



# NVIDIA AI Enterprise

## Quick Start Guide

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# About this Guide

*NVIDIA AI Enterprise Quick Start Guide* provides minimal instructions for a bare-metal, single-node deployment of NVIDIA AI Enterprise on a third-party [NVIDIA-certified system](#) and for using a Cloud License Service (CLS) instance to serve licenses.

If you need complete instructions for installing and configuring NVIDIA AI Enterprise, are using NVIDIA AI Enterprise in an NVIDIA vGPU deployment, or are using multiple nodes, refer to [NVIDIA AI Enterprise User Guide](#).

If you are using Delegated License Service (DLS) instances to serve licenses, refer to [NVIDIA License System User Guide](#).



**Note:** The instructions in this guide do **not** apply to NVIDIA<sup>®</sup> DGX<sup>™</sup> systems. For information about how to use these systems, refer to [NVIDIA DGX Systems](#).



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# Chapter 1. Activating the Accounts for Getting NVIDIA AI Enterprise

After your order for NVIDIA AI Enterprise is processed, you will receive an order confirmation message from NVIDIA. This message contains information that you need for getting NVIDIA AI Enterprise and technical support from NVIDIA.

To get NVIDIA AI Enterprise and technical support from NVIDIA, you must have an NVIDIA Enterprise Account, which provides login access to the following NVIDIA web properties:

- ▶ **NVIDIA NGC™**, which provides access to all enterprise software, services, and management tools included in NVIDIA AI Enterprise
- ▶ **NVIDIA Licensing Portal**, which provides access to your entitlements and options for managing your NVIDIA AI Enterprise license servers
- ▶ **NVIDIA Enterprise Support Portal**, which provides access to NVIDIA AI Enterprise support services

To activate the accounts for getting NVIDIA AI Enterprise, follow this sequence of instructions:

1. Instructions for creating or linking to an NVIDIA Enterprise Account:
  - ▶ [Creating your NVIDIA Enterprise Account](#)
  - ▶ [Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses](#)
2. [Activating your NVIDIA NGC Account](#)
3. [Activating your NVIDIA Enterprise Account](#)

## 1.1. Before You Begin

Before following the procedures in this guide, ensure that the following prerequisites are met:

- ▶ You have a third-party [NVIDIA-certified server platform](#) that supports NVIDIA AI Enterprise.

- ▶ One or more NVIDIA GPUs that support NVIDIA AI Enterprise is installed in your server platform.
- ▶ You have a valid NVIDIA software subscription.
- ▶ If you are using a GPU that is supplied with NVIDIA AI Enterprise software, such as the NVIDIA H100 PCIe GPU, [your NVIDIA AI Enterprise license for H100 has been activated](#).

For information about supported hardware and software, and any known issues for this release of NVIDIA AI Enterprise, refer to [NVIDIA AI Enterprise Release Notes](#).

## 1.2. Your Order Confirmation Message

After your order for NVIDIA AI Enterprise is processed, you will receive an order confirmation message to which your NVIDIA Entitlement Certificate is attached. Your NVIDIA Entitlement Certificate contains your product activation keys and provides instructions for using the certificate.

If you are a data center administrator, follow the instructions in the NVIDIA Entitlement Certificate to use the certificate. Otherwise, forward your order confirmation message, including the attached NVIDIA Entitlement Certificate, to a data center administrator in your organization.

## 1.3. NVIDIA Enterprise Account Requirements

To get NVIDIA AI Enterprise, you must have a suitable NVIDIA Enterprise Account for getting NVIDIA AI Enterprise and technical support from NVIDIA.

Whether or not you have a suitable NVIDIA Enterprise Account depends on whether you have previously purchased NVIDIA AI Enterprise.

- ▶ If you have previously purchased NVIDIA AI Enterprise, you already have a suitable NVIDIA Enterprise Account.

To use this account to get NVIDIA AI Enterprise, download the software assets that you require from the NVIDIA AI Enterprise 3.3 collection on NVIDIA NGC. For details, refer to [Accessing the NVIDIA AI Enterprise Collection](#).

- ▶ If you have obtained an evaluation license but have not previously purchased NVIDIA AI Enterprise, you do **not** have a suitable NVIDIA Enterprise Account.

To create a suitable NVIDIA Enterprise Account, follow the **Register** link in the instructions for using the certificate to create an account for your **purchased** licenses. You can choose to create a separate account for your purchased licenses or link your existing account for an evaluation license to the account for your purchased licenses.

- ▶ To create a separate account for your purchased licenses, follow the instructions in [Creating your NVIDIA Enterprise Account](#), specifying a different e-mail address than the address with which you created your existing account.

- ▶ To link your existing account for an evaluation license to the account for your purchased licenses, follow the instructions in [Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses](#), specifying the e-mail address with which you created your existing account.
- ▶ If you have not previously purchased NVIDIA AI Enterprise, you do **not** have a suitable NVIDIA Enterprise Account.

To create a suitable NVIDIA Enterprise Account, follow the **Register** link in the instructions for using the certificate to create your account. For details, refer to [Creating your NVIDIA Enterprise Account](#).

### 1.3.1. Creating your NVIDIA Enterprise Account

If you do not have an NVIDIA Enterprise Account, you must create an account to be able to log in to the web properties for getting NVIDIA AI Enterprise and technical support from NVIDIA.

For details of these web properties, refer to [Activating the Accounts for Getting NVIDIA AI Enterprise](#).

If you already have an account, skip this task and go to [Installing Your NVIDIA AI Enterprise License Server and License Files](#).

However, if you have an account that was created for an evaluation license and you want to access licenses that you purchased, you must repeat the registration process when you receive your purchased licenses. You can choose to create a separate account for your purchased licenses or link your existing account for an evaluation license to the account for your purchased licenses.

- ▶ To create a separate account for your purchased licenses, perform this task, specifying a different e-mail address than the address with which you created your existing account.
- ▶ To link your existing account for an evaluation license to the account for your purchased licenses, follow the instructions in [Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses](#), specifying the e-mail address with which you created your existing account.

Before you begin, ensure that you have your order confirmation message.

1. In the instructions for using your NVIDIA Entitlement Certificate, follow the **Register** link.
2. Fill out the form on the **NVIDIA Enterprise Account Registration** page and click **Register**.

A message confirming that an account has been created appears and the following e-mail messages are sent:

- ▶ An e-mail message is sent to the e-mail address you provided for the NGC administrator that invites the NGC administrator to access NVIDIA NGC.

- ▶ An e-mail message is sent to the e-mail address you provided for the primary contact that instructs the primary contact to set a password for the NVIDIA Enterprise Account.

### 1.3.2. Linking an Evaluation Account to an NVIDIA Enterprise Account for Purchased Licenses

If you have an account that was created for an evaluation license, you must repeat the registration process when you receive your purchased licenses. To link your existing account for an evaluation license to the account for your purchased licenses, register for an NVIDIA Enterprise Account with the e-mail address with which you created your existing account.

If you want to create a separate account for your purchased licenses, follow the instructions in [Creating your NVIDIA Enterprise Account](#), specifying a different e-mail address than the address with which you created your existing account.

1. In the instructions for using the NVIDIA Entitlement Certificate **for your purchased licenses**, follow the **Register** link.
2. Fill out the form on the **NVIDIA Enterprise Account Registration** page, specifying the e-mail address with which you created your existing account, and click **Register**.

**NVIDIA**

**NVIDIA Enterprise Account Registration**

Please register with your corporate email address.  
If already registered, click [here](#).  
 If you need assistance with registration, please email [enterprise@nvidia.com](mailto:enterprise@nvidia.com).

**Entitlement**

PAK ID/Entitlement ID:

**Primary Contact**

\* Email Address:

\* First Name:  \* Last Name:

\* Claiming Entitlement as:

**Primary Contact Details**

\* Location:

\* Street 1:

\* Street 2:

\* City:

\* State/Province:

\* Postal Code/Zip Code:

\* Phone:

\* Job Role:

Send me the latest enterprise news, announcements, and more from NVIDIA. I can unsubscribe at any time.  
 By registering, you agree to [NVIDIA Account Terms and Conditions](#), [Legal Info](#) & [Privacy Policy](#).

**Register**

3. When a message stating that your e-mail address is already linked to an evaluation account is displayed, click **LINK TO NEW ACCOUNT**.





Log in to the NVIDIA Licensing Portal with the credentials for your existing account.

## 1.4. Activating your NVIDIA NGC Account

After you are registered as an NGC administrator during the creation of your NVIDIA Enterprise Account, you will receive a welcome email that invites you to access NVIDIA NGC.

1. In the welcome email, click **SIGN IN TO NGC**.  
If you don't have access to the welcome email, you can open the [NVIDIA NGC Sign In](#) page in a web browser.
2. On the **NVIDIA NGC Sign In** page, in the **Email Address** field, enter the email address to which the welcome email was sent and click **Continue**.
3. On the **NVIDIA NGC Sign In** page, in the **Email Address** field, enter the email address to which the welcome email was sent and click **Continue**.
4. On the **Create Your Account** page that opens, provide a password for your account, confirm the password, and click **Create Account**.  
The page is updated to notify you that an e-mail instructing you to verify your e-mail address has been sent to the e-mail address you provided.
5. Open the e-mail instructing you to verify your e-mail address and click **Verify Email Address**.  
The page is updated to enable you to complete your registration.
6. In the updated page, complete your registration by selecting the communications that you want to receive from NVIDIA and clicking **Submit**.  
You are returned to the **NVIDIA NGC Sign In** page.
7. On the **NVIDIA NGC Sign In** page, in the **Email Address** field, enter your verified email address and click **Continue**.
8. On the **Set Your Profile** page that opens, agree to the NVIDIA NGC terms of use, agree to the sharing of your registration details with other software providers, and click **Submit**.
9. On the **Terms of Use** page that opens, review and accept the terms of use for NVIDIA NGC, and click **Agree**.

## 1.5. Activating your NVIDIA Enterprise Account

After you are registered as the primary contact during the creation of your NVIDIA Enterprise Account, you will receive a welcome email that instructs you to set a password for the NVIDIA Enterprise Account.

1. Open the e-mail instructing you to set your password and click **SET PASSWORD**.



**Note:** After you have set your password during the initial registration process, you will be able to log in to your account within 15 minutes. However, it may take up to 24 business hours for your entitlement to appear in your account.

For your account security, the **SET PASSWORD** link in this e-mail is set to expire in 24 hours.

2. Enter and re-enter your new password and click **SUBMIT**.

A message confirming that your password has been set successfully appears.

You are then automatically directed to log in to the NVIDIA Licensing Portal with your new password.

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# Chapter 2. Installing Your NVIDIA AI Enterprise License Server and License Files

The NVIDIA License System is used to serve a pool of floating licenses to licensed NVIDIA software products. The NVIDIA License System is configured with licenses obtained from the NVIDIA Licensing Portal.



**Note:** These instructions cover only the configuration of a Cloud License Service (CLS) instance. If you need complete instructions or are using Delegated License Service (DLS) instances to serve licenses, refer to [NVIDIA License System User Guide](#).

## 2.1. Introduction to NVIDIA Software Licensing

To activate licensed functionalities, a licensed client must obtain a software license when it is booted.

A client with a network connection obtains a license by leasing it from a NVIDIA License System service instance. The service instance serves the license to the client over the network from a pool of floating licenses obtained from the NVIDIA Licensing Portal. The license is returned to the service instance when the licensed client no longer requires the license.

## 2.2. Performing an Express CLS Installation

Performing an express CLS installation creates a license server that NVIDIA License System automatically binds to and installs on the default CLS instance. The license server

that you create defines the set of licenses to be allotted to an NVIDIA License System instance.

If no default CLS instance exists, NVIDIA License System creates a default instance for you. After you perform an express installation, no further action is required to complete the initial configuration of the CLS instance. The instance is ready to serve licenses to clients.

1. In the NVIDIA Licensing Portal, navigate to the organization or virtual group for which you want to perform an express CLS installation.
  - a). If you are not already logged in, log in to the [NVIDIA Enterprise Application Hub](#) and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.
  - b). **Optional:** If your assigned roles give you access to multiple virtual groups, click **View settings** at the top right of the page and in the **My Info** window that opens, select the virtual group from the **Virtual Group** drop-down list, and close the **My Info** window.

If no license servers have been created for your organization or virtual group, the NVIDIA Licensing Portal dashboard displays a message asking if you want to create a license server.

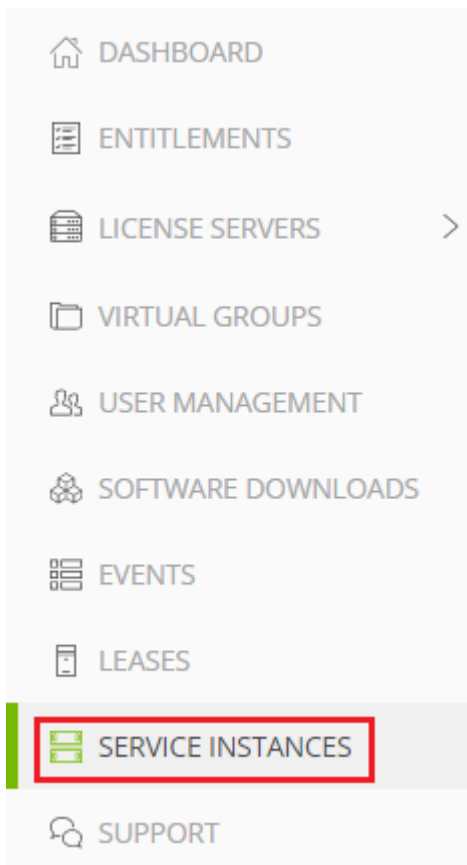
2. In the left navigation pane of the NVIDIA Licensing Portal dashboard, expand **LICENSE SERVER** and click **CREATE SERVER**.

The **Create License Server** wizard opens.

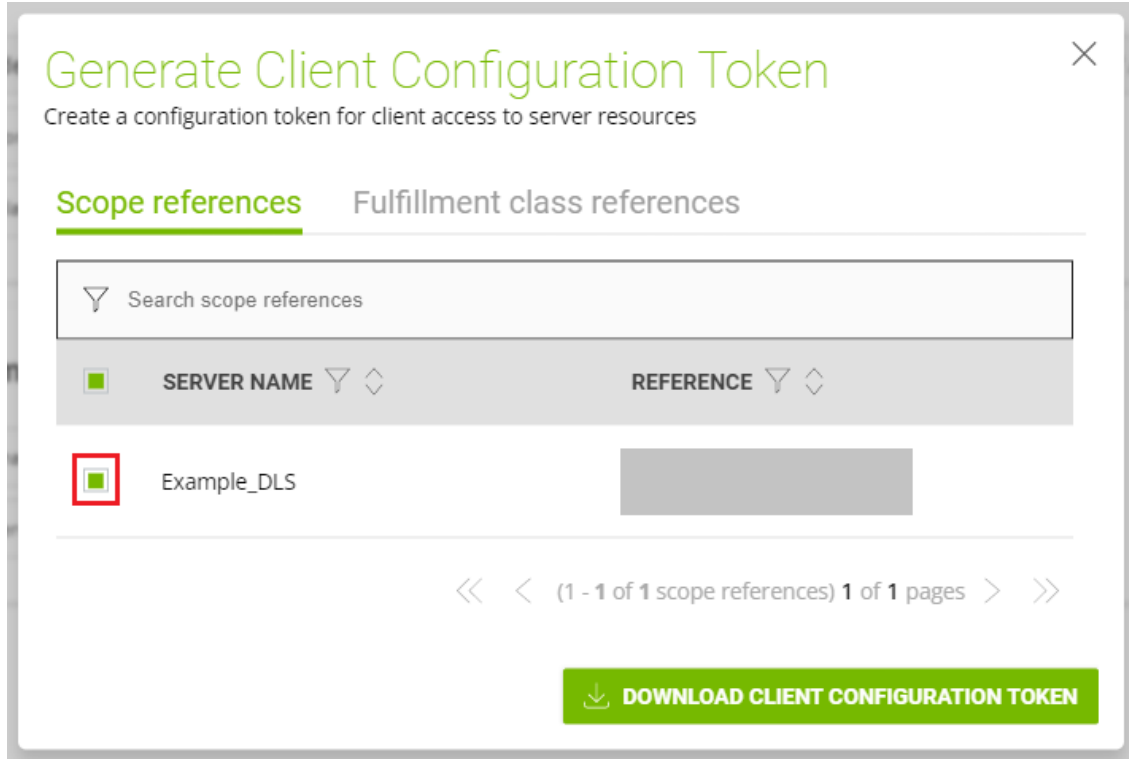
3. On the **Step 1 - Identification** page of the wizard, provide the details of your license server.
  - a). In the **Name** field, enter your choice of name for the license server.
  - b). In the **Description** field, enter a text description of the license server.  
This description is required and will be displayed on the details page for the license server that you are creating.
  - c). Click **NEXT STEP**.
4. On the **Step 2 - Features** page of the wizard, add the licenses for the products that you want to allot to this license server.  
For each product, add the licenses as follows:
  - a). In the list of products, select the product for which you want to add licenses.
  - b). In the text-entry field in the **ADDED** column, enter the number of licenses for the product that you want to add.
  - c). Click **NEXT STEP**.
5. On the **Step 3 - Environment** page, select **Cloud (CLS)**, select the **Express installation** option that is added to the page, and click **NEXT STEP**.
6. On the **Step 4-Configuration** page, select the leasing mode that you require.  
If the license server is to be used for networked licensing, you can simplify the management of licensed products on the server by selecting the **Standard Networked Licensing** mode.
7. Click **CREATE SERVER**.

## 2.3. Generating a Client Configuration Token for a CLS Instance

1. Log in to the [NVIDIA Enterprise Application Hub](#) and click **NVIDIA LICENSING PORTAL** to go to the NVIDIA Licensing Portal.
2. If your assigned roles give you access to multiple virtual groups, select the virtual group for which you are managing licenses from the list of virtual groups at the top right of the NVIDIA Licensing Portal dashboard.
3. In the left navigation pane, click **SERVICE INSTANCES**.



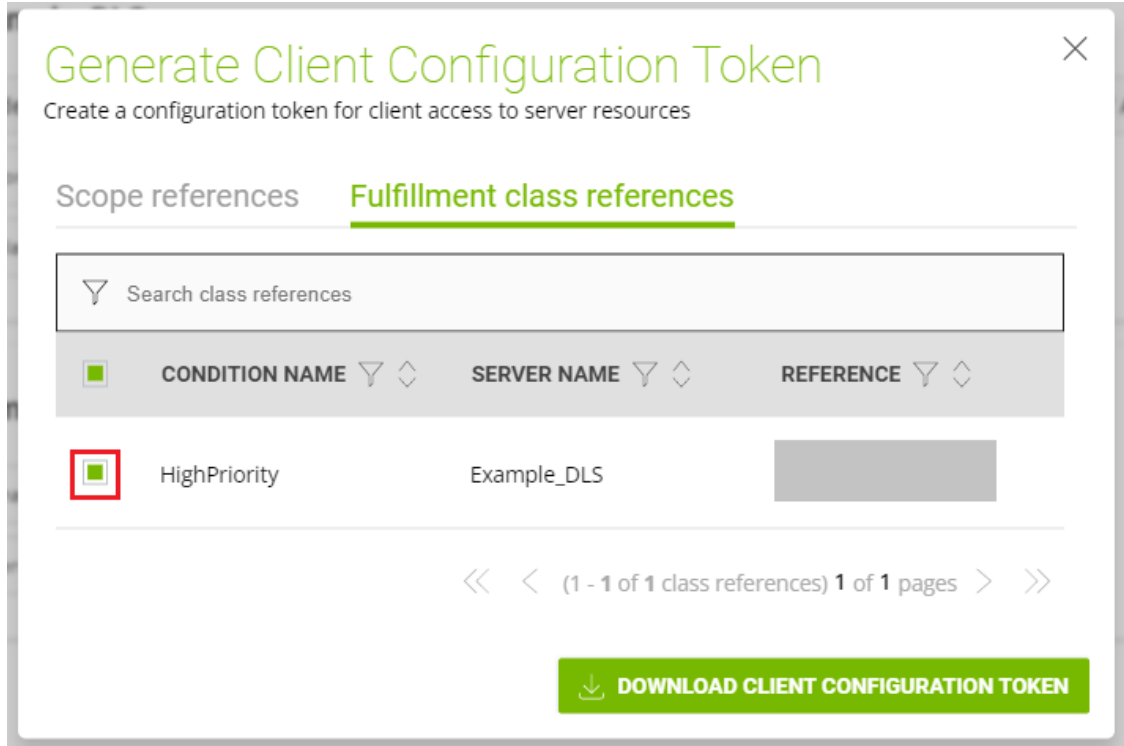
4. On the Service Instances page that opens, from the **Actions** menu for the CLS instance for which you want to generate a client configuration token, choose **Generate client configuration token**.
5. In the **Generate Client Configuration Token** pop-up window that opens, select the references that you want to include in the client configuration token.
  - a). From the list of scope references, select the scope references that you want to include.



You must select **at least one** scope reference.

Each scope reference specifies the license server that will fulfil a license request.

- b). **Optional:** Click the **Fulfillment class references** tab, and from the list of fulfillment class references, select the fulfillment class references that you want to include.



Including fulfillment class references is optional.

- c). **Optional:** In the **Expiration** section, select an expiration date for the client configuration token. If you do not select a date, the default token expiration time is 12 years.
- d). Click **DOWNLOAD CLIENT CONFIGURATION TOKEN**.

A file named `client_configuration_token_mm-dd-yyyy-hh-mm-ss.tok` is saved to your default downloads folder.

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# Chapter 3. Installing and Licensing NVIDIA AI Enterprise Software Components

## 3.1. The Enterprise Catalog

The NVIDIA AI Enterprise Software Suite is distributed through the Enterprise Catalog. After you access the Enterprise Catalog, you will see the NVIDIA AI Enterprise Software Suite collection. Detailed documentation makes it easy to utilize the software, and if additional support is required, users can submit the ticket directly from the portal.

### 3.1.1. Accessing the NVIDIA AI Enterprise Collection

1. Go to the [NVIDIA AI Enterprise](#) collection on NVIDIA NGC and, if prompted, log in.
2. Under **Enterprise Collections**, scroll down to and click the **NVIDIA AI Enterprise 3.3** collection.
3. On the **NVIDIA AI Enterprise 3.3** page that opens, click the **Entities** tab to review the software assets in the **NVIDIA AI Enterprise 3.3** collection.
4. Click the software asset that you are interested in to learn more about or download the asset.

### 3.1.2. Resources

The **NVIDIA AI Enterprise 3.3** collection contains the following resources:

- ▶ GPU Operator
- ▶ Network Operator
- ▶ vGPU Guest Driver, Ubuntu 22.04

1. Go to the [Enterprise Catalog](#).
2. Click the **NVIDIA AI Enterprise 3.3** collection.



3. Click the **Entities** tab and select the resource you are interested in.
4. Download the resource directly from the UI or use the displayed `wget` or [CLI](#) commands.

## 3.2. Installing the NVIDIA AI Enterprise Graphics Driver on Ubuntu from a Debian Package

The NVIDIA AI Enterprise graphics driver for Ubuntu is distributed as a Debian package file.

This task requires `sudo` privileges.

1. Copy the NVIDIA AI Enterprise Linux driver package, for example `nvidia-linux-grid-525_525.147.05_amd64.deb`, to the guest VM where you are installing the driver.
2. Log in to the guest VM as a user with `sudo` privileges.
3. Open a command shell and change to the directory that contains the NVIDIA AI Enterprise Linux driver package.
4. From the command shell, run the command to install the package.
 

```
$ sudo apt-get install ./nvidia-linux-grid-525_525.147.05_amd64.deb
```
5. Verify that the NVIDIA driver is operational.
  - a). Reboot the system and log in.
  - b). After the system has rebooted, confirm that you can see your NVIDIA vGPU device in the output from the `nvidia-smi` command.

```
$ nvidia-smi
```

## 3.3. Configuring a Licensed Client

A client with a network connection obtains a license by leasing it from a NVIDIA License System service instance. The service instance serves the license to the client over the network from a pool of floating licenses obtained from the NVIDIA Licensing Portal. The license is returned to the service instance when the licensed client no longer requires the license.

The graphics driver creates a default location in which to store the client configuration token on the client.

The process for configuring a licensed client is the same for CLS and DLS instances but depends on the OS that is running on the client.

### 3.3.1. Configuring a Licensed Client on Linux with Default Settings

Perform this task from the client.

1. As root, open the file `/etc/nvidia/gridd.conf` in a plain-text editor, such as `vi`.

```
$ sudo vi /etc/nvidia/gridd.conf
```



**Note:** You can create the `/etc/nvidia/gridd.conf` file by copying the supplied template file `/etc/nvidia/gridd.conf.template`.

2. Add the `FeatureType` configuration parameter to the file `/etc/nvidia/gridd.conf` on a new line as `FeatureType="value"`.

`value` depends on the type of the GPU assigned to the licensed client that you are configuring.

GPU Type	Value
NVIDIA vGPU	1. NVIDIA AI Enterprise automatically selects the correct type of license based on the vGPU type.
Physical GPU	The feature type of a GPU in pass-through mode or a bare-metal deployment: <ul style="list-style-type: none"> <li>▶ 0: NVIDIA Virtual Applications</li> <li>▶ 2: NVIDIA RTX Virtual Workstation</li> <li>▶ 4: NVIDIA Virtual Compute Server</li> </ul>

This example shows how to configure a licensed Linux client for NVIDIA Virtual Compute Server.

```
# /etc/nvidia/gridd.conf.template - Configuration file for NVIDIA Grid Daemon
...
# Description: Set Feature to be enabled
# Data type: integer
# Possible values:
# 0 => for unlicensed state
# 1 => for NVIDIA vGPU
# 2 => for NVIDIA RTX Virtual Workstation
# 4 => for NVIDIA Virtual Compute Server
FeatureType=4
...
```

3. Copy the client configuration token to the `/etc/nvidia/ClientConfigToken` directory.
4. Ensure that the file access modes of the client configuration token allow the owner to read, write, and execute the token, and the group and others only to read the token.
  - a). Determine the current file access modes of the client configuration token.

```
# ls -l client-configuration-token-directory
```

- b). If necessary, change the mode of the client configuration token to 744.

```
# chmod 744 client-configuration-token-directory/client_configuration_token_*.tok
```

#### **client-configuration-token-directory**

The directory to which you copied the client configuration token in the previous step.

5. Save your changes to the `/etc/nvidia/gridd.conf` file and close the file.
6. Restart the `nvidia-gridd` service.

The NVIDIA service on the client should now automatically obtain a license from the CLS or DLS instance.

### 3.3.2. Verifying the NVIDIA AI Enterprise License Status of a Licensed Client

After configuring a client with an NVIDIA AI Enterprise license, verify the license status by displaying the licensed product name and status.

To verify the license status of a licensed client, run `nvidia-smi` with the `-q` or `--query` option from the licensed client, **not** the hypervisor host. If the product is licensed, the expiration date is shown in the license status.

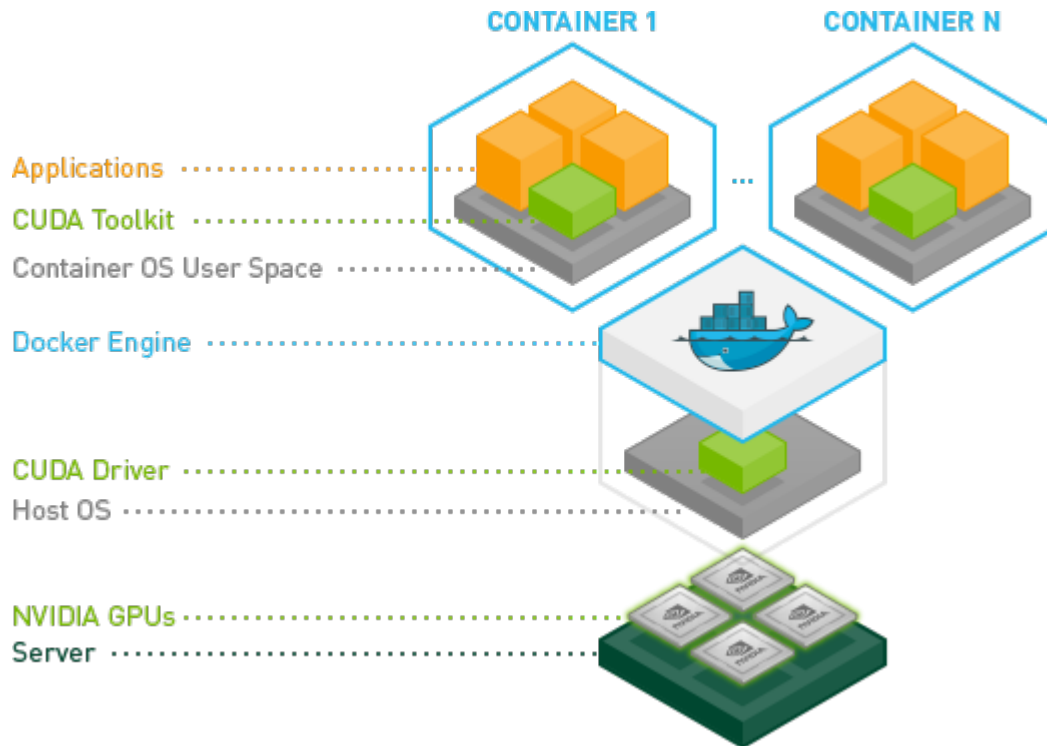
```
nvidia-smi -q
=====NVSMI LOG=====

Timestamp                : Wed Nov 23 10:52:59 2022
Driver Version           : 525.60.06
CUDA Version             : 12.0

Attached GPUs            : 2
GPU 00000000:02:03.0
  Product Name           :
  Product Brand          : NVIDIA Virtual Compute Server
  Product Architecture    : Ampere
  Display Mode           : Enabled
  Display Active         : Disabled
  Persistence Mode       : Enabled
  MIG Mode
    Current              : Disabled
    Pending              : Disabled
  Accounting Mode        : Disabled
  Accounting Mode Buffer Size : 4000
  Driver Model
    Current              : N/A
    Pending              : N/A
  Serial Number          : N/A
  GPU UUID               : GPU-ba5b1e9b-1dd3-11b2-be4f-98ef552f4216
  Minor Number           : 0
  VBIOS Version          : 00.00.00.00.00
  MultiGPU Board         : No
  Board ID               : 0x203
  Board Part Number      : N/A
  GPU Part Number        : 25B6-890-A1
  Module ID              : N/A
  Inforom Version
    Image Version        : N/A
    OEM Object           : N/A
    ECC Object           : N/A
    Power Management Object : N/A
  GPU Operation Mode
    Current              : N/A
    Pending              : N/A
  GSP Firmware Version   : N/A
  GPU Virtualization Mode
    Virtualization Mode  : VGPU
    Host VGPU Mode       : N/A
vGPU Software Licensed Product
  Product Name         : NVIDIA Virtual Compute Server
  License Status      : Licensed (Expiry: 2022-11-23 10:41:16
GMT)
...
...
```

## 3.4. Installing NVIDIA Container Toolkit

Use NVIDIA Container Toolkit to build and run GPU accelerated Docker containers. The toolkit includes a container runtime library and utilities to configure containers to use NVIDIA GPUs automatically.



Ensure that the following software is installed in the guest VM:

- ▶ Docker 20.10 for your Linux distribution. For instructions, refer to [Install Docker Engine on Ubuntu](#) in the Docker product manuals.
- ▶ The NVIDIA AI Enterprise graphics driver. For instructions, refer to [Installing the NVIDIA AI Enterprise Graphics Driver on Ubuntu from a Debian Package](#).



**Note:** You do **not** need to install NVIDIA CUDA Toolkit on the hypervisor host.

1. Set up the GPG key and configure `apt` to use NVIDIA Container Toolkit packages in the file `/etc/apt/sources.list.d/nvidia-docker.list`.

```
$ distribution=$(. /etc/os-release;echo $ID$VERSION_ID)
$ curl -s -L https://nvidia.github.io/nvidia-docker/gpgkey | sudo apt-key add -
$ curl -s -L https://nvidia.github.io/nvidia-docker/$distribution/nvidia-docker.list | sudo tee /etc/apt/sources.list.d/nvidia-docker.list
```

2. Download information from all configured sources about the latest versions of the packages and install the `nvidia-container-toolkit` package.

```
$ sudo apt-get update && sudo apt-get install -y nvidia-container-toolkit
```

- Restart the Docker service.

```
$ sudo systemctl restart docker
```

## 3.5. Verifying the Installation of NVIDIA Container Toolkit

- Run the `nvidia-smi` command contained in the latest official NVIDIA CUDA Toolkit image.

```
$ docker run --gpus all nvidia/cuda:11.0-base nvidia-smi
```

- Start a GPU-enabled container on any two available GPUs.

```
$ docker run --gpus 2 nvidia/cuda:11.0-base nvidia-smi
```

- Start a GPU-enabled container on two specific GPUs identified by their index numbers.

```
$ docker run --gpus '"device=1,2"' nvidia/cuda:10.0-base nvidia-smi
```

- Start a GPU-enabled container on two specific GPUs with one GPU identified by its UUID and the other GPU identified by its index number.

```
$ docker run --gpus '"device=UUID-ABCDEF,1"' nvidia/cuda:11.0-base nvidia-smi
```

- Specify a GPU capability for the container.

```
$ docker run --gpus all,capabilities=utility nvidia/cuda:11.0-base nvidia-smi
```

## 3.6. Installing Software Distributed as Container Images

The NGC container images accessed through the NVIDIA Enterprise Catalog include the AI and data science applications and frameworks. Each container image for an AI and data science application or framework contains the entire user-space software stack that is required to run the application or framework, namely, the CUDA libraries, cuDNN, any required Magnum IO components, TensorRT, and the framework.

Ensure that you have completed the following tasks in *NGC Private Registry User Guide*:

- ▶ [Generating Your NGC API Key](#)
- ▶ [Accessing the NGC Container Registry](#)

Perform this task from the VM.

Obtain the Docker `pull` command for downloading each of the following applications and deep learning framework components from the listing for the application or component in the [NGC Public Catalog](#).

- ▶ Applications:
  - ▶ NVIDIA Clara Parabricks
  - ▶ NVIDIA DeepStream

- ▶ MONAI - Medical Open Network for Artificial Intelligence
- ▶ RAPIDS
- ▶ RAPIDS Accelerator for Apache Spark
- ▶ TAO
- ▶ Deep learning framework components:
  - ▶ NVIDIA TensorRT
  - ▶ NVIDIA Triton Inference Server
  - ▶ PyTorch
  - ▶ TensorFlow 2

## 3.7. Running ResNet-50 with TensorRT

1. Launch the NVIDIA TensorRT container image on all GPUs in interactive mode, specifying that the container will be deleted when it is stopped.
 

```
$ sudo docker run --gpus all -it --rm nvcr.io/nvaie/tensorrt:21.07-py3
```
2. From within the container runtime, change to the directory that contains test data for the ResNet-50 convolutional neural network.
 

```
# cd /workspace/tensorrt/data/resnet50
```
3. Run the ResNet-50 convolutional neural network with FP32, FP16, and INT8 precision and confirm that each test is completed with the result `PASSED`.
  - a). To run ResNet-50 with the default FP32 precision, run this command:
 

```
# trtexec --duration=90 --workspace=1024 --percentile=99 --avgRuns=100 \
--deploy=ResNet50_N2.prototxt --batch=1 --output=prob
```
  - b). To run ResNet-50 with FP16 precision, add the `--fp16` option:
 

```
# trtexec --duration=90 --workspace=1024 --percentile=99 --avgRuns=100 \
--deploy=ResNet50_N2.prototxt --batch=1 --output=prob --fp16
```
  - c). To run ResNet-50 with INT8 precision, add the `--int8` option:
 

```
# trtexec --duration=90 --workspace=1024 --percentile=99 --avgRuns=100 \
--deploy=ResNet50_N2.prototxt --batch=1 --output=prob --int8
```
4. Press **Ctrl+P**, **Ctrl+Q** to exit the container runtime and return to the Linux command shell.

## 3.8. Running ResNet-50 with TensorFlow

1. Launch the **TensorFlow 1** container image on all GPUs in interactive mode, specifying that the container will be deleted when it is stopped.
 

```
$ sudo docker run --gpus all -it --rm \
nvcr.io/nvaie/tensorflow:21.07-tf1-py3
```
2. From within the container runtime, change to the directory that contains test data for `cnn` example.

```
# cd /workspace/nvidia-examples/cnn
```

3. Run the ResNet-50 training test with FP16 precision.

```
# python resnet.py --layers 50 -b 64 -i 200 -u batch --precision fp16
```

4. Confirm that all operations on the application are performed correctly and that a set of results is reported when the test is completed.
5. Press **Ctrl+P**, **Ctrl+Q** to exit the container runtime and return to the Linux command shell.

---

## Chapter 4. Additional Information

Additional information about containers and resources that are available from the NVIDIA AI Enterprise private registry on NGC is available in the documentation for these entities.

Container or Resource	Additional Information
TensorFlow	<ul style="list-style-type: none"><li>▶ <a href="#">TensorFlow Release Notes</a></li><li>▶ <a href="#">TensorFlow User Guide</a></li></ul>
PyTorch	<a href="#">PyTorch Release Notes</a>
NVIDIA Triton Inference Server	<a href="#">Triton Inference Server Documentation on Github</a>
NVIDIA TensorRT	<a href="#">NVIDIA TensorRT Documentation</a>
NVIDIA RAPIDS	<a href="#">RAPIDS Docs on the RAPIDS project site</a>
NVIDIA RAPIDS Accelerator for Apache Spark	<a href="#">RAPIDS Accelerator for Apache Spark Deployment Guide</a>
NVIDIA Clara Parabricks	<a href="#">NVIDIA Clara Parabricks Documentation</a>
NVIDIA DeepStream	<ul style="list-style-type: none"><li>▶ <a href="#">DeepStream 6.2 Release Notes (PDF)</a></li><li>▶ <a href="#">DeepStream SDK Development Guide</a></li><li>▶ <a href="#">DeepStream SDK API Reference</a></li><li>▶ <a href="#">DeepStream Python API</a></li></ul>
MONAI (Medical Open Network for Artificial Intelligence) Enterprise	<a href="#">NVIDIA MONAI Toolkit Documentation</a>
TAO Toolkit	<a href="#">TAO Toolkit Documentation</a>
NVIDIA GPU Operator	<a href="#">NVIDIA GPU Operator Documentation</a>
NVIDIA Network Operator	<a href="#">NVIDIA Network Operator Documentation</a>



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