Virtual Connect Multi-Enclosure Stacking Reference Guide

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Executive Summary

Customers today are challenged with simplifying the network edge by reducing complexity and cost. HP's Virtual Connect solution helps customers simplify server network connections by cleanly separating the server enclosure from the data center network. Stacking multiple enclosures enables the management of up to four enclosures from a single control point.

ME Stacking provides the following benefits:

- Provide connectivity for any blade server to any uplink port in the VC domain, regardless of location
- Reduce the overall number of cables needed for uplink connectivity
- Ability to move a profile between enclosures
- Reduce the datacenter core switch traffic, as internal communication stays inside the virtual connect domain
- Reduces the management touch points by consolidating virtual connect manager interfaces

Within environments where the 10Gb uplink ports are a premium, VC Flex-10 can be used with a minimal number of uplink ports in order to provide connectivity for multiple enclosures. The stack links provide high speed connections between the enclosures that can be adjusted by adding more physical links to the stack. This enables the ability to create a high speed private network connection between blades for services such as VMotion, Cluster heart beats, backups, and IP Storage to name a few.

This whitepaper will provide best practices to designing a multi-enclosure stack, and provide guidance on various approaches.

Multi-Enclosure Stacking Guidelines

ME Stacking enables a base enclosure to have external physical connections to multiple remote enclosures, by using the physical uplink ports (called Stack Links) of the Virtual Connect (VC) modules. Up to 4 Virtual Connect based C7000 enclosures can be stacked together and managed as one Virtual Connect domain for 128 servers, not to exceed a total of 16 VC-Enet and 16 VC-FC modules.

In order to configure ME Stacking, the base enclosure must have 1/10Gb-F Virtual Connect Ethernet Modules or Virtual Connect Flex-10 Modules in bay 1 or redundant pairs installed in bays 1 and 2. The original HP 1/10Gb Virtual Connect Copper Ethernet Modules are not supported in bay 1 and 2 of the base enclosure. The HP 1/10Gb VC Copper module does not contain the required amount of memory to manage multiple enclosure configurations. Remote enclosures may be populated with any Virtual Connect Ethernet modules.

ME Stacking does not require that you have implemented Virtual Connect Enterprise Manager (VCEM) in the environment. VCEM provides a central console to administer LAN and SAN address assignments, perform group-based configuration management, and execute rapid deployment, movement and failover of server connections and their workloads for 250 Virtual Connect domains (up to 1,000 enclosures and 16,000 server blades). ME Stacking and VCEM can be used together to provide the stacking benefits listed above and all the benefits of VCEM for central management of all the domains.

This first Virtual Connect domain created on the first enclosure will become the Base Enclosure. Remote Enclosures will then be imported into the Base Enclosure Virtual Connect Domain. The base enclosure will contain the primary and secondary Virtual Connect Manager instance. All OA's and Virtual Connect modules for each enclosure to be managed must be on the same IP subnet.

It is important that the IP subnet you plan on using for OA and VC traffic is not over utilized. Virtual Connect Manager relies on LAN connectivity between the Onboard Administrators to provide management and control in a multi-enclosure Virtual Connect domain. This connection ensures the

configuration settings of the distributed modules remain in sync. HP recommends isolating the management network from other networks to ensure that the communication integrity remains intact.

HP only supports importing remote enclosures that do not have an existing domain configuration. Importing remote enclosures with an existing domain will have its configuration erased. Merging of domains is not an available feature.

Virtual Connect Fibre Channel does not support ME Stacking using the physical uplink port connections. All enclosures in a single stack must have the identical VC-FC module placement and configuration in each enclosure.

Important: Additional guidelines and configuration rules will be found in the document titled "HP Virtual Connect for c-Class BladeSystem Setup and Installation Guide[1]"

Virtual Connect Domain Stack Planning

Starting the Multi Enclosure Stacking setup requires some upfront planning. The customer will need to create an ME Stack using a base enclosure with an existing virtual connect domain. Imported remote enclosures should not have an existing virtual connect domain.

Important: If the remote enclosure contains an existing domain configuration it will be erased.

Follow these steps to configure Multi Enclosure Stacking through the Virtual Connect Manager GUI.

To import the remote enclosure(s);

- Login to the existing Virtual Connect domain of the first enclosure and select Domain Enclosures in the left pane
- Press the "Find" button
- Enter the IP address and credentials for the OA of the enclosure you wish to import
- Select the enclosure, then press the "Import" button, this may take a few minutes to complete
- From the left pane, select Stacking Links and verify there are no stacking link errors

Figure 1 – Importing an enclosure into an existing VC Domain

[1] http://h18004.www1.hp.com/products/blades/components/c-class-tech-installing.html

Figure 2 – Enter the IP address and credentials of for the OA of the enclosure being imported.

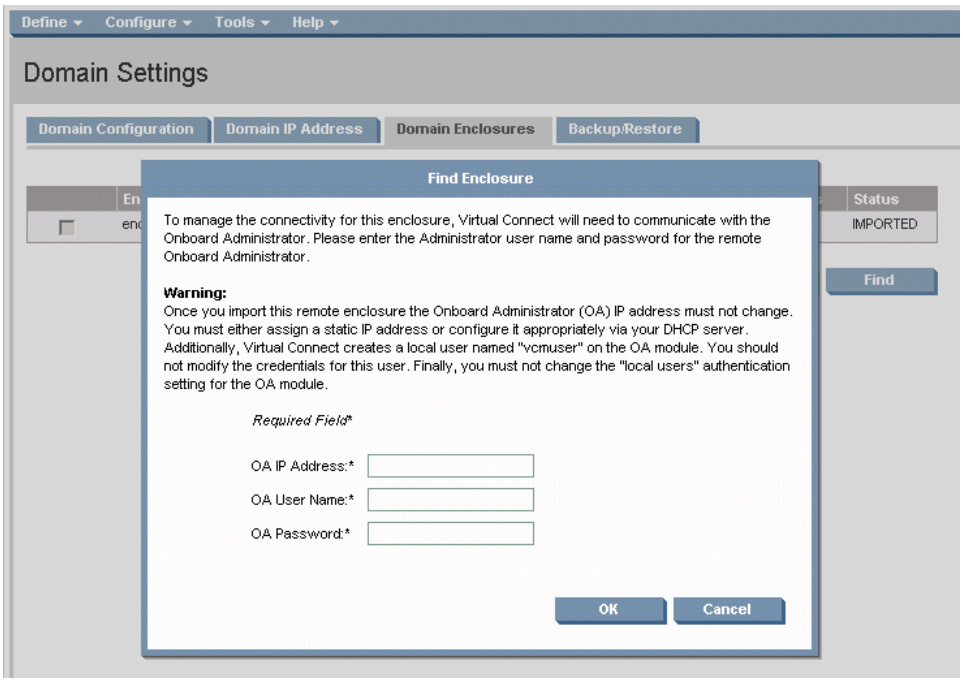


Figure 3 – Import the enclosure

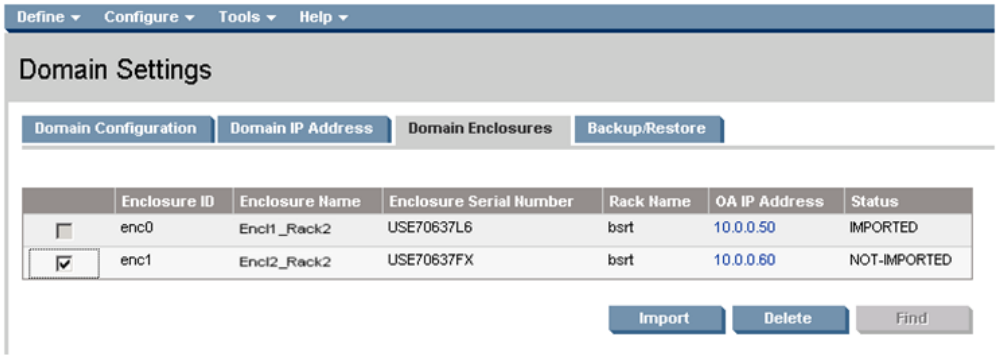
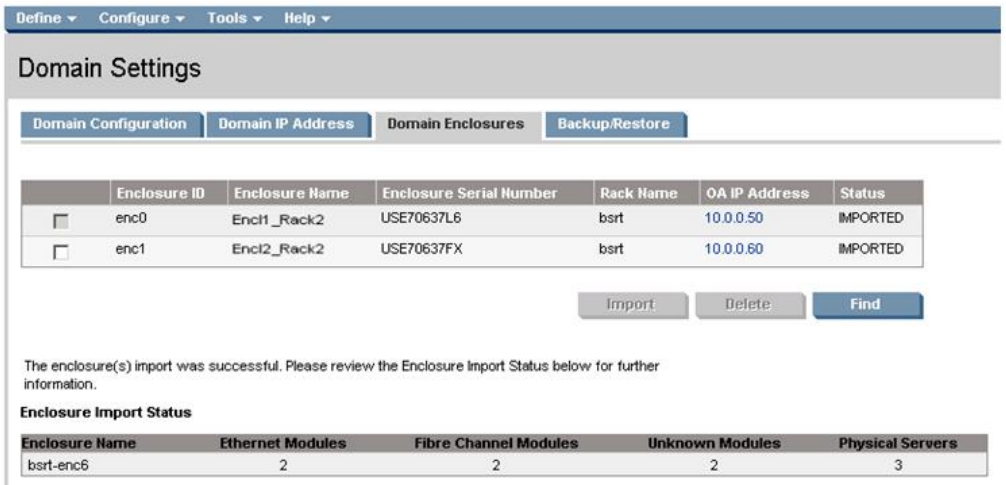
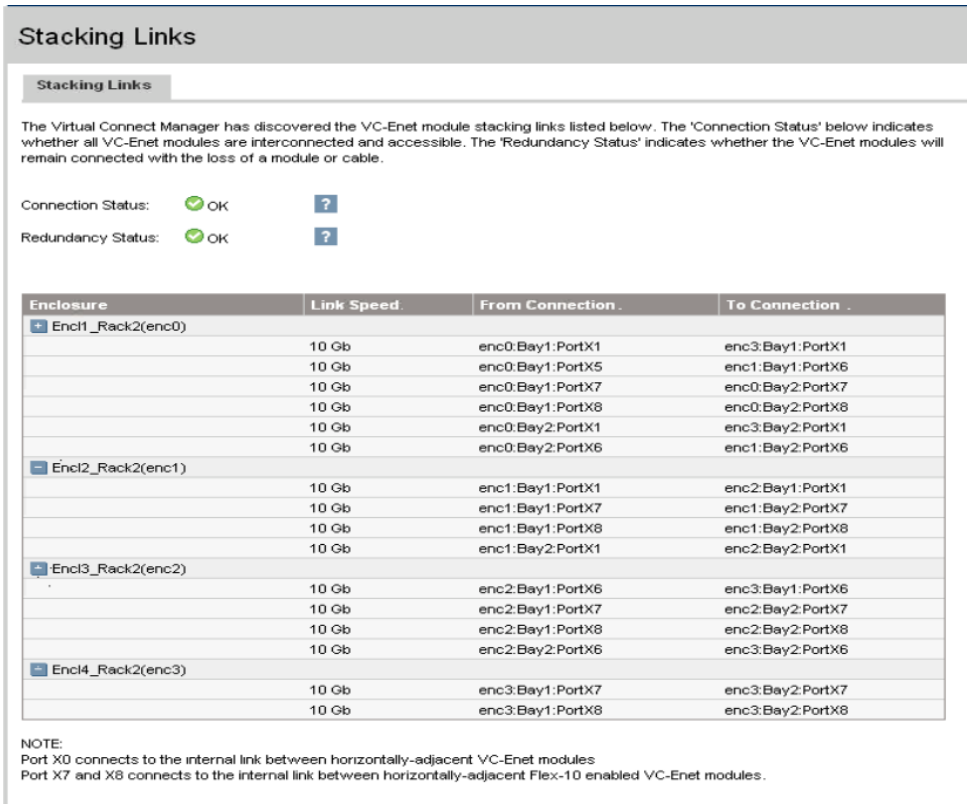


Figure 4 – The enclosure is imported



The enclosures in the stack are assigned an enclosure ID. The base enclosure is assigned enc0, and the remote enclosures are given id's enc1 through 3. The Enclosure name being imported is also displayed in the second column of the graphic.

Figure 5 – VC Domain Stacking Links



After successful configuration of the ME Stack, you will be able to create a VC network and choose any uplink port in the VC domain. A profile can be assigned to any server blade bay, and any enclosure in the Virtual Connect domain.

Figure 6 – Virtual Connect network creation

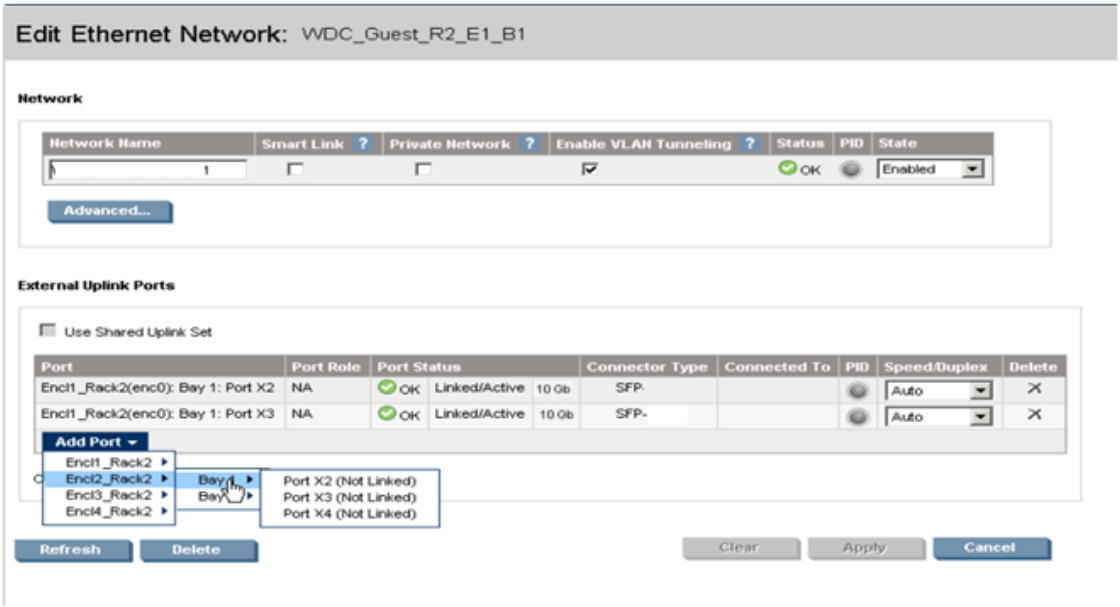
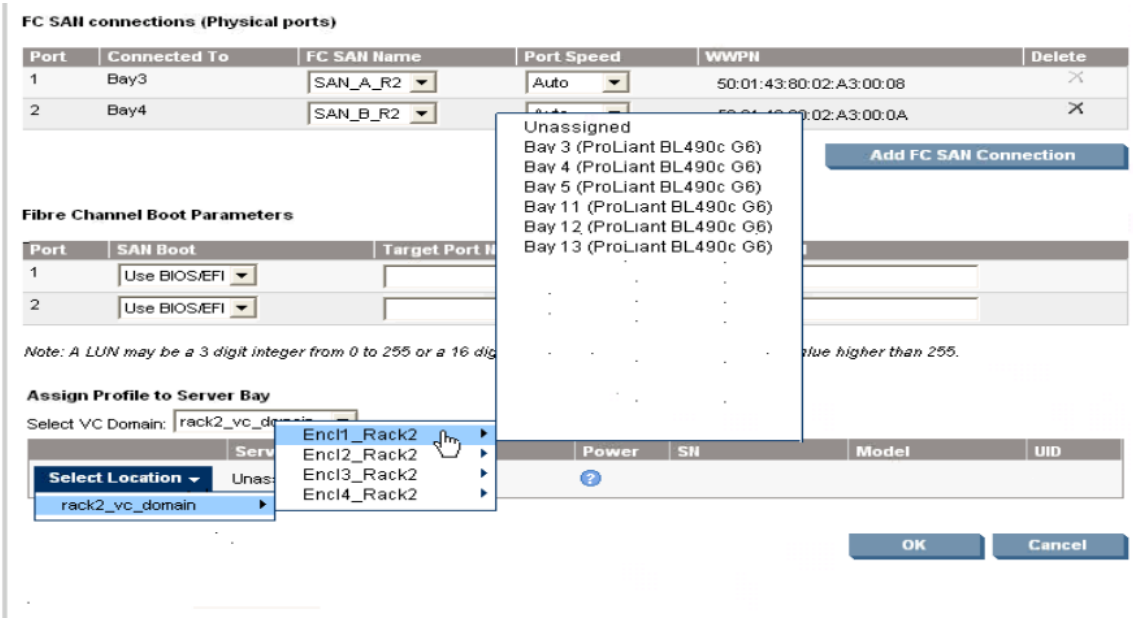


Figure 7 – Blade server profile placement



Virtual Connect Fibre Channel

When VC FC is implemented in a multi-enclosure domain, all enclosures must have identical VC-FC module placement and cabling. VC-FC does not support the concept of Multi-Enclosure stacking. When a VC Fabric is created its configuration is automatically replicated to the remote enclosures. For example, if you create a VC FC fabric with a module in Bay 3, port 1 of Enclosure 0 (Encl1_Rack2) which is connected to SAN_A_R2, this configuration will be replicated to the remote enclosures as shown in the graphic below. This helps to ensure that the profile mobility is maintained, so that when a profile is moved from one enclosure to another within the stack, san connectivity is preserved.

Figure 8- VC FC SAN Fabric view

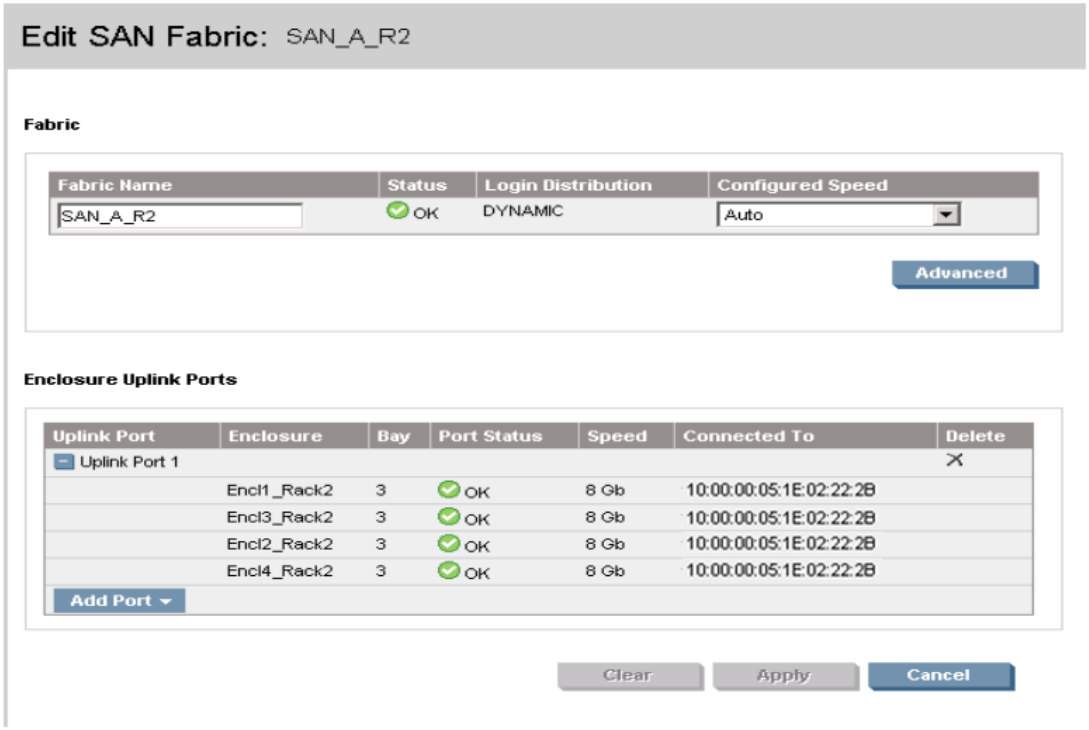
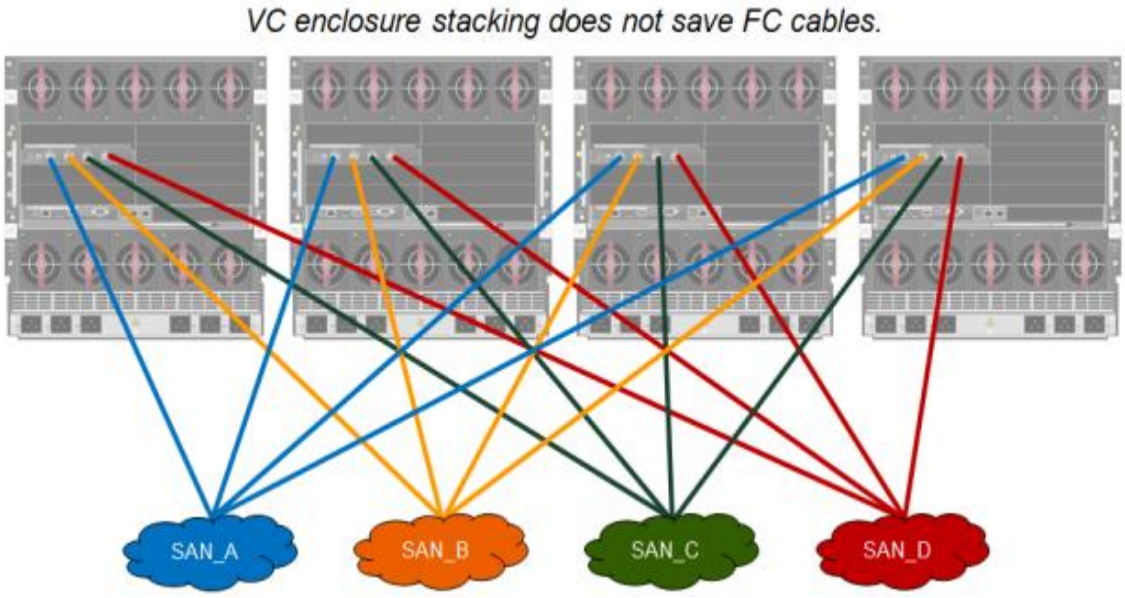


Figure 9: Example of VC FC stacking configuration



Multi Enclosure Stacking External connection architectures

This section will outline multiple scenarios for stacking 2, 3 and 4 enclosures to form a Multi Enclosure Stack. Each example displayed is configured with 4 uplink ports which connect to the external switch.

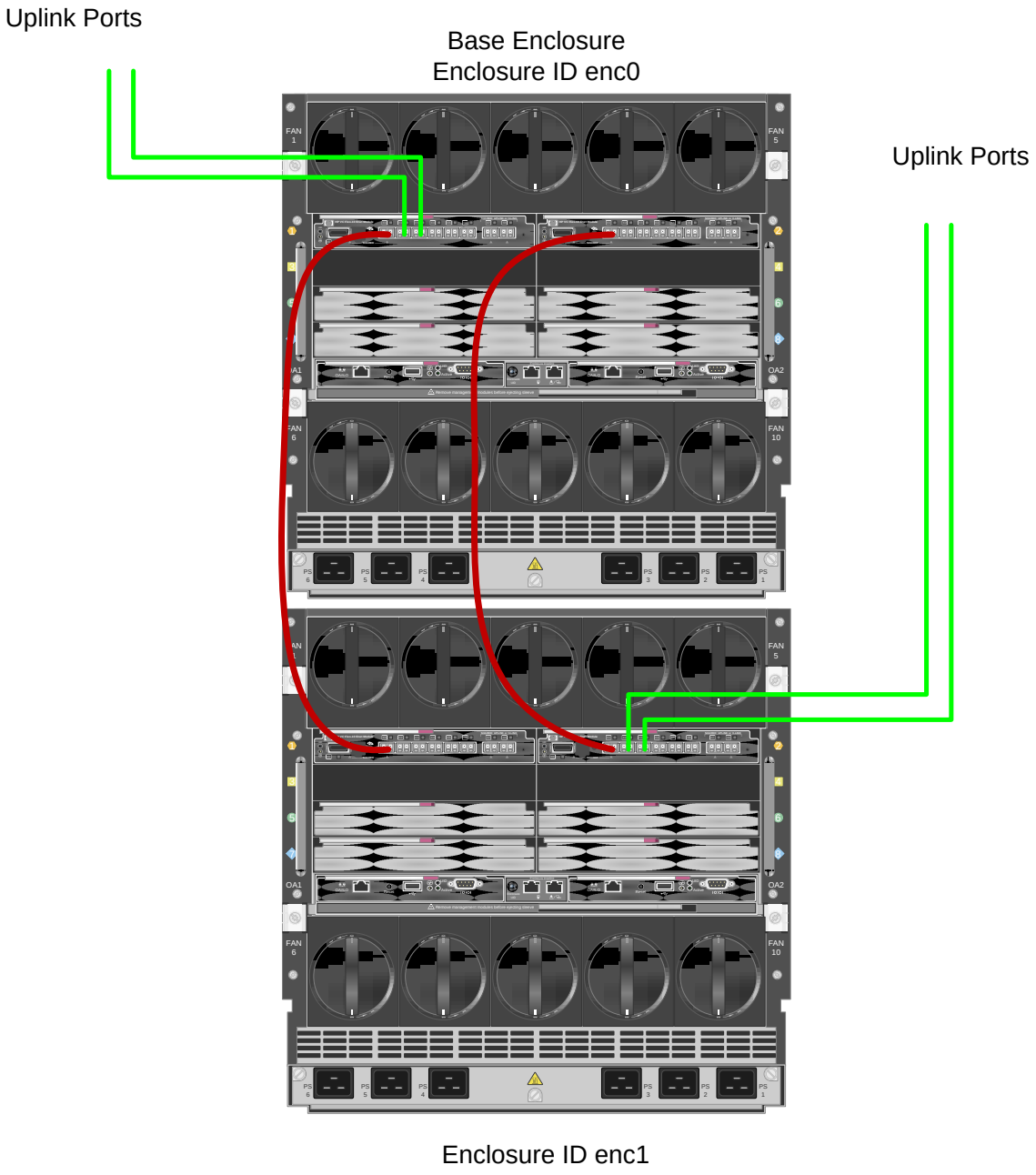
The virtual connect network would be created with an A and B side to allow all links to be in an active state. Blade host operating systems will need to be configured with NIC teaming to provide both path and switch redundancy. More physical uplinks could be setup and additional Virtual Connect networks defined to reduce latency and provide more bandwidth to the networking layer, based on needs and application demands.

The following graphics show the physical connections for stacking enclosures that will provide a configuration that is tolerant of any one module or cable failure. This will be referred to as the simple stack. The simple stack examples utilize the SFP+ DAC (Direct Attached Copper) connection of each Flex-10 module to interconnect the enclosures. This cable is an inexpensive copper 10Gb cable (note; SFP+ DAC has a 10 meter length limit). If Flex-10 modules are used the CX-4 port and port X1 are shared, the CX-4 port will be disabled. An alternative to SFP+ DAC cables are the CX-4 cables, which are somewhat more rigid and thicker than the SFP+ DAC cables.

Simple Stack 2 Enclosures:

Note that uplinks are connected to alternate enclosures/VC modules (left side/right side). In addition to the external stacking cables (red lines) seen in the following graphic, the VC modules are also cross connected internally, creating a L2 ring topology within Virtual Connect.

This configuration provides the ability to sustain a chassis, module, uplink or upstream switch failure/outage and still maintain connectivity to the network. If additional bandwidth is required, uplinks could be added to these VC networks, or additional VC networks could be configured.

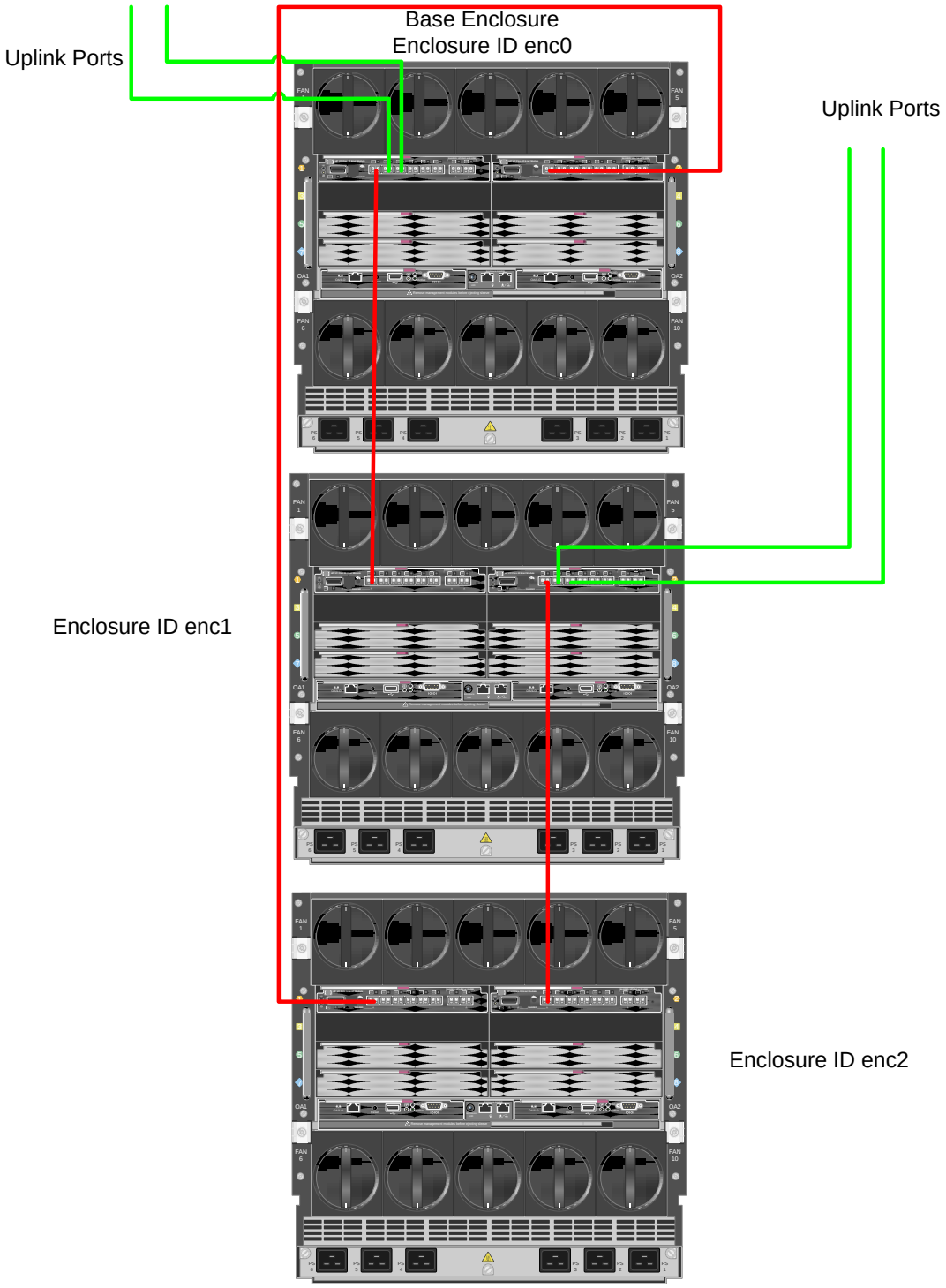


Simple Stack 3 Enclosures:

Note that uplinks are connected to alternate enclosures/VC modules (left side/right side). In addition to the external stacking cables (red lines) seen in the following graphic, the VC modules are also cross connected internally, creating a L2 ring topology within Virtual Connect.

Communications from Enclosure 3 would be routed through either enclosure 1 or two, depending on how the VC networks are assigned to the server profiles.

This configuration provides the ability to sustain a chassis, module, uplink or upstream switch failure/outage and still maintain connectivity to the network. If additional bandwidth is required, uplinks could be added to these VC networks, or additional VC networks could be configured.

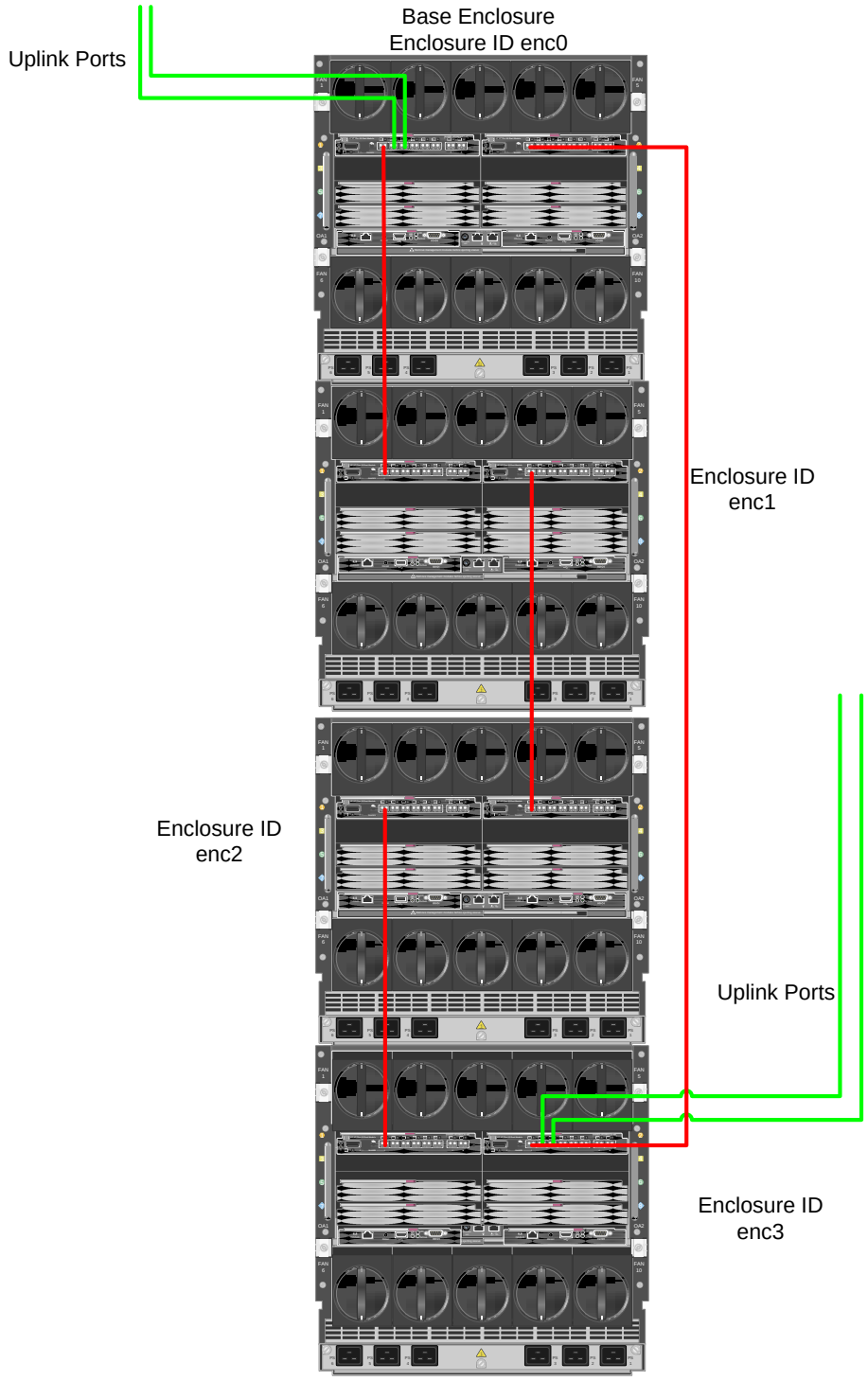


Simple Stack 4 Enclosures:

Note that uplinks are connected to alternate enclosures/VC modules (left side/right side). In addition to the external stacking cables (red lines) seen in the following graphic, the VC modules are also cross connected internally, creating a L2 ring topology within Virtual Connect.

Communications from Enclosure 3 and 4 would be routed through either enclosure 1 or two, depending on how the VC networks are assigned to the server profiles

This configuration provides the ability to sustain a chassis, module, uplink or upstream switch failure/outage and still maintain connectivity to the network. If additional bandwidth is required, uplinks could be added to these VC networks, or additional VC networks could be configured.



Additional stacking cables may be required or desired for some of the following reasons:

a) If you have more than two VC-Enet modules per enclosure.

b) If you want redundancy for more than one cable or module failure.

c) If you want to minimize latency between a NIC and its uplink by reducing the hop count.

d) If you want to increase bandwidth for ip communication between enclosures

Any of these reasons may lead you to add more physical connections in your stacking environment. You can add additional physical links between VC modules where the first stacking link is located. An aggregated port group is formed, creating more bandwidth between those two VC-Enet modules.

The following examples show that a server is either directly connected to a VC-Enet module with uplinks or its traffic has to traverse one or two stacking links to get to an uplink. Improvements can be made by adding more cables to the VC-Enet uplink ports that are connected to upstream switches. More stacking cables can be added to increase bandwidth, or connect to other VC modules to increase the number of paths to the uplink ports.

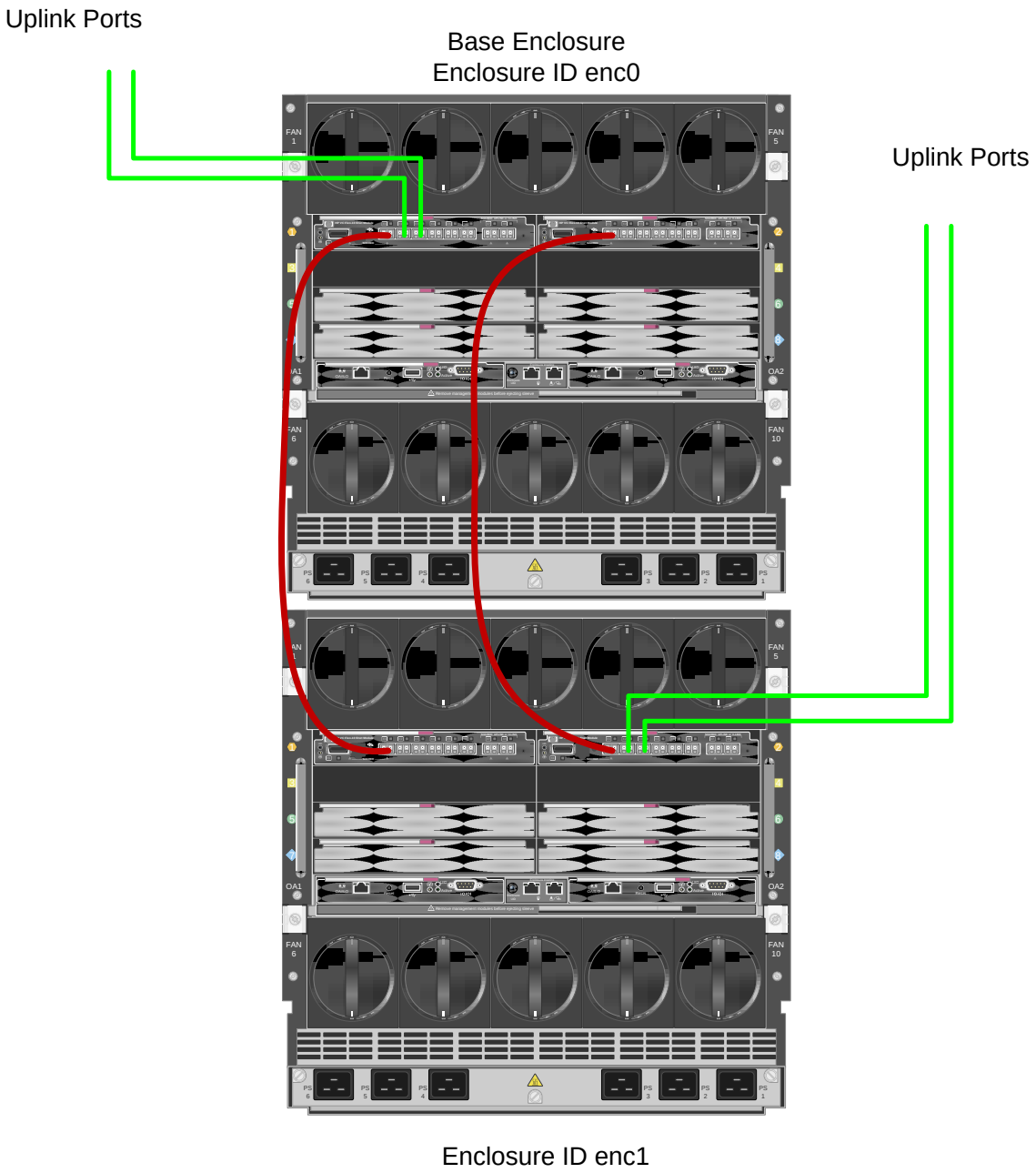
These 4 examples keep the same number of uplink ports in the same positions as the previous scenarios, but provide 1 or 2 stacking link hops from any blade to any uplink port. By reducing the hops between the VC modules will help reduce the latency for blade servers that reside in enclosures that do not have direct uplink ports configured. This connectivity type will be called mesh stacking.

Important: Virtual Connect modules only have 2 microseconds of latency per hop.

ME Mesh Stack 2 Enclosure:

Note that uplinks are connected to alternate enclosures/VC modules (left side/right side). In addition to the external stacking cables (red lines) seen in the following graphic, the VC modules are also cross connected internally, creating a L2 ring topology within Virtual Connect. Any additional stacking links in this configuration will increase bandwidth between the VC modules.

This configuration provides the ability to sustain a chassis, module, uplink or upstream switch failure/outage and still maintain connectivity to the network. If additional bandwidth is required, uplinks could be added to these VC networks, or additional VC networks could be configured.

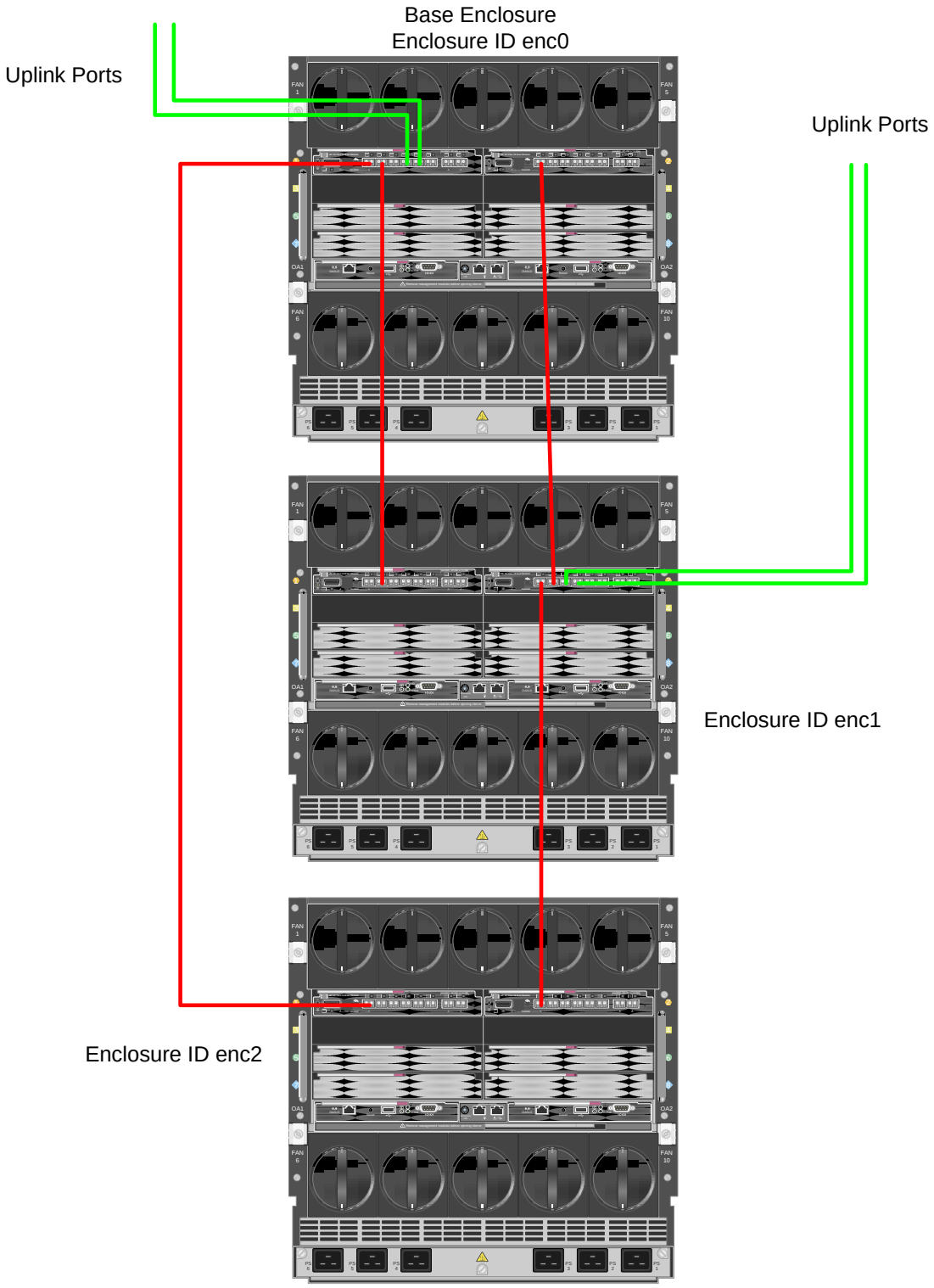


ME Mesh Stack 3 Enclosure:

Note that uplinks are connected to alternate enclosures/VC modules (left side/right side). In addition to the external stacking cables (red lines) seen in the following graphic, the VC modules are also cross connected internally, creating a L2 ring topology within Virtual Connect

This configuration provides the ability to sustain a chassis, module, uplink or upstream switch failure/outage and still maintain connectivity to the network. If additional bandwidth is required, uplinks could be added to these VC networks, or additional VC networks could be configured.

This example provides additional stacking links to reduce hop counts and increase availability, in the event of an uplink or upstream switch failure.

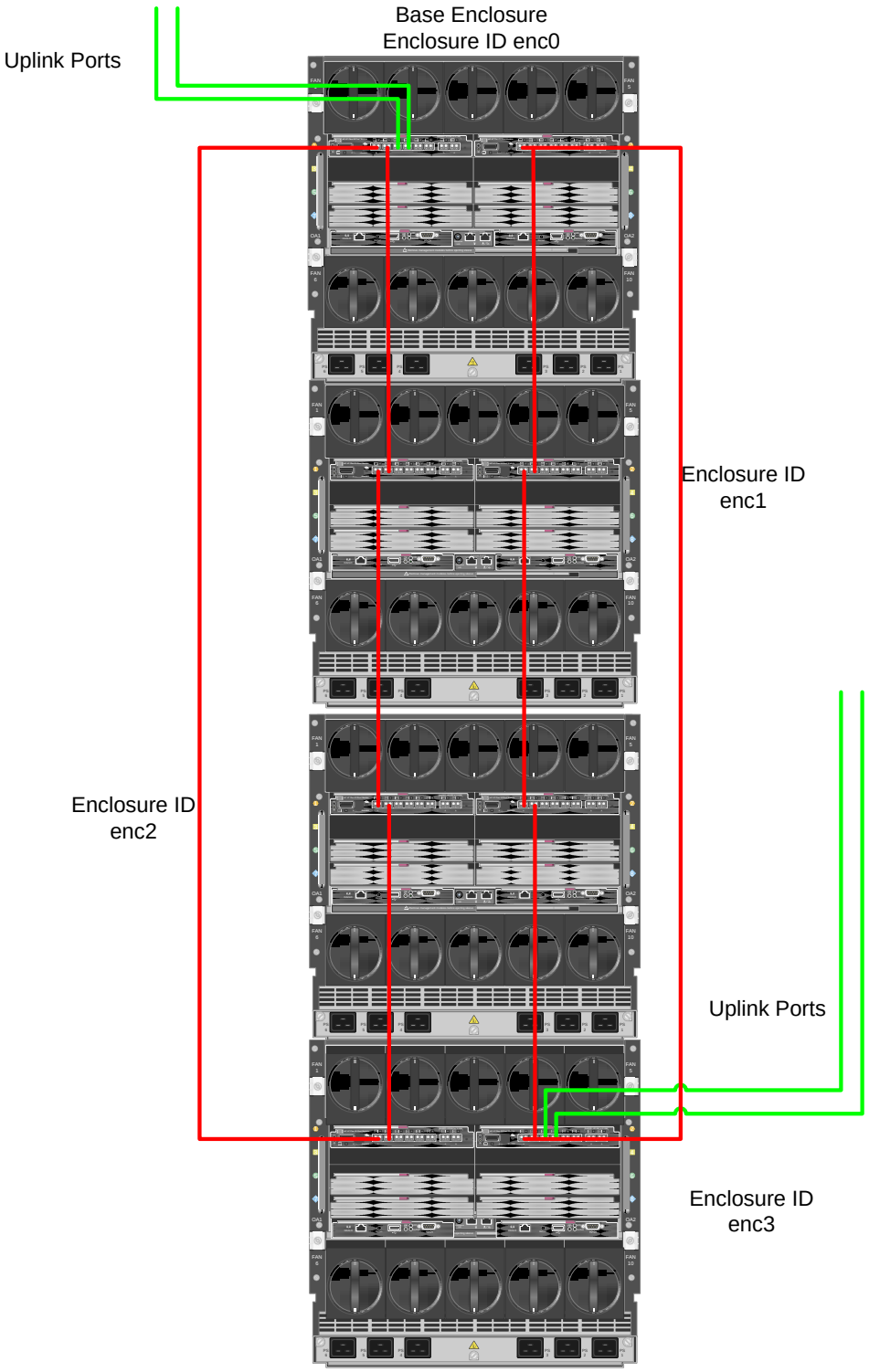


ME HA Stack 4 Enclosure:

Note that uplinks are connected to alternate enclosures/VC modules (left side/right side). In addition to the external stacking cables (red lines) seen in the following graphic, the VC modules are also cross connected internally, creating a L2 ring topology within Virtual Connect.

This configuration provides the ability to sustain a chassis, module, uplink or upstream switch failure/outage and still maintain connectivity to the network. If additional bandwidth is required, uplinks could be added to these VC networks, or additional VC networks could be configured.

This example provides additional stacking links to reduce hop counts and increase availability, in the event of an uplink or upstream switch failure.



To keep costs down, it is recommend to use the copper CX4 or SFP+ Direct Attached Cable (DAC). Both offer a low cost solution for stacking additional ports.

Consolidating Existing VC Domains and Enclosures

This section will outline an example to consolidate multiple independent VC Domains into a ME Stack with one VC domain.

This configuration is more complex as you will be dealing with existing VC domains, VC network uplinks and host configurations. This configuration will need to have some scheduled downtime allotted to make the required changes to the virtual connect infrastructure.

Important: ME Stacking will not support "merging" of existing VC domains, remote enclosure VC domains must be deleted in order for stacking to be successful.

Enclosures being imported must have no previous Virtual Connect domains configured. The Base enclosure becomes the only VC domain for the entire ME Stack.

This is an example set of steps for 'importing' a previously configured remote Virtual Connect domain and what you have to plan for.

- Backup ALL VC domains
- Create a VC CLI script to recreate the Profiles for all the blades in the remote enclosures: do not assign them to server bays at this time. The new profile MAC and WWPN's will be created with the HP Predefined managed range of the base enclosure.
- Decide on new stack uplink port strategy – will all the existing uplink ports be used in the new stacked domain or will additional be added?
- Decide on new naming convention for remote enclosure VC network uplink ports (if the same name as the base enclosure)
- Import the remote enclosures through the cli or GUI interface.
- Take the new WWPN's created in the new unassigned profiles and have them zoned and presented in parallel with the existing WWPN's for storage. Once the enclosures are stacked and the new profiles assigned to the remote servers, remove the old WWPN's from the storage infrastructure.
- If Needed – Create a CLI script to define new VC Networks using the remote enclosure uplink ports.
- Create a CLI script to assign the new profiles to the correct blade server bays.

Firmware Update Process and Behavior

The HP BladeSystem c-Class Virtual Connect Support Utility enables administrators to upgrade VC-Enet and VC-FC firmware, and to perform other maintenance tasks remotely on both HP BladeSystem c-Class c7000 enclosures using a standalone, Windows-based command line utility.

When the utility initiates a firmware upgrade process, all modules are updated at the same time. The utility displays a progress message indicating that an update is in progress and the percentage completed. After the module firmware updates are complete, the utility activates all of the modules. VCSU will update all the VC modules in the entire ME Stack. For production environments, careful planning is required if no outage is desired when using VCSU to update firmware. Please refer to the VCSU User guide located at the following website http://h18004.www1.hp.com/products/blades/components/c-class-tech-installing.html

For more information

www.hp.com/go/bladesystems

Technology for better business outcomes

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4AA2-xxxxEEW, Nov 2009