e1afcb4e558e11f
       Partitions installed in system:
           xilinx_u250_gen3x16_xdma_shell_3_1
               logic-uuid:
               bd5fb8abab266c3265918257b5048e88
               interface-uuid:
               f2f6c5e1273e78948f2c4806221462f2
   ```

Under `Partitions running on FPGA` it displays the base partition running on the FPGA `xilinx_u250_gen3x16_base_3`. A shell partition will also be displayed if it has already been programmed.

Under `Partitions installed in system` it displays available shell partition(s) available to program on the FPGA. In this example, only one shell partition is available `xilinx_u250_gen3x16_xdma_shell_3_1`.

The `logic-uuid` and `interface-uuid` are used by the system to ensure compatible base and shell partitions are used for a given application.

If no shell partitions are displayed under `Partitions installed in system`, it implies no shell partitions compatible with the base partition have been installed. Download and install a compatible shell partition.

2. Enter the following command to program the shell partition on the FPGA.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --program --name
<shell_name> --card <card_bdf>
```

where `<shell_name>` is the name of the shell partition to be programmed to the card identified with BDF `<card_bdf>`.

In the previous example `xilinx_u250_gen3x16_xdma_shell_3_1` will be programmed to card with BDF `00:65:00.0`. See Appendix D: Obtaining xbmgmt Command Options to obtain the `card_bdf` and `shell_name` option.

An output similar to the following example will be displayed:

```
Programming PLP on Card [0000:65:00.0]...
Partition file: /opt/xilinx/firmware/u250/gen3x16/xdma-shell/
partition.xsabin
Program successfully
```

3. Enter the following command and confirm the shell partition displayed under `Partitions installed in the system` and `Partitions running on FPGA` match.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --scan
```

An output similar to the following example will be displayed.

```
Card [0000:65:00.0]
    Partitions running on FPGA:
        xilinx_u250_gen3x16_base_3
            logic-uuid:
            48810c9d17860ef53e9e529e8b14ce39
            interface-uuid:
            695718ec21a232e45e1afcb4e558e11f
        xilinx_u250_gen3x16_xdma_shell_3_1
            logic-uuid:
            bd5fb8abab266c3265918257b5048e88
            interface-uuid:
            f2f6c5e1273e78948f2c4806221462f2
    Partitions installed in system:
```

Send Feedback

```
            xilinx_u250_gen3x16_xdma_shell_3_1
                logic-uuid:
                bd5fb8abab266c3265918257b5048e88
                interface-uuid:
                f2f6c5e1273e78948f2c4806221462f2
```

Under `Partitions running on FPGA` both the base
`xilinx_u250_gen3x16_base_3` and the shell
`xilinx_u250_gen3x16_xdma_shell_3_1` partitions will be displayed.

After the shell partition is programmed, it is not necessary to reprogram it unless the system
is rebooted.

xbutil validate

The `xbutil validate` command validates the correct installation by performing the following
set of tests:

1. Validates the device found.

2. Checks PCIe link status.

3. Runs a verify kernel on the card.

4. Performs the following data transfer tests:

    a. DMA test - Data transfer between host and card memory through PCIe.

    b. Memory test - Data transfer between kernels and card memory.

Prior to running an application, including the validation application, it is necessary to first
program the shell partition to the card using the following command. See "Obtaining xbmgmt
command options" to obtain the `card_bdf` and `shell_name` options. After the shell partition
is programmed, it is not necessary to reprogram it unless the system is warm or cold rebooted.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --program --name <shell_name> --
card <card_bdf>
```

With the shell programmed, run the `validate` command as follows:

```
$ /opt/xilinx/xrt/bin/xbutil validate -d <card_bdf>
```

where `card_bdf` is the BDF of the card to be validated. If `-d` is not specified, the command will
validate all cards in the system.

If the card was installed correctly, you will see a high-level summary of the tests performed similar to the following output. If the output is not similar to the one shown below, see Chapter 7: Troubleshooting.

```
    INFO: Found 1 cards

INFO: Validating card[1]: xilinx_u250_gen3x16_xdma_shell_3_1
INFO: == Starting Kernel version check:
INFO: == Kernel version check PASSED
INFO: == Starting AUX power connector check:
INFO: == AUX power connector check PASSED
INFO: == Starting Power warning check:
INFO: == Power warning check PASSED
INFO: == Starting PCIE link check:
INFO: == PCIE link check PASSED
INFO: == Starting SC firmware version check:
INFO: == SC firmware version check PASSED
INFO: == Starting verify kernel test:
INFO: == verify kernel test PASSED
INFO: == Starting DMA test:
Host -> PCIe -> FPGA write bandwidth = 9066.781182 MB/s
Host <- PCIe <- FPGA read bandwidth = 11837.876581 MB/s
INFO: == DMA test PASSED
INFO: == Starting device memory bandwidth test:
...........
Maximum throughput: 52077 MB/s
INFO: == device memory bandwidth test PASSED
INFO: == Starting PCIE peer-to-peer test:
P2P BAR is not enabled. Skipping validation
INFO: == PCIE peer-to-peer test SKIPPED
INFO: == Starting memory-to-memory DMA test:
bank0 -> bank1 M2M bandwidth: 12426 MB/s
bank0 -> bank2 M2M bandwidth: 12392.3 MB/s
bank0 -> bank3 M2M bandwidth: 11347 MB/s
bank1 -> bank2 M2M bandwidth: 12424.8 MB/s
bank1 -> bank3 M2M bandwidth: 12231.8 MB/s
bank2 -> bank3 M2M bandwidth: 12412.1 MB/s
INFO: == memory-to-memory DMA test PASSED
INFO: == Starting host memory bandwidth test:
Host_mem is not available. Skipping validation
INFO: == host memory bandwidth test SKIPPED
    INFO: Card[0] validated successfully.

    INFO: All cards validated successfully.
```

Note: The DMA bandwidth can vary depending upon NUMA/CPU affinity.

If the shell partition has not been programmed to the card, the output will look similar to the following. Ensure to program the shell as described above.

```
INFO: Found 1 cards

INFO: Validating card[0]: xilinx_u250_gen3x16_base_3
INFO: == Starting Kernel version check:
INFO: == Kernel version check PASSED
INFO: == Starting AUX power connector check:
INFO: == AUX power connector check PASSED
INFO: == Starting Power warning check:
INFO: == Power warning check PASSED
INFO: == Starting PCIE link check:
```

```
INFO: == PCIE link check PASSED
INFO: == Starting SC firmware version check:
INFO: == SC firmware version check PASSED
INFO: == Starting verify kernel test:
Verify xclbin not available. Skipping validation.
INFO: == verify kernel test SKIPPED
INFO: Card[0] validated successfully.

INFO: All cards validated successfully.
```

Next Steps

What you have done so far allows you to deploy and run accelerated applications on your system. Alveo™ Accelerated Solutions page provides information and links to available Xilinx and third-party accelerated applications. These include video processing, financial computing, machine learning, and data analytics.

If you are an application developer who wants to develop and deliver accelerated applications, install the Vitis™ software platform. It allows you to develop, debug, and optimize accelerated applications for Alveo cards. Installation instructions can be found in *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393).

For an overview of developing accelerated applications with Alveo™ with accompanying guided examples, see https://developer.xilinx.com/en/articles/acceleration-basics.html.

For complete details on the development flow and getting started in Vitis, see *Vitis Unified Software Platform Documentation: Embedded Software Development* (UG1400). For an introduction to Vitis methodology, see *Vitis Unified Software Platform Documentation* (UG1416).

Troubleshooting

The following table lists potential issues, causes, and fixes related to card installation.

Table 3: **Card Troubleshooting**

Issue	Potential Cause	Fix
Card not found.	Card not correctly installed.	Reinstall the card following the installation instructions. Check if the card shows up by typing the following Linux command: `lspci -vd 10ee:`
	Card not compatible with server.	Use qualified server. See *Alveo U200 and U250 Data Center Accelerator Cards Data Sheet* (DS962) for system compatibilities.
	Maintenance USB cable attached.	Ensure maintenance USB cable is removed before booting system.
	Kernel version is incompatible.	Run `uname -r` to check the kernel version. Ensure that the kernel version matches the version listed for your OS in Chapter 4: Installing the Deployment Software.
lspci no longer recognizes the card.	Card is overheating.	Ensure that operating ambient conditions do not exceed specifications and passive cards are in a system that provides adequate airflow. For more information about airflow requirements, see *Alveo U200 and U250 Data Center Accelerator Cards Data Sheet* (DS962) and *Alveo U280 Data Center Accelerator Cards Data Sheet* (DS963).
XRT installation incomplete or unsuccessful.	Missing dependent packages.	Contact your Linux administrator.
Deployment platform installation incomplete or unsuccessful.	Missing dependent packages.	Contact your Linux administrator.
`xbmgmt --flash` returns the error: `Specified DSA is not applicable`	Correct type of deployment platform package not installed.	Install the correct type of deployment platform package.
Unable to install packages on RedHat and CentOS.	Incorrect permissions for download directory, for example, a `/home/` directory.	Download the packages to a directory where root has read access (for example, `/tmp`). Use the full path to the RPM package when installing. yum will fail with a relative path to RPM package.

Table 3: **Card Troubleshooting** *(cont'd)*

Issue	Potential Cause	Fix

When running `xbutil` the following message is displayed:
 	
`Failed to open device: 0000:3b:00.0`
`INFO: Found total 1 card(s);`
`0 are usable.`
	Driver has not loaded successfully or the card is not flashed successfully.	Perform a cold reboot.

XRT package fails to install on a supported CentOS release.	Kernel development headers are missing. The XRT package is missing a dependency on `kernel-devel` and `kernel-headers`.	Manually install `kernel-devel` and `kernel-header` with yum install: `$ sudo yum install kernel-headers-`uname -r`` `$ sudo yum install kernel-devel-`uname -r`` ***Note:*** Do not run `sudo yum upgrade`. This will update the kernel-headers to an incompatible version.
Flashing the card does not complete after 20 minutes.	The flash operation has failed.	Perform cold-reboot and then re-flash the card.
Run time fails with following message: `Error: Failed to find Xilinx platform`	Failed to source the `setup.sh` script.	Source `/opt/xilinx/xrt/setup.sh`
When installing the XRT, you see the following message: `N: Can't drop privileges for downloading as file '/root/xrt_201802.2.1.79_16.04.deb' couldn't be accessed by user '_apt'. - pkgAcquire::Run (13: Permission denied)`	This is caused by running `sudo apt install` as root.	The XRT will install correctly, despite the error. You can find more information about this error on AskUbuntu.

Known Issues

The following table lists known issues. See Xilinx Answer Record 71752 and Xilinx Answer Record 71975 for additional known issues.

Table 4: **Known Issues**

Area	Description	Comments/Recommendations
`xbmgmt`	`xbmgmt` commands do not work. There are no errors indicating this in output.	Reinstall the XRT package.

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Table 4: **Known Issues** *(cont'd)*

Area	Description	Comments/Recommendations

General	Driver may not be loaded properly after boot up (or reboot).	After boot up (or reboot), run these two commands to load the device driver:
		`$ sudo rmmod xclmgmt`
		`$ sudo modprobe xclmgmt`

General	The Alveo card has not trained to the full expected PCI Express link width or link speed. The output from `xbutil validate` will look like the following: `$ INFO: Validating device[0]: INFO: Checking PCIE link status: FAILED WARNING: Device trained to lower spec. Expect: Gen3 x16, Current: Gen2x16`	Ensure that the Alveo card is plugged into a Gen 3x16 capable slot, and that the power cable is connected. Then cold reboot and see if the card trains to the correct settings.
General	The card is not present when running `xbutil` or `lspci`. The card may not have been ready when the server enumerated PCI Express.	Potential Fix: Warm Reboot the server, Disable Fast Boot.
General	Card does not show up when running lspci and the red LED on the card is illuminated.	When card is first installed in server, BIOS may not recognize the card correctly and red LED on card is illuminated, indicating an error. Cold boot the server four times until the blue LED on the card is illuminated, indicating the card is successfully running. If the red LED is still illuminated, disconnect the power to the sever for 5 minutes and repeat the step above.

Changing XRT and Target Platform Versions

The Alveo™ data center accelerator card target platform and XRT revisions can change significantly between releases. To ensure a successful upgrade (or downgrade) of the Alveo card XRT and platform, carefully follow the instructions for your specific release pairing. Failure to adhere to these procedures can result in an unstable installation or other issues.

Note: For links to the available platform and XRT revisions, see Chapter 4: Installing the Deployment Software.

> **IMPORTANT!** *Do not enter **Ctrl + c** in the terminal while the firmware is flashing as this can cause the card to become inoperable.*

> **IMPORTANT!** *N'entrez pas **Ctrl + c** dans le terminal lorsque le micrologiciel clignote, car cela pourrait rendre la carte inutilisable.*

> **WICHTIG!** *Geben Sie im Terminal nicht **Strg + c** ein, während die Firmware blinkt, da dies dazu führen kann, dass die Karte nicht mehr funktioniert.*

RedHat and CentOS

During upgrading, downgrading, or uninstalling, it can be useful to list the currently installed Alveo packages. To list all currently installed platform packages, run the following command in a Linux terminal:

```
$ yum list installed | grep xilinx
```

To list the currently installed XRT package, run the following command:

```
$ yum list installed | grep xrt
```

Upgrade

The following steps require XRT 2019.2 or later to be installed. For older installed versions of the XRT, see v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

1. Restore the card to the original manufacturing state by following the instructions in Appendix C: Reverting the Card to Factory Image.

2. Remove the current XRT and installed platform(s).

```
$ sudo yum remove xrt
```

3. Follow the installation procedures outlined in Chapter 4: Installing the Deployment Software.

Downgrade

The following steps require XRT 2019.2 or later to be installed. For older installed versions of the XRT, see v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301)

To downgrade perform the following steps.

1. Restore the card to the original manufacturing state by following the instructions in Appendix C: Reverting the Card to Factory Image.

2. Remove the current XRT and installed platform(s).

```
$ sudo yum remove xrt
```

3. Follow the installation procedures outlined in the chapter "Installing the Deployment Software", in v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

Uninstalling Packages in RedHat and CentOS

To completely uninstall the Alveo XRT and installed deployment platform packages, run the following command in a Linux terminal. Uninstalling XRT also uninstalls the deployment platform.

```
$ sudo yum remove xrt
```

Ubuntu

During upgrading, downgrading, or uninstalling, it can be useful to list the currently installed Alveo packages. To list all currently platform packages, run the following command in a Linux terminal:

```
$ apt list --installed | grep xilinx
```

To list the currently installed XRT package, run the following command:

```
$ apt list --installed | grep xrt
```

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Upgrade

The following steps require XRT 2019.2 or later to be installed. For older installed versions of the XRT, see v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

1. Restore the card to the original manufacturing state by following the instructions in Appendix C: Reverting the Card to Factory Image.

2. Remove the current XRT and installed platform(s).

```
$ sudo apt remove xrt
```

3. Follow the installation procedures outlined in Chapter 4: Installing the Deployment Software.

Downgrade

The following steps require XRT 2019.2 or later to be installed. For older installed versions of the XRT, see v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

To downgrade perform the following steps.

1. Restore the card to the original manufacturing state by following the instructions in Appendix C: Reverting the Card to Factory Image.

2. Remove the current XRT and installed platform(s).

```
$ sudo apt remove xrt
```

3. Follow the installation procedures outlined in the chapter "Installing the Deployment Software" in v1.5 of *Getting Started with Alveo Data Center Accelerator Cards* (UG1301).

Uninstalling Packages in Ubuntu

To completely uninstall the Alveo XRT and installed deployment platform packages, run the following command in a Linux terminal. Uninstalling XRT also uninstalls the deployment platform.

```
$ sudo apt remove xrt
```

Creating a Vault Repository for CentOS

On CentOS, `yum install kernel-headers` always installs the latest version of the headers, but might not match your kernel version. This causes the installation of XRT to skip compilation of the driver modules and will silently fail. To correctly install XRT, you must create a vault repository file that points to versions matching the kernel.

Use the following example repository as a guide to create your own repository. It is an example repository for CentOS 7.4 created in the following file:

`/etc/yum.repos.d/centos74.repo`

```
# CentOS-Base-7.4.repo
#
# This repo is locked to 7.4.1708 version
#
# C7.4.1708
[C7.4.1708-base]
name=CentOS-7.4.1708 - Base
baseurl=http://vault.centos.org/7.4.1708/os/$basearch/
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
enabled=1
[C7.4.1708-updates]
name=CentOS-7.4.1708 - Updates
baseurl=http://vault.centos.org/7.4.1708/updates/$basearch/
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
enabled=1
[C7.4.1708-extras]
name=CentOS-7.4.1708 - Extras
baseurl=http://vault.centos.org/7.4.1708/extras/$basearch/
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
enabled=1
[C7.4.1708-centosplus]
name=CentOS-7.4.1708 - CentOSPlus
baseurl=http://vault.centos.org/7.4.1708/centosplus/$basearch/
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
enabled=1
[C7.4.1708-fasttrack]
name=CentOS-7.4.1708 - CentOSPlus
baseurl=http://vault.centos.org/7.4.1708/fasttrack/$basearch/
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
enabled=1
```

Note: For CentOS 7.5, create the repo file `/etc/yum.repos.d/centos75.repo` and add the previously listed content, replacing "7.4.1708" with "7.5.1804". Similarly, for CentOS 7.6, create the repo file `/etc/yum.repos.d/centos76.repo` and add the previously listed content, replacing "7.4.1708" with "7.6.1810".

Reverting the Card to Factory Image

The Alveo™ card can be reverted to the factory image, also known as golden. This requires that XRT 2019.2 release or later is installed on the same system as the Alveo accelerator card. The steps to revert the card using this method are listed below.

1. Open a terminal window.

2. Run the following command, where `card_bdf` is the BDF of the card to revert to golden.

```
$ sudo  /opt/xilinx/xrt/bin/xbmgmt flash --factory_reset --card
<card_bdf>
```

3. Enter **y** to continue. The following message is displayed on completion.

```
Shell is reset succesfully
Cold reboot machine to load new shell on card
```

4. Cold boot the system so the card FPGA uses the new image.

5. Confirm the card has been reverted to factory image by running the following command.

```
$ sudo  /opt/xilinx/xrt/bin/xbmgmt flash --scan
```

An output similar to the following is displayed.

```
Card [0000:65:00.0]
Card type:  uxx
Flash type:  SPI
Flashable partition running on FPGA:
xilinx_uxx_GOLDEN_x,[SC=x.x]
Flashable partitions installed in system: (None)
```

In this output, under `Flashable partition running on FPGA`, note `GOLDEN` in the name. This indicates that the card has successfully been reverted to factory image.

> **IMPORTANT!** *If the GOLDEN_2 image is running on the FPGA, carefully review the design advisory for Alveo data center accelerator card golden corruption, found in the Xilinx Answer Record AR-71915. Complete the repair instructions associated with the Xilinx Answer prior to proceeding.*

> **IMPORTANT!** *Si l'image GOLDEN_2 est en cours d'exécution sur le FPGA, consultez attentivement l'avis de conception relatif à la corruption dorée de la carte accélératrice de centre de données Alveo, disponible dans l'enregistrement de réponse Xilinx AR-71915. Suivez les instructions de réparation associées à Xilinx Answer avant de poursuivre.*

WICHTIG! *Wenn das GOLDEN_2-Image auf dem FPGA ausgeführt wird, lesen Sie die Designempfehlung zur Goldenen Beschädigung der Alveo Data Center-Beschleunigerkarte unter Xilinx Answer Record AR-71915. Führen Sie die mit der Xilinx Answer verbundenen Reparaturanweisungen aus, bevor Sie fortfahren.*

Obtaining xbmgmt Command Options

Xilinx® Board Management (`xbmgmt`) utility is a standalone command line tool that is included with the XRT installation package. This utility is used for card installation and administration, and requires `sudo` privileges when running it and supports tasks include flashing the card firmware, and scanning the current device and system configuration. Complete command documentation can be found under xbmgmt Utility in the Application Acceleration Development flow of the *Vitis Unified Software Platform Documentation* (UG1416).

This section describes how to obtain the `xbmgmt` command options necessary for flashing the base partition and programming the shell partition.

The following command is used to flash the base partition.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell <base_name> --card
<card_bdf>
```

The following command is used to program the shell partition.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --program --name <shell_name> --
card <card_bdf>
```

Command options, descriptions, and commands to display the options are provided in the following table.

Table 5: **Command Options and Descriptions**

Option	Description	Command
card_bdf	Card Bus Device Function (BDF) for the card in the following format: [Bus : Device : Function]	xbmgmt flash --scan or xbmgmt partition --scan
base_name	Base partition firmware name	xbmgmt flash --scan
shell_name	Shell partition firmware name	xbmgmt partition --scan

Use the following command to list the available base partition.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --scan
```

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An example output of this command is given below with available base partitions displayed under the `Flashable partitions installed in system`. Only one base partition is shown `xilinx_u250_gen3x16_base_3`.

```
Card [0000:65:00.0]
    Card type:          u250
    Flash type:         SPI
    Flashable partition running on FPGA:
        xilinx_u250_gen3x16_base_3,[ID=0x48810c9d17860ef5],[SC=4.6.6]
    Flashable partitions installed in system:
        xilinx_u250_gen3x16_base_3,[ID=0x48810c9d17860ef5],[SC=4.6.6]
```

Use the following command to list the available shell partition.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --scan
```

An example output of this command is as follows with available shell partition displayed under the `Partitions installed in system`. Only one partition is shown `xilinx_u250_gen3x16_xdma_shell_3_1`.

```
Card [0000:65:00.0]
    Partitions running on FPGA:
        xilinx_u250_gen3x16_base_3
            logic-uuid:
            48810c9d17860ef53e9e529e8b14ce39
            interface-uuid:
            695718ec21a232e45e1afcb4e558e11f
        xilinx_u250_gen3x16_xdma_shell_3_1
            logic-uuid:
            bd5fb8abab266c3265918257b5048e88
            interface-uuid:
            f2f6c5e1273e78948f2c4806221462f2
    Partitions installed in system:
        xilinx_u250_gen3x16_xdma_shell_3_1
            logic-uuid:
            bd5fb8abab266c3265918257b5048e88
            interface-uuid:
            f2f6c5e1273e78948f2c4806221462f2
```

Note: A base and shell are compatible if the card plus customization and first version digit in the partition names match.

The `card_bdf` is displayed on the first output line for either command in these examples is `0000:65:00.0`.

Using the command options from the previous example, the command for flashing the base is as follows,

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt flash --update --shell
xilinx_u250_gen3x16_base_3 --card 0000:65:00.0
```

and the command for programming the shell is as follows.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt partition --program --name
xilinx_u250_gen3x16_xdma_shell_3_1 --card 0000:65:00.0
```

Regulatory and Compliance Information

This product is designed and tested to conform to the European Union directives and standards described in this section.

CE Directives

2014/35/EC, *Low Voltage Directive (LVD)*

2014/30/EC, *Electromagnetic Compatibility (EMC) Directive*

CE Standards

EN standards are maintained by the European Committee for Electrotechnical Standardization (CENELEC). IEC standards are maintained by the International Electrotechnical Commission (IEC).

Electromagnetic Compatibility

EN:55032:2015, *Information Technology Equipment Radio Disturbance Characteristics – Limits and Methods of Measurement*

EN:55024:2015, *Information Technology Equipment Immunity Characteristics – Limits and Methods of Measurement*

This is a Class A product. In a domestic environment, this product can cause radio interference, in which case the user might be required to take adequate measures.

Safety

IEC 60950-1, 2nd Edition, 2014, *Information technology equipment – Safety, Part 1: General requirements*

EN 60950-1, 2nd Edition, 2014, *Information technology equipment – Safety, Part 1: General requirements*

Compliance Markings
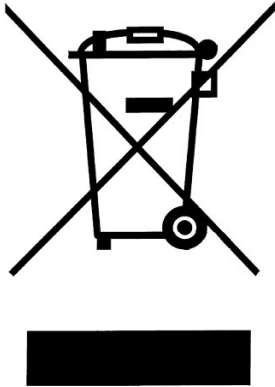
In August of 2005, the European Union (EU) implemented the EU Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC and later the WEEE Recast Directive 2012/19/EU. These directives require Producers of electronic and electrical equipment (EEE) to manage and finance the collection, reuse, recycling and to appropriately treat WEEE that the Producer places on the EU market after August 13, 2005. The goal of this directive is to minimize the volume of electrical and electronic waste disposal and to encourage re-use and recycling at the end of life.

Xilinx has met its national obligations to the EU WEEE Directive by registering in those countries to which Xilinx is an importer. Xilinx has also elected to join WEEE Compliance Schemes in some countries to help manage customer returns at end-of-life.

If you have purchased Xilinx-branded electrical or electronic products in the EU and are intending to discard these products at the end of their useful life, please do not dispose of them with your other household or municipal waste. Xilinx has labeled its branded electronic products with the WEEE Symbol to alert our customers that products bearing this label should not be disposed of in a landfill or with municipal or household waste in the EU.

This product complies with Directive 2002/95/EC on the restriction of hazardous substances (RoHS) in electrical and electronic equipment.

This product complies with CE Directives 2006/95/EC, *Low Voltage Directive (LVD)* and 2004/108/EC, *Electromagnetic Compatibility (EMC) Directive*.

Additional Resources and Legal Notices

Xilinx Resources

For support resources such as Answers, Documentation, Downloads, and Forums, see Xilinx Support.

Documentation Navigator and Design Hubs

Xilinx® Documentation Navigator (DocNav) provides access to Xilinx documents, videos, and support resources, which you can filter and search to find information. To open DocNav:

- From the Vivado® IDE, select **Help → Documentation and Tutorials**.
- On Windows, select **Start → All Programs → Xilinx Design Tools → DocNav**.
- At the Linux command prompt, enter `docnav`.

Xilinx Design Hubs provide links to documentation organized by design tasks and other topics, which you can use to learn key concepts and address frequently asked questions. To access the Design Hubs:

- In DocNav, click the **Design Hubs View** tab.
- On the Xilinx website, see the Design Hubs page.

Note: For more information on DocNav, see the Documentation Navigator page on the Xilinx website.

References

Vitis Documents

These documents provide supplemental material useful with this guide:

1. *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393)
2. *Vitis Unified Software Platform Documentation* (UG1416)
3. *Vitis Unified Software Platform Documentation: Embedded Software Development* (UG1400)
4. *Vitis Application Acceleration Development Flow Tutorials* (GitHub)

Alveo Documents

1. *Alveo U200 and U250 Data Center Accelerator Cards Data Sheet* (DS962)
2. *Alveo Data Center Accelerator Card Platforms User Guide* (UG1120)
3. *Alveo U280 Data Center Accelerator Cards Data Sheet* (DS963)

Additional Xilinx Resources

1. Xilinx licensing website: https://www.xilinx.com/getproduct
2. Vitis Developer Zone: https://www.xilinx.com/products/design-tools/vitis/vitis-platform.html
3. Xilinx Community Forums: https://forums.xilinx.com
4. *Xilinx Third-Party End User License Agreement*
5. *End-User License Agreement*

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