

Teradici PCoIP Graphics Agent for Linux 19.11

This guide is intended for administrators who are deploying the Graphics Agent for Linux as part of the Teradici Cloud Access Software. It assumes thorough knowledge of Linux conventions and networking concepts, including firewall configuration.

About the Graphics Agent for Linux 19.11

The Graphics Agent for Linux is part of Teradici Cloud Access Software. It enables Teradici customers to deliver GPU-powered physical and virtual workstations to end users via remote clients.

Users include high-end knowledge workers, graphic designers, artists, and CAD/CAM designers.

A deployed Graphics Agent for Linux requires these components:

- **A host machine** which provides the desktop to remote clients. The host must be a virtual machine in a data center or in the cloud. See [System Requirements](#) for more information.
- **The agent software** installed on the host machine.
- **A GPU**. The PCoIP Graphics Agent requires an NVIDIA GRID card.

The GPU can be dedicated to the workstation, or shared among virtual workstations by a hypervisor. See [System Requirements](#) for more information.

Where to Find Information about Other Components

This guide describes the Graphics Agent for Linux.

For complete information about all of the components used in PCoIP ecosystems, including architectural diagrams and deployment suggestions, see one of the following documents:

Cloud Access Software architectures and descriptions:

- [Teradici All Access Architecture Guide](#)

For more information about PCoIP clients, see one of the following:

- [Teradici PCoIP Software Client for Windows Administrators' Guide](#)
- [Teradici PCoIP Software Client for macOS Administrators' Guide](#)
- [Teradici PCoIP Software Client for Linux Administrators' Guide](#)
- [Tera2 PCoIP Zero Client Administrators' Guide](#)

For information about Cloud Access licensing, see our [Licensing FAQ](#). Most PCoIP systems use PCoIP Cloud Licensing. For systems using a local PCoIP License server instead, refer to the following guides:

- [Teradici PCoIP License Server Administrators' Guide for *Online Environments*](#)
- [Teradici PCoIP License Server Administrators' Guide for *Offline Environments*](#)

What's New in This Release

Release 19.11 of the Graphics Agent for Linux includes the following enhancements:

PCoIP Ultra Updates

- PCoIP Ultra *with GPU acceleration enabled* shows improved performance on lossy networks.
- PCoIP Ultra *with GPU acceleration enabled* now supports 4:2:0 chroma subsampling color mode, decreasing bandwidth consumption.
- PCoIP Ultra *with GPU acceleration enabled* can now be used from PCoIP Software Clients for macOS (version 19.11).
- PCoIP Ultra *with CPU acceleration enabled* shows increased video playback quality.

Other Improvements

- You can now use the Graphics Agent for Linux with bare-metal [physical PCs](#), when equipped with a [supported GPU](#).
- Added support for AWS EC2 G4 instances. G4 instances must have NVIDIA GRID Quadro Virtual Data Center Workstation licenses to enable more than one display.
- Added support for local termination of additional Wacom tablets:
 - Wacom Cintiq 22HD
 - Wacom Cintiq 22HDT
 - Wacom Cintiq 24 Pro P
 - Wacom Cintiq 24 Pro PT

Important

Local termination with these tablets also requires PCoIP Tera2 Zero Client Firmware 6.5.0 or higher.

- You can now disable the locally-rendered cursor. This prevents double cursors in applications that render their own cursor.
- The cursor now hides as expected during video playback.
- Bug fixes and security enhancements.

For up-to-date release notes, please see [Teradici Support](#).

System Requirements

The Graphics Agent for Linux depends on the following system capacities and capabilities:

Supported Host Instance Types

Environment	Supported instance types
VMware ESXi (6.0+)	VMware Hardware Version 11
KVM (5.0+)	QEMU/KVM
Physical machines	Linux physical machine ¹
AWS EC2	<ul style="list-style-type: none"> • G2 • G3 • G4 ²
Microsoft Azure	<ul style="list-style-type: none"> • NV-series • NVv3-Series
Google Cloud Platform	Any instance with a supported GPU

Host Instance Requirements

Global instance requirements	
Operating Systems	<ul style="list-style-type: none"> • Ubuntu 16.04 LTS, 18.04 LTS • RHEL/CentOS 7.5, 7.6

Global instance requirements	
Remote Host Memory	At least 2GB of RAM is required on the host desktop. The agent should have at least 512MB of available memory.
Remote Host GPU Memory	At least 1GB per 4K UHD display
Remote Host CPUs	At least 2 CPUs are required on the host desktop. Processors must support Streaming SIMD Extensions (SSE) 4.2. To use PCoIP Ultra , processors must support the AVX2 instruction set.
Network Ports	The following ports must be open on the host desktop: <ul style="list-style-type: none"> • TCP 443 • TCP 4172 • UDP 4172 • TCP 60443
Storage	At least 100MB for installation and 100MB for logging are recommended.
User	Cannot be root. You must create a user account for PCoIP connections.

Supported GPUs

Instance	GPU	Driver	Driver download (Ubuntu)	Driver download (RHEL)
VMware ESXi	GPUs as listed in NVIDIA's GRID release notes .	GRID 9.1 (430.46)+	Ubuntu Instructions	RHEL Instructions
Physical PC	<ul style="list-style-type: none"> • Tesla (any) • Quadro (2000+) 	Use the latest driver for your supported GPU	Ubuntu Instructions	RHEL Instructions
AWS EC2 G2	NVIDIA K520	GRID 4.7 (367.128)	Ubuntu Instructions	RHEL Instructions

Instance	GPU	Driver	Driver download (Ubuntu)	Driver download (RHEL)
AWS EC2 G3	NVIDIA M60	GRID 9.1 (430.46)+	Ubuntu Instructions	RHEL Instructions
AWS EC2 G4	NVIDIA T4	GRID 9.1 (430.46)+	Ubuntu Instructions	RHEL Instructions
Microsoft Azure	NVIDIA M60	GRID 9.1 (430.46)+	Ubuntu Instructions	RHEL Instructions
Google Cloud Platform	NVIDIA P4, P100, T4	GRID 9.1 (430.46)+	Ubuntu Instructions	RHEL Instructions

Info: Display limitations on Microsoft Azure

Graphics Agents running on Microsoft Azure may be limited to a single 2560x1600 display, depending on the state of NVIDIA GRID licensing.

Note: NVIDIA Tesla cards have license limitations

Systems using NVIDIA Tesla-based GPUs, including M60, M10, and M6, are subject to licensing restrictions which may further reduce the available number of monitors or their available resolutions. For systems using Tesla-based GPUs, only licensed displays and resolutions will use GRID functionality. For more information, see [NVIDIA's Grid Licensing User Guide](#)

1. Installation on physical machines requires some additional configuration. See the extra installation instructions for [Ubuntu](#) and [RHEL/CentOS](#).
2. AWS EC2 G4 instances must be configured with an NVIDIA GRID Quadro Virtual Data Center Workstation license.

Audio Support

The Graphics Agent for Linux supports audio input and output between the host and the client. Audio can be enabled or disabled and audio bandwidth can be throttled by [configuring the agent](#).

Supported Displays

The Graphics Agent for Linux, in combination with a GPU, supports a maximum of four displays on the PCoIP client and a maximum resolution of 4K UHD (3840×2160).

Important: Display acceleration requires a supported GPU

The Graphics Agent for Linux must be deployed with one or more [supported GPUs](#). GPUs may have their own licensing requirements.

PCoIP agents support any of these monitor configurations:

- Vertical line
- Horizontal line
- Box display

Monitors can be used in any standard rotation (0°, 90°, 180°, or 270°). Any monitor can be the primary.

The Graphics Agent for Linux, in combination with one or more properly configured *and licensed* GPUs, provides the following benefits:

- **Display resolutions:** The Graphics Agent for Linux can provide any resolution a client asks for up to 4K UHD. The practical number of displays available at any given resolution is determined by the GPU, host system hardware, GPU profile licensing, and the connecting client's version.
- **Hot-pluggable displays from Tera2 PCoIP Zero Clients:** Displays may be added and removed as needed during an active PCoIP session when using a Tera2 PCoIP Zero Client.
- **3D application support:** Full-screen 3D applications are supported.

Note: Using multiple high-resolution displays

Systems with multiple high-resolution displays, such as quad 4K UHD topologies, require powerful system infrastructure. Be sure to use a system with sufficient bandwidth, licensed GPUs, and client capability to support your required display topology.



Important: Attaching monitors to the host machine is not supported

PCoIP client supports a maximum of four displays. Attaching extra monitors to the host machine will conflict with client display topologies.

PCoIP Ultra

The Graphics Agent for Linux provides support for PCoIP Ultra, the latest protocol enhancements from Teradici. PCoIP Ultra is optimized for truly lossless support with bit-exact color accuracy and preservation of content detail at the highest frame rates.

PCoIP Ultra protocol enhancements propels our industry-recognized performance into the future of remote computing, with faster, more interactive experience for users of remote workstations working with high-resolution content.

PCoIP Ultra enhancements are disabled by default. You must [enable them manually](#).

PCoIP Ultra is appropriate for specific use cases

For most users, the default PCoIP protocol will provide the best possible experience. Carefully review the recommended use cases in the next section to determine whether you should enable it.

For additional detail on PCoIP Ultra technical requirements for various use cases and troubleshooting steps, refer to [KB 2109: PCoIP Ultra Troubleshooting](#).

When to Enable PCoIP Ultra

PCoIP Ultra is appropriate for users with the following requirements:

CPU optimization:

- Users requiring CPU-optimized delivery of *4K UHD, high-framerate video playback*.
- Efficient scaling across multicore CPUs, leveraging AVX2 instruction sets.

GPU optimization:

- Highest possible CPU efficiency, with encoding offloaded to a GPU
- Video playback under bandwidth constrained environments

For *all other scenarios*, Teradici recommends that you leave PCoIP Ultra disabled.

Requirements

To take advantage of PCoIP Ultra, you need:

- A **PCoIP agent** (any type), 19.11 or later
- A **PCoIP Software Client** (any type), 19.11.0 or later

PCoIP Tera2 Zero Clients do not support PCoIP Ultra

PCoIP Ultra is only available through PCoIP Software Clients.

- **CPU optimization** requires CPU support for the AVX2 instruction set on both the agent and client machines.
- **GPU optimization** requires an NVIDIA graphics card that supports NVENC on the agent machine.

Environment restriction

GPU acceleration works best on a LAN-only network with limited packet loss.

Enabling PCoIP Ultra

To enable PCoIP Ultra features, turn on *one* of the following configuration settings in the `pcoip-agent.conf` configuration file:

- **CPU optimization:** To enable CPU optimization, turn on the `pcoip.ultra_cpu_optimization` [setting](#).
- **GPU optimization:** To enable GPU optimization, turn on the `pcoip.ultra_gpu_optimization` [setting](#).

Only one setting can be active at a time. If both are enabled, GPU optimization will take precedence and CPU optimization will be inactive.

All PCoIP Ultra settings take effect on the next PCoIP session. No configuration is required on the PCoIP Software Client.

Setting configuration values

If you don't know how to set PCoIP agent configuration values, refer to [Configuring the Graphics Agent for Linux](#).

Recommended client adjustments

For improved performance when using PCoIP Ultra, disable *Enhanced A/V Sync* on your PCoIP software client.

- **Windows** clients: Open `C:\%appdata%\Teradici\Teradici PCoIP Client.ini` in an editor and add the following line:

```
enable_enhanced_avsync=0
```

- **macOS** clients: From a command prompt, enter the following command:

```
defaults write "com.teradici.Teradici PCoIP Client" enable_enhanced_avsync 0
```

- **Linux** clients: open `~/ .config/Teradici/Teradici PCoIP Client.ini` in an editor and add the following line:

```
enable_enhanced_avsync=0
```

Printing Support

The PCoIP Graphics Agent for Linux does not support local printing on remote clients.

Local, network, and cloud printers are supported in various ways:

- Linux hosts can print to any printer on the host machine's local area network.
- If your host workstation has access to the Internet, cloud-based printing is supported through cloud-printing services such as Google Cloud Print and HP Mobile Printing.

USB Support

The Graphics Agent for Linux provides support for USB devices and [certain Wacom tablets](#) attached to PCoIP clients.

USB bridging must be explicitly installed

When installing the Graphics Agent for Linux, you must explicitly enable support for USB bridging by installing the required USB dependencies yourself. Refer to the installation steps for [Ubuntu](#) and [RHEL/CentOS](#) for the required commands. If the required USB dependencies are not installed, the Graphics Agent for Linux will be incapable of bridging USB devices.

This requirement does not affect support for keyboards, and mice or other pointer devices. It does not affect Wacom tablet support.

If the required USB packages are installed, USB bridging support is enabled by default. Administrators can disable or configure USB behavior by changing [configuration options](#).

Keyboards, mice, and other pointer devices are managed by PCoIP clients, and are always allowed.

Wacom Tablet Support

The Graphics Agent for Linux supports Wacom tablets in two configurations: *bridged*, where peripheral data is sent to the desktop for processing, and *locally terminated*, where peripheral data is processed locally at the PCoIP Tera2 Zero Client.

Locally terminated Wacom tablets are much more responsive and tolerate high-latency connections, but require a PCoIP Tera2 Zero Client with current firmware.

Locally Terminated Wacom Tablets

Locally-terminated tablets have greatly improved responsiveness, and tolerate higher-latency (including 25ms and higher) networks.

Local termination requires:

- A Graphics Agent for Linux version 2.15 or higher.
- One of the following clients (refer to the next table for specific client support):
 - **PCoIP Tera2 Zero Client** with firmware version **6.2.0** or higher
 - **PCoIP Software Client for Windows**, version **19.11** or higher

Caution: Using Wacom Local Termination on Ubuntu Cloud Hosts

Cloud-based Ubuntu hosts may fail to properly handle locally terminated Wacom tablets. When this occurs, pressure sensitivity and other advanced features will not work properly. To correct this issue, follow [this procedure](#).

The following Wacom tablet models have been tested and are supported with local termination on a PCoIP Tera2 Zero Client:

PCoIP client support for *locally terminated* Wacom tablets and the Graphics Agent for Linux

	PCoIP Tera2 Zero Client 6.2.0+, except as noted	PCoIP Software Client for Windows	PCoIP Software Client for macOS
Intuos 4 4x6 PTK-440	✓	—	—
Intuos Pro S PTH-451	—	—	—
Intuos Pro Medium PTH-660	✓	✓	—
Intuos Pro Large PTH-860	✓	✓	—
Cintiq 22HD	✓	—	—
Cintiq 22HDT	—	—	—
Cintiq 24P	✓ ¹	—	—
Cintiq 24PT	✓ ¹	—	—
Cintiq 32 Pro	—	—	—

Other Wacom tablets may work, but have not been tested and should not be used in production environments.

Bridged Wacom Tablets

Bridged Wacom tablets are supported only in low-latency environments. Tablets in network environments with greater than 25ms latency will show reduced responsiveness and are not recommended.

The following Wacom tablet models have been tested and are supported with a PCoIP Tera2 Zero Client, a PCoIP Software Client for Windows or a PCoIP Software Client for macOS:

PCoIP client support for *bridged* Wacom tablets and the Graphics Agent for Linux

	PCoIP Tera2 Zero Client	PCoIP Software Client for Windows	PCoIP Software Client for macOS
Intuos 4 4x6 PTK-440	✓	✓	✓
Intuos Pro S PTH-451	✓	✓	✓
Intuos Pro Medium PTH-660	✓	—	✓
Intuos Pro Large PTH-860	✓	—	✓
Cintiq 22HD	✓	✓	✓
Cintiq 22HDT	✓	✓	✓
Cintiq 24P	—	—	—
Cintiq 24PT	—	—	—
Cintiq 32 Pro	—	—	—

Other Wacom tablets may work, but have not been tested.

1. Local termination for Cintiq 24P and 24PT requires Tera2 Zero Client firmware 6.5.0 or higher.

Frequently Asked Questions

Can I use a screensaver?

Yes. However, a blank, static screensaver will provide the most efficient CPU and network bandwidth usage.

Why can't I use the maximum number of monitors or monitor resolution?

GPU profile licensing, GPUs, or clients may limit monitor resolution and monitor count, which will prevent you from utilizing the full agent specification. For more information, see [supported displays](#).

Which graphics rendering APIs are supported?

The Graphics Agent captures and delivers the output from the GPU, which is responsible for providing rendering APIs like OpenGL. See the documentation for your GPU for more information about rendering APIs.

How quickly does a PCoIP agent complete a connection?

PCoIP agents can usually achieve a connection in 15 to 30 seconds. Teradici uses the statistical value Top Percentile (TP) to measure the time to establish a session:

- TP99: Ninety-nine percent of connections complete in under 30 seconds.
- TP50: Fifty percent of connections complete in under 15 seconds.

Why is my application not sending audio?

The PCoIP agent delivers audio over PCoIP connections by reassigning the system's default audio device. Only applications that use the system default audio device will send or receive audio over PCoIP; applications that are configured to use non-default devices will not work. If you don't hear audio from your application, make sure it is configured to use the system default audio device.

I'm using Teradici Cloud Licensing. What network blocks should I leave open?

If you are using Teradici Cloud Licensing, you will need to whitelist the following:

- teradici.flexnetoperations.com
- teradici.compliance.flexnetoperations.com

Alternatively, you can also ensure the following network blocks are whitelisted:

- **Production:** 64.14.29.0/24
- **Disaster Recovery:** 64.27.162.0/24

The following network blocks are not currently in use, but may also be used in the future:

- **Production:** 162.244.220.0/24
- **Disaster Recovery:** 162.244.222.0/24

PCoIP Graphics Agent for Linux Installation Guide

Installation instructions are provided here for Ubuntu and RHEL/CentOS distributions of Linux:

- Instructions for [Ubuntu installations](#)
- Instructions for [RHEL or CentOS installations](#)

Installing the PCoIP Graphics Agent for Linux on Ubuntu

Before you proceed with installation, a few prerequisites must be met.

Prerequisites

These instructions assume you have already built the remote desktop machine, and that the machine meets the [agent's requirements](#).

Important: A desktop environment is required

Before proceeding, install a desktop environment of your choice. Kubuntu distributions are bundled with KDE; you can install KDE from other distributions by using this command:

```
sudo apt install kubuntu-desktop
```

To install Mate Desktop, use this command:

```
sudo apt install ubuntu-mate-desktop
```

These commands are provided as a convenience; there is no requirement for KDE or Mate Desktop. Any desktop environment will work.

The Graphics Agent for Linux has additional requirements for GPU acceleration. Make sure your machine is configured with a [supported card](#) before you start (we'll install the correct driver as part of this process).

A few other things to confirm before proceeding:

- SSH must be enabled.
- You must have a license registration code for the agent instance from Teradici.
- The desktop machine requires the following ports to be open: TCP 443, TCP 60443, TCP 4172, and UDP 4172.
- Your GPUs must be licensed with their manufacturers (if required).

- You must be have super user (root) privileges and be able to issue `sudo` commands.
- If you are using a PCoIP Local License Server, you'll need to know it's URL and port numbers.

Important: Protect your license registration code

The license registration code you receive from Teradici is unique to your organization, and should be protected as you would any sensitive data.

Be careful that you do not inadvertently expose your registration code in forums or other public areas by pasting log messages without redacting sensitive information.

Installation Overview

Once your prerequisites are in place, you can proceed with installation. Here's a brief overview of the process:

1. Connect to the machine using SSH.
2. Install the appropriate [GPU drivers](#) for your system.
3. Install the PCoIP Agent on a [PCoIP Agent](#).
4. If required, [configure](#) the agent software.
5. Disconnect the SSH session.
6. Connect to the desktop using a PCoIP client.

If you're ready to start, connect to your machine with an SSH client and proceed to [Installing GPU Drivers](#).

Installing GPU Drivers on Linux machines

Before installing the PCoIP Agent, you need to install the correct driver for your configured GPUs. SSH into your machine and then proceed with the installation instructions below.

The correct driver versions for release 19.11 are shown below. Be sure to install the specified driver, and *not the latest available version*. Teradici qualifies Graphics Agent support against the driver versions listed here.

Documentation for download and installation of these drivers is provided by their manufacturers. As a convenience, we've provided the current locations of relevant third-party documentation here. While we do our best to keep these links up to date, Teradici does not control these resources or their locations and it's possible that they could break.

Install NVIDIA GRID Drivers on AWS Instances

Instance Type	Supported GPUs	Supported NVIDIA GRID driver version	Installation instructions
EC2 G2	NVIDIA K520	GRID 4.7 (367.128)	Download the driver directly from NVIDIA and follow their instructions to install. You can only access this driver if you have purchased a corresponding card.
EC2 G3	NVIDIA M60	GRID 9.1 (430.46)+	Download the driver from Amazon using the AWS CLI or SDKs , as documented by Amazon .
EC2 G4	NVIDIA T4	GRID 9.1 (430.46)+	Download the driver from Amazon using the AWS CLI or SDKs , as documented by Amazon . G4 instances must also include NVIDIA licensing, as documented by NVIDIA .

Install NVIDIA Drivers on Physical PCs

Instance Type	Supported GPUs	Supported NVIDIA driver version	Installation instructions
Physical PC	<ul style="list-style-type: none"> • Tesla (any) • Quadro (2000+) 	Use the latest driver for your supported GPU	Download the driver directly from NVIDIA and follow their instructions to install. You may only have access to this driver if you have purchased a corresponding card.

Install NVIDIA GRID Drivers on Azure NV-series Instances

Instance Type	Supported GPUs	Supported NVIDIA GRID driver version	Installation instructions
Azure NV-series	NVIDIA M60	GRID 9.1 (430.46)+	Microsoft Azure documentation.

Install NVIDIA GRID Drivers on Google Cloud Instances

Instance Type	Supported GPUs	Supported NVIDIA GRID driver version	Installation instructions
Google Cloud instances	NVIDIA P4, P100, T4	GRID 9.1 (430.46)+	Google Cloud Documentation

Install NVIDIA GRID Drivers on Other Instance Types

Instance Type	Supported GPUs	Supported NVIDIA GRID driver version	Installation instructions
All other instance types	GPUs as listed in NVIDIA's GRID release notes.	GRID 9.1 (430.46)+	Instructions shown below.

To install NVIDIA driver for all other instances, including non-cloud instances:

1. Install tools required to install the NVIDIA drivers:

```
sudo apt install build-essential
```

2. Disable the Nouveau video driver (two commands):

```
echo 'blacklist nouveau' | sudo tee -a /etc/modprobe.d/blacklist.conf
```

3. As a super user (sudo), edit the file `/etc/default/grub`. Append the following to the **GRUB_CMDLINE_LINUX** entry:

```
rd.driver.blacklist=nouveau nouveau.modeset=0
```

For example:

```
GRUB_CMDLINE_LINUX="crashkernel=auto console=ttyS0,38400n8
rd.driver.blacklist=nouveau nouveau.modeset=0"
```

Generate a new grub configuration to include the above changes, then reboot:

```
sudo grub2-mkconfig -o /boot/grub2/grub.cfg
sudo reboot
```

4. Install the NVIDIA driver:

```
sudo ./NVIDIA-Linux-x86_64-xxx.xx-grid.run
```

Where `xxx.xx` is the NVIDIA driver version shown in Linux System Requirements.

5. Respond to the installer prompts as follows:

- Accept the EULA
- Say *yes* to installing 32-bit binaries
- Say *no* to modifying the x.org file

6. Verify the NVIDIA installation:

```
nvidia-smi
```

If the installation was successful, you will see your video card in the response.

Installing the PCoIP Agent

Once the NVIDIA drivers are present, you can install the [Graphics Agent for Linux](#).

Installing the Graphics Agent for Linux on Ubuntu

To install the PCoIP Graphics Agent for Linux software:

1. If a Teradici signing key already exists on the desktop, delete it:

```
sudo apt-key del 4E45878267D7ADA8
```

2. Download the Teradici repo:

```
sudo wget -O teradici-repo-latest.deb https://downloads.teradici.com/ubuntu/teradici-repo-$(lsb_release -cs)-latest.deb
```

3. Install the Teradici repo:

```
sudo apt install --reinstall ./teradici-repo-latest.deb
```

!!! note: "Beta software is available" Users who wish to test pre-release versions of software can do so by selecting the beta distribution channel before installing. To switch to the beta channel, edit `pcoip.list` and comment the appropriate lines:

```
```bash
sudo vi /etc/apt/sources.list.d/pcoip.list
```
```

```
Teradici does not recommend installing beta software in production systems.
```

4. **Optionally** install USB dependencies, if you intend to support USB devices other than keyboards, mice, and pointer devices. *If you skip this step, USB redirection will be completely disabled and bridged USB devices will not work.*

```
sudo apt install usb-vhci-dkms
```

5. Install the PCoIP Graphics Agent for Linux:

```
sudo apt update
sudo apt install pcoip-agent-graphics
```

6. Note your machine's local IP address. Clients connecting directly to the host workstation will need this number to connect.
7. Enter the license registration code you received from Teradici.

 **Note: These instructions are for Cloud Licensing**

These instructions assume you are using Teradici Cloud Licensing to activate your PCoIP session licenses. If you are using the Teradici License Server instead, see [Licensing the Graphics Agent for Linux](#).


For unproxied internet connections, type:

```
pcoip-register-host --registration-code=<XXXXXX@YYY-YYYY-YYY>
```

For proxied internet connections, type:

```
pcoip-register-host --registration-code=<XXXXXX@YYY-YYYY-YYY> --proxy-server=<serverURL> --proxy-port=<port>
```

8. Reboot the Linux instance.

 **Installing on stock Ubuntu 18.04 installations**

When connecting to the Graphics Agent for Linux installed on a stock Ubuntu 18.04 installation, users may not be able to establish PCoIP sessions. You can work around this issue by setting the `pcoip.desktop_session` value in `pcoip-agent.conf`:

1. Open `/etc/pcoip-agent/pcoip-agent.conf` in a text editor
2. Add the following line:

```
pcoip.desktop_session = ubuntu
```

3. Save and close the editor.

 **Note: Desktop user interfaces will only be available using PCoIP**

Once installed and running, the PCoIP Graphics Agent for Linux takes over the graphics subsystem which is then unavailable to hypervisors. You can only view the graphical user interface when connecting with a PCoIP client.

For example, you cannot view an ESXi virtual machine console through VSphere; you must connect to the machine using PCoIP.

Installing the Graphics Agent for Linux on a Physical PC

When installing the PCoIP Agent on a physical machine, additional steps are required. **If you installed the Graphics Agent for Linux on a virtual machine, you can ignore these steps.**

 **Important: Install the agent first**

You must install the Graphics Agent for Linux as [described above](#) before proceeding.

These steps are only required when installing on a physical, non-virtualized machine:

1. Attempt to start a PCoIP session. The session will not be successful, but the attempt generates log information we'll use next.
2. Look in `/var/log/Xorg.100.log` for lines like this:


```
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-0): connected
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-0): Internal DisplayPort
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-0): 1440.0 MHz maximum
pixel clock
[ 293.834] (--) NVIDIA(GPU-0):
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-1): connected
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-1): Internal TMDS
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-1): 165.0 MHz maximum
pixel clock
[ 293.834] (--) NVIDIA(GPU-0):
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-2): connected
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-2): Internal DisplayPort
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-2): 1440.0 MHz maximum
pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-3): connected
[ 293.835] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-3): Internal TMDS
[ 293.835] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-3): 165.0 MHz maximum
```

```

pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-4: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-4: Internal DisplayPort
[ 293.835] (--) NVIDIA(GPU-0): DFP-4: 1440.0 MHz maximum pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-5: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-5: Internal TMDS
[ 293.835] (--) NVIDIA(GPU-0): DFP-5: 165.0 MHz maximum pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-6: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-6: Internal DisplayPort
[ 293.835] (--) NVIDIA(GPU-0): DFP-6: 1440.0 MHz maximum pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-7: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-7: Internal TMDS
[ 293.835] (--) NVIDIA(GPU-0): DFP-7: 165.0 MHz maximum pixel clock

```

- Note the names of the outputs with the highest maximum pixel clocks (as many as four will be shown). In the above example, you would note `DFP-0` , `DFP-2` , `DFP-4` , and `DFP-6` .

 **Note: Systems with fewer than four displays**

If there are fewer than four outputs in your system, note them all.

- On the host machine, look in `/tmp` for a generated configuration file with a name similar to `xorg.pcoip.#####.conf`.
- Copy this file to `/etc/X11/xorg.conf.d/10-xorg-pcoip.conf`, and make it writeable (replacing `#####` with the actual value):

```

cp /tmp/xorg.pcoip.#####.conf /etc/X11/xorg.conf.d/10-xorg-pcoip.conf
chmod u+w /etc/X11/xorg.conf.d/10-xorg-pcoip.conf

```

- Open `/etc/X11/xorg.conf.d/10-xorg-pcoip.conf` in a text editor.
- Change the `ConnectedMonitor` and `UseDisplayDevice` settings to the display IDs you noted earlier, as a comma-separated list. Using our example (your values may be different):

```

Option "UseDisplayDevice" "DFP-0,DFP-2,DFP-4,DFP-6"
Option "ConnectedMonitor" "DFP-0,DFP-2,DFP-4,DFP-6"

```

8. Next, map these output values to your expected displays. In the `Device` section of `10-xorg-pcoip.conf`, modify the monitor options to correspond to the displays in the previous step. Each output should be mapped to a monitor identifier from one of the `Monitor` sections in `10-xorg-pcoip.conf`.

Continuing our example, we would map the four outputs to four monitors like this (yours may be different):

```
Option "Monitor-DFP-0" "Monitor0"  
Option "Monitor-DFP-2" "Monitor1"  
Option "Monitor-DFP-4" "Monitor2"  
Option "Monitor-DFP-6" "Monitor3"
```

9. Save and close `10-xorg-pcoip.conf`.
10. To prevent the NVIDIA driver from changing the kernel mode setting, add the `nomodeset` parameter to the GRUB configuration:
 - a. Open `/etc/default/grub` in a text editor.
 - b. Add `nomodeset` to `GRUB_CMDLINE_LINUX_DEFAULT`.
 - c. Save and close the file.
 - d. Rebuild the GRUB configuration:

```
sudo update-grub
```

- e. Reboot the machine.
11. Attempt a PCoIP connection again. The connection should succeed.

If the session does not start, make sure that the displays are correctly configured.

Once you've installed the software, you can [configure it](#), [register licenses](#), or [connect to it](#).

Licensing The Graphics Agent for Linux

The Graphics Agent for Linux must be assigned a valid PCoIP session license before it will work. Until you've registered it, you can't connect to the desktop using a PCoIP client.

You receive a registration code when you purchase a pool of licenses from Teradici. Each registration code can be used multiple times; each use consumes one license in its pool.

Note: Registration code format

Registration codes look like this: `ABCDEFGH12@AB12-C345-D67E-89FG`

PCoIP agent license registrations are managed automatically by Teradici's [Cloud Licensing service](#). If necessary, you can manage them yourself, using your own locally-installed [PCoIP license server](#) instead.

If you need to purchase licenses, contact [Teradici](#).

Using Teradici Cloud Licensing

To use Cloud Licensing, all you need to do is provide a registration code for each PCoIP agent in your deployment (the same registration code can be used multiple times).

To provide the registration code:

SSH into the agent machine, and invoke `pcoip-register-host` with the license registration code and proxy settings if required:

```
pcoip-register-host --registration-code=<registration-code> [--proxy-server=<proxy-server-address>] [--proxy-port=<proxy-port-number>]
```

Whitelist network blocks for Teradici Cloud Licensing

If you are using Teradici Cloud Licensing, you will need to whitelist the following:

- teradici.flexnetoperations.com
- teradici.compliance.flexnetoperations.com

Alternatively, you can also ensure the following network blocks are whitelisted:

- **Production:** 64.14.29.0/24
- **Disaster Recovery:** 64.27.162.0/24

The following network blocks are not currently in use, but may also be used in the future:

- **Production:** 162.244.220.0/24
- **Disaster Recovery:** 162.244.222.0/24

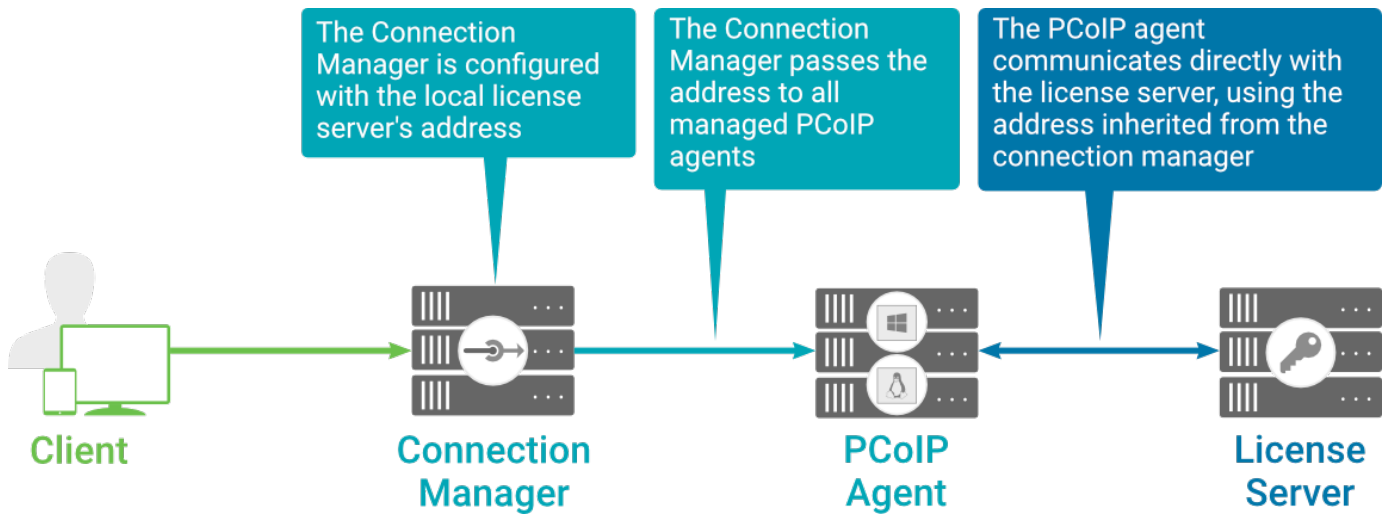
Licensing PCoIP Agents With a Local License Server

In deployments where PCoIP agents cannot access the internet, or where cloud-based licensing is not permitted or desired, a local PCoIP License Server can be used instead. The PCoIP License Server manages PCoIP session licenses within your private environment.

Configuring PCoIP agents to use a local license server is done in one of two ways, depending on whether your deployment uses a PCoIP Connection Manager, or whether your PCoIP clients connect directly to PCoIP agents.

Brokered Environment Licensing

In *brokered* deployments, the license server address is configured in the Connection Manager, which passes it through to its managed PCoIP agents.



Local license validation using a Graphics Agent for Linux and a brokered connection

When using a Connection Manager, the license server address is only configured once no matter how many PCoIP agents are behind the Connection Manager.

To set the License Server URL in the Connection Manager:

1. On the Connection Manager machine, use a text editor to open `/etc/ConnectionManager.conf`.
2. Set the `LicenseServerAddress` parameter with the address of your local license server:
 - `http:// {license-server-address} : {port} /request`
3. Save and close the configuration file.
4. Restart the Connection Manager.

Verifying Your Brokered Licensing Configuration

To verify your system's licensing configuration, run `pcoip-validate-license` from the console on the Graphics Agent for Linux machine. The command will ping the license server and attempt to retrieve information on an available license:

```
pcoip-validate-license --license-server-url <license-server-address> [--proxy-server <proxy-server-address>] [--proxy-port <proxy-port-number>]
```

Where `<license-server-address>` is the address of the license server to ping, formatted as `http:// {license-server-address} : {port} /request`

If the license server is behind a proxy server, provide the proxy information via the `--proxy-server` and `--proxy-port` parameters.

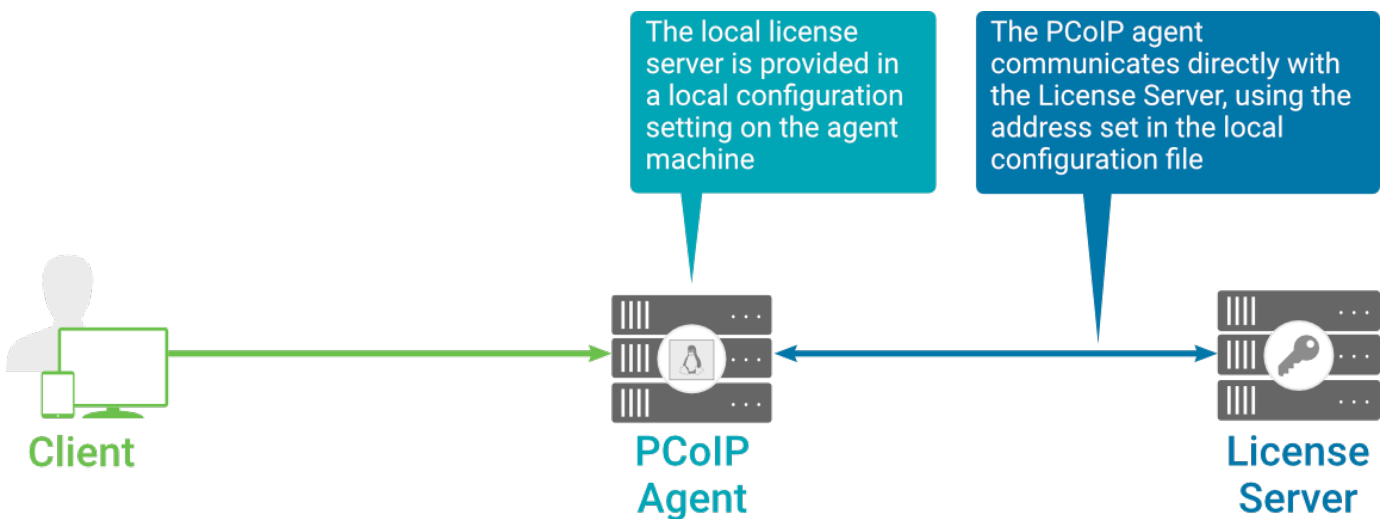
If successful, the response will show that a valid license was found on the license server, and its expiration date.

If the connection is unsuccessful, investigate the following possibilities:

- The license server address is incorrect, or formatted incorrectly.
- The license server is inaccessible.
- There are no available licenses on the license server. `pcoip-validate-license` will only return a positive response if there is at least one available session license.
- If you have only one license on the license server and run `pcoip-validate-license` from a PCoIP session, the command will fail because you are currently using the single license. In this scenario, disconnect your PCoIP session and try again from an SSH session instead.

Unbrokered Environment Licensing

In direct, or unbrokered, deployments, each PCoIP agent is configured with the license server address via a local agent setting. When a client initiates a new PCoIP session, the PCoIP agent uses its local configuration to communicate with the license server.



Local license validation using a Graphics Agent for Linux and a direct (unbrokered) connection

Each PCoIP agent in your environment must be individually configured with the license server's URL.

To configure the License Server URL on the Graphics Agent for Linux machine:

1. Using a text editor, open `/etc/pcoip-agent/pcoip-agent.conf`.

2. Add or modify the `pcoip.license_server_path` directive:

```
pcoip.license_server_path = <license-server-address>
```

Where `<license-server-address>` is the address of the license server, formatted as `http:// {license-server-address} : {port} /request`.

3. If the license server is behind a proxy server, provide the proxy information using the `pcoip.license_proxy_server` and `pcoip.license_proxy_port` directives.
4. Save and close `pcoip-agent.conf`.

The changes will take effect on the next PCoIP session.

Verifying Your Unbrokered Licensing Configuration

To verify your system's licensing configuration, run `pcoip-validate-license` from the console on the Graphics Agent for Linux machine. The command will ping the license server and attempt to retrieve information on an available license:

```
pcoip-validate-license --license-server-url <license-server-address> [--proxy-server <proxy-server-address>] [--proxy-port <proxy-port-number>]
```

Where `<license-server-address>` is the address of the license server to ping, formatted as `http:// {license-server-address} : {port} /request`

If the license server is behind a proxy server, provide the proxy information via the `--proxy-server` and `--proxy-port` parameters.

If successful, the response will show that a valid license was found on the license server, and its expiration date.

If the connection is unsuccessful, investigate the following possibilities:

- The license server address is incorrect, or formatted incorrectly.
- The license server is inaccessible.
- There are no available licenses on the license server. `pcoip-validate-license` will only return a positive response if there is at least one available session license.

- If you have only one license on the license server and run `pcoip-validate-license` from a PCoIP session, the command will fail because you are currently using the single license. In this scenario, disconnect your PCoIP session and try again from an SSH session instead.

Updating the Graphics Agent for Linux on Ubuntu

Updates to the Graphics Agent for Linux will be published on a regular basis. New stable builds will be produced approximately every three months.

To upgrade to the latest version, use the following three commands:

```
sudo apt update  
sudo apt install pcoip-agent-graphics  
sudo reboot
```

Installing the PColP Graphics Agent for Linux on RHEL or CentOS

Before you proceed with installation, a few prerequisites must be met.

Prerequisites

These instructions assume you have already built the remote desktop machine, and that the machine meets the [agent's requirements](#).


Before proceeding with Graphics Agent for Linux installation, install a desktop environment. To install a desktop environment in RHEL or CentOS, use the following command:

```
sudo yum groupinstall 'Server with GUI'
```

The Graphics Agent for Linux has additional requirements for GPU acceleration. Make sure your machine is configured with a [supported card](#) before you start (we'll install the correct driver as part of this process).

A few other things to confirm before proceeding:

- SSH must be enabled.
- You must have a license registration code for the agent instance from Teradici.
- The desktop machine requires the following ports to be open: TCP 443, TCP 60443, TCP 4172, and UDP 4172.
- Your GPUs must be licensed with their manufacturers (if required).
- You must have super user (root) privileges and be able to issue `sudo` commands.
- If you are using a PColP Local License Server, you'll need to know its URL and port numbers.

 **Important: Protect your license registration code**

The license registration code you receive from Teradici is unique to your organization, and should be protected as you would any sensitive data.

Be careful that you do not inadvertently expose your registration code in forums or other public areas by pasting log messages without redacting sensitive information.

Installation Overview

Once your prerequisites are in place, you can proceed with installation. Here's a brief overview of the process:

1. Connect to the machine using SSH.
2. Install the appropriate [GPU drivers](#) for your system.
3. Install the [PCoIP Agent](#).
4. If required, [configure](#) the agent software.
5. Disconnect the SSH session.
6. Connect to the desktop using a PCoIP client.

If you're ready to start, connect to your machine with an SSH client and proceed to [Installing GPU Drivers](#).

Installing GPU Drivers on Linux machines

Before installing the PCoIP Agent, you need to install the correct driver for your configured GPUs. SSH into your machine and then proceed with the installation instructions below.

The correct driver versions for release 19.11 are shown below. Be sure to install the specified driver, and *not the latest available version*. Teradici qualifies Graphics Agent support against the driver versions listed here.

Documentation for download and installation of these drivers is provided by their manufacturers. As a convenience, we've provided the current locations of relevant third-party documentation here. While we do our best to keep these links up to date, Teradici does not control these resources or their locations and it's possible that they could break.

Install NVIDIA GRID Drivers on AWS Instances

| Instance Type | Supported GPUs | Supported NVIDIA GRID driver version | Installation instructions |
|---------------|----------------|--------------------------------------|--|
| EC2 G2 | NVIDIA K520 | GRID 4.7 (367.128) | Download the driver directly from NVIDIA and follow their instructions to install. You can only access this driver if you have purchased a corresponding card. |
| EC2 G3 | NVIDIA M60 | GRID 9.1 (430.46)+ | Download the driver from Amazon using the <i>AWS CLI or SDKs</i> , as documented by Amazon . |
| EC2 G4 | NVIDIA T4 | GRID 9.1 (430.46)+ | Download the driver from Amazon using the <i>AWS CLI or SDKs</i> , as documented by Amazon .

G4 instances must also include NVIDIA licensing, as documented by NVIDIA . |

Install NVIDIA Drivers on Physical PCs

| Instance Type | Supported GPUs | Supported NVIDIA driver version | Installation instructions |
|---------------|---|--|--|
| Physical PC | <ul style="list-style-type: none"> • Tesla (any) • Quadro (2000+) | Use the latest driver for your supported GPU | Download the driver directly from NVIDIA and follow their instructions to install. You may only have access to this driver if you have purchased a corresponding card. |

Install NVIDIA GRID Drivers on Azure NV-series Instances

| Instance Type | Supported GPUs | Supported NVIDIA GRID driver version | Installation instructions |
|-----------------|----------------|--------------------------------------|--|
| Azure NV-series | NVIDIA M60 | GRID 9.1 (430.46)+ | Microsoft Azure documentation. |

Install NVIDIA GRID Drivers on Google Cloud Instances

| Instance Type | Supported GPUs | Supported NVIDIA GRID driver version | Installation instructions |
|------------------------|---------------------|--------------------------------------|--|
| Google Cloud instances | NVIDIA P4, P100, T4 | GRID 9.1 (430.46)+ | Google Cloud Documentation |

Install NVIDIA GRID Drivers on Other Instance Types

| Instance Type | Supported GPUs | Supported NVIDIA GRID driver version | Installation instructions |
|--------------------------|--|--------------------------------------|---------------------------|
| All other instance types | GPUs as listed in NVIDIA's GRID release notes. | GRID 9.1 (430.46)+ | Instructions shown below. |

To install NVIDIA driver for all other instances, including non-cloud instances:

1. Install tools required to install the NVIDIA drivers:

```
sudo yum install kernel-devel
```

2. Disable the Nouveau video driver (two commands):

```
echo 'blacklist nouveau' | sudo tee -a /etc/modprobe.d/blacklist.conf
```

3. As a super user (sudo), edit the file `/etc/default/grub`. Append the following to the **GRUB_CMDLINE_LINUX** entry:

```
rd.driver.blacklist=nouveau nouveau.modeset=0
```

For example:

```
GRUB_CMDLINE_LINUX="crashkernel=auto console=ttyS0,38400n8
rd.driver.blacklist=nouveau nouveau.modeset=0"
```

Generate a new grub configuration to include the above changes, then reboot:

```
sudo grub2-mkconfig -o /boot/grub2/grub.cfg
sudo reboot
```

4. Install the NVIDIA driver:

```
sudo ./NVIDIA-Linux-x86_64-xxx.xx-grid.run
```

Where `xxx.xx` is the NVIDIA driver version shown in Linux System Requirements.

**Important: Azure installations require Hyper-V daemon installation**

If you are running on an Azure instance, you also need to install the Azure Hyper-V daemon:

```
sudo yum install hyperv-daemons
```

5. Respond to the installer prompts as follows:

- Accept the EULA
- Say *yes* to installing 32-bit binaries
- Say *no* to modifying the x.org file

6. Update `initramfs` using `dracut`:

```
dracut -fv
```

7. Verify the NVIDIA installation:

```
nvidia-smi
```

If the installation was successful, you will see your video card in the response.

Installing the PCoIP Agent

Once the NVIDIA drivers are present, you can install the [Graphics Agent for Linux](#).

Installing the Graphics Agent for Linux on RHEL or CentOS

To install the PCoIP Graphics Agent for Linux software:

1. Install wget:

```
sudo yum install wget
```

2. Install the Teradici repository:

```
sudo yum install https://downloads.teradici.com/rhel/teradici-repo-latest.noarch.rpm
```

!!! note: "Beta software is available" Users who wish to test pre-release versions of software can do so by selecting the beta distribution channel before installing. To switch to the beta channel:

```
```bash
sudo yum-config-manager --disable pcoip-stable
sudo yum-config-manager --enable pcoip-beta
```
```

Teradici does not recommend installing beta software in production systems.

3. Install the EPEL repository:

```
sudo wget https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm
sudo rpm -i epel-release-latest-7.noarch.rpm
```

4. **Optionally** install USB dependencies, if you intend to support USB devices other than keyboards, mice, and pointer devices. *If you skip this step, USB redirection will be completely disabled and bridged USB devices will not work.*

```
sudo yum install usb-vhci
```

5. Install the PCoIP Graphics Agent for Linux:

```
sudo yum install pcoip-agent-graphics
```

6. Note your machine's local IP address. Clients connecting directly to the host workstation will need this number to connect.
7. Enter the license registration code you received from Teradici.

 **Note: These instructions are for Cloud Licensing**

These instructions assume you are using Teradici Cloud Licensing to activate your PCoIP session licenses. If you are using the Teradici License Server instead, see [Licensing the Graphics Agent for Linux](#).

For unproxied internet connections, type:

```
pcoip-register-host --registration-code=<XXXXXX@YYY-YYYY-YYY>
```

For proxied internet connections, type:

```
pcoip-register-host --registration-code=<XXXXXX@YYY-YYYY-YYY> --proxy-server=<serverURL> --proxy-port=<port>
```

8. Reboot the Linux instance.

Installing the Graphics Agent for Linux on a Physical PC

When installing the PCoIP Agent on a physical machine, additional steps are required. **If you installed the Graphics Agent for Linux on a virtual machine, you can ignore these steps.**

 **Important: Install the agent first**

You must install the Graphics Agent for Linux as [described above](#) before proceeding.

These steps are only required when installing on a physical, non-virtualized machine:

1. Attempt to start a PCoIP session. The session will not be successful, but the attempt generates log information we'll use next.

2. Look in `/var/log/Xorg.100.log` for lines like this:

```
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-0): connected
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-0): Internal DisplayPort
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-0): 1440.0 MHz maximum
pixel clock
[ 293.834] (--) NVIDIA(GPU-0):
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-1): connected
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-1): Internal TMDS
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-1): 165.0 MHz maximum
pixel clock
[ 293.834] (--) NVIDIA(GPU-0):
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-2): connected
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-2): Internal DisplayPort
[ 293.834] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-2): 1440.0 MHz maximum
pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-3): connected
[ 293.835] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-3): Internal TMDS
[ 293.835] (--) NVIDIA(GPU-0): LNX Linux XGA (DFP-3): 165.0 MHz maximum
pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-4: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-4: Internal DisplayPort
[ 293.835] (--) NVIDIA(GPU-0): DFP-4: 1440.0 MHz maximum pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-5: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-5: Internal TMDS
[ 293.835] (--) NVIDIA(GPU-0): DFP-5: 165.0 MHz maximum pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-6: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-6: Internal DisplayPort
[ 293.835] (--) NVIDIA(GPU-0): DFP-6: 1440.0 MHz maximum pixel clock
[ 293.835] (--) NVIDIA(GPU-0):
[ 293.835] (--) NVIDIA(GPU-0): DFP-7: disconnected
[ 293.835] (--) NVIDIA(GPU-0): DFP-7: Internal TMDS
[ 293.835] (--) NVIDIA(GPU-0): DFP-7: 165.0 MHz maximum pixel clock
```

3. Note the names of the outputs with the highest maximum pixel clocks (as many as four will be shown). In the above example, you would note `DFP-0`, `DFP-2`, `DFP-4`, and `DFP-6`.

 **Note: Systems with fewer than four displays**

If there are fewer than four outputs in your system, note them all.

4. On the host machine, look in `/tmp` for a generated configuration file with a name similar to `xorg.pcoip.#####.conf`.
5. Copy this file to `/etc/X11/xorg.conf.d/10-xorg-pcoip.conf`, and make it writeable (replacing `#####` with the actual value):

```
cp /tmp/xorg.pcoip.#####.conf /etc/X11/xorg.conf.d/10-xorg-pcoip.conf
chmod u+w /etc/X11/xorg.conf.d/10-xorg-pcoip.conf
```

6. Open `/etc/X11/xorg.conf.d/10-xorg-pcoip.conf` in a text editor.
7. Change the `ConnectedMonitor` and `UseDisplayDevice` settings to the display IDs you noted earlier, as a comma-separated list. Using our example (your values may be different):

```
Option "UseDisplayDevice" "DFP-0,DFP-2,DFP-4,DFP-6"
Option "ConnectedMonitor" "DFP-0,DFP-2,DFP-4,DFP-6"
```

8. Next, map these output values to your expected displays. In the `Device` section of `10-xorg-pcoip.conf`, modify the monitor options to correspond to the displays in the previous step. Each output should be mapped to a monitor identifier from one of the `Monitor` sections in `10-xorg-pcoip.conf`.

Continuing our example, we would map the four outputs to four monitors like this (yours may be different):

```
Option "Monitor-DFP-0" "Monitor0"
Option "Monitor-DFP-2" "Monitor1"
Option "Monitor-DFP-4" "Monitor2"
Option "Monitor-DFP-6" "Monitor3"
```

9. Save and close `10-xorg-pcoip.conf`.
10. To prevent the NVIDIA driver from changing the kernel mode setting, add the `nomodeset` parameter to the GRUB configuration:
 - a. Open `/etc/default/grub` in a text editor.
 - b. Add `nomodeset` to `GRUB_CMDLINE_LINUX_DEFAULT`.
 - c. Save and close the file.
 - d. Rebuild the GRUB configuration:

```
sudo grub2-mkconfig -o /boot/grub2/grub.cfg
```

e. Reboot the machine.

11. Attempt a PCoIP connection again. The connection should succeed.

If the session does not start, make sure that the displays are correctly configured.

Once you've installed the software, you can [configure it](#), [register licenses](#), or [connect to it](#).

 **Note: Desktop user interfaces will only be available using PCoIP**

Once installed and running, the PCoIP Graphics Agent for Linux takes over the graphics subsystem which is then unavailable to hypervisors. You can only view the graphical user interface when connecting with a PCoIP client.

For example, you cannot view an ESXi virtual machine console through VSphere; you must connect to the machine using PCoIP.

Licensing The Graphics Agent for Linux

The Graphics Agent for Linux must be assigned a valid PCoIP session license before it will work. Until you've registered it, you can't connect to the desktop using a PCoIP client.

You receive a registration code when you purchase a pool of licenses from Teradici. Each registration code can be used multiple times; each use consumes one license in its pool.

Note: Registration code format

Registration codes look like this: `ABCDEFGH12@AB12-C345-D67E-89FG`

PCoIP agent license registrations are managed automatically by Teradici's [Cloud Licensing service](#). If necessary, you can manage them yourself, using your own locally-installed [PCoIP license server](#) instead.

If you need to purchase licenses, contact [Teradici](#).

Using Teradici Cloud Licensing

To use Cloud Licensing, all you need to do is provide a registration code for each PCoIP agent in your deployment (the same registration code can be used multiple times).

To provide the registration code:

SSH into the agent machine, and invoke `pcoip-register-host` with the license registration code and proxy settings if required:

```
pcoip-register-host --registration-code=<registration-code> [--proxy-server=<proxy-server-address>] [--proxy-port=<proxy-port-number>]
```

Whitelist network blocks for Teradici Cloud Licensing

If you are using Teradici Cloud Licensing, you will need to whitelist the following:

- teradici.flexnetoperations.com
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Alternatively, you can also ensure the following network blocks are whitelisted:

- **Production:** 64.14.29.0/24
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- **Disaster Recovery:** 162.244.222.0/24

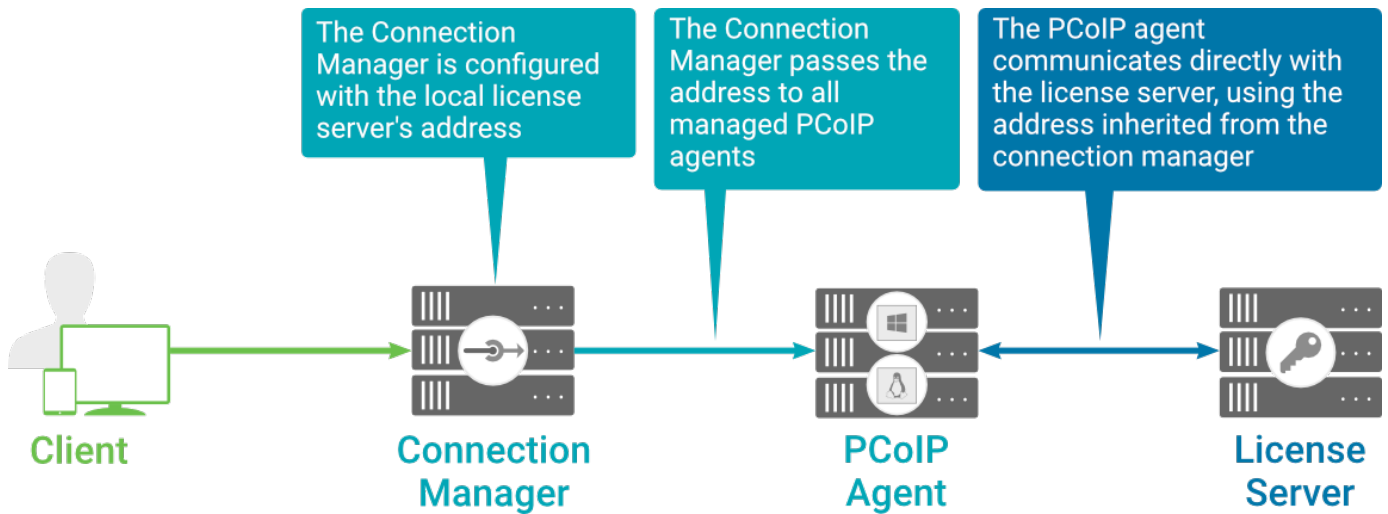
Licensing PCoIP Agents With a Local License Server

In deployments where PCoIP agents cannot access the internet, or where cloud-based licensing is not permitted or desired, a local PCoIP License Server can be used instead. The PCoIP License Server manages PCoIP session licenses within your private environment.

Configuring PCoIP agents to use a local license server is done in one of two ways, depending on whether your deployment uses a PCoIP Connection Manager, or whether your PCoIP clients connect directly to PCoIP agents.

Brokered Environment Licensing

In *brokered* deployments, the license server address is configured in the Connection Manager, which passes it through to its managed PCoIP agents.



Local license validation using a Graphics Agent for Linux and a brokered connection

When using a Connection Manager, the license server address is only configured once no matter how many PCoIP agents are behind the Connection Manager.

To set the License Server URL in the Connection Manager:

1. On the Connection Manager machine, use a text editor to open `/etc/ConnectionManager.conf`.
2. Set the `LicenseServerAddress` parameter with the address of your local license server:
 - `http:// {license-server-address} : {port} /request`
3. Save and close the configuration file.
4. Restart the Connection Manager.

Verifying Your Brokered Licensing Configuration

To verify your system's licensing configuration, run `pcoip-validate-license` from the console on the Graphics Agent for Linux machine. The command will ping the license server and attempt to retrieve information on an available license:

```
pcoip-validate-license --license-server-url <license-server-address> [--proxy-server <proxy-server-address>] [--proxy-port <proxy-port-number>]
```

Where `<license-server-address>` is the address of the license server to ping, formatted as `http:// {license-server-address} : {port} /request`

If the license server is behind a proxy server, provide the proxy information via the `--proxy-server` and `--proxy-port` parameters.

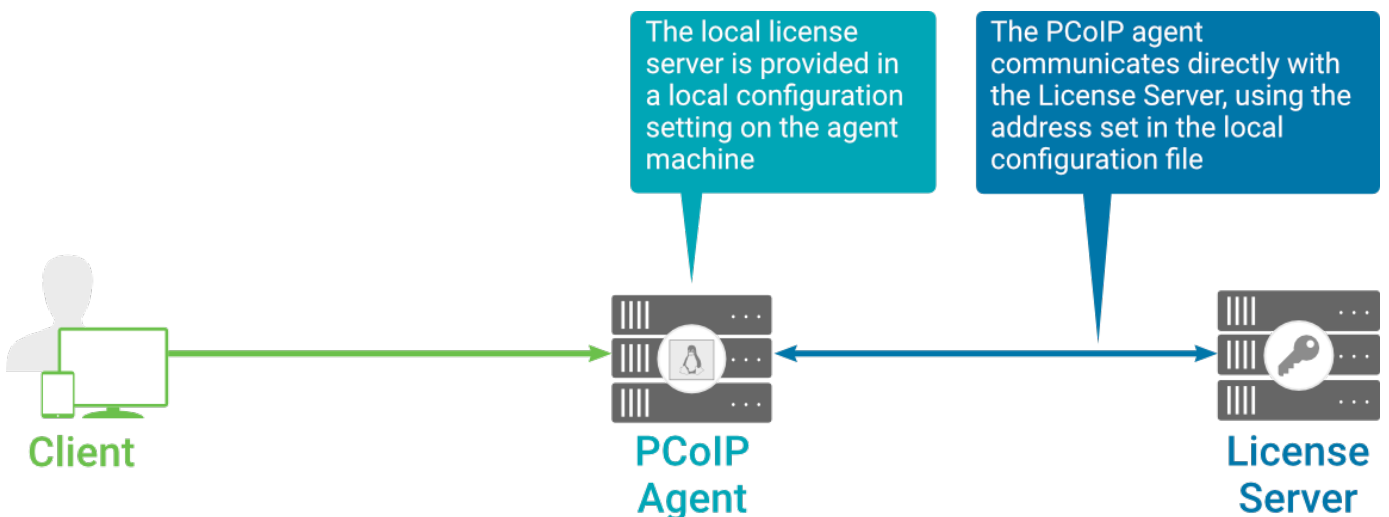
If successful, the response will show that a valid license was found on the license server, and its expiration date.

If the connection is unsuccessful, investigate the following possibilities:

- The license server address is incorrect, or formatted incorrectly.
- The license server is inaccessible.
- There are no available licenses on the license server. `pcoip-validate-license` will only return a positive response if there is at least one available session license.
- If you have only one license on the license server and run `pcoip-validate-license` from a PCoIP session, the command will fail because you are currently using the single license. In this scenario, disconnect your PCoIP session and try again from an SSH session instead.

Unbrokered Environment Licensing

In direct, or unbrokered, deployments, each PCoIP agent is configured with the license server address via a local agent setting. When a client initiates a new PCoIP session, the PCoIP agent uses its local configuration to communicate with the license server.



Local license validation using a Graphics Agent for Linux and a direct (unbrokered) connection

Each PCoIP agent in your environment must be individually configured with the license server's URL.

To configure the License Server URL on the Graphics Agent for Linux machine:

1. Using a text editor, open `/etc/pcoip-agent/pcoip-agent.conf`.

2. Add or modify the `pcoip.license_server_path` directive:

```
pcoip.license_server_path = <license-server-address>
```

Where `<license-server-address>` is the address of the license server, formatted as `http:// {license-server-address} : {port} /request`.

3. If the license server is behind a proxy server, provide the proxy information using the `pcoip.license_proxy_server` and `pcoip.license_proxy_port` directives.
4. Save and close `pcoip-agent.conf`.

The changes will take effect on the next PCoIP session.

Verifying Your Unbrokered Licensing Configuration

To verify your system's licensing configuration, run `pcoip-validate-license` from the console on the Graphics Agent for Linux machine. The command will ping the license server and attempt to retrieve information on an available license:

```
pcoip-validate-license --license-server-url <license-server-address> [--proxy-server <proxy-server-address>] [--proxy-port <proxy-port-number>]
```

Where `<license-server-address>` is the address of the license server to ping, formatted as `http:// {license-server-address} : {port} /request`

If the license server is behind a proxy server, provide the proxy information via the `--proxy-server` and `--proxy-port` parameters.

If successful, the response will show that a valid license was found on the license server, and its expiration date.

If the connection is unsuccessful, investigate the following possibilities:

- The license server address is incorrect, or formatted incorrectly.
- The license server is inaccessible.
- There are no available licenses on the license server. `pcoip-validate-license` will only return a positive response if there is at least one available session license.

- If you have only one license on the license server and run `pcoip-validate-license` from a PCoIP session, the command will fail because you are currently using the single license. In this scenario, disconnect your PCoIP session and try again from an SSH session instead.

Updating the Graphics Agent for Linux on RHEL or CentOS

Updates to the Graphics Agent for Linux will be published on a regular basis. New stable builds will be produced approximately every three months.

To upgrade to the latest version, use the following three commands:

```
sudo yum makecache  
sudo yum update pcoip-agent-graphics  
sudo reboot
```

Configuring the PCoIP Agent

You can configure the PCoIP agent, and optimize PCoIP protocol behavior for local network conditions, by adjusting configuration directives found in `/etc/pcoip-agent/pcoip-agent.conf`.

You can find detailed information and descriptions about each setting [in the next section](#). You can also consult the MAN pages for `pcoip-agent.conf`:

```
man pcoip-agent.conf
```

Applying Configuration Changes

To set or change a configuration value, add or modify directives in `pcoip-agent.conf`. Place one directive on each line, in this format:

```
directive.name = <value>
```

For example, to set the [maximum frame rate](#) to *60 frames per second*, set the [maximum bandwidth](#) to *900000 kilobits/second*, and the [device bandwidth floor](#) to *5000 kilobits/second*, you would set values in `pcoip-agent.conf` like this:

```
pcoip.maximum_frame_rate = 60
pcoip.max_link_rate = 900000
pcoip.device_bandwidth_floor = 5000
```

A complete list of configurable values is shown next in [Configurable Settings](#).

Configurable Settings

The following settings can be configured on the Graphics Agent for Linux. Refer to [Configuring the PCoIP agent](#) to understand how to modify these settings.

Build-to-lossless

| Directive | Options | Default |
|---|-------------------------------|---------|
| <code>pcoip.enable_build_to_lossless</code> | 0 (off), 1 (on) | — |

This setting takes effect immediately. Specifies whether to turn the build-to-lossless feature of the PCoIP protocol off or on; this feature is turned off by default.

When build-to-lossless is turned off images and other desktop content may never build to a lossless state. In network environments with constrained bandwidth, turning off build-to-lossless can provide bandwidth savings. Build-to-lossless is recommended for environments that require images and desktop content to be built to a lossless state.

Clipboard redirection

| Directive | Options | Default |
|---|---|---------|
| <code>pcoip.server_clipboard_state</code> | 0 —Disabled in both directions
1 —Enabled in both directions
2 —Enabled client to agent only
3 —Enabled agent to client only | — |

This setting takes effect when you start the next session. Determines the direction in which clipboard redirection is allowed. You can select one of these values:

- Disabled in both directions
- Enabled in both directions (default setting)
- Enabled client to agent only (That is, allow copy and paste only from the client system to the host desktop.)
- Enabled agent to client only (That is, allow copy and paste only from the host desktop to the client system.)

Clipboard redirection is implemented as a virtual channel. If virtual channels are disabled, clipboard redirection does not function.

Connection addresses

| Directive | Options | Default |
|--|--------------------------------------|---------|
| <code>pcoip.connection_address</code> | string (up to 511 characters) | — |
| <code>pcoip.client_connection_address</code> | string (up to 511 characters) | — |

This setting takes effect when you start the next session. Configuring this allows you to control the IP address used by PCoIP sessions.

Connection address controls the IP used by the agent for the PCoIP session.

Client connection address controls the IP address that the client is told to use when establishing the PCoIP session.

Note that neither of these values should need to be set under normal circumstances.

Desktop environment

| Directive | Options | Default |
|------------------------------------|--------------------------------------|---------|
| <code>pcoip.desktop_session</code> | string (up to 511 characters) | — |

This setting takes effect when you start the next session. Choose the desktop environment that will be launched from `/usr/share/xsessions/*.desktop`, defaults to "kde-plasma" if present, else the first session found alphabetically in `/usr/share/xsessions`.

Note that this setting only takes effect after an existing desktop session ends (either due to a reboot or logging out).

Enable Disclaimer Authentication

| Directive | Options | Default |
|---|-------------------------------|---------|
| <code>pcoip.enable_disclaimer_auth</code> | 0 (off), 1 (on) | — |

This setting takes effect when you start the next session. When this setting is enabled, users connecting via direct connect will be presented a disclaimer prior to password based authentication. If the disclaimer is rejected, the user will not be able to connect.

Disclaimer files must be placed in `/etc/pcoip-agent/disclaimers/` and must be readable by the "pcoip" system user. Files must be named according to the locale, e.g. `en_US.txt` for `en_US`, `ko_KR.txt` for `ko_KR`, etc. If a file matching the negotiated locale is not present, `en_US` will be used as a fallback. If disclaimer text cannot be found, an blank disclaimer will be presented.

Enable PCoIP Ultra CPU optimization

| Directive | Options | Default |
|---|-------------------------------|---------|
| <code>pcoip.ultra_cpu_optimization</code> | 0 (off), 1 (on) | — |

This setting takes effect when you start the next session. When this setting is disabled or not configured PCoIP Ultra CPU optimization is not enabled. These optimizations require the CPU support for the AVX2 instruction set on both the agent and client and is not compatible with the PCoIP Zero client. CPU optimization is recommended for 4k resolutions with video playback requirements of 30 fps.

Enable PCoIP Ultra GPU optimization

| Directive | Options | Default |
|---|-------------------------------|---------|
| <code>pcoip.ultra_gpu_optimization</code> | 0 (off), 1 (on) | — |

This setting takes effect when you start the next session. When this setting is disabled or not configured PCoIP Ultra GPU optimization is not enabled. These optimizations require an NVidia graphics card on the agent VM capable of NVEnc. GPU optimization is recommended when minimal CPU impact of pixel encoding is desired. Enabling this setting will override enabling PCoIP CPU optimizations.

Enable/disable USB in the PCoIP session

| Directive | Options | Default |
|-------------------------------|-------------------------------|---------|
| <code>pcoip.enable_usb</code> | 0 (off), 1 (on) | 1 |

This setting takes effect when you start the next session. Determines whether USB support is enabled in PCoIP sessions. When this setting is not configured, USB is enabled by default. By default all devices are supported unless restrictions are configured through the USB device rules setting.

Enable/disable audio in the PCoIP session

| Directive | Options | Default |
|---------------------------------|-------------------------------|---------|
| <code>pcoip.enable_audio</code> | 0 (off), 1 (on) | 1 |

This setting takes effect when you start the next session. Determines whether audio is enabled in PCoIP sessions. Both endpoints must have audio enabled. When this setting is enabled, PCoIP audio is allowed. When it is disabled, PCoIP audio is disabled. When this setting is not configured, audio is enabled by default.

Hide local cursor

| Directive | Options | Default |
|--|-------------------------------|---------|
| <code>pcoip.disable_locally_rendered_cursor</code> | 0 (off), 1 (on) | — |

This setting takes effect immediately. When this setting is enabled the local cursor on the client will be hidden. This may resolve duplicate cursor issues if there is a host rendered cursor within the host environment but may also result in no visible cursor. With this setting enabled there may be delays in mouse movements due to network latency and video processing times. By default, this setting is disabled, meaning that local cursors will be used, providing the most responsive user experience.

Host key auto repeats

| Directive | Options | Default |
|--|-------------------------------|---------|
| <code>pcoip.use_host_autorepeat</code> | 0 (off), 1 (on) | — |

This setting takes effect when you start the next session. Configuring this allows you to enable or disable host generated key auto repeats. When not configured or disabled, key auto repeats are driven by the client.

License server URL

| Directive | Options | Default |
|--|--------------------------------------|---------|
| <code>pcoip.license_server_path</code> | string (up to 511 characters) | — |

This setting takes effect when you start the next session. This policy sets the license server path. Enter the license server path in 'http://address:port/request' format.

Maximum PCoIP session bandwidth

| Directive | Range | Increment | Default |
|----------------------------------|--------------|-----------|---------|
| <code>pcoip.max_link_rate</code> | 104 – 900000 | 100 | 900000 |

This setting takes effect when you start the next session. Specifies the maximum bandwidth, in kilobits per second, in a PCoIP session. The bandwidth includes all imaging, audio, virtual channel, USB, and control PCoIP traffic.

Set this value based on the overall capacity of the link to which your endpoint is connected, taking into consideration the number of expected concurrent PCoIP sessions. For example, with a single user VDI configuration (e.g. a single PCoIP session) that connects through a 4Mbit/s Internet connection, set this value to 4Mbit (or 10% less than this value to leave some allowance for other network traffic).

Setting this value prevents the agent from attempting to transmit at a higher rate than the link capacity, which would cause excessive packet loss and a poorer user experience. This value is symmetric. It forces the client and agent to use the lower of the two values that are set on the client and agent side. For example, setting a 4Mbit/s maximum bandwidth forces the agent to transmit at a lower rate, even though the setting is configured on the client.

When this setting is disabled or not configured on an endpoint, the endpoint imposes no bandwidth constraints. When this setting is configured, the setting is used as the endpoint's maximum bandwidth constraint in kilobits per second.

The default value when this setting is not configured is 900000 kilobits per second.

This setting applies to the agent and client. If the two endpoints have different settings, the lower value is used.

PCoIP Security Certificate Settings

| Directive | Options | Default |
|--|---|---------|
| <code>pcoip.ssl_cert_type</code> | 1 —From certificate storage
2 —Generate a unique self-signed certificate
0 —From certificate storage if possible, otherwise generate | — |
| <code>pcoip.ssl_cert_min_key_length</code> | 1024 —1024 bits
2048 —2048 bits
3072 —3072 bits
4096 —4096 bits | — |

This setting takes effect when you start the next session. A certificate is used to secure PCoIP related communications. The way PCoIP components choose a certificate is based on the certificate type and the key length. Without a certificate being generated or selected, a PCoIP Session cannot be established.

Depending on the value chosen for the option, 'How the PCoIP agent chooses the certificate...' and the availability of appropriate certificates, PCoIP components may acquire a CA signed certificate from certificate storage or generate an in-memory self-signed certificate.

In order for a CA signed certificate to be loadable by PCoIP components, it must be stored at `/etc/pcoip-agent/ssl-certs` in three `.pem` files, owned by the `pcoip` user, only readable by the owning user.

- `pcoip-key.pem` must contain an unlocked RSA key
- `pcoip-cert.pem` must contain a certificate that signs the key in `pcoip.pem`
- `pcoip-cacert.pem` must contain a CA certificate chain that validates the certificate in `pcoip-cert.pem`.

Note: Self-signed certificates are 3072 bits long.

Select a minimum key length (in bits) for a CA signed certificate. Longer length certificates will require more computing resources and may reduce performance, but will increase security. Shorter length certificates will provide better performance at the cost of lower security.

Note: Please refer to Teradici documentation for instructions on creating and deploying certificates.

PCoIP Security Settings

| Directive | Options | Default |
|--|---|---------|
| <code>pcoip.tls_security_mode</code> | 0 —Maximum Compatibility | — |
| <code>pcoip.tls_cipher_blacklist</code> | string (up to 1023 characters) | — |
| <code>pcoip.data_encryption_ciphers</code> | 6 —AES-256-GCM, AES-128-GCM (default, AES-256-GCM preferred)
4 —AES-256-GCM only
2 —AES-128-GCM only | — |

This setting takes effect when you start the next session. Controls the cryptographic cipher suites and encryption ciphers used by PCoIP endpoints.

The endpoints negotiate the actual cryptographic cipher suites and encryption ciphers based on the settings configured here. Newer versions of TLS and stronger cipher suites will be preferred during negotiation between endpoints.

If this setting is not configured or disabled, the TLS Security Mode will be set to Maximum Compatibility, and the PCoIP Data Encryption Ciphers will be set to AES-256-GCM, AES-128-GCM.

TLS Security Mode

Maximum Compatibility offers TLS 1.1, 1.2 and a range of cipher suites including those that support Perfect Forward Security (PFS) and SHA-1. Supported cipher suites:

- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_GCM_SHA384
- TLS_RSA_WITH_AES_128_GCM_SHA256
- TLS_RSA_WITH_AES_256_CBC_SHA256
- TLS_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_CBC_SHA
- TLS_RSA_WITH_AES_128_CBC_SHA

Blacklisted Cipher Suites

Provides the ability to block specific cipher suites from being offered during negotiation. Must be entered as a semi-colon separated list of cipher suites.

PCoIP Data Encryption Ciphers

Encryption ciphers used for PCoIP UDP data encryption. "AES-256-GCM, AES-128-GCM" is the default setting. AES-256-GCM will get negotiated if the client supports it, otherwise, AES-128-GCM will get negotiated.

PCoIP USB allowed and unallowed device rules

| Directive | Options | Default |
|-------------------------------------|------------------------------------|----------|
| <code>pcoip.usb_auth_table</code> | 23XXXXXX
2203XXXX | 23XXXXXX |
| <code>pcoip.usb_unauth_table</code> | 2203XXXX | — |

This setting takes effect when you start the next session. This setting only applies if the related setting to Enable/disable USB in the PCoIP session is enabled, and specifies the USB devices that are authorized and not authorized for PCoIP sessions. Only devices listed in the USB authorization table are permitted in PCoIP sessions, provided they are not subsequently excluded by an entry in the USB unauthorization table.

You can define a maximum of 10 USB authorization rules and a maximum of 10 USB unauthorization rules. Separate multiple rules with the vertical bar (|) character.

Each rule can be a combination of a Vendor ID (VID) and a Product ID (PID), or a rule can describe a class of USB devices. A class rule can allow or disallow an entire device class, a single subclass, or a protocol within a subclass.

The format of a combination VID/PID rule is 1xxxxyyyy, where xxxx is the VID in hexadecimal format and yyyy is the PID in hexadecimal format. For example, the rule to authorize or block a device with VID 0x1a2b and PID 0x3c4d is 11a2b3c4d.

For class rules, use one of the following formats:

Allow all USB Format: 23XXXXXX devices Example: 23XXXXXX

Allow USB Format: 22classXXXX devices with a Example: 22aaXXXX specific class ID

Allow a specific Format: 21class-subclassXX subclass Example: 21aabbXX

Allow a specific Format: 20class-subclass-protocol protocol Example: 20aabbcc

For example, the USB authorization string to allow USB HID (mouse and keyboard) devices (class ID 0x03) and mass storage devices (class ID 0x08) is 2203XXXX|2208XXXX. The USB unauthorization string to disallow USB Mass Storage devices (class ID 0x08) is 2208XXXX.

An empty USB authorization string means that no USB devices are authorized. An empty USB unauthorization string means that only USB devices in the authorization list are allowed.

If these settings are unconfigured, the default behavior is that all devices are allowed.

PCoIP event log verbosity

| Directive | Range | Increment | Default |
|--------------------------------------|-------|-----------|---------|
| <code>pcoip.event_filter_mode</code> | 0 – 3 | 1 | 2 |

This setting takes effect immediately. Configures the PCoIP event log verbosity ranging from 0 (least verbose) to 3 (most verbose).

PCoIP image quality levels

| Directive | Options | Range | Increment | Default |
|--|------------------------------------|----------|-----------|---------|
| <code>pcoip.minimum_image_quality</code> | | 30 – 100 | 10 | 40 |
| <code>pcoip.maximum_initial_image_quality</code> | | 30 – 100 | 10 | 80 |
| <code>pcoip.frame_rate_vs_quality_factor</code> | | 0 – 100 | 10 | 50 |
| <code>pcoip.maximum_frame_rate</code> | | 0 – 120 | 1 | – |
| <code>pcoip.yuv_chroma_subsampling</code> | 0 –4:4:4
1 –4:2:0 | | | – |
| <code>pcoip.use_client_img_settings</code> | 0 (off), 1 (on) | | | – |

This setting takes effect immediately. Controls how PCoIP renders images during periods of network congestion. The Minimum Image Quality, Maximum Initial Image Quality, and Maximum Frame Rate values interoperate to provide fine control in network-bandwidth constrained environments.

Use the Minimum Image Quality value to balance image quality and frame rate for limited-bandwidth scenarios. You can specify a value between 30 and 100. The default value is 40. A lower value allows higher frame-rates, but with a potentially lower quality display. A higher value provides higher image quality, but with potentially lower frame rates when network bandwidth is constrained. When network bandwidth is not constrained, PCoIP maintains maximum quality regardless of this value.

Use the Maximum Initial Image Quality value to reduce the network bandwidth peaks required by PCoIP by limiting the initial quality of the changed regions of the display image. You can specify a value between 30 and 100. The default value is 80. A lower value reduces the image quality of content changes and decreases peak bandwidth requirements. A higher value increases the image quality of content changes and increases peak bandwidth requirements. Unchanged regions of the image progressively build to a lossless (perfect) quality regardless of this value. A value of 80 or lower best utilizes the available bandwidth.

The Minimum Image Quality value cannot exceed the Maximum Initial Image Quality value.

Use the Frame Rate vs Image Quality value to favor image sharpness over smooth motion during a PCoIP session when network bandwidth is limited. Lower values favor smoothness, higher values favor sharpness of image.

Use the Maximum Frame Rate value to manage the average bandwidth consumed per user by limiting the number of screen updates per second. You can specify a value between 1 and 120 frames per second. The default value is 30 for PCoIP Standard Agent and 60 for PCoIP Graphics Agent. A higher value can use more bandwidth but provides less jitter, which allows smoother transitions in changing images such as video. A lower value uses less bandwidth but results in more jitter.

YUV chroma subsampling is set to 4:4:4 by default for maximum image quality. Setting YUV chroma subsampling to 4:2:0 is only supported in combination with PCoIP Ultra GPU optimization. This setting will enable chroma subsampling to further compress the imaging to reduce bandwidth usage at the cost of reduced color accuracy.

Set the 'Use image settings from client' when you want to use the 'Minimum Image Quality', 'Maximum Initial Image Quality', 'Maximum Frame Rate', 'Disable Build to Lossless' values from the client instead of the host. Currently, only Zero Client Firmware 3.5 and above support these settings on the client side.

These image quality values apply to the soft host only and have no effect on a soft client.

When this setting is disabled or not configured, the default values are used.

PCoIP session MTU

| Directive | Range | Increment | Default |
|-----------------------------|------------|-----------|---------|
| <code>pcoip.mtu_size</code> | 500 – 1500 | 1 | 1200 |

This setting takes effect when you start the next session. Specifies the Maximum Transmission Unit (MTU) size for UDP packets for a PCoIP session.

The MTU size includes IP and UDP packet headers. TCP uses the standard MTU discovery mechanism to set MTU and is not affected by this setting. The maximum MTU size is 1500 bytes. The minimum MTU size is 500 bytes. The default value is 1200 bytes.

Typically, you do not have to change the MTU size. Change this value if you have an unusual network setup that causes PCoIP packet fragmentation.

This setting applies to the agent and client. If the two endpoints have different MTU size settings, the lowest size is used.

If this setting is disabled or not configured, the client uses the default value in the negotiation with the agent.

PCoIP session audio bandwidth limit

| Directive | Range | Increment | Default |
|--|------------|-----------|---------|
| <code>pcoip.audio_bandwidth_limit</code> | 0 – 100000 | 1 | 500 |

This setting takes effect immediately. Specifies the maximum audio bandwidth that can be used for audio output (sound playback) from the virtual desktop to the client in a PCoIP session. Note that the network transport overhead can add an additional 20-40% bandwidth to this number.

Audio processing monitors the bandwidth needed for audio and selects the audio compression algorithm that provides the best quality possible, without exceeding the bandwidth limit:

- 256 kbit/s or higher - stereo, high-quality, compressed audio
- 48 kbit/s to 255 kbit/s - stereo audio ranging between FM radio quality down to AM radio quality
- 32 kbit/s to 47 kbit/s - monaural AM radio or phone call quality
- Below 32 kbit/s - results in no audio playback

If this setting is not configured, a default audio bandwidth limit of 256 kbit/s is configured to constrain the audio compression algorithm selected.

Note that zero clients on older firmware have less efficient audio compression algorithms that may require setting this limit higher to achieve the same audio quality or upgrading the firmware.

PCoIP session bandwidth floor

| Directive | Range | Increment | Default |
|---|------------|-----------|---------|
| <code>pcoip.device_bandwidth_floor</code> | 0 – 100000 | 1 | – |

This setting takes effect immediately. Specifies a lower limit, in kilobits per second, for the bandwidth that is reserved by the PCoIP session.

This setting configures the minimum expected bandwidth transmission rate for the endpoint. When you use this setting to reserve bandwidth for an endpoint, the session does not have to wait for bandwidth to become available, which improves session responsiveness.

Make sure that you do not over-subscribe the total reserved bandwidth for all endpoints. Make sure that the sum of bandwidth floors for all connections in your configuration does not exceed the network capability.

The default value is 0, which means that no minimum bandwidth is reserved. When this setting is disabled or not configured, no minimum bandwidth is reserved.

This setting applies to the agent and client, but the setting only affects the endpoint on which it is configured.

PCoIP statistics interval

| Directive | Range | Increment | Default |
|---|-----------|-----------|---------|
| <code>pcoip.server_statistics_interval_seconds</code> | 0 – 65535 | 1 | – |

This setting takes effect immediately. Configuring this allows you to set an interval in seconds for logging performance statistics to the PCoIP server log. When not configured, logging is disabled by default.

PCoIP transport header

| Directive | Options | Default |
|---|--|---------|
| <code>pcoip.transport_session_priority</code> | <ul style="list-style-type: none"> 1—High Priority 2—Medium Priority (default) 3—Low Priority 4—Undefined Priority | – |

This setting takes effect when you start the next session. Configures the PCoIP transport header.

PCoIP transport header is a 32-bit long header which is added to all PCoIP UDP packets (only if the transport header is enabled/supported by both sides). PCoIP transport header allows network devices to make better prioritization/Qos decisions when dealing with network congestions. The transport header is enabled by default.

The transport session priority determines the PCoIP session priority reported in the PCoIP Transport Header. Network devices make better prioritization/Qos decisions based on the specified transport session priority. The transport session priority value is negotiated by the PCoIP agent and client. If agent has specified a transport session priority value (high, medium, or low), then the session uses the agent specified session priority. If only the client has specified a transport session priority (high, medium, or low), then the session uses the client specified session priority. If neither agent nor client has specified a transport session priority (or specified 'undefined priority'), then the session uses/defaults to the medium session priority.

PCoIP virtual channels

| Directive | Options | Default |
|---------------------------------|---|---------|
| <code>pcoip.enable_vchan</code> | 1 —Enable all virtual channels other than those in the list
2 —Disable all virtual channels other than those in the list | — |
| <code>pcoip.vchan_list</code> | string (up to 255 characters) | — |

This setting takes effect when you start the next session. Specifies the virtual channels that can or cannot operate over a PCoIP session.

There are two modes of operation:

- Enable all virtual channels except for <list> (default setting)
- Disable all virtual channels except for <list>

When specifying which virtual channels to include or not include in the list, the following rules apply:

- An empty list is allowed
- Multiple virtual channel names in the list must be separated by the vertical bar (|) character. For example: channelA|channelB
- Vertical bar or backslash (\) characters in virtual channel names must be preceded by a backslash. For example: the channel name "awk\ward\channel" must be specified as "awk\ward\channel" (without the double quotes)
- A maximum of 15 virtual channels are allowed in a single PCoIP session

The virtual channel must be enabled on both agent and client for it to be used.

Proxy Access to a remote License Server

| Directive | Options | Range | Increment | Default |
|---|--------------------------------------|-------|-----------|---------|
| <code>pcoip.license_proxy_server</code> | string (up to 511 characters) | | | — |

| Directive | Options | Range | Increment | Default |
|---------------------------------------|---------|-----------|-----------|---------|
| <code>pcoip.license_proxy_port</code> | | 0 – 65535 | 1 | – |

This setting takes effect when you start the next session. If a proxy is required to access a local License Server or the Cloud License Server, enter those parameters here. These parameters are loaded only during agent startup.

Timezone redirection

| Directive | Options | Default |
|---|-------------------------------|---------|
| <code>pcoip.enable_timezone_redirect</code> | 0 (off), 1 (on) | 1 |

This setting takes effect when you start the next session. Configuring this allows you to enable or disable timezone redirection. When not configured, timezone redirection is enabled by default.

X server remote access

| Directive | Options | Default |
|-------------------------------------|-------------------------------|---------|
| <code>pcoip.allow_x_remoting</code> | 0 (off), 1 (on) | – |

This setting takes effect when you restart the agent. Configuring this allows you to enable or disable remote access to the X server run by the PCoIP Agent. When not configured, remote access is disabled by default.

Making a Connection from a PCoIP Client

Once you've installed and configured your Graphics Agent for Linux, you're ready to accept incoming connections from remote *PCoIP Clients*. PCoIP clients are remote endpoint devices available in as software or firmware and make secure PCoIP connections to the remote desktop through the installed Graphics Agent for Linux.

For more information about PCoIP client connectivity requirements and usage instructions, see the following documentation:

- Software clients:
 - [Teradici PCoIP Software Client for Windows](#)
 - [Teradici PCoIP Software Client for macOS](#)
 - [Teradici PCoIP Software Client for Linux](#)
- Mobile Clients:
 - [Teradici PCoIP Mobile Client for iOS](#)
 - [Teradici PCoIP Mobile Client for Android](#)
 - [Teradici PCoIP Mobile Client for Chromebooks](#)
- Zero clients:
 - [Teradici Tera2 PCoIP Zero Client](#)

PCoIP Agent Deployment and Client Connectivity Requirements

PCoIP clients can connect to your desktops hosted in proof-of-concept, cloud, or datacenter deployments. Requirements and network security levels will vary depending on your deployment type. See [Supported PCoIP Architectures](#) for each deployment's components and requirements.

Managing Client Connections

In most cases, PCoIP clients connect to PCoIP agents through a *connection broker*. The broker is responsible for matching users to their available desktops, and then establishing the PCoIP session with their selected resource.

PCoIP agents do not need to be configured to use these brokering services. All relevant configuration is done at the broker, which then communicates with the agent.

Brokering Options

There are several ways you can manage client connections to remote desktops

Direct Connections

In direct connection scenarios—where a broker is not involved—the PCoIP agent acts as its own broker. In these cases, a client user will provide the IP address or FQDN of the agent machine to their client, and the connection is made securely with no intermediate step.

Teradici Cloud Access Manager

Teradici [Cloud Access Manager](#) is a cloud-based service available as part of Cloud Access Software that centrally manages PCoIP deployments. It enables highly scalable and cost-effective Cloud Access Software deployments by managing cloud compute costs and brokering PCoIP connections to remote Windows or Linux workstations.

Teradici PCoIP Connection Manager

The **Teradici PCoIP Connection Manager** is provided in a bundle with the **Teradici PCoIP Security Gateway**, and allows self-managed brokering services. For information about the Teradici PCoIP Connection Manager, including installation and configuration instructions, see the [Connection Manager and Security Gateway documentation](#).

Third-party Connection Brokers

Teradici PCoIP agents also support third-party connection brokers. For a current list of brokering partners, see [Teradici Technology Partners](#) on Teradici's website.

Security Certificates in PCoIP Agents

PCoIP requires a certificate to establish a session. By default, PCoIP agents generate a self-signed certificate that secures the PCoIP session. Each component in the PCoIP system can generate these self-signed certificates, which will automatically work together without requiring any configuration.

You can, if needed, create and deploy your own custom certificates instead of relying on Teradici's self-signed certificates. This section explains how to create and implement custom certificates.

Using Custom Security Certificates

You can use OpenSSL, Microsoft Certification Authority, or a public certificate authority (CA) of your choice to create your certificates. If you are not using OpenSSL, consult your certificate authority's documentation for instructions on creating certificates in a Windows Certificate Store-compatible format.

The procedures in this section use OpenSSL to generate certificates that will satisfy most security scanner tools when the root signing certificate is known to them.

Caution: Certificates are stored in the Windows Certificate Store

Certificates are stored in the Windows certificate store. If you have old certificates that are stored on the host, they should be deleted to avoid conflicts or confusion.

Custom Certificate Guidelines

If you choose to use your own certificates, follow these general guidelines:

- Save your root CA signing certificate in a safe place for deployment to clients.
- Back up private and public keys to secure locations.
- Never store files created when generating keys or certificates on network drives without password protection.

- Once certificates have been deployed to the Windows certificate store, the files they came from are no longer needed and can be deleted.
- Standard automatic tools, such as Automatic Certificate Enrollment and Group Policy, can be used for deploying automatically generated certificates. Both Automatic Certificate Enrollment and Group Policies are implemented through Active Directory. See MSDN Active Directory documentation for more information.

Pre-session Encryption Algorithms

Connections are negotiated using the following supported RSA cipher suites:

- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_GCM_SHA384
- TLS_RSA_WITH_AES_128_GCM_SHA256
- TLS_RSA_WITH_AES_256_CBC_SHA256
- TLS_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_CBC_SHA
- TLS_RSA_WITH_AES_128_CBC_SHA

**Note: Minimum SSL version**

These Max Compatibility security level cipher suites have a minimum required SSL version of TLS 1.0.

Custom Security Certificates

In order for a CA signed certificate to be loadable by PCoIP components, it must be stored in `/etc/pcoip-agent/ssl-certs` in three **.pem** files, owned by the `pcoip` user, and only readable by the owning user:

- **pcoip-key.pem** must contain an unlocked RSA key
- **pcoip-cert.pem** must contain a certificate that signs the key in `pcoip.pem`
- **pcoip-cacert.pem** must contain a CA certificate chain that validates the certificate in `pcoip-cert.pem`

Configure the Graphics Agent for Linux to use custom certificates

The Graphics Agent for Linux can be configured to look locally for certificates or to generate its own by setting the `pcoip.ssl_cert_type` directive in `pcoip-agent.conf`.

For more detailed information, see [Configuring the Agent](#).

Select a Security Key Length

When the Graphics Agent for Linux is attempting to find a certificate in storage, the required key length can be set via the `pcoip.ssl_cert_min_key_length` directive in `pcoip-agent.conf`.

If the system cannot find a local certificate with the specified key length, it will either self-generate a certificate (if `pcoip.ssl_cert_type` is 0), or refuse the connection (if `pcoip.ssl_cert_type` is 1). This setting has no effect if `pcoip.ssl_cert_type` is set to 2.

For more detailed information, see [Configuring the Agent](#).

Reference

This section contains reference information regarding the PCoIP Graphics Agent for Linux.

Choose a reference topic from the navigation menu to continue.

Reference Information for vSphere Users

This section contains reference information useful for vSphere users configuring displays with the PCoIP Graphics Agent.

You can find information here for:

- [Configuring multiple monitors for NVIDIA GRID vGPUs](#)
- [Configuring displays for NVIDIA GRID with pass-through](#)

Configuring Multiple Monitors for NVIDIA GRID vGPU

This section describes how to add a shared NVIDIA GRID PCI device to your virtual machine and specify its GPU profile. The following instructions are only required for virtualized workstations using a [supported NVIDIA GRID vGPU video card](#).

Note: Monitor limitations

The PCoIP Graphics Agent supports up to four displays. Your video card may limit the actual number of displays you can have.

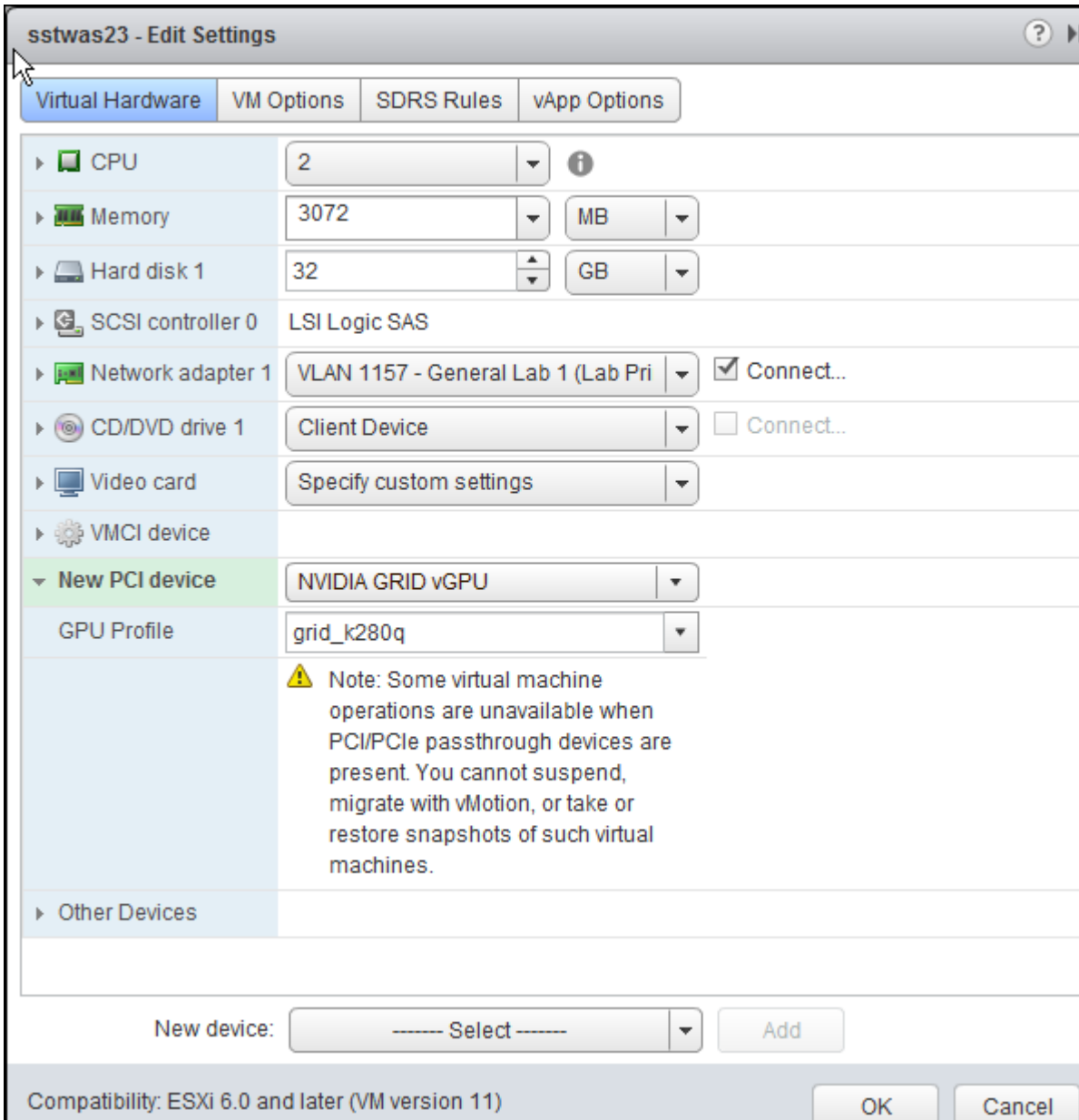
Before you begin, ensure the following prerequisites are met:

- You have installed the NVIDIA GRID graphics card and supported driver on the ESXi host.
- You have installed VMware Tools on your ESXi host and the VMware SVGA 3D driver on the virtual machine.
- You have local administrative permission to the workstation.
- You have disabled OS power management features on the workstation.

To add a shared PCI device and specify its GPU profile:

1. Using vSphere Web Client, right-click the virtual machine in the Navigator list and select **Power > Power Off**.

- Right-click the virtual machine and select **Edit Settings**.



- In the New device drop-down list, select **Shared PCI Device** and then click **Add**.
- Click **Reserve all memory**.
- In the GPU Profile drop-down list, select the profile for your card. This profile determines how many virtual display heads, or displays, are available for your card.
- Click **OK**.
- Start the virtual machine.

Configuring Displays for NVIDIA GRID with Pass-Through

This section describes how to add an NVIDIA GRID PCI device to your ESXi host.

The following instructions are only required for virtualized workstations using a supported NVIDIA GRID video card with pass-through. For specific supported models, see [System Requirements](#).

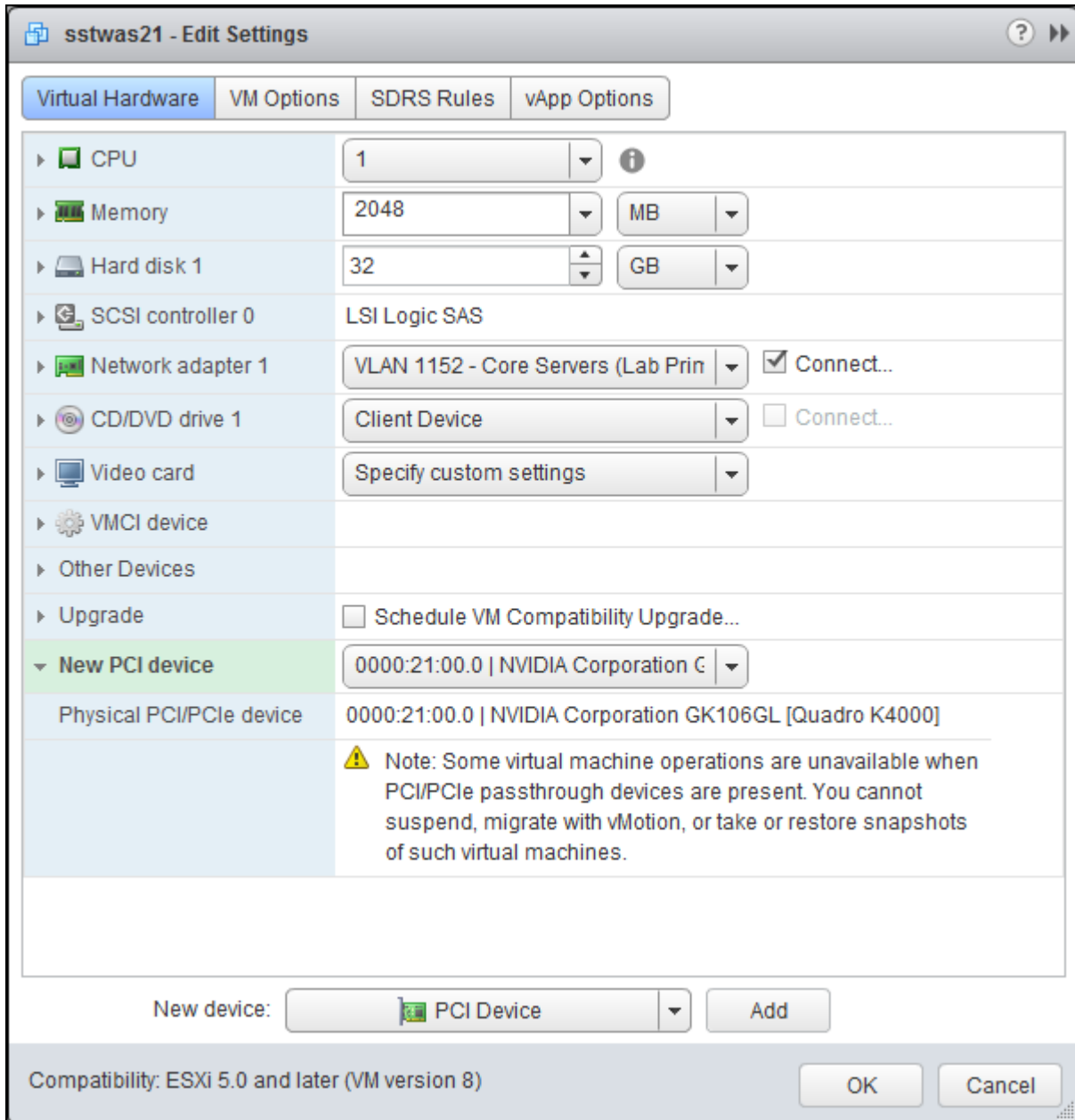
Before you begin, ensure the following prerequisites are met:

- You have installed the NVIDIA GRID graphics card.
- You have installed VMware Tools on your ESXi host and the VMware SVGA 3D driver on the virtual machine.
- You have local administrative permission to the workstation.
- You have disabled OS power management features on the workstation.

To add a PCI device:

1. Using vSphere Web Client, right-click the virtual machine in the Navigator list and select **Power > Power Off**.
2. Right-click the virtual machine and select **Edit Settings**.

- In the *New device* drop-down list, select **PCI Device** and then click **Add**.



- Click **OK**.
- Start the virtual machine.

Contacting Support

If you encounter any problems installing, configuring, or running the Graphics Agent for Linux, you can create a [support ticket](#) with Teradici.

Before creating a ticket, be prepared with the following:

- A detailed description of the problem
- Your agent version number ([how do I find my version number?](#))
- A prepared [support file](#)

The Teradici Community Forum

The PCoIP Community Forum enables users to have conversations with other IT professionals to learn how they resolved issues, find answers to common questions, have peer group discussions on various topics, and access the Teradici PCoIP Technical Support Service team. Teradici staff are heavily involved in the forums.

To visit the Teradici community, go to <https://communities.teradici.com>.

Finding the Graphics Agent for Linux Version Number

To find the agent's version number in Ubuntu:

```
dpkg -l "pcoip*"
```

To find the agent's version number in RHEL or CentOS:

```
rpm -qai "pcoip*"
```

The console will display a table of all registered PCoIP components and their version number, if they have one.

Creating a Technical Support File

Teradici may request a support file from your system in order to troubleshoot and diagnose PCoIP issues. The support file is an archive containing PCoIP Graphics Agent for Linux logs and other diagnostic data that can help support diagnose your problem.

To create a support file, type the following command as a super user:

```
sudo pcoip-support-bundler
```

The support file will be created and placed in your `/tmp` directory. A message will display containing the full system path to the generated file.

Performing Diagnostics

Each PCoIP component creates and updates a log file which records its activity as the system is used. Most troubleshooting within a PCoIP system begins by examining these log files and looking for error conditions or other indications that may explain why the system is not operating as expected.

Log files for the Graphics Agent for Linux and other Teradici PCoIP components are saved to [specific directories](#).

Note: Bundling log files for support

When investigating issues with Teradici support, you may need to provide a support file which includes system log files. Instructions are provided [here](#).

Locating Agent Log Files

Log files for the PCoIP agent are located in the following directories by default. If you changed your agent's location during installation, the log files will be in your custom location instead.


| Component | Log file location |
|------------------|---|
| Agent | <code>/var/log/pcoip-agent/agent.log</code> |
| Arbiter | <code>/var/log/pcoip-agent/arbiter.log</code> |
| Session Launcher | <code>/var/log/pcoip-agent/session-launcher.log</code> |
| Server/User | <code>/var/log/pcoip-agent/server.<user>.log</code> |

Note: Bundling log files for support

When investigating issues with Teradici support, you may need to provide a support file which includes system log files. Instructions are provided [here](#).

Setting Log Verbosity

Each PCoIP component generates diagnostic log messages. The default log levels are recommended for use in a production deployment. When troubleshooting a particular problem, Teradici Support Services may recommend adjusting the PCoIP event log verbosity level to obtain more information from certain parts of the system.

 **Note: This is a global setting**

The `pcoip.event_filter_mode` directive is a global setting, and affects the output levels of all PCoIP components.

To change the log verbosity level, set the `pcoip.event_filter_mode` directive in the `pcoip-agent.conf` file. See [Configuring the PCoIP Agent](#) for instructions.

Log rotation

Log files in Linux agents are managed by `logrotate`. To manage how log files are rotated, edit the following files:

- `/etc/logrotate.d/pcoip-*`
- `/usr/share/pcoip-agent/pcoip-server.logrotate`

Session Log IDs

At the start of each PCoIP session, a unique session ID is generated by the PCoIP Client and passed to all connected PCoIP components (including the Graphics Agent for Linux). Log messages generated by the agent are prefixed with this session ID, making it easy to identify. All log messages generated during a single session, by any PCoIP component, will be prefixed with the same session log ID in RFC-4122 format:

```
yyyy-mm-ddThh:mm:ss.ffffffZ xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx > ...
```

For example:

```
2015-11-06T08:01:18.688879Z 4208fb66-e22a-11d1-a7d7-00a0c982c00d > ...
```

Log messages that do not pertain to a specific session will show a string of zeroes in place of the session log ID number.

If a PCoIP component does not receive a session log ID from the PCoIP client, or receives an invalid value, it will generate a new session log ID and distribute it to the other components in the system.

Troubleshooting License Issues

Teradici includes a license validation utility that scans your local system and any connected physical or cloud-based license servers for active licenses, and informs you of when your license subscription expires. For more information, see [Welcome to Cloud Licensing](#).

To run the license validation tool, type:

```
pcoip-validate-license
```

For more detailed information on `pcoip-validate-license`, type:

```
man pcoip-validate-license
```

To list your licenses and their expiration status, type:

```
pcoip-list-licenses
```

For more detailed instructions on `pcoip-list-licenses`, type:

```
man pcoip-list-licenses
```