



NVIDIA AI Enterprise

Release Notes

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Chapter 1. What's New in NVIDIA AI Enterprise

Changes in this release of NVIDIA AI Enterprise are as follows:

- ▶ New releases of the following software components of NVIDIA AI Enterprise
 - ▶ NVIDIA GPU Operator: 22.9.0
 - ▶ NVIDIA Network Operator: 1.3.0
 - ▶ NVIDIA vGPU software: 13.4

This release includes security updates for the NVIDIA Virtual GPU Manager and graphics driver for Linux- see *Security Bulletin: NVIDIA GPU Display Driver - August 2022*, which is listed on the [NVIDIA Product Security](#) page

- ▶ Miscellaneous bug fixes
- ▶ Withdrawal of support for VMware vSphere 6.7

Chapter 2. Supported Hardware and Software

NVIDIA GPUs:

- ▶ NVIDIA V100
- ▶ NVIDIA A100 PCIe 40GB
- ▶ NVIDIA A100 HGX 40GB
- ▶ NVIDIA A100 PCIe 80GB
- ▶ NVIDIA A100 HGX 80GB
- ▶ NVIDIA A40 (SR-IOV Mode Only)
- ▶ NVIDIA A30
- ▶ NVIDIA A10
- ▶ NVIDIA A16
- ▶ NVIDIA RTX A6000
- ▶ NVIDIA RTX A5000
- ▶ NVIDIA T4

[NVIDIA-certified systems](#) for NVIDIA GPU Cloud that support the supported NVIDIA GPUs and are also certified for use with VMware vSphere ESXi hypervisor

Multi-node scaling requires an ethernet NIC that supports RoCE. For best performance, NVIDIA recommends using an NVIDIA® Mellanox® ConnectX®-6 Dx and an NVIDIA A100 GPU in each VM used for multi-node scaling. Refer to the Sizing guide and the Multi-Node Training solution guide for further information.

Hypervisor software:

- ▶ VMware vSphere Hypervisor (ESXi) Enterprise Plus Edition 7.0 Update 3
- ▶ VMware vCenter Server 7.0 Update 3

Guest operating systems:

- ▶ Ubuntu 20.04 LTS
- ▶ Red Hat Enterprise Linux 8.4

2.1. NVIDIA AI Enterprise Software Components

Software Component	NVIDIA Release
NVIDIA vGPU Software	13.4 : <ul style="list-style-type: none"> ▶ Virtual GPU Manger: 470.141.05 ▶ Graphics Driver for Linux: 470.141.03
NVIDIA GPU Operator	22.9.0
NVIDIA Network Operator	1.3.0
TensorFlow 2	21.08-tf2-py3
TensorFlow 1	21.08-tf1-py3
PyTorch	21.08-py3
NVIDIA Triton Inference Server	21.08-py3 and 21.08-py3-sdk
NVIDIA TensorRT	21.08-py3
RAPIDS	21.08-cuda11.4-ubuntu20.04-py3.8-lws0.1.1

2.2. Switching the Mode of a GPU that Supports Multiple Display Modes

Some GPUs support displayless and display-enabled modes but must be used in NVIDIA AI Enterprise deployments in displayless mode.

The GPUs listed in the following table support multiple display modes. As shown in the table, some GPUs are supplied from the factory in displayless mode, but other GPUs are supplied in a display-enabled mode.

GPU	Mode as Supplied from the Factory
NVIDIA A40	Displayless
NVIDIA RTX A5000	Display enabled
NVIDIA RTX A6000	Display enabled

A GPU that is supplied from the factory in displayless mode, such as the NVIDIA A40 GPU, might be in a display-enabled mode if its mode has previously been changed.

To change the mode of a GPU that supports multiple display modes, use the `displaymodeselector` tool, which you can request from the [NVIDIA Display Mode Selector Tool](#) page on the NVIDIA Developer website.



Note:

Only the following GPUs support the `displaymodeselector` tool:

- ▶ NVIDIA A40
- ▶ NVIDIA RTX A5000
- ▶ NVIDIA RTX A6000

Other GPUs that support NVIDIA AI Enterprise do not support the `displaymodeselector` tool and, unless otherwise stated, do not require display mode switching.

2.3. Requirements for Using C-Series vCS vGPUs

Because C-Series vCS vGPUs have large BAR memory settings, using these vGPUs has some restrictions on VMware ESXi.

2.4. Requirements for Using vGPU on GPUs Requiring 64 GB or More of MMIO Space with Large-Memory VMs

Some GPUs require 64 GB or more of MMIO space. When a vGPU on a GPU that requires 64 GB or more of MMIO space is assigned to a VM with 32 GB or more of memory on ESXi, the VM's MMIO space must be increased to the amount of MMIO space that the GPU requires.

For more information, refer to:

- ▶ [VMware Knowledge Base Article: VMware vSphere VMDirectPath I/O: Requirements for Platforms and Devices \[2142307\]](#)
- ▶ [#unique_8](#)

For more information, refer to [VMware Knowledge Base Article: VMware vSphere VMDirectPath I/O: Requirements for Platforms and Devices \[2142307\]](#).

With ESXi 6.7 or later, no extra configuration is needed.

No extra configuration is needed.

The following table lists the GPUs that require 64 GB or more of MMIO space and the amount of MMIO space that each GPU requires.

2.5. Linux Only: Error Messages for Misconfigured GPUs Requiring Large MMIO Space

In a Linux VM, if the requirements for using C-Series vCS vGPUs or GPUs requiring large MMIO space in pass-through mode are not met, the following error messages are written to the VM's `dmesg` log during installation of the NVIDIA AI Enterprise graphics driver:

```
NVRM: BAR1 is 0M @ 0x0 (PCI:0000:02:02.0)
[ 90.823015] NVRM: The system BIOS may have misconfigured your GPU.
[ 90.823019] nvidia: probe of 0000:02:02.0 failed with error -1
[ 90.823031] NVRM: The NVIDIA probe routine failed for 1 device(s).
```

2.6. NVIDIA CUDA Toolkit Version Support

The releases in this release family of NVIDIA AI Enterprise support NVIDIA CUDA Toolkit 11.4.

To build a CUDA application, the system must have the NVIDIA CUDA Toolkit and the libraries required for linking. For details of the components of NVIDIA CUDA Toolkit, refer to [NVIDIA CUDA Toolkit Release Notes for CUDA 11.4](#).

To run a CUDA application, the system must have a CUDA-enabled GPU and an NVIDIA display driver that is compatible with the NVIDIA CUDA Toolkit release that was used to build the application. If the application relies on dynamic linking for libraries, the system must also have the correct version of these libraries.

For more information about NVIDIA CUDA Toolkit, refer to [CUDA Toolkit 11.4 Documentation](#).



Note:

If you are using NVIDIA AI Enterprise with CUDA on Linux, avoid conflicting installation methods by installing CUDA from a distribution-independent runfile package. Do not install CUDA from a distribution-specific RPM or Deb package.

To ensure that the NVIDIA AI Enterprise graphics driver is not overwritten when CUDA is installed, deselect the CUDA driver when selecting the CUDA components to install.

For more information, see [NVIDIA CUDA Installation Guide for Linux](#).

2.7. Support

is supported only on a subset of supported GPUs, VMware vSphere Hypervisor (ESXi) releases, and guest operating systems.

is supported on all supported GPUs, hypervisor software releases, and guest operating systems.



Note: vGPU migration is disabled for a VM for which any of the following NVIDIA CUDA Toolkit features is enabled:

- ▶ Unified memory
- ▶ Debuggers
- ▶ Profilers

Supported GPUs

- ▶ Tesla M6
- ▶ Tesla M10
- ▶ Tesla M60
- ▶ Tesla P4
- ▶ Tesla P6
- ▶ Tesla P40

Supported VMware vSphere Hypervisor (ESXi) Releases

Supported Guest OS Releases

Known Issues with Support

Use Case	Affected GPUs	Issue
Migration to or from a host running an NVIDIA AI Enterprise 11 release before 11.6	Tesla T4	#unique_12
<ul style="list-style-type: none"> ▶ Migration from a host running NVIDIA AI Enterprise 11.3 to a host running a different release ▶ Migration to a host running NVIDIA AI Enterprise 11.3 from a host running a different release 	Tesla T4	#unique_13
Migration from a host that is running a vGPU	▶ Tesla T4	#unique_14

Use Case	Affected GPUs	Issue
manager 11 release to a host that is running a vGPU manager 13 release.	<ul style="list-style-type: none"> ▶ Tesla V100 	
Migration to or from a host running an NVIDIA AI Enterprise 11 release	GPUs based on the NVIDIA Volta™ architecture	#unique_15
Migration to or from a host running an NVIDIA AI Enterprise 14 release	<ul style="list-style-type: none"> ▶ Tesla T4 ▶ Tesla V100 	#unique_16
Migration between hosts with different ECC memory configuration	All GPUs that support	Migration of VMs configured with vGPU stops before the migration is complete

Known Issues with vGPU Migration Support

Use Case	Affected GPUs	Issue
Migration between hosts with different ECC memory configuration	All GPUs that support vGPU migration	Migration of VMs configured with vGPU stops before the migration is complete

2.8. Multiple vGPU Support

To support applications and workloads that are compute or graphics intensive, multiple vGPUs can be added to a single VM. The assignment of more than one vGPU to a VM is supported only on a subset of vGPUs and VMware vSphere Hypervisor (ESXi) releases.

Supported vGPUs

Only Q-series vGPUs that are allocated all of the physical GPU's frame buffer are supported.

Only time-sliced vGPUs that are allocated all of the physical GPU's frame buffer are supported. MIG-backed vGPUs are **not** supported.



Note:

1. This type of vGPU cannot be assigned with other types of vGPU to the same VM.

Maximum vGPUs per VM

NVIDIA AI Enterprise supports up to a maximum of four vGPUs per VM on VMware vSphere Hypervisor (ESXi).

Supported Hypervisor Releases

Supported Hypervisor Releases

All hypervisors that support NVIDIA AI Enterprise are supported.

2.9. Peer-to-Peer CUDA Transfers over NVLink Support

Peer-to-peer CUDA transfers enable device memory between vGPUs on different GPUs that are assigned to the same VM to be accessed from within the CUDA kernels. NVLink is a high-bandwidth interconnect that enables fast communication between such vGPUs. Peer-to-Peer CUDA transfers over NVLink are supported only on a subset of vGPUs, VMware vSphere Hypervisor (ESXi) releases, and guest OS releases.

Supported vGPUs

Only Q-series vGPUs that are allocated all of the physical GPU's frame buffer on physical GPUs that support NVLink are supported.

Only time-sliced vGPUs that are allocated all of the physical GPU's frame buffer on physical GPUs that support NVLink are supported.

Supported Hypervisor Releases

Peer-to-Peer CUDA Transfers over NVLink are supported on all hypervisor releases that support the assignment of more than one vGPU to a VM. For details, see [Multiple vGPU Support](#).

Supported Guest OS Releases

Linux only. Peer-to-Peer CUDA Transfers over NVLink are **not** supported on Windows.

Limitations

- ▶ PCIe is not supported.
- ▶ SLI is not supported.

2.10. Unified Memory Support

Unified memory is a single memory address space that is accessible from any CPU or GPU in a system. It creates a pool of managed memory that is shared between the CPU and GPU to provide a simple way to allocate and access data that can be used by code running on any CPU

or GPU in the system. Unified memory is supported only on a subset of vGPUs and guest OS releases.



Note: Unified memory is disabled by default. If used, you must enable unified memory individually for each vGPU that requires it by setting a vGPU plugin parameter.

Supported vGPUs

Only Q-series vGPUs that are allocated all of the physical GPU's frame buffer on physical GPUs that support unified memory are supported.

Only time-sliced vGPUs that are allocated all of the physical GPU's frame buffer on physical GPUs that support unified memory are supported.

Supported Guest OS Releases

Linux only. Unified memory is **not** supported on Windows.

Limitations

- ▶ When unified memory is enabled for a VM, NVIDIA CUDA Toolkit profilers are disabled.

2.11. NVIDIA GPU Operator Support

NVIDIA GPU Operator simplifies the deployment of NVIDIA AI Enterprise with software container platforms on immutable operating systems. An immutable operating system does not allow the installation of the NVIDIA AI Enterprise graphics driver directly on the operating system. NVIDIA GPU Operator is supported only on specific combinations of VMware vSphere Hypervisor (ESXi) release, container platform, and guest OS release.

Chapter 3. Known Product Limitations

Known product limitations for this release of NVIDIA AI Enterprise are described in the following sections.

3.1. Issues occur when the channels allocated to a vGPU are exhausted

Description

Issues occur when the channels allocated to a vGPU are exhausted and the guest VM to which the vGPU is assigned fails to allocate a channel to the vGPU. A physical GPU has a fixed number of channels and the number of channels allocated to each vGPU is inversely proportional to the maximum number of vGPUs allowed on the physical GPU.

When the channels allocated to a vGPU are exhausted and the guest VM fails to allocate a channel, the following errors are reported on the hypervisor host or in an NVIDIA bug report:

```
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0): Guest attempted to
allocate channel above its max channel limit 0xfb
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0): VGPU message 6
failed, result code: 0x1a
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0):
0xc1d004a1, 0xff0e0000, 0xff0400fb, 0xc36f,
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0):          0x1,
0xff1fe314, 0xff1fe038, 0x100b6f000, 0x1000,
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0):
0x80000000, 0xff0e0200, 0x0, 0x0, (Not logged),
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0):          0x1, 0x0
Jun 26 08:01:25 srvxen06f vgpu-3[14276]: error: vmiop_log: (0x0): , 0x0
```

Workaround

Use a vGPU type with more frame buffer, thereby reducing the maximum number of vGPUs allowed on the physical GPU. As a result, the number of channels allocated to each vGPU is increased.

3.2. Total frame buffer for vGPUs is less than the total frame buffer on the physical GPU

Some of the physical GPU's frame buffer is used by the hypervisor on behalf of the VM for allocations that the guest OS would otherwise have made in its own frame buffer. The frame buffer used by the hypervisor is not available for vGPUs on the physical GPU. In NVIDIA vGPU deployments, frame buffer for the guest OS is reserved in advance, whereas in bare-metal deployments, frame buffer for the guest OS is reserved on the basis of the runtime needs of applications.

If error-correcting code (ECC) memory is enabled on a physical GPU that does not have HBM2 memory, the amount of frame buffer that is usable by vGPUs is further reduced. All types of vGPU are affected, not just vGPUs that support ECC memory.

On all GPUs that support ECC memory and, therefore, dynamic page retirement, additional frame buffer is allocated for dynamic page retirement. The amount that is allocated is inversely proportional to the maximum number of vGPUs per physical GPU. All GPUs that support ECC memory are affected, even GPUs that have HBM2 memory or for which ECC memory is disabled.

The approximate amount of frame buffer that NVIDIA AI Enterprise reserves can be calculated from the following formula:

$$\text{max-reserved-fb} = \text{vgpu-profile-size-in-mb} \div 16 + 16 + \text{ecc-adjustments} + \text{page-retirement-allocation} + \text{compression-adjustment}$$

max-reserved-fb

The maximum total amount of reserved frame buffer in Mbytes that is not available for vGPUs.

vgpu-profile-size-in-mb

The amount of frame buffer in Mbytes allocated to a single vGPU. This amount depends on the vGPU type. For example, for the T4-16Q vGPU type, *vgpu-profile-size-in-mb* is 16384.

ecc-adjustments

The amount of frame buffer in Mbytes that is not usable by vGPUs when ECC is enabled on a physical GPU that does not have HBM2 memory.

- ▶ If ECC is enabled on a physical GPU that does not have HBM2 memory *ecc-adjustments* is $\text{fb-without-ecc} / 16$, which is equivalent to 64 Mbytes for every Gbyte of frame buffer assigned to the vGPU. *fb-without-ecc* is total amount of frame buffer with ECC disabled.
- ▶ If ECC is disabled or the GPU has HBM2 memory, *ecc-adjustments* is 0.

page-retirement-allocation

The amount of frame buffer in Mbytes that is reserved for dynamic page retirement.

- ▶ On GPUs based on the NVIDIA Maxwell GPU architecture, $\text{page-retirement-allocation} = 4 \div \text{max-vgpus-per-gpu}$.

- ▶ On GPUs based on NVIDIA GPU architectures **after** the Maxwell architecture, *page-retirement-allocation* = $128 \div \text{max-vgpu-per-gpu}$

max-vgpu-per-gpu

The maximum number of vGPUs that can be created simultaneously on a physical GPU. This number varies according to the vGPU type. For example, for the T4-16Q vGPU type, *max-vgpu-per-gpu* is 1.

compression-adjustment

The amount of frame buffer in Mbytes that is reserved for the higher compression overhead in vGPU types with 12 Gbytes or more of frame buffer on GPUs based on the Turing architecture.

compression-adjustment depends on the vGPU type as shown in the following table.

For all other vGPU types, *compression-adjustment* is 0.

3.3. Single vGPU benchmark scores are lower than pass-through GPU

Description

A single vGPU configured on a physical GPU produces lower benchmark scores than the physical GPU run in pass-through mode.

Aside from performance differences that may be attributed to a vGPU's smaller frame buffer size, vGPU incorporates a performance balancing feature known as Frame Rate Limiter (FRL). On vGPUs that use the best-effort scheduler, FRL is enabled. On vGPUs that use the fixed share or equal share scheduler, FRL is disabled.

FRL is used to ensure balanced performance across multiple vGPUs that are resident on the same physical GPU. The FRL setting is designed to give good interactive remote graphics experience but may reduce scores in benchmarks that depend on measuring frame rendering rates, as compared to the same benchmarks running on a pass-through GPU.

3.4. VMs configured with large memory fail to initialize vGPU when booted

Description

When starting multiple VMs configured with large amounts of RAM (typically more than 32GB per VM), a VM may fail to initialize vGPU. In this scenario, the VM boots in VMware SVGA mode. The NVIDIA AI Enterprise GPU is present in **Windows Device Manager** but displays a warning sign, and the following device status:

```
Windows has stopped this device because it has reported problems. (Code 43)
```

When this error occurs, vGPU message failed messages and XID error messages are written to the VMware vSphere VM's log file.

Chapter 4. Resolved Issues in NVIDIA AI Enterprise

Only resolved issues that have been previously noted as known issues or had a noticeable user impact are reported.

No resolved issues are reported in this release of NVIDIA AI Enterprise.

Chapter 5. Known Issues

5.1. Migration of VMs configured with vGPU stops before the migration is complete

Description

When a VM configured with vGPU is migrated to another host, the migration stops before it is complete.

This issue occurs if the ECC memory configuration (enabled or disabled) on the source and destination hosts are different. The ECC memory configuration on both the source and destination hosts must be identical.

Workaround

Before attempting to migrate the VM again, ensure that the ECC memory configuration on both the source and destination hosts are identical.

Status

Not an NVIDIA bug

Ref.

200520027

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