

IBM Power Systems

PowerVM NovaLink

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Note

Before using this information and the product it supports, read the information in "Notices" on page 37.

This edition applies to IBM PowerVM NovaLink Version 1.0.0.6, to IBM AIX Version 7.2, to IBM AIX Version 7.1, to IBM AIX Version 6.1, to IBM Virtual I/O Server Version 2.2.6.0, and to all subsequent releases and modifications until otherwise indicated in new editions. This version does not run on all reduced instruction set computer (RISC) models nor does it run on CISC models.

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PowerVM NovaLink

PowerVM® NovaLink is a software interface that is used for virtualization management. You can install PowerVM NovaLink on a PowerVM server. PowerVM NovaLink enables highly scalable modern cloud management and deployment of critical enterprise workloads. You can use PowerVM NovaLink to provision large numbers of virtual machines on PowerVM servers quickly and at a reduced cost.

PowerVM NovaLink runs on a Linux logical partition on a POWER8® processor-based server that is virtualized by PowerVM. You can manage the server through a representational state transfer application programming interface (REST API) or through a command-line interface (CLI). You can also manage the server by using PowerVC or other OpenStack solutions. PowerVM NovaLink is available at no additional charge for servers that are virtualized by PowerVM.

PowerVM NovaLink can be installed only on POWER8 processor-based servers.

Benefits of PowerVM NovaLink

PowerVM NovaLink provides the following benefits:

- Rapidly provisions large numbers of virtual machines on PowerVM servers.
- Simplifies the deployment of new systems. The PowerVM NovaLink installer creates a PowerVM NovaLink partition and Virtual I/O Server (VIOS) partitions on the server and installs operating systems and the PowerVM NovaLink software. The PowerVM NovaLink installer reduces the installation time and facilitates repeatable deployments.
- Reduces the complexity and increases the security of your server management infrastructure. PowerVM NovaLink provides a server management interface on the server. The server management network between PowerVM NovaLink and its virtual machines is secure by design and is configured with minimal user intervention.
- Operates with PowerVC or other OpenStack solutions to manage your servers.
- PowerVM NovaLink 1.0.0.6 supports PowerVM Open I/O. Open I/O enables Software Defined Environments for Software Defined Networking (SDN) and storage. As the I/O is hosted by a single Linux partition, it is targeted for the cloud, development, and test environments. Production environments where the workload does not have built-in resiliency should continue to use the Virtual I/O Server to host I/O.

PowerVM NovaLink architecture

The PowerVM NovaLink software runs on an Ubuntu Linux, or a Red Hat Enterprise Linux version 7.3 logical partition. The PowerVM NovaLink partition uses I/O resources that are virtualized by the Virtual I/O Server. The PowerVM NovaLink software is delivered by using the *dpkg* package manager for Ubuntu versions of PowerVM NovaLink, and the standard Red Hat Packet Manager (RPM) for Red Hat versions of PowerVM NovaLink, similar to any other software in Linux.

PowerVM NovaLink includes an installer that configures the PowerVM NovaLink environment in one action. The PowerVM NovaLink installer creates the Linux and Virtual I/O Server logical partitions and installs the operating systems and PowerVM NovaLink software.

The PowerVM NovaLink stack consists of the following services:

- PowerVM NovaLink Core Services provide direct interfaces to the managed system.
 - REST API which is similar to that on the Hardware Management Console (HMC) and a python-based software development kit: <https://github.com/powervm/pypowervm>

- Command-line interface (CLI) for shell interaction with PowerVM. This CLI differs from CLI of the HMC to provide a complete PowerVM CLI that encompasses both hypervisor and VIOS configurations.
- OpenStack Services provide drivers and plug-ins for use by OpenStack-based management solutions, including PowerVC:
 - PowerVM virtualization driver for OpenStack Nova: <https://github.com/openstack/nova-powervm>
 - PowerVM Shared Ethernet Adapter agent for OpenStack Neutron: <https://github.com/openstack/networking-powervm>
 - PowerVM compute agent plug-ins for OpenStack Ceilometer: <https://github.com/openstack/ceilometer-powervm>

Managed system co-management

POWER8 processor-based servers can be co-managed by PowerVM NovaLink and an HMC that is at version 8.4.0, or later. An HMC that co-manages a POWER8 processor-based server can also manage POWER6® and POWER7® processor-based servers.

When a managed system is co-managed by the HMC and PowerVM NovaLink, you set either PowerVM NovaLink or the HMC to be in the master mode. Certain system management, partition management, and Capacity on Demand (CoD) tasks can be performed only from the interface that is in master mode. For example, if PowerVM NovaLink is in the master mode, you can run partition change operations only by using PowerVM NovaLink. If you want to run partition change operations by using the HMC, you must set the HMC to master mode.

Firmware updates for a co-managed system can be performed only from the HMC. The HMC must be set to the master mode to update the firmware.

To set the HMC to the master mode, run the following command from the HMC command line, where *managed_system* is the name of the managed system:

```
chcimgmt -m managed_system -o setmaster -t norm
```

After you have completed your tasks on the HMC, run the following command from the HMC command line to make PowerVM NovaLink the master again.

```
chcimgmt -m managed_system -o relmaster
```

Note: When a server is co-managed by the HMC and PowerVM NovaLink, partition profiles and system plans are not supported, regardless of whether the HMC is set to the master mode. While you can use the HMC to modify the virtualization configuration of the system when the HMC is the master, you must use the HMC Enhanced UI (or CLI) as it is optimized for working with the current configuration of a partition. However, you must use PowerVC or another OpenStack solution to manage the virtualization for your PowerVM NovaLink servers.

The HMC retains its hardware and service management roles in a co-managed environment, even when the HMC is not in master mode. However, you must set the HMC to master mode to perform any operations that change the system state. Operations that change the system state include firmware update, repair and verify, power on, or power off.

For more information about OpenStack, see the OpenStack documentation (<http://docs.openstack.org/>).

For more information about PowerVC, see the PowerVC Standard Edition information in IBM® Knowledge Center (<https://www.ibm.com/support/knowledgecenter/SSXK2N>).

What's new in PowerVM NovaLink

Read about new or significantly changed information in IBM PowerVM NovaLink since the previous update of this topic collection.

June 2017

The following updates were made to the content:

- The PowerVM NovaLink installer now supports *automated* installation of Red Hat Enterprise Linux (RHEL) by using a configured kickstart file. For more information about installing PowerVM NovaLink on an RHEL logical partition, see “Installing the PowerVM NovaLink software on a Red Hat Enterprise Linux partition” on page 18.
- PowerVM NovaLink supports PowerVM Open I/O, which supports Software Defined Environments (SDE) for Software Defined Networking (SDN) and storage.

December 2016

The following updates were made to the content:

- PowerVM NovaLink also supports Red Hat Enterprise Linux (RHEL) version 7.3, or later. For more information about installing PowerVM NovaLink on an RHEL logical partition, see “Installing the PowerVM NovaLink software on a Red Hat Enterprise Linux partition” on page 18.
- Updated information in various topics for clarity.

PowerVM NovaLink system requirements

For successful operation, PowerVM NovaLink requires hardware and software to meet specific criteria.

POWER8 server requirements

PowerVM NovaLink can be installed on POWER8 processor-based servers with firmware level FW840.11, or later. However, it is highly recommend to have an installation of the most recent firmware, and all Software Defined Environment capabilities are supported only when the firmware is at level FW860.12, or later.

PowerVM NovaLink partition requirements

PowerVM NovaLink requires its own partition on its managed system. The table lists the system resources that are required by the PowerVM NovaLink partition.

Table 1. System requirements of the PowerVM NovaLink partition

System requirements	Standard VIOS-based environment	PowerVM Open I/O (SDN and SDE)
Processors	0.5 shared processors that are uncapped with a nonzero weight and two virtual processors	
Memory	4.5 GB adjusted to 2.5 GB after installation	8 GB - 64 GB, depending on the number of partitions that are hosted
Storage	>= 30 GB vSCSI storage (LV, PV, NPIV)	SDN Only: >= 30 GB vSCSI storage (LV, PV, NPIV) SDN + Storage: Local SAS disk
Physical I/O	None	Physical network adapters (SDN and SDE), SAS devices (SDE)
Network	Virtual Ethernet	

If you install the PowerVM NovaLink environment on a new managed system, the PowerVM NovaLink installer creates the PowerVM NovaLink partition automatically. When the PowerVM NovaLink installer creates the PowerVM NovaLink partition on a new managed system, the PowerVM NovaLink installer always uses virtualized storage that is provisioned from the Virtual I/O Server, except when the installation is done with the SDE mode. . The installer creates logical volumes from the VIOS rootvg for the PowerVM NovaLink partition. If you set the PowerVM NovaLink installer to use I/O redundancy, the storage for the PowerVM NovaLink partition is automatically mirrored for redundancy by using RAID 1.

When you install PowerVM NovaLink in the Open I/O Software Defined Environment (SDE) mode, the PowerVM NovaLink installer uses the local storage that is available on the PowerVM server for the PowerVM NovaLink partition.

If you install the PowerVM NovaLink software on a system that is already managed by a HMC, use the HMC to create a Linux logical partition that has the required amount of resources. When you use the HMC to create the Linux logical partition, set the `powervm_mgmt_capable` flag to true.

PowerVM NovaLink by default installs Ubuntu 16.04.2 LTS, but also supports Red Hat Enterprise Linux version 7.3, or later. The installer provides an option to install RHEL after the required setup or configuration of the system completes.

PowerVM Open I/O Software Defined Environment (SDE)

In the Open I/O SDE mode, the PowerVM NovaLink installer does not install the VIOS as part of the installation process because the PowerVM NovaLink partition hosts the storage and network for the client logical partitions.

In the Open I/O SDE mode, the PowerVM NovaLink partition must be running the Ubuntu Linux operating system. The Red Hat Enterprise Linux operating system is not currently supported because the kernel level must be version 4.4, or later. To support the Live Partition Mobility operation in SDE mode, a Mover Service Partition (MSP) is required. To install an MSP on the PowerVM system, you can run the following command:

```
sudo apt install pvm-msp
```

Supported operating systems for hosted logical partitions

PowerVM NovaLink supports all operating systems that are supported on the machine type and model of the managed system.

Virtual I/O Server partition requirements

PowerVM NovaLink requires Virtual I/O Server version 2.2.5.0 or later.

If you install the PowerVM NovaLink environment on a new managed system, configure one disk with at least 60 GB of storage for each Virtual I/O Server instance that you plan to create on the system. You can configure the disks in your local serial-attached Small Computer System Interface (SAS) storage or on your storage area network (SAN). If you create two instances of Virtual I/O Server, create each disk on a separate SAS controller or Fibre Channel (FC) card for redundancy. Otherwise, the resource requirements for Virtual I/O Servers that are installed by the PowerVM NovaLink installer are the same as the resource requirements for Virtual I/O Servers that are not installed by the PowerVM NovaLink.

For more information about the requirements for Virtual I/O Server logical partitions, see Planning for the Virtual I/O Server.

Reliable Scalable Cluster Technology (RSCT) for Resource Monitoring Control (RMC) connections

To enable IPv6 link-local address support for Resource Monitoring Control (RMC) connections, update the Reliable Scalable Cluster Technology (RSCT) packages on AIX® and Linux logical partitions to be at version 3.2.1.0 or later.

For information about updating RSCT packages, see “Updating RSCT packages for PowerVM NovaLink” on page 23.

PowerVC requirement

PowerVC version 1.3 or later is required to manage a PowerVM NovaLink host. PowerVC version 1.3.2 or later is required to manage a host that has PowerVM NovaLink version 1.0.0.4 or later, whether the Software Defined Networking (SDN) used or not.

Hardware Management Console (HMC) requirement

HMC version 8.4.0, service pack 1, or later, is required to co-manage a system with PowerVM NovaLink.

Resource Monitoring Control (RMC) and PowerVM NovaLink

Resource Monitoring Control (RMC) is used by a management console to perform dynamic operations on a logical partition. RMC connections between PowerVM NovaLink and each logical partition are routed through a dedicated internal virtual network. Such a configuration simplifies the network architecture for RMC, which increases the resiliency of the network to security attacks.

The RMC internal virtual network is configured such that client logical partitions can communicate only with the PowerVM NovaLink partition and not with each other.

For easier configuration of the RMC internal virtual network, assign an IPv6 link-local address to the RMC virtual network interfaces. To assign IPv6 link-local addresses to the RMC virtual network interfaces on AIX and Linux logical partitions, the Reliable Scalable Cluster Technology (RSCT) packages must be at version 3.2.1.0 or later. For more information about how to update RSCT packages, see “Updating RSCT packages for PowerVM NovaLink” on page 23.

A Hardware Management Console (HMC) cannot use the RMC internal virtual network, even if the HMC co-manages the system with PowerVM NovaLink. For an HMC to perform dynamic operations on a co-managed system, you must configure an RMC connection between the HMC and each logical partition.

Installing PowerVM NovaLink

Use the PowerVM NovaLink installer to install the entire PowerVM NovaLink environment on a new managed system (Greenfield Installation). Alternatively, for systems that are already running and managed by a Hardware Management Console (HMC), create a Linux logical partition, and use the PowerVM NovaLink installer to prepare and install the Linux operating system and the PowerVM NovaLink (and related) software.

If you plan to use the PowerVM NovaLink installer to install the entire PowerVM NovaLink environment on a new managed system, add the Virtual I/O Server installation files to the PowerVM NovaLink image.

For easier installation of PowerVM NovaLink on multiple servers, set up a netboot (bootp) server to install PowerVM NovaLink from a network.

The PowerVM NovaLink software is supported via a PowerVM support contract. Support for the underlying operating system (Ubuntu or RHEL) on which the PowerVM NovaLink software runs can be obtained separately, either directly with the Linux vendor or through IBM.

Adding the Virtual I/O Server installation files to the PowerVM NovaLink installer

The downloaded PowerVM NovaLink installer contains a copy of the Ubuntu Linux operating system and the PowerVM NovaLink software. To install the entire PowerVM NovaLink environment on new servers, add the Virtual I/O Server (VIOS) installation files to the PowerVM NovaLink installer.

Before you add VIOS installation files to the PowerVM NovaLink installer, complete the following tasks:

- If you do not already have the installer, download the PowerVM NovaLink installer. You can download the PowerVM NovaLink installer from the My Entitled Systems support site (<http://www.ibm.com/server/eserver/ess>) in the **My entitled software** area. Download the installer for the **5692-A6P 2324 NovaLink** feature code. Use the installer to create a bootable USB drive. Alternatively, you can add the installer to a netboot server for network installation.
- Obtain the Virtual I/O Server installation discs.
- Obtain a Linux PC or notebook. The Linux PC or notebook must have at least 60 GB of free space.

To add Virtual I/O Server installation files to the PowerVM NovaLink installer, complete the following steps:

1. Access the command-line interface on the Linux PC or notebook.
2. Insert the first Virtual I/O Server installation disc and extract the disc image to your home directory by entering the following command. Replace `/dev/srx` with the device name (for example, `/dev/sr0`).

```
sudo cat /dev/srx > $HOME/dvdimage.v1.iso
```
3. Insert the second Virtual I/O Server installation disc and extract the disc image to your home directory by entering the following command. Replace `srx` with the device name (for example, `sr0`).

```
sudo cat /dev/srx > $HOME/dvdimage.v2.iso
```
4. Copy the PowerVM NovaLink installer to the home directory on the Linux PC or notebook.
5. Copy the installation files from the Virtual I/O Server installation images by entering the following commands.

```
sudo mkdir -p /tmp/mount_point
sudo mkdir /vios_files
sudo mount -o loop $HOME/dvdimage.v1.iso /tmp/mount_point
sudo cp /tmp/mount_point/nimol/ioserver_res/booti.chrp.mp.ent.Z /vios_files/
sudo cp /tmp/mount_point/nimol/ioserver_res/ispot.tar.Z /vios_files/
sudo cp /tmp/mount_point/nimol/ioserver_res/bosinst.data /vios_files/
sudo cp /tmp/mount_point/usr/sys/inst.images/mksysb_image /vios_files/
sudo cp /tmp/mount_point/usr/sys/inst.images/mksysb_image2 /vios_files/
sudo umount /tmp/mount_point
sudo mount -o loop $HOME/dvdimage.v2.iso /tmp/mount_point
sudo cp /tmp/mount_point/usr/sys/inst.images/mksysb_image /vios_files/mksysb_image3
sudo umount /tmp/mount_point
```

6. Open the `/vios_files/bosinst.data` file in a text editor and set the `SIZE_MB` entry in the `target_disk_data` section to be `SIZE_MB=61140`.
7. Copy the files from the PowerVM NovaLink installer by entering the following commands. Ensure that the hidden `.disk` directory is copied to the new directory.

```
sudo mkdir /novalink
sudo mount -o loop $HOME/novalink_ppc64e1_v1.iso /tmp/mount_point
cd /novalink
sudo cp -pR /tmp/mount_point/* .
sudo cp -pR /tmp/mount_point/.disk .
```

8. Copy the Virtual I/O Server installation files to the `vios/inst.images` directory by entering the following command.

```
sudo cp /vios_files/* /novalink/vios/inst.images/
```


9. Regenerate the PowerVM NovaLink installer with the Virtual I/O Server installation files by entering the following command on one line.

```
genisoimage -r -T -udf --allow-limited-size --netatalk -chrp-boot  
-iso-level 4 -part -no-desktop -o $HOME/novalink-ubuntu-ppc64el.iso /novalink
```

10. To create a bootable USB drive by using the PowerVM NovaLink image, complete the following steps. If you plan to install PowerVM NovaLink from a netboot server, you do not need to complete this step.
 - a. Insert a USB drive into the PC or notebook. The USB drive must have at least 6 GB of free space.
 - b. Use the **dmesg** command to show the device name of the USB drive (for example, `sd`).
 - c. Enter the **mount** command to check for partitions on the USB drive. If partitions exist, enter the **umount** command as a root user to unmount all partitions from the USB drive. For example, if the device name is `/dev/sdc`, run the **mount** command and check for any mount points with `/dev/sdcx` (for example, `/dev/sdc1`). Enter the `umount /dev/sdcx` command for all such mount points that you find.
 - d. Copy the image to the USB drive by entering the following command. Replace `/dev/sdx` with the device name.

```
dd if=novalink-ubuntu-ppc64el.iso of=/dev/sdx bs=1M
```

Related information:

 [Customizing and using the bosinst.data file](#)

Setting up network installation of PowerVM NovaLink

For easier installation of PowerVM NovaLink to multiple servers, you can choose to install PowerVM NovaLink from a network by using netboot.

Complete the following tasks to set up network installation of PowerVM NovaLink:

- Set up a bootp server for network boot requests.
- Set up a tftp server for downloads of the initial files.
- Set up an http server for downloads of the remaining files.

To set up a netboot (bootp) server for PowerVM NovaLink installation on an Ubuntu Linux logical partition on a POWER8 or x86 system:

1. Access the command line of an Ubuntu Linux logical partition.
2. Install the *bootp* protocol on the Ubuntu Linux logical partition by entering the following command.

```
sudo apt-get install bootp
```
3. Check whether your system is running *systemd* or *upstart* as the default *init* daemon. Ubuntu 15.04 and later versions might use the *systemd* daemon, and previous Ubuntu versions such as Ubuntu 14.04 LTS use the *upstart* daemon by default. For the Ubuntu logical partition that is running the *upstart* daemon such as Ubuntu 14.04 LTS, create the netboot (bootp) service file `/etc/init/bootp.conf` by entering the command `sudo vi /etc/init/bootp.conf`. Enter the following text in the `/etc/init/bootp.conf` file.

```
# bootp - myservice job file  
description "my service description"  
author "Me "  
# Stanzas  
#  
# Stanzas control when and how a process is started and stopped  
# See a list of stanzas here: http://upstart.ubuntu.com/wiki/Stanzas#respawn  
# When to start the service  
start on runlevel [2345]  
# When to stop the service  
stop on runlevel [016]  
# Essentially lets upstart know the process will detach itself to the background
```

```

expect fork
# Automatically restart process if crashed
respawn
script
# Start the process
exec /usr/sbin/bootpd -d2 /etc/bootptab 2> /var/log/bootp.log &
end script

```

For the Ubuntu logical partition that is running the *systemd* daemon, such as Ubuntu 15.04, or later versions, create the netboot (bootp) service file `/etc/systemd/system/bootp.service` by entering the command `sudo vi /etc/systemd/system/bootp.service`. Enter the following text in the `/etc/systemd/system/bootp.service` file:

```

# The bootp.service file
[Unit]
Description=Bootp Service

[Service]
Type=forking
Restart=always

# Start it up
ExecStart=/usr/sbin/bootpd -d2 /etc/bootptab 2> /var/log/bootp.log &

# And stop it this way. See ApMain signal_handler
KillSignal=SIGTERM

[Install]
WantedBy=multi-user.target

```

4. Create the netboot (bootp) server database file `/etc/bootptab` by entering the command `sudo vi /etc/bootptab`. Enter the following text in the `/etc/bootptab` file. Replace *HOST_IP_ADDRESS*, *SUBNET MASK*, *GATEWAY_IP_ADDRESS*, *DOMAIN_NAME*, *NAME_SERVER_IP_ADDRESS*, and *BOOT_SERVER_IP_ADDRESS* with the values for your network.

```

neo-dev-19:\
bf=core.elf:\
ip=HOST_IP_ADDRESS:\
sm=SUBNET_MASK:\
gw=GATEWAY_IP_ADDRESS:\
dn=DOMAIN_NAME:\
ns=NAME_SERVER_IP_ADDRESS:\
sa=BOOT_SERVER_IP_ADDRESS:

```

5. Reload the service configuration information.

For the Ubuntu logical partition that is running the *upstart* daemon, such as Ubuntu 14.04 LTS, and earlier versions, enter the following command:

```
sudo initctl reload-configuration
```

For the Ubuntu logical partition that is running *systemd* daemon, such as Ubuntu 15.04, and later versions, enter the following command:

```
sudo systemctl daemon-reload
```

6. Start the bootp service by entering the following commands:

```
sudo service isc-dhcp-server stop
sudo service bootp start
```

7. Install the *tftpd-hpa* and *tftp-hpa* packages on the Ubuntu Linux logical partition by running the **sudo apt-get install tftpd-hpa apache2** command. After installation of the packages, the tftp server starts in a secure mode and uses `/var/lib/tftpboot` as the root directory.

8. Create a grub `/var/lib/tftpboot/core.elf` file that supports network booting by entering the following command in one line: `grub-mkimage --output=/var/lib/tftpboot/core.elf --format=powerpc-ieee1275 boot configfile echo elf http ieee1275_fb linux loadenv ls net normal ofnet reboot regexp serial sleep tftp time true date -p /`

A prebuilt `core.elf` file can be found in the installer ISO file at `/pvm/core.elf`. See step.

9. Create a `/var/lib/tftpboot/grub.cfg` file. A template file is located in the installer ISO file at the following location: `/pvm/sample_grub.cfg`. Alternatively, you can create a `/var/lib/tftpboot/grub.cfg` file by entering the command `sudo vi /var/lib/tftpboot/grub.cfg` and by entering the following text in the `/var/lib/tftpboot/grub.cfg` file. Replace `GATEWAY_ADDRESS`, `SUBNET MASK`, `GATEWAY_IP_ADDRESS`, and `HOST_NAME` with the values for your network.

```
# Sample GRUB configuration for NovaLink network installation
set default=0
set timeout=-1

menuentry 'PowerVM NovaLink Install/Repair' {
  insmod http
  insmod tftp
  regexp -s 1:mac_pos1 -s 2:mac_pos2 -s 3:mac_pos3 -s 4:mac_pos4 -s 5:mac_pos5 -s 6:mac_pos6
  '(.):(:):(:):(:):(:):(:)' ${net_default_mac}
  set bootif=01-${mac_pos1}-${mac_pos2}-${mac_pos3}-${mac_pos4}-${mac_pos5}-${mac_pos6}
  regexp -s 1:prefix '(.)\.\(.\*)' ${net_default_ip}
  # Setup variables with values from Grub's default variables
  set ip=${net_default_ip}
  set serveraddress=${net_default_server}
  set domain=${net_ofnet_network_domain}
  # If tftp is desired, replace http with tftp in the following line
  set root=http,${serveraddress}
  set gateway=GATEWAY_ADDRESS
  set netmask=SUBNET_MASK
  set nameserver=NAME_SERVER_IP_ADDRESS
  set hostname=HOST_NAME
  # In this sample file, the directory novalink is assumed to exist on the
  # BOOTP server and has the NovaLink ISO content
  linux //novalink/install/vmlinux \
  live-installer/net-image=http://${serveraddress}/novalink/install/filesystem.squashfs \
  pkgset/language-pack-patterns= \
  pkgset/install-language-support=false \
  netcfg/disable_dhcp=true \
  netcfg/choose_interface=auto \
  netcfg/get_ipaddress=${ip} \
  netcfg/get_netmask=${netmask} \
  netcfg/get_gateway=${gateway} \
  netcfg/get_nameservers=${nameserver} \
  netcfg/get_hostname=${hostname} \
  netcfg/get_domain=${domain} \
  debian-installer/locale=en_US.UTF-8 \
  debian-installer/country=US \
  # The pvm-installmode=SDN is new for NovaLink 1.0.0.4 and later versions.
  # If it is not specified there will be no SDN panel in the installation wizard.
  # If you are using SDN Tech Preview, please uncomment the following line:
  # pvm-installmode=SDN \
  # The directory novalink-repo on the BOOTP server contains the content
  # of the pvmrepo.tgz file obtained from the pvm/repo directory on the
  # NovaLink installer ISO file.
  pvm-repo=http://${serveraddress}/novalink-repo \
  pvm-installer-config=http://${serveraddress}/pvm/repo/pvm-install.cfg \
  # The directory novalink-vios on the BOOTP server contains the files
  # needed to perform a NIM install of Virtual I/O Servers
  pvm-viosdir=http://${serveraddress}/novalink-vios \
  BOOTIF=${bootif} -- quiet
  initrd //novalink/install/netboot_initrd.gz
}
```

10. Create a `/tftpboot/grub.cfg/var/www/html/novalink-vios` directory and then copy the Virtual I/O Server installation files to this directory. Complete the following steps:

- a. Insert the first Virtual I/O Server installation disc and extract the disc image to your home directory by entering the following command. Replace `/dev/srx` with the device name (for example, `/dev/sr0`).

```
sudo cat /dev/srx > $HOME/dvdimage.v1.iso
```

- b. Insert the second Virtual I/O Server installation disc and extract the disc image to your home directory by entering the following command. Replace *srx* with the device name (for example, *sr0*).

```
sudo cat /dev/srx > $HOME/dvdimage.v2.iso
```

- c. Copy the installation files from the Virtual I/O Server installation images by entering the following commands.

```
sudo mkdir -p /tmp/mount_point
sudo mkdir novalink-vios
sudo mount -o loop $HOME/dvdimage.v1.iso /tmp/mount_point
sudo cp /tmp/mount_point/nimol/ioserver_res/booti.chrp.mp.ent.Z $HOME/novalink-vios
sudo cp /tmp/mount_point/nimol/ioserver_res/ispot.tar.Z $HOME/novalink-vios
sudo cp /tmp/mount_point/nimol/ioserver_res/bosinst.data $HOME/novalink-vios
sudo cp /tmp/mount_point/usr/sys/inst.images/mksysb_image $HOME/novalink-vios
sudo cp /tmp/mount_point/usr/sys/inst.images/mksysb_image2 $HOME/novalink-vios
sudo umount /tmp/mount_point
sudo mount -o loop $HOME/dvdimage.v2.iso /tmp/mount_point
sudo cp /tmp/mount_point/usr/sys/inst.images/mksysb_image $HOME/novalink-vios/mksysb_image3
sudo umount /tmp/mount_point
```

- d. Open the `/var/www/html/novalink-vios/bosinst.data` file in a text editor and set the `SIZE_MB` entry in the `target_disk_data` section to be `SIZE_MB=61140`.

- e. Concatenate the `mksysb` files into a single file by entering the following commands.

```
sudo mkdir -p /var/www/html/novalink-vios
sudo cp $HOME/novalink-vios/booti.chrp.mp.ent.Z /var/www/html/novalink-vios/
sudo cp $HOME/novalink-vios/ispot.tar.Z /var/www/html/novalink-vios/
sudo cp $HOME/novalink-vios/bosinst.data /var/www/html/novalink-vios/
sudo cp $HOME/novalink-vios/mksysb_image /var/www/html/novalink-vios/mksysb
sudo cat $HOME/novalink-vios/mksysb_image2 >> /var/www/html/novalink-vios/mksysb
sudo cat $HOME/novalink-vios/mksysb_image3 >> /var/www/html/novalink-vios/mksysb
```

11. Copy the PowerVM NovaLink installer ISO file to your netboot (bootp) server at the following location: `$HOME/novalink.iso`.

12. Create a `/var/www/html/novalink` directory. Mount the PowerVM NovaLink image over it by entering the following commands.

```
sudo mkdir -p /var/www/html/novalink
sudo mount -o loop $HOME/novalink.iso /var/www/html/novalink
```

13. Create a `/var/www/html/novalink-repo` directory, then extract the PowerVM NovaLink installation files into the directory by entering the following commands.

```
sudo mkdir -p /var/www/html/novalink-repo
cd /var/www/html/novalink-repo
sudo tar -xzf /var/www/html/novalink/pvm/repo/pvmrepo.tgz
sudo cp /var/www/html/novalink/pvm/core.elf /var/lib/tftpboot
```

Installing the PowerVM NovaLink environment on a new managed system

Use the PowerVM NovaLink installer to install the PowerVM NovaLink environment on a new managed system.

This information can be used for managed systems that are in factory configuration and that are not managed by a Hardware Management Console (HMC). For information about how to install the PowerVM NovaLink software on a system that is managed by an HMC, see “Installing the PowerVM NovaLink software on a system that is managed by an HMC” on page 15.

Before you install the PowerVM NovaLink environment on a new managed system, complete the following tasks:

1. Install the hardware as needed and connect all cables except for the power cables. Install the hardware as required and connect all the cables. Note down the location code associated to each

network adapter and their ports to be used. This information will be used during the installation. To understand the location codes for POWER8 systems, see Part locations and location codes.

2. Update the system firmware to the latest version. For information on how to update the system firmware, see *Installing firmware using the USB port on the service processor on a system that is not managed by a management console*.
3. Locate a Linux PC or notebook with the *ipmitool* installed to use as a console for initial configuration. If you have not configured the IP address of the Flexible Service Processor (FSP) of the managed system, then you also need an Ethernet cable to connect the PC or notebook to an FSP port of the managed system.
4. If you do not already have the installation image, download the PowerVM NovaLink install image. You can download the PowerVM NovaLink installation image from the My Entitled Systems support site (<http://www.ibm.com/server/eserver/ess>) from the **My entitled software** section. Download the image for the **5692-A6P 2324 NovaLink** feature code. Use the installation image to create a bootable USB drive. Alternatively, you can set up a netboot (bootp) server that has the PowerVM NovaLink image to install PowerVM NovaLink from a network.
5. Add the Virtual I/O Server installation files to the PowerVM NovaLink image. For information about how to add the Virtual I/O Server installation files to the PowerVM NovaLink image, see “Adding the Virtual I/O Server installation files to the PowerVM NovaLink installer” on page 6.
6. If you plan to use Red Hat Enterprise Linux (RHEL) instead of Ubuntu on the PowerVM NovaLink logical partition, ensure that you have the RHEL media and use a kickstart file. For more information on what the sample kickstart file looks like, see “Installing the PowerVM NovaLink software on a Red Hat Enterprise Linux partition” on page 18. When the installation completes, you can select the option to install RHEL on the **Confirm Installation** panel. The PowerVM NovaLink installer reboots to the SMS menu after creating and installing the Virtual I/O Server logical partitions.
7. To install PowerVM NovaLink by using a netboot (bootp) server, you must set up the netboot server that has the PowerVM NovaLink image. For information about how to set up a netboot server, see “Setting up network installation of PowerVM NovaLink” on page 7. If you are planning to use Software Defined Networking (SDN), add the following line to the `grub.cfg` file:
`pvm-installmode=SDN`
8. Configure one disk with at least 60 GB of storage for each Virtual I/O Server instance that you plan to create on the server. You can configure the disks in the local serial-attached Small Computer System Interface (SAS) of the server storage, or on a storage area network (SAN) storage. If you create two instances of Virtual I/O Server, create each disk on a separate SAS controller or Fibre Channel (FC) card for redundancy.
9. Obtain a static IP address (including gateway, DNS, and netmask) for the PowerVM NovaLink logical partition and for each of the VIOS logical partitions. Configure them appropriately during the PowerVM NovaLink install.

To install the PowerVM NovaLink environment on a new managed system, complete the following steps:

1. If you are installing PowerVM NovaLink from a bootable USB drive, plug the drive into a USB port on the managed system. If you want to network install PowerVM NovaLink, connect an Ethernet port (other than the service processor ports) to the network in which the netboot server resides.
2. Prepare the system for PowerVM NovaLink installation by using the Advanced System Management Interface (ASMI) by completing the following steps.
 - a. If you have already configured the IP address of the FSP of the managed system, access the ASMI by using the administrator account by using a browser on another system. Otherwise, access the ASMI by using the PC or notebook. For information about how to connect to ASMI by using the PC or notebook, see *Accessing the ASMI using a PC or notebook and web browser*.
 - b. If the system is found connected to an HMC, disconnect it by clicking **System Configuration > Hardware Management Consoles**, then click **Reset the server to a non-HMC-managed configuration**.
 - c. If the system is powered on, power off the system from the ASMI by clicking **Power/Restart Control > Power On/Off System**.

- d. If the system was used earlier, you must clear the system firmware configuration by clicking **System Service Aids > Factory Configuration**. Ensure that you select only **Reset server firmware settings**.
- e. Enable Intelligent Platform Management Interface (IPMI) in the managed system by clicking **System Configuration > Console Type > IPMI**.
- f. Set the IPMI password by clicking **Login Profile > Change Password > User ID IPMI** and entering a password.
- g. From ASMI, power on the system to boot to the SMS menu by clicking **Power/Restart Control > Power On/Off System** and change **AIX/Linux partition mode boot** to **Boot to SMS menu**. If **Boot to SMS menu** is not an available option, click **System Configuration > Firmware Configuration**, select **PowerVM**, and click **Save**. Set **Server Firmware Start Policy** to **Running**. Click **Save settings and power on**.
- h. Use the IPMI console on a running Linux instance in another system to access the SMS menu: This Linux instance must have the **ipmitool** command installed. Enter the following command, and then enter the IPMI password (as set in step 2f) when prompted to check the power status of the system:

```
ipmitool -I lanplus -H FSP-ip-addr chassis power status
```

where *FSP-ip-addr* is IP address of the FSP that is used in a browser to access ASMI.

Connect the IPMI console to the system by running the following command:

```
ipmitool -I lanplus -H FSP-ip-addr sol activate
```

On successful completion of the **ipmitool** command, a prompt as shown below is displayed on the IPMI console:

```
[SOL Session operational. Use ~? for help]
```

- 3. If you are installing PowerVM NovaLink from the network, open an SSH terminal session to the netboot server and add the managed system to the `/etc/bootptab` file on the netboot server. Choose an IP address, subnet mask, and gateway IP address for the managed system, and note the IP address of the netboot server.
- 4. Select the boot device by using the SMS menu. You can select either a USB drive or a netboot server as the boot device. For your chosen boot device, complete the steps listed in the following table.

Boot device type	Steps
USB drive	<ol style="list-style-type: none"> 1. From the SMS menu, enter 5 to select boot options. 2. Enter 1 to select the install/boot device. 3. Enter 7 to view a list of all boot devices, and then enter the number that corresponds to the USB drive. 4. Enter 2 to perform a normal mode boot, and then enter 1 to exit the SMS menu and to start the boot process.

Boot device type	Steps
Netboot server	<ol style="list-style-type: none"> 1. From the main menu, enter 2 to set up the remote IPL. 2. Enter the number that corresponds to the Ethernet adapter that you want to use. 3. Enter the number for IPv4 IP addresses. 4. Enter the number for BOOTP as your network service. 5. Enter 1 for IP parameters. 6. Set the IP parameters: <ul style="list-style-type: none"> • Client IP Address is the IP address that you set for the managed system in the <code>/etc/bootptab</code> file on the netboot server. • Server IP Address is the IP address of the netboot server. • Gateway IP Address is the gateway IP address that you set for the managed system in the <code>/etc/bootptab</code> file on the netboot server. • Subnet Mask is the subnet mask that you set for the managed system in the <code>/etc/bootptab</code> file on the netboot server. 7. Press ESC, enter 3 for ping test, enter 1 for execute ping test, and verify that the netboot server is reachable. 8. Enter M to return to the main menu. 9. From the main menu, enter 5 to select boot options. 10. Enter 1 to select the install/boot device. 11. Select Network, BOOTP and then select the network card that you configured. 12. Enter 2 to perform a normal mode boot, and then enter 1 to exit the SMS menu and to start the boot process.

5. At the GNU GRand Unified Bootloader (GRUB) screen, select the **PowerVM NovaLink Install/Repair** option.
 - To install PowerVM NovaLink in Software Defined Networking (SDN) mode, select the Advanced options for PowerVM NovaLink, and select the **PowerVM NovaLink Install/Repair** option.
 - To install PowerVM NovaLink in Software Defined Environment (SDE) mode, use the same procedure as for SDN mode above, then press **E** to edit the option, and modify `pvm-installmode=SDN` to `pvm-installmode=SDE`.
6. Complete the PowerVM NovaLink installation wizard.
 - a. Select **Choose to perform installation** and press **Next**. Use the **Tab** key to move the cursor to the **Next** button and press the **Enter** or **Space** key.
 - b. Select **Choose to provide custom values** and press **Next**.
 - c. Press **I Accept** for the license agreement and press **Next**.
 - d. Enter the user name and password of the administrators of PowerVM NovaLink and the Virtual I/O Servers and press **Next**.
 - e. Enter the network configuration settings for the PowerVM NovaLink logical partition and press **Next**.
 - f. If you choose the SDN install option, complete the following steps:
 - Select **Choose to enable SDN** and press **Next**.

- Specify the processor and memory settings for the PowerVM NovaLink logical partition and press **Next**.
- g. Select whether you want I/O redundancy and press **Next**. If you select **Choose to create I/O redundancy**, the installation creates 2 VIOS logical partitions that collectively provide redundancy for the disk data of the VIOS-client logical partition.
 - h. Specify the processor and memory settings for VIOS logical partitions and press **Next**.
 - i. Verify the physical I/O settings. This screen assigns physical I/O (disk and network) adapters on the server to the VIOS logical partitions. If you are using the SDN mode, you can also allocate network adapters to the PowerVM NovaLink logical partition. The network adapters assigned to the PowerVM NovaLink logical partition will be assigned to Open vSwitch-client logical partitions in the managed system.

By default, the installer automatically divides all physical I/O adapters between the two VIOS instances if VIOS redundancy was selected and the following conditions apply:

- Each VIOS must be assigned at least one adapter that serves disk I/O
- Each VIOS must be assigned at least one Ethernet adapter that is cabled.
- If using SDN mode, the PowerVM NovaLink logical partition must be assigned at least one cabled Ethernet adapter

Note that this screen may consist of multiple sub-screens for a server with many adapters. Use the **View More** and **View Previous** buttons to navigate among the sub-screens. To assign an adapter to an owner-logical partition, use the **Tab** key to skip to the correct radio button, press the **Enter** or **Space** key to select the radio button. Press **Next** to go to the next wizard task. To understand the location codes for POWER8 systems, see Part locations and location codes.

- j. If you are using SDN mode, complete the following steps:
 - Select the ports to be used for SDN Virtual Network Bridge and press **Next**. This screen lists all the network ports from the previously assigned network adapters. Select two or more ports to create a link aggregation device.
 - Select the Link Aggregation parameters for the SDN Virtual Network Bridge and press **Next**.
- k. Select the ports to be used for VIOS-SEA Network Bridges and press **Next**. This screen lists all the network ports from the previously assigned network adapters. This step will be repeated for each VIOS instance.
- l. If you selected two or more ports to be used for VIOS-SEA Network Bridges, select the Link-aggregation type and press **Next**.
- m. Enter the Network configuration settings for Virtual I/O Servers and press **Next**.
- n. Review the settings in the summary screen and press **Finish**. In the Summary screen, you can review the configured installation options, and optionally manually edit the options. To change specific configuration settings, move the cursor to the specific field and select the **Edit Settings** button.
 - Changing the Time zone: By default the PowerVM NovaLink installer sets the default timezone value to America/New_York. You can change the time-zone to a different value from the **Summary** screen by doing the following actions:
 - Select **Edit Settings**.
 - In another window, on a Linux system, run the following command:


```
timedatectl list-timezones
```

and find the line for your time zone location. For example: “America/Indiana/Indianapolis”.
 - Move the cursor to the line containing *timezone =*, and replace it with the desired timezone value. For example: “America/Indiana/Indianapolis”.
 - Press Ctrl+X to save and exit to the **Summary** screen.
 - To use your own Network Installation Manager (NIM) server for installation of Virtual I/O Server, complete the following actions:

- Select **Edit Settings**.
- Set **VIOSNIMServerConfig > viosinstallprompt** to *True* and exit.

After you specify installation parameters, the PowerVM NovaLink installer creates one or two Virtual I/O Server logical partitions. PowerVM NovaLink installer then creates a Linux logical partition and installs the Ubuntu Linux operating system and the PowerVM NovaLink software on the partition.

For faster installation of PowerVM NovaLink on a system with more than 100 GB of memory, press Ctrl+C when prompted to at the end of the Installer wizard and choose the reboot option. Choosing to reboot allows you to avoid waiting for the memory and I/O slots to be reallocated dynamically. Dynamic reallocation of memory can take a long time to complete on a system with a large amount of memory. However, you must complete the wizard again after the reboot operation completes.

During the installation of the Virtual I/O Server partitions, you can open a virtual terminal session for the partitions to change the partition configuration if necessary. To open a virtual terminal session for a Virtual I/O Server partition, press Ctrl+Z to access a shell prompt and enter `mkvterm --id 2` or `mkvterm --id 3`. To exit the virtual terminal session enter `CTRL]`, then type `exit` to go back to the PowerVM NovaLink installer status screen.

When PowerVM NovaLink installation is complete, the PowerVM NovaLink installer saves an install configuration file in the `/var/log/pvm-install/nowalink-install.cfg` file. You can use this file for silent installation of PowerVM NovaLink from a bootp server. The file should be added to the bootp server under the root directory of the Web server or any subdirectory under it, then the `grub.cfg` file should be updated to indicate the path of the config file. For example, if the root directory of the Web server is `/var/www/html` and the file is added under `/var/www/html/pvm/repo/pvm/`, add the following statement to the `grub.cfg` file:

```
pvm-installer-config=http://$server_address/pvm/repo/pvm/nowalink-install.cfg
```

When the installation of PowerVM NovaLink is complete, update the Ubuntu Linux operating system and the PowerVM NovaLink software if needed. If the PowerVM NovaLink logical partition cannot access the online repository, edit the repository configuration files to remove sources that are not reachable so that they do not slow the package retrieval process.

Installing the PowerVM NovaLink software on a system that is managed by an HMC

You can install PowerVM NovaLink on a system that is managed by a Hardware Management Console (HMC). For a system that is managed by an HMC, the PowerVM NovaLink installer installs the Ubuntu Linux operating system and the PowerVM NovaLink software on a Linux partition.

Before you install the PowerVM NovaLink software on a system that has logical partitions, complete the following tasks:

- Install the hardware as needed, connect all cables, and set up the system so that it is managed by an HMC.
- If you do not already have the PowerVM NovaLink installation image, download the image. You can download the PowerVM NovaLink installation image from the My Entitled Systems support site (<http://www.ibm.com/server/eserver/ess>) in the **My entitled software** section. Download the image for the **5692-A6P 2324 NovaLink** feature code. Use the installation image to create a bootable USB drive. Alternatively, you can set up a netboot (bootp) server that has the PowerVM NovaLink image to install PowerVM NovaLink from a network. You can also mount the PowerVM NovaLink image as a virtual optical drive in a Virtual I/O Server partition.
- To install PowerVM NovaLink by using a netboot (bootp) server, you must set up the netboot (bootp) server that has the PowerVM NovaLink image. For information about how to set up a netboot (bootp)

server, see “Setting up network installation of PowerVM NovaLink” on page 7. If you are planning to use Software Defined Networking (SDN), add the following line to the `grub.cfg` file:
`pvm-installmode=SDN.`

- Update the system firmware to the latest version. Download the latest system firmware from IBM Fix Central (<http://www.ibm.com/support/fixcentral/>). You can update the system firmware by using the HMC.

To install the PowerVM NovaLink software on a system that has logical partitions, complete the following steps:

1. If you are installing PowerVM NovaLink from a bootable USB drive, plug the drive into a USB port on the managed system. If you are installing PowerVM NovaLink from the network, connect an Ethernet port other than the service processor ports to the network on which the netboot server resides.
2. Create a Linux logical partition on the managed system by using the HMC. When you create the Linux logical partition, assign the following resources to the partition:
 - 0.5 shared processors that are uncapped with a non-zero weight and 2 virtual processors. If you are planning to use SDN, you must have at least 4GB of memory for the Linux partition.
 - 6.5 GB of memory, which you can adjust to 2.5 GB after installation.
 - At least 30 GB of storage.
 - A virtualized network that is bridged through the shared Ethernet adapter (SEA). If you are planning to use SDN, you must allocate at least one physical network adapter to the Linux partition.
 - Maximum virtual slots that are set to 200 or higher.

Use the following links to find information about how to create a Linux partition by using the HMC.

- For more information about how to create a Linux partition by using the HMC Classic interface, see [Creating additional logical partitions](#).
- For more information about how to create a Linux partition by using the HMC Enhanced+ interface, see [Creating a logical partition by using a template](#)

From the HMC command line, enter the following command to apply the profile for the Linux partition. In this command, *sys_name* is the name of the managed system, *lpar_id* is the partition ID of the Linux partition, and *profile_name* is the name of the profile.

```
chsyscfg -m sys_name -r lpar -o apply --id lpar_id -n profile_name
```

3. From the HMC command line, enter the following command to enable co-management. In this command, *sys_name* is the name of the managed system.

```
chcomgmt -m sys_name -o setmaster -t norm
```
4. From the HMC command line, enter the following command to enable PowerVM NovaLink support for the logical partition. In this command, *sys_name* is the name of the managed system and *lpar_id* is the ID of the PowerVM NovaLink partition.

```
chsyscfg -m sys_name -r lpar -i lpar_id=lpar_id,powervm_mgmt_capable=1
```
5. Activate the logical partition by using the HMC. When you activate the logical partition, ensure that the HMC is set to open a terminal window for the logical partition when the logical partition is activated.
 - For more information about how to activate the logical partition by using the HMC Classic interface, see [Activating a logical partition](#).
 - For more information about how to activate the logical partition by using the HMC Enhanced or HMC Enhanced+ interface, see [Activating AIX or Linux partitions](#).

The SMS menu is displayed in the terminal window.

6. Return to the terminal window for the logical partition and select the boot device by using the SMS menu. You can select either a USB drive or a netboot server as the boot device. To select the boot device, complete the steps for the type of boot device that you are using.

Boot device type	Steps
USB drive	<ol style="list-style-type: none"> 1. From the main menu, enter 5 to select boot options. 2. Enter 1 to select the install/boot device. 3. Enter 7 to view a list of all boot devices, and then enter the number that corresponds to the USB drive. 4. Enter 2 to perform a normal mode boot, and then enter 1 to exit the SMS menu and to start the boot process.
Netboot server	<ol style="list-style-type: none"> 1. From the main menu, enter 2 to set up the remote IPL. 2. Enter the number that corresponds to the Ethernet adapter that you want to use. 3. Enter the number for IPv4 IP addresses. 4. Enter the number for BOOTP as your network service. 5. Enter 1 for IP parameters. 6. Set the IP parameters: <ul style="list-style-type: none"> • Client IP Address is the IP address that you set for the managed system in the <code>/etc/bootptab</code> file on the netboot server. • Server IP Address is the IP address of the netboot server. • Gateway IP Address is the gateway IP address that you set for the managed system in the <code>/etc/bootptab</code> file on the netboot server. • Subnet Mask is the subnet mask that you set for the managed system in the <code>/etc/bootptab</code> file on the netboot server. 7. Press ESC, enter 3 for ping test, enter 1 for execute ping test, and verify that the netboot server is reachable. 8. Enter M to return to the main menu. 9. From the main menu, enter 5 to select boot options. 10. Enter 1 to select the install/boot device. 11. Select Network, and then select the configured network card. 12. Enter 2 to perform a normal mode boot, and then enter 1 to exit the SMS menu and to start the boot process.

7. At the GNU GRand Unified Bootloader (GRUB) screen, select the **PowerVM NovaLink Install/Repair** option.
8. Complete the PowerVM NovaLink installation wizard.
 - a. Select **Choose to perform installation** and select **Next**.
 - b. Select **I Accept** for the license agreement and select **Next**.
 - c. Enter the user name and password of the PowerVM NovaLink administrator and click **Next**.
 - d. Enter or verify the network configuration settings and select **Next**.
 - e. If you configured GRUB to enable SDN mode, select **Choose to enable SDN** and select **Next**.
 - f. If you are using the SDN mode, complete the following steps:

- Select the ports to be used for SDN Virtual Network Bridge and select **Next**. This screen lists all the network ports from the previously assigned network adapters. Select two or more ports to create a link aggregation device.
 - Select the Link Aggregation parameters for the SDN Virtual Network Bridge and select **Next**.
- g. Review the settings and click **Finish**.

After you specify installation parameters, the PowerVM NovaLink installer installs the Ubuntu Linux operating system and the PowerVM NovaLink software on the Linux partition.

After the installation is complete, update the Ubuntu Linux operating system and the PowerVM NovaLink software if needed. If the PowerVM NovaLink logical partition cannot access the online repository, edit the repository configuration files to remove sources that are not reachable so that they do not slow the package retrieval process.

Installing the PowerVM NovaLink software on a Red Hat Enterprise Linux partition

If you choose not to use the Ubuntu Linux operating system that is installed by default with PowerVM NovaLink software, install the PowerVM NovaLink software on a Red Hat Enterprise Linux (RHEL). PowerVM NovaLink requires RHEL version 7.3, or later, for IBM Power Systems (little endian).

The PowerVM NovaLink software is supported via a PowerVM support contract. Support for the underlying operating system (Ubuntu or RHEL) on which the PowerVM NovaLink software runs can be obtained separately, either directly with the Linux vendor or through IBM.

To install PowerVM NovaLink on your managed system, complete the following tasks:

- When your managed system is in the manufacturing default configuration and is not managed by a Hardware Management Console (HMC), see “Installing the PowerVM NovaLink environment on a new managed system” on page 10 for more information on installing PowerVM NovaLink.
- When your managed system is managed by a Hardware Management Console (HMC), see “Installing the PowerVM NovaLink software on a system that is managed by an HMC” on page 15 for more information on installing PowerVM NovaLink.

The PowerVM NovaLink installer has both an automatic and manual option for RHEL installation.

Automated Installation

If you are performing a manual install, go to Manual Installation. To perform an automated, network-based installation of RHEL and PowerVM NovaLink by using a kickstart file, complete the following steps:

1. You must have a web server to host your RHEL install media and kickstart file. This can be a Linux, AIX, or any operating system that has a running web server.
2. Mount the RHEL 7 ISO to a network location such that the `vmlinuz` file and the `initrd.img` file are accessible over HTTP or HTTPS protocol at the following locations: `<mount location>/ppc/ppc64/vmlinuz` and `<mount location>/ppc/ppc64/initrd.img`. The installer should be able to copy the `vmlinuz` file and the `initrd.img` file to a local location to start the RHEL installation.
3. Configure your kickstart file for automated installation. For more details about the configuration, see the sample kickstart file. Complete the following steps to configure the kickstart file:
 - Verify that all of the storage and network information matches your environment.
 - In the “# Setup your yum repository for Red Hat Enterprise Linux” section of the sample kickstart file, complete all YUM repository setup, Red Hat subscription management, and registration that is required to perform YUM installation of RHEL packages. For more information about setting up your YUM repository, see the Setting up the YUM Repository section.
4. Mount your kickstart file to a network location that is accessible over `http` or `https`.

5. In the last page of the install wizard, select the option to install RHEL and add the appropriate Installation Source and Kickstart File location. The values selected in the wizard can be automated by using the PowerVM NovaLink install configuration file.
6. Complete the installation, and after the Virtual I/O Servers are installed, the system performs a network boot to your RHEL installation source, and the installation proceeds, depending on the settings that are specified in the kickstart file.

Manual Installation

When the PowerVM NovaLink installation wizard completes, perform the following actions:

- After the Virtual IO Servers are created and installed, the system reboots to the SMS menu.
- You can now point to a network boot server that has RHEL images, and reinstall RHEL on the PowerVM NovaLink partition by using the sample kickstart file.

Manual Installation: Setting up the YUM repository

The YUM repository is set up for PowerVM NovaLink binary Red Hat Package Manager (RPM) and the dependencies of the RPMs. To install the YUM repository, complete the following steps:

1. Sign in to the RHEL partition as root user.
2. Run the following command: `rpm -ivh http://public.dhe.ibm.com/systems/virtualization/Novalink/rhel/73/novalink_1.0.0/ibm-novalink-repo-latest.noarch.rpm`. This command installs the YUM repository configuration file along with script that will be used to import the GPG key into the RPM database. This enables checking of subsequent installation of PowerVM NovaLink packages to ensure they have not been corrupted or altered.
3. Run the following command to import the key into the RPM database: `/opt/ibm/novalink/bin/import-ibm-novalink-repo-key.sh`
4. Run the following command to obtain RPM files from RSCT: `wget ftp://public.dhe.ibm.com/software/server/POWER/Linux/yum/download/ibm-power-repo-latest.noarch.rpm rpm -vih --nodeps ibm-power-repo-latest.noarch.rpm`
5. Run the `/opt/ibm/lop/configure` command and accept the license statement to set up the repository.
6. For information about how to enable Extra Packages for Enterprise Linux (EPEL) repository for the partition, see <https://fedoraproject.org/wiki/EPEL>.

Manual Installation: Installing PowerVM NovaLink packages on a running RHEL 7 partition

To manually install the PowerVM NovaLink environment on an RHEL partition, complete the following steps:

1. Before installing PowerVM NovaLink, run the following command to install the *kernel-devel* package:
`yum install kernel-devel`

Note: Do not combine this command with step 3.

2. Sign in to the RHEL partition as root user.
3. To install the PowerVM NovaLink stack, run the following command: `yum install pvm-novalink python-positional`
4. After the installation is complete, you can add the *admin* user to the *pvm_admin* group by running the following command: `usermod -G pvm_admin <admin_user_id>`

RHEL sample kickstart file configuration

For the automatic and manual options of RHEL installation, you can setup an installation of RHEL 7.3 along with the PowerVM NovaLink packages by using a kickstart file. An example kickstart file is as follows:

```

# This is a sample kickstart file for installing NovaLink and its dependent
# packages on Red Hat Enterprise Linux.
# Modify this file as needed to match your site's configuration. You must setup
# your yum subscription management registration for the new system before NovaLink
# or any extended packages can install. Look at the example in the post install
# settings for more information.

# Firewall configuration
firewall --disabled

# Install OS instead of upgrade
install

# Define the repository for Extra Packages for Enterprise Linux (EPEL)
# If this repository cannot be reached, the installation of NovaLink
# will fail due to dependent packages from EPEL.
# Follow instructions at https://fedoraproject.org/wiki/EPEL
# after the system reboots to setup the EPEL repo, then install NovaLink again.
repo --name=epel --baseurl=http://download.fedoraproject.org/pub/epel/7/ppc64le

# Default root password "passw0rd" encrypted using python one liner:
# python -c 'import crypt,base64,os; print(crypt.crypt("passw0rd", "$6$" +
base64.b64encode(os.urandom(6))))'
# The default password will be used when the base OS is installed. It will be
# changed later in post installation based on what is specified as the NovaLink user password.
rootpw --iscrypted $6$F5jDDW3B$Vf3th7JxE2nfwoz0nbr16moBeEanQbRqZRjvWeC03nJIumI3
intY0m4JUn19Hg0uEncViM.sn05Dkq.zC3yo70

# Password hashing algorithm
auth --passalgo=sha512

# Use text mode install
text

# System keyboard
keyboard us

# System language
lang en_US

# SELinux configuration
selinux --disabled

# Do not configure the X Window System
skipx
services --enabled=sshd

# Installation logging level. Possible values are info, debug, warning, error,
# or critical
logging --level=info

# System timezone
timezone America/New_York

# Clear the Master Boot Record
zerombr

# Storage data and setup below. By default, this kickstart file
# assumes 2 disks: sda and sdb, to be on a RAID. A sample single
# disk setup is also provided. Set this up to properly reflect your
# environment.

# 1 DISK SETUP START
# Uncomment everything until "1 DISK SETUP END"
# if configuring single disk with no redundant VIOS
# Also, you must edit the PreP partition setting in
# the post install at the end of this file if using

```

```

# a single drive environment.

# bootloader --driveorder=sda
# part None --fstype prepboot --ondrive=sda --size 8
# part /boot --size 300 --fstype ext4 --ondisk /dev/sda
# part pv.01 --size 1 --grow --ondisk /dev/sda
# volgroup pvmvg pv.01
# logvol / --vgname=pvmvg --name=root --size=9216
# logvol /var --vgname=pvmvg --name=var --size=10240
# logvol /tmp --vgname=pvmvg --name=tmp --size=1024
# logvol swap --vgname=pvmvg --name=swap --fstype swap --size=4096
# logvol /home --vgname=pvmvg --name=home --size=1 --grow
# clearpart --drives=sda --all --initlabel

# 1 DISK SETUP END

# 2 DISK WITH RAID SETUP START
# Comment everything until "2 DISK WITH RAID SETUP END"
# if configuring single disk with no redundant VIOS

# Set drive boot order
bootloader --driveorder=sda,sdb

# RAID1 2 disk partition recipe using LVM over RAID
# Second disk needs to have PreP partition created
part None --fstype prepboot --ondrive=sdb --size 8

# Setup RAID
part raid.00 --size 256 --asprimary --ondrive=sda
part raid.10 --size 256 --asprimary --ondrive=sdb
part raid.01 --size 29696 --asprimary --ondrive=sda
part raid.11 --size 29696 --asprimary --ondrive=sdb

raid /boot --fstype ext4 --device raid1-boot --level=RAID1 raid.00 raid.10
raid pv.01 --device raid1-pv --level=RAID1 raid.01 raid.11

# Build out volume group and logical volumes.
volgroup pvmvg pv.01

logvol / --vgname=pvmvg --name=root --size=9216
logvol /var --vgname=pvmvg --name=var --size=10240
logvol /tmp --vgname=pvmvg --name=tmp --size=1024
logvol swap --vgname=pvmvg --name=swap --fstype swap --size=4096
logvol /home --vgname=pvmvg --name=home --size=1 --grow

# Partition clearing information
clearpart --drives=sda,sdb --all --initlabel

# 2 DISK WITH RAID SETUP END

# reqpart will take care of PreP partition on first disk
reqpart

# Reboot the lpar after install completes
reboot

%packages
kernel-headers
kernel-devel
openssh*
parted*
net-tools*
@base
epel-release
telnet
%end

```

```

%post
curTTY=$(tty)
exec < $curTTY > $curTTY 2> $curTTY
echo "Running post configuration"
clear
set -x

# Setup your yum repository for Red Hat Enterprise Linux
# NOTE: YOU MUST SET THIS UP BEFORE ANYTHING ELSE CAN INSTALL BELOW.
# An example of setting this up programmatically:
# subscription-manager register --username <username> --password <password> --auto-attach

# Setup Novalink's yum repository
cat > /etc/yum.repos.d/pvm.repo <<EOF
[novalink]
name=Novalink
baseurl=http://public.dhe.ibm.com/systems/virtualization/Novalink/rhel/73/novalink_1.0.0/
failovermethod=priority
enabled=1
gpgcheck=0
EOF

# Setup yum repository for IBM's RSCT.
cat > /etc/yum.repos.d/ibm-power.repo <<EOF
[IBM_Power_Tools]
name=IBM Power Tools
baseurl=http://public.dhe.ibm.com/software/server/POWER/Linux/yum/OSS/RHEL/7/ppc64le
enabled=1
gpgcheck=0
[IBM_Power_SDK_Tools]
name=IBM Power SDK Tools
baseurl=http://public.dhe.ibm.com/software/server/POWER/Linux/yum/SDK/RHEL/7/ppc64le
enabled=1
gpgcheck=0
[Advance_Toolchain]
name=Advance Toolchain
baseurl=ftp://ftp.unicamp.br/pub/linuxpatch/toolchain/at/redhat/RHEL7
enabled=1
gpgcheck=0
EOF

# Create the user from the Novalink configuration file or entered
# into the Novalink install wizard.
useradd `nvram --print-config=nv-user`
usermod -p `nvram --print-config=nv-pass` `nvram --print-config=nv-user`

# Set the root's password to be the same as the Novalink user. Remove
# the line below if you don't want the root password to be the same
# as the Novalink's user password
usermod -p `nvram --print-config=nv-pass` root

# Install python positional & Novalink
yum --assumeyes install pvm-novalink python-positional

# Add Novalink user to pvm_admin group
usermod -G pvm_admin `nvram --print-config=nv-user`

# Setup firewall rule for RSCT
cat > /etc/firewalld/services/rmc.xml <<EOF
<?xml version="1.0" encoding="utf-8"?>
<service>
  <short>RMC</short>
  <description>
Reliable Scalable Cluster Technology (RSCT) is a set of software components that together
provide a comprehensive clustering environment for AIX®, Linux, Solaris, and Windows
operating systems. RSCT is the infrastructure used by a variety of IBM® products to provide
clusters with improved system availability, scalability, and ease of use.</description>

```

```

<port protocol="tcp" port="657"/>
  <port protocol="udp" port="657"/>
</service>
EOF
systemctl enable firewalld.service
firewall-offline-cmd --add-service=rmc

# nvram cleanup
nvram -p common --update-config nv-pass=
nvram -p common --update-config nv-user=

# Make sure PreP partitions are mirrored
# 2 DISK START
dd if=/dev/sda1 of=/dev/sdb1
parted /dev/sda set 1 boot on
parted /dev/sdb set 1 boot on
# 2 DISK END

# 1 DISK START
# parted /dev/sda set 1 boot on
# 1 DISK END
%end

```

When the installation is complete, update the PowerVM NovaLink software if required. If the PowerVM NovaLink logical partition cannot access the online repository, edit the configuration file to use an accessible repository.

Updating RSCT packages for PowerVM NovaLink

Resource Monitoring Control (RMC) connections between PowerVM NovaLink and each logical partition are routed through a dedicated internal virtual network. For easier configuration of the internal virtual network, assign an IPv6 link-local address to the RMC virtual network interfaces. To assign IPv6 link-local addresses to the RMC virtual network interfaces on AIX and Linux logical partitions, the Reliable Scalable Cluster Technology (RSCT) packages must be at version 3.2.1.0 or later.

RSCT packages at version 3.2.1.0 support an IPv6 Link Local addressed virtual Ethernet adapter on each AIX and Linux logical partition. The AIX or Linux logical partition uses the virtual Ethernet adapter to connect to the PowerVM NovaLink partition through a virtual switch (which is called MGMTSWITCH). The virtual switch is configured to communicate only with the trunk port. An AIX or Linux logical partition can use this virtual network only to connect with the PowerVM NovaLink partition. AIX or Linux logical partitions can connect with partitions other than the PowerVM NovaLink partition only if you configure a separate network for this purpose.

You must ensure that the RMC virtual Ethernet interfaces assigned to the logical partitions are configured with the IPv6 link local addresses. The RMC virtual Ethernet interfaces are those interfaces which are associated with the virtual switch MGMTSWITCH which is created on PowerVM NovaLink. To find the RMC virtual Ethernet interface (by using the MAC address of the virtual Ethernet interface) of a logical partition (by using the ID of the logical partition), you can enter the following command on the PowerVM NovaLink logical partition:

```
pvmctl eth list | grep -e MAC -e MGMTSWITCH
```

You can refer to the IP configuration of the RMC virtual Ethernet interface on the PowerVM NovaLink logical partition to configure the IP address of the RMC virtual Ethernet interface on other logical partitions.

- For more information about how to verify the version of RSCT packages on AIX logical partitions and how to update RSCT packages from the AIX installation media, see [Verifying RSCT installation on AIX nodes](#).
- For more information about how to install or update the RSCT packages, see [Verifying RSCT installation on Linux nodes](#).

- For logical partitions that run Ubuntu, you can obtain the RSCT packages from the following APT repository: <https://launchpad.net/~ibmpackages/+archive/ubuntu/rsct>.
- For RHEL based partitions, you can obtain the RSCT packages by enabling the YUM *ibm-power-repo* repository by completing the following steps:
 - Run the following command to obtain RPM files from RSCT:


```
rpm -vih --nodeps http://public.dhe.ibm.com/software/server/POWER/Linux/yum/download/ibm-power-repo-latest.noarch.rpm
```
 - Run the following command and accept the license statement to set up the repository:


```
/opt/ibm/lop/configure
```

You must install the DynamicRM package to enable DLPAR and Mobility operations.

After you update RSCT packages on a logical partition, capture an image of the operating system along with the updated RSCT package. You can then deploy the image that has the updated RSCT package, which eliminates the need to update RSCT for new logical partitions. For more information about how to use PowerVC to capture an image, see [Capturing a virtual machine](#).

Updating PowerVM NovaLink

The PowerVM NovaLink software uses standard Linux operating system tools to update itself. Use the Ubuntu **apt** function to update the Ubuntu Linux operating system, and the PowerVM NovaLink and related software. Similarly, you can use the *yum* function to update the software in a Red Hat Enterprise Linux environment.

The Ubuntu Linux operating system is maintained by Canonical Ltd. Fixes for operating system components can be retrieved from the Canonical repositories.

The PowerVM NovaLink software is provided by IBM. Updates to the PowerVM NovaLink can be obtained from the PowerVM NovaLink repository that is hosted by IBM.

If the PowerVM NovaLink partition can connect to online repositories, you can update the Ubuntu Linux operating system and the PowerVM NovaLink software from the online repositories. Otherwise, you must clone the online repositories and update the Ubuntu Linux operating system and the PowerVM NovaLink software from the cloned repositories.

Updating PowerVM NovaLink from an online repository

You can update the Ubuntu Linux operating system and the PowerVM NovaLink software on your PowerVM NovaLink logical partition by using an online repository.

If the PowerVM NovaLink logical partition cannot access the online repository, update the PowerVM NovaLink logical partition from a repository that is cloned from the online repository. To change the location of the repository, edit the files `/etc/apt/sources.list` (for Ubuntu Linux repository) and `/etc/apt/sources.list.d/pvm.list` (for PowerVM NovaLink repository), and remove sources that are not reachable so that they do not slow down the package retrieval process.

Before you update PowerVM NovaLink from an online repository, complete the following steps for an Ubuntu logical partition:

- Verify that the following line exists in the source list file on the PowerVM NovaLink partition (`/etc/apt/sources.list.d/pvm.list`), and add the following line, if required.


```
deb http://public.dhe.ibm.com/systems/virtualization/Novalink/debian novalink_<i>version</i> non-free
```

In this line, *version* is the version number of the PowerVM NovaLink software (for example, 1.0.0).

Before you update PowerVM NovaLink from an online repository, complete the following steps for a RHEL logical partition:

- Verify that the following line exists in the source list file on the PowerVM NovaLink partition (`/etc/yum.repos.d/pvm.repo`), and add the following line, if required.
`baseurl=http://public.dhe.ibm.com/systems/virtualization/Novalink/rhel/73/novalink_1.0.0`

You must have `sudo` access on the PowerVM NovaLink partition to complete this task.

To update PowerVM NovaLink from an online repository, complete the following steps:

1. On an Ubuntu logical partition, access the Ubuntu Linux command-line interface on the PowerVM NovaLink partition.
 - a. To update the Debian Advanced Packaging Tool (APT) with the latest information about Ubuntu Linux operating system updates, enter the following command:
`sudo apt-get update`
 - b. To update APT with the latest information about updates for the PowerVM NovaLink software, enter the following command:
`sudo apt-get install pvm-novalink`
2. On a Red Hat Enterprise Linux logical partition, enter the following command:
`sudo yum update pvm-novalink`

Updating PowerVM NovaLink from a cloned repository

You can update the Ubuntu or Red Hat Enterprise Linux (RHEL) operating system, and the PowerVM NovaLink software on your PowerVM NovaLink logical partition by using a cloned repository. Use a cloned repository to update the PowerVM NovaLink software if the PowerVM NovaLink partition does not have direct access to the online repository.

This information describes how to use a File Transfer Protocol (FTP) server to store your cloned repository. The PowerVM NovaLink partition must be able to access the FTP server. Alternatively, you can use a Hypertext Transfer Protocol (HTTP) server to store your cloned repository.

For an Ubuntu logical partition, before you update PowerVM NovaLink from a cloned repository, open the source list file on the PowerVM NovaLink partition (`/etc/apt/sources.list.d/pvm.list`), remove each line that references an online repository, and add the following line to the file. In this line, *ftp_ip* is the IP address or host name of the FTP server, *repo_path* is the repository path in the FTP server, and *version* is the version number of the PowerVM NovaLink software (for example, 1.0.0).

```
http://ftp_ip/repo_path novalink_version non-free
```

For RHEL, before you update PowerVM NovaLink from a cloned repository, edit the YUM repository configuration file (`/etc/yum.repos.d/pvm.repo`) on the PowerVM NovaLink partition, to change the line that contains the *baseurl* variable that references the online YUM repository. Add the address of the server where the clone repository resides (*baseurl=ftp://ftp_ip/repo_path*).

You must have `sudo` access on the PowerVM NovaLink partition to complete this task.

To update PowerVM NovaLink from a cloned repository, complete the following steps:

1. On your FTP server, clone the PowerVM NovaLink repository by entering the following commands, where *repo_path* is the repository path in the FTP server:
`l cd repo_path`

For an Ubuntu logical partition:

```
wget --mirror http://anonymous@public.dhe.ibm.com/systems/virtualization/Novalink/debian*
```

For a RHEL logical partition:

```
wget --mirror http://anonymous@public.dhe.ibm.com/systems/virtualization/Novalink/rhel/73/*
```

2. Connect to the Ubuntu or RHEL Linux command-line interface on the PowerVM NovaLink partition.

3. For an Ubuntu logical partition, to update the Debian Advanced Packaging Tool (APT) with the latest information about Ubuntu Linux operating system updates, enter the following command:

```
sudo apt-get update
```
4. For RHEL, to update the YUM repository with the latest information for the PowerVM NovaLink software, enter the following command:

```
sudo yum update pvm-novalink
```
5. To update APT with the latest information about updates for the PowerVM NovaLink software, enter the following command:

```
sudo apt-get install pvm-novalink
```

Updating the firmware on a system that is managed by PowerVM NovaLink

To update the firmware on a system that is managed by only PowerVM NovaLink, use the **ldfware** command on the service partition. If the system is co-managed by PowerVM NovaLink and a Hardware Management Console (HMC), you must use the HMC to update the firmware. The HMC must be set to the master mode to update the firmware.

To set the HMC to the master mode for a system that is co-managed by the PowerVM NovaLink, run the following command from the HMC command line. In this command, *managed_system* is the name of the managed system.

```
chcomgmt -m managed_system -o setmaster -t norm
```

After you set the HMC to the master mode, you can update the firmware by using the standard HMC procedure. For information about how to update the firmware by using the HMC, see *Managed system updates*.

The information that is provided here applies to a managed system that is already managed by PowerVM NovaLink. For information about how to update the firmware on a system on which you plan to install PowerVM NovaLink, see *Installing firmware using the USB port on the service processor on a system that is not managed by a management console*.

Download the latest system firmware from IBM Fix Central (<http://www.ibm.com/support/fixcentral/>).

To update the firmware on a system that is managed by PowerVM NovaLink:

1. Power off all client partitions by entering the following command for each client partition, where *partition_id* is the partition ID.

```
pvmctl lpar power-off -i id=partition_id
```
2. Power off all Virtual I/O Server partitions except for the service partition by entering the following command for each Virtual I/O Server partition, where *partition_id* is the partition ID.

```
pvmctl vios power-off -i id=partition_id
```

By default, the service partition is the partition with partition ID 2. To determine which partition is the service partition, enter the following command:

```
pvmctl vios list -d id name service
```

The `is_service_partition` property of the service partition is True.

3. Power off the PowerVM NovaLink partition by entering the following command, where *novalink_id* is the partition ID of the PowerVM NovaLink partition. The partition ID of the PowerVM NovaLink partition is typically 1.

```
pvmctl lpar power-off -i id=novalink_id
```
4. Copy the firmware to a temporary location in the service partition.

5. Run the following command on the service partition, where *firmware_path* is the location of the firmware in the service partition.
`ldfware -file firmware_path`
6. If the managed system does not completely power off automatically, power off the managed system by using the Advanced System Management Interface (ASMI). Complete the following steps:
 - a. Access the ASMI by using the PC or notebook. For information about how to connect to ASMI, see [Accessing the ASMI using a PC or notebook and web browser](#).
 - b. Power off the system by clicking **Power/Restart Control > Power On/Off System**.
7. Power on the system.

PowerVM NovaLink API

Use the PowerVM NovaLink application programming interface (API) to programmatically control the management of virtualization functions on a managed system. The PowerVM NovaLink API is based on the API that is used by the Hardware Management Console (HMC).

Differences from the Hardware Management Console (HMC) API

The PowerVM NovaLink API differs from the Hardware Management Console (HMC) API in the following ways.

- The PowerVM NovaLink API does not allow you to use PUT or POST methods on virtual networks.
- The PowerVM NovaLink API does not include Atom links for elements that are otherwise discoverable by using a specific Atom feed. For example, a managed system object does not include a list of logical partition Atom links.
- The PowerVM NovaLink API does not include all optional schema elements from the Hardware Management Console (HMC) API.

For more information about the HMC API, see the [HMC REST APIs](#)

For more information about the `pypowervm` open source library, see the [pypowervm website \(https://github.com/pypowervm/pypowervm\)](https://github.com/pypowervm/pypowervm).

PowerVM NovaLink command-line interface

The PowerVM NovaLink command-line interface (CLI) is a Python-based CLI for administrative functions on a system that is managed through PowerVM NovaLink.

pvmctl command

The command-line interface uses the **pvmctl** command for most operations. The command can be entered at the command line of the PowerVM NovaLink partition.

The **pvmctl** command can be run only by users who are in the `pvm_admin` group. To add a user to the `pvm_admin` group, enter the following command.

```
sudo adduser user_id pvm_admin
```

The `admin` user for the PowerVM NovaLink partition is added to the `pvm_admin` group automatically when PowerVM NovaLink is installed.

Displaying version information

To display version information for the PowerVM NovaLink software, enter the command `pvmctl --version`.

Command help

The **pvmtcl** command includes help information that lists the operations that are used by the command. To view the help information, enter one of the following commands.

To view a list of objects on which you can perform actions, enter the command `pvmtcl help` or `pvmtcl --help`.

To view a list of operations for a specific object type, enter the command `pvmtcl object_type help` or `pvmtcl object_type --help`.

To view information about the arguments for a specific object type and operation, enter the command `pvmtcl object_type operation help` or `pvmtcl object_type operation --help`.

Supported object types

The following object types are supported by the PowerVM NovaLink CLI. You can use either the full object type or the indicated short names for each object type.

- ManagedSystem (sys)
- LogicalPartition (lpar or vm)
- VirtualIOServer (vios)
- SharedStoragePool (ssp)
- IOSlot (io)
- LoadGroup (lgrp)
- LogicalUnit (lu)
- LogicalVolume (lv)
- NetworkBridge (nbr or bridge)
- PhysicalVolume (pv)
- SharedEthernetAdapter (sea)
- SharedStoragePool (ssp)
- VirtualEthernetAdapter (vea or eth)
- VirtualFibreChannelMapping (vfc or vfcmapping)
- VirtualMediaRepository (vmr or repo)
- VirtualNetwork (vnet or net)
- VirtualOpticalMedia (vom or media)
- VirtualSCSIMapping (scsi or scsimapping)
- VirtualSwitch (vswitch or vsw)

Command structure

The CLI uses the following command structure.

```
pvmtcl [--version] [object] [operation] [arguments...] [help | --help]
```

For example, to list the logical partitions on the managed system, enter the following command:

```
pvmtcl LogicalPartition list
```

To list all Virtual I/O Server names, IDs, states, and their associated I/O Adapter device names, use the `--display-fields` (or `-d`) argument:

```
pvmtcl vios list -d name id state IOAdapter.dev_name
```

To list the names, IDs, states, and associated I/O Adapter device names of all Virtual I/O Servers that are not running, use the `--where` argument to add the condition to the command:

```
pvmctl vios list -d name id state IOAdapter.dev_name --where VirtualIOServer.state!=running
```

To list a network bridge with a port VLAN ID of 10, use the `--object-id` (or `-i`) argument:

```
pvmctl bridge list --object-id pvid=10
```

To update the desired memory of a logical partition with name `mylpar` to 512 MB, use the `--set-fields` argument:

```
pvmctl lpar update -i name=mylpar --set-fields PartitionMemoryConfiguration.desired=512
```

To delete a virtual Ethernet adapter, specify its parent identifier with the `--parent-id` (or `-p`) argument:

```
pvmctl vea delete -i pvid=1 --parent-id name=lp_name
```

To create a new logical partition, view the required arguments by using the command `pvmctl lpar create help`.

The following command creates an AIX/Linux logical partition named `new_lpar` with one dedicated processor and 512 MB of memory:

```
pvmctl lpar create --name new_lpar --proc 1 --proc-type dedicated  
--sharing-mode normal --type AIX/Linux --mem 512
```

Virtual terminal command

Enter the `mkvterm` command to open a virtual terminal connection to an AIX or Linux logical partition.

For example, to open a virtual terminal connection to a partition with partition ID 3, enter the following command:

```
mkvterm --id 3
```

To exit the virtual terminal, press `Control + J`.

Partition configuration backup and restore commands

Enter the `bkprofdata` and `rstprofdata` commands to back up and restore the partition configuration data of a managed system. These commands back up and restore only the partition configuration data in the hypervisor.

For example, to backup the partition configuration to the `/tmp/mybackup.bak` file, enter the following command:

```
bkprofdata -o backup -f /tmp/mybackup.bak
```

To restore the partition configuration data from the `/tmp/mybackup.bak` file by using phase 2 restoration, enter the following command:

```
rstprofdata -l 2 -f /tmp/mybackup.bak
```

Virtual I/O Server command

Use the `viosvr cmd` command to run commands on an instance of the Virtual I/O Server.

For example, to run the `lsmmap -all` command on the Virtual I/O Server with partition ID 2, enter the following command:

```
viosvr cmd --id 2 -c "lsmmap -all"
```

Related information:

Recovering the PowerVM NovaLink partition

The PowerVM NovaLink installer contains recovery tools that you can use to recover from a hardware failure. To access recovery tools, boot the PowerVM NovaLink installer.

Checking service status

The PowerVM NovaLink partition contains the following system services that must always be running: `pvm-core` and `pvm-rest`. If you are not able to complete tasks on the PowerVM NovaLink partition, verify whether these services are running. Use the `systemctl` command to view the status of these services and to stop, start, and restart these services.

To view the status of a service, enter the following command, where `service_name` is `pvm-core` or `pvm-rest`.

```
sudo systemctl status service_name
```

To start a service, enter the following command.

```
sudo systemctl start service_name
```

To restart a service, enter the following command.

```
sudo systemctl restart service_name
```

To stop a service, enter the following command.

```
sudo systemctl stop service_name
```

Rebuilding the PowerVM NovaLink RAID array

By default, the PowerVM NovaLink partition uses two 30 GB logical volumes, each of which is hosted by an instance of Virtual I/O Server. The logical volumes are mirrored by using RAID 1. Each time you reboot one of the instances of Virtual I/O Server, the RAID array puts one of the disks into failure mode. The RAID array is rebuilt automatically every 15 minutes. However, if you want to rebuild the RAID array immediately after a Virtual I/O Server reboot, enter the following command at the PowerVM NovaLink command line.

```
sudo /usr/sbin/pvm-rebuild-raid
```

Shutting down the PowerVM NovaLink partition

The PowerVM NovaLink partition always restarts itself if you use normal operating system commands to shut down. To shut down the PowerVM NovaLink partition, enter the following command, where `novalink_id` is the partition ID of the PowerVM NovaLink partition.

```
pvmctl lpar power-off -i id=novalink_id
```

Log file location

Log files for PowerVM NovaLink are located in the `/var/log/pvm` directory on the PowerVM NovaLink partition. Use the `/usr/sbin/pedbg` command on the PowerVM NovaLink partition to gather the log files for service and support.

Accessing recovery tools from the PowerVM NovaLink installer

The PowerVM NovaLink installer contains tools that you can use to recover from a part failure or from a managed system failure. To access the tools, start the PowerVM NovaLink installer.

To access recovery tools from the PowerVM NovaLink installer, you must locate a Linux PC or notebook to use as a console. You also need an Ethernet cable to connect the PC or notebook to the managed system.

To access recovery tools from the PowerVM NovaLink installer, complete the following steps:

1. Access the ASMI by using the PC or notebook. For information about how to connect to ASMI, see *Accessing the ASMI using a PC or notebook and web browser*.
2. Power off the system by clicking **Power/Restart Control > Power On/Off System**.
3. Click **Power/Restart Control > Power On/Off System**, change **AIX/Linux partition mode boot to Boot to SMS menu**, and click **Save settings**.
4. Enter the following commands on the command line of the Linux PC or notebook, where *ip_add* is the IP address that you used to connect to the ASMI and *password* is your ASMI password:


```
ipmitool -I lanplus -H ip_add -P password chassis power on
ipmitool -I lanplus -H ip_add -P password sol activate
```
5. Select the boot device by using the SMS menu. You can select either a USB drive or a netboot server as the boot device. To select the boot device, complete the steps for the type of boot device that you are using.

Boot device type	Steps
USB drive	<ol style="list-style-type: none"> 1. At the Boot selection window, enter 1 to select the SMS Menu. 2. Enter 2 to continue with password entry. Enter admin. 3. From the main menu, enter 5 to select boot options. 4. Enter 1 to select the install/boot device. 5. Enter 7 to view a list of all boot devices, and then enter the number that corresponds to the USB drive. 6. Enter 2 to perform a normal mode boot, and then enter 1 to exit the SMS menu and to start the boot process.

Boot device type	Steps
Netboot server	<ol style="list-style-type: none"> 1. At the Boot selection window, enter 1 to select the SMS Menu. 2. Enter 2 to continue with password entry. Enter admin. 3. From the main menu, enter 2 to set up the remote IPL. 4. Enter the number that corresponds to the Ethernet adapter that you want to use. 5. Enter the number for IPv4 IP addresses. 6. Enter the number for BOOTP as your network service. 7. Enter 1 for IP parameters. 8. Set the IP parameters: <ul style="list-style-type: none"> • Client IP Address is the IP address that you set for the managed system in the /etc/bootptab file on the netboot server. • Server IP Address is the IP address of the netboot server. • Gateway IP Address is the gateway IP address that you set for the managed system in the /etc/bootptab file on the netboot server. • Subnet Mask is the subnet mask that you set for the managed system in the /etc/bootptab file on the netboot server. 9. Press ESC, enter 3 for ping test, enter 1 for execute ping test, and verify that the netboot server is reachable. 10. Enter M to return to the main menu. 11. From the main menu, enter 5 to select boot options. 12. Enter 1 to select the install/boot device. 13. Select Network, and then select the network card you configured. 14. Enter 2 to perform a normal mode boot, and then enter 1 to exit the SMS menu and to start the boot process.

6. At the GNU GRand Unified Bootloader (GRUB) screen, select the **PowerVM NovaLink Install/Repair** option, and then select the rescue mode option.

After you are in rescue mode, you can use the **pvmctl** command to manage virtualization on the managed system.

PowerVM NovaLink system backup and restoration

PowerVM NovaLink automatically backs up hypervisor and Virtual I/O Server configuration data by using cron jobs. After failure of the managed system, access rescue mode by booting the PowerVM NovaLink image. Use rescue mode to restore the system with the backed up hypervisor and Virtual I/O Server configuration data.

Backup file location

Backup files are stored in the /var/backups/pvm/SYSTEM_MTMS/ directory on the PowerVM NovaLink partition. Virtual I/O Server configuration backups are stored in the default Virtual I/O Server locations

for user padmin (~padmin/cfgbackups), and then copied to the novalink directory for consolidation. The backup cron jobs create and copy the backups automatically.

Up to 23 hourly backups and 31 daily backups are stored at a time.

Storing backup files at a remote location

For secure storage of backup files at a remote location, mount a Network File System (NFS) remote file system to the /var/backups/pvm/ directory. Alternatively, you can use the backup software of your choice to back up the contents of the /var/backups/pvm/ directory.

Partition IDs in backup files

For simpler recovery, the PowerVM NovaLink partition ID is always set to 1 in backup files. If some other logical partition has partition ID 1, the partition ID of that partition is swapped with the PowerVM NovaLink partition ID. For example, if PowerVM NovaLink partition ID is 2 and partition ID 1 belongs to a Virtual I/O Server partition, when PowerVM NovaLink backs up hypervisor and Virtual I/O Server configuration data, the PowerVM NovaLink partition ID becomes 1 and the Virtual I/O Server partition ID becomes 2.

System restoration by using the rescue mode

Use rescue mode to restore your managed system after system failure.

System restoration includes the following phases.

- The first phase restores the hypervisor configuration, the PowerVM NovaLink partition, and the Virtual I/O Server partitions. During this phase, you can choose to reinstall Virtual I/O Server manually on the Virtual I/O Server partitions. You can also manually restore the viosbr data to the Virtual I/O Server logical partitions during this phase, if necessary. At the end of this phase, the system performs a full system reboot to apply the hypervisor configuration. Run this phase only if the system is already reset to factory settings. For information about how to reset a system to factory settings, see Restoring your server to factory settings.
- The second phase restores the client logical partitions. The client logical partitions are restored in partition ID order. If the managed system runs out of memory or processor resources, the remaining partitions are created with no resources.

To reinstall your PowerVM NovaLink environment instead of restoring it, you can use only the second phase. To reinstall your PowerVM NovaLink environment, complete the following steps:

1. Install PowerVM NovaLink by using automated installation.
2. Use rescue mode to restore the client logical partitions.
3. Restore the viosbr data to the Virtual I/O Server partitions manually.

Resetting a PowerVM NovaLink-managed system to an HMC-managed system

You can co-manage a managed system by using both PowerVM NovaLink and the Hardware Management Console (HMC). However, you cannot use partition profiles and system plans on a co-managed system, even if the HMC is set to the master mode. To use partition profiles and system plans on a managed system, you must remove PowerVM NovaLink from the managed system.

Before you reset the PowerVM NovaLink-managed system to an HMC-managed system, cable the server to an HMC if you have not already done so. For information about how to cable the server to an HMC, see [Cabling the server to the HMC](#).

To reset a PowerVM NovaLink-managed system to an HMC-managed system:

1. Set the HMC to master mode by entering the following command at the HMC command line, where *managed_system* is the name of the managed system.
`chcomgmt -o setmaster -t norm -m managed_system`
2. Power off the PowerVM NovaLink partition by entering the following command at the HMC command line. In this command, *managed_system* is the name of the managed system and *partition_id* is the partition ID of the PowerVM NovaLink partition.
`chsysstate -m managed_system -r lpar -o shutdown --id partition_id --immed`
3. Remove the PowerVM NovaLink partition by entering the following command at the HMC command line. In this command, *managed_system* is the name of the managed system and *partition_id* is the partition ID of the PowerVM NovaLink partition.
`rmsyscfg -r lpar -m managed_system --id partition_id`
4. Release master authority for the managed system by entering the following command at the HMC command line, where *managed_system* is the name of the managed system.
`chcomgmt -o relmaster -m managed_system`

PowerVM NovaLink Access Control Framework

PowerVM NovaLink Access Control Framework is used to provide access for non-root users to access (read, write, and execute) the privileged files or commands for various types of tasks such as viewing the configuration of PowerVM NovaLink logical partition. It uses the *sudo* and *acl* facility on an operating system instance. The *sudo* facility is generally used to provide permissions to run privileged commands with specific arguments.

You can set up the access control framework by completing the following steps:

1. Install the framework. The following files are installed when the *pvm-core* package of PowerVM NovaLink 1.0.0.4 is installed in the PowerVM NovaLink logical partition:
 - `/etc/security/pvm_access.conf`: This file contains the default access rules for the group **pvm_viewer**. The rules allow the members of the **pvm_viewer** group to view configuration information of various resources such as hardware, firmware, logical partitions, CPU, memory, networks, Open vSwitch, and storage of the system managed by using PowerVM NovaLink. The group **pvm_viewer** is also created when this configuration file is installed.
 - `/usr/bin/pvm_access`: This command is used to apply or enable the access rules defined in the `/etc/security/pvm_access.conf` file. It also provides options to check, get and disable the rules defined in the `/etc/security/pvm_access.conf` file.
2. Enabling the framework and adding authorized users. This configuration is performed by the PowerVM NovaLink administrator user.
 - a. Enter the `sudo pvm_access -h` command to list the optional flags of the **pvm_access** command.
 Syntax: `pvm_access [-c | -s | -g | -d | -h | --help`
 Where
 - `-c` is used to verify the correctness of the access rules
 - `-s` is used to set the access rules
 - `-g` is used to get your access rules
 - `-d` is used to disable the access rules
 - `-h | --help` is used to print this help
 - b. Enter `sudo cat /etc/security/pvm_access.conf` to view the access rules. You can also add or modify rules if required. The `pvm_access.conf` file contains sufficient information for understanding or updating the rules in this file.
 - c. Enter `sudo pvm_access -c` to verify whether the rules defined in the `pvm_access.conf` file are correct. The command returns an error if any rule is incorrect. The command also verifies the requirements for using this framework.

- d. Enter `sudo pvm_access -s` to set, apply, or enable the access rules defined in the `pvm_access.conf` file. Running the command generates the following files:
 - `/etc/sudoers.d/pvm_access_sudoer`
 - `/etc/profile.d/pvm_access_profile.sh`
 - `/etc/profile.d/pvm_access_aliases`
 - `/etc/profile.d/pvm_access_aliases_unset`

Running the command also logs the list of rules applied, together with some other information in the `/var/log/pvm/pvm_access.log` file.

- e. To create a user called **pviewer**, belonging to the group **pvm_viewer**, enter the following commands:

```
sudo adduser pviewer
sudo usermod -aG pvm_viewer pviewer
```

3. Using the framework as a user. For example, a user called **pviewer**, who is privileged by this framework.

- a. Enter `pvm_access -g` to list the files you are allowed to read or write, and the commands (with arguments) that you are allowed to execute. You can also redirect the output and search for commands or files that you want to view. For example `pvm_access -g | grep pvmctl`
- b. The following commands are enabled for the users, for example **pviewer** belonging to the group **pvm_viewer**.

```
pvmctl lpar list
pvmctl -help
lshw
lsmcode
```

Note: If your shell type is not **bash**, you need to switch to the **bash** shell and then source the `/etc/profile.d/pvm_access_aliases` file by typing the following command:

```
bash ./etc/profile.d/pvm_access_aliases
```

To avoid switching to the **bash** shell and sourcing the `/etc/profile.d/pvm_access_aliases` file, you can modify the login shell of the user by using the `sudo usermod -s /bin/bash <userName>` command. To unset the aliases that are created by `/etc/profile.d/pvm_access_aliases`, you can source the `/etc/profile.d/pvm_access_aliases_unset` file.

4. Disabling the access rules. This task is performed by the PowerVM NovaLink administrator user. Enter `sudo pvm_access -d` to disable the rules. It removes all the files generated when the rules were enabled. It also unsets the ACLs modified by the script.

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Accessibility features for IBM Power Systems servers

Accessibility features assist users who have a disability, such as restricted mobility or limited vision, to use information technology content successfully.

Overview

The IBM Power Systems servers include the following major accessibility features:

- Keyboard-only operation
- Operations that use a screen reader

The IBM Power Systems servers use the latest W3C Standard, WAI-ARIA 1.0 (www.w3.org/TR/wai-aria/), to ensure compliance with US Section 508 (www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-section-508-standards/section-508-standards) and Web Content Accessibility Guidelines (WCAG) 2.0 (www.w3.org/TR/WCAG20/). To take advantage of accessibility features, use the latest release of your screen reader and the latest web browser that is supported by the IBM Power Systems servers.

The IBM Power Systems servers online product documentation in IBM Knowledge Center is enabled for accessibility. The accessibility features of IBM Knowledge Center are described in the Accessibility section of the IBM Knowledge Center help (www.ibm.com/support/knowledgecenter/doc/kc_help.html#accessibility).

Keyboard navigation

This product uses standard navigation keys.

Interface information

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The IBM Power Systems servers web user interface relies on cascading style sheets to render content properly and to provide a usable experience. The application provides an equivalent way for low-vision users to use system display settings, including high-contrast mode. You can control font size by using the device or web browser settings.

The IBM Power Systems servers web user interface includes WAI-ARIA navigational landmarks that you can use to quickly navigate to functional areas in the application.

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Programming interface information

This PowerVM NovaLink publication documents intended Programming Interfaces that allow the customer to write programs to obtain the services of IBM PowerVM NovaLink Version 1.0.0.6, IBM AIX Version 7.2, IBM AIX Version 7.1, IBM AIX Version 6.1, and IBM Virtual I/O Server Version 2.2.6.0.

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