HP BladeSystem Reference Architecture:

Virtual Connect Flex-10 and VMware vSphere 4.0

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Executive Summary

HP is revolutionizing the way IT thinks about networking and server management. When combined with Virtual Connect, the BladeSystem architecture streamlines the typical change processes for provisioning in the datacenter.

The HP ProLiant BladeSystem Generation 6 servers with Virtual Connect Flex-10 flexible networking adapters are a beneficial platform for VMware vSphere infrastructure. These servers include virtualization friendly features such as large memory capacity, dense population, room for additional mezzanine cards and 8 - 24 (with Intel Hyper-Threading technology enabled) processing cores. The following ProLiant BL Servers ship standard with a pair of Virtual Connect Flex-10 network adapters (NC532i):

- BL495 G5/G6
- BL460 G6
- BL490 G6
- BL685 G6

Virtual Connect Flex-10 is the world's first technology to divide and fine-tune 10Gb Ethernet network bandwidth at the server edge. It carves the capacity of a 10Gb Ethernet connection into four discrete NIC ports, called FlexNICs, and adds the unique ability to fine-tune each connection to adapt to your virtual server channels and workloads on-the-fly. The effect of using Flex-10 is a dramatic reduction in the number of interconnect modules required to uplink outside of the enclosure, while still maintaining full redundancy across the service console, VMkernel and virtual machine (VM) networks. This translates to a lower cost infrastructure with fewer management points and cables that can still achieve a per server increase in bandwidth.

When designing a vSphere Network infrastructure with Virtual Connect Flex-10, there are two frequent network architectures customers choose. This document describes how to design highly available Virtual Connect Flex-10 strategy with:

- **Virtual Connect Managed VLANs** - In this design, we are maximizing the management features of Virtual Connect, while providing customers with the flexibility to provide "any networking to any host" within the Virtual Connect domain. Simply put, this design will not over-provision servers, while keeping the number of uplinks used to a minimum. This helps reduce infrastructure cost and complexity by trunking the necessary VLANs (IP Subnets) to the Virtual Connect domain, and minimizing potentially expensive 10Gb uplink ports.
- **Virtual Connect Pass-through VLANs** - This design addresses customer requirements to support a significant number of VLANs for Virtual Machine traffic. The previous design has a limited number of VLANs it can support. While providing similar server profile network connection assignments as the previous design, more uplink ports are required, and VLAN Tunneling must be enabled within the Virtual Connect domain.

Both designs provide highly available network architecture, and also take into account enclosure level redundancy and vSphere cluster design. By spreading the cluster scheme across both enclosures, each can provide local HA in case of network and enclosure failure.

Finally, this document will provide a key design best practice for vSphere 4 network architecture with Virtual Connect Flex-10, including:

- Local vSwitch design for VMkernel functions
- vDS design for Virtual Machine networking
- vSwitch and dvPortGroup load balance algorithms

Designing an HP Virtual Connect Flex-10 Architecture for VMware vSphere

In this section, we will discuss two different and viable strategies for customers to choose from. Both provide flexible connectivity for hypervisor environments. We will provide the pros and cons to each approach, and provide you with the general steps to configure the environment.

Designing a Highly Available Flex-10 Network Strategy with Virtual Connect Managed VLANs

In this design, two HP ProLiant c-Class 7000 Enclosures with Virtual Connect Flex-10 modules are stacked to form a single Virtual Connect management domain[1]. By stacking Virtual Connect Ethernet modules, customer can realize the following benefits:

- Management control plane consolidated
- More efficient use of WWID, MAC and Serial Number Pools
- Provide greater uplink port flexibility and bandwidth
- Profile management across stacked enclosures

Shared Uplink Sets provide administrators the ability to distribute VLANs into discrete and defined Ethernet Networks (vNet.) These vNets can then be mapped logically to a Server Profile Network Connection allowing only the required VLANs to be associated with the specific server NIC port. This also allows customers the flexibility to have various network connections for different physical Operating System instances (i.e. VMware ESX host and physical Windows host.)

As of Virtual Connect Firmware 2.30 release, the following Shared Uplink Set rules apply per domain:

- 320 Unique VLANs per Virtual Connect Ethernet module
- 128 Unique VLANs per Shared Uplink Set
- 28 Unique Server Mapped VLANs per Server Profile Network Connection
- Every VLAN on every uplink counts towards the 320-VLAN limit. If a Shared Uplink Set is comprised of multiple uplinks, each VLAN on that Shared Uplink Set is counted multiple times.

By providing two stacked Enclosures, this will allow for not only Virtual Connect Ethernet module failure, but also Enclosure failure. The uplink ports assigned to each Shared Uplink Set (SUS) were vertically offset to allow for horizontal redundancy purposes, as shown in Figure 1-2.

The IP Storage vNet (NFS and/or iSCSI) has been designed for dedicated access. This design approach provides administrators to dedicate a network (physically switched, directly connected or logical within a Shared Uplink Set) to provide access to IP-based storage arrays. Directly connecting an IP-based Storage array has certain limitations:

- Each storage array front-end port will require a unique vNet
- Each defined vNet will require separate server network connections
- You are limited to the number of IP-based arrays based on the number of unassigned uplink ports

[1] Only available with Virtual Connect Manager Firmware 2.10 or greater. Please review the Virtual Connect Manager Release Notes for more information regarding domain stacking requirements: http://h18004.www1.hp.com/products/blades/components/c-class-tech-installing.html

Virtual Connect has the capability to create an internal, private network without uplink ports, by using the low latency mid-plane connections to facilitate communication. This vNet can be used for cluster heartbeat networks, or in this case VMotion and/or Fault Tolerance traffic. Traffic will not pass to the upstream switch infrastructure, which will eliminate the bandwidth otherwise consumed.

Figure 1-1: Logical design

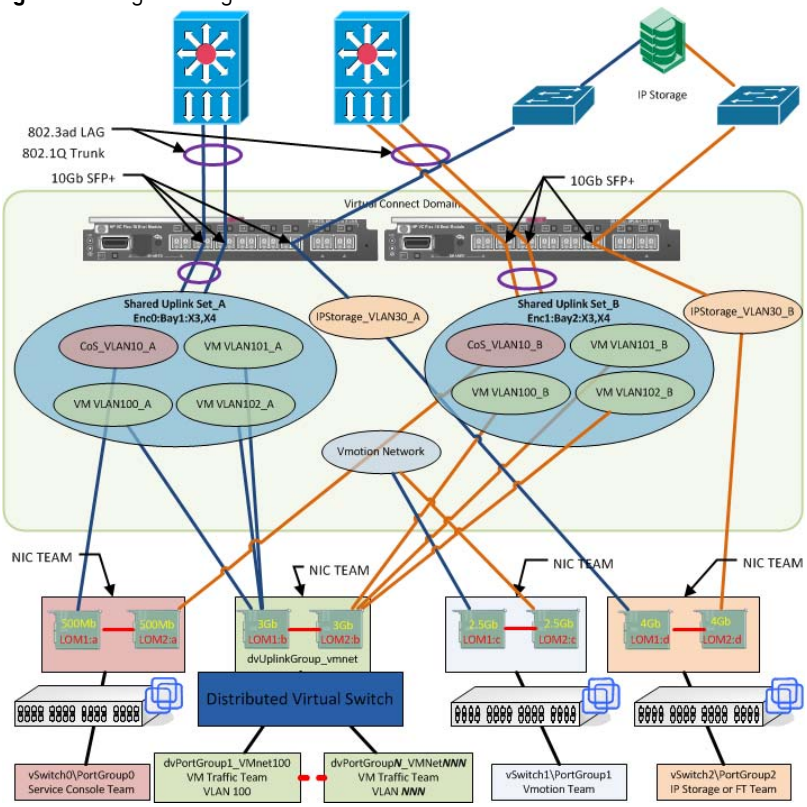


Figure 1-2: Physical design

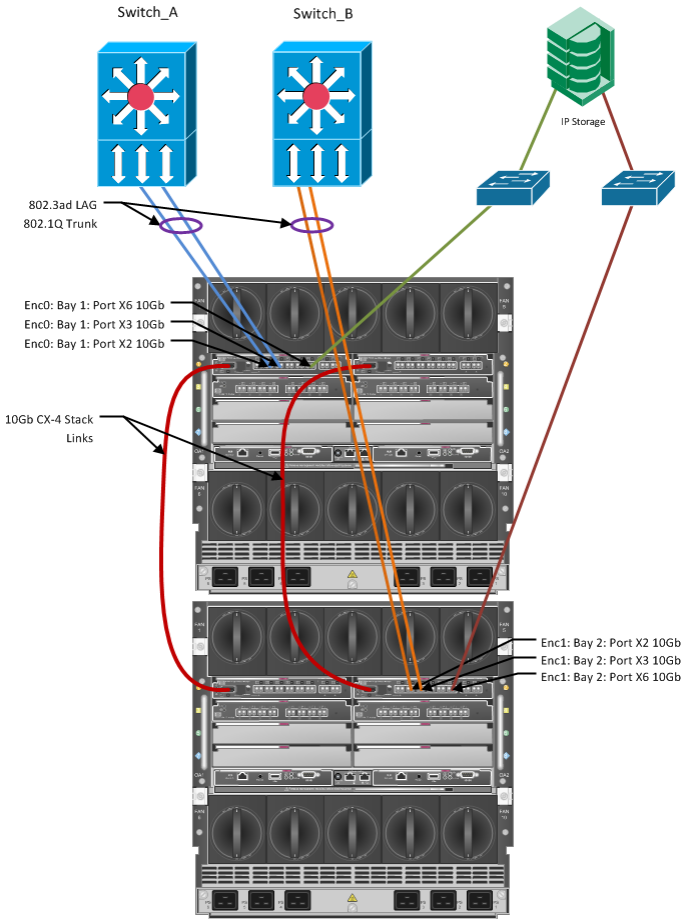
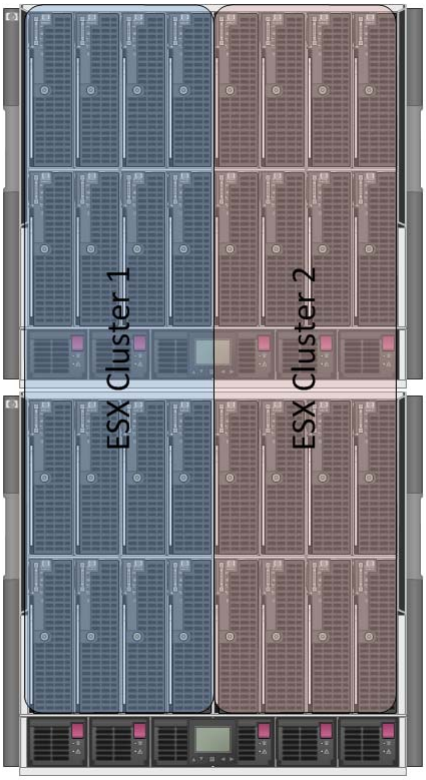


Figure 1-3: Physical VMware vSphere Cluster Design

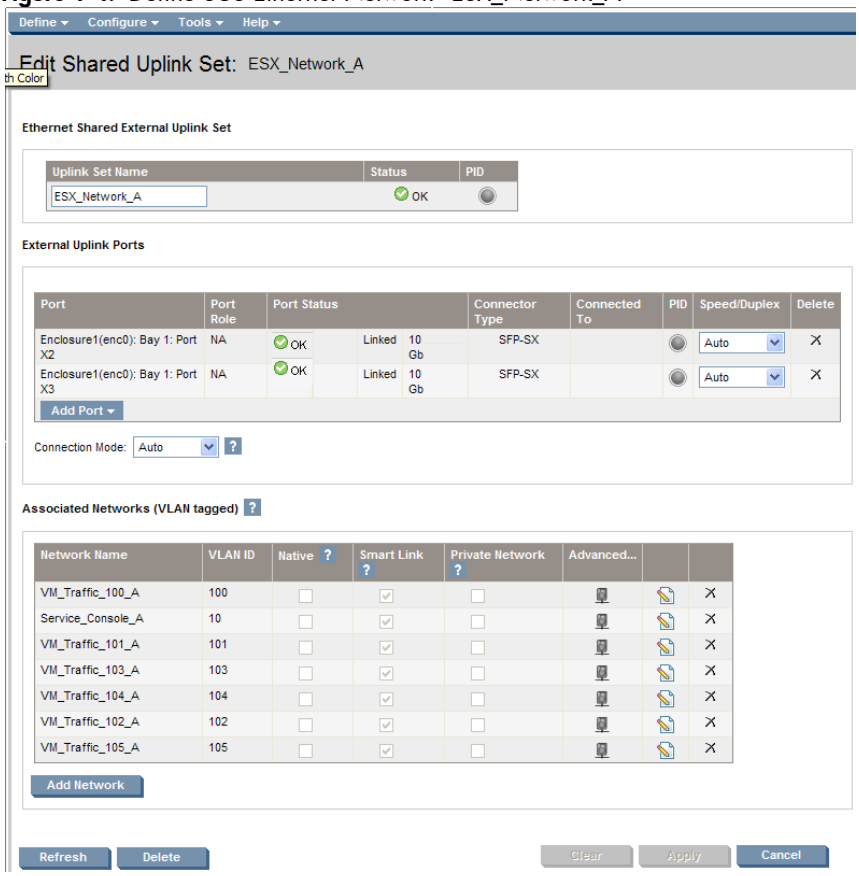


Configuring the VC-Enet module

The following steps assume the Virtual Connect Domain has been created, the appropriate user accounts or role-based access has been provisioned, and hardware address management scheme has been chosen (i.e. VC managed pools or factory default addresses.)

1. Connect the assigned uplink ports on the VC-Flex10 module to the upstream switch
2. From the Ethernet Networks View, Select *Define* then *Shared Uplink Set.* Use "ESX_Network_A" as the SUS Name. Select *Add Network* then create a name and VLAN ID for each VLAN tag configured to pass over the uplink ports. Create the network labels and VLAN associations as shown in Figure 1-4. Assign uplink ports "Enc0: Bay 1: Port X2" and "Enc0: Bay 1: Port X3" to the Shared Uplink Set.
    a. By adding multiple uplink ports from the same I/O module, and the *Connection Mode* is set to *Auto*, Virtual Connect will attempt to form a LACP (802.3ad) Link Aggregate Group (LAG.) A LAG cannot span multiple Virtual Connect modules. Changing the *Connection Mode* to *Failover* will prohibit Virtual Connect from forming a LAG. The upstream switch must have its 802.3ad configuration mode set to On.
    b. To verify Virtual Connect has formed an LACP LAG, navigate to *Interconnect Bays* and select the I/O bay where the uplink ports are linked. Locate the *LAG ID* column, and that the assigned uplink ports share the same LAG ID. If not, please verify the upstream switch configuration. Repeat for any additional uplink ports.

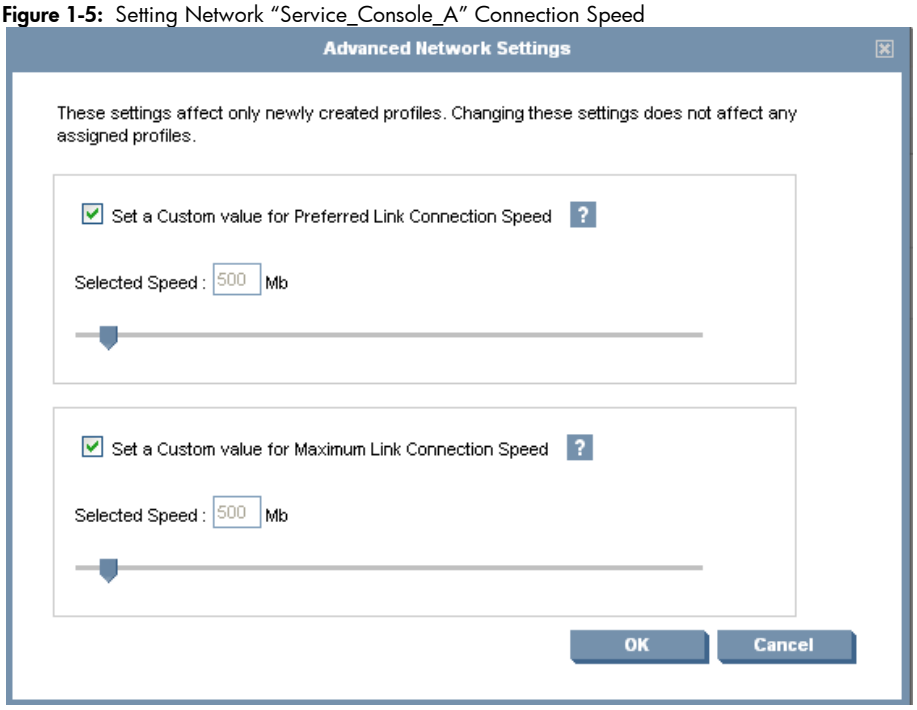
Figure 1-4: Define SUS Ethernet Network "ESX_Network_A"



By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

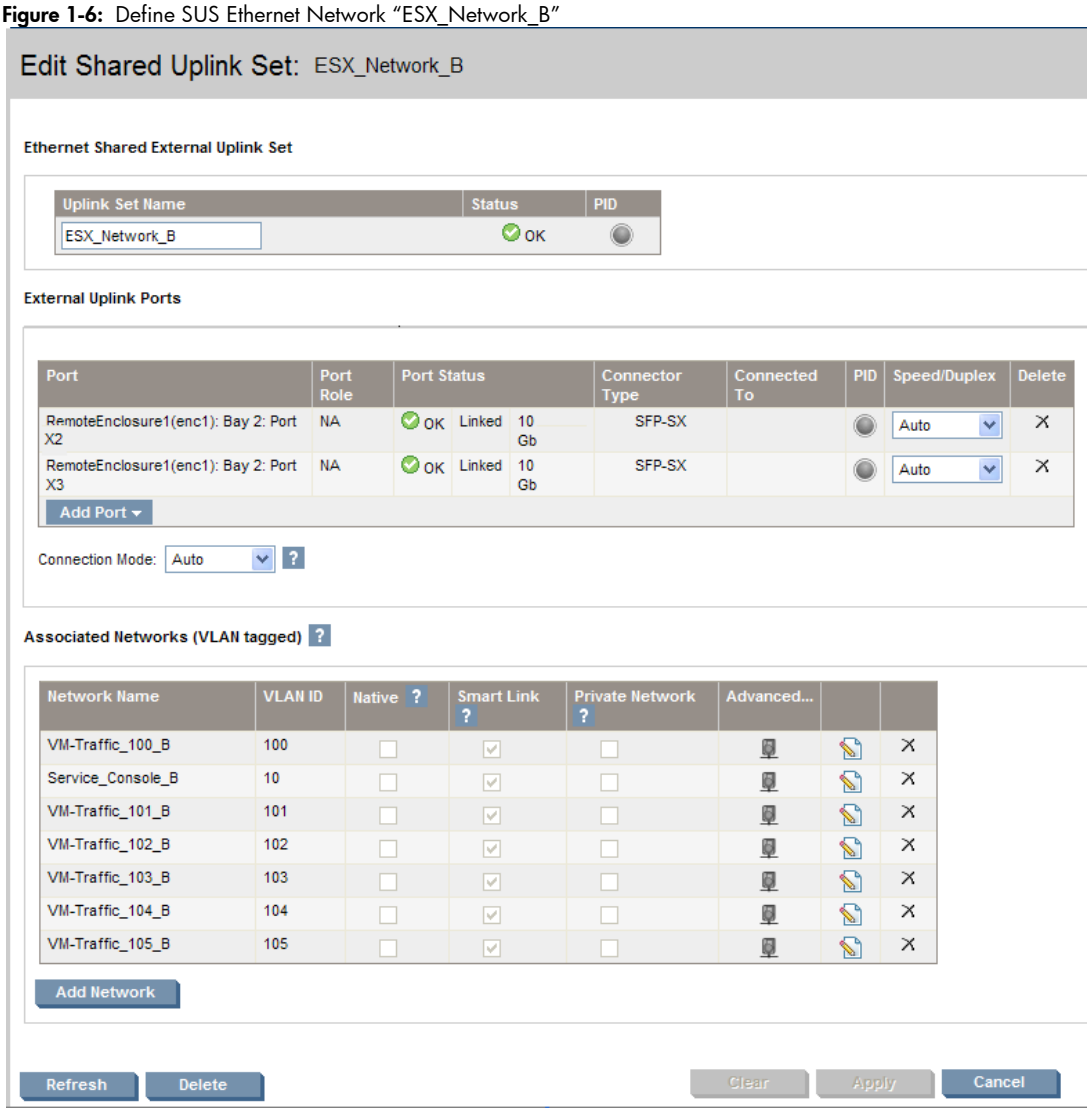
Set the Service Console network to 500Mb Preferred and Max, as demonstrated in Figure 1-5. Set all VM-Traffic networks to 3Gb Preferred and Max.

Figure 1-5: Setting Network "Service_Console_A" Connection Speed



3. Click OK to apply the link connection speed settings.
4. From the Ethernet Networks View, Select *Define* then *Shared Uplink Set.* Use "ESX_Network_B" as the SUS Name. Select *Add Network* then create a name and VLAN ID for each VLAN tag configured to pass over the uplink ports. Create the network labels and VLAN associations as shown in Figure 1-6. Assign uplink ports "Enc1: Bay 2: Port X2" and "Enc1: Bay 2: Port X3" to the Shared Uplink Set.
    a. By adding multiple uplink ports from the same I/O module, and the *Connection Mode* is set to *Auto*, Virtual Connect will attempt to form a LACP (802.3ad) Link Aggregate Group (LAG.) A LAG cannot span multiple Virtual Connect modules. Changing the *Connection Mode* to *Failover* will prohibit Virtual Connect from forming a LAG. The upstream switch must be configured for 802.3ad LACP negotiation.
    b. To verify Virtual Connect has formed an LACP LAG, navigate to *Interconnect Bays* and select the I/O bay where the uplink ports are linked. Locate the *LAG ID* column, and that the assigned uplink ports share the same LAG ID. If not, please verify the upstream switch configuration. Repeat for any additional uplink ports.

Figure 1-6: Define SUS Ethernet Network "ESX_Network_B"

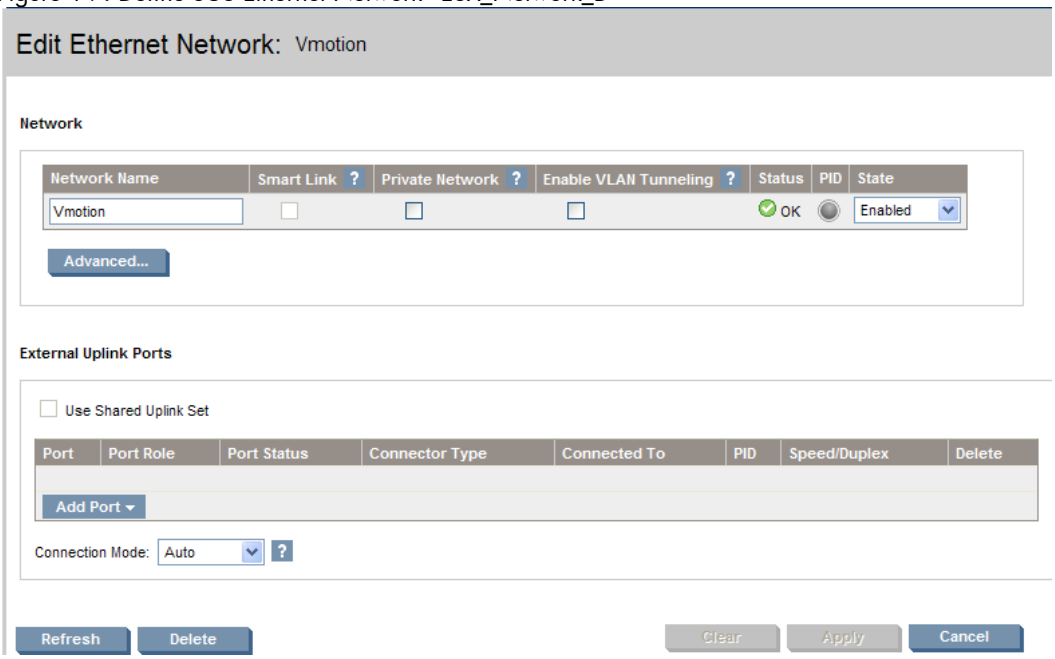


By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

Set the Service Console network to 500Mb Preferred and Max, and all VM-Traffic networks to 3Gb Preferred and Max.

5. From the Ethernet Networks View, Select *Define* then *Ethernet Network*
6. Provide the Network Label "VMOTION " as shown in Figure 1-7. You will not assign an uplink port.

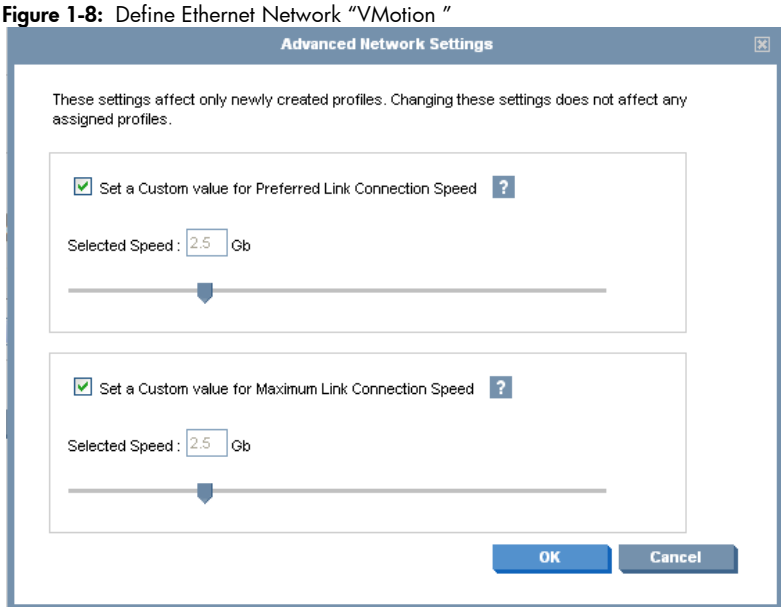
Figure 1-7: Define SUS Ethernet Network "ESX_Network_B"



7. By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

   Set VMotion network to 2.5Gb Preferred and Max.

Figure 1-8: Define Ethernet Network "VMotion "

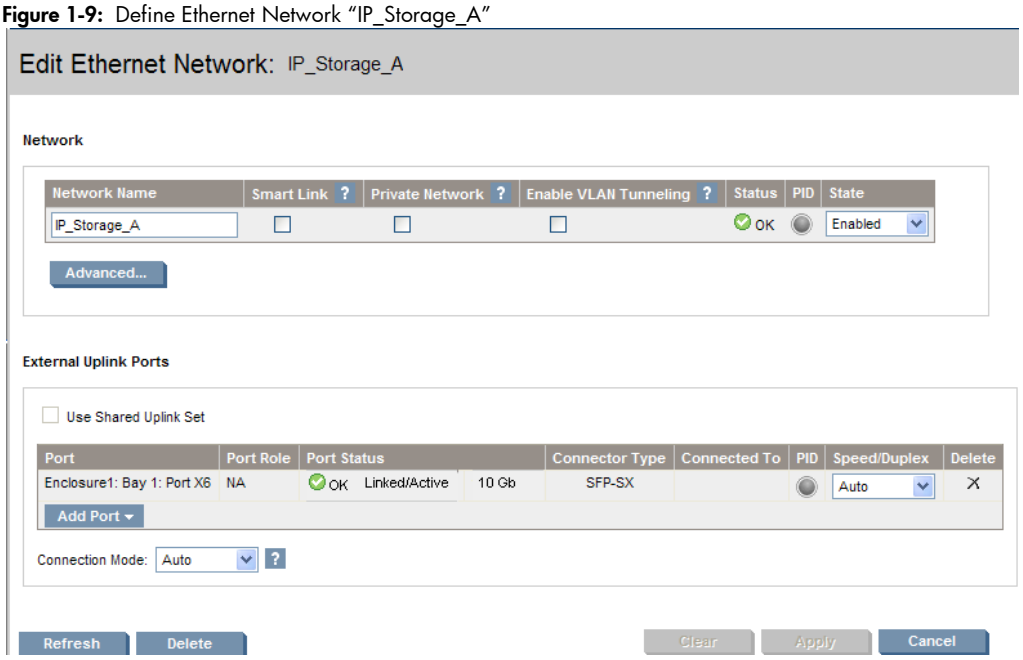


8. Click Apply to create the new VNet.
9. Create a Virtual Connect Network "IP_Storage_A", and select the uplink ports by selecting the *Add Port* menu selecting Enc0: Bay 1: Port X6, as shown in Figure 1-9.

   By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

   Set IP_Storage_A network to 4Gb Preferred and Max.

Figure 1-9: Define Ethernet Network "IP_Storage_A"



10. Click Apply to create the new VNet.
11. Create a Virtual Connect Network "IP_Storage_B", and select the uplink ports by selecting the *Add Port* menu selecting Enc1: Bay 2: Port X6.

    By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

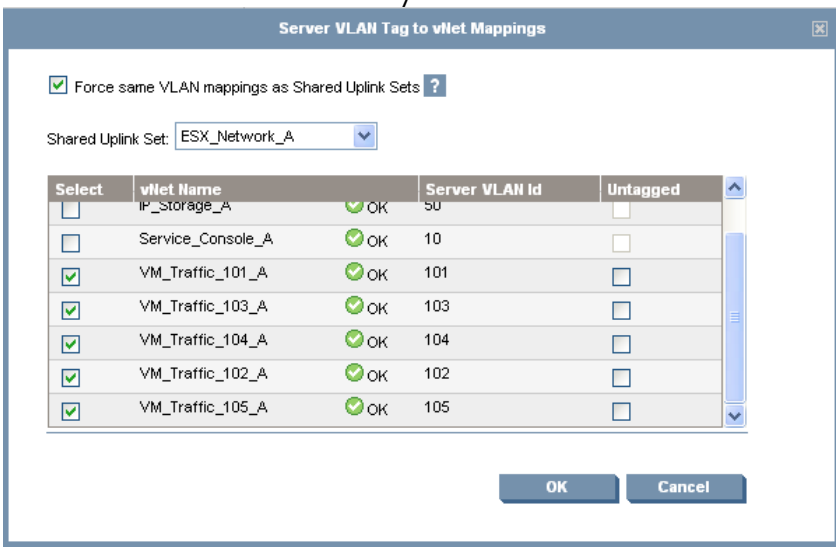
    Set IP_Storage_B network to 4Gb Preferred and Max.
12. Click Apply to create the new VNet.

Defining a Server Profile

We will create a server profile with 8 server NICs that will be visible to the operating system. Each server NIC will connect to a specific network. The server profiles will have VC managed addresses.

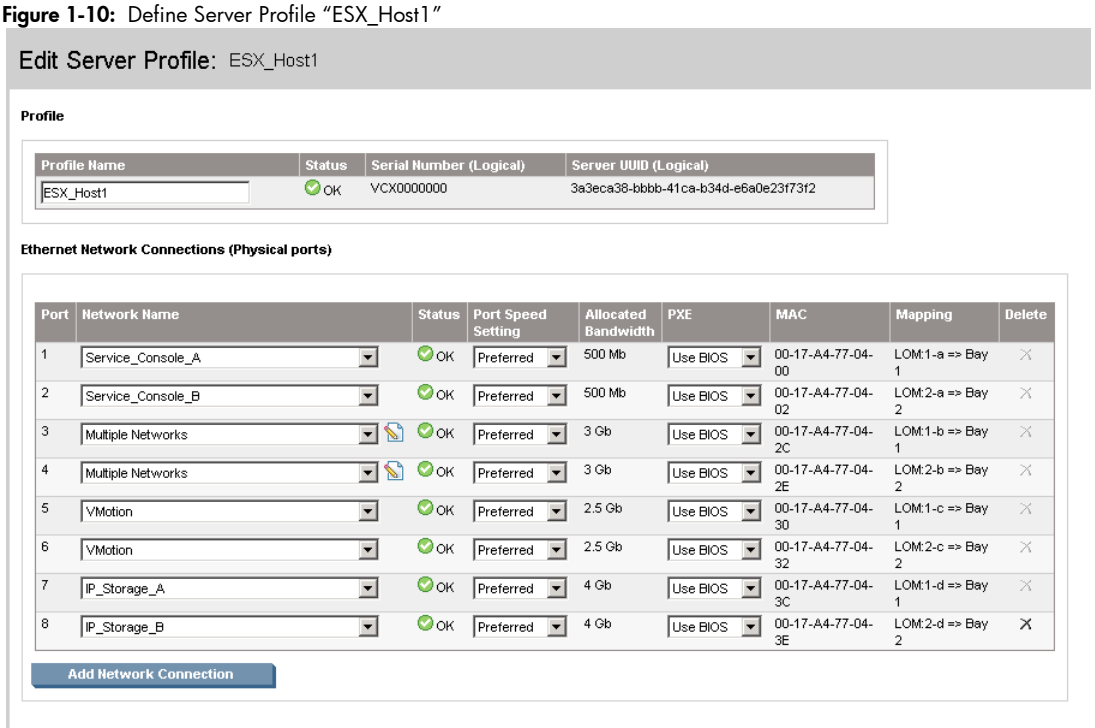
1. On the main menu Server Box, select *Define Server Profile*
2. Create a server profile called "ESX_Host1"
3. Add a network connection 6 times, for a total of 8 Network Connections, as shown in Figure 1-10.
4. In the Network Port 1 drop down box, select Service_Console_A
5. In the Network Port 2 drop down box, select Service_Console_B
6. In the Network Port 3 drop down box, select Multiple Networks
    a. From the server to vlan mapping table that comes up, select the button *Force same vlan mappings as Shared Uplink Set*
    b. The Shared Uplink Set drop down select *ESX_Network_A*

c. Select all the VM Network VLANS you want this NIC to receive



7. In the Network Port 4 drop down box, select Multiple Networks,
   a. From the server to VLAN mapping table that comes up, select the button *Force same VLAN mappings as Shared Uplink Set*
   b. The Shared Uplink Set drop down select *ESX_Network_B*
   c. Select all the VM Network VLANS you want this NIC to receive
8. In the Network Port 5 drop down box, select VMotion
9. In the Network Port 6 drop down box, select VMotion
10. In the Network Port 7 drop down box, select IP_Storage_A
11. In the Network Port 8 drop down box, select IP_Storage_B
12. In the Assign Profile to Server Bay box, locate the Select Location drop down and select Bay 1, then apply

Figure 1-10: Define Server Profile "ESX_Host1"



You should now have a server profile assigned to Enc0: Bay1, with 8 Server NIC connections. NICs 1 and 2 should be assigned to the Service Console, and NICs 3 and 4 should be assigned to the VM-

Network network, NICs 5 and 6 assigned to the VMotion network and NICs 7 and 8 assigned to the IP Storage network.

To ease the creation of the second profile, you can simply copy an existing server profile, provide a name and assign it to a server bay or use the "Network Profile Wizard" this will allow you to create a template and create more than one profile at a time.

Designing a Highly Available Flex-10 Network Strategy with Pass-through VLANs

In this design, two HP ProLiant c-Class 7000 Enclosure with Virtual Connect Flex-10 modules are stacked to form a single Virtual Connect management domain[2]. By stacking Virtual Connect Ethernet modules, customer can realize the following benefits:

- Management control plane consolidated
- More efficient use of WWID, MAC and Serial Number Pools
- Provide greater uplink port flexibility and bandwidth
- Profile management across stacked enclosures

This design does not take into account for other physical server instances (i.e. Windows Server.) If the design requires support for multiple types of physical OS instances, where the non-hypervisor hosts require access to a specific VLAN, additional uplink ports will be required. This will add additional cost and administrative overhead to the overall design.

This design also does not take into account where multiple hypervisor hosts will require different Virtual Machine networking. If there is a prerequisite to support this, additional uplink ports will be necessary to tunnel the specific VLAN(s).

By providing two stacked Enclosure, this will allow for not only Virtual Connect Ethernet module failure, but also Enclosure failure. The uplink ports assigned to each vNet were offset to allow for horizontal redundancy purposes. To reduce SFP and upstream port cost, a 1Gb SFP transceiver would be used to provide Service Console networking.

The IP Storage vNet (NFS and/or iSCSI) has been designed for dedicated access. This design approach provides administrators to dedicate a network (physically switched or directly connected) to provide access to IP-based storage arrays. Directly connecting an IP-based Storage array has certain limitations:

- Each storage array front-end port will require a unique vNet
- Each defined vNet will require separate server network connections
- You are limited to the number of IP-based arrays based on the number of unassigned uplink ports

Virtual Connect has the capability to create an internal, private network without uplink ports, by using the low latency mid-plane connections to facilitate communication. This vNet can be used for cluster heartbeat networks, or in this case VMotion and/or Fault Tolerance traffic. Traffic will not pass to the upstream switch infrastructure, which will eliminate the bandwidth otherwise consumed.

[2] Only available with Virtual Connect Manager Firmware 2.10 or greater. Please review the Virtual Connect Manager Release Notes for more information regarding domain stacking requirements: http://h18004.www1.hp.com/products/blades/components/c-class-tech-installing.html

Figure 1-11: Logical design

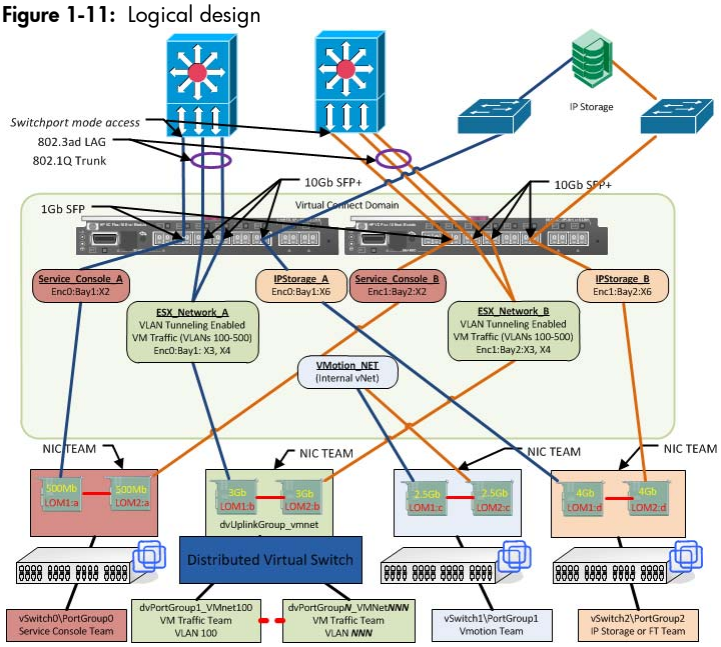


Figure 1-12: Physical design

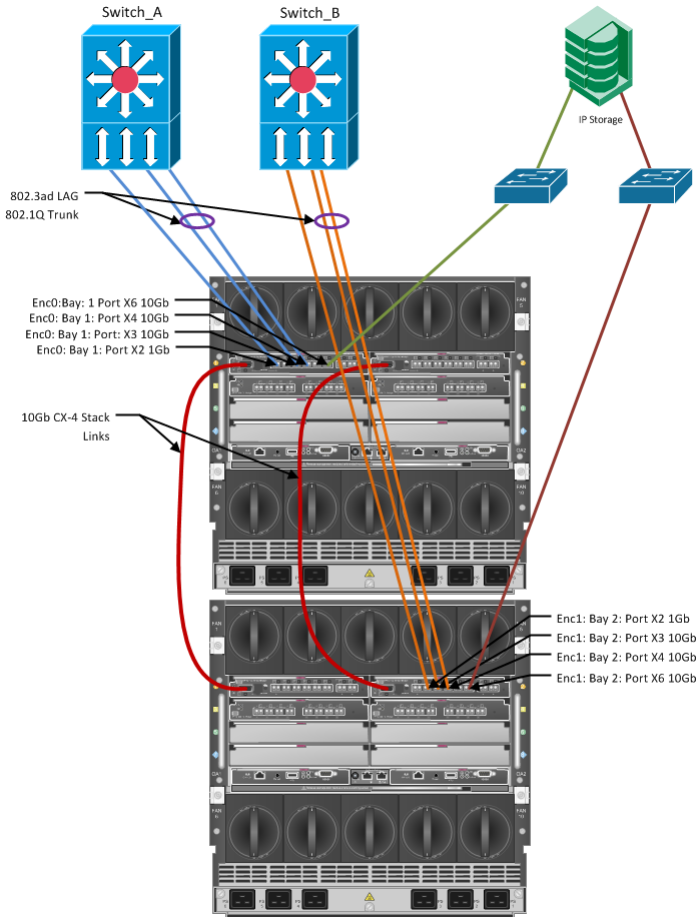
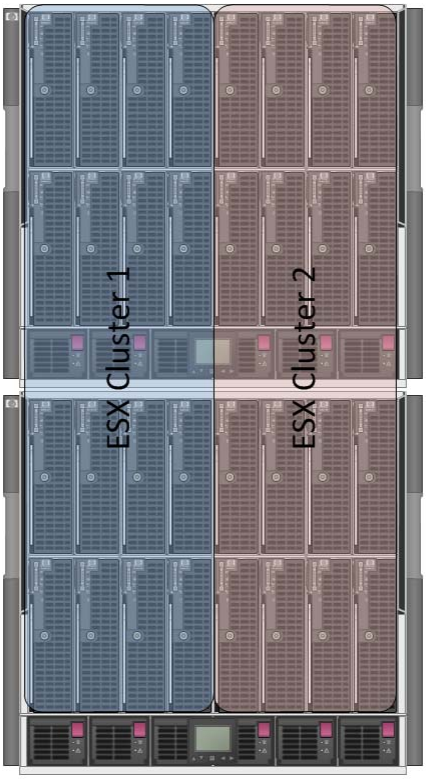


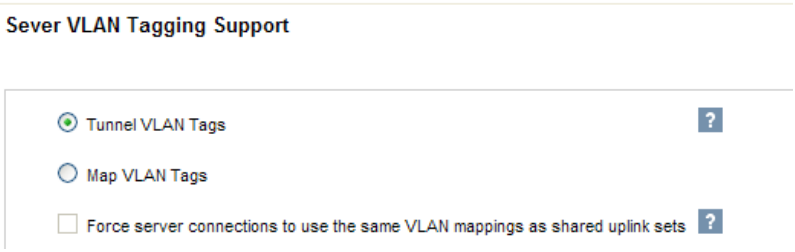
Figure 1-13: Physical VMware vSphere Cluster Design



Configuring the VC-Enet module

The following steps assume the Virtual Connect Domain has been created, the appropriate user accounts or role-based access has been provisioned, and hardware address management scheme has been chosen (i.e. VC managed pools or factory default addresses.)

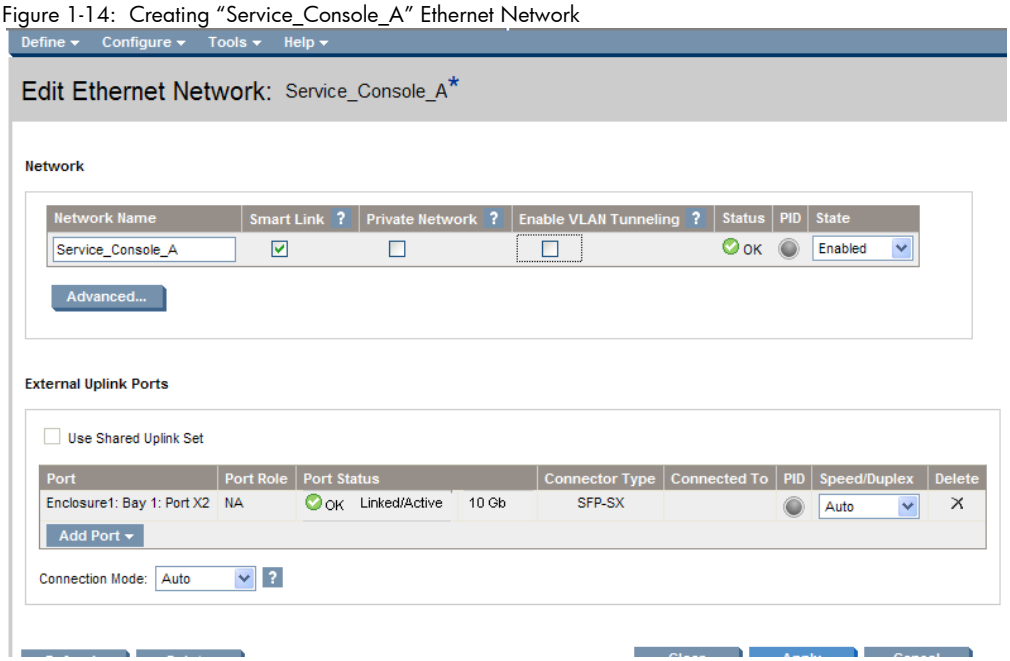
1. When Creating the VC Domain, Configure the VC Ethernet network as Tunnel VLAN Tags



NOTE: Enabling VLAN Tunneling within Virtual Connect disables the ability to use the Server Mapped VLANs feature.

2. Connect the assigned uplink ports on the VC-Flex10 module to the upstream switch
3. Create one VC-Enet network using Virtual Connect uplink Enc0: Bay1: Port X2 with a 1Gb SFP. For this scenario, the network name created will be "Service_Console_A".
4. Select *Define* then *Ethernet Network*
5. Provide the Network Label "Service_Console_A" and select the uplink ports by selecting the *Add Port* menu as shown in Figure 1-14.

Figure 1-14: Creating "Service_Console_A" Ethernet Network



By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

Set the Service_Console_A network to 500Mb Preferred and Max.

6. Click Apply to create the new VNet.

7. Repeat Steps 4 and 5 for "Service_Console_B" vNet, and assign Enc1: Bay 2: Port X2 as the uplink port.
8. Select *Define* then *Ethernet Network*
9. Create a Virtual Connect Network "ESX_Network_A", enable the *Enable VLAN Tunneling* option, and select the uplink ports by selecting the *Add Port* menu selecting Enc0:Bay1:X3 and X4 as shown in Figure 1-15.

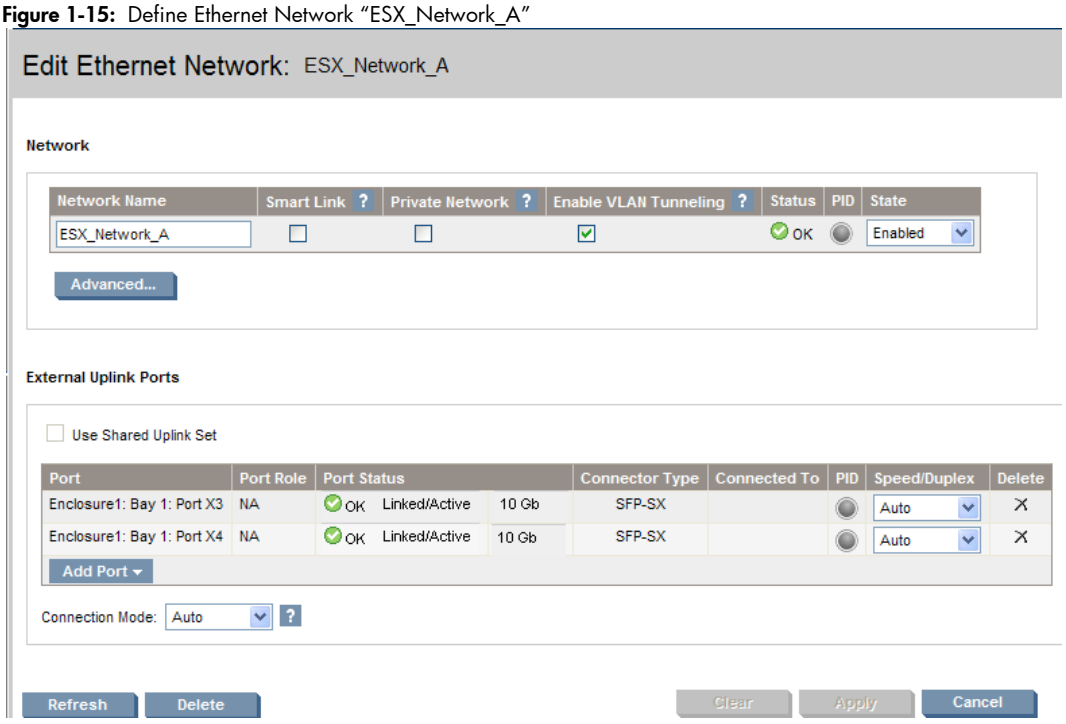
    a. By adding multiple uplink ports from the same I/O module, and the *Connection Mode* is set to *Auto*, Virtual Connect will attempt to form a LACP (802.3ad) Link Aggregate Group (LAG.) A LAG cannot span multiple Virtual Connect modules. Changing the *Connection Mode* to *Failover* will prohibit Virtual Connect from forming a LAG. The upstream switch must have its 802.3ad configuration mode set to On.

    b. To verify Virtual Connect has formed an LACP LAG, navigate to *Interconnect Bays* and select the I/O bay where the uplink ports are linked. Locate the *LAG ID* column, and that the assigned uplink ports share the same LAG ID. If not, please verify the upstream switch configuration. Repeat for any additional uplink ports.

By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

Set the ESX_Network_A network to 3Gb Preferred and Max.

Figure 1-15: Define Ethernet Network "ESX_Network_A"



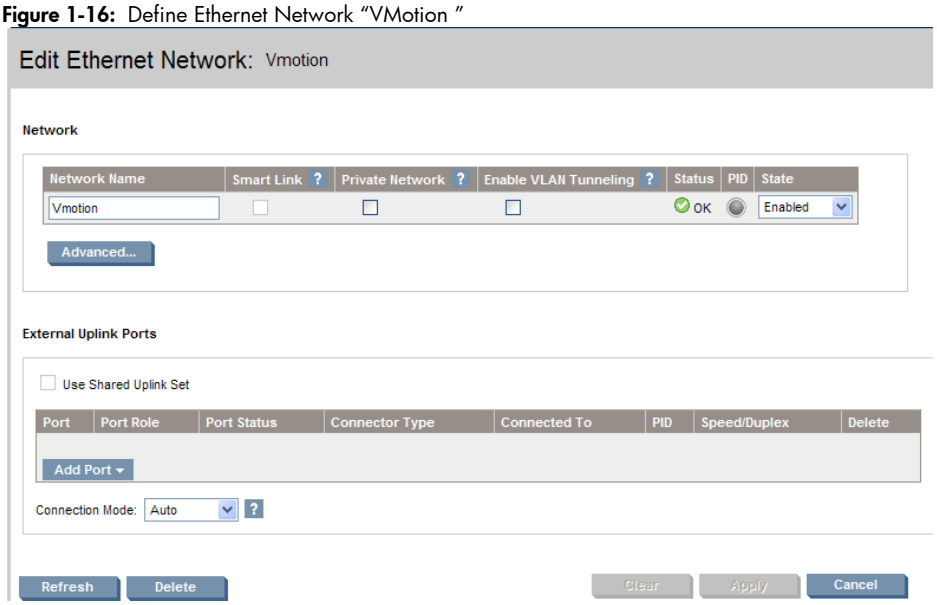
10. Click Apply to create the new VNet.
11. Repeat Steps 8 and 9 for "ESX_Network_B" vNet, and assign Enc1: Bay 2: Port X3 and X4 as the uplink ports.
12. Select *Define* then *Ethernet Network*
13. Provide the Network Label "VMOTION " as shown in Figure 1-16. You will not assign an uplink port.

    By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC

for the specific network.

Set vNet-VMotion network to 2.5Gb Preferred and Max.

Figure 1-16: Define Ethernet Network "VMotion "

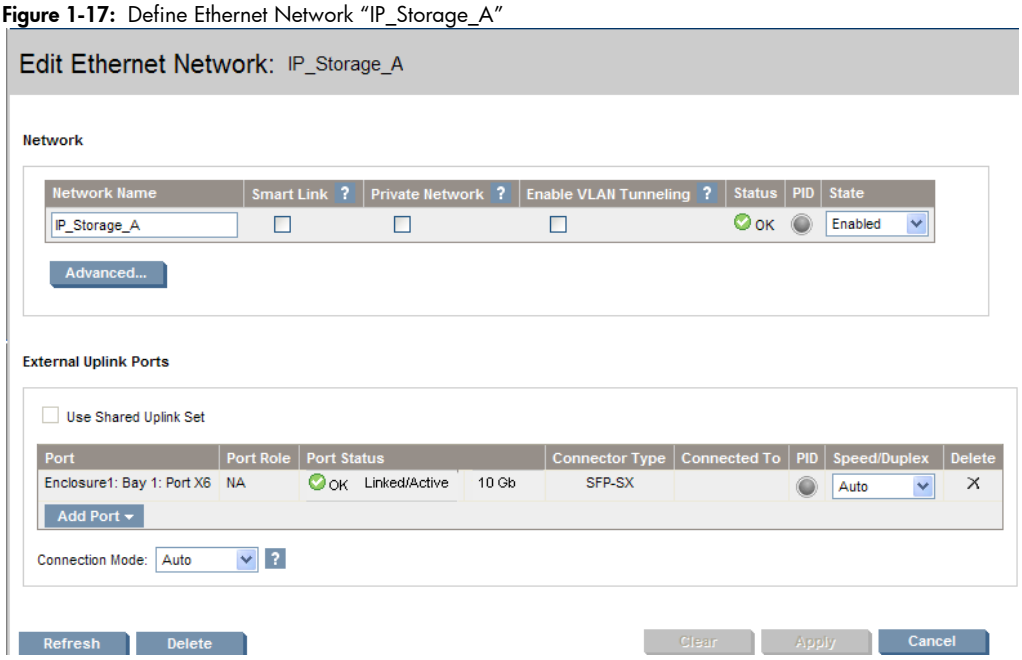


14. Click Apply to create the new vNet.
15. Select *Define* then *Ethernet Network*
16. Create a Virtual Connect Network "IP_Storage_A", and select the uplink ports by selecting the *Add Port* menu selecting Enc0: Bay 1: Port X6, as shown in Figure 1-17.

    By selecting the *Advanced* button, the LAN Administrator can set the Preferred and Maximum Port Speed. This allows the LAN Administrator to control the Transmit bandwidth at the Flex-NIC for the specific network.

    Set IP_Storage_A network to 4Gb Preferred and Max.

Figure 1-17: Define Ethernet Network "IP_Storage_A"



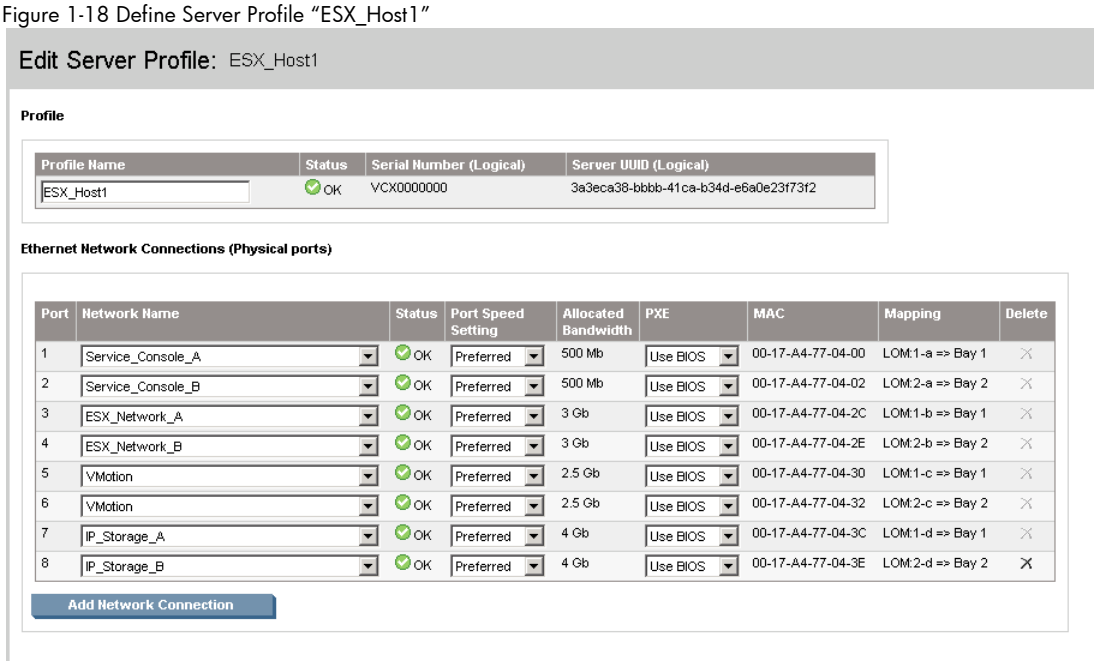
17. Click Apply to create the new vNet.
18. Repeat Steps 15 and 16 for "IP_Storage_B" vNet, and assign Enc1: Bay 2: Port X6 as the uplink port.

Defining a Server Profile

We will create a server profile with 8 server NICs. Each server NIC will connect to a specific network.

1. On the main menu, select *Define*, then *Server Profile*
2. Create a server profile called "ESX_Host1"
3. Add a network connection 6 times, for a total of 8 Network Connections, as shown in Figure 1-18
4. In the Network Port 1 drop down box, select Service_Console_A
5. In the Network Port 2 drop down box, select Service_Console_B
6. In the Network Port 3 drop down box, select ESX_Network_A
7. In the Network Port 4 drop down box, select ESX_Network_B
8. In the Network Port 5 drop down box, select VMotion
9. In the Network Port 6 drop down box, select VMotion
10. In the Network Port 7 drop down box, select IP_Storage_A
11. In the Network Port 8 drop down box, select IP_Storage_B
12. In the Assign Profile to Server Bay box, locate the Select Location drop down and select Enc0: Bay 1, they apply

Figure 1-18 Define Server Profile "ESX_Host1"



You should now have a server profile assigned to Enc0: Bay 1, with 8 Server NIC connections.

Designing a vSphere Network Architecture with Virtual Connect Flex-10

The introduction of VMware vSphere 4, customers are now able to centrally manage the network configuration within the hypervisor. This new feature, called vNetwork Distributed Switch[3] (vDS), allows an administrator to create a centralized distributed vswitch. Port Groups are still utilized in this new model, but have a different association to host uplink ports. Host uplink ports are added to Uplink Groups (dvUplinkGroup), where a logical association between the dvUplinkGroup and a PortGroup (dvPortGroup) is formed. vDS can service any of the vmkernel functions; Service Console, VMotion , IP Storage, and Virtual Machine traffic. However, they are limited to only a single dvUplinkGroup[4]. The hypervisor networking design will incorporate a hybrid approach, using Standard vSwitches for Vmkernel functions, while Virtual Machine traffic will utilize dvPortGroups.

In this chapter, we will outline the overall vDS design and guide you through how to configure a hybrid vDS infrastructure based on the two Virtual Connect Flex-10 design scenarios in the previous chapter. The vDS design will remain the same, regardless of the Flex-10 design chosen.

vDS Design and dvPortGroup Implications

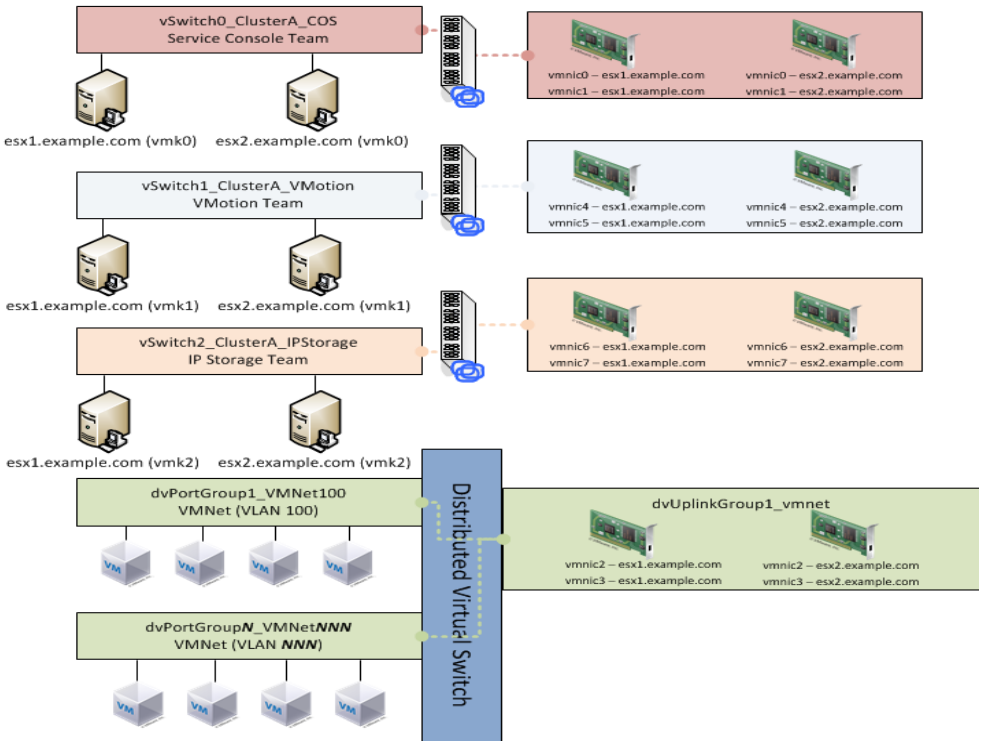
When designing a vDS infrastructure, one must take into account how their vNetwork Distributed Switch infrastructure will be created. A vDS should be tied to a broadcast domain, or physical uplink ports, even if supporting multiple VLANs.

All hosts within the datacenter may well may share the same Virtual Machine networking (i.e. VLAN association and IP subnet{s}), but not the same vmkernel networking. Thus, each cluster of hosts should have their own Standard vSwitch for vmkernel networking. In our design example, each cluster of hosts would have their own local Standard vSwitch for each VMkernel function, while sharing the same dvPortGroup and dvUplinkGroups for the Virtual Machine traffic. Figure 2-1 illustrates this point.

[3] Requires vSphere 4.0 Enterprise Plus licensing

[4] Please refer to the "Configuration Maximums for VMware vSphere 4.0" document, http://www.vmware.com/pdf/vsphere4/r40/vsp_40_config_max.pdf

Figure 2-1 Hypervisor Networking Design



VMware Fault Tolerance (FT) could introduce more complexity in to the overall design. VMware states that a single 1Gb NIC should be dedicated for FT logging, which could starve any shared pNIC with that of another vmkernel function (i.e. VMotion traffic.) The design example given in this document, FT has not been taken into consideration. Even though FT could be shared with another vmkernel function, and if FT is a design requirement, then the overall impact of its inclusion should be examined.
With the design example given, there are four options one could choose:

Table 2-1 VMware Fault Tolerance Options

FT Design Choice	Justification	Rating
Share with VMotion network	The design choice to keep VMotion traffic internally to the Enclosure allows the use of low latency links for inter-Enclosure communication. By giving enough bandwidth for VMotion and FT traffic, latency should not be an issue.	****
Share with IP Storage network	Sharing with the IP Storage network allows for customers to use the external switch infrastructure for non-stacked Enclosure to replicate FT logging. However, this traffic will be introduced onto the storage Ethernet fabric, and could unfavorably impact the overall IP Storage network.	***
Non-redundant VMotion and FT networks	Dedicate one pNIC for VMotion traffic, and the other for FT logging traffic. Neither network will provide pNIC redundancy.	**
Replace IP Storage network	If IP Storage is not a design choice, then one can simply it with an internal FT network.	*

Implementation of the vDS

The following steps will guide you through how to setup and configure the vDS based on design given in this document.

1. Within the vSphere Client, select *Home → Inventory → Networking*, or press Ctrl+Shift+N.
2. Select the Datacenter where you want to create the vDS, Right-Click and select *New vNetwork Distributed Switch*
3. Provide a dvSwitch name, and specify the number of dvUplink ports that will be available to this dvSwitch. Note that the number of dvUplink ports can be modified later.
4. Click Next
5. You can choose to assign Host NICs (pNICs) during this time, or later by adding new hosts to the dvSwitch.
6. Click Next
7. If you chose to add pNICs later, you can allow the wizard to create a default port group or not by selecting the check mark box.
8. Click Finish
9. After the dvSwitch is created, you can now add any additional pNICs to the dvSwitch and create the additional dvPortGroups for each VM network.

Figure 2-2 shows the Add Host to Distributed Virtual Switch wizard. You will notice that vmnic2 and vmnic3 are available for the dvUplinkGroup assignment.

Figure 2-2: Add Host to Distributed Virtual Switch Wizard

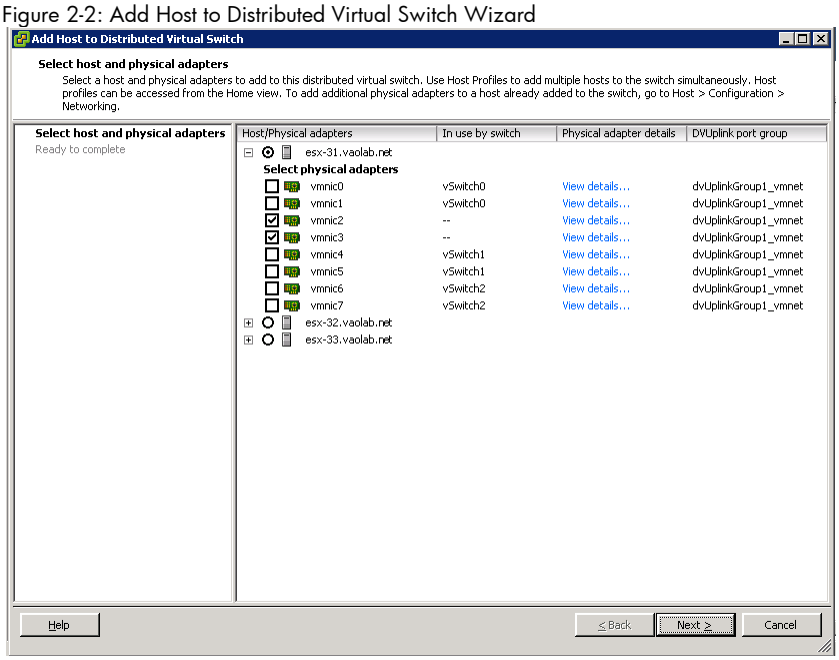


Figure 2-3: Host DVS Configuration View

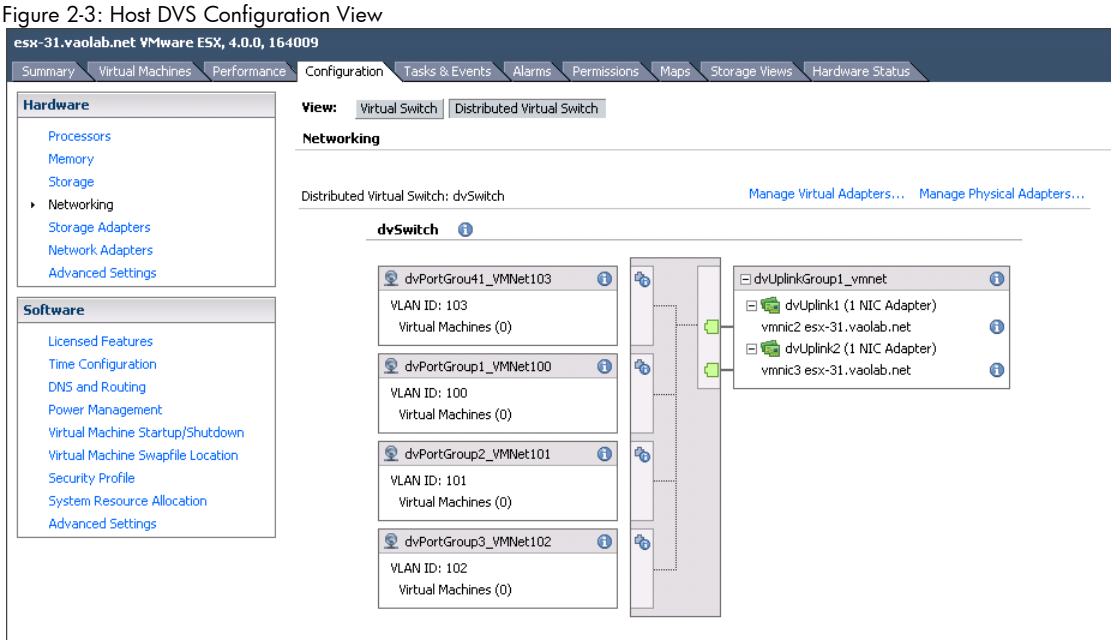
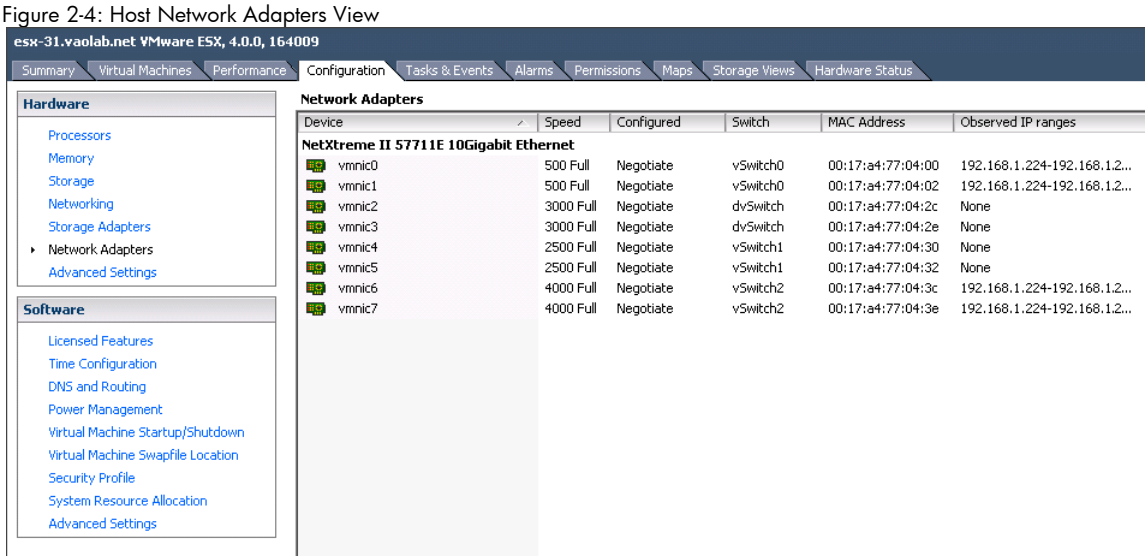


Figure 2-4: Host Network Adapters View



Hypervisor Load Balancing Algorithms

VMware provides a number of different NIC teaming algorithms, which are outlined in Table 2-2. As the table shows, any of the available algorithms can be used, except IP Hash. IP Hash requires switch assisted load balancing (802.3ad), which Virtual Connect does not support 802.3ad with server downlink ports. HP and VMware recommend using Originating Virtual Port ID, as shown in Table 2-2 and Figure 2-5.

Table 2-2 VMware Load Balancing Algorithms

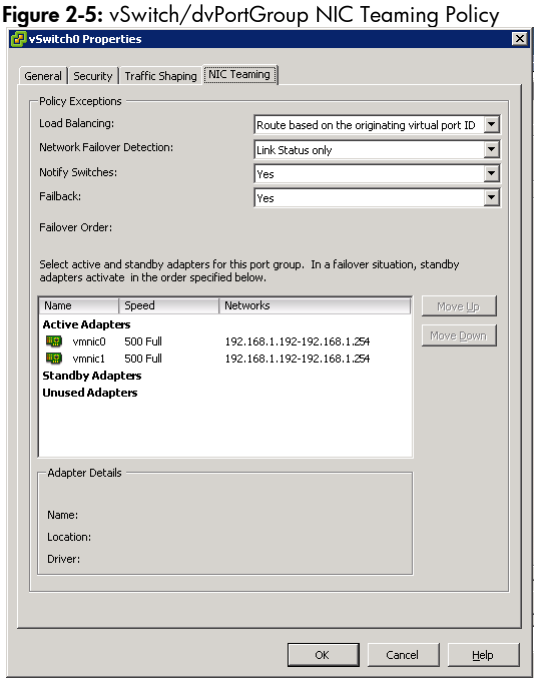
Name	Algorithm	Works with VC
Originating Virtual Port ID	Choose an uplink based on the virtual port where the traffic entered the virtual switch.	Yes
Source MAC Address	MAC Address seen on vnic port	Yes

Table 2-2 VMware Load Balancing Algorithms

Name	Algorithm	Works with VC
IP Hash	Hash of Source and Destination IP's. Requires switch assisted load balancing, 802.3ad. Virtual Connect does not support 802.3ad on server downlink ports, as 802.3ad is a Point-to-Point bonding protocol.	No
Explicit Failover	Highest order uplink from the list of Active pNICs.	Yes

Virtual Connect firmware v2.30 introduced Dynamic Control Channel (DCC) support to enable *Smart Link* with FlexNICs. This allows for individual FlexNIC state change if the uplink ports for a defined vNet are no longer available to force NIC teaming software failover.

Figure 2-5: vSwitch/dvPortGroup NIC Teaming Policy



Appendix A: Virtual Connect Bill of Materials

Table A-1 Virtual Connect Flex-10 Mapped VLAN BoM

Partnumber	Description	Qty
455880-B21	HP Virtual Connect Flex-10 Ethernet Module	4
444477-B21	.5m 10Gb CX4 Stacking Cable	2
455883-B21	10Gb SR SFP+ transceiver	6
Or		
487655-B21	3m SFP+ 10Gb Copper DAC	6

Table A-2 Virtual Connect Flex-10 Tunneled VLAN BoM

Partnumber	Description	Qty
455880-B21	HP Virtual Connect Flex-10 Ethernet Module	4
444477-B21	.5m 10Gb CX4 Stacking Cable	2
453154-B21	1Gb RJ45 SFP transceiver	2
455883-B21	10Gb SR SFP+ transceiver	6
or		
487655-B21	3m SFP+ 10Gb Copper DAC	6

Appendix B: Virtual Connect CLI Config Reference

Designing a Highly Available Flex-10 Network Strategy with Virtual Connect Managed VLANs

Define Virtual Connect Ethernet Network via CLI

The following command(s) can be copied and pasted into an SSH based CLI session with Virtual Connect

```
# SIDE A
# Create SUS Ethernet Network ESX_Network_A, and add uplink ports from chassis 1, bay
1, port 2 and port 3
add uplinkset ESX_Network_A
add uplinkport enc0:1:x2 Uplinkset=ESX_Network_A
add uplinkport enc0:1:x3 Uplinkset=ESX_Network_A

# Create network Service Console_A
add network Service_Console_A VLanid=10 PrefSpeedType=Custom PrefSpeed=500
MaxSpeedType=Custom MaxSpeed=500 uplinkset=ESX_Network_A
set network Service_Console_A SmartLink=Enabled

# Create network VM_Traffic_A: need one for each VLAN ID
add network VM_Traffic_A VLanid=100 PrefSpeedType=Custom PrefSpeed=3000
MaxSpeedType=Custom MaxSpeed=3000 uplinkset=ESX_Network_A
set network VM_Traffic_A SmartLink=Enabled

# Create IP Storage Network for direct connect to iSCSI Array
add network IP_Storage_A VLanTunnel=Enabled PrefSpeedType=Custom PrefSpeed=4000
MaxSpeedType=Custom MaxSpeed=4000
add uplinkport enc0:1:X6 Network=IP_Storage_A
set network IP_Storage_A SmartLink=Enabled
# SIDE B
# Create SUS Ethernet Network ESX_Network_B, and add uplink ports from chassis 2, bay
2, port 2 and port 3
add uplinkset ESX_Network_B
add uplinkport enc1:2:x2 Uplinkset=ESX_Network_B
add uplinkport enc1:2:x3 Uplinkset=ESX_Network_B

# Create network Service Console_B
add network Service_Console_B VLanid=10 PrefSpeedType=Custom PrefSpeed=500
MaxSpeedType=Custom MaxSpeed=500 uplinkset=ESX_Network_B
set network Service_Console_B SmartLink=Enabled

# Create network VM_Traffic_B: need one for each VLAN ID
add network VM_Traffic_B VLanid=100 PrefSpeedType=Custom PrefSpeed=3000
MaxSpeedType=Custom MaxSpeed=3000 uplinkset=ESX_Network_B
```

```
set network VM_Traffic_B SmartLink=Enabled

# Create IP Storage Network for direct connect to iSCSI Array
add network IP_Storage_B VLanTunnel=Enabled PrefSpeedType=Custom PrefSpeed=4000
MaxSpeedType=Custom MaxSpeed=4000
add uplinkport enc1:2:X6 Network=IP_Storage_B
set network IP_Storage_B SmartLink=Enabled

# Create Internal Ethernet Network VMOTION
add network VMOTION  PrefSpeedType=Custom PrefSpeed=2500 MaxSpeedType=Custom
MaxSpeed=2500
```

Defining a Server Profile via CLI

The following command(s) can be copied and pasted into an SSH based CLI session with Virtual Connect

```
# Create Server Profile ESX_Host1
add profile ESX_Host1 -NoDefaultEnetConn
add enet-connection ESX_Host1 pxe=UseBIOS Network=Service_Console_A
SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=Service_Console_B
SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS
add server-port-map ESX_Host1:3 VM_Traffic_100_A VLanId=100
add server-port-map ESX_Host1:3 VM_Traffic_101_A VLanId=101
add server-port-map ESX_Host1:3 VM_Traffic_102_A VLanId=102
add server-port-map ESX_Host1:3 VM_Traffic_103_A VLanId=103
add server-port-map ESX_Host1:3 VM_Traffic_104_A VLanId=104
add server-port-map ESX_Host1:3 VM_Traffic_105_A VLanId=105
add enet-connection ESX_Host1 pxe=UseBIOS
add server-port-map ESX_Host1:4 VM_Traffic_100_B VLanId=100
add server-port-map ESX_Host1:4 VM_Traffic_101_B VLanId=101
add server-port-map ESX_Host1:4 VM_Traffic_102_B VLanId=102
add server-port-map ESX_Host1:4 VM_Traffic_103_B VLanId=103
add server-port-map ESX_Host1:4 VM_Traffic_104_B VLanId=104
add server-port-map ESX_Host1:4 VM_Traffic_105_B VLanId=105
add enet-connection ESX_Host1 pxe=UseBIOS Network=VMOTION  SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=VMOTION  SpeedType=Preferred
add enet-connection ENC1 ESX_Host1 pxe=UseBIOS Network=IP_Storage_A
SpeedType=Preferred
add enet-connection ENC1 ESX_Host1 pxe=UseBIOS Network=IP_Storage_B
SpeedType=Preferred
assign profile ESX_Host1 enc0:1
```

Define Virtual Connect Ethernet Network via CLI

The following command(s) can be copied and pasted into an SSH based CLI session with Virtual Connect

```
# Set Domain Advanced Ethernet Settings to "Tunnel VLAN Tags"
Set enet-vlan vlantagcontrol=tunnel
# SIDE A
# Create Ethernet Network Service_Console_A, and add uplink ports from chassis 1, bay 1, port 2
add network Service_Console_A PrefSpeedType=Custom PrefSpeed=500 MaxSpeedType=Custom MaxSpeed=500
add uplinkport enc0:1:X2 Network=Service_Console_A
set network Service_Console_A SmartLink=Enabled

# Create Ethernet Network ESX_Network_A
add network ESX_Network_A VLanTunnel=Enabled PrefSpeedType=Custom PrefSpeed=3000 MaxSpeedType=Custom MaxSpeed=3000
add uplinkport enc0:1:X3 Network=ESX_Network_A
add uplinkport enc0:1:X4 Network=ESX_Network_A
set network ESX_Network_A SmartLink=Enabled

#Create IP Storage Network for direct connect to iSCSI Array
add network IP_Storage_A VLanTunnel=Enabled PrefSpeedType=Custom PrefSpeed=4000 MaxSpeedType=Custom MaxSpeed=4000
add uplinkport enc0:1:X6 Network=IP_Storage_A
set network IP_Storage_A SmartLink=Enabled

# SIDE B
# Create Ethernet Network Service_Console_B, and add uplink ports from chassis 2, bay 2, port 2
add network Service_Console_B PrefSpeedType=Custom PrefSpeed=500 MaxSpeedType=Custom MaxSpeed=500
add uplinkport enc1:2:X2 Network=Service_Console_B
set network Service_Console_B SmartLink=Enabled

# Create Ethernet Network ESX_Network_B
add network ESX_Network_B VLanTunnel=Enabled PrefSpeedType=Custom PrefSpeed=3000 MaxSpeedType=Custom MaxSpeed=3000
add uplinkport enc1:2:X3 Network=ESX_Network_B
add uplinkport enc1:2:X4 Network=ESX_Network_B
set network ESX_Network_B SmartLink=Enabled

#Create IP Storage Network for direct connect to iSCSI Array
add network IP_Storage_B VLanTunnel=Enabled PrefSpeedType=Custom PrefSpeed=4000 MaxSpeedType=Custom MaxSpeed=4000
```

```
add uplinkport enc1:2:X6 Network=IP_Storage_B
set network IP_Storage_B SmartLink=Enabled

# Create Ethernet Network VMOTION
add network VMOTION  PrefSpeedType=Custom PrefSpeed=2500 MaxSpeedType=Custom
MaxSpeed=2500
```

Defining a Server Profile via CLI

The following command(s) can be copied and pasted into an SSH based CLI session with Virtual Connect

```
# Create Server Profile ESX_Host1
add profile ESX_Host1 -NoDefaultEnetConn
add enet-connection ESX_Host1 pxe=UseBIOS Network=Service_Console_A
SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=Service_Console_B
SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=ESX_Network_A
SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=ESX_Network_B
SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=VMOTION  SpeedType=Preferred
add enet-connection ESX_Host1 pxe=UseBIOS Network=VMOTION  SpeedType=Preferred
add enet-connection ENC1 ESX_Host1 pxe=UseBIOS Network=IP_Storage_A
SpeedType=Preferred
add enet-connection ENC1 ESX_Host1 pxe=UseBIOS Network=IP_Storage_B
SpeedType=Preferred
assign profile ESX_Host1 enc0:1
```

Appendix C: Terminology cross-reference

Table C-1 Terminology cross-reference

Customer term	Industry term	IEEE term	Cisco term	Nortel term	HP Virtual Connect term
Port Bonding or Virtual Port	Port Aggregation or Port-trunking LACP	802.3ad LACP	Etherchannel or channeling (PaGP)	MultiLink Trunking (MLT)	802.3ad LACP
VLAN Tagging	VLAN Trunking	802.1Q	Trunking	802.1Q	Shared Uplink Set 802.1Q

Appendix D: Glossary of Terms

Table D-1 Glossary

Term	Definition
vNet/Virtual Connect Ethernet Network	A standard Ethernet Network consists of a single broadcast domain. However, when "VLAN Tunnelling" is enabled within the Ethernet Network, VC will treat it as an 802.1Q Trunk port, and all frames will be forwarded to the destined host untouched.
Shared Uplink Set (SUS)	An uplink port or a group of uplink ports, where the upstream switch port(s) is configured as an 802.1Q trunk. Each associated Virtual Connect Network within the SUS is mapped to a specific VLAN on the external connection, where VLAN tags are removed or added as Ethernet frames enter or leave the Virtual Connect domain.
Auto Port Speed**	Let VC automatically determine best Flex NIC speed
Custom Port Speed**	Manually set Flex NIC speed (up to Maximum value defined)
DCC**	Device Control Channel: method for VC to change Flex-10 NIC port settings on the fly (without power no/off)
EtherChannel*	A Cisco proprietary technology that combines multiple NIC or switch ports for greater bandwidth, load balancing, and redundancy. The technology allows for bi-directional aggregated network traffic flow.
Flex NIC**	One of four virtual NIC partitions available per Flex-10 Nic port. Each capable of being tuned from 100Mb to 10Gb
Flex-10 Nic Port**	A physical 10Gb port that is capable of being partitioned into 4 Flex NICs
IEEE 802.1Q	An industry standard protocol that enables multiple virtual networks to run on a single link/port in a secure fashion through the use of VLAN tagging.
IEEE 802.3ad	An industry standard protocol that allows multiple links/ports to run in parallel, providing a virtual single link/port. The protocol provides greater bandwidth, load balancing, and redundancy.
LACP	Link Aggregation Control Protocol (see IEEE802.3ad)
LOM	LAN-on-Motherboard. Embedded network adapter on the system board
Maximum Link Connection Speed**	Maximum Flex NIC speed value assigned to vNet by the network administrator. Can NOT be manually overridden on the server profile.
Multiple Networks Link Speed Settings**	Global Preferred and Maximum Flex NIC speed values that override defined vNet values when multiple vNets are assigned to the same Flex NIC
MZ1 or MEZZ1; LOM	Mezzanine Slot 1; LAM on Motherbard/systemboard NIC
Network Teaming Software	A software that runs on a host, allowing multiple network interface ports to be combined to act as a single virtual port. The software provides greater bandwidth, load balancing, and redundancy.
pNIC**	Physical NIC port. A Flex NIC is seen by VMware as a pNIC
Port Aggregation	Combining ports to provide one or more of the following benefits: greater bandwidth, load balancing, and redundancy.

Port Aggregation Protocol (PAgP)*	A Cisco proprietary protocol aids in the automatic creation of Fast EtherChannel links. PAgP packets are sent between Fast EtherChannel-capable ports to negotiate the forming of a channel.
Port Bonding	A term typically used in the Unix/Linux world that is synonymous to NIC teaming in the Windows world.
Preferred Link Connection Speed**	Preferred Flex NIC speed value assigned bt a vNet by the network administrator.
Trunking (Cisco)	802.1Q VLAN tagging
Trunking (Industry)	Combining ports to provide one or more of the following benefits: greater bandwidth, load balancing, and redundancy.
VLAN	A virtual network within a physical network.
VLAN Tagging	Tagging/marking an Ethernet frame with an identity number representing a virtual network.
VLAN Trunking Protocol (VTP)*	A Cisco proprietary protocol used for configuring and administering VLANs on Cisco network devices.
vNIC	Virtual NIC port. A software-based NIC used by VMs

*The feature is not supported by Virtual Connect.
**This feature was added for Virtual Connect Flex-10.

For more information

For more information on BladeSystem and Virtual Connect, see the HP website (www.hp.com/go/bladesystem).
For information on how to configure the Virtual Connect domain refer to the Virtual Connect User Guide and the Virtual Connect Ethernet Cookbook (http://h18004.www1.hp.com/products/blades/components/c-class-tech-installing.html).

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