Chapter 8

Data Center Design with VMware ESX 4.0 and Cisco Nexus 5000 and 1000V Series Switches 4.0(4)SV1(1) and 2000 Series Fabric Extenders

Contents

Introduction

This chapter provides network design recommendations for the deployment of the Cisco Nexus® 1000V Switch version 4.0(4)SV1(1) in a VMware vSphere environment.

This chapter assumes that the reader is familiar with the use of VMware ESX 3.5 with Cisco® networking infrastructure prior to the introduction of the Cisco Nexus 1000V, as described at this URL: http://www.cisco.com/application/pdf/en/us/guest/netsol/ns304/c649/ccmigration_09186a00807a15d0.pdf.

This chapter discusses the use of VMware vSphere and ESX 4 in conjunction with the Cisco Nexus 1000V and complements the following publication: http://www.cisco.com/en/US/prod/collateral/switches/ps9441/ps9902/guide_c07-556626.html.

Additional information about the Cisco Nexus 1000V can be found at these URLs:

- http://www.cisco.com/en/US/products/ps9902/index.html
- http://www.cisco.com/en/US/products/ps9902/product_solution_overview_list.html

The configuration guide for the Cisco Nexus 1000V can be found at this URL: http://www.cisco.com/en/US/products/ps9902/products_installation_and_configuration_guides_list.html.

VMware vSphere Concepts

This design guide provides guidelines for the deployment of virtualized servers based on VMware vSphere: http://www.vmware.com/products/vsphere/.

Compared with VMware Virtual Infrastructure 3 (http://www.vmware.com/products/vi/), VMware vSphere networking includes the following networking improvements:

- Distributed switching with either the native VMware implementation, the VMware vNetwork Distributed Switch (vDS), or the Cisco Nexus 1000V distributed virtual switch (DVS)
- Support for a new paravirtualized adapter, vmxnet3, which supports 10 Gigabit Ethernet speeds, Message Signaled Interrupts Extension (MSI-X), receive-side scaling (RSS) when using Microsoft Windows Server 2008 as a guest OS, TCP segmentation offload, TCP, and User Datagram Protocol (UDP) checksum offload
- Better network performance as well as more I/O operations per second (IOPS)

Why Distributed Switching?

Distributed switching, with either the Cisco Nexus 1000V or VMware vDS, simplifies the provisioning of network properties across the VMware ESX infrastructure.

With VMware vSphere, the user has the choice of deploying the following switching constructs and products:

- **Standard virtual switch (vSwitch):** This switch construct has local significance; it is provisioned per VMware ESX host.
- **VMware vNetwork Distributed Switch:** This is a distributed switch. You can define the switching properties for up to 64 VMware ESX hosts at a time, instead of having to configure each VMware ESX host individually for networking. The VMware vNetwork Distributed Switch is configured through VMware vCenter.

- **Cisco Nexus 1000V:** This is a distributed switch (encompassing up to 64 VMware ESX hosts at a time), just like the VMware vNetwork Distributed Switch with the additional benefit of that it can be configured through the Cisco NX-OS Software command-line interface (CLI). The Cisco Nexus 1000V simplifies the separation of roles between the network administrator, who manages the network configurations using the Cisco tools, and the server administrator, who manages the virtual machines using VMware vCenter. Additional benefits include security and switching features that simplify network troubleshooting and increase the security of VMware deployments; these features are beyond the scope of this guide.

VMware vSphere introduces the concept of the distributed virtual port group (in contrast to regular port groups). A distributed virtual port group has characteristics similar to a regular port group (virtual LAN [VLAN] assignment, network interface card [NIC] teaming policy, quality-of-service [QoS] policy, etc.), but it is configured across multiple VMware ESX hosts.

The Cisco Nexus 1000V is fully compatible with distributed virtual port groups, using a construct called the port profile. A port profile as defined on the Cisco Nexus 1000V appears to VMware vCenter as a distributed virtual port group.

VMware Traffic Requirements

The three most relevant traffic types that you need to consider when deploying virtualized servers are as follows:

- **Virtual machine data traffic:** You need to consider data traffic transmitted or received by virtual machines.
- **VMware ESX management traffic:** VMware vCenter Server requires access to the VMware ESX management interface to monitor and configure the VMware ESX host.
- **VMware VMkernel traffic:** VMware VMotion uses the VMware VMkernel path to copy the memory from the originating host to the destination VMware ESX host. VMware VMotion traffic does not constantly require a high level of bandwidth, requiring high bandwidth only when VMware VMotion is initiated; it usually generates a burst of data over a period of 10 to 60 seconds. The duration of the virtual machine migration is extended based on the amount of bandwidth available. Because VMware VMotion processing is mainly a memory operation, it can easily take advantage of connectivity that exceeds Gigabit Ethernet bandwidth.

Cisco Nexus 1000V Concepts

The Cisco Nexus 1000V is a distributed software switch. It consists of two main components: the virtual supervisor module (VSM, the control-plane component) and the virtual Ethernet module (VEM, the data-plane component). Together these components provide the abstraction of a physical switch, whose supervisor is the VSM and whose line cards are the VEMs that run within each VMware ESX host.

All configurations are performed on the VSM and are propagated to the VEMs that are associated with it.

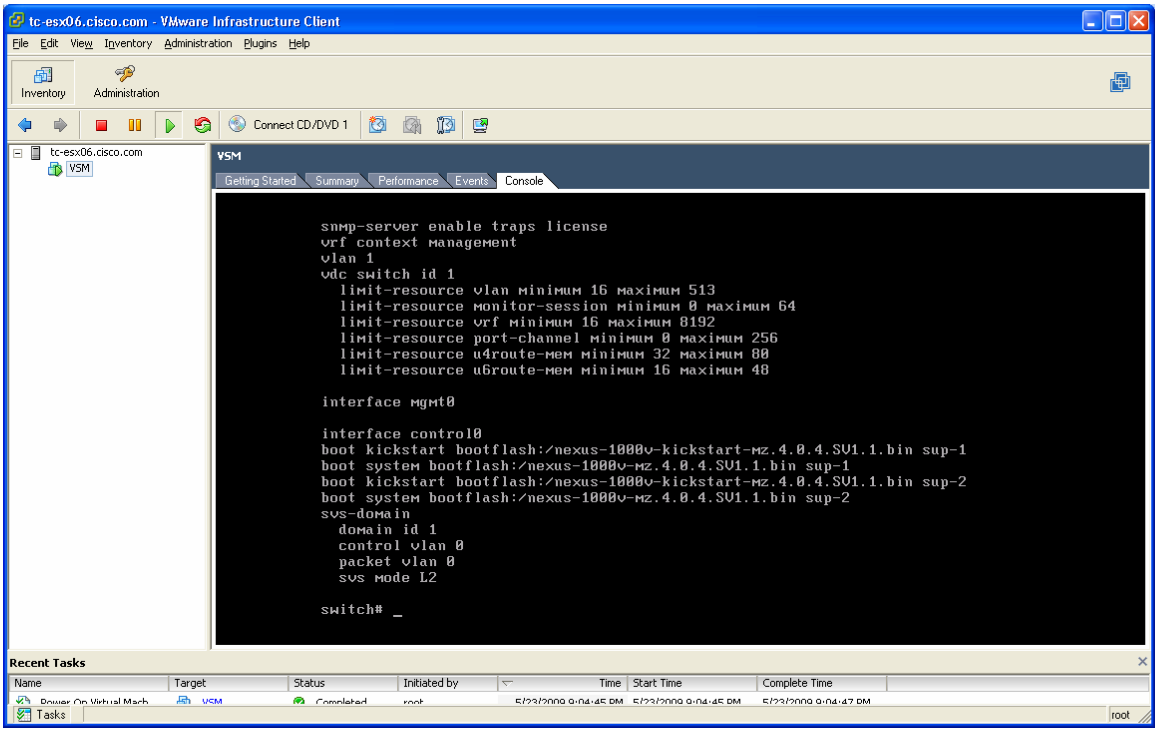
A VSM can be a virtual machine and can run redundantly just like a redundant supervisor. A single VSM can manage up to 64 VEMs concurrently.

You can add a VMware ESX host to the Cisco Nexus 1000V vDS from VMware vCenter to make a VMware ESX host become part of a Cisco Nexus 1000V domain, and as a result run a VEM.

Virtual Supervisor Module

A VSM running as a virtual machine provides the abstraction of a CLI managing a large modular switch. The user uses Secure Shell (SSH) Protocol at the management interface of the VSM, or simply uses the console—that is, the virtual machine console screen--to configure the network characteristics of the VMware deployment. Figure 1 shows an example of the VSM console.

Figure 1. VSM Console



```
snmp-server enable traps license
vrf context management
vlan 1
vdc switch id 1
  limit-resource vlan minimum 16 maximum 513
  limit-resource monitor-session minimum 0 maximum 64
  limit-resource vrf minimum 16 maximum 8192
  limit-resource port-channel minimum 0 maximum 256
  limit-resource u4route-mem minimum 32 maximum 80
  limit-resource u6route-mem minimum 16 maximum 48

interface mgmt0

interface control0
boot kickstart bootflash:/nexus-1000v-kickstart-mz.4.0.4.SV1.1.bin sup-1
boot system bootflash:/nexus-1000v-mz.4.0.4.SV1.1.bin sup-1
boot kickstart bootflash:/nexus-1000v-kickstart-mz.4.0.4.SV1.1.bin sup-2
boot system bootflash:/nexus-1000v-mz.4.0.4.SV1.1.bin sup-2
svs-domain
  domain id 1
  control vlan 0
  packet vlan 0
  svs mode L2

switch# _
```

Recent Tasks

Name	Target	Status	Initiated by	Time	Start Time	Complete Time
Power On Virtual Mach	VSM	Completed	root	5/23/2009 9:04:45 PM	5/23/2009 9:04:45 PM	5/23/2009 9:04:47 PM

The VSM forwards the configurations (VLANs, QoS, private VLANs [VLANs], etc.) to all the VEMs that are part of the same domain (discussed later in this chapter), or, in other words, that are under the same Cisco Nexus 1000V.

VSM Roles

VSMs are typically deployed in pairs, just like supervisors in a modular switch.

A VSM can run in one of the following roles:

- **Active:** Controls the system and is reachable for configurations as the mgmt0 interface of a physical switch
- **Standby:** Continuously monitors the active VSM to take over in case of switchover
- **Standalone:** Default role for the VSM when there is no other VSM peer with which to run redundantly

A dual-VSM configuration allows uninterrupted traffic forwarding with stateful switchover (SSO) when a failure occurs in the VSM. The two VSMs operate in an active-standby capacity in which only one is active at any given time, while the other acts as a standby backup. The two VSMs constantly synchronize the state and configuration to provide transparent and stateful switchover of most services if the active VSM fails.

Useful commands to control the role configuration are as follows:

```
system redundancy role {standalone | primary | secondary}
show system redundancy status
copy running-config startup-config
```

VSM Network Adapters

The VSM has virtual machine requirements much like other more traditional guest operating systems. At a high level, the VSM requires a single virtual CPU, 2 GB of dedicated RAM, and three virtual network adapters of type e1000.

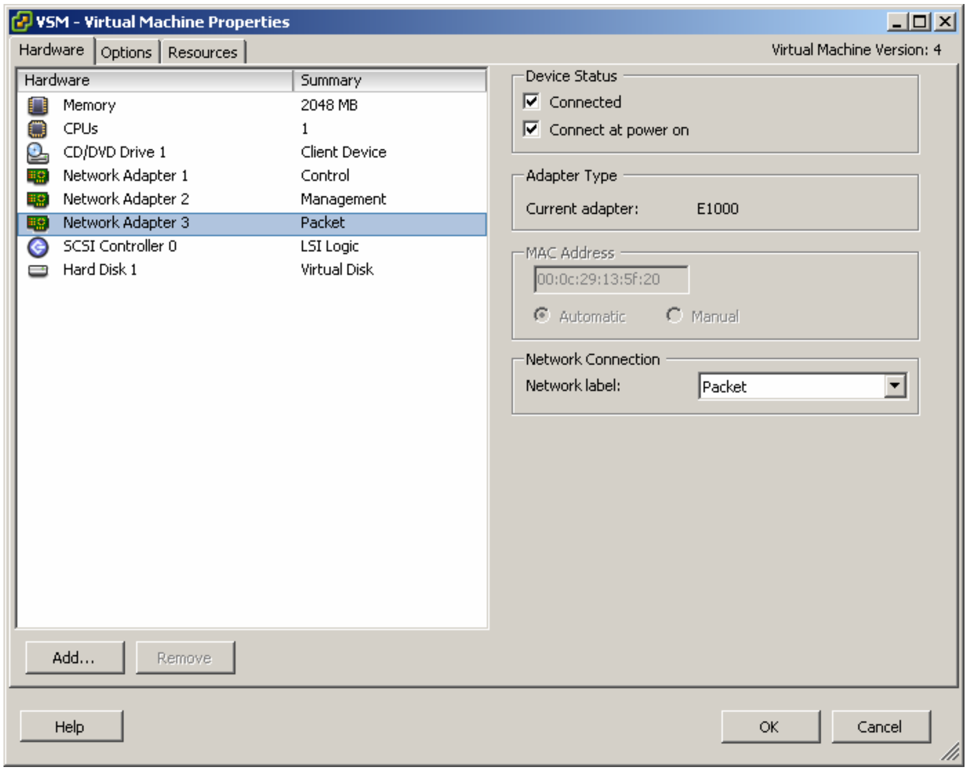
The VSM requires three network adapters to carry these traffic types:

- **User management interface:** This interface is the equivalent of mgmt0 interface on a physical switch. This interface is also the one that is used for VMware Virtual Infrastructure Methodology (VIM) over HTTPS communication between the VSM and VMware vCenter. This is always Network Adapter 2.
- **Ethernet out-of-band management interface (the control interface):** This interface carries the low-level control traffic between the VSM and the VEM. This is always Network Adapter 1.
- **Packet interface:** This interface is always the third interface on the VSM and is always Network Adapter 3 in the virtual machine network properties.

The VSM is considered the authoritative container for all configuration information. If the connection between the VSM and VMware vCenter Server is disrupted, the VSM helps ensure that any configuration changes that have been made during this period of disrupted communication are propagated to VMware vCenter Server when the link is restored.

Figure 2 shows the three adapters needed on the VSM and the type of adapter that the VSM requires (E1000). Three port groups are defined for the VSM: control, management, and packet.

Figure 2. VSM Adapter Properties



VSM - Virtual Machine Properties

Hardware | Options | Resources — Virtual Machine Version: 4

Hardware	Summary
Memory	2048 MB
CPUs	1
CD/DVD Drive 1	Client Device
Network Adapter 1	Control
Network Adapter 2	Management
Network Adapter 3	Packet
SCSI Controller 0	LSI Logic
Hard Disk 1	Virtual Disk

Device Status

☑ Connected

☑ Connect at power on

Adapter Type

Current adapter: E1000

MAC Address

00:0c:29:13:5f:20

● Automatic ○ Manual

Network Connection

Network label: Packet

VSM-to-VEM Communication

The following are the most important traffic types that make the VEMs and the VSM operate like a single entity:

- **Control traffic:** This traffic is generated by the Cisco Nexus 1000V and exchanged between the primary and secondary VSMs as well as the VSMs and VEMs. It requires very little bandwidth (less than 10 KBps) but demands absolute priority. Control traffic should be considered the most important traffic in a Cisco Nexus 1000V network.

- **Packet traffic:** Packet traffic is used to transport selected packets to the VSM for processing. The bandwidth required for the packet interface is extremely low, and its use is intermittent. If Cisco Discovery Protocol and Interior Gateway Management Protocol (IGMP) features are turned off, there is no packet traffic at all.

Control and packet VLANs are carried on the uplink from the VMware ESX server to the switch. For this reason, the initial communication between the VSM and the VEM is aided by VMware vCenter to remove any dependency on the success of the VSM-to-VEM communication, so that communication can begin even if the network configuration on the uplinks is not yet functioning.

Opaque Data

The data that the VSM stores on VMware vCenter and as a result on the VEM is referred as opaque data.

This additional information is added to the VMware ESX host through VMware vCenter and can be verified from the VMware ESX console as follows:

```
[root@tc-esx02 ~]# /usr/sbin/vemcmd show card
Card UUID type  2: 41483531-3341-5553-4537-33304e34524e
Card name: tc-esx02
Switch name: tc-n1kv04
Switch alias: DvsPortset-0
Switch uuid: e3 29 06 50 10 ea 06 a3-58 e6 63 f3 d9 1e a4 e7
Card domain: 1
Card slot: 1
VEM Control (AIPC) MAC: 00:02:3d:10:01:00
VEM Packet (Inband) MAC: 00:02:3d:20:01:00
VEM Control Agent (DPA) MAC: 00:02:3d:40:01:00
VEM SPAN MAC: 00:02:3d:30:01:00
Management IP address: 10.51.35.102
Max physical ports: 32
Max virtual ports: 216
Card control VLAN: 23
Card packet VLAN: 24
       Processors: 4
  Processor Cores: 4
Processor Sockets: 2
Physical Memory: 4293214208
```

Troubleshooting the VSM-to-VEM Connectivity

Each VEM has a MAC address on the control VLAN, and if the communication is properly established, the VSM sees the VEMs. This connectivity can be verified by using the following command:

```
tc-n1kv04# show svs neighbor

Active Domain ID: 1

AIPC Interface MAC: 000c-2913-5f0c
Inband Interface MAC: 000c-2913-5f20

Src MAC           Type   Domain-id    Node-id     Last learnt (Sec. ago)
```

In this example, the VSM does not see any VEM, which indicates a problem in the networking configuration that is required between the VSM and the VEM.

To trace the Layer 2 communication between the VSM and the VEM, view the Layer 2 forwarding table on the Cisco Nexus 5000 Series Switch and look specifically for the MAC addresses listed in the output of the **/usr/sbin/vemcmd show card** command and **show svs neighbor:** the VSM Asynchrnonous Inter Process Communication (AIPC) MAC address and the VEM AIPC MAC address in the **/vemcmd show** command.

Upon successful configuration, the VSM and VEMs can communicate:

```
tc-n1kv04# show svs neighbors

Active Domain ID: 1

AIPC Interface MAC: 000c-2913-5f0c
Inband Interface MAC: 000c-2913-5f20

Src MAC           Type   Domain-id    Node-id     Last learnt (Sec. ago)
------------------------------------------------------------------------

0002-3d40-0102     VEM         1         0302        53.98
0002-3d40-0103     VEM         1         0402        46.00
```

When VSM-to-VEM communication is established, the VEMs appear in the VSM as if they were modules in a modular switch:

```
tc-n1kv04# show module
Mod  Ports  Module-Type                      Model              Status
---  -----  -------------------------------- ------------------ ------------
1    0      Virtual Supervisor Module        Nexus1000V         active *
3    248    Virtual Ethernet Module          NA                 ok
4    248    Virtual Ethernet Module          NA                 ok

Mod  Sw               Hw
---  ---------------  ------
1    4.0(4)SV1(1)     0.0
3    4.0(4)SV1(1)     0.4
4    4.0(4)SV1(1)     0.4

Mod  MAC-Address(es)                         Serial-Num
---  --------------------------------------  ----------
1    00-19-07-6c-5a-a8 to 00-19-07-6c-62-a8  NA
3    02-00-0c-00-03-00 to 02-00-0c-00-03-80  NA
4    02-00-0c-00-04-00 to 02-00-0c-00-04-80  NA

Mod  Server-IP        Server-UUID                           Server-Name
---  ---------------  ------------------------------------  --------------------
1    10.51.35.114     NA                                    NA
3    10.51.35.103     41483531-3341-5553-4538-31384e375632  tc-esx03.cisco.com
```

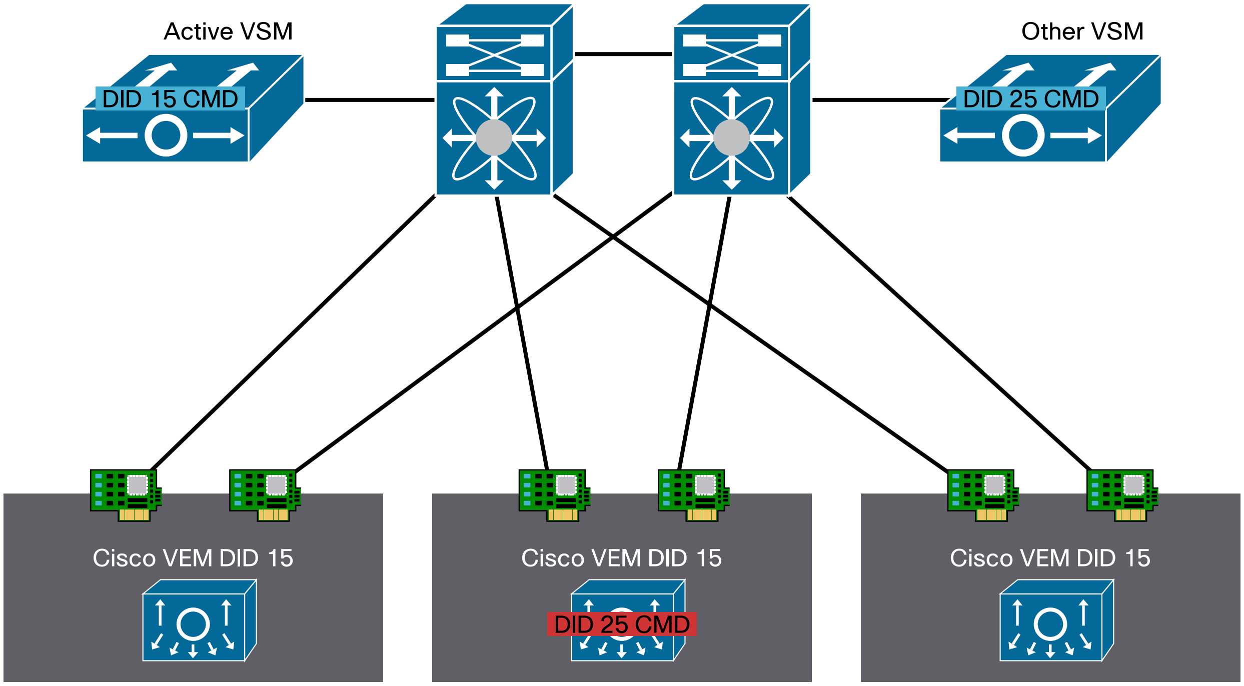
VEM-to-slot-number mapping can be modified by changing the **host vmware id** configuration line:

```
tc-n1kv04# show module vem counters
--------------------------------------------------------------------------------
Mod  InNR OutMI  InMI OutHBeats  InHBeats InAipcMsgs  OutTO OutTOC InsCnt RemCnt
--------------------------------------------------------------------------------
  3     2     2     2      3924      2680       2852      0      0      2      1
  4     2     3     3      3916      3806       5328      0      0      3      2
```

Domain

Since multiple VSM and VEMs can share the same control and packet VLANs, the system must be able to determine which VSM goes with which VEM. The concept of the domain is used to bind VSM to VEMs (Figure 3).

Figure 3. The Domain ID “Joins” VEMs that Belong to the Same VSM as Part of the Same vDS



VSM-to-VMware vCenter Communication

The communication between VSM and VMware vCenter uses the management interface (mgmt0) on the VSM. The protocol runs on HTTPS. The key information is provided to VMware vCenter by pointing the browser to the VSM IP address and downloading the extension key, extension.xml, which is added to VMware vCenter as a plug-in.

VMware Distributed Resource Scheduler, High Availability, and Fault Tolerance

The Cisco Nexus 1000V supports VMware Distributed Resource Scheduler (DRS), High Availability (HA), and Fault Tolerance (FT) for the virtual machines connected to it (specifically, the VEM).

For the VSM, as of 4.0(4)SV1(1), VMware DRS cannot be used to manage the VSM virtual machine, and neither VMware FT nor HA can be used for the VSM virtual machine. In addition, the VSM should not be migrated with VMware VMotion.

Port Profiles

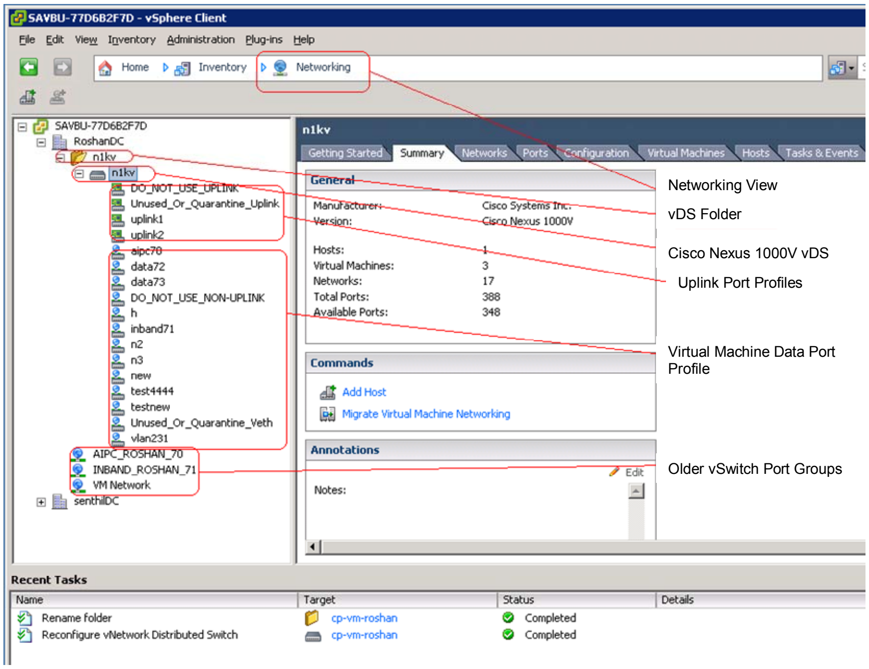
As a first approximation, port profiles are the equivalent of a distributed virtual port group on a VMware vNetwork Distributed Switch. Port profiles are used to configure interfaces. A port profile can be assigned to multiple interfaces, giving them all the same configuration. Changes to the port profile can be propagated automatically to the configuration of any interface assigned to it.

In the VMware vCenter Server, a port profile is represented as a distributed virtual port group. The virtual Ethernet and Ethernet interfaces are assigned in VMware vCenter Server to a port profile to:

- Define port configuration by policy
- Apply a single policy across a large number of ports
- Support both virtual Ethernet and Ethernet ports

Figure 4 shows the different types of port profiles available when using the Cisco Nexus 1000V as a vDS.

Figure 4. Port Profiles Types



Manufacturer: Cisco Systems Inc.
Version: Cisco Nexus 1000V

Hosts: 1
Virtual Machines: 3
Networks: 17
Total Ports: 388
Available Ports: 348

Name	Target	Status	Details
Rename folder	cp-vm-roshan	Completed	
Reconfigure vNetwork Distributed Switch	cp-vm-roshan	Completed	

Uplink Port Profiles

Port profiles that are configured as capability uplinks can be assigned by the server administrator to physical ports (vmnics).

An uplink port profile can also be a system port profile. An uplink port profile is a system port profile when it carries the system VLANs used for the communication between the VSM and the VEM.

The system port profiles are used to carry the system VLANs:

- System VLANs cannot be deleted when the profile is in use.
- Nonsystem VLANs in a system port profile can be freely added or deleted, even when the profile is in use: that is, when one or more vDS ports are carrying that profile.
- System VLANs can always be added to a system port profile or a nonsystem port profile, even when the profile is in use.
- The native VLAN on a system port profile can be a system VLAN or a nonsystem VLAN.

A typical configuration of an uplink port profile that is also a system port profile looks like this:

```
port-profile system-uplink
  capability uplink
  vmware port-group fabric_uplinks
  switchport mode trunk
  switchport trunk allowed vlan 23-24
  <channel-group configuration>
  no shutdown
  system vlan 23-24
state enabled
```

Some parameters in this configuration are of special interest:

- **capability uplink:** This parameter indicates that this port profile is to be used on the physical NICs.
- **system vlan:** This parameter makes this particular uplink port profile also a system port profile. The most common use of system vlan is to add the packet and control VLANs to this port profile. These VLANs still need to be configured under switchport trunk for them to be forwarding.
- **state enabled:** This parameter indicates that the configuration should be implemented on to all the hosts that are associated with the Cisco Nexus 1000V DVS.

Every VMware ESX host must have at least one physical interface associated with a system port profile. Without this port profile, the Cisco Nexus 1000V associations with the VMware ESX host can still happen, but the VEMs will not appear as line cards or modules on the VSM.

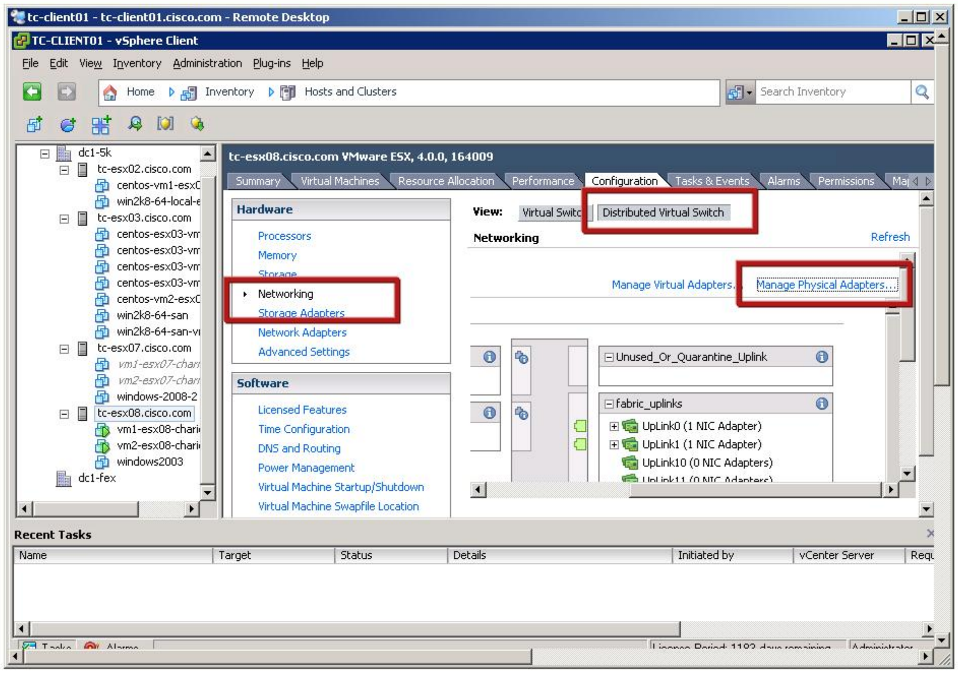
The system VLANs have a special meaning because they are granted network communication in a preferential way over the regular VLANs, so that even if the PortChannel configuration on the uplink port profile is not fully functional, the VSM can still configure the VEM.

In the absence of the system VLAN definition, the VEM connectivity would be dependent on a successful PortChannel configuration on the VSM. But this configuration would require a preexistent functioning PortChannel configuration to help ensure VSM-to-VEM connectivity. The system VLAN configuration removes this dependency, allowing the VSM to configure the VEM even if the PortChannel setup has not yet been completed for the virtual machine production VLANs.

You can assign vmnics to an uplink port profile when you add a VMware ESX host to the Cisco Nexus 1000V from VMware vCenter and you select the distributed virtual uplink port profile.

This association can be modified later as shown in Figure 5, by selecting a VMware ESX host and selecting the **Networking** configuration, the **Distributed Virtual Switch** view, and then **Manage Physical Adapters**.

Figure 5. vmnic to Uplink Port Profile Association



After the VEMs are associated with the VSM, the network adapters of the VMware ESX hosts appear as a Ethernet module and port as follows:

```
interface Ethernet4/4
  inherit port-profile system-uplink

interface Ethernet4/5
inherit port-profile system-uplink
```

Regular Port Profiles

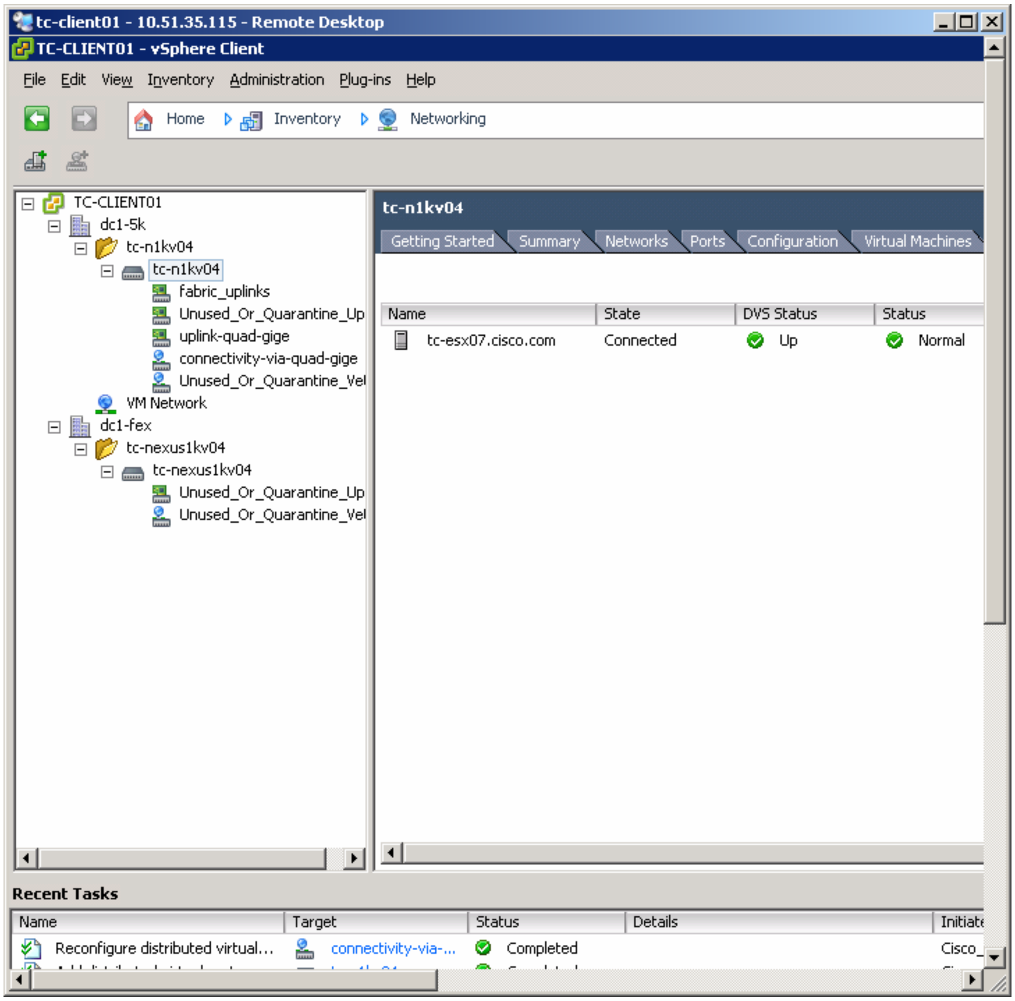
Regular port profiles are assigned to virtual machine virtual adapters. In Cisco Nexus 1000V terminology, these virtual adapters are referred to as virtual Ethernet (vEth) interfaces.

A regular port profile is defined as follows:

```
port-profile vm-connectivity
  vmware port-group connectivity-via-quad-gige
  switchport mode access
switchport access vlan 50
no shutdown
state enabled
```

This would appear on the VMware vCenter server as shown in Figure 6, listed as one of the distributed virtual port groups.

Figure 6. Regular Port Profiles Appear as a Distributed Virtual Port Group


tc-client01 - 10.51.35.115 - Remote Desktop
TC-CLIENT01 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home
Inventory
Networking
tc-n1kv04
Getting Started
Summary
Networks
Ports
Configuration
Virtual Machines
Recent Tasks

- TC-CLIENT01
  - dc1-5k
    - tc-n1kv04
      - tc-n1kv04
        - fabric_uplinks
        - Unused_Or_Quarantine_Up
        - uplink-quad-gige
        - connectivity-via-quad-gige
        - Unused_Or_Quarantine_Vet
    - VM Network
  - dc1-fex
    - tc-nexus1kv04
      - tc-nexus1kv04
        - Unused_Or_Quarantine_Up
        - Unused_Or_Quarantine_Vet

Name	State	DVS Status	Status
tc-esx07.cisco.com	Connected	✓ Up	✓ Normal

Name	Target	Status	Details	Initiat
Reconfigure distributed virtual...	connectivity-via-...	✓ Completed		Cisco_

Link Between Port Profiles and Uplink Port Profiles

Virtual machines attach to port profiles through the choice of the distributed virtual port group from the VMware vCenter configuration. The association between the port profile and a VLAN defines the way the traffic flows from the virtual machine to the outside network.

You can have multiple uplink port profiles for each VMware ESX host, but they cannot have overlapping VLANs, which would break the uniqueness of the association.

By defining which VLAN is on which port profile and on which uplink port profile, you can control which path the virtual machines take to communicate to the rest of the network.

Ethernet Ports

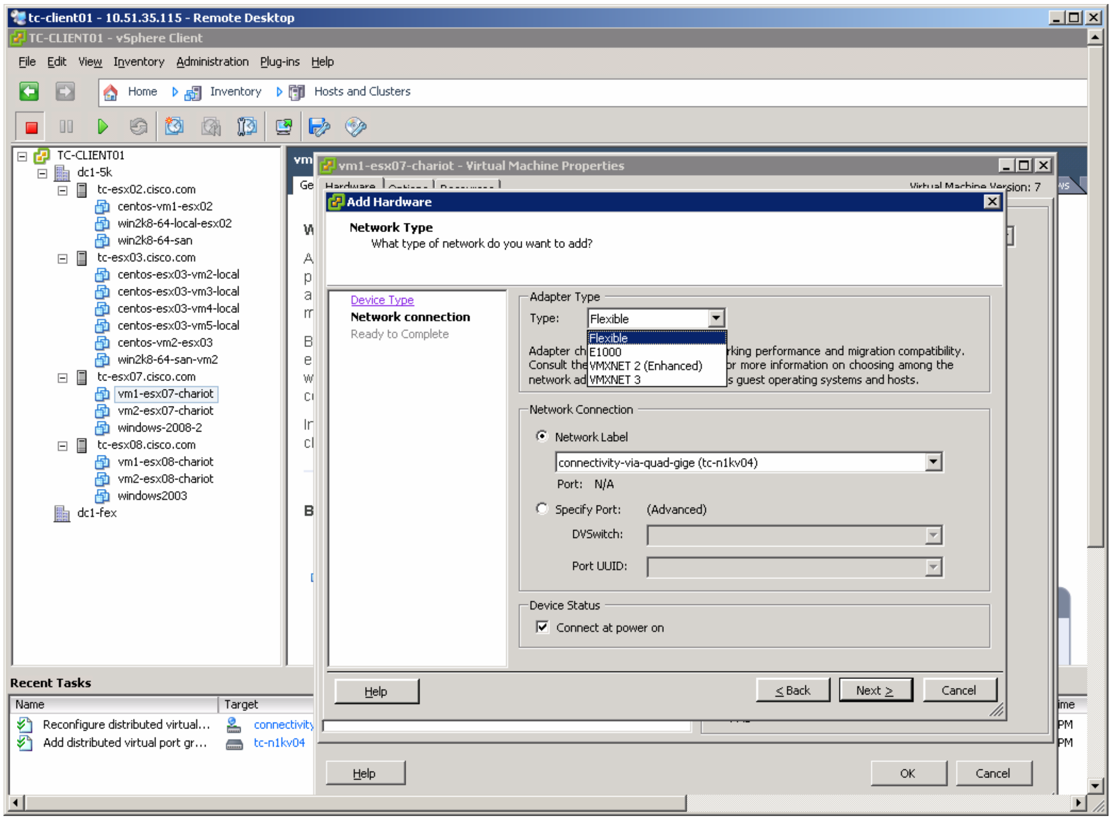
With the Cisco Nexus 1000V, the network ports can be of two types:

- **Ethernet module and port:** The module represents the VMware ESX host, and the port is one of the physical NICs. This port type is used as an uplink. It is equivalent to a vmnic in VMware terminology.
- **Virtual Ethernet ports:** A vEth port is equivalent to a vnic in VMware terminology. These ports have a number that is preserved should the virtual machine move from one VMware ESX host to a different one.

Virtual Ethernet Ports

When you configure a virtual machine, you can choose the adapter for the virtual machine and the distributed virtual port group to which that the adapter attaches as shown in Figure 7.

Figure 7. Adapter Selection from the VM Configuration Properties



Network Type
What type of network do you want to add?

Adapter Type
Type: Flexible
Flexible
E1000
VMXNET 2 (Enhanced)
VMXNET 3

Adapter ch…king performance and migration compatibility. Consult the…or more information on choosing among the network ad…s guest operating systems and hosts.

Network Connection
● Network Label
connectivity-via-quad-gige (tc-n1kv04)
Port: N/A
○ Specify Port: (Advanced)
DVSwitch:
Port UUID:

Device Status
☑ Connect at power on

As you can see in this example, the virtual machine is configured to use the network label connectivity-via-quad-gige, which is a Cisco Nexus 1000V port profile. The user can also select the proper adapter. The choice of the adapter is beyond the scope of this guide. For a Gigabit Ethernet configuration, an e1000 or a vmxnet2 are sufficient.

For a 10 Gigabit Ethernet deployment, vmxnet3 allows you to take better advantage of the 10 Gigabit Adapter acceleration features.

When the virtual machine is up, the vEth associated with it appears in the Cisco Nexus 1000V CLI as follows:

```
Vethernet1 is up
    Port description is vm1-esx07-chariot, Network Adapter 2
    Hardware is Virtual, address is 0050.5686.12e4
    Owner is VM "vm1-esx07-chariot", adapter is Network Adapter 2
```

Layer 2 Forwarding and Loop Prevention with Cisco Nexus 1000V

The Cisco Nexus 1000V forwards Layer 2 traffic according to transparent bridging rules that have been modified for a virtualized server environment. Each VEM within a Cisco Nexus 1000V maintains a Layer 2 forwarding table independently from the other VMware ESX hosts.

The entries related to the virtual machines locally attached are programmed statically, while the MAC address entries associated with the uplinks are dynamically learned.

The Cisco Nexus 1000V does not run any spanning tree (and hence also does not send Bridging Protocol Data Units [BPDUs]). Loop prevention with multiple physical NICs connected to a Layer 2 topology is achieved by a combination of PortChannels and MAC address pinning.

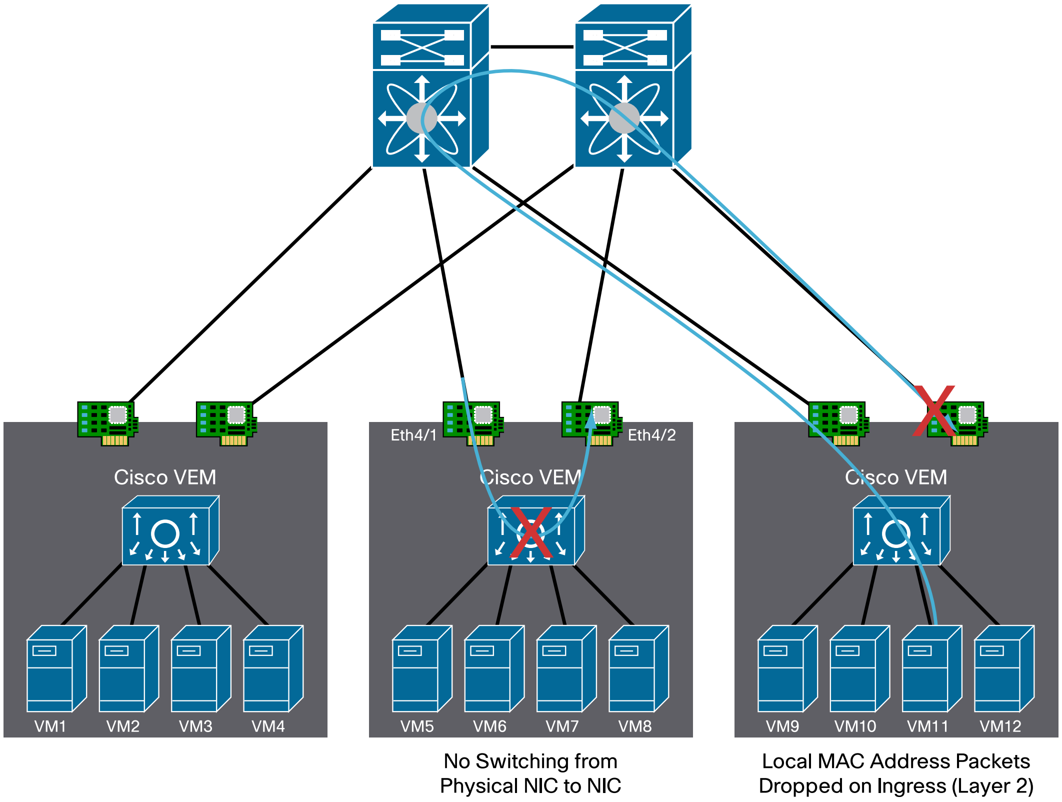
Cisco Nexus 1000V Connected to Two Devices That Support Virtual PortChannels

The simplest scenario is a Cisco Nexus 1000V connected to two upstream switches that support virtual PortChannel (vPC) capability. In this case, the configuration of the port profile consists of a single channel group spanning both upstream switches. No special loop prevention mechanism is required in this case.

Cisco Nexus 1000V Connected to Two Devices That Do Not Support vPC

If the Cisco Nexus 1000V is connected to two devices that do not support vPC, it divides the physical NICs into two groups either automatically or through a subgroup ID configuration (defined by the network administrator). To prevent loops, the Cisco Nexus 1000V behaves as shown in Figure 8. If a frame enters the VEM from one uplink, it will not be reflected back on any other uplink. If a frame originates from a virtual machine (such as VM11 in the figure) and it appears on one of the uplinks of the VMware ESX host where VM11 exists, this frame will be dropped.

Figure 8. Loop Prevention Without Spanning Tree



PortChannel Capabilities on the Cisco Nexus 1000V

A user can configure redundant connectivity from the VMware ESX host to the upstream switches by configuring an uplink port profile with a PortChannel.

The simplest configuration specifies **channel-group auto mode on** in the uplink port profiles.

If the ports that are using the same port profile are going to different upstream switches, vPC is required if it is supported by the upstream switches.

Several possible configuration scenarios exist based on whether the upstream switches are capable or configured to support PortChannels. vPC host mode is a feature on the Cisco Nexus 1000V that allows interoperating with switches that are not configured for PortChannels on all ports that connect to the VMware ESX host. vPC host mode can also use Cisco Discovery Protocol to discover to which device each port is connected, to configure the uplinks correctly.

vPC Configuration with Link Aggregation Control Protocol

In the best scenario, an VMware ESX server is connected to an access switch that is vPC capable. In this case, the Cisco Nexus 1000V can be configured with uplinks split to two access switches that form a vPC.

Link Aggregation Control Protocol (LACP) would be used both on the upstream switch and in on the Cisco Nexus so that the PortChannel goes up as a result of the negotiation between the Cisco Nexus 1000V and the access switches.

In the following uplink configuration, the PortChannel is configured for LACP and active mode is used on the Cisco Nexus 1000V:

```
port-profile system-uplink
  capability uplink
  vmware port-group fabric_uplinks
  switchport mode trunk
  switchport trunk allowed vlan 23-24,50
  channel-group auto mode active
  no shutdown
system vlan 23-24
state enabled
```

A successful configuration will show the VMware ESX vmnic ports in the P state as shown here:

```
tc-n1kv04# show port-channel summary
Flags:  D - Down        P - Up in port-channel (members)
        I - Individual  H - Hot-standby (LACP only)
        s - Suspended   r - Module-removed
        S - Switched    R - Routed
        U - Up (port-channel)
--------------------------------------------------------------------------------
Group Port-       Type     Protocol  Member Ports
      Channel
--------------------------------------------------------------------------------
2     Po2(SU)     Eth      LACP      Eth4/4(P)    Eth4/5(P)
3     Po3(SU)     Eth      LACP      Eth6/3(P)    Eth6/5(P)
```

This configuration shows that the channel group numbers (2 and 3) are dynamically generated. The Gigabit Ethernet uplinks Eth6/3 and 6/5 are connected to two Cisco Nexus 2000 Series Fabric Connectors configured for vPC, and the 10 Gigabit Ethernet ports Eth4/4 and 4/5 are directly connected to two Cisco Nexus 5000 Series Switches configured for vPC.

If you are using Cisco NX-OS Release 4.1(3)N1 on the Cisco Nexus 5000 Series and the LACP negotiation does not complete correctly, the cause may be a problem (big ID CSCtb84803) that was fixed in Cisco NX-OS Release 4.1(3)N2(1). Also, if you are using first-generation converged network adapter (CNA) 10 Gigabit Ethernet cards and LACP negotiation is not successful, you may need to disable **lldp transmit** on the Cisco Nexus 5000 Series 10 Gigabit Ethernet ports as follows:

```
(config-if)#no lldp transmit
```

vPC Host Mode Configuration with Cisco Discovery Protocol

When the two upstream switches support Cisco Discovery Protocol but do not support vPC, the configuration of the port profile is as follows:

```
port-profile system-uplink
  capability uplink
  channel-group auto mode on sub-group cdp
```

vPC Host Mode Configuration Without Cisco Discovery Protocol

If the upstream switches do not support Cisco Discovery Protocol or vPC, the network administrator needs to split the interfaces into groups (subgroups).

Under the main port profile, the configuration is as before:

```
 port-profile system-uplink
  capability uplink
  channel-group auto mode on sub-group cdp
```

Because the upstream switches do not support Cisco Discovery Protocol, ports will be operationally down until you configure subgroup IDs on the member ports as follows:

```
interface Ethernet3/4
  description to_access_switch_1
  inherit port-profile system-uplink
  sub-group-id 0
  channel-group 3 force

!
interface Ethernet3/5
   description to_access_switch_2
  inherit port-profile system-uplink
  sub-group-id 1
  channel-group 3 force
!
```

Design Considerations with the Cisco Nexus 1000V

VSM Deployment Considerations

The VSM can run attached to a standard vSwitch or to a VEM. Both configurations are possible. This guide focuses on the use of VSM attached to a standard vSwitch. With this approach, the control plane is not dependent on the forwarding plane that it is managing.

The server running the VSM is connected through 10 Gigabit Ethernet interfaces to the Cisco Nexus 5000 Series Switch and with dual lights-out management (LOM) to the management network (Figure 9).

Figure 9. Example of a VSM Placement in a vPC Design with Servers Equipped with 10 Gigabit Ethernet Adapters

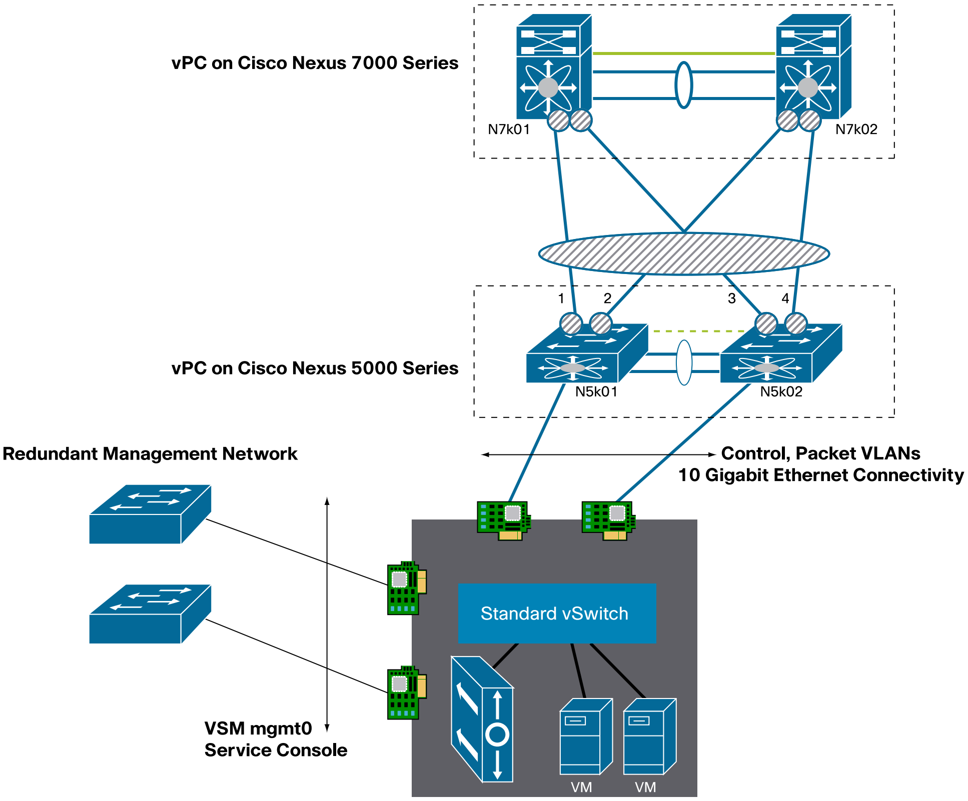
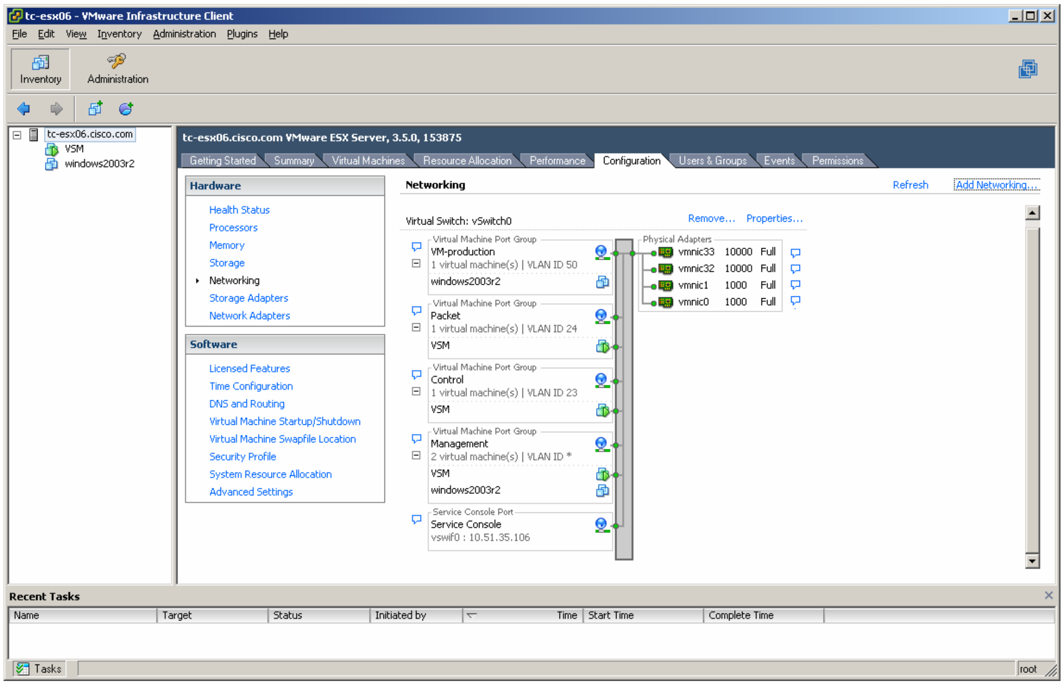

vPC on Cisco Nexus 7000 Series
N7k01
N7k02
1
2
3
4
vPC on Cisco Nexus 5000 Series
N5k01
N5k02
Redundant Management Network
Control, Packet VLANs
10 Gigabit Ethernet Connectivity
Standard vSwitch
VSM mgmt0
Service Console
VM
VM

Figure 10 shows the VSM network connectivity through the vSwitch.

Figure 10. View of the VSM from vCenter



Virtual Switch: vSwitch0

Virtual Machine Port Group
VM-production
1 virtual machine(s) | VLAN ID 50
windows2003r2

Virtual Machine Port Group
Packet
1 virtual machine(s) | VLAN ID 24
VSM

Virtual Machine Port Group
Control
1 virtual machine(s) | VLAN ID 23
VSM

Virtual Machine Port Group
Management
2 virtual machine(s) | VLAN ID *
VSM
windows2003r2

Service Console Port
Service Console
vswif0 : 10.51.35.106

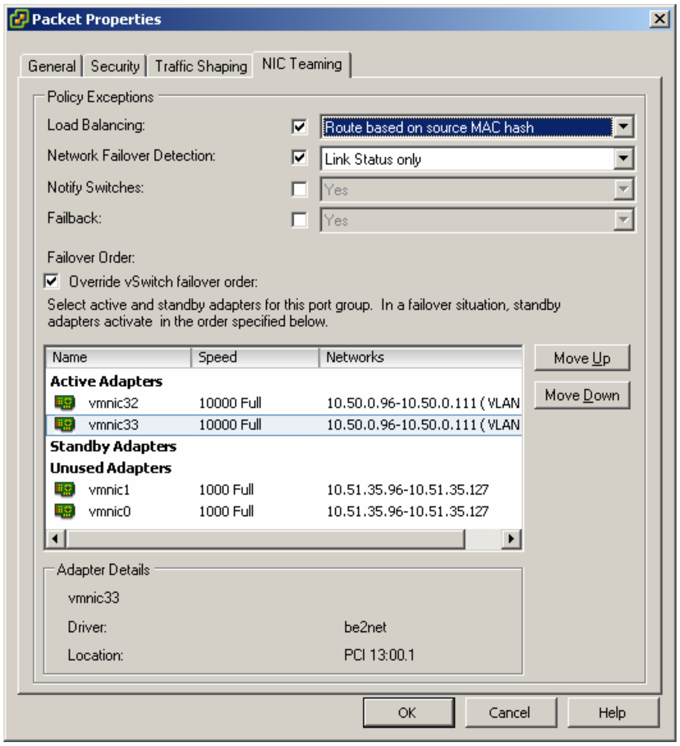
Physical Adapters

vmnic33	10000	Full
vmnic32	10000	Full
vmnic1	1000	Full
vmnic0	1000	Full

Name	Target	Status	Initiated by	Time	Start Time	Complete Time

If the Cisco Nexus 5000 Series Switch is configured to support vPC, which is highly desirable when you deploy VMware, then you should also configure the control and packet port groups for PortChannels as shown in Figure 11.

Figure 11. PortChannel Teaming Configuration on the vSwitch for Packet and Control VLAN



Policy Exceptions

Load Balancing: ☑ Route based on source MAC hash

Network Failover Detection: ☑ Link Status only

Notify Switches: □ Yes

Failback: □ Yes

Failover Order:

☑ Override vSwitch failover order:

Select active and standby adapters for this port group. In a failover situation, standby adapters activate in the order specified below.

Name	Speed	Networks
Active Adapters		
vmnic32	10000 Full	10.50.0.96-10.50.0.111 (VLAN
vmnic33	10000 Full	10.50.0.96-10.50.0.111 (VLAN
Standby Adapters		
Unused Adapters		
vmnic1	1000 Full	10.51.35.96-10.51.35.127
vmnic0	1000 Full	10.51.35.96-10.51.35.127

Adapter Details

vmnic33

Driver: be2net

Location: PCI 13:00.1

Load Balancing is set to **Route based on source MAC hash** because the packet and control VLANs at the time of this writing cannot be routed. Under **Active Adapters**, you would list only the 10 Gigabit Ethernet adapters, and the LOM interfaces would be on the **Unused Adapters** list for this port group.

The configuration on the primary Cisco Nexus 5000 Series Switch would be as follows:

```
tc-nexus5k01(config)# int eth1/6
tc-nexus5k01(config-if)# channel-group 6 mode on
tc-nexus5k01(config-if)# int po6
tc-nexus5k01(config-if)# vpc 6
tc-nexus5k01(config-if)#int po6
tc-nexus5k01(config-if)# switchport
tc-nexus5k01(config-if)# switchport mode trunk
tc-nexus5k01(config-if)# switchport trunk allowed vlan 23-24
tc-nexus5k01(config-if)# spanning-tree port type edge trunk
```

The configuration on the secondary Cisco Nexus 5000 Series Switch would be as follows (identical):

```
tc-nexus5k01(config)# int eth1/6
tc-nexus5k01(config-if)# channel-group 6 mode on
tc-nexus5k01(config-if)# int po6
tc-nexus5k01(config-if)# vpc 6
tc-nexus5k01(config-if)#int po6
tc-nexus5k01(config-if)# switchport
tc-nexus5k01(config-if)# switchport mode trunk
tc-nexus5k01(config-if)# switchport trunk allowed vlan 23-24
tc-nexus5k01(config-if)# spanning-tree port type edge trunk
```

Enter a **show vpc brief** command on the Cisco Nexus 5000 Series Switch to confirm whether the configuration was completed correctly:

```
vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
6      Po6         up     success     success                    23-24
```

If the configuration does not show success, typical causes include lack of configuration of the control and packet VLANs on the peer link.

You may also want to verify whether any Type-1 or Type 2 inconsistency occurred on the Cisco Nexus 5000 Switch for those vPC ports:

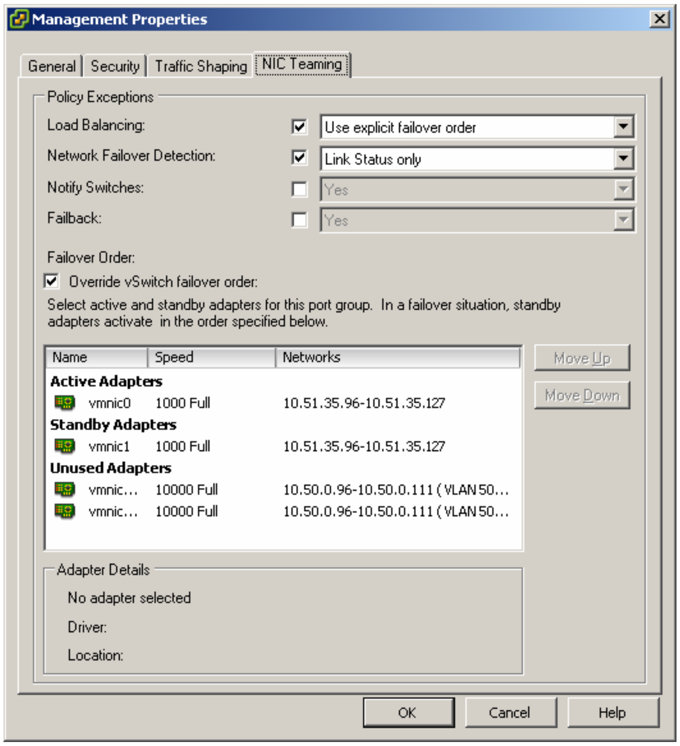
```
tc-nexus5k01# show vpc consistency-parameters int po6

    Legend:
        Type 1 : vPC will be suspended in case of mismatch

Name                        Type  Local Value            Peer Value
-------------               ----  ---------------------- -----------------------
STP Port Type               1     Edge Trunk Port        Edge Trunk Port
STP Port Guard              1     None                   None
STP MST Simulate PVST       1     Default                Default
mode                        1     on                     on
Speed                       1     10 Gb/s                10 Gb/s
Duplex                      1     full                   full
Port Mode                   1     trunk                  trunk
Native Vlan                 1     1                      1
Shut Lan                    1     No                     No
Allowed VLANs               -     23-24                  23-24
```

For mgmt0, you can use the classic active-standby behavior on the LOMs that are also used by the service console (Figure 12).

Figure 12. Active/Standby Teaming Configuration for the Service Console and Management 0 Interface via the Lan On Motherboard Interfaces



Management Properties

Policy Exceptions

Load Balancing: ☑ Use explicit failover order

Network Failover Detection: ☑ Link Status only

Notify Switches: □ Yes

Failback: □ Yes

Failover Order:

☑ Override vSwitch failover order:

Select active and standby adapters for this port group. In a failover situation, standby adapters activate in the order specified below.

Name	Speed	Networks
Active Adapters		
vmnic0	1000 Full	10.51.35.96-10.51.35.127
Standby Adapters		
vmnic1	1000 Full	10.51.35.96-10.51.35.127
Unused Adapters		
vmnic...	10000 Full	10.50.0.96-10.50.0.111 (VLAN 50...
vmnic...	10000 Full	10.50.0.96-10.50.0.111 (VLAN 50...

Adapter Details

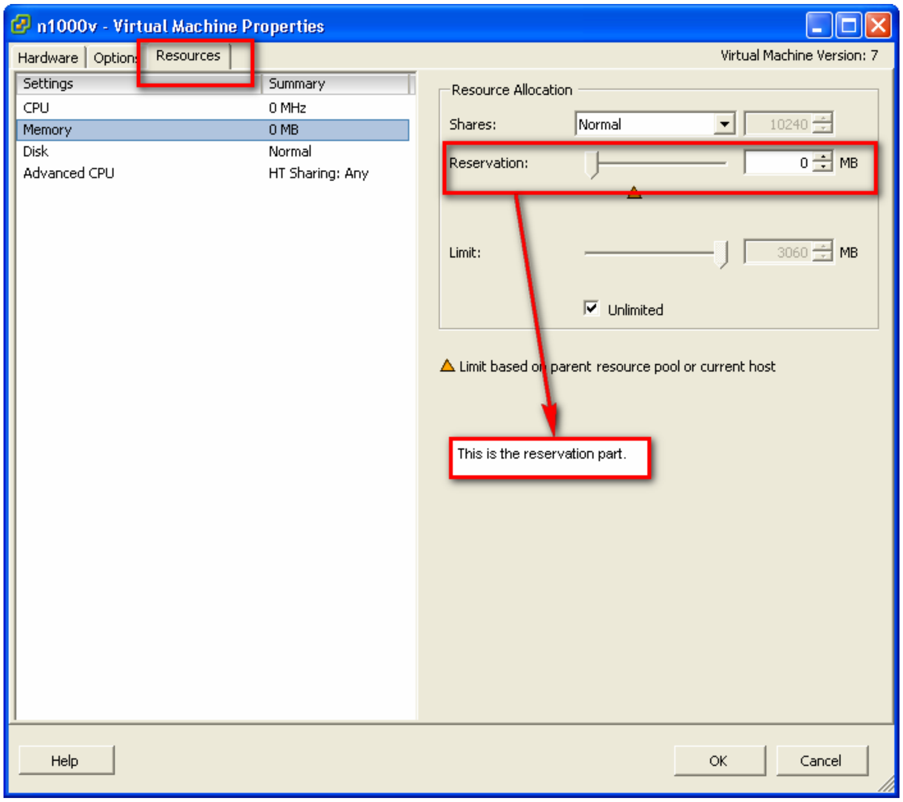
No adapter selected

Driver:

Location:

Although this topic is beyond the scope of this guide, do not forget to allocate 2 GB of RAM for the VSM by using the reservation configuration.

Figure 13. Memory Allocation for the VSM



n1000v - Virtual Machine Properties

Virtual Machine Version: 7

Settings	Summary
CPU	0 MHz
Memory	0 MB
Disk	Normal
Advanced CPU	HT Sharing: Any

Resource Allocation

Shares: Normal 10240

Reservation: 0 MB

Limit: 3060 MB

☑ Unlimited

⚠ Limit based on parent resource pool or current host

This is the reservation part.

The initial configuration on the VSM needs to reflect the control and packet VLANs that have been chosen and the domain ID. Here is an example of the configuration:

```
vlan 23
  name control_vlan
vlan 24
name packet_vlan

svs-domain
  domain id 1
  control vlan 23
  packet vlan 24
  svs mode L2
```

Uplink Port Profiles

The uplink port profile configuration is the most relevant configuration for the connectivity between the Cisco Nexus 1000V and the upstream switches.

Every VMware ESX host must have at least one interface associated with a system uplink port profile to help ensure VSM-to-VEM communication.

In addition to the system VLANs, the uplink port profiles need to carry primarily the virtual machine production VLANs, VMware VMkernel traffic, and, potentially, service console traffic (which in this guide is configured on the LOM ports).

If you use a unique uplink port profile, it will also be a system port profile, and the system VLAN will include packet and control VLANs. If the service console uses the Cisco Nexus 1000V path, the service console VLAN should be listed as one of the system VLANs.

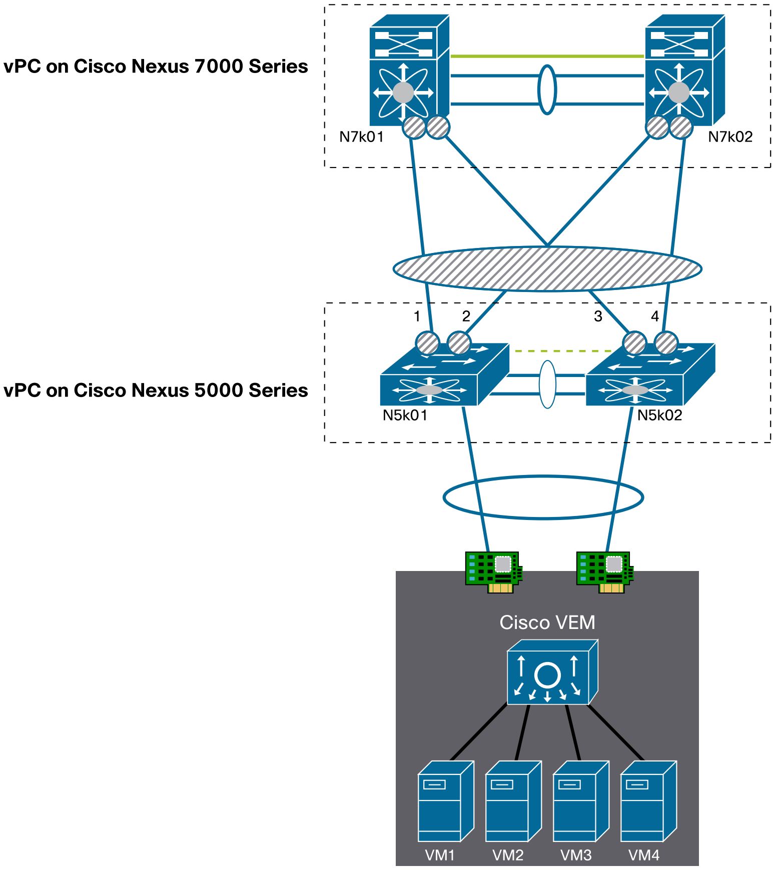
Depending on the capabilities of the upstream switch, several designs are possible.

Design with Cisco Nexus 5000 Series Switches (vPC Mode) and 10 Gigabit Ethernet Adapters

This is the simplest configuration: You configure **channel-group auto mode active** (or **passive**, or **on**) in the uplink port profile. The active and passive modes are preferred because of the LACP negotiation capabilities.

A typical topology, shown in Figure 14, consists of VMware ESX servers with two 10 Gigabit Ethernet ports with CNAs (which can also concurrently support TCP/IP traffic and Fibre Channel over Ethernet [FCoE] traffic).

Figure 14. Cisco Nexus 1000V Topology with vPC on the Cisco Nexus 5000 Series Switches


vPC on Cisco Nexus 7000 Series
N7k01
N7k02
1
2
3
4
vPC on Cisco Nexus 5000 Series
N5k01
N5k02
Cisco VEM
VM1
VM2
VM3
VM4

In this case, the following configurations characterize the design:

- This design requires the creation of one uplink port profile.
- The uplink port profile is also a system port profile, so it carries system VLANs (control and packet).
- The VMware ESX network adapters are connected to both Cisco Nexus 5000 Series Switches.
- The uplink port profile is configured with **channel-group auto mode active**.
- The system VLANs are defined twice in the uplink port profile: under the **system vlan** configuration and as allowed VLANs in the **switchport trunk allowed vlan** configuration.
- The upstream Cisco Nexus 5000 Series Switch is configured for vPC.
- The system VLANs are trunked on the Cisco Nexus 5000 Series vPC ports as well as on the peer link (because of vPC).
- The spanning-tree root and secondary roots for system VLANs and VMware VMkernel VLANs are defined as one of the Cisco Nexus 5000 Series Switches if the VMware ESX cluster exists only in the context of the Cisco Nexus 5000 vPC pair or as one of the Cisco Nexus 7000 Series Switches if these VLANs span multiple Cisco Nexus 5000 Series Switches.
- If the VMware ESX cluster is spread across more than one Cisco Nexus 5000 Series Switch, it is better to place the root for all the VLANs listed above on the Cisco Nexus 7000 Series Switch. In this case, the system VLANs and the VMware VMkernel VLAN are trunked to the upstream Cisco Nexus 7000 Series Switch.

The port profile configuration for the channel group is as follows:

```
port-profile system-uplink
  capability uplink
  vmware port-group fabric_uplinks
  switchport mode trunk
  switchport trunk allowed vlan 23-24, <production vlans>, <vmkernel vlan>
  channel-group auto mode active
  no shutdown
  system vlan 23-24
state enabled
```

The configuration on each Cisco Nexus 5000 vPC peer would be as follows:

```
interface Ethernet1/2
  description tc-esx02
  switchport mode trunk
  switchport trunk allowed vlan 23-24, <production vlans>, <vmkernel vlan>
  untagged cos 0
  spanning-tree port type edge trunk
  channel-group 2 mode passive

interface port-channel2
  switchport mode trunk
  switchport trunk allowed vlan 23-24, <production vlans>, <vmkernel vlan>
  vpc 2
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
```

When you enter the **show port-channel summary** command, you should see that all the PortChannels on the Cisco Nexus 1000V are in P mode:

```
tc-n1kv04# show port-channel summary
Flags:  D - Down        P - Up in port-channel (members)
        I - Individual  H - Hot-standby (LACP only)
        s - Suspended   r - Module-removed
        S - Switched    R - Routed
        U - Up (port-channel)
--------------------------------------------------------------------------------
Group Port-       Type     Protocol  Member Ports
      Channel
--------------------------------------------------------------------------------
1     Po1(SU)     Eth      NONE      Eth3/3(P)    Eth3/4(P)
2     Po2(SU)     Eth      LACP      Eth4/4(P)    Eth4/5(P)
```

On the Cisco Nexus 5000 Series Switch, you also should see that the vPCs are in the up state:

```
tc-nexus5k01# show vpc br
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link
```

```
vPC domain id                   : 2
Peer status                     : peer adjacency formed ok
vPC keep-alive status           : peer is alive
Configuration consistency status: success
vPC role                        : primary

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ --------------------------------------------------
1    Po10   up     1,10-14,21-24,30,50,60

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
2      Po2         up     success     success                    23-24,50,60
3      Po3         up     success     success                    23-24,50,60
```

Design with Cisco Nexus 2148T Series Fabric Extender (vPC Mode) and Quad Gigabit Ethernet Adapters

With four network adapter ports and a Cisco Nexus 2148T Series Fabric Extenders deployment, you can implement a configuration that provides the VMware ESX server with the maximum possible bandwidth by doing the following:

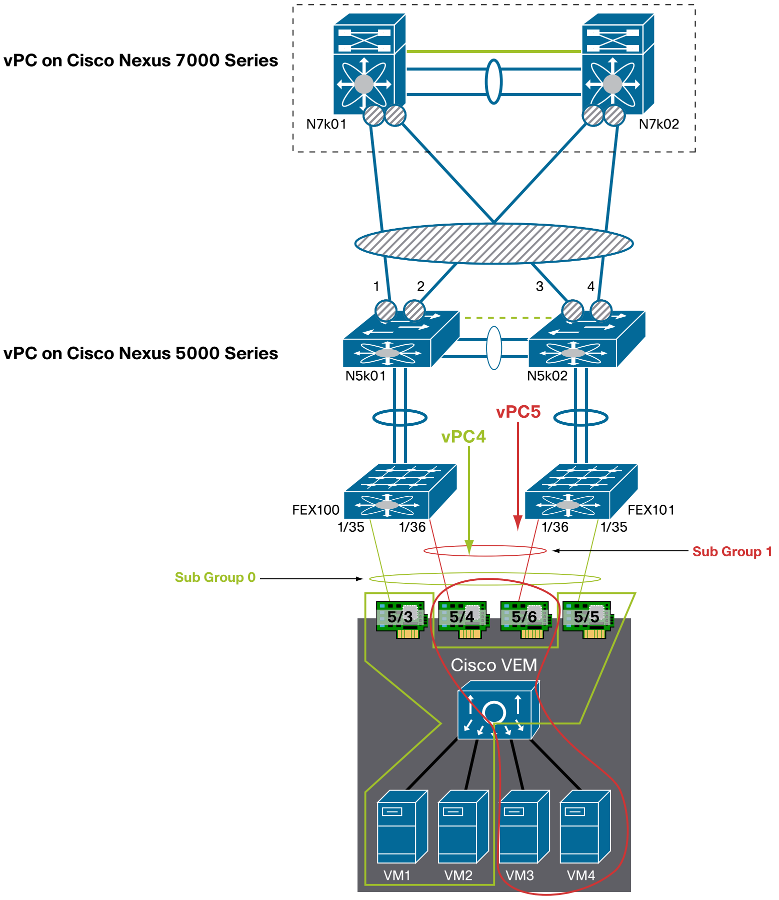
- Create a single uplink port profile that is also the system port profile.
- Use vPC on the fabric extender with groups of two ports.
- Use the vPC host-mode pinning capabilities on the subgroups to provide load distribution across two fabric extender vPCs (which become a single vPC host mode from the perspective of the Cisco Nexus 1000V).

The Cisco Nexus 2000 Series Fabric Extenders support two ports for vPCs with the Cisco Nexus 5000 Series Switch running Cisco NX-OS Release 4.1(3)N1 or later. Thus, you cannot create a single channel group of four ports, but you can create two subgroups by using the vPC host-mode feature.

On the fabric extender, there would be two vPCs, but from the perspective of the Cisco Nexus 1000V, there would be a single vPC host mode. Each subgroup consists of two ports only, thus meeting the Cisco Nexus 2000 Series vPC constraints.

As Figure 15 shows, the virtual machines each use one subgroup: either subgroup 0 or subgroup 1. Each subgroup runs vPC to the two upstream fabric extenders devices, and the loop-prevention rules apply between subgroup 0 and subgroup 1.

Figure 15. Cisco Nexus 1000V Topology with vPC on the Cisco Nexus 2148T

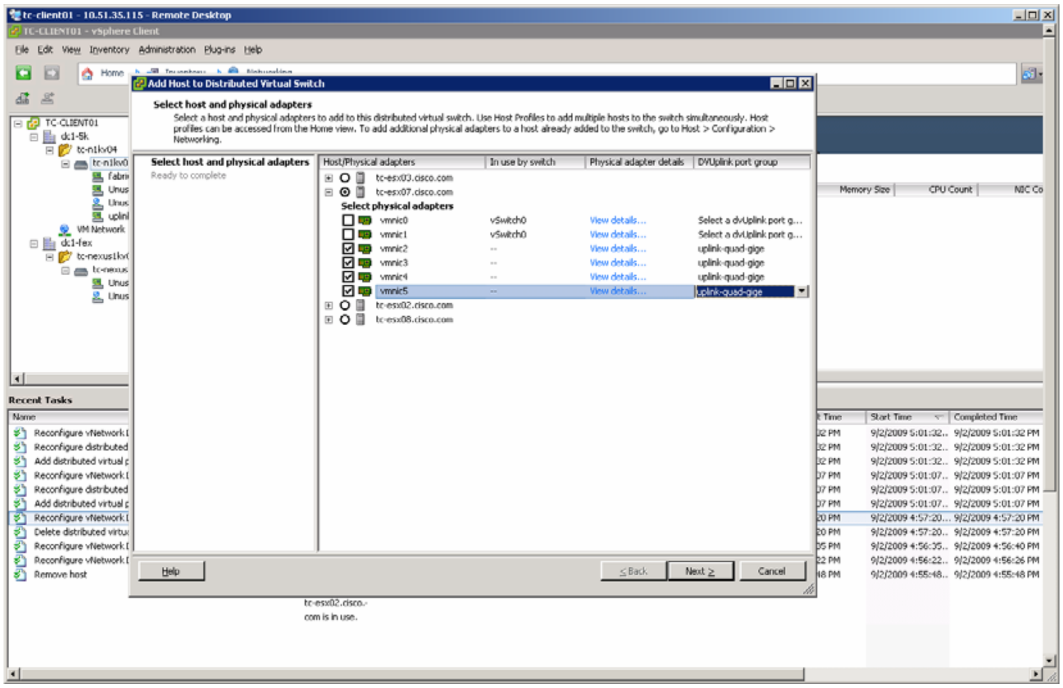


On the Cisco Nexus 1000V, you configure an uplink and system port profile as follows:

```
port-profile uplink-quad-gige
  capability uplink
  vmware port-group uplink-quad-gige
  switchport mode trunk
  switchport trunk allowed vlan 23-24, <production vlans>, <vmkernel vlan>
  channel-group auto mode on sub-group cdp
  no shutdown
  system vlan 23-24
  state enabled
```

You then add the VMware ESX host to the Cisco Nexus 1000V and associate the vmnics with the distributed virtual uplink port group as shown in Figure 16.

Figure 16. Associating vmnics with the Uplink Port Profile



Add Host to Distributed Virtual Switch

Select host and physical adapters

Select a host and physical adapters to add to this distributed virtual switch. Use Host Profiles to add multiple hosts to the switch simultaneously. Host profiles can be accessed from the Home view. To add additional physical adapters to a host already added to the switch, go to Host > Configuration > Networking.

Select host and physical adapters
Ready to complete

Host/Physical adapters	In use by switch	Physical adapter details	DVUplink port group
⊞ ○ tc-esx03.cisco.com			
⊟ ● tc-esx07.cisco.com			
Select physical adapters			
☐ vmnic0	vSwitch0	View details...	Select a dvUplink port g...
☐ vmnic1	vSwitch0	View details...	Select a dvUplink port g...
☑ vmnic2	--	View details...	uplink-quad-gige
☑ vmnic3	--	View details...	uplink-quad-gige
☑ vmnic4	--	View details...	uplink-quad-gige
☑ vmnic5	--	View details...	uplink-quad-gige
⊞ ○ tc-esx02.cisco.com			
⊞ ○ tc-esx08.cisco.com			

Recent Tasks

Name	t Time	Start Time	Completed Time
Reconfigure vNetwork I	32 PM	9/2/2009 5:01:32..	9/2/2009 5:01:32 PM
Reconfigure distributed	32 PM	9/2/2009 5:01:32..	9/2/2009 5:01:32 PM
Add distributed virtual p	32 PM	9/2/2009 5:01:32..	9/2/2009 5:01:32 PM
Reconfigure vNetwork I	07 PM	9/2/2009 5:01:07..	9/2/2009 5:01:07 PM
Reconfigure distributed	07 PM	9/2/2009 5:01:07..	9/2/2009 5:01:07 PM
Add distributed virtual p	07 PM	9/2/2009 5:01:07..	9/2/2009 5:01:07 PM
Reconfigure vNetwork I	20 PM	9/2/2009 4:57:20...	9/2/2009 4:57:20 PM
Delete distributed virtu	20 PM	9/2/2009 4:57:20..	9/2/2009 4:57:20 PM
Reconfigure vNetwork I	35 PM	9/2/2009 4:56:35..	9/2/2009 4:56:40 PM
Reconfigure vNetwork I	22 PM	9/2/2009 4:56:22..	9/2/2009 4:56:26 PM
Remove host	48 PM	9/2/2009 4:55:48..	9/2/2009 4:55:48 PM

tc-esx02.cisco.-
com is in use.

This results in the following configurations (which match Figure 16):

```
interface Ethernet5/3
  inherit port-profile uplink-quad-gige
  sub-group-id 0

interface Ethernet5/4
  inherit port-profile uplink-quad-gige
  sub-group-id 1

interface Ethernet5/5
  inherit port-profile uplink-quad-gige
  sub-group-id 0

interface Ethernet5/6
  inherit port-profile uplink-quad-gige
  sub-group-id 1
```

On the Cisco Nexus 5000 and 2000 Series, you configure vPCs as follows:

```
interface Ethernet100/1/35
  description tc-esx07-vmnic2
  switchport mode trunk
  switchport trunk allowed vlan 23-24,30,50,60
  untagged cos 0
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  channel-group 4
```

```
interface port-channel4
  switchport mode trunk
  switchport trunk allowed vlan 23-24,30,50,60
  vpc 4
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 1000

interface Ethernet100/1/36
  description tc-esx07-vmnic3
  switchport mode trunk
  switchport access vlan 50
  switchport trunk allowed vlan 23-24,30,50,60
  untagged cos 0
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
channel-group 5

interface port-channel5
  switchport mode trunk
  switchport access vlan 50
  switchport trunk allowed vlan 23-24,30,50,60
  vpc 5
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 1000
```

Use the **show** command to verify that the two virtual machines, VM1-ESX07 and VM2-ESX07, are pinned to subgroup 0 and subgroup 1, respectively. You can also see that vmnic2 and vmnic4 are part of the PortChannel associated with subgroup 0, and that vmnic3 and vmnic5 are part of the PortChannel associated with subgroup 1:

```
[root@tc-esx07 ~]# /usr/sbin/vemcmd show port
  LTL    IfIndex   Vlan    Bndl  SG_ID Pinned_SGID  Type  Admin State  CBL Mode
Nam
   17   1a040200      1 T   303      0           2  PHYS     UP    UP    1  Trunk
vmnic2
   18   1a040300      1 T   303      1           2  PHYS     UP    UP    1  Trunk
vmnic3
   19   1a040400      1 T   303      0           2  PHYS     UP    UP    1  Trunk
vmnic4
   20   1a040500      1 T   303      1           2  PHYS     UP    UP    1  Trunk
vmnic5
   47   1b040000     50       0      2           0  VIRT     UP    UP    4 Access
vm1-esx07
   48   1b040010     50       0      2           1  VIRT     UP    UP    4 Access
vm2-esx07
```

Tune the PortChannel load-balancing algorithm with this command:

```
tc-n1kv04(config)# port-channel load-balance ethernet source-ip-port
```

You can use all four available paths. When virtual machine 2 is sending traffic, this traffic is hashed according to the PortChannel load-balancing algorithm previously selected and could end up on eth5/4 or eth5/6 from the perspective of the Cisco Nexus 1000V, which is eth100/1/36 or eth101/1/36 from the perspective of the Cisco Nexus 5000 Series Switch.

If eth100/1/35 fails, the flows are reassigned to eth101/1/35. If both of these fail, virtual machine 1 is repinned to subgroup 1, thus using vmnic3 and vmnic3 as the following **show** command illustrates:

```
[root@tc-esx07 ~]# /usr/sbin/vemcmd show port
  LTL    IfIndex   Vlan    Bndl  SG_ID Pinned_SGID  Type  Admin State  CBL Mode
Name
   17   1a040200      1 T     0      0           2  PHYS     UP  DOWN    0  Trunk
vmnic2
   18   1a040300      1 T   303      1           2  PHYS     UP    UP    1  Trunk
vmnic3
   19   1a040400      1 T     0      0           2  PHYS     UP  DOWN    0  Trunk
vmnic4
   20   1a040500      1 T   303      1           2  PHYS     UP    UP    1  Trunk
vmnic5
   47   1b040000     50       0      2           1  VIRT     UP    UP    4 Access
vm1-esx07-chariot.eth1
   48   1b040010     50       0      2           1  VIRT     UP    UP    4 Access
vm2-esx07-chariot.eth1
```

Most failures converge within 700 milliseconds (ms).

Scaling the Design with Multiple Uplink Port Profiles

If the physical server has more than four NICs, or if for any reason you need to divide the traffic instead of distributing it, you will need to configure multiple port profiles for the same VEM.

The two design models previously described become the building blocks for this type of design. You should group NICs, and for each group you must decide whether you want to implement:

- PortChannels (typically assisted by a vPC configuration on the physical switch)
- vPC host mode with the creation of subgroups

Each group of ports forms a port profile and carries a set of VLANs that is distinct from the set of VLANs in the other port profiles.

One of the port profiles also carries the system VLANs and the VMware VMkernel VLAN.

For example, if a VMware ESX host carries 20 VLANs and you have 8 NICs, you may want to do as follows:

- Group the NICs into pairs of 2.
- Make sure that each group is dual-attached to separate physical switches.
- Make one of the port profiles the system port profile by assigning system VLANs to it.
- Assign the VMware VMkernel VLAN to the system uplink port profile.
- Spread the 20 VLANs across each of the port profiles (the system uplink port profile can be included as well). Each port profile would carry 5 VLANs, and the system port profile would also carry the control, packet, and VMware VMkernel VLANs.

Design for VMware VMkernel

The transport of the VMware VMkernel traffic has traditionally been implemented by using a dedicated Gigabit Ethernet port from the VMware ESX server. The combination of vPC technology and 10 Gigabit Ethernet adapters creates an opportunity to simplify the server network infrastructure by consolidating the VMware VMkernel traffic and the production traffic.

There are several reasons for doing this:

- VMware VMkernel benefits from additional network bandwidth such as the use of 10 Gigabit Ethernet adapters.
- The use of designs based on vPC eliminates blocking ports and reduces the possibility of a spanning-tree loop (which would be the result of a vPC failure followed by a spanning-tree failure).

Thus while the use of the LOM ports for service console connectivity offers convenience, there are several reasons for use the production NICs to transport VMware VMkernel traffic.

VMware VMkernel traffic benefits for the additional 10 Gigabit Ethernet bandwidth because it can be assimilated to a memory copy from one VMware ESX host to another VMware ESX host. Memory operations can take advantage of the available bandwidth because they are not constrained by the I/O performance of local or remote disks.

To implement a VMware VMkernel solution, you need to provision a VLAN that can be local to the Cisco Nexus 5000 Series Switches if the VMware ESX cluster does not span additional Cisco Nexus 5000 Series Switches, or if needed it can span multiple Cisco Nexus 5000 Series Switch pairs.

This VLAN needs to be trunked on the vPC ports connected to the VMware ESX hosts (which are part of a vPC):

```
tc-nexus5k01(config)# int po2
tc-nexus5k01(config-if)# switchport trunk allowed vlan add 30
tc-nexus5k01(config-if)# int po3
tc-nexus5k01(config-if)# switchport trunk allowed vlan add 30
```

In addition, as in all vPC designs, it needs to be trunked on the peer link:

```
tc-nexus5k01(config-if)# int po10
tc-nexus5k01(config-if)# switchport trunk allowed vlan add 30
```

The configuration steps need to be repeated on the primary and secondary Cisco Nexus 5000 Series Switches.

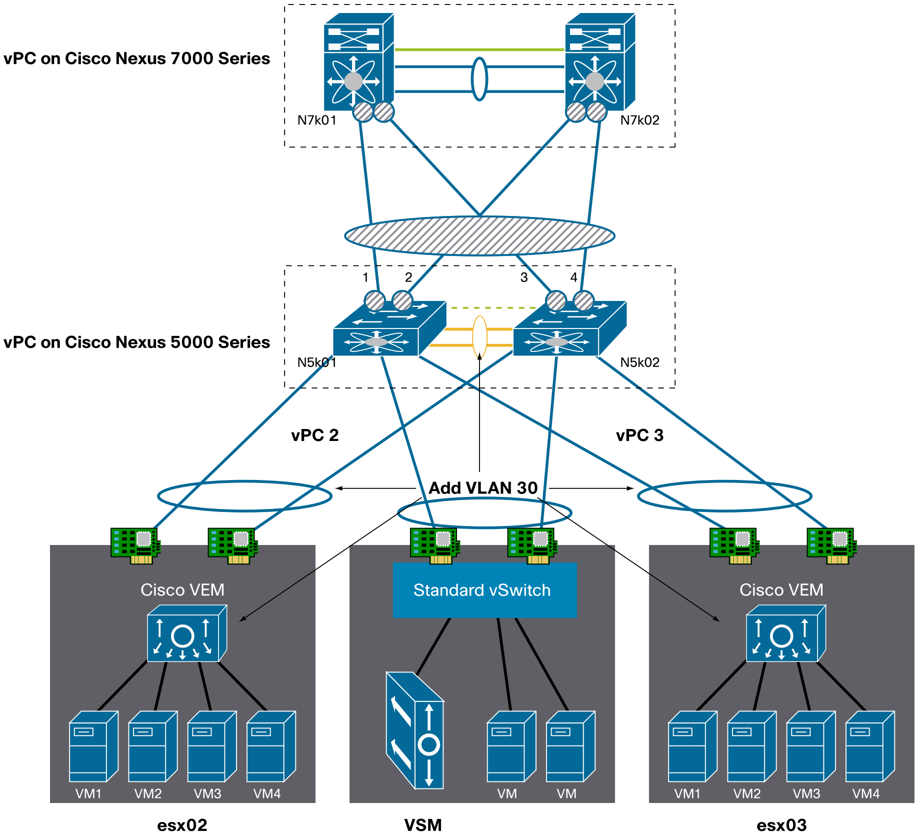
The configuration on the Cisco Nexus 1000V requires the addition of the VMware VMkernel VLAN to the appropriate uplink port profile:

```
tc-n1kv04(config)# port-profile system-uplink
tc-n1kv04(config-port-prof)# switchport trunk allowed vlan add 30
```

You also need to create a port profile to attach to the VMware VMkernel interface:

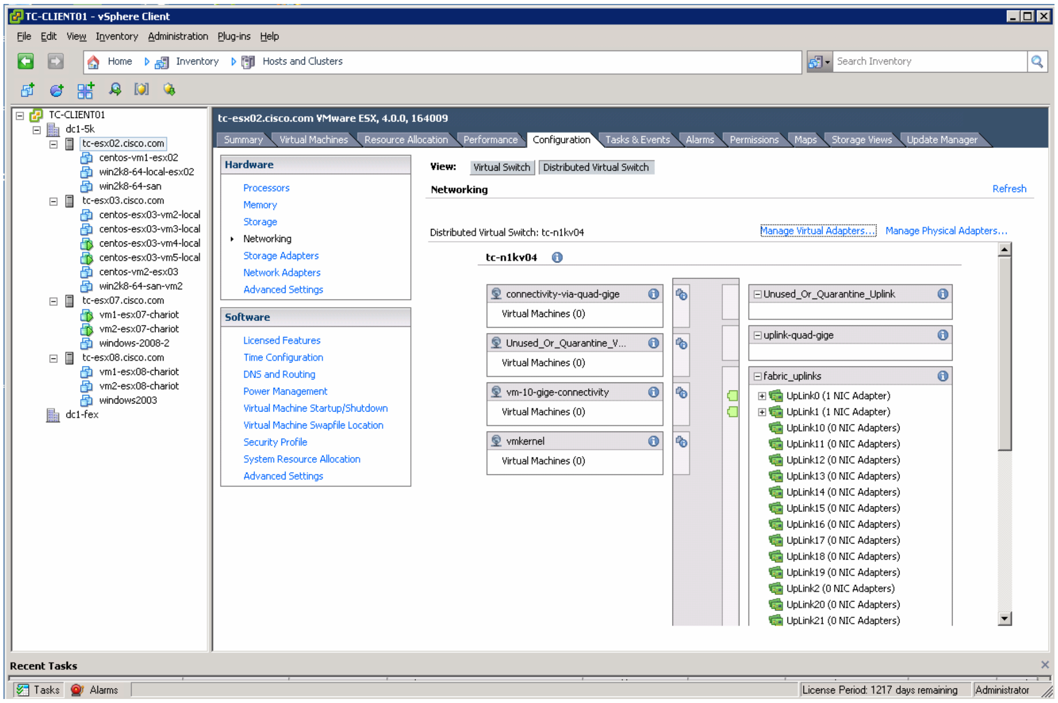
```
port-profile vmkernel
  vmware port-group
  switchport mode access
  switchport access vlan 30
  no shutdown
state enabled
```

Figure 17. Carrying the VMkernel on the Production 10 Gigabit Ethernet Adapters



In VMware vCenter, you then need to attach the VMware VMkernel interface to the port profile that was just provisioned. Go to the **Inventory/Host** view and select each VMware ESX host. Then select the **Configuration** tab and the **Distributed Virtual Switch** view. Select **Manage Virtual Adapters** as shown in Figure 18.

Figure 18. Location of the Configuration for the VMkernel Interface



TC-CLIENT01 - vSphere Client

File Edit View Inventory Administration Plug-ins Help

Home ▷ Inventory ▷ Hosts and Clusters

Search Inventory

TC-CLIENT01
- dc1-5k
  - tc-esx02.cisco.com
    - centos-vm1-esx02
    - win2k8-64-local-esx02
    - win2k8-64-san
  - tc-esx03.cisco.com
    - centos-esx03-vm2-local
    - centos-esx03-vm3-local
    - centos-esx03-vm4-local
    - centos-esx03-vm5-local
    - centos-vm2-esx03
    - win2k8-64-san-vm2
  - tc-esx07.cisco.com
    - vm1-esx07-chariot
    - vm2-esx07-chariot
    - windows-2008-2
  - tc-esx08.cisco.com
    - vm1-esx08-chariot
    - vm2-esx08-chariot
    - windows2003
- dc1-fex

tc-esx02.cisco.com VMware ESX, 4.0.0, 164009

Summary | Virtual Machines | Resource Allocation | Performance | Configuration | Tasks & Events | Alarms | Permissions | Maps | Storage Views | Update Manager

Hardware

Processors
Memory
Storage
▸ Networking
Storage Adapters
Network Adapters
Advanced Settings

Software

Licensed Features
Time Configuration
DNS and Routing
Power Management
Virtual Machine Startup/Shutdown
Virtual Machine Swapfile Location
Security Profile
System Resource Allocation
Advanced Settings

View: Virtual Switch | Distributed Virtual Switch

Networking Refresh

Distributed Virtual Switch: tc-n1kv04 Manage Virtual Adapters... Manage Physical Adapters...

tc-n1kv04

connectivity-via-quad-gige
Virtual Machines (0)

Unused_Or_Quarantine_V...
Virtual Machines (0)

vm-10-gige-connectivity
Virtual Machines (0)

vmkernel
Virtual Machines (0)

Unused_Or_Quarantine_Uplink

uplink-quad-gige

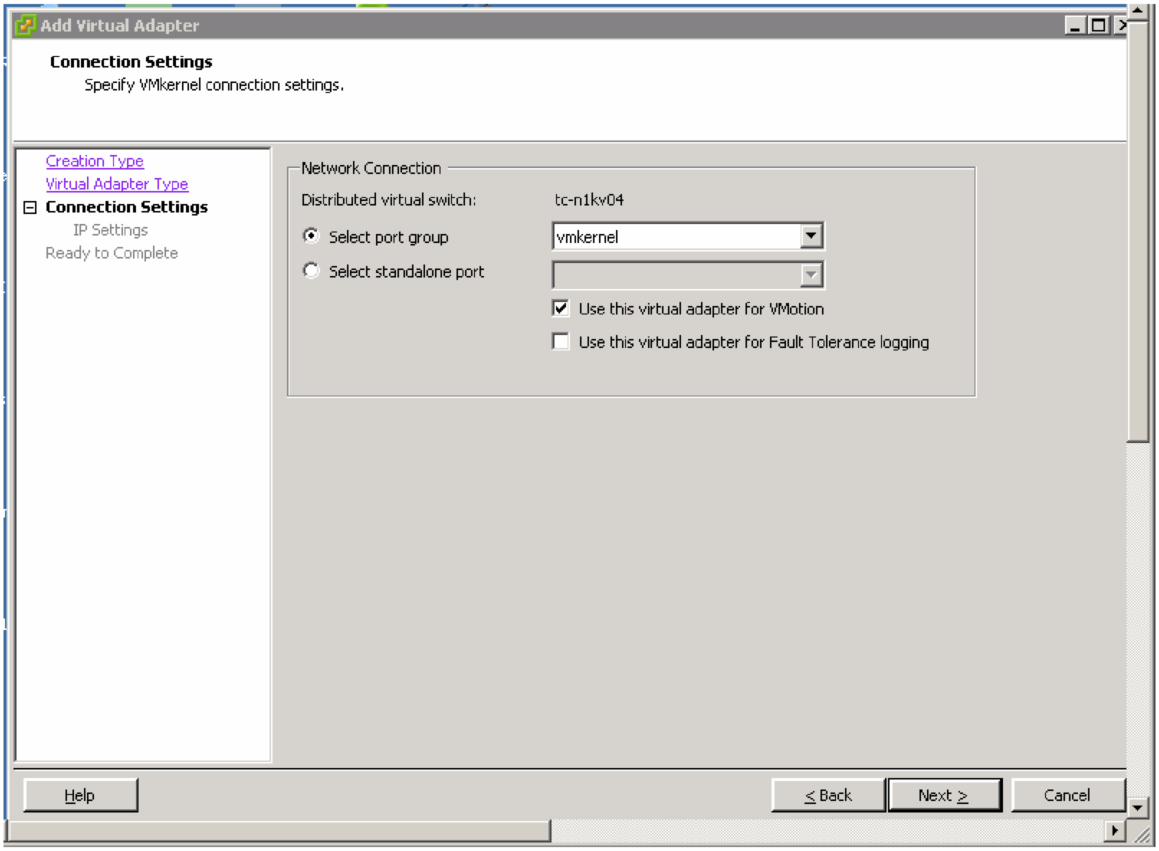
fabric_uplinks
- UpLink0 (1 NIC Adapter)
- UpLink1 (1 NIC Adapter)
- UpLink10 (0 NIC Adapters)
- UpLink11 (0 NIC Adapters)
- UpLink12 (0 NIC Adapters)
- UpLink13 (0 NIC Adapters)
- UpLink14 (0 NIC Adapters)
- UpLink15 (0 NIC Adapters)
- UpLink16 (0 NIC Adapters)
- UpLink17 (0 NIC Adapters)
- UpLink18 (0 NIC Adapters)
- UpLink19 (0 NIC Adapters)
- UpLink2 (0 NIC Adapters)
- UpLink20 (0 NIC Adapters)
- UpLink21 (0 NIC Adapters)

Recent Tasks

Tasks | Alarms | License Period: 1217 days remaining | Administrator

Add a new virtual adapter and select **vmkernel** as shown in Figure 19.

Figure 19. Associating the VMkernel with the Port Profile



Connection Settings
Specify VMkernel connection settings.

Network Connection

Distributed virtual switch: tc-n1kv04

● Select port group: vmkernel

○ Select standalone port

☑ Use this virtual adapter for VMotion

□ Use this virtual adapter for Fault Tolerance logging

The virtual adapters will then appear in the Cisco Nexus 1000V as virtual Ethernet interfaces:

```
tc-n1kv04# show int virtual

--------------------------------------------------------------------------------
Port        Adapter        Owner                    Mod Host
--------------------------------------------------------------------------------
Veth1       Net Adapter 2  vm1-esx07-chariot        5   tc-esx07.cisco.com
Veth2       Net Adapter 2  vm2-esx07-chariot        5   tc-esx07.cisco.com
Veth5                      centos-esx03-vm5-local e 3   tc-esx03.cisco.com
Veth6                      centos-esx03-vm4-local e 3   tc-esx03.cisco.com
Veth7       vmk0           VMware VMkernel          4   tc-esx02.cisco.com
Veth8       vmk0           VMware VMkernel          3   tc-esx03.cisco.com
```

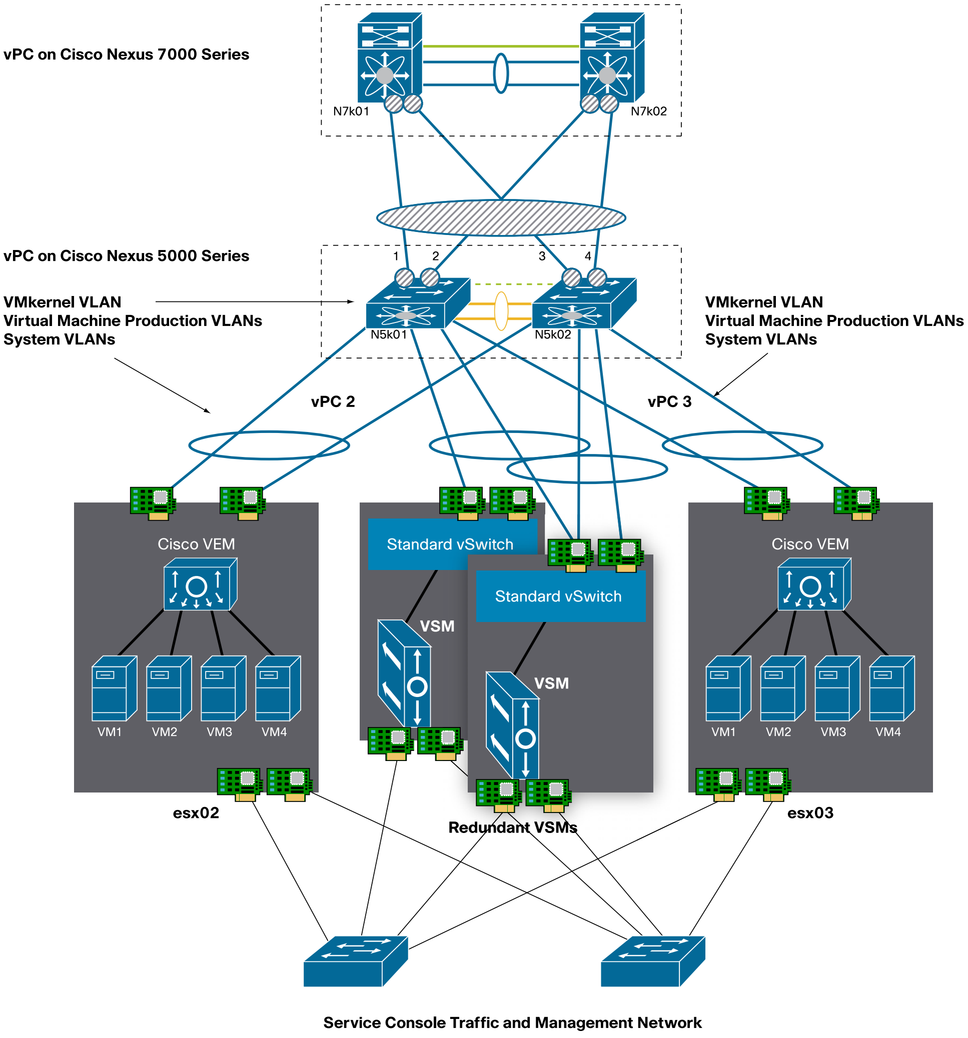
Overall Topology

Figure 20 shows the overall topology for running a VMware ESX deployment with dual 10 Gigabit Ethernet connected servers:

- vPC is highly recommended on the access layer switches; and it interfaces with PortChannel active mode configuration on the Cisco Nexus 1000V.
- Every VMware ESX host is configured with a system uplink port profile that also carries the VMware VMkernel VLAN.

- The service console connectivity can be provisioned in-band over the same uplink port profile by defining the service console as a system VLAN, or in a more conservative way it can use the Gigabit Ethernet LOMs on rackable servers.
- The mgmt0 connectivity from the VSM uses an out-of-band management network. The VSM can connect through a VEM on the VMware ESX hosts that run the VSM, or it can use a standard vSwitch. The current approach is to separate the managing entity from the entity that it manages; therefore, in this document, the VSM connects to the management network through a standard vSwitch.
- VMware VMkernel and system VLANs can be contained in the pair of Cisco Nexus 5000 Series Switches running vPC, in which case these VLANs do not need to be trunked to the upstream Cisco Nexus 7000 Series Switches, and the Cisco Nexus 5000 Series Switches can then be configured as the root and secondary root for these VLANs.
- As always with vPC deployments, any VLAN that is added to the vPC to the VMware ESX hosts needs to be present on the peer link as well.

Figure 20. Overall Design with the Cisco Nexus1000v 4.0(4)SV1(1) and Cisco Nexus 2148T



In topologies that use multiple quad Gigabit Ethernet adapters, the following recommendations apply in addition to the previous ones:

- Create a system uplink port profile and assign at least two vmnics to the system port profile for redundancy, with each vmnic attached to a different upstream switch.
- VMware VMkernel can be carried in-band, and potentially on the system uplink port profile.
- Divide the remaining vmnics into groups of two, in which each group has one NIC connected to one switch, and the other NIC is connected to another switch for redundancy. Each group defines an uplink port profile.
- Depending on the capabilities of the upstream switches, you can configure each uplink port profile in channel-group active mode (if the upstream switch supports vPC and LACP), or you can create subgroups (if the upstream switch does not support vPC).

In all cases, the access switch ports connected to a VMware ESX host and VEM should be configured as follows:

- They should be trunks.
- The trunk should carry the virtual machine production VLANs, system VLANs, and VMware VMkernel VLAN as needed, matching the corresponding Cisco Nexus 1000V configuration.
- The spanning-tree port type edge trunk should be enabled

Each VMware ESX host can still run a standard vSwitch to enable simple out-of-band management connectivity for the virtual machines, which can be used for cluster heartbeats, for example, or in general low-bandwidth Layer 2 connectivity between virtual machines.

Configuration Steps

Cisco Nexus 5000 Series Configuration

This sample configuration shows the steps needed to create the vPC between the VMware ESX host running the Cisco Nexus 1000V and the Cisco Nexus 5000 Series Switches. This configuration omits the vPC infrastructure configuration, which should be well known to the reader (and is documented in other guides).

PortChannel 2 is a vPC connecting the 10 Gigabit Ethernet ports of the Cisco Nexus 5000 Series Switch to the two 10 Gigabit Ethernet Intel 82598 adapters on the VMware ESX host.

Replicate the following configuration identically on both Cisco Nexus 5000 Series Switches.

1. Define the port as **type edge trunk**, configure the port to carry the system VLANs (control and packet), and configure the channel group for LACP (or for mode on if you prefer a static configuration):

```
interface Ethernet1/2
  description tc-esx02
  switchport mode trunk
  switchport trunk allowed vlan <system vlans>, <production vlans>, <vmkernel>
  untagged cos 0
  spanning-tree port type edge trunk
  channel-group 2 mode passive
```

```
interface port-channel2
  switchport mode trunk
  switchport trunk allowed vlan <system vlans>, <production vlans>, <vmkernel>
  vpc 2
  spanning-tree port type edge trunk
speed 10000
```

2. Add the system VLANs to the peer link:

```
int po10
   switchport trunk allowed add vlan <system vlans>, <production vlans>, <vmkernel>
```

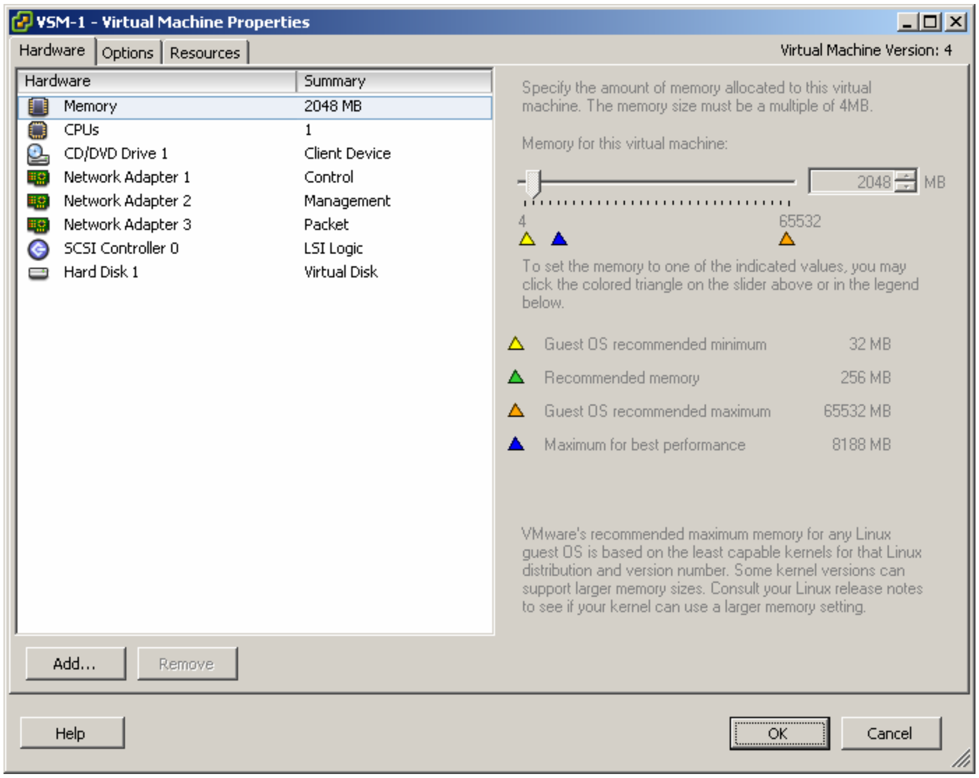
3. Verify that the vPC is up by entering the command **show vpc brief**.

If you are using Cisco NX-OS Release 4.1(3)N1 on the Cisco Nexus 5000 Series Switch and the LACP negotiation does not complete correctly, the cause may be a problem (bug ID CSCtb84803) that was fixed in Cisco NX-OS Release 4.1(3)N2(1). Also, if you are using first-generation CNA 10 Gigabit Ethernet cards and LACP negotiation is not successful, you may need to disable **lldp transmit** on the Cisco Nexus 5000 Series 10 Gigabit Ethernet ports as follows:

```
(config-if)#no lldp transmit
```

Configuration of the VSM

1. Make sure that the network adapters of the VSM are associated with the appropriate VLANs as shown in the sample in the following screen:
   - Control (often referred to as the AIPC interface): Network Adapter 1
   - Management: Network Adapter 2 sharing the traffic with the service console and providing mgmt0 to the VSM
   - Packet: Network Adapter 3



Virtual Machine Version: 4

Hardware	Summary
Memory	2048 MB
CPUs	1
CD/DVD Drive 1	Client Device
Network Adapter 1	Control
Network Adapter 2	Management
Network Adapter 3	Packet
SCSI Controller 0	LSI Logic
Hard Disk 1	Virtual Disk

Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4MB.

Memory for this virtual machine: 2048 MB

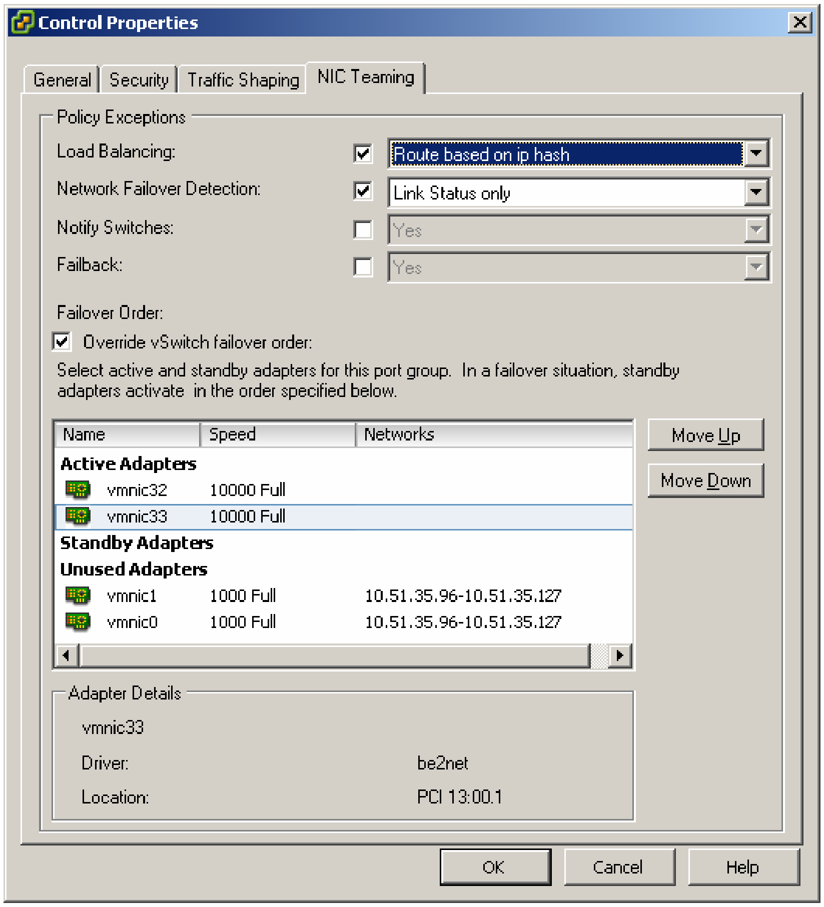
4 65532

To set the memory to one of the indicated values, you may click the colored triangle on the slider above or in the legend below.

△	Guest OS recommended minimum	32 MB
△	Recommended memory	256 MB
△	Guest OS recommended maximum	65532 MB
▲	Maximum for best performance	8188 MB

VMware's recommended maximum memory for any Linux guest OS is based on the least capable kernels for that Linux distribution and version number. Some kernel versions can support larger memory sizes. Consult your Linux release notes to see if your kernel can use a larger memory setting.

2. Network Adapter 2 uses the LOM vmnics in any of the possible NIC teaming configurations. Network Adapters 1 and 3 share the connectivity to the Cisco Nexus 5000 Series Switch (or the Cisco Nexus 2000 Series Fabric Extender) in vPC mode. Configure NIC teaming for Network Adapters 2 and 3 as shown here:



Policy Exceptions

Load Balancing: ☑ Route based on ip hash

Network Failover Detection: ☑ Link Status only

Notify Switches: ☐ Yes

Failback: ☐ Yes

Failover Order:

☑ Override vSwitch failover order:

Select active and standby adapters for this port group. In a failover situation, standby adapters activate in the order specified below.

Name	Speed	Networks
Active Adapters		
vmnic32	10000 Full	
vmnic33	10000 Full	
Standby Adapters		
Unused Adapters		
vmnic1	1000 Full	10.51.35.96-10.51.35.127
vmnic0	1000 Full	10.51.35.96-10.51.35.127

Adapter Details

vmnic33

Driver: be2net

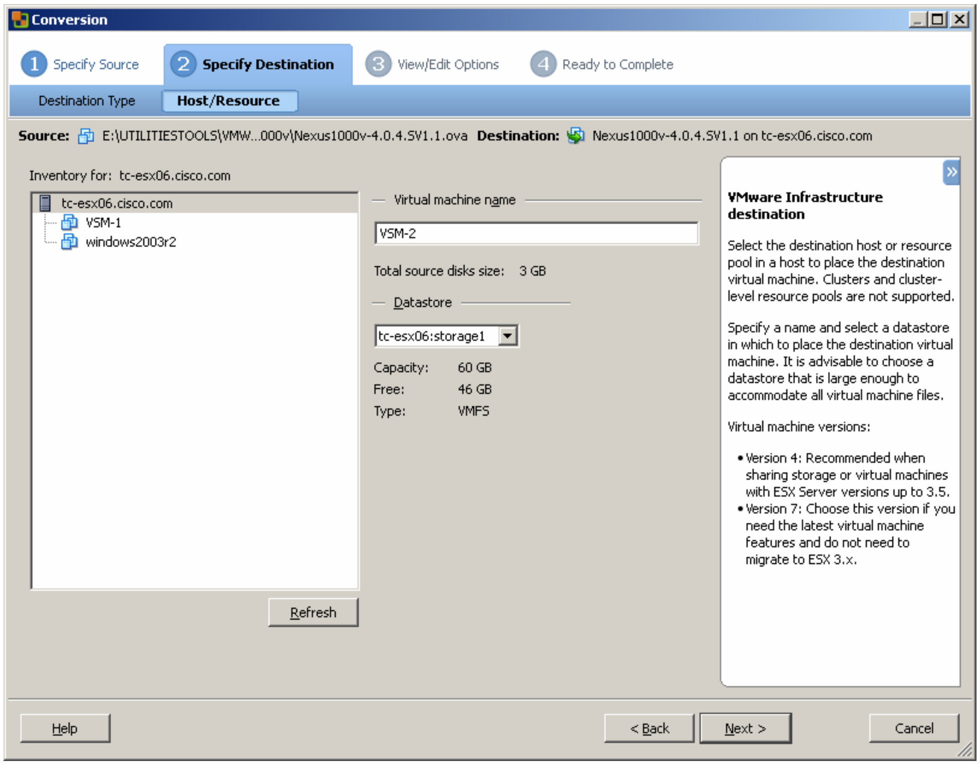
Location: PCI 13:00.1

Configure the associated interface on the Cisco Nexus 5000 Series Switch is as follows:

```
interface port-channel6
  switchport mode trunk
  switchport trunk allowed vlan 23-24
  vpc 6
  spanning-tree port type edge trunk
  speed 10000
```

Configuring Redundancy

1. Create an additional VSM by using VMware vCenter Converter with the Cisco Nexus 1000V Open Virtualization Format (OVF) or Open Virtualization Format Archive (OVA) file as shown here:



Source: E:\UTILITIESTOOLS\VMW...000v\Nexus1000v-4.0.4.SV1.1.ova Destination: Nexus1000v-4.0.4.SV1.1 on tc-esx06.cisco.com

Inventory for: tc-esx06.cisco.com

- tc-esx06.cisco.com
  - VSM-1
  - windows2003r2

Virtual machine name: VSM-2

Total source disks size: 3 GB

Datastore: tc-esx06:storage1

Capacity: 60 GB
Free: 46 GB
Type: VMFS

VMware Infrastructure destination

Select the destination host or resource pool in a host to place the destination virtual machine. Clusters and cluster-level resource pools are not supported.

Specify a name and select a datastore in which to place the destination virtual machine. It is advisable to choose a datastore that is large enough to accommodate all virtual machine files.

Virtual machine versions:

- Version 4: Recommended when sharing storage or virtual machines with ESX Server versions up to 3.5.
- Version 7: Choose this version if you need the latest virtual machine features and do not need to migrate to ESX 3.x.

2. When the VSM comes up, follow this procedure:

   a) Make the VSM standalone.

   b) Configure packet and control VLANs and the domain ID.

   c) Assign a management IP address to mgmt0 and assign mgmt0 to virtual route forwarding (VRF) management.

   d) Assign a default route to VRF context management.

   e) Verify that the VSM can communicate over the management network.

   f) Change the role to secondary.

   g) Verify that the network adapters of the redundant VSM are connected to the correct port groups

   h) Reload the VSM

The two VSMs should form an active-standby relationship.

Initial VSM and Cisco Nexus 1000V Configuration

1. Enter the following command to see the license information:

```
tc-nexus1kv04# show license host-id
```

2. Use the product authorization key (PAK) and the host ID to request a license from http://www.cisco.com/go/license/

```
install license bootflash:<licence file>

svs-domain
  domain id 1
  control vlan 23
  packet vlan 24
  svs mode L2
```

3. Make sure that the network adapters on the VSM are correctly assigned and that teaming is correctly configured. Give the VSM a mgmt0 IP address:

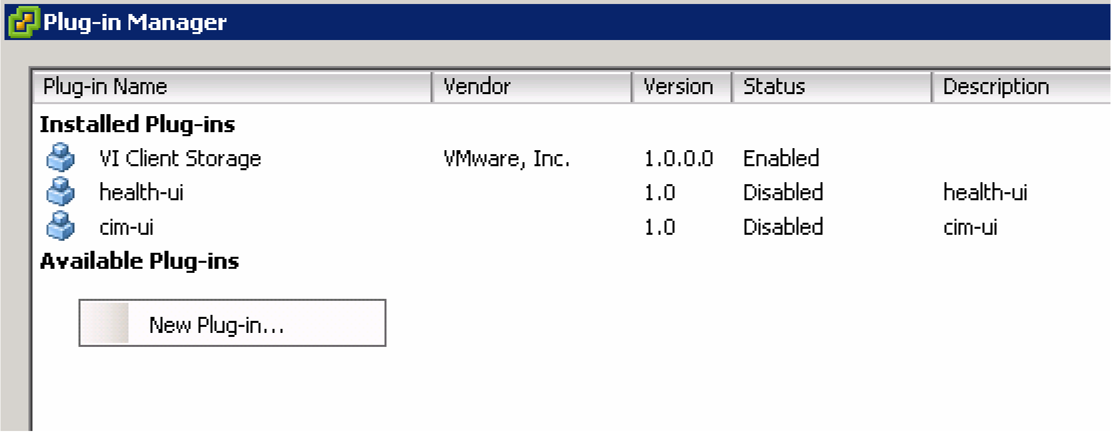
```
vrf context management
  ip route 0.0.0.0/0 10.51.35.97

interface mgmt0
  vrf member management
  ip address 10.51.35.114/27
```

4. For the VSM to talk to VMware vCenter, VMware vCenter needs information about the VSM credentials, so import the XML plug-in (extension.xml, which includes the keys needed to establish an SSL channel between the VSM and VMware vCenter). Each individual VSM needs its own extension.xml file (and associated extension key) for it to communicate with VMware vCenter. You can download the extension.xml from http://{VSM_IP_ADDR}/cisco_nexus_1000v_extension.xml.
5. To check the extension key from the Cisco Nexus 1000V VSM, enter the following command:

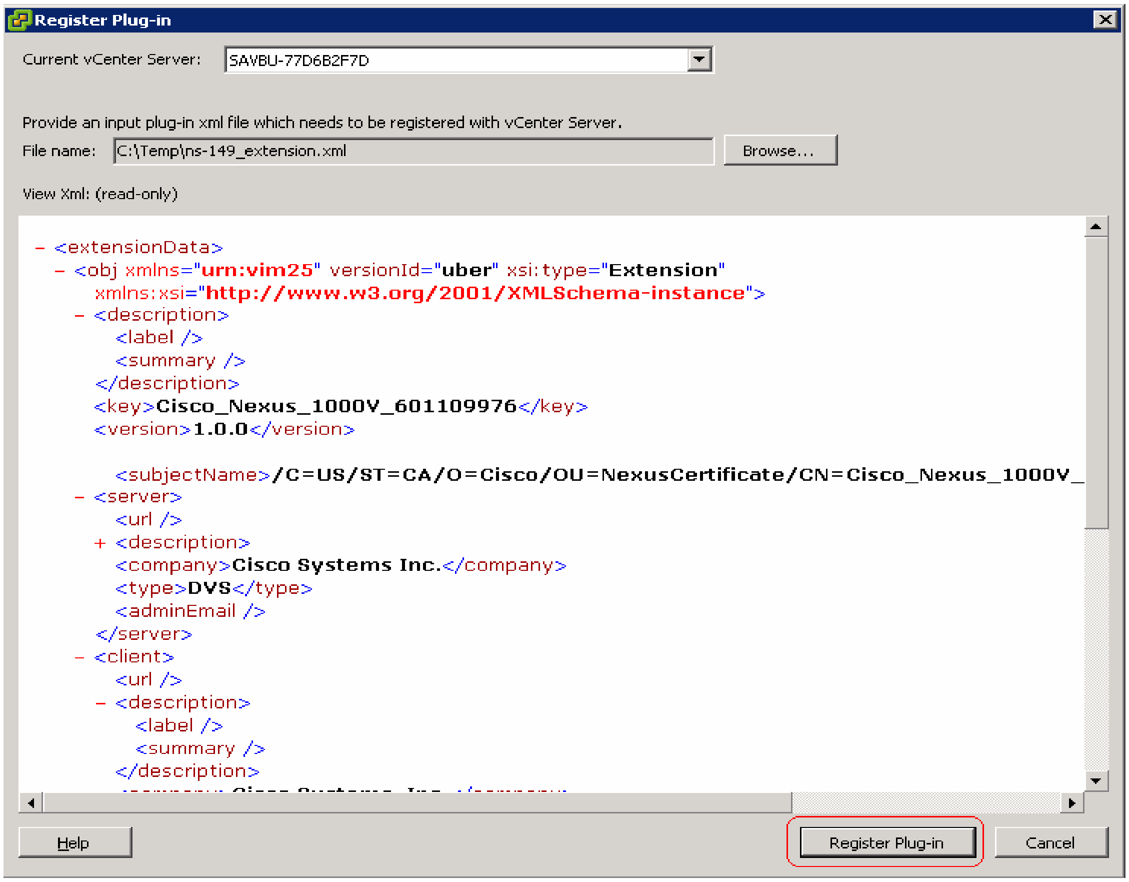
```
show vmware vc extension-key
```

6. Add the plug-in as shown here:



Plug-in Name	Vendor	Version	Status	Description
Installed Plug-ins				
VI Client Storage	VMware, Inc.	1.0.0.0	Enabled	
health-ui		1.0	Disabled	health-ui
cim-ui		1.0	Disabled	cim-ui
Available Plug-ins				

7. Register the plug-in as shown here:



Current vCenter Server: SAVBU-77D6B2F7D

Provide an input plug-in xml file which needs to be registered with vCenter Server.

File name: C:\Temp\ns-149_extension.xml

View Xml: (read-only)

```
- <extensionData>
  - <obj xmlns="urn:vim25" versionId="uber" xsi:type="Extension"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    - <description>
        <label />
        <summary />
      </description>
      <key>Cisco_Nexus_1000V_601109976</key>
      <version>1.0.0</version>

        <subjectName>/C=US/ST=CA/O=Cisco/OU=NexusCertificate/CN=Cisco_Nexus_1000V_
    - <server>
        <url />
      + <description>
        <company>Cisco Systems Inc.</company>
        <type>DVS</type>
        <adminEmail />
      </server>
    - <client>
        <url />
      - <description>
          <label />
          <summary />
        </description>
        <company>Cisco Systems Inc.</company>
```

8. Establish connectivity between the VSM and vCenter as follows

```
svs connection VC
protocol vmware-vim
vmware dvs <datacenter name>
  remote ip address 10.51.35.115 (ip address of vCenter server)
connect
```

Configuring the System Port Profile

1. Configure the system VLANs:

```
vlan 23
vlan 24
```

2. Configure the system uplink port profiles:

```
port-profile system-uplink
  capability uplink
  vmware port-group fabric_uplinks
  switchport mode trunk
  switchport trunk allowed vlan 23-24
  channel-group auto mode active
  no shutdown
  system vlan 23-24
  state enabled
```

3. Configure the Cisco Nexus 5000 and 2000 Series ports to carry the system VLANs as follows:

```
interface Ethernet <Nexus 5k or 2k interface connected to ESX host>
  description n5k-intf-to-esx
  switchport mode trunk
  switchport trunk allowed vlan add 23,24
  spanning-tree port type edge trunk
```

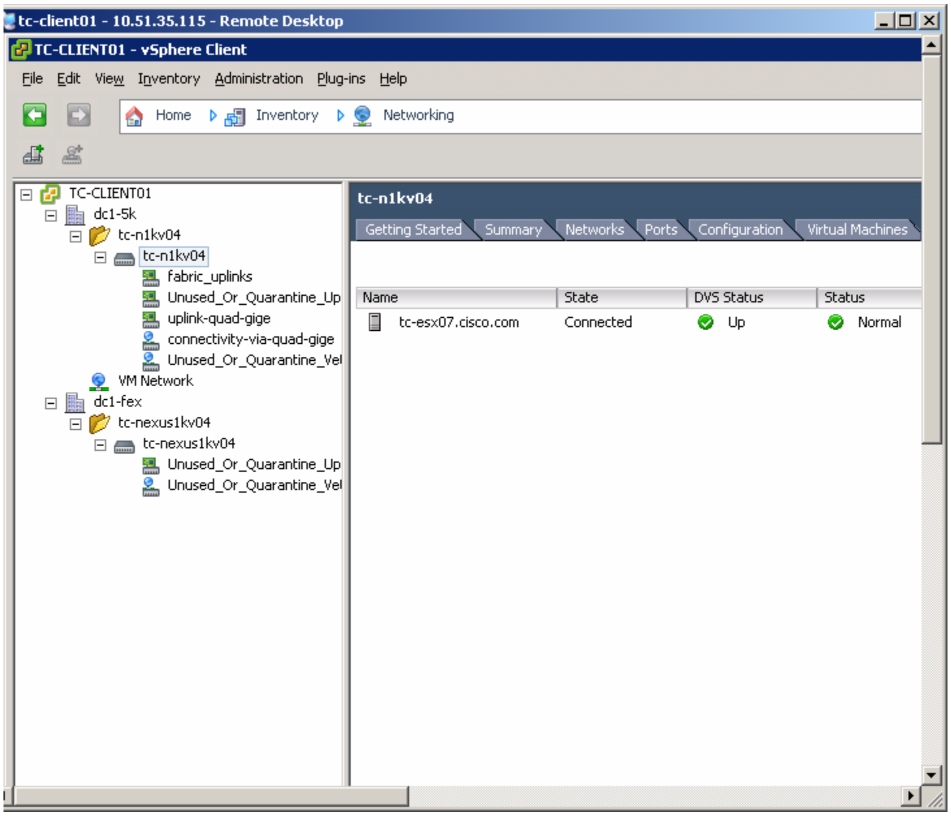
4. When the interfaces are configured for vPC, configure the PortChannel interface on both Cisco Nexus 5000 Series Switches.

Adding VMware ESX Hosts to the Cisco Nexus 1000V

1. Make sure that you have installed the VEM component on the VMware ESX host either by using VMware Update Manager or by manually copying the vib file (which you can download with your browser from the VSM):

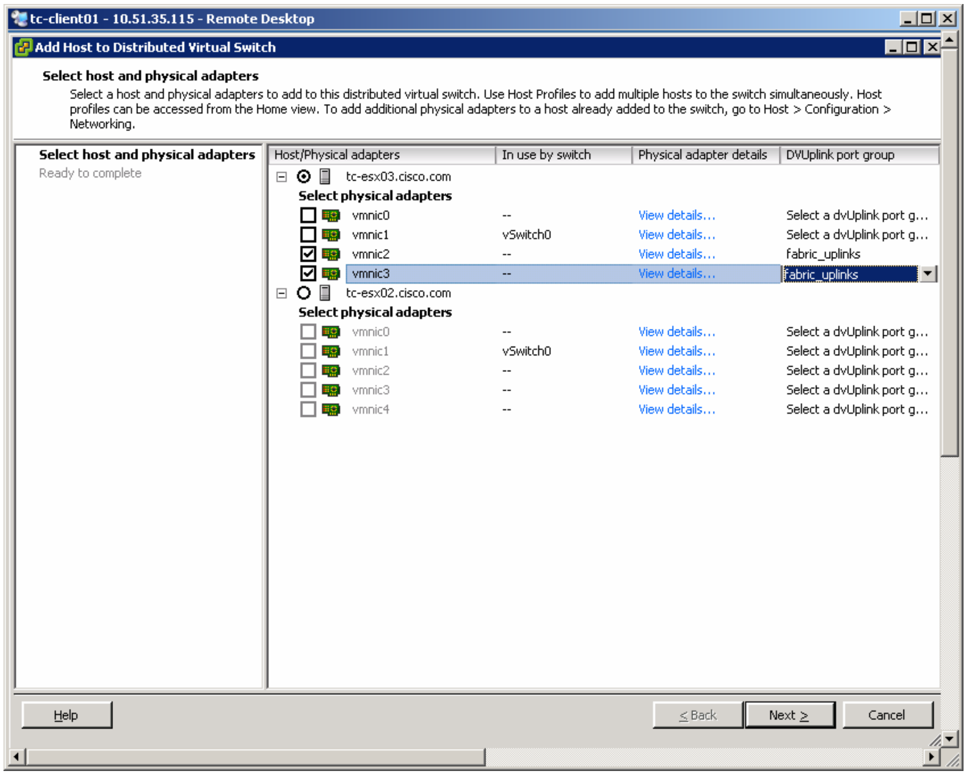
```
esxupdate -b ./cross_cisco-vem-v100-4.0.4.1.1.27-0.4.2-release.vib update
```

2. Add hosts to the Cisco Nexus 1000V from VMware vCenter as needed by right-clicking the vDS icon of the Cisco Nexus1000V (labeld tc-n1kv04 or tc-nexus1kv04) shown here (make sure the Cisco Nexus 1000V is selected):



Name	State	DVS Status	Status
tc-esx07.cisco.com	Connected	✓ Up	✓ Normal

3. Select the correct uplink port profile from the distributed virtual uplink port group tab as shown here:



tc-client01 - 10.51.35.115 - Remote Desktop

Add Host to Distributed Virtual Switch

Select host and physical adapters

Select a host and physical adapters to add to this distributed virtual switch. Use Host Profiles to add multiple hosts to the switch simultaneously. Host profiles can be accessed from the Home view. To add additional physical adapters to a host already added to the switch, go to Host > Configuration > Networking.

Select host and physical adapters
Ready to complete

Host/Physical adapters	In use by switch	Physical adapter details	DVUplink port group
⊟ ● tc-esx03.cisco.com			
Select physical adapters			
□ vmnic0	--	View details...	Select a dvUplink port g...
□ vmnic1	vSwitch0	View details...	Select a dvUplink port g...
☑ vmnic2	--	View details...	fabric_uplinks
☑ vmnic3	--	View details...	fabric_uplinks ▼
⊟ ○ tc-esx02.cisco.com			
Select physical adapters			
□ vmnic0	--	View details...	Select a dvUplink port g...
□ vmnic1	vSwitch0	View details...	Select a dvUplink port g...
□ vmnic2	--	View details...	Select a dvUplink port g...
□ vmnic3	--	View details...	Select a dvUplink port g...
□ vmnic4	--	View details...	Select a dvUplink port g...

Configuring Uplink Port Profiles

1. Configure the production VLANs:

```
vlan 50
vlan 60
```

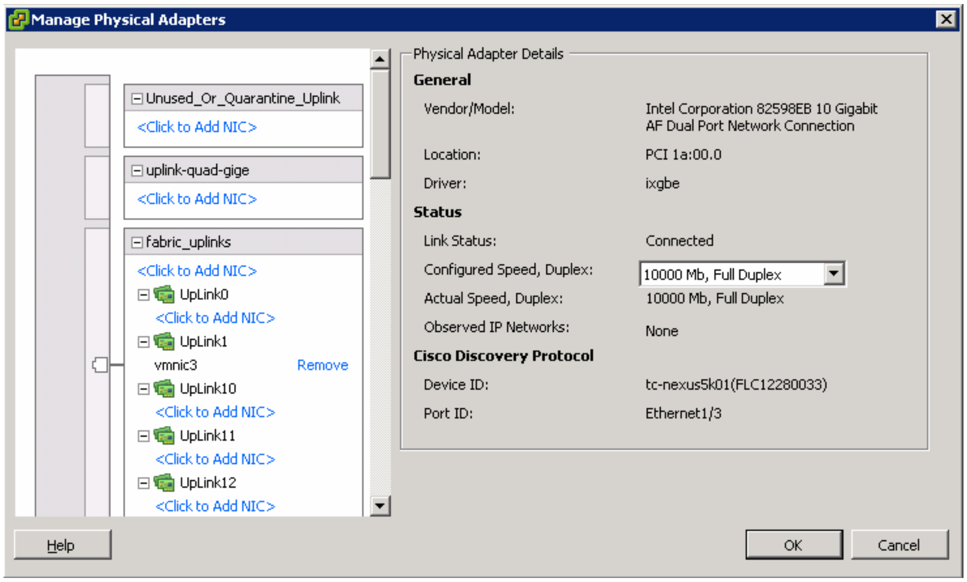
2. Configure the uplink port profiles by adding them to an existing system uplink port profile:

```
port-profile system-uplink
  switchport trunk allowed vlan add 50,60
```

3. You can also configure additional uplink port profiles all together and reassign physical interfaces as needed:

```
port-profile web-traffic-uplink
  capability uplink
  vmware port-group web-traffic
  switchport mode trunk
  switchport trunk allowed vlan 50,60
  channel-group auto mode active
  no shutdown
  state enabled
```

4. Reassign the physical NICs to the newly defined uplink port profile from VMware vCenter by selecting the VMware ESX host, selecting the **Configuration** tab and then **Manage Physical Adapters**. Here, you can remove a vmnic from an uplink port profile and move it to a different one, or you can add a vmnic to an uplink port profile as shown here:



⊟ Unused_Or_Quarantine_Uplink
<Click to Add NIC>
⊟ uplink-quad-gige
<Click to Add NIC>
⊟ fabric_uplinks
<Click to Add NIC>
⊟ UpLink0
<Click to Add NIC>
⊟ UpLink1
vmnic3 Remove
⊟ UpLink10
<Click to Add NIC>
⊟ UpLink11
<Click to Add NIC>
⊟ UpLink12
<Click to Add NIC>

Physical Adapter Details

General

Vendor/Model: Intel Corporation 82598EB 10 Gigabit AF Dual Port Network Connection
Location: PCI 1a:00.0
Driver: ixgbe

Status

Link Status: Connected
Configured Speed, Duplex: 10000 Mb, Full Duplex
Actual Speed, Duplex: 10000 Mb, Full Duplex
Observed IP Networks: None

Cisco Discovery Protocol

Device ID: tc-nexus5k01(FLC12280033)
Port ID: Ethernet1/3

5. If the upstream switches do not support PortChannels, you can change the port profile configuration as follows:

```
port-profile web-traffic-uplink
  capability uplink
  vmware port-group web-traffic
  switchport mode trunk
  switchport trunk allowed vlan 50,60
  channel-group auto mode on sub-group cdp
  no shutdown
  state enabled
```

6. Define the subgroups by entering the command **sub-group [0 | 1]** on a per-interface basis.

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