OS10 Virtualization Guide

for Open Edition and Enterprise Edition release 10.2.0x

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Contents

OS10 Virtualization

You can use a virtual machine to run the Dell Networking OS10 software — either OS10 Open Edition (OS10 OE) or OS10 Enterprise Edition (OS10 EE). The Dell virtualization infrastructure simulates Dell devices, such as an S6000-ON.

Using the OS10 virtualization environment, you can:

- Simulate, experiment with, and test various network topologies
- Simulate hardware failures and events, such as over-temperature alarms
- Test various OS10 device configurations and OS10 CLI integration with your operational environment — OS10 Enterprise Edition
- Prototype, develop, and test new applications — OS10 Open Edition

What is a Virtual Machine?

A virtual machine (VM) emulates a computer system and uses the physical resources of the physical machine on which it runs — called the *host system*.

Requirements

- Workstation or laptop with a minimum of 4 GB RAM, and at least 64 GB disk space available. You need a laptop or workstation with more RAM if you plan to start more than one VM. At run-time, each OS10 VM uses 2 GB RAM and 16 GB disk space.
- 64-bit x86 CPU with 1.3 GHz or faster core speed (dual-core recommended)
- One Ethernet network interface connected to your network (optional)
- A virtualization environment — you can use either Windows or Linux OS as a host system for that environment:
    - VMware Workstation 12 or higher
    - Virtual Box 5.0.x or higher
- Dell Open Virtual Appliance (OVA) OS10 VM file — contains a bootable ONIE image
- Select either of the following:
    - OS10 Open Edition binary image and the *OS10 Open Edition Programmability Guide*
    - OS10 Enterprise Edition binary image and the *OS10 Enterprise Edition User Guide*

OS10 Virtualization Concepts

The OS10 VM uses the same software binaries as those executed on Dell hardware devices. The only exceptions are the components of the hardware abstraction layer — System device interface (SDI) implementation and switch abstraction interface (SAI) implementation. When you install OS10 on a VM platform, the OS10 installer replaces regular SDI and SAI components with their VM-specific counterparts.

Together with the VM-specific SDI and SAI implementations, the OS10 virtualization infrastructure allows you to simulate hardware events and functionality, such as:

- Temperature sensor readings
- Power supply unit (PSU) and fan tray events (removal/insertion)
- Small form factor (SFF) device events (removal/insertion)

In addition, the OS10 virtualization environment allows you to simulate and test various network topologies.

Create OS10 VM

You are now ready to create a virtual machine (VM) to run the OS10 software on. Creating a VM consists of three steps:

1   Import OVA file.
2   Start OS10 virtual machine.
3   Install OS10.

Import OVA File

Import the NOS-VM-Template.ova file in one of the following environments:

·   A Virtual Box environment

·   A VMware environment, such as VMware workstation

The import process results in a new VM being created. The VM is configured with one virtual CPU, 2GB RAM, one network adapter and 16GB virtual disk. The name of the VM is NOS-VM-Template. Change the VM name as needed.

For more information, see Install Virtualization Environment.
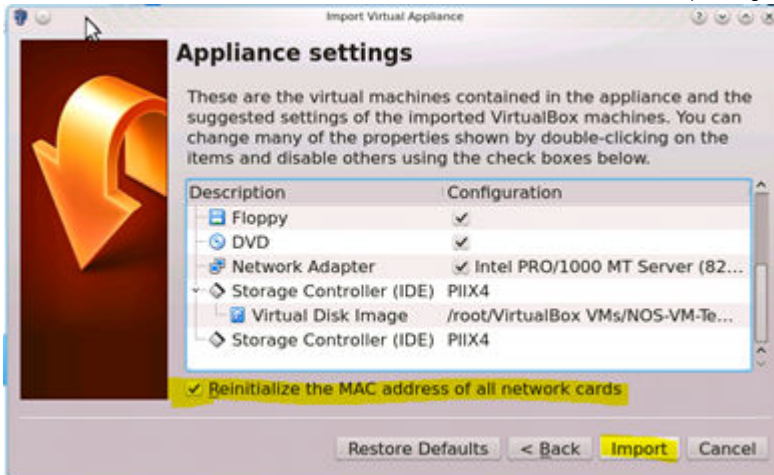
Import OVA File in Virtual Box Environment

1   Select **File > Import Appliance** from VirtualBox Manager.
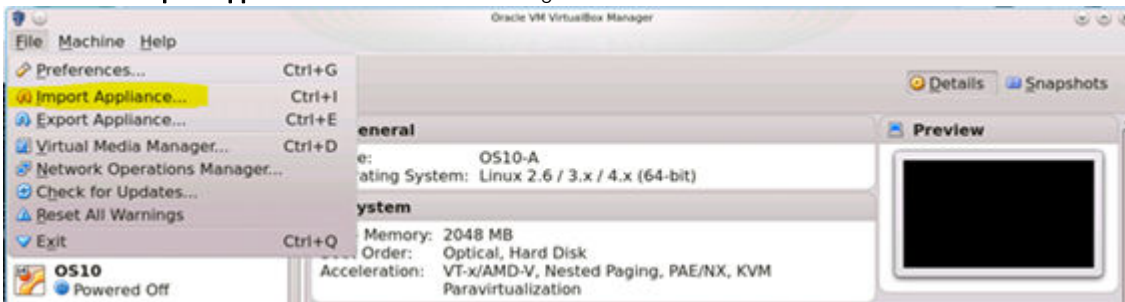
2   Select **Expert Mode**.

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3   Select **Reinitialize the MAC address of all network cards** before importing the appliance, then click **Import**.
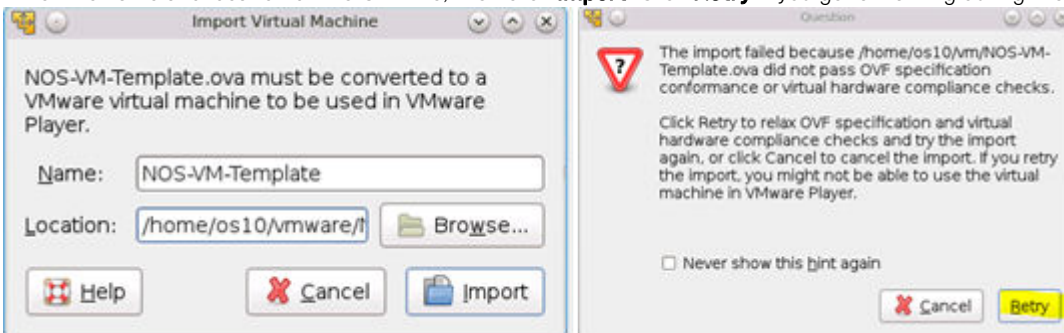

Import OVA File in VMware Workstation Environment

1   Select **File > Open a Virtual Machine**.
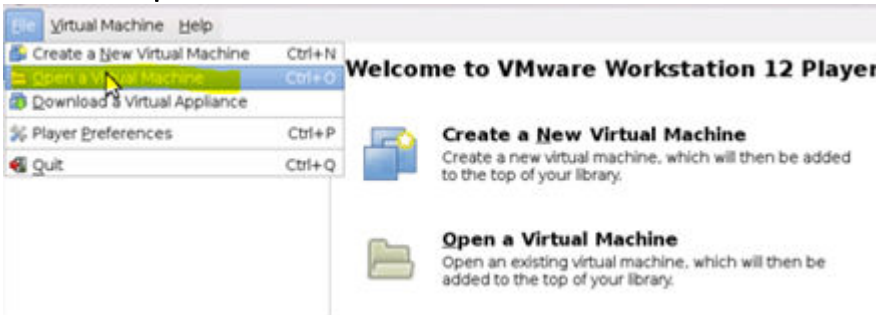
2   Enter the name and location of the OVA file, then click **Import**. Click **Retry** if you get a warning during the import process.

3   Select the **Network Adapter** from the left, click **Generate**, then click **Advanced**.
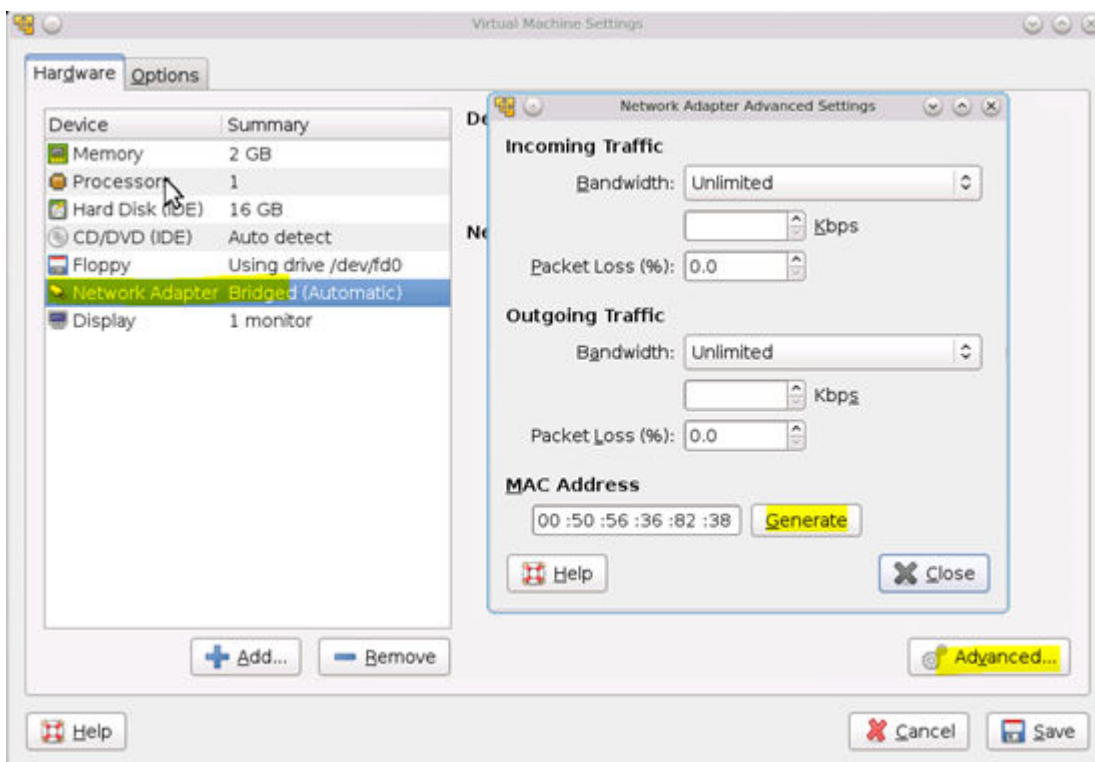
4   After importing the VM, select **Virtual Machine > Virtual Machine Settings** and generate a MAC address for the virtual NIC interface.

Start OS10 VM

Start the VM as described in your virtualization environment documentation. The ONIE image is pre-installed in the OS10 VM OVA, and the ONIE automatic installation process starts by default when the VM boots.

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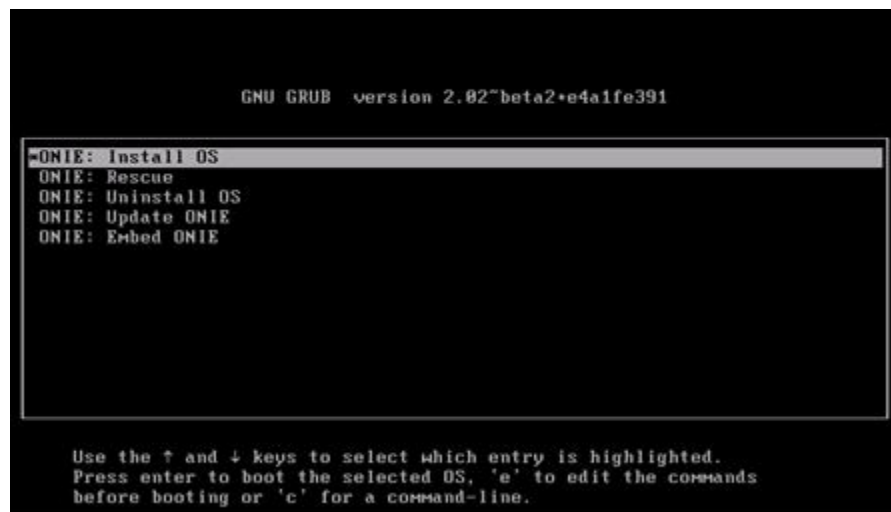
Install OS10

The OS10 image installation on a VM is the same as when you install it on an ONIE-enabled Dell device. You can install either OS10 Open Edition or OS10 Enterprise Edition.

- **Install OS10 Open Edition** — use the OS10 Open Edition binary image and follow the OS10 software installation instructions provided in the OS10 Open Edition Programmability Guide.
- **Install OS10 Enterprise Edition** — use the OS10 Enterprise Edition binary image and follow the OS10 software installation instructions provided in the OS10 Enterprise Edition User Guide.

Use OS10 VMs

The OS10 VM software executes the same image as Dell hardware devices. The OS10 CLI (Enterprise Edition only) and the Linux shell (both Enterprise Edition and Open Edition) provide the same commands and capabilities.

The VM console provides functionality similar to a serial console on Dell hardware devices. Using the VM console, you can log into either the CLI or Linux shell as described in the *OS10 Enterprise Edition User Guide* or the *OS10 Open Edition Programmability Guide*. You can also log into the Management interface after setting IP parameters adapted to your network environment.
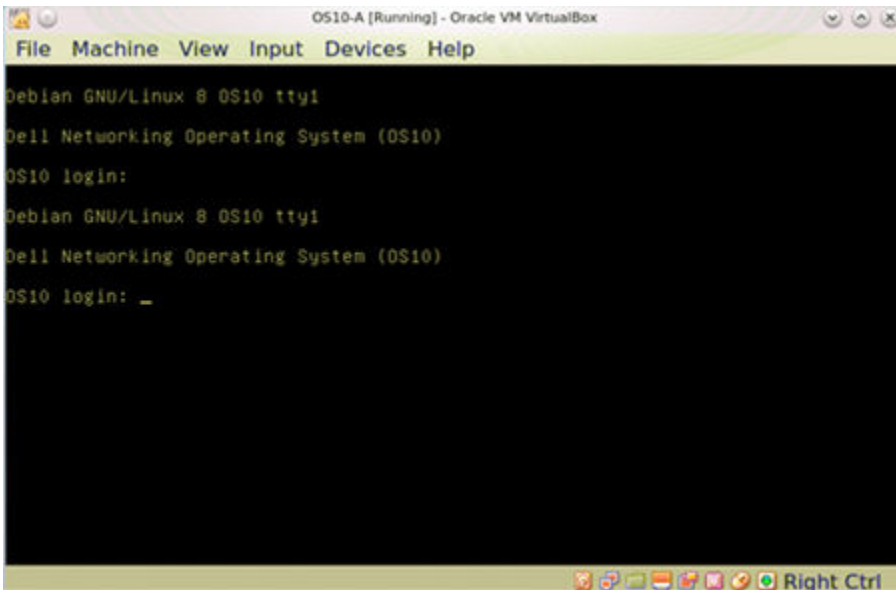
Hardware Platform Simulation

The hardware platform simulation tool `os10-vm-plat-event` is part of the OS10 virtualization infrastructure – it is only installed on an OS10 VM.

This tool allows you to interactively simulate:

· Fan tray events
· PSU events
· Optics (transceiver) events
· Temperature sensor events and status changes

1   Execute the command from the Linux shell as a privileged user.

```
linuxadmin@OS10:~$ sudo os10-vm-plat-event
[sudo] password for linuxadmin:

  Media:
    32 ports
     3 fantrays
        1 - 2 fans
        2 - 2 fans
        3 - 2 fans
     2 psus
        1 - 1 fan
```

```
            2 - 1 fan
         5 thermal sensors

      Enter PlatCmd: [-h|-q|#]
         -h    Help
         -q    Quit
          #    Event to generate
               1 = Optics
               2 = Fantray
               3 = PSU
               4 = Thermal Sensors
```

Enter PlatCmd: 4

```
      Enter ThermalCmd: [-h|-q|-e|#]
         -h    Help
         -q    Quit
         -e    Exit
          #    Thermal event to generate
               1 = Insert fault
               2 = Clear fault
               3 = Set temp
               4 = List sensors & temps
```

Enter ThermalCmd: 3

```
      Enter ThermalSensor: [-q|-e|#]
         -q    Quit
         -e    Exit
          #    Sensor [1..5]
               Temp [0..255]           Default: 20

          1    T2 temp sensor          40     (low 10, hi 100, crt 85)
          2    system-NIC temp sensor  20     (low 10, hi 100, crt 85)
          3    Ambient temp sensor     20     (low 10, hi 100, crt 85)
          4    CPU0 temp sensor        20     (low 10, hi 100, crt 85)
          5    CPU1 temp sensor        20     (low 10, hi 100, crt 85)
```

Enter ThermalSensor: 1
Enter ThermalTemp: 95

```
OS10# Oct 15 9:21:26: %Node.1-Unit.1-TM.1:PRI:OS10 %log-alert:EQM_THERMAL_CRIT_CROSSED:
Critical thermal threshold crossed: SET: Thermal Event Crossed, type:CARD,slot:1,T2 temp
sensor:95

OS10# show alarms

Index   Severity   Name                              Raise-time       Source
-----   --------   ------------------------------    ---------------  --------------
0       critical   EQM_THERMAL_CRIT_CROSSED          Oct 15 19:14:46  Node.1-Unit.1
```

The example shows how to generate a *thermal critical level crossed* alarm for an OS10 Enterprise Edition VM, by setting the value of the T2 thermal sensor above the critical level (95 C). An alarm log is emitted at the OS10 CLI. A subsequent `show alarms` command displays the *thermal critical crossed* alarm.

2   Use **e** to exit the current menu level, and **q** to exit the interactive simulation tool.

Virtual Network Interfaces

The OS10 VM resulted from importing the OVA template has a single virtual network adapter – network adapter 1. By default, this adapter is bridged to the physical Ethernet network device on your workstation or laptop. OS10 uses network adapter 1 for the Management interface:

- `eth0` — OS10 Open Edition
- `mgmt 1/1/1` — OS10 Enterprise Edition

ⓘ **NOTE:** You can change the modification network adapter 1 to *host-only* if you plan to connect to the Management interface only from your laptop or workstation.

You can add new network adapters to simulate front panel ports. Simulated front panel ports allow you to create and test virtual network topologies. The following shows typical mapping of VM network adapters to OS10 network interfaces.

VM Network Adapter	OS10 EE Interface Name (CLI)	Linux Interface Name (non-breakout mode)	MAC Address Assignment
Network adapter 1	`mgmt 1/1/1`	mgmt101-001 (OS10 EE) eth0 (OS10 OE)	Base address
Network adapter 2	ethernet 1/1/1	e101-001-0	Addr2 = Base + 1
Network adapter 3	ethernet 1/1/2	e101-002-0	Addr3 = Addr2 + 4
...	...	`` `...	
Network adapter *N*	ethernet 1/1/*N-1*	e101-*N-1*-0	Addr*N* = Addr*N-1* + 4

ⓘ **NOTE:** Manually assign MAC addresses of supplementary network adapters as shown. This is required to match the OS10 software MAC address assignment.

Example

Base MAC Address (Adapter 1)	`08:00:27:`**AA:00:FE**	
Adapter 2	`08:00:27:AA:00:FF`	**AA:00:FE** `+ 1 = AA:00:FF`
Adapter 3	`08:00:27:AA:01:03`	`AA:00:FF + 4 = AA:01:03`
Adapter 3	`08:00:27:AA:01:07`	`AA:01:03 + 4 = AA:01:07`

The number of supported network adapters depend on the virtualization environment capabilities.

Simulation of Network Topologies

Steps to create a simulated network topology:

1 Plan your simulated network topologies (nodes, connections, IP addresses, protocols)
2 Create as many VM instances as nodes in your network topology
3 Setup each VM with supplementary network adapters — simulate front panel ports
4 Connect the network adapters attached to different VM nodes to match your network topology — use the networking configuration tools of your virtualized environment

ⓘ **NOTE:** You typically run the network configuration tools as a privileged command (`sudo`) in Linux, and as administrator in Windows.

The following example shows a simulated network topology.

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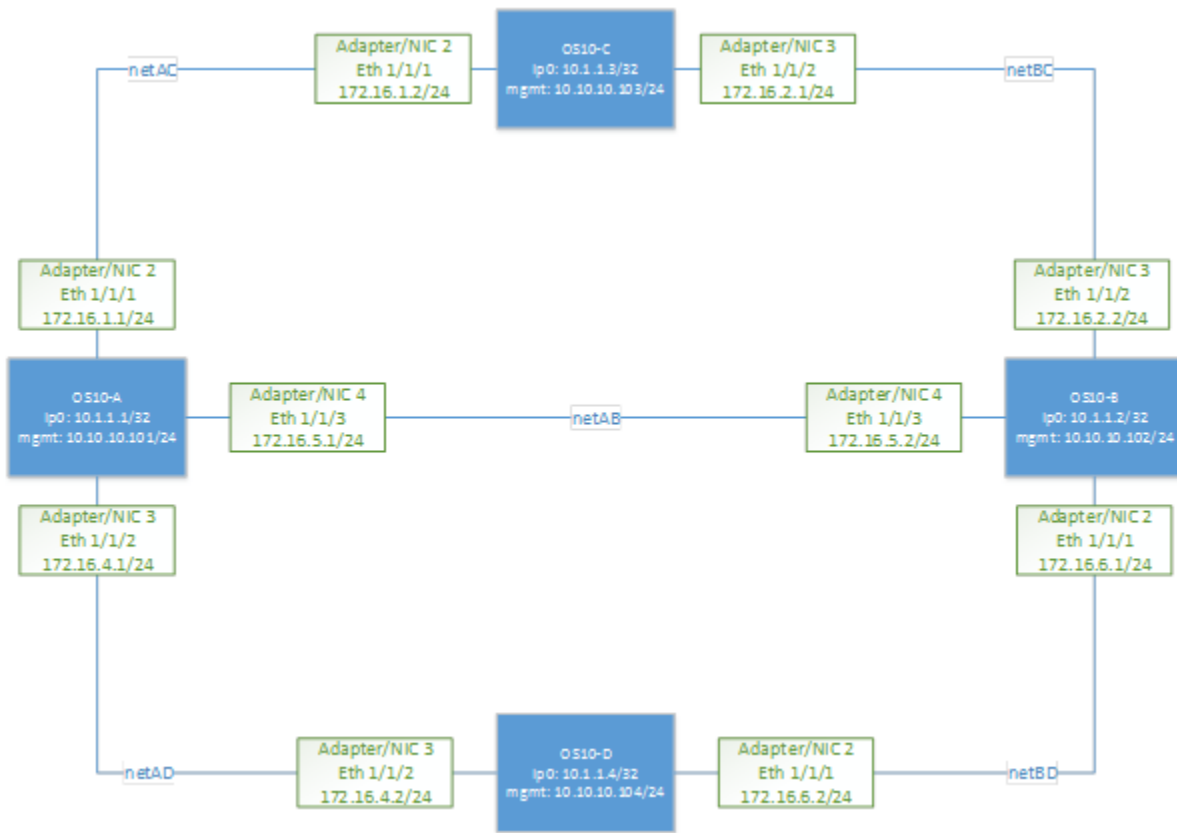
All nodes (OS10-A, OS10-B, OS10-C and OS10-B) are configured as OSPF routers.

In a Virtual Box environment, use *internal networks* to connect adapters associated to different VMs – the labels of the vertices correspond to the names of the internal networks.

> (i) **NOTE: Use *Host only* networks in a VMware environment. In this case, connected network adapters are assigned to the same *Host only* network.**

Node Configurations

After installing the OS10 image on each node, configure all nodes as OSPF routers — area 0.

The following shows the OS10-A node configuration:

```
interface ethernet1/1/1
ip address 172.16.1.1/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
interface ethernet1/1/2
ip address 172.16.4.1/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
interface ethernet1/1/3
ip address 172.16.5.1/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
```

```
interface loopback0
ip address 10.1.1.1/32
no shutdown
ip ospf 100 area 0.0.0.0
!
interface mgmt1/1/1
ip address 10.10.10.101/24
no shutdown
!
router ospf 100
log-adjacency-changes
!
```

The following shows the OS10-B node configuration:

```
interface ethernet1/1/1
ip address 172.16.6.1/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
interface ethernet1/1/2
ip address 172.16.2.2/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
interface ethernet1/1/3
ip address 172.16.5.2/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!

interface loopback0
ip address 10.1.1.2/32
no shutdown
ip ospf 100 area 0.0.0.0
!
interface mgmt1/1/1
ip address 10.10.10.102/24
no shutdown
!
router ospf 100
log-adjacency-changes
!
```

The following shows the OS10-C node configuration:

```
interface ethernet1/1/1
ip address 172.16.1.2/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
interface ethernet1/1/2
ip address 172.16.2.1/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!

interface loopback0
ip address 10.1.1.3/32
no shutdown
ip ospf 100 area 0.0.0.0
!
interface mgmt1/1/1
ip address 10.10.10.103/24
```

```
no shutdown
!
router ospf 100
log-adjacency-changes
!
```

The following shows the OS10-D node configuration:

```
interface ethernet1/1/1
ip address 172.16.6.2/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!
interface ethernet1/1/2
ip address 172.16.4.2/24
no switchport
no shutdown
ip ospf 100 area 0.0.0.0
!

interface loopback0
ip address 10.1.1.4/32
no shutdown
ip ospf 100 area 0.0.0.0
!
interface mgmt1/1/1
ip address 10.10.10.104/24
no shutdown
!
router ospf 100
log-adjacency-changes
!
```

OSPF Neighbors and Topology

Create, configure and start all VMs, then show OSPF topology, OSPF neighbors and OSPF routes. Use the virtualization environment commands to simulate link failures and trigger OSPF route changes.

The following shows the OSPF status of node OS10-B:

```
OS10# show ip ospf topology
Router ID          Flags        Cost        Nexthop        Interface        Area
--------------------------------------------------------------------------------
172.16.1.1         -/-/-/       1           172.16.5.1     ethernet1/1/3    0.0.0.0
172.16.6.2         -/-/-/       1           172.16.6.2     ethernet1/1/1    0.0.0.0

OS10# show ip ospf neighbor
Neighbor ID        Pri  State       Dead Time     Address        Interface        Area
--------------------------------------------------------------------------------------
172.16.1.2         1    Full/BDR    00:00:34      172.16.2.1     ethernet1/1/2    0.0.0.0
172.16.1.1         1    Full/BDR    00:00:37      172.16.5.1     ethernet1/1/3    0.0.0.0
172.16.6.2         1    Full/DR     00:00:36      172.16.6.2     ethernet1/1/1    0.0.0.0

OS10# show ip ospf routes
Prefix          Cost        Nexthop        Interface        Area        Type
----------------------------------------------------------------------------
10.1.1.1/32     2           172.16.5.1     ethernet1/1/3    0.0.0.0     intra-area
10.1.1.3/32     2           172.16.2.1     ethernet1/1/2    0.0.0.0     intra-area
10.1.1.4/32     2           172.16.6.2     ethernet1/1/1    0.0.0.0     intra-area
...
```

VM Node Setup

1   Use the steps in Create OS10 VM to create new nodes. Enable three more network adapters (2 to 4) for each node.

ⓘ **NOTE:** You can install the OS10 image on node OS10-A, and clone the OS10-A VM to create OS10-B, OS10-C, and OS10-D — this shortens the installation process.

2   Select the **Reinitialize the MAC address of all network cards** checkbox to avoid MAC address conflicts in your network, then click **Next**.


3   Select **Full clone**, then click **Clone**.
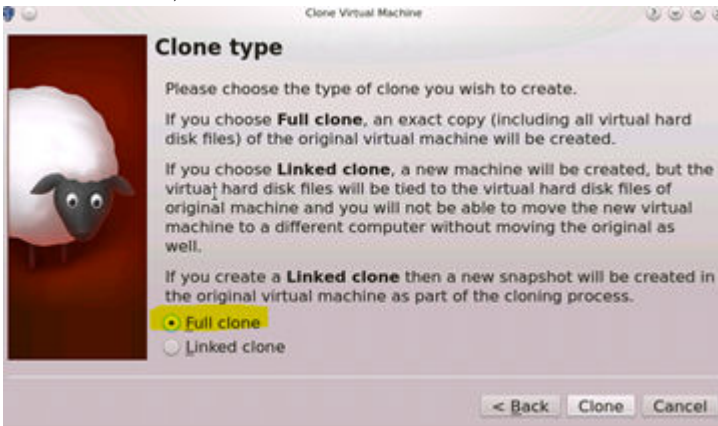
Network Connection — Virtual Box

1   Configure all network connections in the simulated network by setting up their associated network adapters, prior to starting the VMs.

2   Create a network connection by setting up the network adapters at both ends of the connection — OS10-A and OS10-B.

3   Click the Settings icon in the upper-left corner, select **Network**, then verify OS10-A is the network adapter (shown at the top).

4   Select the **Adapter 2** tab and enter **netAC** for the name of the network adapter.

5   Verify **Advanced** and **Allow All** is set for the Promiscuous Mode, then click **OK**. All Virtual Box network adapters that correspond to front panel ports must be configured with Promiscuous Mode set to **Allow All**.

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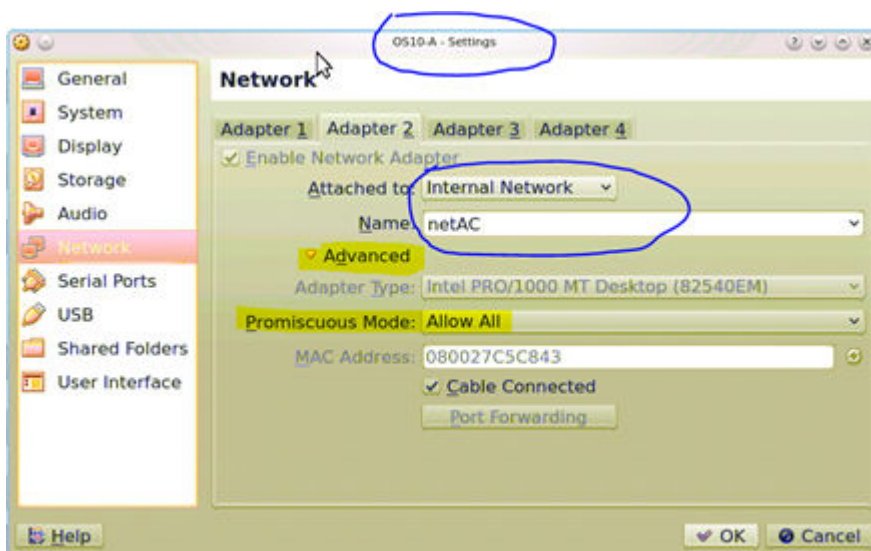
6   Repeat Step 2 and select the OS10-C network adapter.

7   Verify the settings match the OS10-A network adapter, then click **OK**.
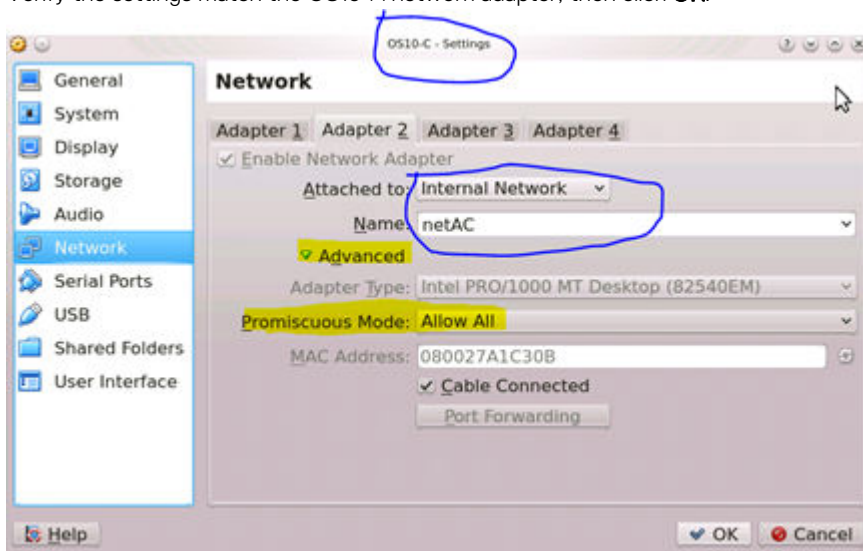
The following explains the configure network connection `netAC` example:

- `OS10-A VM`, Adapter 2, attached to Internal Network `netAC` — you can create a new Internal Network by entering a new internal network *name* for the adapter configuration (`netAC` in this case).
- `OS10-C VM`, Adapter 2, attached to Internal Network `netAC`.

Simulate Link Failures

In a Virtual Box environment, simulate a link failure by disconnecting the network adapter at either end of a virtual network connection.
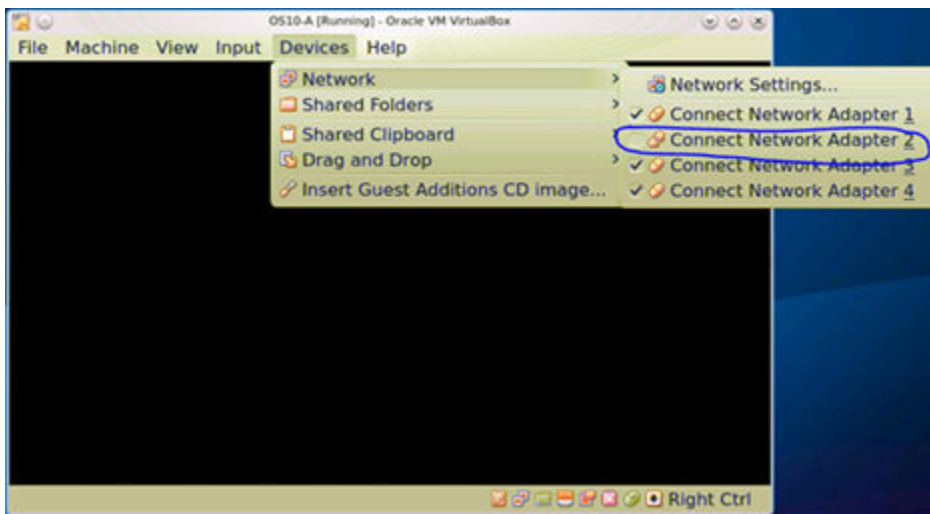
In the case of the simulated network example, a link failure triggers an OSPF link state DOWN event, for routers at either end of the connection.

```
OS10# Oct 16 17:13:39: %Node.1-Unit.1:PRI:OS10 %log-notice:OSPFV2_ADJ_CHANGE: OSPF Process:100,
Nbr 172.16.1.1 on ethernet1/1/1 state changed to DOWN
```

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Install Virtualization Environment

This information explains how to install a virtualization environment using either Virtual Box or VMware workstation.

Install Virtual Box

Download and install from www.virtualbox.org. You can download either the Windows or Linux version, depending on your host system OS.

Install VMware Workstation

- You can download and install VMware Workstation Pro (either the Windows or Linux version) at my.vmware.com.
- You can use instead VMware Player instead. VMware Player provide more limited functionality at www.vmware.com.

Dell Internal Users Only

You can install VMware Workstation 12 from the Dell Software Center.

1 Click **Start** from your Dell laptop, then select **Software Center**. You can also open a browser and go to Dell Software Catalog, and log in your Dell credentials.
2 Click **Install** to automatically download and install the software.