NVIDIA Data Center GPU Driver version 470.103.01 (Linux) / 472.98 (Windows)

Release Notes

RN-08625-470 _v3.0 | January 2022

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Chapter 1. Version Highlights

This section provides highlights of the NVIDIA Data Center GPU R470 Driver (version 470.103.01 Linux and 472.98 Windows).

For changes related to the 470 release of the NVIDIA display driver, review the file "NVIDIA_Changelog" available in the .run installer packages.

- Linux driver release date: 1/31/2022
- Windows driver release date: 1/31/2022

1.1. Software Versions

For this release, the software versions are listed below.

- CUDA Toolkit 11: 11.4

  Note that starting with CUDA 11, individual components of the toolkit are versioned independently. For a full list of the individual versioned components (e.g. nvcc, CUDA libraries etc.), see the CUDA Toolkit Release Notes
- NVIDIA Data Center GPU Driver: 470.103.01 (Linux) / 472.98 (Windows)
- Fabric Manager: 470.103.01 (Use `nv-fabricmanager -v`)
- GPU VBIOS:
  - 92.00.19.00.01 (NVIDIA A100 SKU200 with heatsink for HGX A100 8-way and 4-way)
  - 92.00.19.00.02 (NVIDIA A100 SKU202 w/o heatsink for HGX A100 4-way)
- NVSwitch VBIOS: 92.10.14.00.01
- NVFlash: 5.641

Due to a revision lock between the VBIOS and driver, VBIOS versions >= 92.00.18.00.00 must use corresponding drivers >= 450.36.01. Older VBIOS versions will work with newer drivers.

For more information on getting started with the NVIDIA Fabric Manager on NVSwitch-based systems (for example, HGX A100), refer to the Fabric Manager User Guide.

1.2. New Features

General

- Added support for the following NVIDIA GPU products:
  - NVIDIA A16
  - NVIDIA A100 80 GB PCIe
- Enabled new MIG profiles for the NVIDIA A30 where each of the 4 partitions has double the memory, 6GB up from 3GB per partition slice. See the MIG Device Names section of the NVIDIA MIG User Guide.
- This release includes support for OpenCL 3.0

  Maintains backward compatibility with OpenCL 1.2. NVIDIA OpenCL 3.0 continues to support existing OpenCL 1.2 functionality as well as Khronos and vendor extensions that are already supported with NVIDIA OpenCL 1.2 drivers. The following new features beyond existing NVIDIA OpenCL 1.2 features are supported by NVIDIA OpenCL 3.0
  - RGBA vector component naming in OpenCL C kernels
  - pragma_unroll hint
  - opencl_3d_image_writes
  - clCreate*WithProperties APIs which can be used as replacement for existing clCreateBuffer/Image APIs.
  - clSetContextDestructorCallback
  - clCloneKernel from OpenCL 2.1
  - clEnqueueSVMMigrateMem from OpenCL 2.1
  - Incorporates the experimental 2.0 Device side enqueue

    The current implementation is limited to 64-bit platforms only, Allows kernels to be enqueued with global_work_size larger than the compute capability of the NVIDIA GPU. The current implementation supports only combinations of global_work_size and local_work_size that are within the compute capability of the NVIDIA GPU.

    The maximum supported CUDA grid and block size of NVIDIA GPUs is available at http://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html#compute-capabilities. For a given grid dimension, the global_work_size can be determined by CUDA grid size x CUDA block size.

    For executing kernels (whether from the host or the device), OpenCL 3.0 supports non-uniform ND-ranges where global_work_size does not need to be divisible by the

local_work_size. This capability is not yet supported in the NVIDIA driver, and therefore not supported for device side kernel enqueues.

Note: Other OpenCL 2.X entry-points which are now optional and are not supported in NVIDIA OpenCL 3.0 will behave as described at https://www.khronos.org/registry/OpenCL/specs/3.0-unified/html/OpenCL_API.html#opencl-3.0-backwards-compatibility

1.3. Fixed Issues

- **Security updates**: See *Security Bulletin: NVIDIA GPU Display Driver - February 2022*, which is posted shortly after the release date of this driver and will be listed on the NVIDIA Product Security page.

1.4. Known Issues

General

- `nvidia-release-upgrade` may report that not all updates have been installed and exit.

  When running the `nvidia-release-upgrade` command on DGX systems running DGX OS 4.99.x, it may exit and tell users: "Please install all available updates for your release before upgrading" even though all upgrades have been installed.

  Users who see this can run the following command:

  ```
  sudo apt install -y nvidia-fabricmanager-450/bionic-updates --allow-downgrades
  ```

  After running this, proceed with the regular upgrade steps:

  ```
  sudo apt update
  sudo apt full-upgrade -y
  sudo apt install -y nvidia-release-upgrade
  sudo nvidia-release-upgrade
  ```

- By default, Fabric Manager runs as a systemd service. If using `DAEMONIZE=0` in the Fabric Manager configuration file, then the following steps may be required.

  1. Disable FM service from auto starting. (`systemctl disable nvidia-fabricmanager`)
  2. Once the system is booted, manually start FM process. (`/usr/bin/nv-fabricmanager -c /usr/share/nvidia/nvswitch/fabricmanager.cfg`). Note, since the process is not a daemon, the SSH/Shell prompt will not be returned (use another SSH shell for other activities or run FM as a background task).

- On NVSwitch systems with Windows Server 2019 in shared NVSwitch virtualization mode, the host may hang or crash when a GPU is disabled in the guest VM. This issue is under investigation.

GPU Performance Counters

The use of developer tools from NVIDIA that access various performance counters requires administrator privileges. See this note for more details. For example, reading NVLink utilization metrics from `nvidia-smi (nvidia-smi nvlink -g 0)` would require administrator privileges.

NoScanout Mode

NoScanout mode is no longer supported on NVIDIA Data Center GPU products. If NoScanout mode was previously used, then the following line in the "screen" section of /etc/X11/xorg.conf should be removed to ensure that X server starts on data center products:

```
Option         "UseDisplayDevice" "None"
```

NVIDIA Data Center GPU products now support one display of up to 4K resolution.

Unified Memory Support

Some Unified Memory APIs (for example, CPU page faults) are not supported on Windows in this version of the driver. Review the CUDA Programming Guide on the system requirements for Unified Memory

CUDA and unified memory is not supported when used with Linux power management states S3/S4.

IMPU FRU for Volta GPUs

The driver does not support the IPMI FRU multi-record information structure for NVLink. See the Design Guide for Tesla P100 and Tesla V100-SXM2 for more information.

OpenCL 3.0 Known Issues

- Device-Side-Enqueue related queries may return 0 values, although corresponding built-ins can be safely used by kernel. This is in accordance with conformance requirements described at https://www.khronos.org/registry/OpenCL/specs/3.0-unified/html/OpenCL_API.html#opencl-3.0-backwardscompatibility
- Shared virtual memory - the current implementation of shared virtual memory is limited to 64-bit platforms only.

Chapter 2. Virtualization

To make use of GPU passthrough with virtual machines running Windows and Linux, the hardware platform must support the following features:

- A CPU with hardware-assisted instruction set virtualization: Intel VT-x or AMD-V.
- Platform support for I/O DMA remapping.
- On Intel platforms the DMA remapper technology is called Intel VT-d.
- On AMD platforms it is called AMD IOMMU.

Support for these features varies by processor family, product, and system, and should be verified at the manufacturer's website.

Supported Hypervisors

The following hypervisors are supported:

Hypervisor	Notes
Citrix XenServer	Version 6.0 and later
VMware vSphere (ESX / ESXi)	Version 5.1 and later.
Red Hat KVM	Red Hat Enterprise Linux 7 with KVM
Microsoft Hyper-V	Windows Server 2016 Hyper-V Generation 2

Tesla products now support one display of up to 4K resolution.

Supported Graphics Cards

The following GPUs are supported for device passthrough:

GPU Family	Boards Supported
NVIDIA Ampere GPU Architecture	NVIDIA A100, A40, A30, A16, A10
Turing	NVIDIA T4
Volta	NVIDIA V100
Pascal	Tesla: P100, P40, P4

GPU Family	Boards Supported
Maxwell	Tesla: M60, M40, M6, M4
Kepler	Tesla: K520, K80

Chapter 3. Hardware and Software Support

Support for these features varies by processor family, product, and system, and should be verified at the manufacturer's website.

Supported Operating Systems for NVIDIA Data Center GPUs

The Release 470 driver is supported on the following operating systems:

- Windows x86_64 operating systems:
  - Microsoft Windows® Server 2022
  - Microsoft Windows® Server 2019
  - Microsoft Windows® Server 2016
  - Microsoft Windows® 11
  - Microsoft Windows® 10
- The table below summarizes the supported Linux 64-bit distributions. For a complete list of distributions, kernel versions supported, see the CUDA Linux System Requirements documentation.

Distribution	x86_64	POWER	Arm64 Server
OpenSUSE Leap 15.x (where y <= 3)	Yes	No	No
Red Hat Enterprise Linux / CentOS 8.y (where y <= 5)	Yes	Yes	Yes
Red Hat Enterprise Linux / CentOS 7.y (where y <= 9)	Yes	No	No
SUSE Linux Enterprise Server 15.x (where y <= 3)	Yes	No	Yes (see note)
Ubuntu 20.04 LTS	Yes	No	Yes

Distribution	x86_64	POWER	Arm64 Server
Ubuntu 18.04.z LTS (where z <= 6)	Yes	No	No

Note that SUSE Linux Enterprise Server (SLES) 15.3 is provided as a preview for Arm64 server since there are known issues when running some CUDA applications related to dependencies on `glibc 2.27`.

Supported Operating Systems and CPU Configurations for HGX A100

The Release 470 driver is validated with HGX A100 on the following operating systems and CPU configurations:

- Linux 64-bit distributions:
  - Red Hat Enterprise Linux 8.5 (in 4/8/16-GPU configurations)
  - Red Hat Enterprise Linux 7.9 (in 4/8/16-GPU configurations)
  - CentOS Linux 8.5 (in 4/8/16-GPU configurations)
  - CentOS Linux 7.9 (in 4/8/16-GPU configurations)
  - Ubuntu 18.04.6 LTS (in 4/8/16-GPU configurations)
  - SUSE SLES 15.3 (in 4/8/16-GPU configurations)
- CPU Configurations:
  - AMD Rome in PCIe Gen4 mode
  - Intel Skylake/Cascade Lake (4-socket) in PCIe Gen3 mode

Supported Virtualization Configurations

The Release 470 driver is validated with HGX A100 on the following configurations:

- Passthrough (full visibility of GPUs and NVSwitches to guest VMs):
  - 8-GPU configurations with Ubuntu 18.04.4 LTS
- Shared NVSwitch (guest VMs only have visibility of GPUs and full NVLink bandwidth between GPUs in the same guest VM):
  - 16-GPU configurations with Ubuntu 18.04.4 LTS
  - 1/2/4/8-GPU configurations with Windows x86_64 operating systems:
    - Microsoft Windows® Server 2019
    - Microsoft Windows® Server 2016
    - Microsoft Windows® 10

API Support

This release supports the following APIs:

- NVIDIA® CUDA® 11.4 for NVIDIA® Kepler™, Maxwell™, Pascal™, Volta™, Turing™ and NVIDIA Ampere architecture GPUs
- OpenGL® 4.6
- Vulkan® 1.2
- DirectX 11
- DirectX 12 (Windows 10)
- Open Computing Language (OpenCL™ software) 3.0

Note that for using graphics APIs on Windows (i.e. OpenGL, Vulkan, DirectX 11 and DirectX 12) or any WDDM 2.0+ based functionality on Data Center GPUs, vGPU is required. See the vGPU documentation for more information.

Supported NVIDIA Data Center GPUs

The NVIDIA Data Center GPU driver package is designed for systems that have one or more Data Center GPU products installed. This release of the driver supports CUDA C/C++ applications and libraries that rely on the CUDA C Runtime and/or CUDA Driver API.

ATTENTION: Release 470 will be the last driver branch to support Data Center GPUs based on the Kepler architecture. This includes discontinued support for the following compute capabilities:

- sm_30 (Kepler)
- sm_32 (Kepler)
- sm_35 (Kepler)
- sm_37 (Kepler)

For more information on GPU products and compute capability, see https://developer.nvidia.com/cuda-gpus.

NVIDIA Server Platforms	
Product	**Architecture**
NVIDIA HGX A100	A100 and NVSwitch
NVIDIA HGX-2	V100 and NVSwitch

RTX-Series / T-Series Products	
Product	**GPU Architecture**
NVIDIA RTX A6000	NVIDIA Ampere
NVIDIA RTX A5000	NVIDIA Ampere
NVIDIA RTX A4000	NVIDIA Ampere
Quadro RTX 8000	Turing

RTX-Series / T-Series Products	
Product	**GPU Architecture**
Quadro RTX 6000	Turing
NVIDIA T1000	Turing
NVIDIA T600	Turing
NVIDIA T400	Turing

Data Center A-Series Products	
Product	**GPU Architecture**
NVIDIA A100 NVIDIA A100 80 GB PCIe	NVIDIA Ampere
NVIDIA A40	NVIDIA Ampere
NVIDIA A30	NVIDIA Ampere
NVIDIA A16	NVIDIA Ampere
NVIDIA A10	NVIDIA Ampere

Data Center T-Series Products	
Product	**GPU Architecture**
NVIDIA T4	Turing

Data Center V-Series Products	
Product	**GPU Architecture**
NVIDIA V100	Volta

Data Center P-Series Products	
Product	**GPU Architecture**
NVIDIA Tesla P100	Pascal
NVIDIA Tesla P40	Pascal
NVIDIA Tesla P4	Pascal

Data Center K-Series Products	
Product	**GPU Architecture**
NVIDIA Tesla K520	Kepler
NVIDIA Tesla K80	Kepler

Data Center M-Class Products	
Product	**GPU Architecture**
NVIDIA Tesla M60	Maxwell
NVIDIA Tesla M40 24 GB	Maxwell
NVIDIA Tesla M40	Maxwell
NVIDIA Tesla M6	Maxwell
NVIDIA Tesla M4	Maxwell

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