SAP HANA with SUSE KVM and NetApp Storage

NetApp solutions for SAP

NetApp
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SAP HANA with SUSE KVM and NetApp Storage

Deploy SAP HANA on SUSE KVM with NetApp storage using SR-IOV and NFS

Deploy SAP HANA Single-Host on SUSE KVM using NetApp storage with SR-IOV network interfaces and NFS or FCP storage access. Follow this workflow to configure virtual interfaces, assign them to VMs, and set up storage connections for optimal performance.

For an overview of SAP HANA on KVM virtualization, refer to the SUSE documentation: SUSE Best Practices for SAP HANA on KVM.

1 Review the configuration requirements

Review the key requirements for deploying SAP HANA on SUSE KVM using NetApp storage with SR-IOV and storage protocols.

2 Configure SR-IOV network interfaces

Set up SR-IOV (Single Root I/O Virtualization) on the KVM host and assign virtual interfaces to the VM for network communication and storage access.

3 Configure Fibre Channel networking

Assign physical FCP HBA ports to the VM as PCI devices for using FCP LUNs with SAP HANA.

4 Configure NetApp storage for SAP HANA

Set up NFS or FCP storage connections between the VM and NetApp storage systems for SAP HANA database files.

Deployment requirements for SAP HANA on SUSE KVM with NetApp storage

Review the requirements for deploying SAP HANA Single-Host on SUSE KVM using NetApp storage with SR-IOV network interfaces and NFS or FCP storage protocols.

The deployment requires certified SAP HANA servers, NetApp storage systems, SR-IOV capable network adapters, and SUSE Linux Enterprise Server for SAP Applications as the KVM host.

Infrastructure requirements

Make sure the following components and configurations are in place:

- Certified SAP HANA servers and NetApp storage systems. Refer to the SAP HANA Hardware Directory for available options:
- SUSE Linux Enterprise Server for SAP Applications 15 SP5/SP6 as the KVM host
- NetApp ONTAP storage system with Storage Virtual Machine (SVM) configured for NFS and/or FCP traffic
- Logical interfaces (LIFs) created on the appropriate networks for NFS and FCP traffic
- SR-IOV capable network adapters (e.g., Mellanox ConnectX series)
- Fibre Channel HBA adapters for FCP storage access
- Network infrastructure supporting the required VLANs and network segments
- VM configured according to the SUSE Best Practices for SAP HANA on KVM

Important considerations

- SR-IOV must be used for SAP HANA network communication and for storage access using NFS. Each virtual function (VF) assigned to a VM requires at least 10 Gbit/s bandwidth.
- Physical FCP HBA ports must be assigned to the VM as PCI devices for using FCP LUNs. A physical port can only be assigned to one VM.
- SAP HANA Multiple-Host systems are not supported in this configuration.

Additional resources

- For the latest information including supported CPU architecture and limitations, refer to the SAP Note 3538596 - SAP HANA on SUSE KVM Virtualization with SLES 15 SP5 - SAP for Me.
- For information about configuring ONTAP storage systems, refer to the ONTAP 9 documentation.
- For SAP HANA storage configuration with NetApp systems, refer to the NetApp SAP solutions documentation.

What's next?

After you've reviewed the deployment requirements, configure SR-IOV network interfaces.

Configure SR-IOV network interfaces for SAP HANA on SUSE KVM

Configure SR-IOV network interfaces on SUSE KVM for SAP HANA. Set up virtual functions (VFs), assign them to VMs, and configure redundant network connections for optimal performance and storage access.

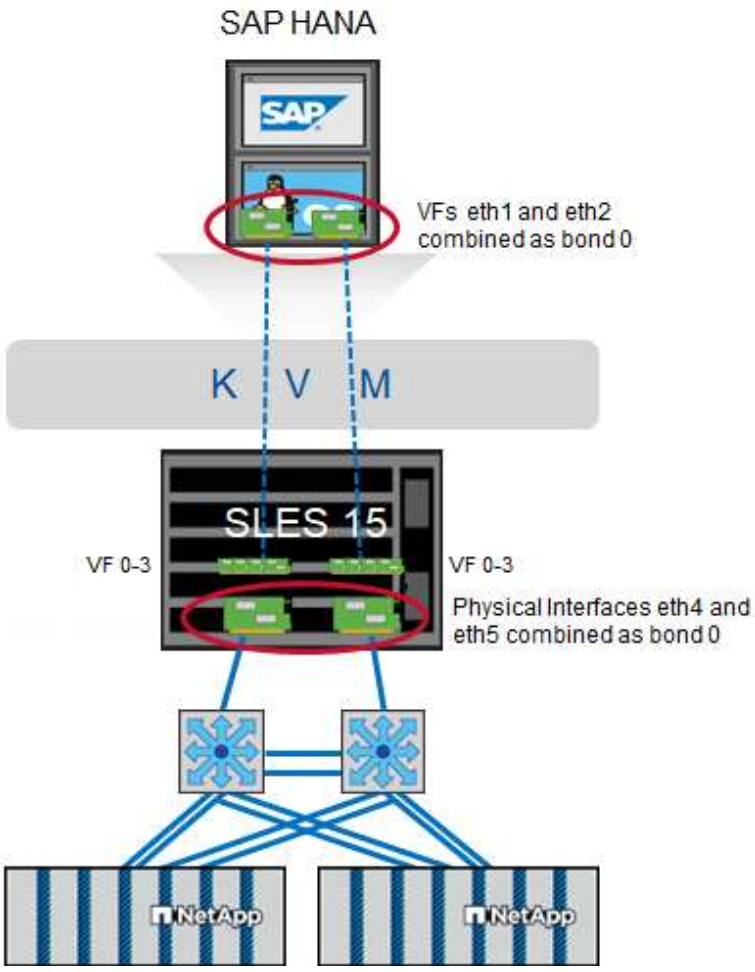
Step 1: Setup SR-IOV

Enable and configure SR-IOV functionality in the adapter firmware to allow virtual function creation.

This procedure is based on NVIDIA Enterprise Support Portal | HowTo Configure SR-IOV for ConnectX-4/ConnectX-5/ConnectX-6 with KVM (Ethernet). The SUSE SAP HANA KVM guide describes this based on an

INTEL NIC.

It is recommended to use redundant ethernet connections by combining two physical ports as trunk/bond. The virtual ports (VF) assigned to the VM need to be trunked as well within the VM.



Before you begin

Make sure the following prerequisites are met:

- KVM is installed
- SR-IOV is enabled in the servers BIOS
- PCI Passthrough is enabled by adding “intel_iommu=on” and “iommu=pt” as option at the bootloader
- Latest MLNX_OFED drivers are installed at KVM hosts and VM.

Each VF assigned to a VM requires at least 10 Gbit/s bandwidth. Do not create and assign more than two VFs for a 25GbE physical port.

Steps

1. Run MFT (Mellanox Firmware Tools):

```
# mst start
Starting MST (Mellanox Software Tools) driver set
Loading MST PCI module - Success
Loading MST PCI configuration module - Success
Create devices
Unloading MST PCI module (unused) - Success
```

2. Locate the device:

```
# mst status
MST modules:
------------
MST PCI module is not loaded
MST PCI configuration module loaded

MST devices:

------------

/dev/mst/mt4125_pciconf0 - PCI configuration cycles access.
domain:bus:dev.fn=0000:ab:00.0 addr.reg=88 data.reg=92
cr_bar.gw_offset=-1

Chip revision is: 00
```

3. Check the status of the device:

```
mlxconfig -d /dev/mst/mt4125_pciconf0 q |grep -e SRIOV_EN -e NUM_OF_VFS
NUM_OF_VFS 8
SRIOV_EN True(1)_
```

4. If necessary, enable SR-IOV:

```
mlxconfig -d /dev/mst/mt4125_pciconf0 set SRIOV_EN=1
```

5. Set the max amount of VFs:

```
mlxconfig -d /dev/mst/mt4125_pciconf0 set  NUM_OF_VFS=4
```

6. Reboot the server if the feature needed to be enabled or the amount of max VFs has been changed.

Step 2: Create the virtual interfaces

Create virtual functions (VFs) on the physical network ports to enable SR-IOV functionality. In this step, four VFs are created per physical port.

Steps

1. Find the device:

```
# ibstat

CA 'mlx5_0'
CA type: MT4125
Number of ports: 1
Firmware version: 22.36.1010
Hardware version: 0
Node GUID: 0xa088c20300a6f6fc
System image GUID: 0xa088c20300a6f6fc
Port 1:
State: Active
Physical state: LinkUp
Rate: 100
Base lid: 0
LMC: 0
SM lid: 0
Capability mask: 0x00010000
Port GUID: 0xa288c2fffea6f6fd
Link layer: Ethernet
CA 'mlx5_1'
CA type: MT4125
Number of ports: 1
Firmware version: 22.36.1010
Hardware version: 0
Node GUID: 0xa088c20300a6f6fd
System image GUID: 0xa088c20300a6f6fc
Port 1:
State: Active
Physical state: LinkUp
Rate: 100
Base lid: 0
LMC: 0
SM lid: 0
Capability mask: 0x00010000
Port GUID: 0xa288c2fffea6f6fd
Link layer: Ethernet
```

If a bond has been created the output would look like the following:

```
# ibstat
CA 'mlx5_bond_0'
CA type: MT4125
Number of ports: 1
Firmware version: 22.36.1010
Hardware version: 0
Node GUID: 0xa088c20300a6f6fc
System image GUID: 0xa088c20300a6f6fc
Port 1:
State: Active
Physical state: LinkUp
Rate: 100
Base lid: 0
LMC: 0
SM lid: 0
Capability mask: 0x00010000
Port GUID: 0xa288c2fffea6f6fc
Link layer: Ethernet
#:/etc/sysconfig/network # cat /sys/class/infiniband/mlx5_bond_0/device/
aerdevcorrectable iommugroup/ resetmethod
aerdevfatal irq resource
aerdevnonfatal link/ resource0
arienabled localcpulist resource0wc
brokenparitystatus localcpus revision
class maxlinkspeed rom
config maxlinkwidth sriovdriversautoprobe
consistentdmamaskbits mlx5_core.eth.0/ sriovnumvfs
urrentlinkspeed mlx5_core.rdma.0/ sriovoffset
currentlinkwidth modalias sriovstride
d3coldallowed msibus sriovtotalvfs
device msiirqs/ sriovvfdevice
dmamaskbits net/ sriovvftotalmsix
driver/ numanode subsystem/
driveroverride pools subsystemdevice
enable power/ subsystemvendor
firmwarenode/ powerstate uevent
infiniband/ ptp/ vendor
infinibandmad/ remove vpd
infinibandverbs/ rescan
iommu/ reset
```

```
# ibdev2netdev
mlx5_0 port 1 ==> eth4 (Up)
mlx5_1 port 1 ==> eth5 (Up)
```

2. Get the total VFs that are allowed and configured in the firmware:

```
# cat /sys/class/net/eth4/device/sriov_totalvfs
4
# cat /sys/class/net/eth5/device/sriov_totalvfs
4
```

3. Get the current number of VFs on this device:

```
# cat /sys/class/infiniband/mlx5_0/device/sriov_numvfs
0
# cat /sys/class/infiniband/mlx5_1/device/sriov_numvfs
0
```

4. Set the desired number of VFs:

```
# echo 4 > /sys/class/infiniband/mlx5_0/device/sriov_numvfs
# echo 4 > /sys/class/infiniband/mlx5_1/device/sriov_numvfs
```

If you already configured a bond using these two ports the first command needs to be executed against the bond:

```
# echo 4 > /sys/class/infiniband/mlx5_bond_0/device/sriov_numvfs
```

5. Check the PCI bus:

```
# lspci -D | grep Mellanox

0000:ab:00.0 Ethernet controller: Mellanox Technologies MT2892 Family
[ConnectX-6 Dx]
0000:ab:00.1 Ethernet controller: Mellanox Technologies MT2892 Family
[ConnectX-6 Dx]
0000:ab:00.2 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:00.3 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:00.4 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:00.5 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:01.2 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:01.3 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:01.4 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
0000:ab:01.5 Ethernet controller: Mellanox Technologies ConnectX Family
mlx5Gen Virtual Function
```

```
# ibdev2netdev -v

0000:ab:00.0 mlx5_0 (MT4125 - 51TF3A5000XV3) Mellanox ConnectX-6 Dx
100GbE QSFP56 2-port PCIe 4 Ethernet Adapter fw 22.36.1010 port 1
(ACTIVE) ==> eth4 (Up)
0000:ab:00.1 mlx5_1 (MT4125 - 51TF3A5000XV3) Mellanox ConnectX-6 Dx
100GbE QSFP56 2-port PCIe 4 Ethernet Adapter fw 22.36.1010 port 1
(ACTIVE) ==> eth6 (Up)
0000:ab:00.2 mlx523 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth6
(Down)
0000:ab:00.3 mlx5_3 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth7
(Down)
0000:ab:00.4 mlx5_4 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth8
(Down)
0000:ab:00.5 mlx5_5 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth9
(Down)
0000:ab:01.2 mlx5_6 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth10
(Down)
0000:ab:01.3 mlx5_7 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth11
(Down)
0000:ab:01.4 mlx5_8 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth12
(Down)
0000:ab:01.5 mlx5_9 (MT4126 - NA) fw 22.36.1010 port 1 (DOWN ) ==> eth13
(Down)
```

6. Check the VFs configuration via the IP tool:

```
# ip link show
…
6: eth4: <BROADCAST,MULTICAST,SLAVE,UP,LOWER_UP> mtu 9000 qdisc mq
master bond0 state UP mode DEFAULT group default qlen 1000

link/ether a0:88:c2:a6:f6:fd brd ff:ff:ff:ff:ff:ff permaddr
a0:88:c2:a6:f6:fc
vf 0 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off
vf 1 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off
vf 2 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off
vf 3 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off

altname enp171s0f0np0
altname ens3f0np0

7: eth5: <BROADCAST,MULTICAST,SLAVE,UP,LOWER_UP> mtu 9000 qdisc mq
master bond0 state UP mode DEFAULT group default qlen 1000

link/ether a0:88:c2:a6:f6:fd brd ff:ff:ff:ff:ff:ff
vf 0 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off
vf 1 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off
vf 2 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off
vf 3 link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff, spoof checking
off, link-state auto, trust off, query_rss off

altname enp171s0f1np1
altname ens3f1np1
…
```

Step 3: Enable VFs during boot

Configure the VF settings to persist across system reboots by creating systemd services and startup scripts.

1. Create a systemd unit file `/etc/systemd/system/after.local` with the following content:

```
[Unit]
Description=/etc/init.d/after.local Compatibility
After=libvirtd.service Requires=libvirtd.service

[Service]
Type=oneshot
ExecStart=/etc/init.d/after.local
RemainAfterExit=true

[Install]
WantedBy=multi-user.target
```

2. Create the script */etc/init.d/after.local*:

```
#! /bin/sh
#
#
# ...
echo 4 > /sys/class/infiniband/mlx5_bond_0/device/sriov_numvfs
echo 4 > /sys/class/infiniband/mlx5_1/device/sriov_numvfs
```

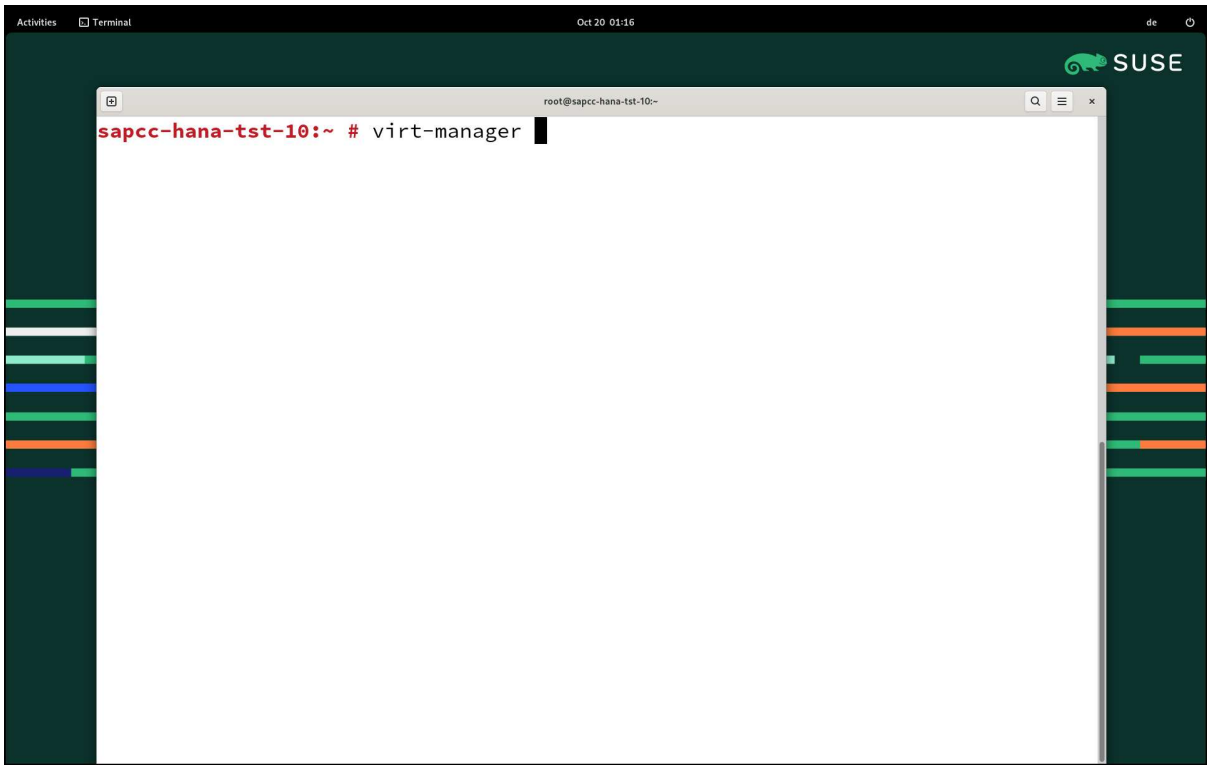
3. Ensure that the file can be executed:

```
# cd /etc/init.d/
# chmod 750 after.local
```

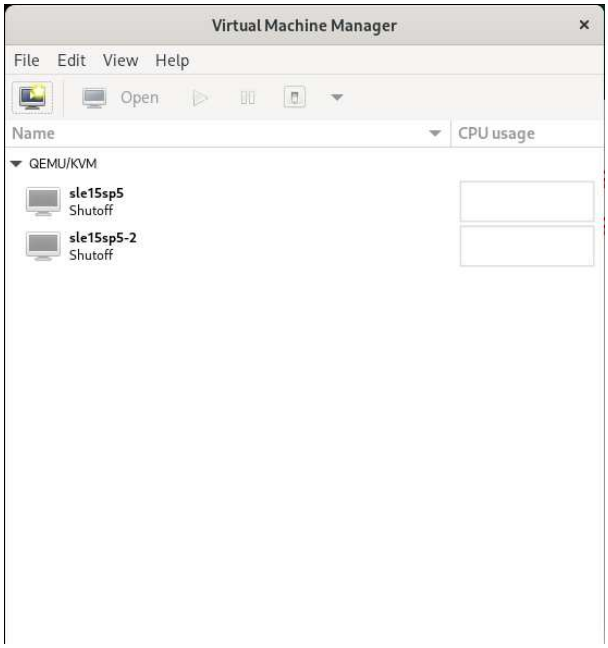
Step 4: Assign the virtual interfaces to the VM

Assign the created virtual functions to the SAP HANA VM as PCI host devices using *virt-manager*

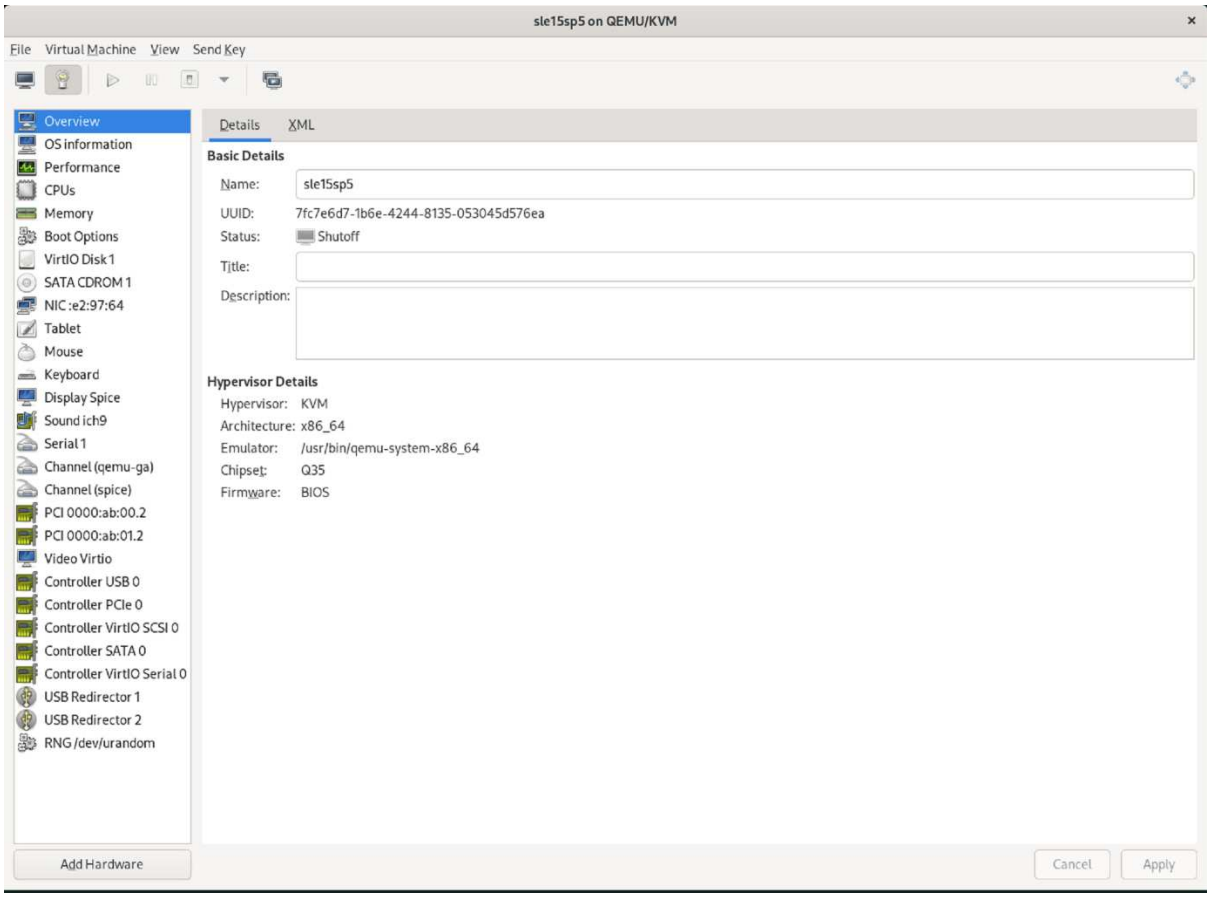
1. Start virt-manager.



2. Open the desired VM.

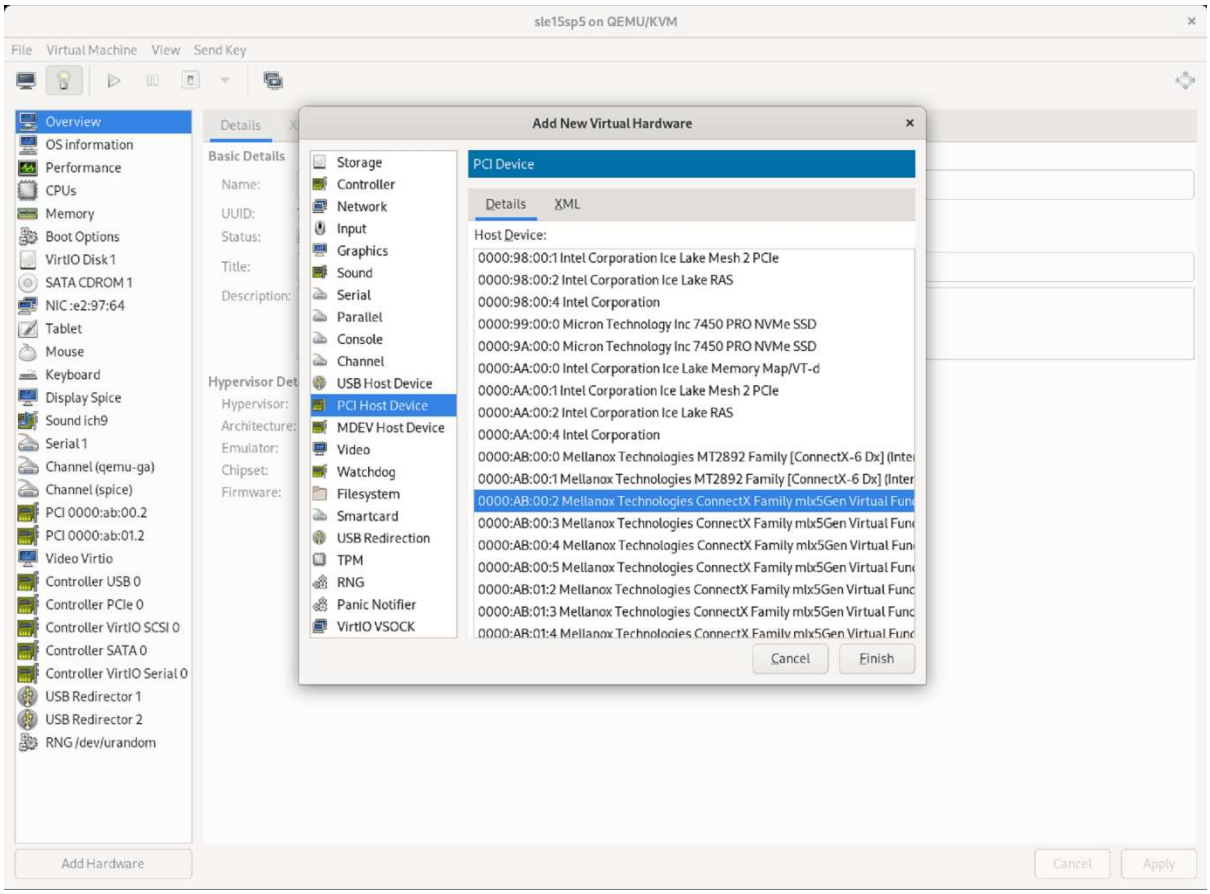


3. Select **Add Hardware**.

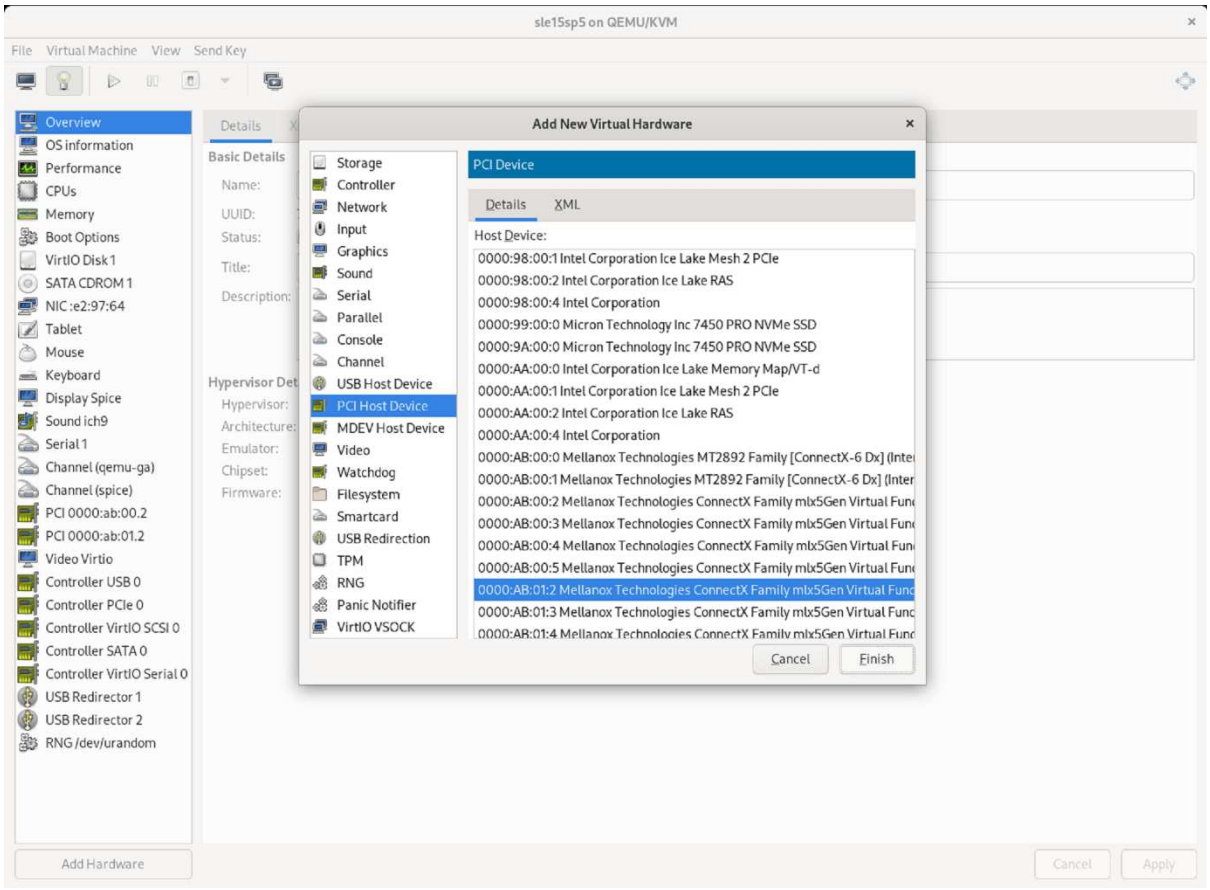


4. Choose the desired virtual NIC from the first physical port from the list of PCI Host Device and press finish.

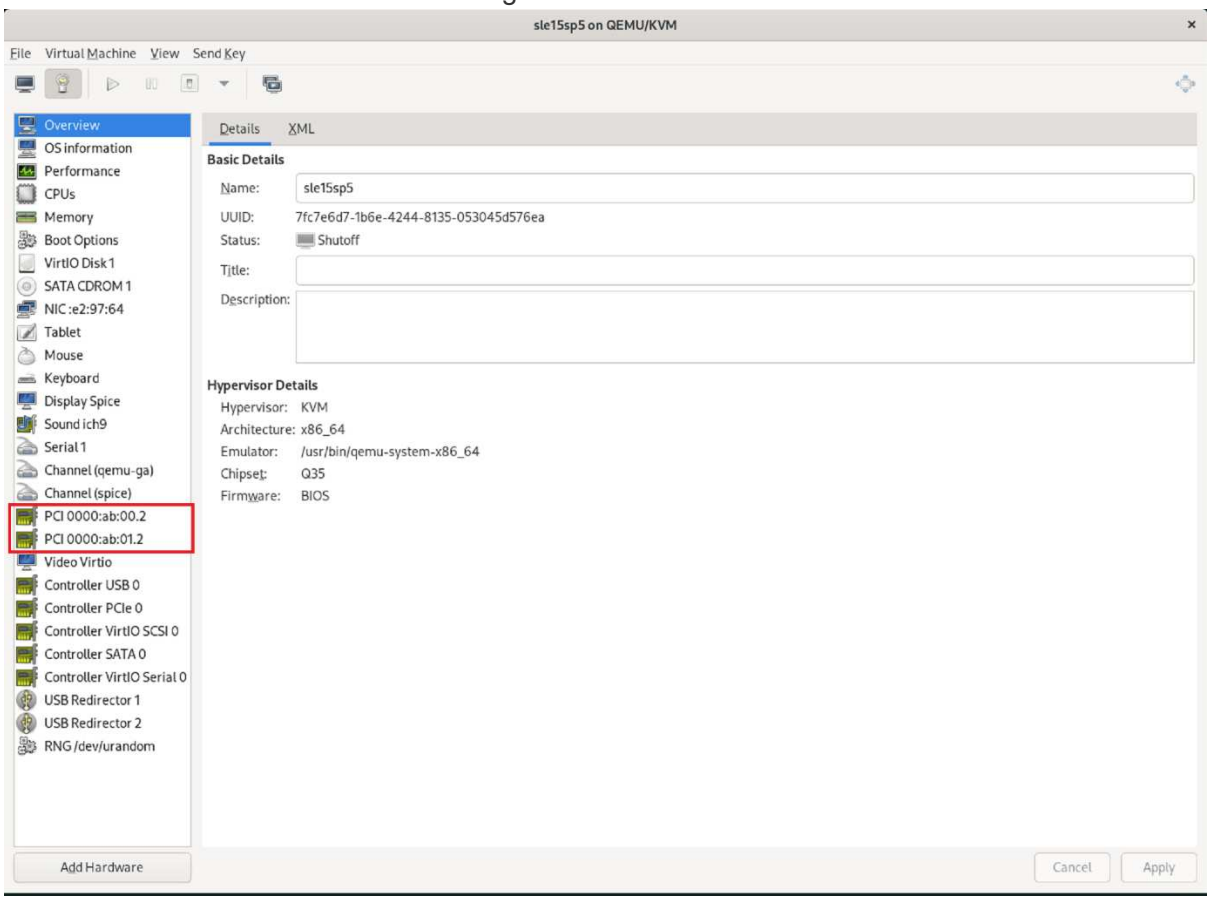
   In this example 0000.AB:00:2 - 0000.AB:00:4 belong to the first physical port and 0000.AB:01:2 - 0000.AB:01:4 belong to the second physical port.



5. Choose the next virtual NIC port from the list of PCI Host Device, use a virtual port from the second physical port and select **Finish**.

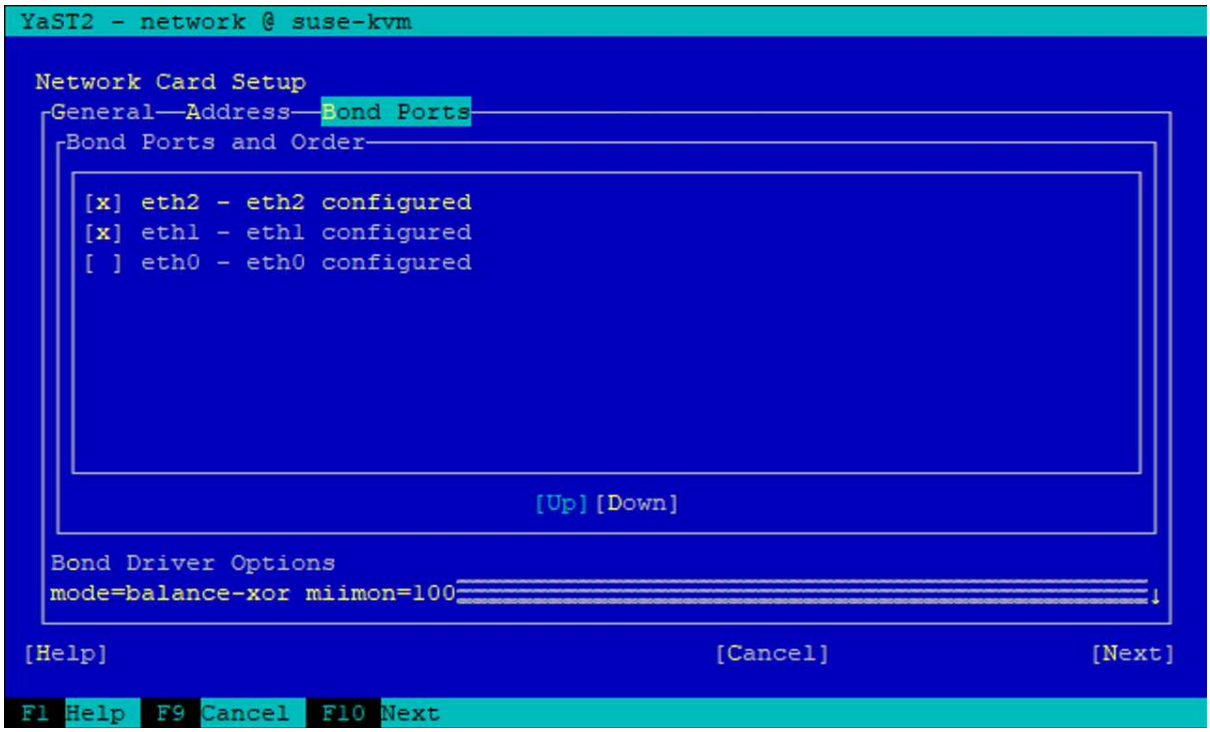


6. Afterwards the virtual interfaces are assigned to the VM and the VM can be started.



Step 5: Configure network interfaces within the VM

Log in to the VM and configure the two VFs as bond. Choose either mode 0 or mode 2. Do not use LACP as LACP can only be used on physical ports. The figure below shows a mode 2 configuration using YAST.



What's next?

After you've configured SR-IOV network interfaces, configure Fibre Channel networking if FCP shall be used as storage protocoll.

Configure Fibre Channel networking for SAP HANA on SUSE KVM

Configure Fibre Channel networking for SAP HANA on SUSE KVM by assigning physical HBA ports to VMs as PCI devices. Set up redundant FCP connections using two physical ports attached to different fabric switches.

ⓘ The following steps are only required if FCP is used as storage protocol. IF NFS is used, these steps are not needed.

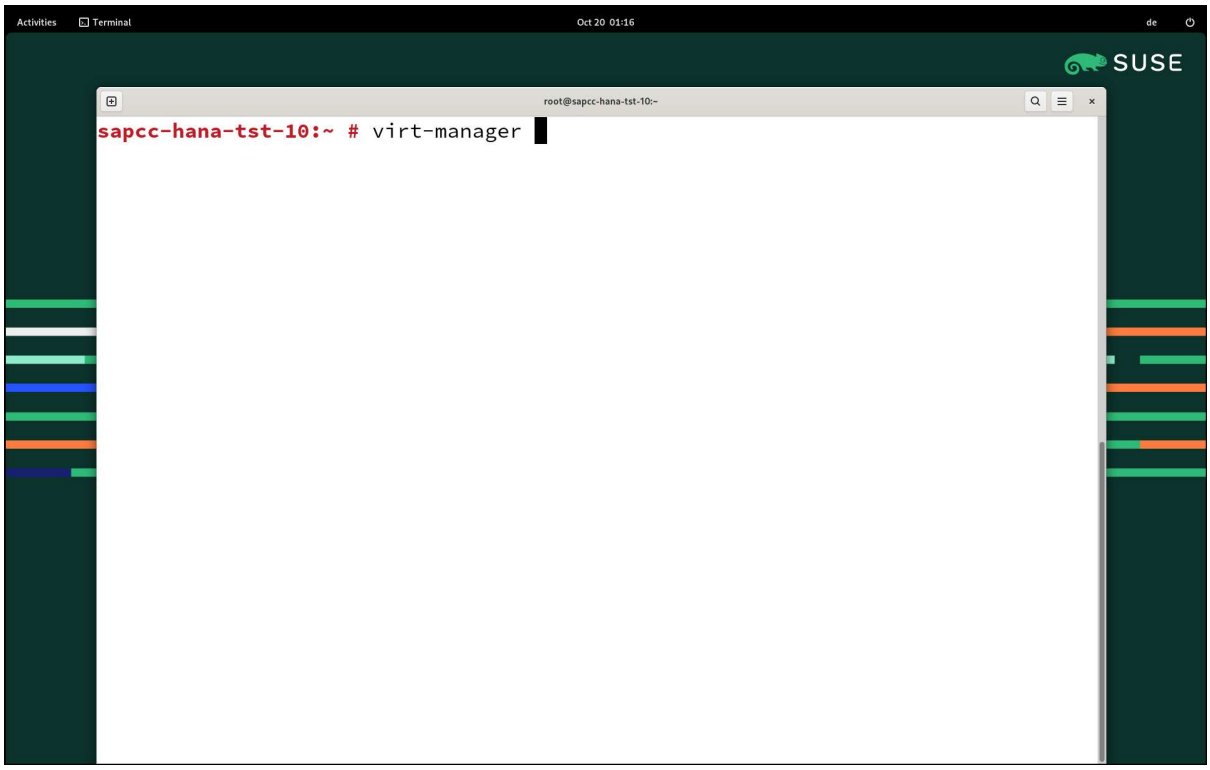
About this task

Since no SR-IOV equivalent feature exists for FCP, assign the physical HBA ports directly to the VM. Use two physical ports attached to different fabrics for redundancy.

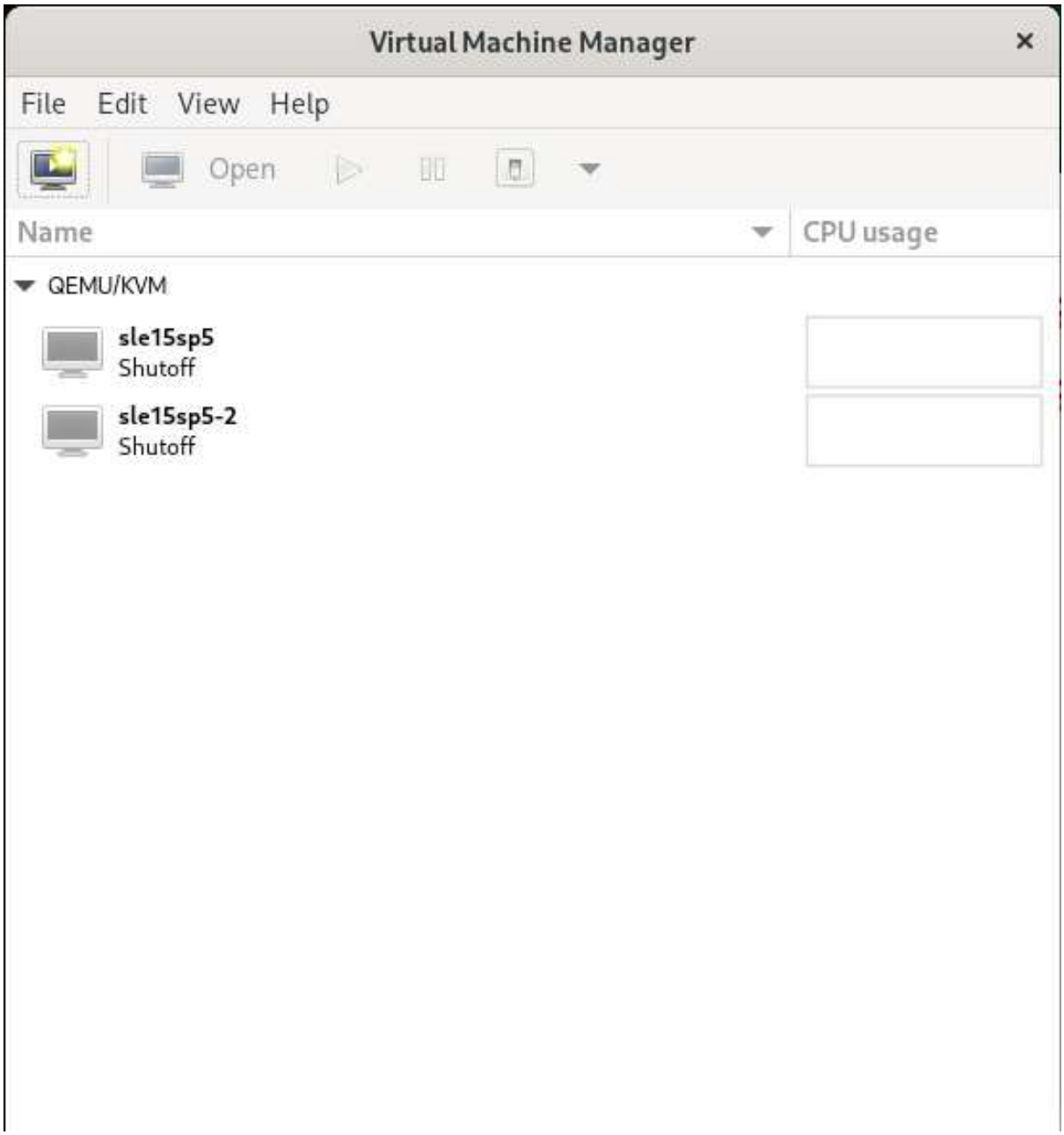
ⓘ A physical port can only be assigned to one VM.

Steps

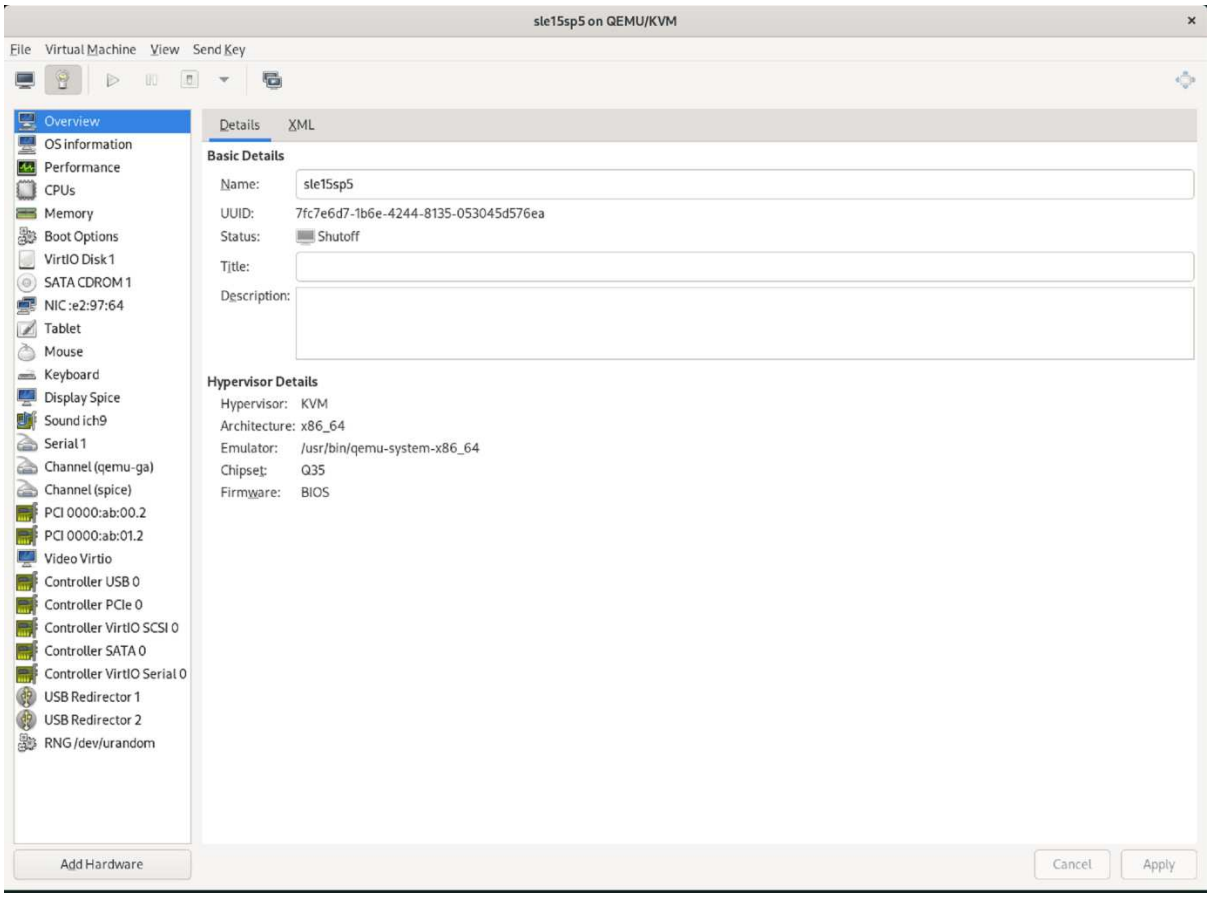
1. Start virt-manager:



2. Open the desired VM.

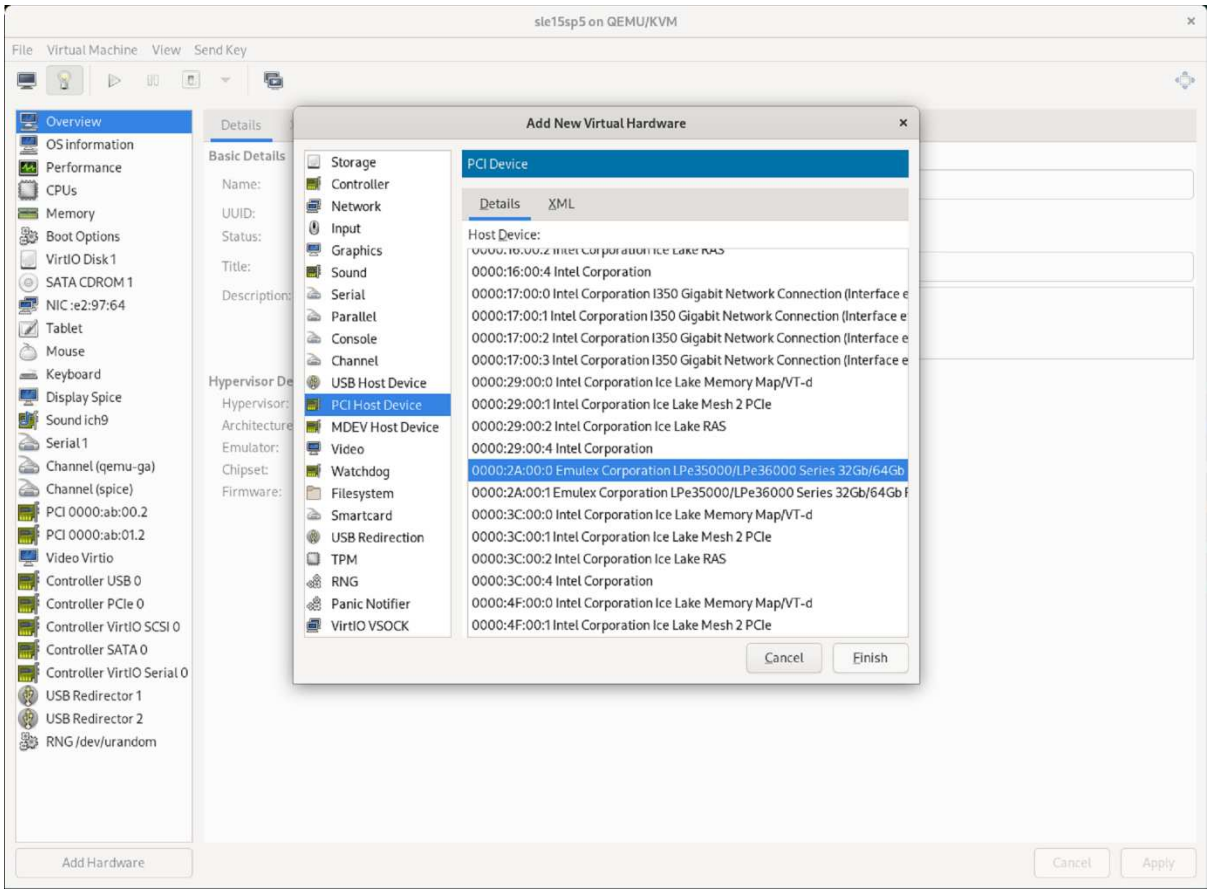


3. Select **Add Hardware**.

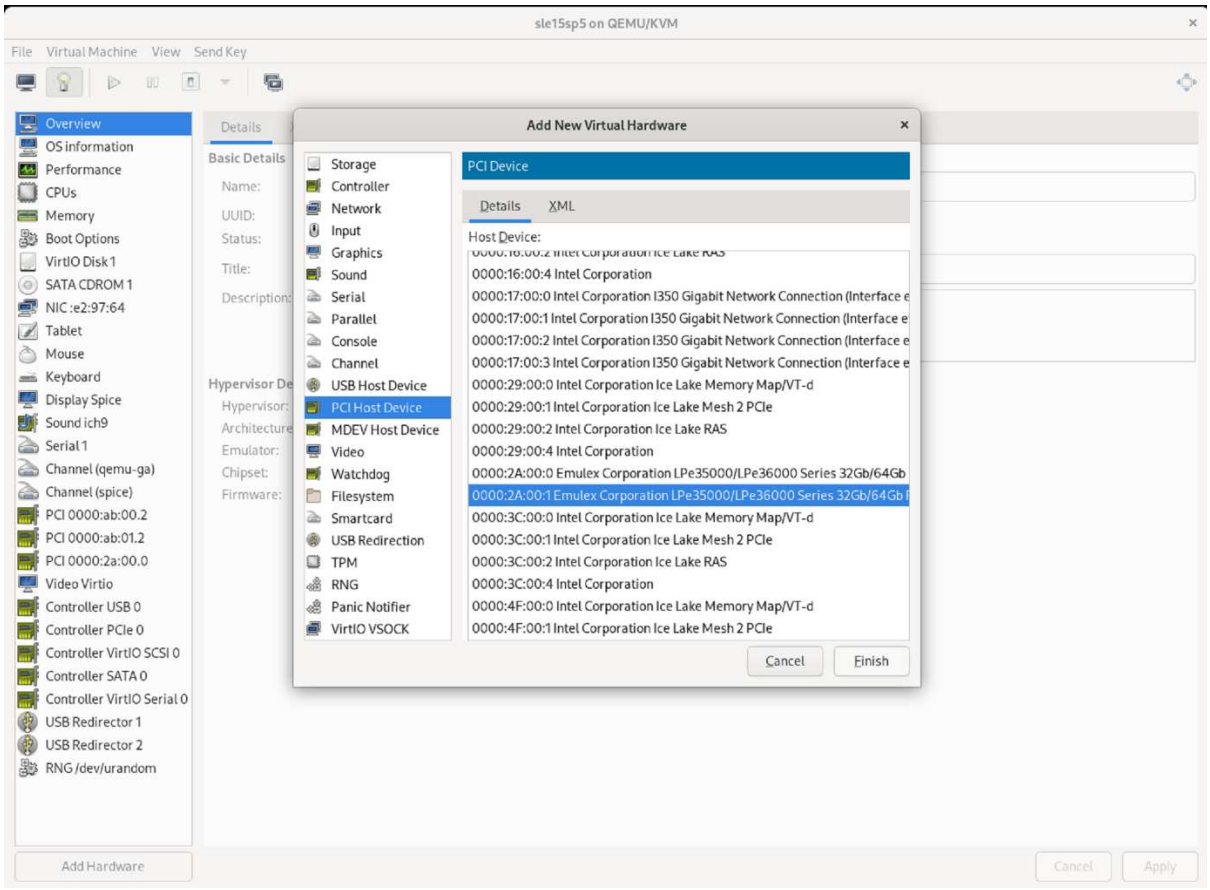


4. Choose the desired HBA port from the list of PCI Host Device and press finish.

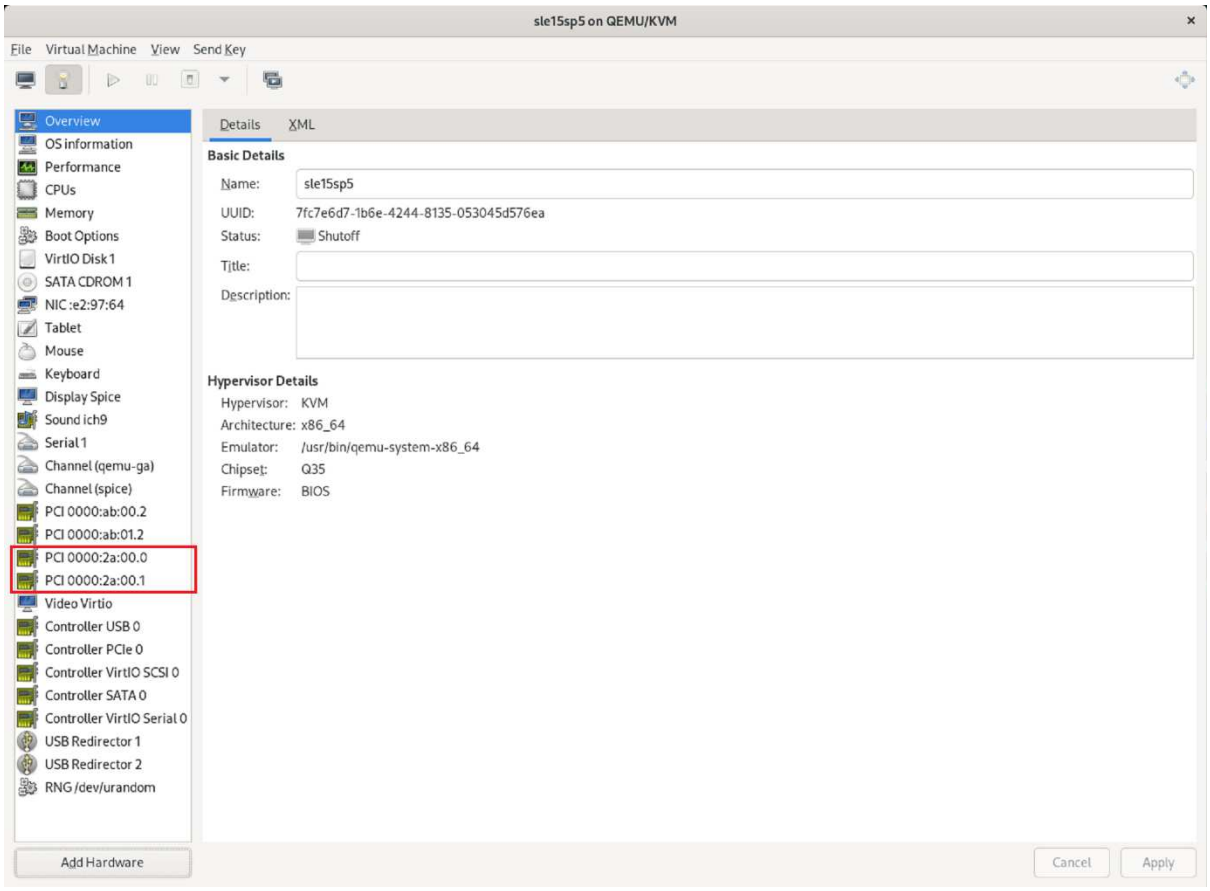
   In this example 0000.A2:00:0.



5. Choose the desired HBA port from the list of PCI Host Device belonging to the second fabric and press finish. In this example 0000.A2:00:1.



6. Afterwards the physical HBA ports are assigned to the VM and the VM can be started.



Physical ports are passed through to the VM, so no additional preparation is required within the VM.

What's next?

After you've configured Fibre Channel networking, configure NetApp storage for SAP HANA.

Configure NetApp storage for SAP HANA on SUSE KVM

Configure NetApp storage for SAP HANA on SUSE KVM using NFS or FCP protocols. Set up storage connections between the VM and NetApp ONTAP systems for optimal database performance.

After configuring the VM with SR-IOV network interfaces or FCP HBA ports, configure storage access from within the VM. Use the appropriate NetApp SAP HANA configuration guide based on your chosen storage protocol.

Configure NFS storage for SAP HANA

Use the SR-IOV network interfaces previously created if the NFS protocol shall be used for SAP HANA storage.

Follow the comprehensive configuration steps in the SAP HANA on NetApp AFF Systems with NFS - Configuration Guide.

Key configuration considerations for KVM environments:

- Use the SR-IOV virtual functions (VFs) configured earlier for network traffic
- Configure network bonding within the VM for redundancy
- Ensure proper network switching between the VM and NetApp storage SVMs
- Configure storage controllers and VM according to the SAP HANA Configuration Guide.

Configure FCP storage for SAP HANA

Use the physical HBA ports assigned to the VM as PCI devices if the FCP protocol shall be used for SAP HANA storage.

Choose the appropriate configuration guide based on your NetApp storage system:

- For NetApp AFF systems: SAP HANA on NetApp AFF Systems with Fibre Channel Protocol
- For NetApp ASA systems: SAP HANA on NetApp ASA Systems with Fibre Channel Protocol

Key configuration considerations for KVM environments:

- Use the physical HBA ports that were assigned to the VM via PCI passthrough
- Configure multipathing within the VM for redundancy across fabric switches
- Configure storage controllers and VM according to the SAP HANA Configuration Guide

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