DGX Software Stack for Ubuntu

Installation Guide
# Table of Contents

Chapter 1. Introduction........................................................................................................ 1
  1.1. DGX Software Stack Highlights............................................................................... 1
  1.2. Additional Documentation....................................................................................... 2
  1.3. Customer Support.................................................................................................... 2

Chapter 2. Prerequisites...................................................................................................... 3

Chapter 3. Installation Considerations............................................................................ 4

Chapter 4. Installing Ubuntu.............................................................................................. 6
  4.1. Connecting to the DGX System.............................................................................. 6
  4.2. Booting from the Installation Media..................................................................... 6
  4.3. Running the Ubuntu Installer............................................................................... 7

Chapter 5. Installing the DGX Software Stack................................................................. 13
  5.1. Installing DGX System Configurations and Tools............................................. 13
  5.2. Configuring Data Drives....................................................................................... 14
  5.3. Installing NVIDIA CUDA Drivers..................................................................... 15
  5.4. Installing the Mellanox OpenFabrics Enterprise Distribution (MLNX_OFED)... 17
  5.5. Installing Docker and the NVIDIA Container Toolkit......................................... 18
  5.6. Installing the NVIDIA System Management (NVSM) Tool [Recommended]..... 19

Chapter 6. Installing Additional Software....................................................................... 20

Chapter 7. Additional Software and Configuration Options........................................... 21

Appendix A. Third-Party License Notices........................................................................ 22
  A.1. Mellanox (OFED).................................................................................................... 22
  A.2. msecli..................................................................................................................... 22
Chapter 1. Introduction

NVIDIA® DGX™ systems are shipped preinstalled with DGX™ OS, a customized installation of Ubuntu with additional software from NVIDIA to provide a turnkey solution for running AI and analytics workloads. This offers users a fast on-boarding experience for using DGX systems and keeping them updated with the latest software versions.

The additional software, the NVIDIA DGX Software Stack, provides platform-specific configurations, diagnostic and monitoring tools, and drivers that are required for a stable, tested, and supported OS to run AI, machine learning, and analytics applications on DGX systems.

The DGX OS installer is released in the form of an ISO image to reimage a DGX system, but you also have the option to install a vanilla version of Ubuntu 20.04 and the NVIDIA DGX Software Stack on DGX servers (DGX A100, DGX-2, DGX-1) while still benefiting from the advanced DGX features. This installation method supports more flexibility, such as custom partition schemes or using a specific base Ubuntu image. Cluster deployments also benefit from this installation method by taking advantage of Ubuntu’s standardized automated and non-interactive installation process.

This document explains the steps for installing and configuring Ubuntu and the NVIDIA DGX Software Stack on DGX systems. It also provides instructions and examples for an automated installation process. The intended audience are IT professionals managing a cluster of DGX systems and integration partners.

1.1. DGX Software Stack Highlights

- Support for Ubuntu 20.04 LTS distribution
- NVIDIA System Management (NVSM)
  - Provides active health monitoring and system alerts for NVIDIA DGX nodes in a data center. It also provides simple commands for checking the health of the DGX systems from the command line.
- Data Center GPU Management (DCGM)
  - This software enables node-wide administration of GPUs and can be used for cluster and data-center level management.
- DGX system-specific support packages
- NVIDIA GPU driver, and CUDA toolkit and domain specific libraries
Introduction

- Docker Engine and NVIDIA Container Toolkit
- Caching NFS data using cachefilesd
- Tools to convert data disks between RAID levels
- Disk drive encryption and root filesystem encryption
- Mellanox OpenFabrics Enterprise Distribution for Linux (MOFED) and Mellanox Software Tools (MST) for systems with Mellanox network cards

1.2. Additional Documentation

- **DGX Systems Documentation**
  All documentation for DGX products, including product user guides, software release notes, firmware update container information, and best practices documentation.
  - [NVIDIA DGX-1 User Guide](#)
  - [NVIDIA DGX-2 User Guide](#)
  - [NVIDIA DGX A100 User Guide](#)
- **DGX OS 5 User Guide**
  This document describes the NVIDIA® DGX™ OS 5 software for DGX systems.
- **MIG User Guide**
  The new Multi-Instance GPU (MIG) feature allows the NVIDIA A100 GPU to be securely partitioned into up to seven separate GPU Instances for CUDA applications.
- **NGC Private Registry**
  This document describes how to access the NGC container registry for using containerized deep learning GPU-accelerated applications on your DGX system.
- **NVSM Software User Guide**
  Contains instructions for using the NVIDIA System Management software.
- **DCGM Software User Guide**
  Contains instructions for using the Data Center GPU Manager software.

1.3. Customer Support

NVIDIA Enterprise Support is the support resource for DGX customers and is able to assist with hardware, software, or NGC application issues. For details on how to obtain support, visit the NVIDIA Enterprise Support website [https://www.nvidia.com/en-us/support/enterprise/](https://www.nvidia.com/en-us/support/enterprise/)
Chapter 2. Prerequisites

The following prerequisites are required or recommended, where indicated.

Ubuntu Software Requirements

The DGX Software Stack requires the following software versions:

- Ubuntu 20.04
- Linux Kernel 5.4 LTS

Access to Software Repositories

The DGX Software Stack is available from repositories that can be accessed from the internet. If your installation does not allow connection to the internet, see the section Installing the Software on Air-Gapped DGX Systems for information about installing and upgrading software on “air-gapped” systems.

If you are using a proxy server, then follow the instructions in the section Network Configuration for setting up a proxy configuration.
Chapter 3. Installation Considerations

Installing the NVIDIA DGX Software Stack on Ubuntu allows you to select from additional configuration options that would otherwise not be available with the preconfigured DGX OS installer. This includes drive partitioning, filesystem choices, and software selection.

Before you start installing Ubuntu and the NVIDIA DGX Software Stack, you should evaluate the following options. The installation and configuration instructions will be covered in the respective section of this document.

System Drive Mirroring (RAID-1) [recommended]

The DGX A100 and DGX-2 systems embed two system drives for mirroring the OS partitions (RAID-1). This ensures data resiliency if one drive fails. If you want to enable mirroring, you need to enable it during the drive configuration of the Ubuntu installation. It cannot be enabled after the installation.

Data Drive RAID-0 or RAID-5

DGX systems are equipped with multiple data drives that can be configured as RAID-0 for performance or RAID-5 for resiliency. RAID-0 provides the maximum storage capacity and performance, but does not provide any redundancy. If a single SSD in the array fails, all data stored on the array is lost.

RAID-0 is recommended for data caching. You can use cachefilesd to provide caching for NFS shares. The network file system (NFS) is required to take advantage of the cache file system. RAID-5 should be used for persistent data storage.

You have the option to configure RAID and data caching after the initial Ubuntu installation using the nvidia-config-raid tool or during the Ubuntu installation. The nvidia-config-raid tool is recommended for manual installation.

Note: The DGX-1 uses a hardware RAID controller that cannot be configured during the Ubuntu installation. You can still use the nvidia-config-raid tool or change the configuration in the BIOS.
System Drive Encryption [optional]

Root filesystem encryption is a software-based method to protect the content stored in the system partition(s) from unauthorized access by encrypting the data on-the-fly. It requires users to unlock the filesystem on every boot, either manually by entering a passphrase or automatically using a centralized key server.

System drive encryption can only be enabled during the installation of Ubuntu.

Data Drive Encryption [optional]

Data drive encryption is only supported on the DGX A100 that is equipped with self-encrypting-drives (SED). It can be enabled after Ubuntu is installed using the `nv-encrypt` tool. It requires either to store the keys in the TPM or external key-management.

System Drive Partitioning

Ubuntu uses only a single partition for the entire filesystem by default. This can be configured during the Ubuntu installation for deployments that require a more faceted partition scheme for security reasons. The recommended partitioning scheme is to use only a single partition for the Linux root partition with the ext4 filesystem.
Chapter 4. Installing Ubuntu

There are several methods for installing Ubuntu as described in the Ubuntu Server Guide. For convenience, this section provides additional instructions that are specific to DGX for installing Ubuntu following the Basic Installation. If you have a preferred method for installing Ubuntu, then you can skip this section.

Steps that are covered in this section:

‣ Connecting to the DGX system
‣ Booting from the install media
‣ Running the Ubuntu installer (including network and storage configuration steps)

4.1. Connecting to the DGX System

During the initial installation and configuration steps, you need to connect to the console of the DGX system. There are several ways to connect to the DGX system, such as through a virtual KVM (keyboard, video, and mouse) using the BMC, or a direct connection with a local monitor and keyboard. Refer to the user guide for a list of supported connection methods and the specific product instructions.

‣ DGX A100 User Guide
‣ DGX -2 USer Guide
‣ DGX-1 User Guide

4.2. Booting from the Installation Media

Boot the Ubuntu ISO image in one of the following ways:

‣ Remotely through the BMC for systems that provide a BMC.
  Refer to the Reimaging the System Remotely section in the corresponding DGX user guide listed above for instructions.
‣ Locally from a UEFI-bootable USB flash drive or DVD-ROM.
Refer to *Installing the DGX OS Image from a USB Flash Drive or DVD-ROM* section in the corresponding DGX user guide listed above for instructions.

### 4.3. Running the Ubuntu Installer

After booting the ISO image, the Ubuntu installer should start and guide you through the installation process.

**Note:** The screenshots in the following steps are taken from a DGX A100. Other DGX systems have differences in drive partitioning and networking.

During the boot process of the ISO image, you might see some error messages due to older drivers, etc. They can be safely ignored.

1. Select your language at the welcome screen, then follow the instructions to select whether to update the installer (if offered) and to choose your keyboard.
2. At the **Network connections** screen, configure your network.

The installer tries to automatically retrieve a DHCP address for all network interfaces, so you should be able to continue without any changes. However, you also have the option to manually configure the interface(s).

3. At the **Guided storage configuration** screen, configure the partitioning and file systems.

All DGX systems are shipped preinstalled with DGX OS. The drives are, therefore, already partitioned and formatted. DGX OS installer configures a single ext4 partition for the root partition in addition to the EFI boot partition.

You have the following options:

- Keep the current partition layout and formatting [recommended]
- Create a custom partition scheme [advanced]
- Use a single disk with the default Ubuntu partition scheme

Creating a new custom partition scheme with a RAID configuration is a more involved process and out of the scope for this document. Refer to the Ubuntu installation guide for more information. When you choose the option to use an entire disk, Ubuntu will only use one of the two redundant boot drives.

**Note:** The RAID level for the data drive can be changed after the installation of Ubuntu.

The following instructions describe the steps for keeping the current partition layout. It still requires you to re-create and reformat the partitions.

**Note:** DGX-1 is using a hardware RAID controller and the RAID membership can only be configured in the RAID controller BIOS. The default configuration consists of two virtual devices:

- The first virtual device (sda) is a single disk and used as the system drive
- Second virtual device (sdb) consists of the rest of the disks for data.
a). Select **Custom storage layout**, then click **Done**.

![Custom storage layout](image)

b). Identify the system drive.

The system drive on the DGX-2 and DGX A100 is a RAID 1 array and you should find it easily. The DGX-1 has a hardware RAID controller and you will see a single drive as sda.

c). Select the system drive and then click **Format**.

![Format](image)

d). Set Format to **ext4** (do not select “Leave formatted as <filesystem>”).
e). Set Mount to "/":

f). Set the boot flag on the raw devices.

Identify the system drives under AVAILABLE DEVICES (not the RAID array) and select “Use as Boot Device” for the first device. On DGX-2 and DGX A100 that have two drives, repeat this process for the second drive and select “Use as another Boot Device”.
g). Complete the configuration.

- **RAID 0 Array**: In most cases, the RAID 0 array for the data drives will have already been created from the factory. If it hasn’t been created you can either create them in the Storage configurations dialog or by using the `config_raid_array` tool after completing the Ubuntu installation.

- **(Optional) Enable drive encryption**: Note that encryption can only be enabled during the Storage configuration. It cannot be changed after the installation. To change the encryption state again you need to reinstall the OS. To enable drive encryption, you have to create a virtual group and volume. This is out of the scope for this document. Please refer to the Ubuntu documentation for more details.

- **Swap Partition**: The default installation does not define a swap partition. Linux uses any configured swap partition for temporarily storing data when the system memory is full, incurring a performance hit. With the large memory of DGX systems swapping is not recommended.

The “FILE SYSTEM SUMMARY” at the top of the page should display the root partition on the RAID 1 drive for and a boot/efi partition (the two drives will only show up as a single entry). On DGX-1 with the hardware RAID controller, it will show the root partition on sda.
Select **Done** and accept all changes.

4. Follow the instructions for the remaining tasks.

   Create a default user in the *Profile setup* dialog and choose any additional SNAP package you want to install in the *Featured Server Snaps* screen.

5. Wait for the installation to complete.

   Log messages are presented while the installation is running.

6. Select **Reboot Now** when the installation is complete to restart the system.

   After reboot, you can log in using the username and password for the user you have created above.

When using LVM, Ubuntu’s default partitioning scheme, DGX-2 users may run into [https://bugs.launchpad.net/ubuntu/+source/lvm2/+bug/1834250](https://bugs.launchpad.net/ubuntu/+source/lvm2/+bug/1834250). The “/dev/sda: open failed: No medium found” messages are harmless, and can be avoided by updating `/etc/lvm/lvm.conf` with the following filter: "global_filter = ["r|/dev/sda"]": ```
Chapter 5. Installing the DGX Software Stack

This section requires that you have already installed Ubuntu on the DGX and rebooted the system.

ATTENTION:

By installing the DGX Software Stack you are confirming that you have read and agree to be bound by the DGX Software License Agreement. You are also confirming that you understand that any pre-release software and materials available that you elect to install in a DGX may not be fully functional, may contain errors or design flaws, and may have reduced or different security, privacy, availability, and reliability standards relative to commercial versions of NVIDIA software and materials, and that you use pre-release versions at your risk.

5.1. Installing DGX System Configurations and Tools

The NVIDIA DGX Software Stack includes system-specific configurations and tools to take advantage of the advanced DGX features. They are provided from NVIDIA repositories in the form of software packages that can be installed on top of a typical Ubuntu installation. All system-specific software components are bundled into meta packages specific to a system:

- system-configurations
- system-tools
- system-tools-ext

For details about the content of these packages, refer to the DGX OS Release Notes.

The following steps enable the NVIDIA repositories and install the system specific packages.

1. Enable the NVIDIA repositories by extracting the repository information and copy it to /etc/apt/.
   This adds the URIs and GPG keys for the NVIDIA repositories, and configures preferences to control the package versions that should be installed.
curl https://repo.download.nvidia.com/baseos/ubuntu/focal/dgx-repo-files.tgz | 
sudo tar xzf - -C /etc/apt

2. Update the internal APT database with the latest version information of all packages.
sudo apt update

3. **Recommended**: Upgrade all software packages with the latest versions.
sudo apt upgrade

4. Install the DGX system tools and configurations.
   - For DGX-1, install the DGX-1 configurations and DGX-1 system tools:
     sudo apt install -y dgx1-system-configurations dgx1-system-tools dgx1-system-tools-extra
   - For DGX-2, install the DGX-2 configurations and DGX-2 system tools:
     sudo apt install -y dgx2-system-configurations dgx2-system-tools dgx2-system-tools-extra
   - For DGX A100, install DGX A100 configurations and DGX A100 system tools:
     sudo apt install -y dgx-a100-system-configurations dgx-a100-system-tools dgx-a100-system-tools-extra

5. Disable the ondemand governor to set the governor to performance mode.
sudo systemctl disable ondemand

6. **Recommended**: Disable unattended upgrades.
Ubuntu periodically checks for security and other bug fixes and automatically installs updates software packages typically overnight. Because this may be disruptive, you should regularly check for updates and install them manually.
sudo apt purge -y unattended-upgrades

7. **Recommended**: Enable serial-over-lan console output.

```
Note: If you have boot drive encryption enabled, the prompt for entering the passphrase and input will be over the serial console if you install this package.
```
sudo apt install -y nvidia-ipmisol

8. **Optional**: Modify the logrotate policy to collect more logging information (but size-limited):
sudo apt install -y nvidia-logrotate
   The configuration changes will take effect only after rebooting the system. To minimize extra reboots, you can defer this step until after the drivers have been installed later in this document.

### 5.2. Configuring Data Drives

The data drives in the DGX systems can be configured as RAID 0 or RAID 5. RAID 0 provides the maximum storage capacity and performance, but does not provide any redundancy.

RAID 0 is often used for data caching. You can use cachefilesd to provide a cache for NFS shares.

```
Important: You can change the RAID level later but this will destroy the data on those drives.
```
Except for the DGX-1, the RAID configuration can be configured during the Ubuntu installations. If you have already configured the RAID array during the Ubuntu installation, you can skip the first step and go to step 2.

1. **Configure the /raid partition.**
   
   All DGX systems support RAID 0 and RAID 5 arrays.
   
   ▪ To create a RAID 0 array:
     ```
     sudo /usr/bin/configure_raid_array.py -c -f
     ```
   
   ▪ To create a RAID 5 array:
     ```
     sudo /usr/bin/configure_raid_array.py -c -f -5
     ```
   
   The command creates the /raid mount point and RAID array, and adds a corresponding entry in /etc/fstab.

2. **Optional**: Install tools for managing the self-encrypting drives (SED) for the data drives on the DGX A100.
   
   This requires to store the keys in the TPM or use external key servers. Refer to the “Managing Self-Encrypting Drives” section in the [DGX A100 User Guide](#) for usage information.
   
   a). Install the `nv-disk-encrypt` package.
     ```
     sudo apt install -y nv-disk-encrypt
     ```
   
   b). Reboot the system.
     ```
     sudo reboot
     ```

3. **Optional**: If you wish to use your RAID array for read caching of NFS mounts, you can install `cachefilesd` and set the cachefs option for an NFS share.
   
   a). Install `cachefilesd` and `nvidia-conf-cachefilesd`.
     ```
     sudo apt install -y cachefilesd nvidia-conf-cachefilesd
     ```
   
   b). Enable caching on all NFS shares you want to cache by setting the `fsc` flag.
     ```
     Edit /etc/fstab and add the `fsc` flag to the mount options as shown in this example.
     ```
     ```
     <nfs_server>:<export_path> /mnt nfs
     rw,noatime,rsize=32768,wsize=32768,nolock,tcp,intr,fsc,nofail 0 0
     ```
   
   c). Mount the NFS share.
     ```
     If the share is already mounted, use the remount option.
     ```
     ```
     mount <mount-point> -o,remount
     ```
   
   d). To validate that caching is enabled, issue the following.
     ```
     cat /proc/fs/nfsfs/volumes
     ```
     Look for the text `FSC=yes` in the output of the command. The NFS will be mounted with caching enabled upon subsequent reboot cycles.

### 5.3. Installing NVIDIA CUDA Drivers
You have the option to choose between different NVIDIA CUDA driver releases for your DGX system. The latest driver release includes new features but might not provide the same support duration as an older release.

Consult the Data Center Driver Release Notes for more details and the minimum required driver release for the GPU architecture.

Use the following command to display a list of installed drivers.

1. Ensure to have the latest version of the package database.
   ```bash
   sudo apt update
   ```

2. Display a list of all available drivers.
   ```bash
   sudo apt list nvidia-driver*server
   ```
   Example Output:
   ```plaintext
   nvidia-driver-418-server/focal-updates,focal-security 418.226.00-0ubuntu0.20.04.2 amd64
   nvidia-driver-440-server/focal-updates,focal-security 450.156.00-0ubuntu0.20.04.2 amd64
   . . .
   ```

The following steps install the NVIDIA CUDA driver and configure the system. Replace the release version used as an example (450) with the release you want to install. Ensure that the driver release you intend to install is supported by the GPU in the system.

3. Ensure to have the latest version of the package database.
   ```bash
   sudo apt update
   ```

4. Ensure you have the latest kernel version installed.
   The driver package has a dependency to the kernel and updating the database might have updated the version information.
   ```bash
   sudo apt install -y linux-generic
   ```

5. Install NVIDIA CUDA driver.
   ❯ For non-NVswitch systems like DGX-1:
     ```bash
     sudo apt install -y nvidia-driver-470-server linux-modules-nvidia-470-server-generic libnvidia-nscq-470 nvidia-modprobe datacenter-gpu-manager nv-persistence-mode
     ```
   ❯ For NVswitch systems like DGX-2 and DGX A100, be sure to also install the fabric-manager package:
     ```bash
     ```

6. Enable the persisted daemon and other services:
   ❯ For non-NVswitch systems, such as DGX-1:
     ```bash
     sudo systemctl enable nvidia-persistenced nvidia-dcgm
     ```
   ❯ For NVswitch systems like DGX-2 and DGX A100, be sure to also enable the NVIDIA fabric manager service:
     ```bash
     sudo systemctl enable nvidia-fabricmanager nvidia-persistenced nvidia-dcgm
     ```

7. Reboot the system to load the drivers and to update system configurations.
   a). Issue reboot.
   ```bash
   sudo reboot
   ```
b). After the system has rebooted, verify that the drivers have been loaded and are handling the NVIDIA devices.

```bash
nvidia-smi
```

The output should show all available GPUs and show the Persistence-Mode `On`:

```
+-----------------------------------------------------------------------------
| NVIDIA-SMI 450.119.04 Driver Version: 450.119.04 CUDA Version: 11.4          |
|----------------------------+----------------------+-----------------------|
| GPU Name      Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan Temp Perf Pwr:Usage/Cap| Memory-Usage | GPU-Util | Compute M. | MIG M. |
|============================+======================+=======================|
| 0 Tesla V100-SXM2...    On | 00000000:06:00.0 Off |                     0 |
| N/A   35C  P0  42W / 300W |      0MiB / 16160MiB |   0%          Default |
|                            |                      |                   N/A |
|----------------------------+----------------------+-----------------------|
| 1 Tesla V100-SXM2...    On | 00000000:07:00.0 Off |                     0 |
| N/A   35C  P0  44W / 300W |      0MiB / 16160MiB |   0%          Default |
|                            |                      |                   N/A |
|----------------------------+----------------------+-----------------------|
| 7 Tesla V100-SXM2...    On | 00000000:8A:00.0 Off |                     0 |
| N/A   35C  P0  43W / 300W |      0MiB / 16160MiB |   0%          Default |
|                            |                      |                   N/A |
|----------------------------+----------------------+-----------------------|
```

5.4. Installing the Mellanox OpenFabrics Enterprise Distribution (MLNX_OFED)

DGX systems include high-performance network cards to connect to other systems over Infiniband or Ethernet. You have the option between the driver included in Ubuntu and the Mellanox OpenFabrics Enterprise Distribution (Mellanox OFED or MOFED). MOFED provides the necessary drivers and system software required for multi-node GPU applications, allowing the system to transfer data between GPUs of different systems directly (RDMA) without having to copy the data to the system memory. This also requires the nv-peer-memory module.

The following steps install MOFED and all the required additional software.

1. Install the MOFED Driver
   ```bash
   sudo apt install -y mlnx-ofed-all nvidia-mlnx-ofed-misc
   ```
2. Enable and start the openibd service:
   ```bash
   sudo systemctl enable --now openibd
   ```
3. Enable nv-peer-mem. This service loads the peer-mem module on every boot.
   ```bash
   sudo update-rc.d nv_peer_mem defaults
   ```
5.5. Installing Docker and the NVIDIA Container Toolkit

Containers provide isolated environments with a full filesystem of the required software for specific applications. To use the NVIDIA provided containers for AI and other frameworks on the DGX and GPUs, you need to install Docker and the NVIDIA Container Toolkit. It takes care of providing access to the GPUs to the software running inside the container.

Note that these tools are also required by the Firmware Update Containers for upgrading the system firmware.

1. Install docker-ce, NVIDIA Container Toolkit, and optimizations for typical DL workload.
   ```bash
   sudo apt install -y docker-ce nvidia-container-toolkit nv-docker-options
   ```
2. Restart the docker daemon.
   ```bash
   sudo systemct1 restart docker
   ```

To validate the installation, run a container and check that it can access the GPUs. The following instructions assume that the NVIDIA GPU driver has been installed and loaded.

See the section Running Containers for more information about this command. For a description of nvcr.io, see the NGC Registry Spaces documentation.

---

**Note:** This validation downloads a container from the NGC registry and requires that the system has internet access.

1. Execute the following command start a container and run the nvidia-smi tool inside the container:
   ```bash
   sudo docker run --gpus=all --rm nvcr.io/nvidia/cuda:11.0-base nvidia-smi
   ```

**Example Output**

```
| NVIDIA-SMI 450.102.04 Driver Version: 450.102.04 CUDA Version: 11.0     |
|-----------------+---------------------+---------------------+---------------------|
| GPU       Name     Persistence-M | Bus-Id        Memory-Usage | GPU-Util  Compute M. |
| Fan  Temp  Perf  Pwr:Usage/Cap |         Memory-Usage |               MIG M. |
|-----------------+---------------------+---------------------+---------------------|
|   0  Tesla V100-SXM2...  On   | 00000000:06:00.0 Off |                    0 |
| N/A   35C    P0    42W / 300W |      0MiB / 16160MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+---------------------+---------------------+---------------------|
|   1  Tesla V100-SXM2...  On   | 00000000:07:00.0 Off |                    0 |
| N/A   35C    P0    44W / 300W |      0MiB / 16160MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+---------------------+---------------------+---------------------|
|   7  Tesla V100-SXM2...  On   | 00000000:08A:00.0 Off |                    0 |
| N/A   35C    P0    43W / 300W |      0MiB / 16160MiB |      0%      Default |
```
```
2. Verify that the output shows all available GPUs and has Persistence-Mode set to On.

5.6. Installing the NVIDIA System Management (NVSM) Tool [Recommended]

The NVIDIA System Management (NVSM) is a software framework for monitoring NVIDIA DGX nodes in a data center. It allows customers to get a quick health report of the system and is typically required by the NVIDIA support team to resolve issues.

The following steps install and configure NVSM.

1. Install the NVIDIA System Management tool (NVSM):
   ```
   sudo apt install -y nvsm
   ```

2. Optional: Modify message-of-the-day (MOTD) to display NVSM health monitoring alerts and release information.
   ```
   sudo apt install -y nvidia-motd
   ```
Chapter 6. Installing Additional Software

The Ubuntu and the NVIDIA repositories provide many additional software packages for a variety of applications. The DGX OS Installer, for example, installs several additional software packages to aid system administration and developers that are not installed by default.

The following steps install the additional software packages that get installed by the DGX OS Installer:

1. Install additional software for system administration tasks:
   
   ```
   sudo apt install -y chrpath cifs-utils fping iperf ipmitool lsscsi net-tools nfs-common quota rasdaemon pm-utils samba-common samba-libs sysstat vlan
   ```

2. Install additional software for development tasks:
   
   ```
   sudo apt install -y build-essential automake bison cmake dpatch flex gcc-multilib gdb g++-multilib libelf-dev libltdl-dev linux-tools-generic m4 swig
   ```

The NVIDIA CUDA Developer repository provides an easy mechanism to deploy NVIDIA tools and libraries, such as the CUDA toolkit, cuDNN, or NCCL.

Refer also to Installing Additional Software for more information about installing and upgrading software packages.
For further installation and configuration options, refer also to these chapters in the DGX OS 5 User Guide that are also applicable to the DGX Software Stack installation method:

- Network Configuration
- Additional Features and Instructions
- Data Storage Configuration
- Running NGC Containers
- Installing the Software on Air-Gapped DGX Systems
Appendix A. Third-Party License Notices

This NVIDIA product contains third party software that is being made available to you under their respective open source software licenses. Some of those licenses also require specific legal information to be included in the product. This section provides such information.

A.1. Mellanox (OFED)
MLNX OFED [http://www.mellanox.com/] is provided under the following terms:

Copyright (c) 2006 Mellanox Technologies.
All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Concept definition.

A.2. msecli
The msecli utility is provided under the following terms:

Micron Technology, Inc. Software License Agreement
PLEASE READ THIS LICENSE AGREEMENT ("AGREEMENT") FROM MICRON TECHNOLOGY, INC. ("MTI") CAREFULLY: BY INSTALLING, COPYING OR OTHERWISE USING THIS SOFTWARE AND ANY RELATED PRINTED MATERIALS ("SOFTWARE"), YOU ARE ACCEPTING AND AGREEING TO THE TERMS OF THIS AGREEMENT. IF YOU DONOT AGREE WITH THE TERMS OF THIS AGREEMENT, DO NOT INSTALL THE SOFTWARE. LICENSE: MTI hereby grants to you the following rights: You may use and make one
(1) backup copy the Software subject to the terms of this Agreement. You must maintain all copyright notices on all copies of the Software. You agree not to modify, adapt, decompile, reverse engineer, disassemble, or otherwise translate the Software. MTI may make changes to the Software at any time without notice to you. In addition MTI is under no obligation whatsoever to update, maintain, or provide new versions or other support for the Software.

OWNERSHIP OF MATERIALS: You acknowledge and agree that the Software is proprietary property of MTI (and/or its licensors) and is protected by United States copyright law and international treaty provisions. Except as expressly provided herein, MTI does not grant any express or implied right to you under any patents, copyrights, trademarks, or trade secret information. You further acknowledge and agree that all right, title, and interest in and to the Software, including associated proprietary rights, are and shall remain with MTI (and/or its licensors). This Agreement does not convey to you an interest in or to the Software, but only a limited right to use and copy the Software in accordance with the terms of this Agreement. The Software is licensed to you and not sold.

DISCLAIMER OF WARRANTY: THE SOFTWARE IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND. MTI EXPRESSLY DISCLAIMS ALL WARRANTIES EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, NONINFRINGEMENT OF THIRD PARTY RIGHTS, AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. MTI DOES NOT WARRANT THAT THE SOFTWARE WILL MEET YOUR REQUIREMENTS, OR THAT THE OPERATION OF THE SOFTWARE WILL BE UNINTERRUPTED OR ERROR-FREE. FURTHERMORE, MTI DOES NOT MAKE ANY REPRESENTATIONS REGARDING THE USE OR THE RESULTS OF THE USE OF THE SOFTWARE IN TERMS OF ITS CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. THE ENTIRE RISK ARISING OUT OF USE OR PERFORMANCE OF THE SOFTWARE REMAINS WITH YOU. IN NO EVENT SHALL MTI, ITS AFFILIATED COMPANIES OR THEIR SUPPLIERS BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, INCIDENTAL, OR SPECIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF YOUR USE OF OR INABILITY TO USE THE SOFTWARE, EVEN IF MTI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Because some jurisdictions prohibit the exclusion or limitation of liability for consequential or incidental damages, the above limitation may not apply to you.

TERMINATION OF THIS LICENSE: MTI may terminate this license at any time if you are in breach of any of the terms of this Agreement. Upon termination, you will immediately destroy all copies the Software.

GENERAL: This Agreement constitutes the entire agreement between MTI and you regarding the subject matter hereof and supersedes all previous oral or written communications between the parties. This Agreement shall be governed by the laws of the State of Idaho without regard to its conflict of laws rules.

CONTACT: If you have any questions about the terms of this Agreement, please contact MTI's legal department at (208) 368-4500. By proceeding with the installation of the Software, you agree to the terms of this Agreement. You must agree to the terms in order to install and use the Software.
Notice

This document is provided for information purposes only and shall not be regarded as a warranty of a certain functionality, condition, or quality of a product. NVIDIA Corporation ("NVIDIA") makes no representations or warranties, expressed or implied, as to the accuracy or completeness of the information contained in this document and assumes no responsibility for any errors contained herein. NVIDIA shall have no liability for the consequences or use of such information or for any infringement of patents or other rights of third parties that may result from its use. This document is not a commitment to develop, release, or deliver any Material (defined below), code, or functionality.

NVIDIA reserves the right to make corrections, modifications, enhancements, improvements, and any other changes to this document, at any time without notice.

Customer should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

NVIDIA products are sold subject to the NVIDIA standard terms and conditions of sale supplied at the time of order acknowledgement, unless otherwise agreed in an individual sales agreement signed by authorized representatives of NVIDIA and customer ("Terms of Sale"). NVIDIA hereby expressly objects to applying any customer general terms and conditions with regards to the purchase of the NVIDIA product referenced in this document. No contractual obligations are formed either directly or indirectly by this document.

NVIDIA products are not designed, authorized, or warranted to be suitable for use in medical, military, aircraft, space, or life support equipment, nor in applications where failure or malfunction of the NVIDIA product can reasonably be expected to result in personal injury, death, or property or environmental damage. NVIDIA accepts no liability for inclusion and/or use of NVIDIA products in such equipment or applications and therefore such inclusion and/or use is at customer’s own risk.

NVIDIA makes no representation or warranty that products based on this document will be suitable for any specified use. Testing of all parameters of each product is not necessarily performed by NVIDIA. It is customer’s sole responsibility to evaluate and determine the applicability of any information contained in this document, ensure the product is suitable and fit for the application planned by customer, and perform the necessary testing for the application in order to avoid a default of the application or the product. Weaknesses in customer’s product designs may affect the quality and reliability of the NVIDIA product and may result in additional or different conditions and/or requirements beyond those contained in this document. NVIDIA accepts no liability related to any default, damage, costs, or problem which may be based on or attributable to: (i) the use of the NVIDIA product in any manner that is contrary to this document or (ii) customer product designs.

No license, either expressed or implied, is granted under any NVIDIA patent right, copyright, or other NVIDIA intellectual property right under this document. Information published by NVIDIA regarding third-party products or services does not constitute a license from NVIDIA to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property rights of the third party, or a license from NVIDIA under the patents or other intellectual property rights of NVIDIA.

Reproduction of information in this document is permissible only if approved in advance by NVIDIA in writing, reproduced without alteration and in full compliance with all applicable export laws and regulations, and accompanied by all associated conditions, limitations, and notices.

THIS DOCUMENT AND ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS [TOGETHER AND SEPARATELY, "MATERIALS"] ARE BEING PROVIDED "AS IS." NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY, OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL NVIDIA BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF ANY USE OF THIS DOCUMENT, EVEN IF NVIDIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Notwithstanding any damages that customer might incur for any reason whatsoever, NVIDIA’s aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms of Sale for the product.

VESA DisplayPort

DisplayPort and DisplayPort Compliance Logo, DisplayPort Compliance Logo for Dual-mode Sources, and DisplayPort Compliance Logo for Active Cables are trademarks owned by the Video Electronics Standards Association in the United States and other countries.

HDMI

HDMI, the HDMI logo, and High-Definition Multimedia Interface are trademarks or registered trademarks of HDMI Licensing LLC.

OpenCL

OpenCL is a trademark of Apple Inc. used under license to the Khronos Group Inc.

Trademarks

NVIDIA, the NVIDIA logo, DGX, DGX-1, DGX-2, DGX A100, DGX Station, and DGX Station A100 are trademarks and/or registered trademarks of NVIDIA Corporation in the United States and other countries. Other company and product names may be trademarks of the respective companies with which they are associated.

Copyright

© 2022 NVIDIA Corporation. All rights reserved.