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UCS Architecture Overview

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Agenda

- Overview of UCS and Components
- Hardware Abstraction
- Network Abstraction
- Innovative Technologies
- Multi-Tenant & Security
- Monitoring & Fault Alerting

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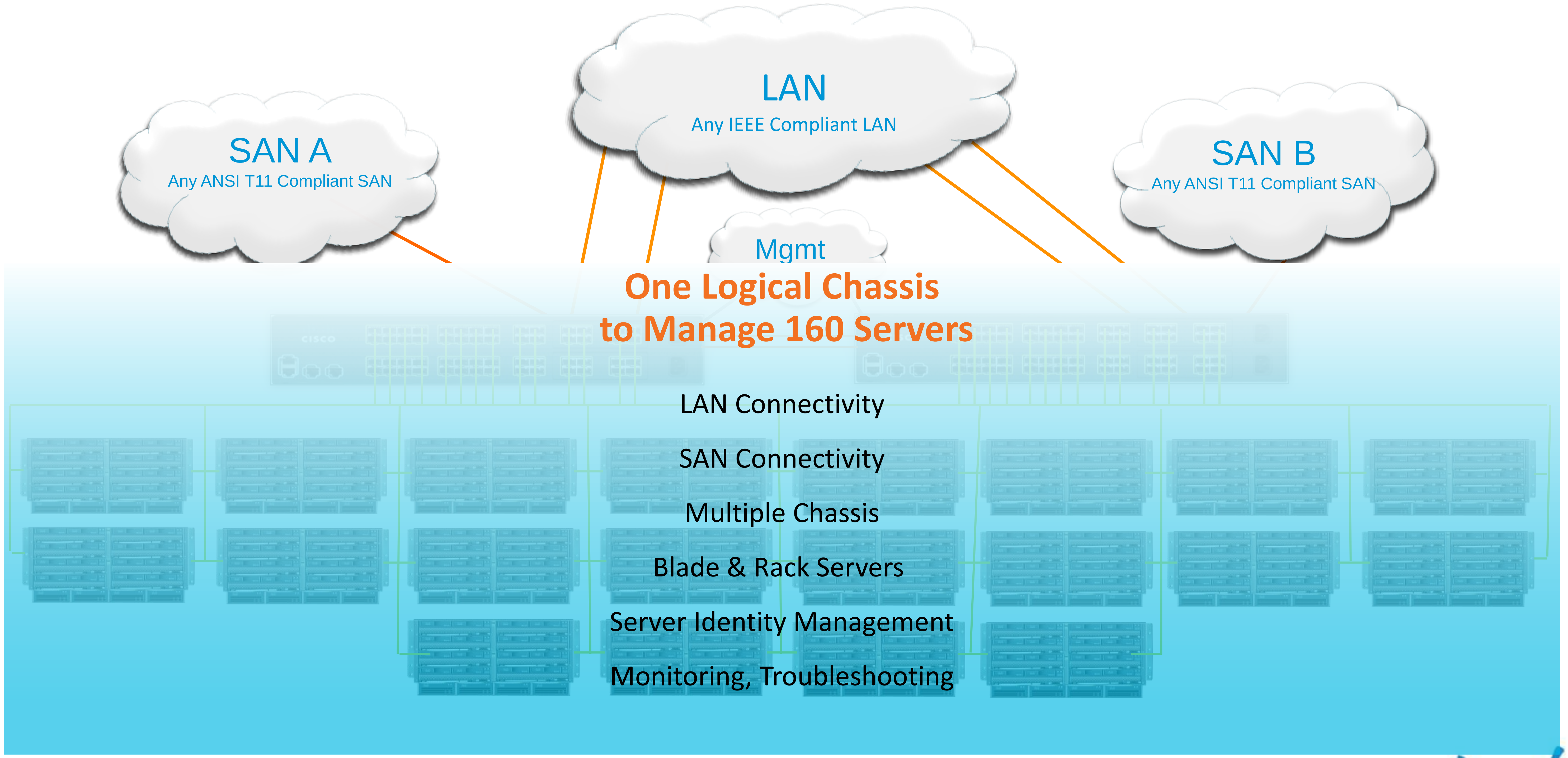
Unified Computing System Overview

Cisco Unified Computing System



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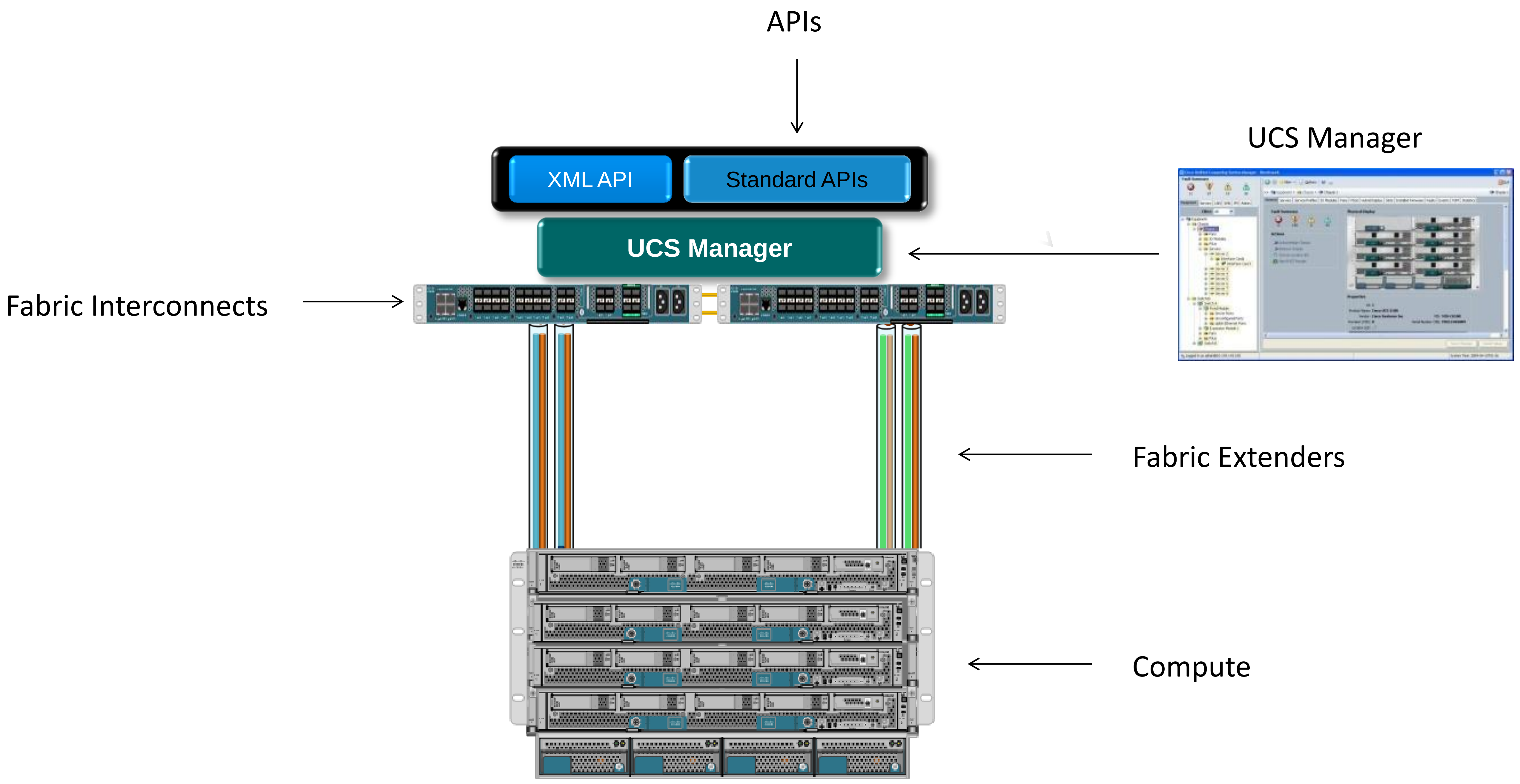
Cisco UCS Architecture



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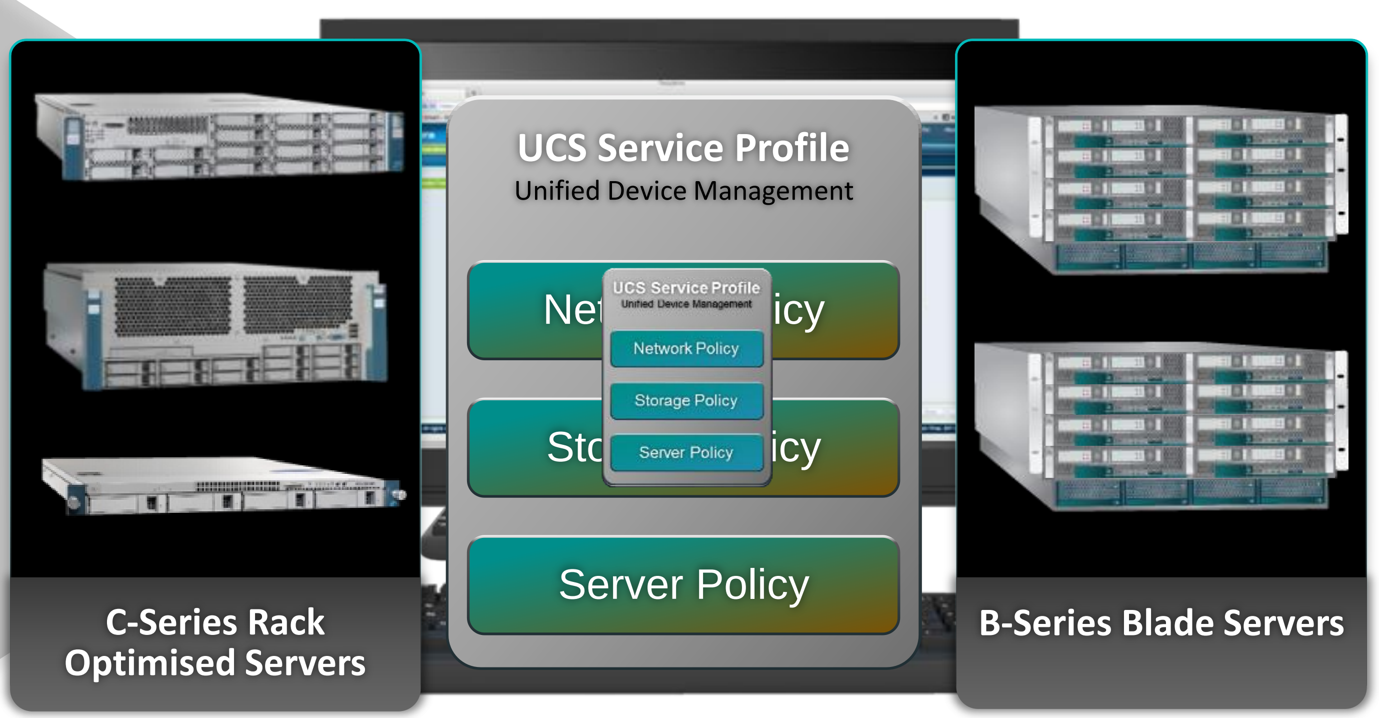
Unified Management

UCS Manager

Unified Management
A Single Unified System
For Blade and Rack Servers



- Integral part of UCS system
- Manages all aspects of the UCS
- Single point of management for UCS

- Open API
- Integrated Automation
- Add capacity without complexity

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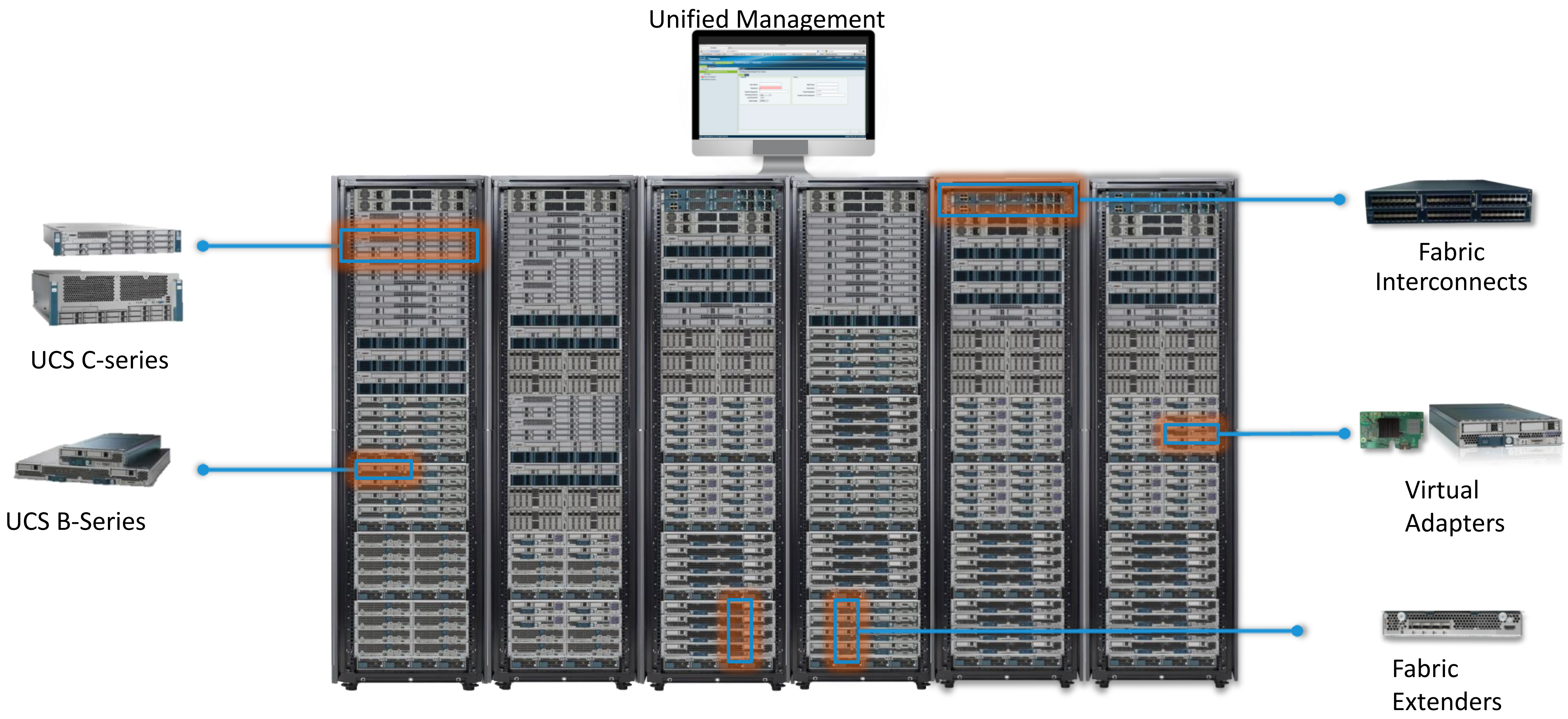
UCS Benefits



Unified Management

Industry-leading compute without compromise

High Performance Virtual Networks

Highest Scale Unified Fabric

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Building Blocks of Cisco UCS

An Integrated System Optimises Data Centre Efficiency

UCS Manager

- Embedded—manages entire UCS Domain

Fabric Interconnect

- 10GE unified fabric switch

Chassis IO Module

- Remote line card

Blade Server Chassis

- Flexible bay configurations

Blade and Rack Servers

- x86 industry standard
- Patented extended memory

I/O Adapters

- Choice of multiple adapters

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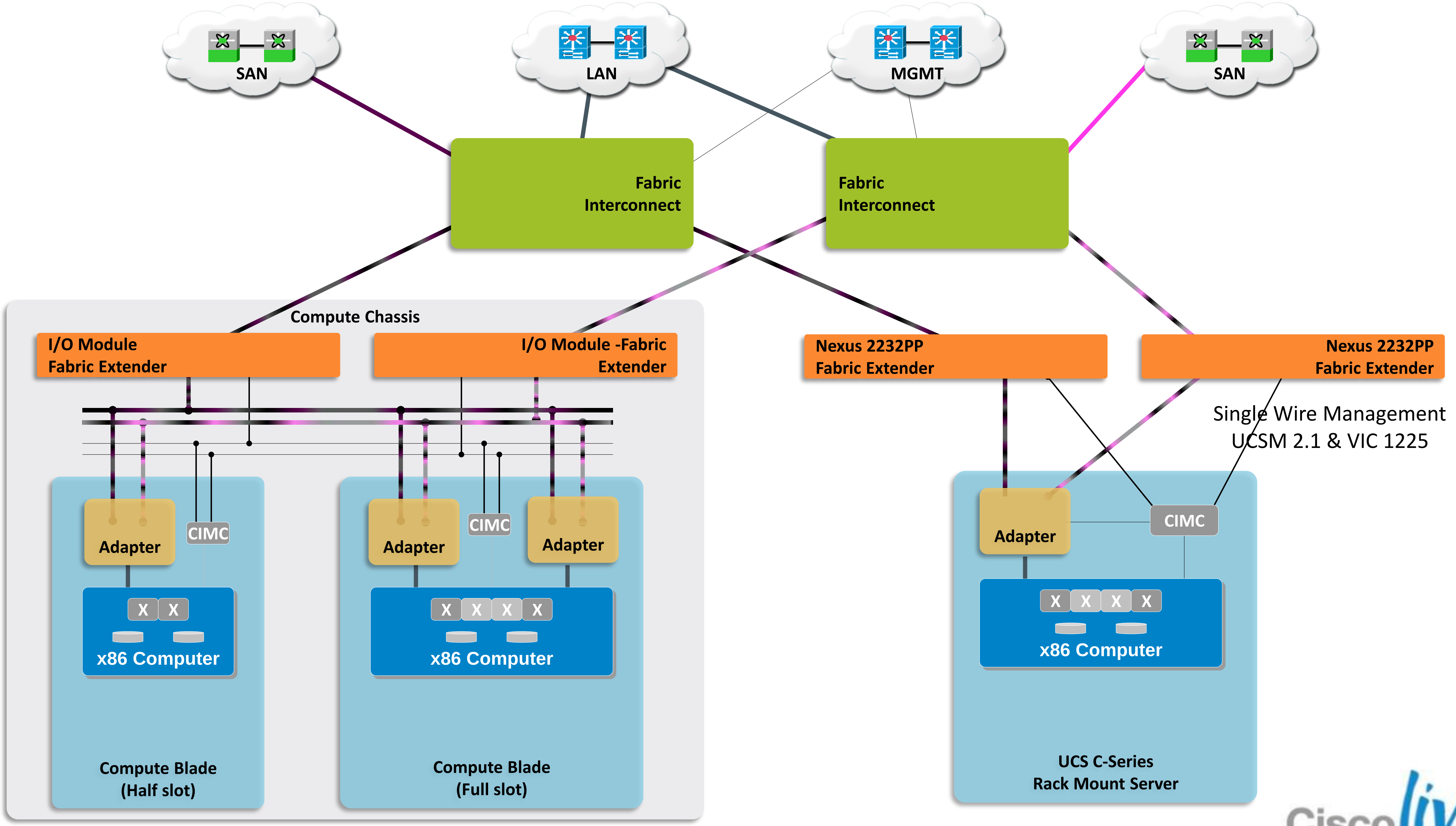
Building Block Connectivity



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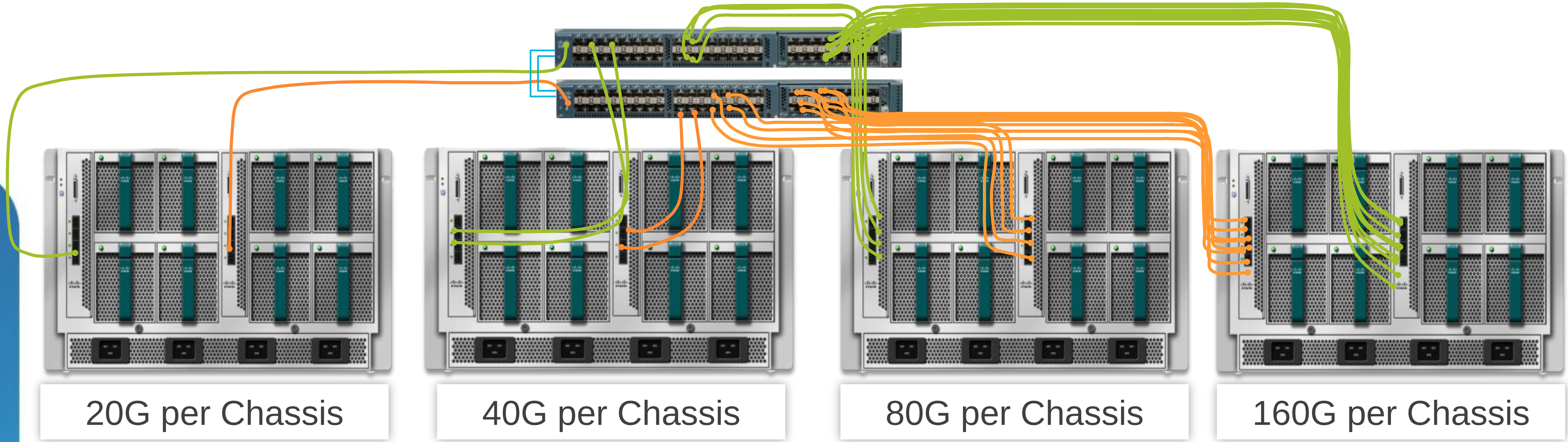
Wire for Bandwidth, Not Connectivity



- Wire Once Architecture
- All links can be active all the time
- Policy-driven bandwidth allocation
- Virtual interface granularity

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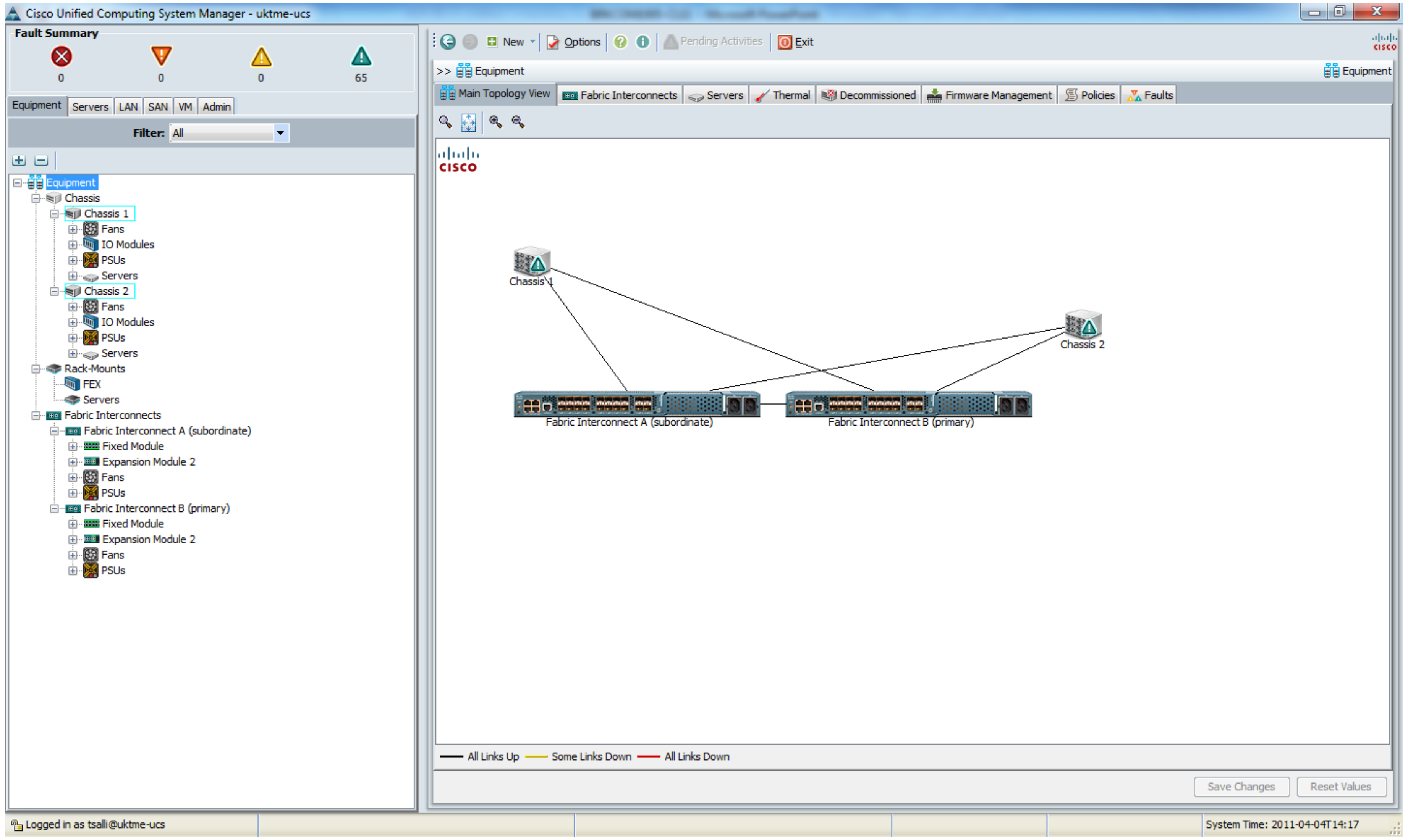
Unified Computing System Manager



- Embedded device manager for family of UCS components
- Enables stateless computing via Service Profiles
- Efficient scale: Same effort for 1 to N blades
- APIs for integration with new and existing data centre infrastructure

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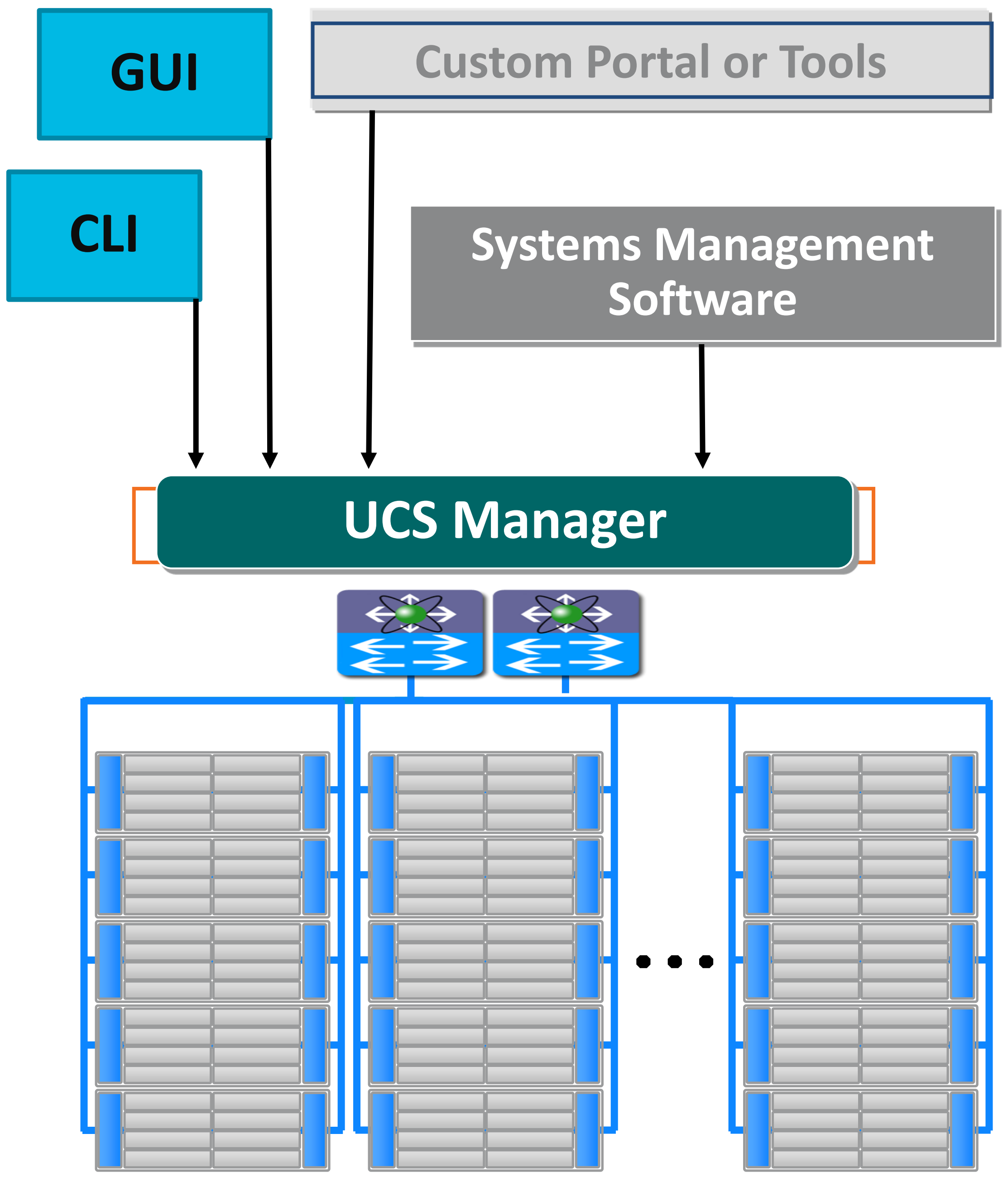
UCS Manager



- Single point of management for UCS system of components
  - –Adapters, blades, chassis, fabric extenders, fabric interconnects
- Embedded device manager
  - –Discovery, Inventory, Configuration, Monitoring, Diagnostics, Statistics Collection
  - –Coordinated deployment to managed endpoints
- APIs for integration with new and existing data centre infrastructure
  - –SMASH-CLP, IPMI, SNMP
  - –XML-based SDK for commercial & custom implementations

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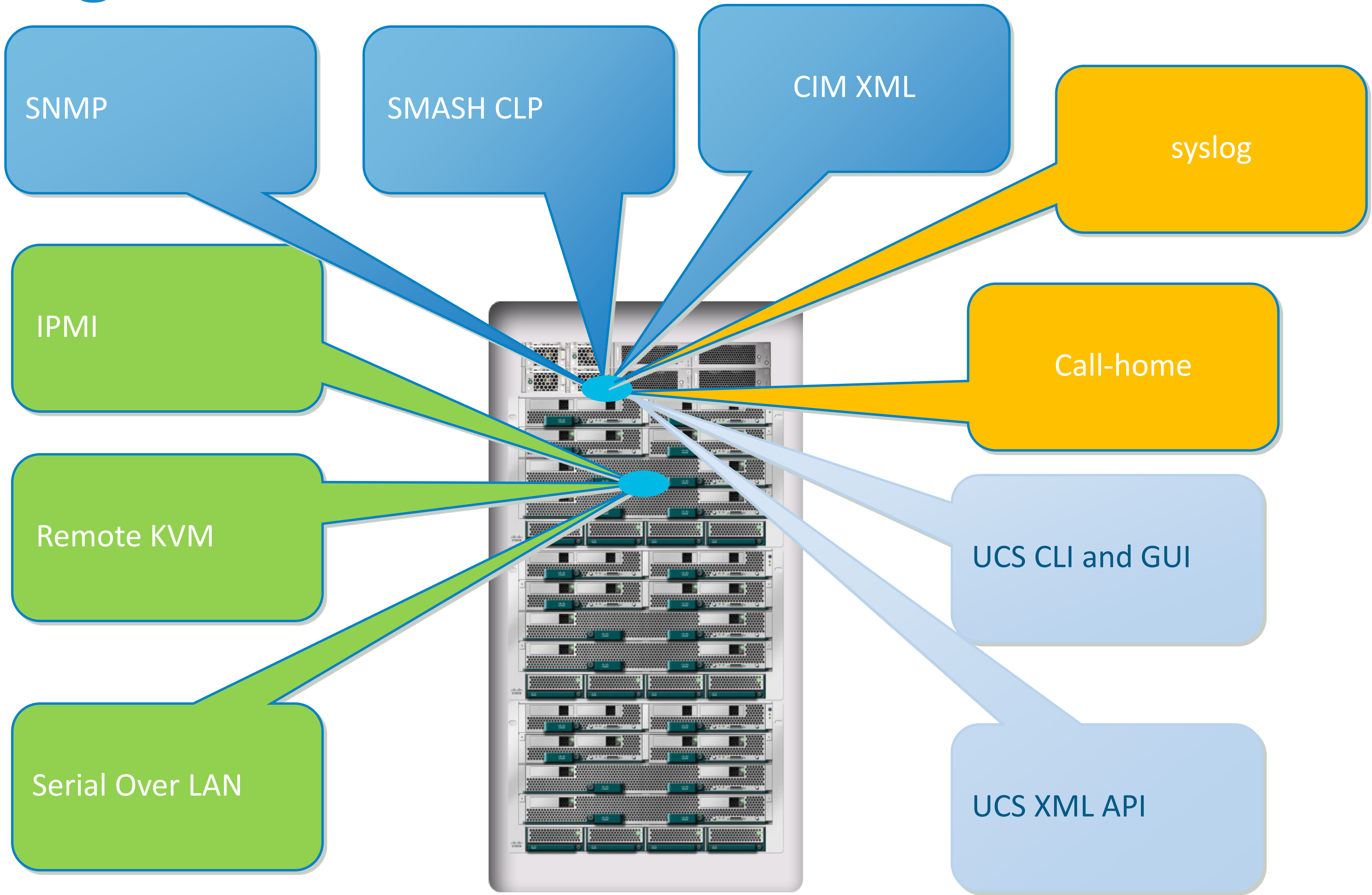
Management Protocols



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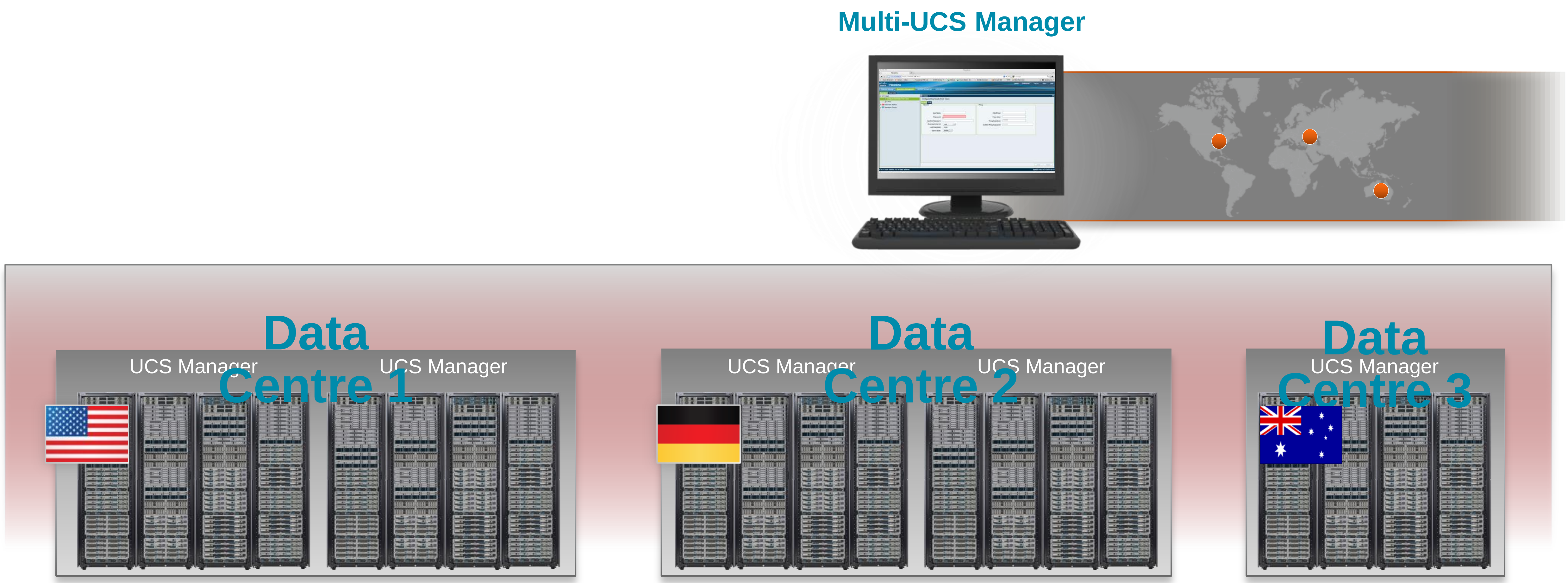
UCS Centrale



- Unifies management of multi UCS domains
- Leverages UCS Manager technology
- Simplify global operations with centralised inventory, faults, logs, and server consoles
- Delivers global policies, service profiles, ID pools, and templates
- Foundation for high availability, disaster recovery, and workload mobility
- Model based API for large scale automation

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Server Hardware Abstraction

UCS Technical System Architecture

Virtualising More than the Server

- One way is to scale out a compute platform on cheap commodity servers and implement services on this platform.
  - The DC network provides L2/L3 connectivity between compute nodes and end-users.
  - The value is in the APIs the end-user has access to within the compute layer (not network).
  - Built for application developers and Internet companies using web services based applications.
- The other is looking ahead and implementing a Next-Gen computing platform
  - Support Enterprise Class features.
  - Treating network and compute resources as equally important to scale, secure and provide differentiated services.
  - Built for Enterprises looking to adapt to Cloud infrastructure automation with option of sharing/bursting IT services to a Cloud Compute Platform.

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What is a "stateless" computing architecture?

- Stateless client computing is where every compute node has no inherent state pertaining to the services it may host.
- In this respect, a compute node is just an execution engine for any application (CPU, memory, and disk – flash or hard drive).
- The core concept of a stateless computing environment is to separate state of a server that is built to host an application, from the hardware it can reside on.
- The servers can easily then be deployed, cloned, grown, shrunk, de-activated, archived, re-activated, etc.

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What is our Unified Computing Architecture?

- We start with a data model of the existence, identity, and configuration of a Server and its various sub-components
- We grow this data model to include the upstream I/O needs to include the configuration of the upstream ports that face this server
- We include policies to define groupings of these servers, priorities, security segmentation, and many others
- We probe newly inserted hardware, to classify and get them ready for deployment* and map these desired server models to the actual hardware when servers are required

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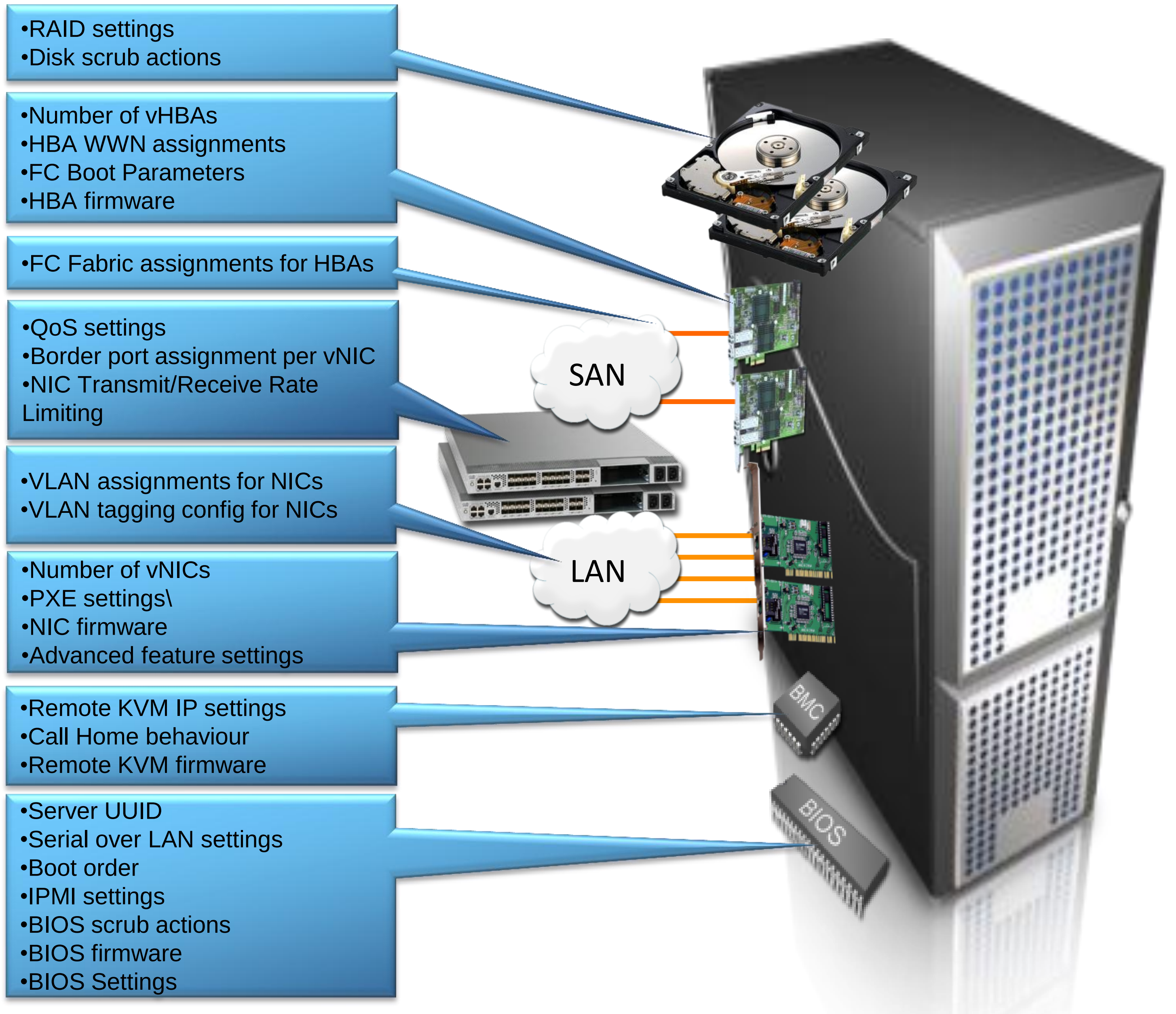
Traditional Servers

Hardware Centric

- Servers are specifically purchased for applications
- Hardware dictates the identity of the servers
- Management of servers handled individually or through add-on software



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UCS Technologies for Elasticity

A Traditional Server (Server has state on every host)

- Server Name = vmhost-cluster1-1
- UUID = 12345678-ABCD-9876-5432-ABCDEF123456 (Burned In)
- Description = ESX4-1 – Host in Cluster 1
- Network Side LAN Config
  - Adapter PCI Order = PHYSICAL INSERTION TO RISER
  - Number of NIC's = PHYSICAL PRESENCE IN SERVER
  - vNIC0 Switch = PHYSICAL CONNECTION to Switch A
  - vNIC0 VLAN Trunking = Enabled (COORDINATION)
  - vNIC0 Native VLAN = VLAN 100 (COORDINATION)
  - vNIC0 Allowed VLANs = 101,102,103… (COORDINATION)
  - vNIC0 MAC Address = BURNED IN
  - vNIC0 QoS policy = MQC COMMANDS PER PORT
  - vNIC1 Switch = PHYSICAL CONNECTION to Switch B
  - vNIC1 VLAN Trunking = Enabled (COORDINATION)
  - vNIC1 Native VLAN = VLAN 100 (COORDINATION)
  - vNIC1 Allowed VLANs = 101,102,103… (COORDINATION)
  - vNIC1 MAC Address = BURNED IN
  - vNIC1 QoS policy = MQC COMMANDS PER PORT
- Server Side LAN Config
  - vNIC0 Network = PHYSICAL CONNECTION Switch A **
  - vNIC1 Network = PHYSICAL CONNECTION Switch B **
  - Bonding Driver = MANUALLY Setup Intel PROset
  - VLAN Interfaces = MANUALLY Setup Intel PROset for 100,101,102,103,…
  - ESX Networking = MANUALLY Setup multiple vSwitches, VLAN Tags, vCenter PortGroups
- Local Storage = 73GB, 10k RPM, Disk1 73GB, 10k RPM, Disk2
- RAID = MANUALLY Setup through boot utility

SAN Config

- SAN Connection for Server = HBA PHYSICAL PRESENCE IN SERVER
- Node ID = BURNED IN
- Adapter PCI Order = PHYSICAL INSERTION TO RISER
- Adapter Parameters = MANUALLY Setup through boot utility
- vHBA0 Switch = PHYSICAL CONNECTION to Switch A
- vHBA0 VSAN = VSAN1-FabricA (COORDINATION)
- vHBA0 WWPN = BURNED IN
- vHBA1 Switch = PHYSICAL CONNECTION to Switch B
- vHBA1 VSAN = VSAN1-FabricB (COORDINATION)
- vHBA1 WWPN = BURNED IN
- iSCSI Boot Setup? = Option ROM to configure per server

Boot order = MANUALLY Setup within the BIOS

1. Virtual CD-ROM
2. vHBA0, 50:00:16:aa:bb:cc:0a:01, LUN 00, primary (COORDINATION)
3. vHBA1, 50:00:16:aa:bb:cc:0b:01, LUN 00, secondary (COORDINATION)
4. vNIC0

Host Firmware = BURNED IN For: Disk Controller, BIOS Version, HBA Option ROM, NIC, Mainboard, etc.

Management Firmware Policy = BURNED IN on BMC

IPMI Access = ANYONE ON MANAGEMENT NETWORK

Serial-over-LAN access = PHYSICAL CONNECTION OF SERIAL PORT

Monitoring Threshold Policy = MANUAL THRESHOLDS FOR ALL COMPONENTS

BIOS Settings = MANUALLY SET FOR ALL CUSTOMISATIONS AND USAGE

OS Configuration = Create Linux bond.0, or Windows Team

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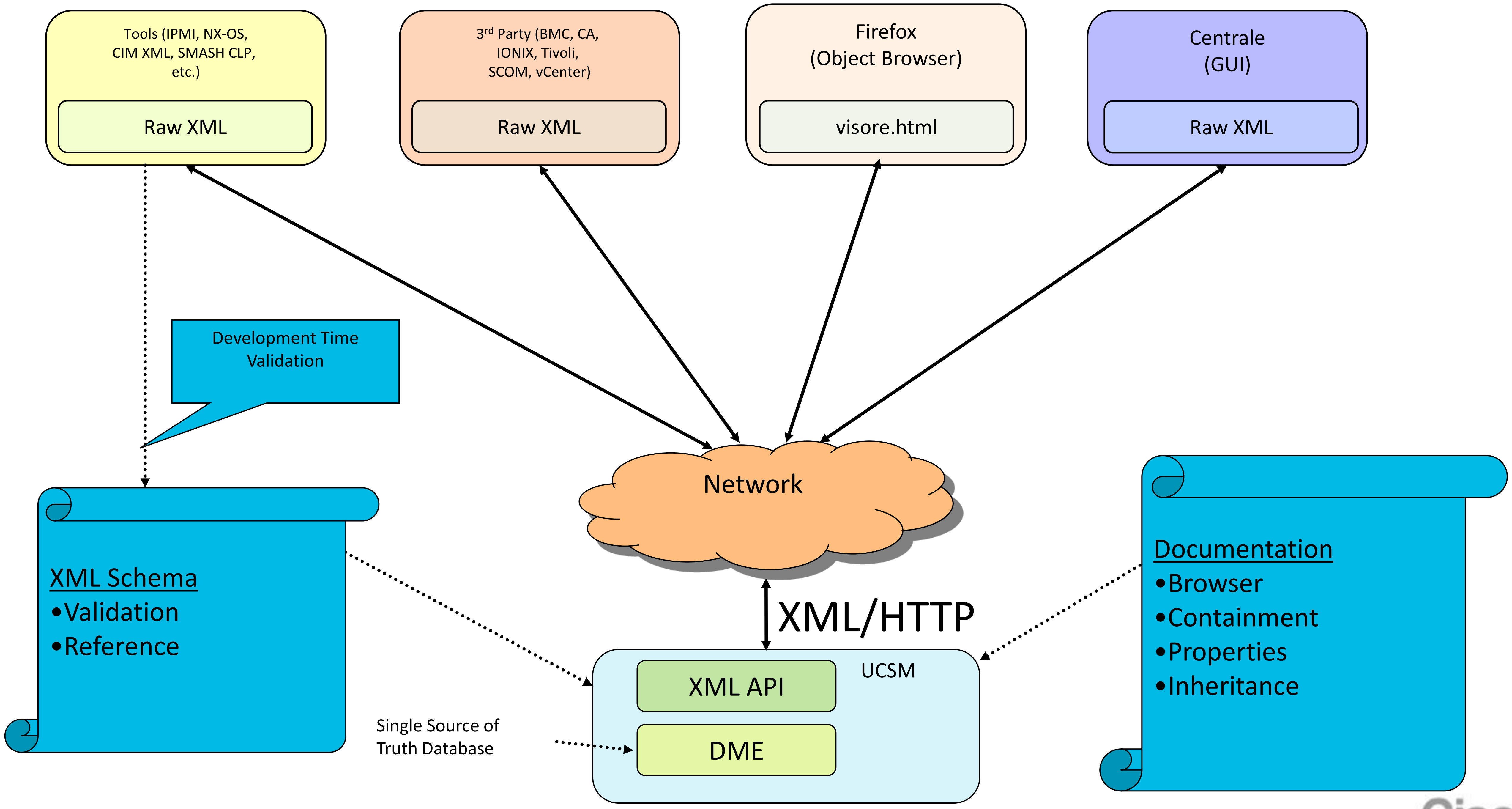
UCS Technologies for Elasticity

XML Objects are Fundamental



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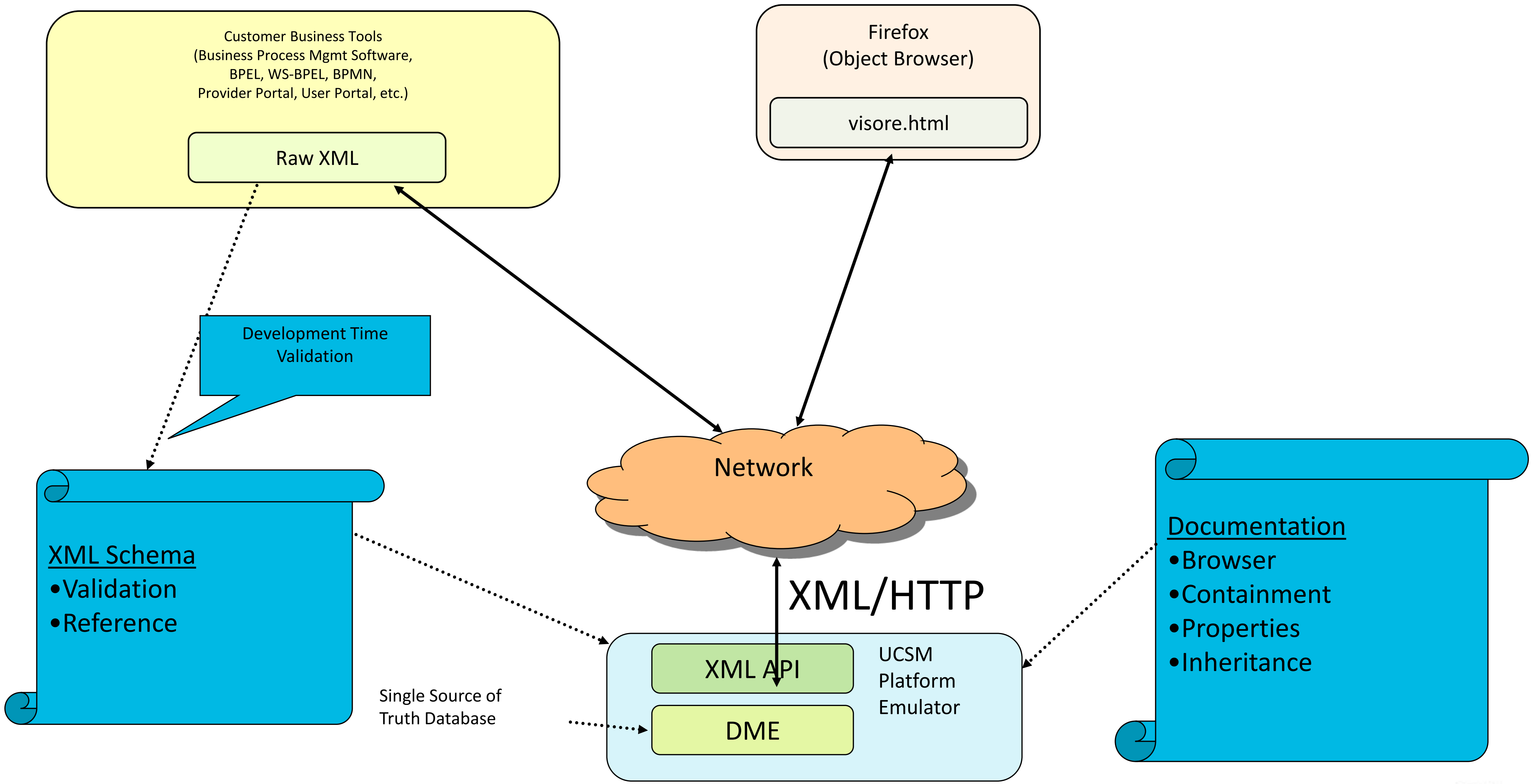
UCS Technologies for Elasticity

Open XML Development – No UCS Hardware Required



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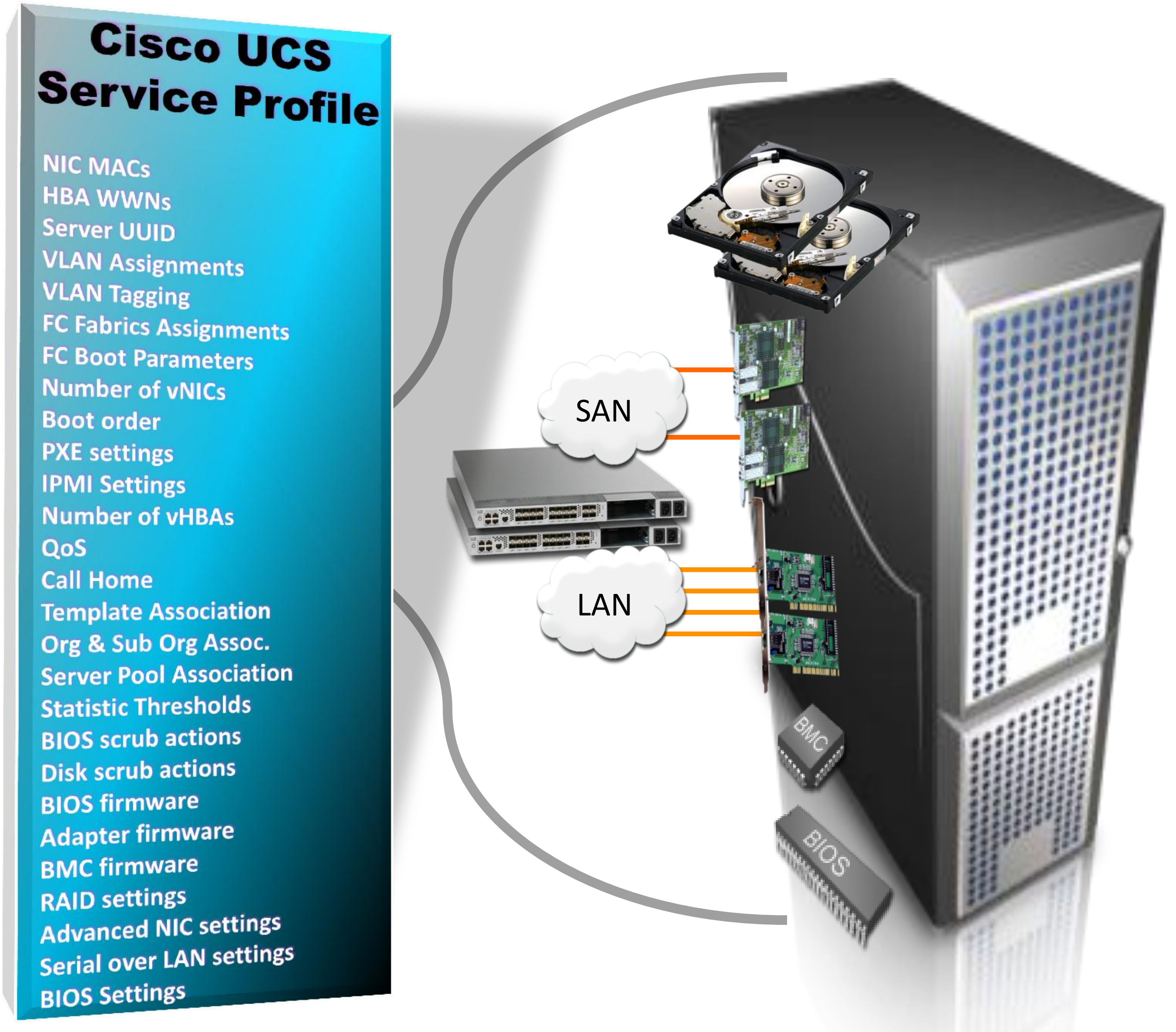
UCS Service Profiles

Workload Centric

- Servers are specifically purchased for additional capacity and provide service elasticity
- Server identities are defined by the service profile
- Management of servers provided through the very system that defines them (UCSM).



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UCS Service Profiles

A UCS Server (not a blade, but an XML object in database)

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Boot order = MANUALLY Setup within the BIOS

1. Virtual CD-ROM
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3. vHBA1, 50:00:16:aa:bb:cc:0b:01, LUN 00, secondary (COORDINATION)
4. vNIC0

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Serial-over-LAN access = PHYSICAL CONNECTION OF SERIAL PORT

Monitoring Threshold Policy = MANUAL THRESHOLDS FOR ALL COMPONENTS

BIOS Settings = MANUALLY SET FOR ALL CUSTOMISATIONS AND USAGE

OS Configuration = Create Linux bond.0, or Windows Team

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UCS Service Profiles

Most Things are Static – what about using templates and pools

- Profile Name = vmhost-cluster1-[#]
- UUID = 12345678-ABCD-9876-5432-[SuffixPool]
- Description = ESX4-1 – Host in Cluster 1
- Network Side LAN Config
  - Adapter PCI Order = vNIC0 first, then vNIC1, then vHBA…..
  - Number of NIC's = VMware-Static-NIC-Policy
  - vNIC0 Switch = Switch A
  - vNIC0 Pin Group = SwitchA-pingroupA
  - vNIC0 VLAN Trunking = Enabled
  - vNIC0 Native VLAN = VLAN 100
  - vNIC0 MAC Address = [MAC_Pool_ESX]
  - vNIC0 Hardware Failover Enabled = No
  - vNIC0 QoS policy = VMware-QoS-policy
  - vNIC1 Switch = Switch B
  - vNIC1 Pin Group = SwitchB-pingroupA
  - vNIC1 VLAN Trunking = Enabled
  - vNIC1 Native VLAN = VLAN 100
  - vNIC1 MAC Address = [MAC_Pool_ESX]
  - vNIC1 Hardware Failover Enabled = No
  - vNIC1 QoS policy = VMware-QoS-policy
  - Policy for VM vNIC's = 101_Policy, 102_Policy, 103_Policy...
- Server Side LAN Config
  - ESX Networking= VM vNIC tied to Port-Group:
    101_Policy, 102_Policy, 103_Policy, etc.
- Local Storage Profile = RAID1
- Scrub Policy = Scrub local disks only

SAN Config

- Node ID = [WWNN_Pool_ESX]
- Adapter Parameters = VMware-4-1-BFS
- vHBA0 Switch = Switch A
- vHBA0 VSAN = VSAN1-FabricA
- vHBA0 WWPN = [WWPN_Pool_ESX]
- vHBA1 Switch = Switch B
- vHBA1 VSAN = VSAN1-FabricB
- vHBA1 WWPN = [WWPN_Pool_ESX]
- iSCSI Boot Setup? = Programmed in per policy to boot IQN

Boot Policy = boot-from-ProdVMax

Boot order =

1. Virtual CD-ROM
2. vHBA0, 50:00:16:aa:bb:cc:0a:01, LUN 00, primary
3. vHBA1, 50:00:16:aa:bb:cc:0b:01, LUN 00, secondary
4. vNIC0

Host Firmware Policy = VIC-EMC-vSphere4

Management Firmware Policy = 1-3-mgmt-fw

IPMI Profile = standard-IPMI

Serial-over-LAN policy = VMware-SOL

Monitoring Threshold Policy = VMware-Thresholds

BIOS Settings = VMware-IntelVT-Settings

OS Configuration = Create Linux bond.0, or Windows Team

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UCS Service Profiles

Taking it further, adapters grouped with LAN/SAN config

- Profile Name = vmhost-cluster1-[#]
- UUID = 12345678-ABCD-9876-5432-[SuffixPool]
- Description = ESX4-1 – Host in Cluster 1

- Network Side LAN Config
  - Adapter PCI Order = vNIC0 first, then vNIC1, then vHBA…..
  - Number of NIC's = VMware-Static-NIC-Policy
  - vNIC0 Adapter Template = [ESX-A-LAN-Fabric]
  - vNIC1 Adapter Template = [ESX-B-LAN-Fabric]
  - Policy for VM vNIC's = 101_Policy, 102_Policy, 103_Policy...

- Server Side LAN Config
  - ESX Networking= VM vNIC tied to Port-Group:

    101_Policy, 102_Policy, 103_Policy, etc.

- Local Storage Profile = RAID1
- Scrub Policy = Scrub local disks only

SAN Config

- Node ID = [WWNN_Pool_ESX]
- Adapter Parameters = VMware-4-1-BFS
- vHBA0 Adapter Template = [ESX-A-SAN-Fabric]
- vHBA1 Adapter Template = [ESX-B-SAN-Fabric]
- iSCSI Boot Setup? = Programmed in per policy to boot IQN

Boot Policy = boot-from-ProdVMax

Boot order =

1. Virtual CD-ROM
2. vHBA0, 50:00:16:aa:bb:cc:0a:01, LUN 00, primary
3. vHBA1, 50:00:16:aa:bb:cc:0b:01, LUN 00, secondary
4. vNIC0

Host Firmware Policy = VIC-EMC-vSphere4

Management Firmware Policy = 1-3-mgmt-fw

IPMI Profile = standard-IPMI

Serial-over-LAN policy = VMware-SOL

Monitoring Threshold Policy = VMware-Thresholds

BIOS Settings = VMware-IntelVT-Settings

OS Configuration = Create vSwitch active/active setups

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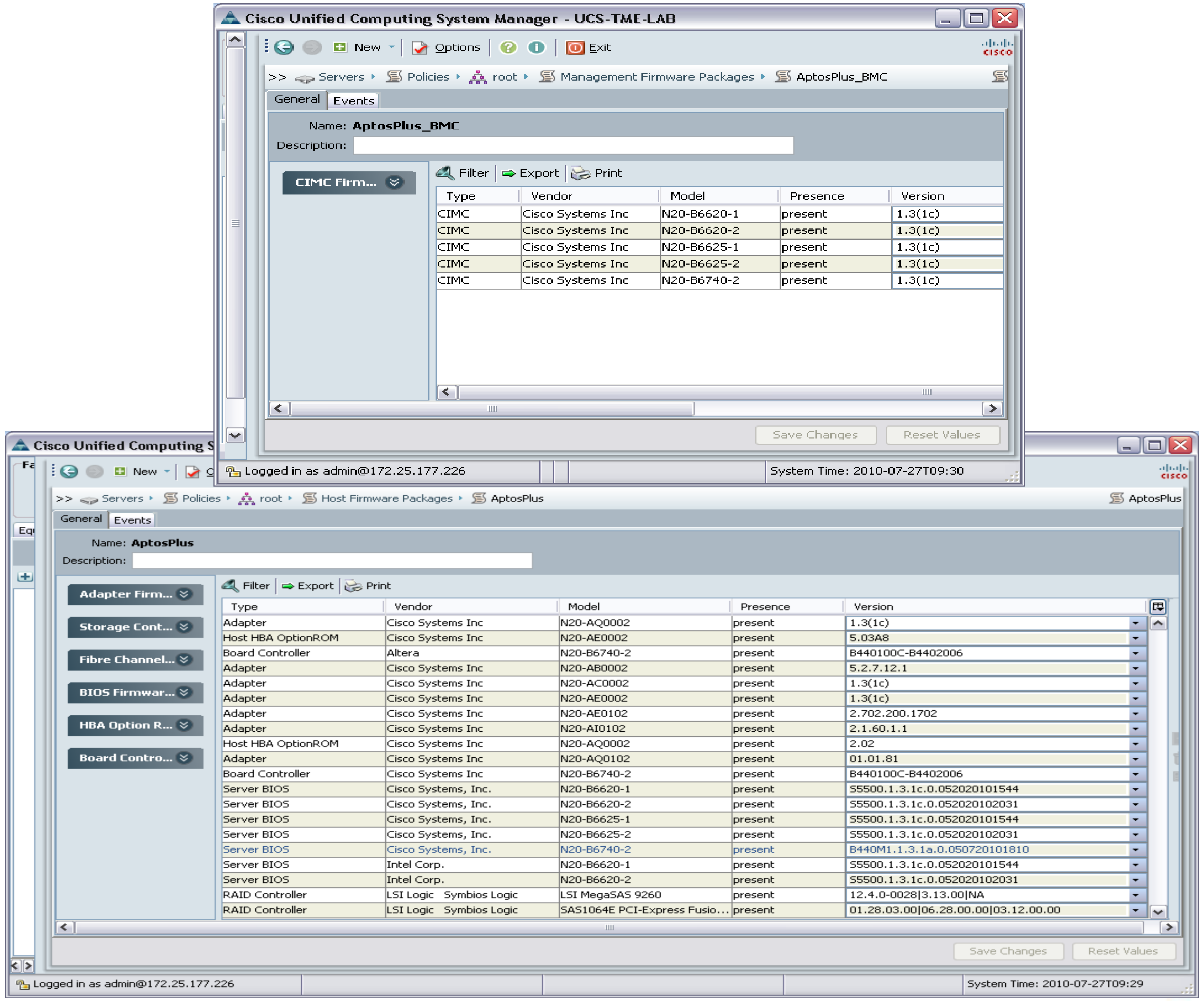
UCS Service Profiles

Centralised Firmware Management

- Complete control of firmware that is qualified for use per application that will be running
- Various Components
  - Management Controller
  - BIOS
  - Option ROM
  - RAID Controller
  - NIC's
  - HBA's
  - Main Board
- Pulled into a profile or a profile template
- Allows for removing the firmware state on server
  - Easier automation possible



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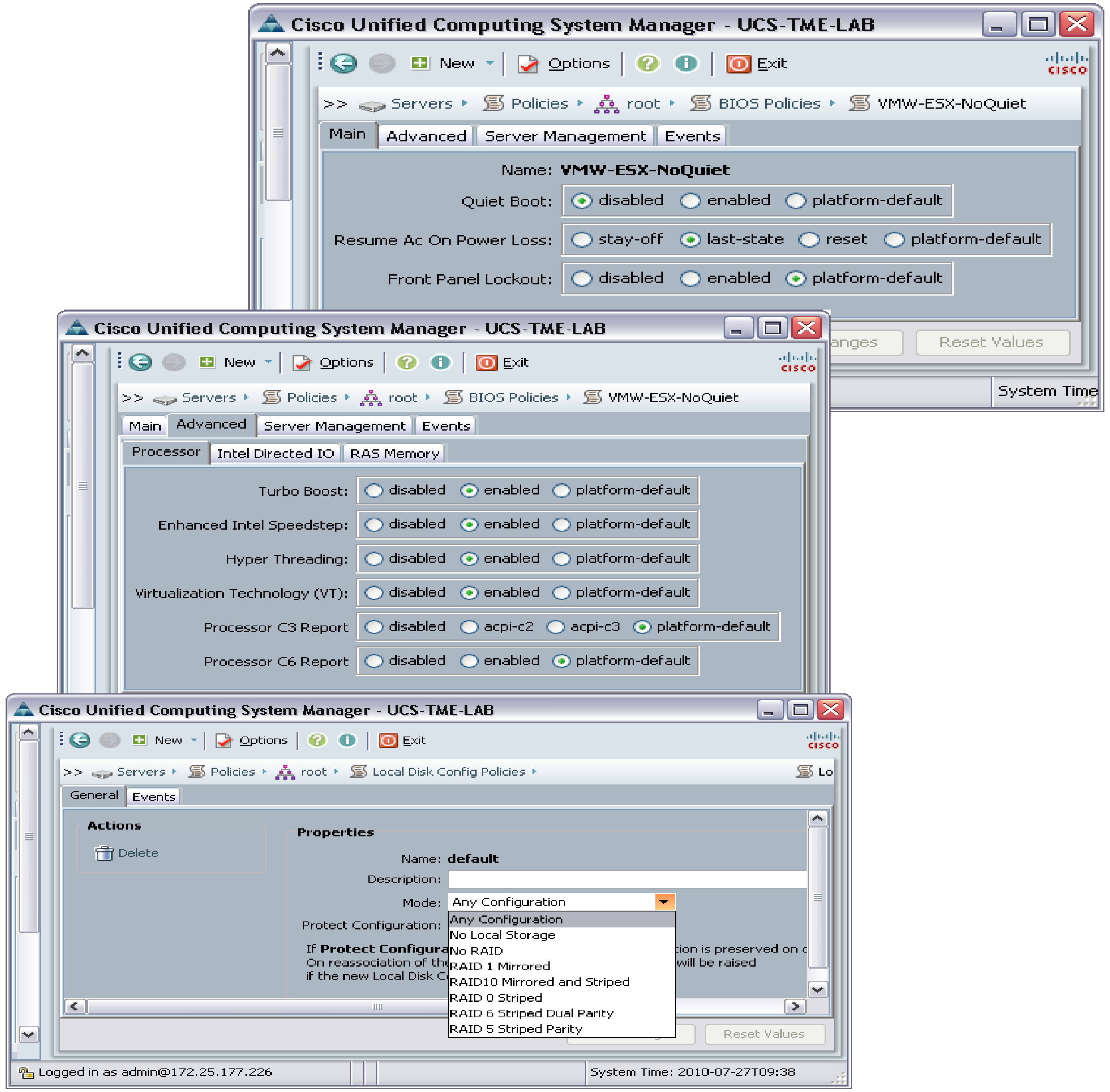
UCS Service Profiles

BIOS and RAID Controller Management

- Complete control of BIOS settings
  - All pertinent fields are configurable in a BIOS policy
  - When profile is associated, the BIOS settings are also matched to the preference of the application
- Complete control of RAID settings
  - RAID configuration can be setup on a profile basis
  - RAID can be protected – if a profile application to an existing RAID server, can raise exception rather than applying
- Allows for removing the low-level configuration state on server
  - Easier automation possible



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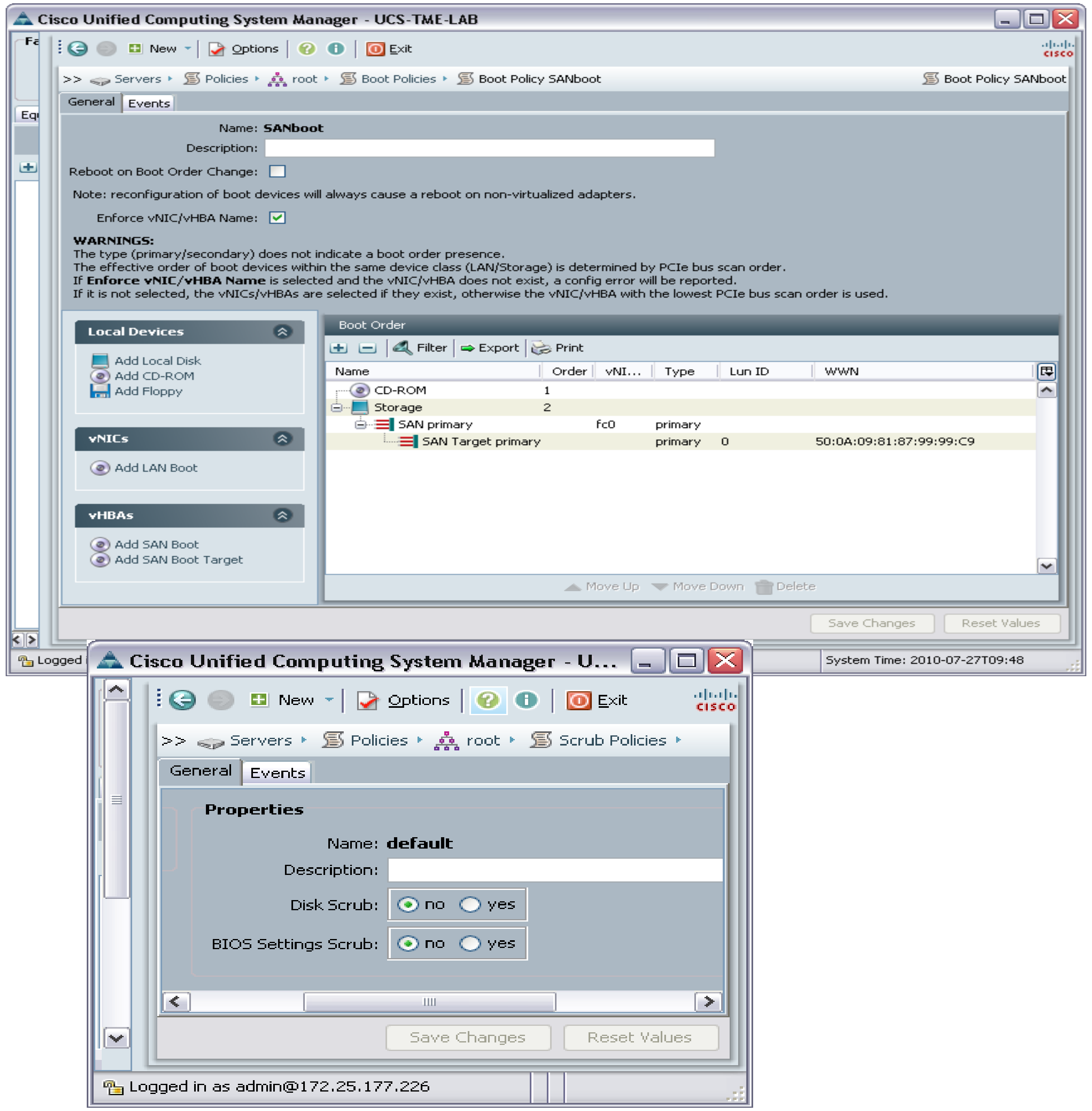
UCS Service Profiles

Boot and Server Disassociate Management

- Complete control of system boot policy separate from the BIOS settings
  - PXE, FC SAN boot today
  - iSCSI boot soon
  - Virtual media (CDROM, .iso, USB, floppy)
- Complete control of how to return a server to the infrastructure when no longer required
  - Called “Scrub Policy”
  - Optionally clear BIOS settings
  - Optionally wipe local disk boot sector and table
- Allows for removing the low-level configuration state on server
  - Easier automation possible



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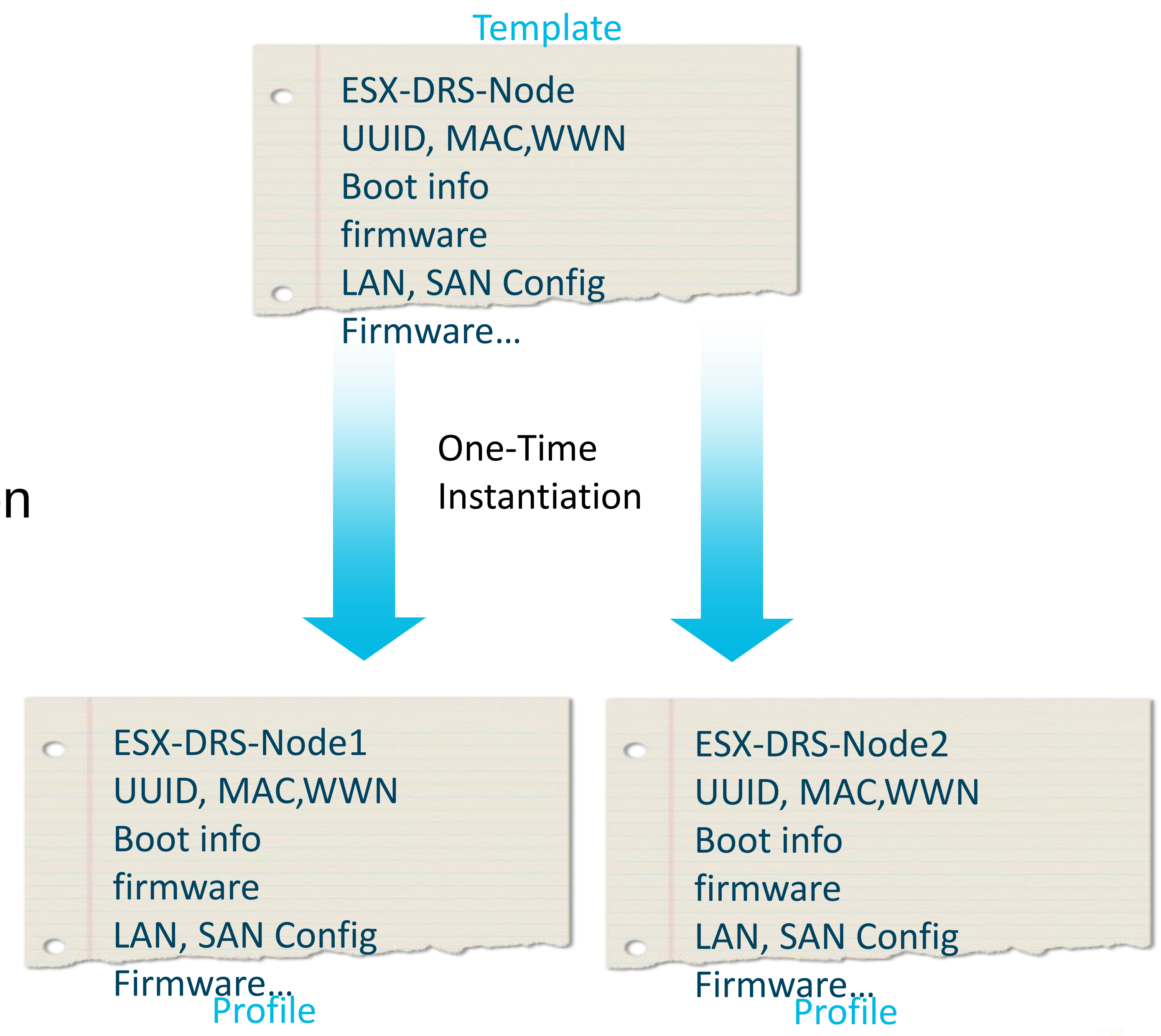
UCS Service Profiles

Initial Service Profile Templates

- Default mode if customer using templating
- Create 1 or more profiles from template
  - Can later create more when needed
- Draw 1 or more entries from pools of server unique template data
  - UUID, MAC, WWN, etc.
  - When profile is created
- Administrator or XML API can then modify configuration of profile
  - Used functionally as a starting-point
  - Shows as bound to initial template (record of origin)
- Ability to extrapolate a given profile into an initial template for future use
- Local disk implies state, Boot from SAN or iSCSI is stateless
  - Boot and Data images can stay on SAN storage for when needed



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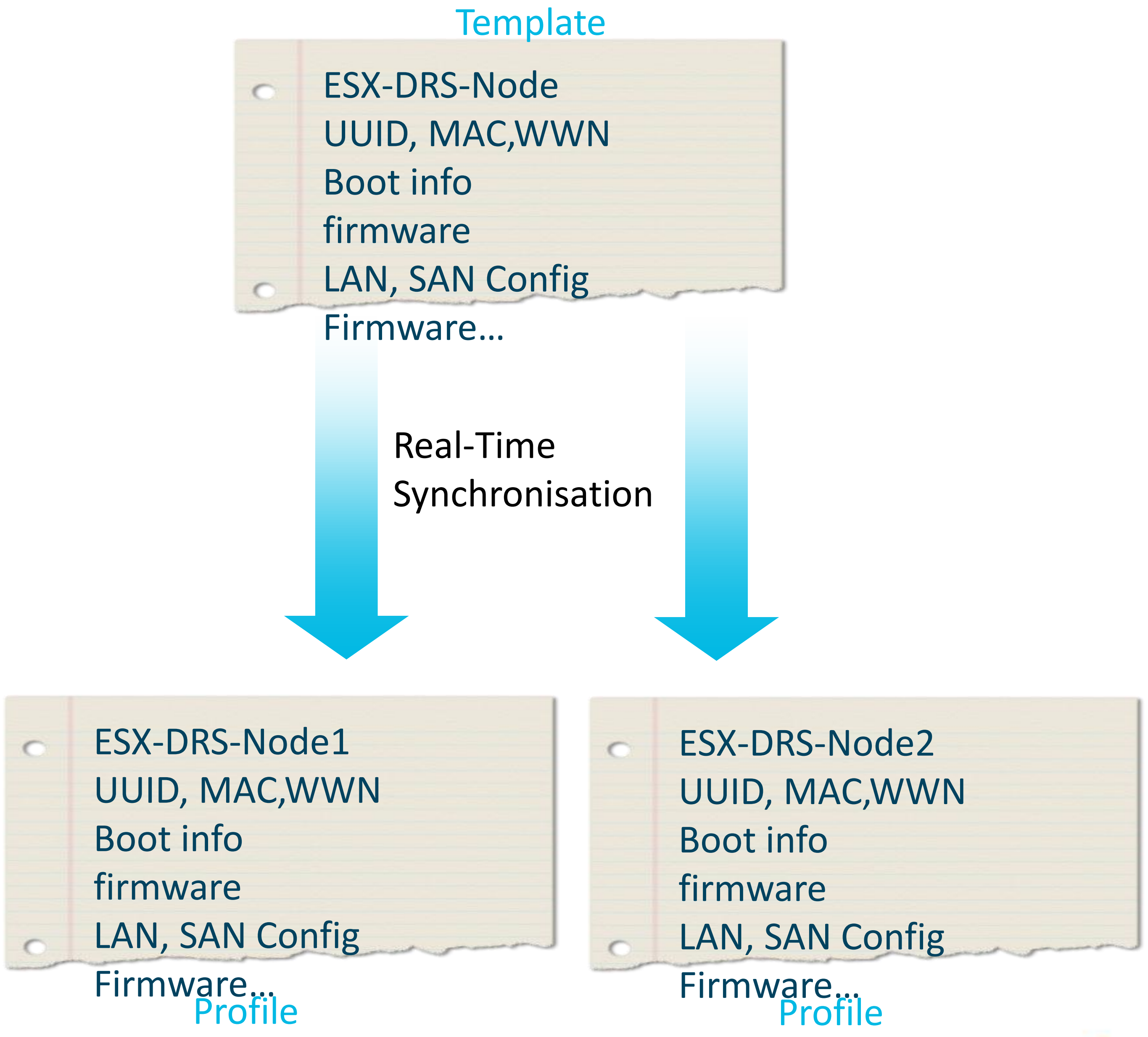
UCS Service Profiles

Updating Service Profile Templates

- Method to coordinate changes over groups of servers
- Create 1 or more profiles from template
  - Can later create more when needed
- Draw 1 or more entries from pools of server unique template data
  - UUID, MAC, WWN, etc.
  - When profile is created
- Administrator or XML API can then modify configuration of profile
  - Shows as bound to updating template (proof of tie)
  - No ability to modify the profiles directly
- Ability to extrapolate a given profile into an updating template for future use
- Later changes to template are propagated to profiles
  - Understanding of service impacting changes key



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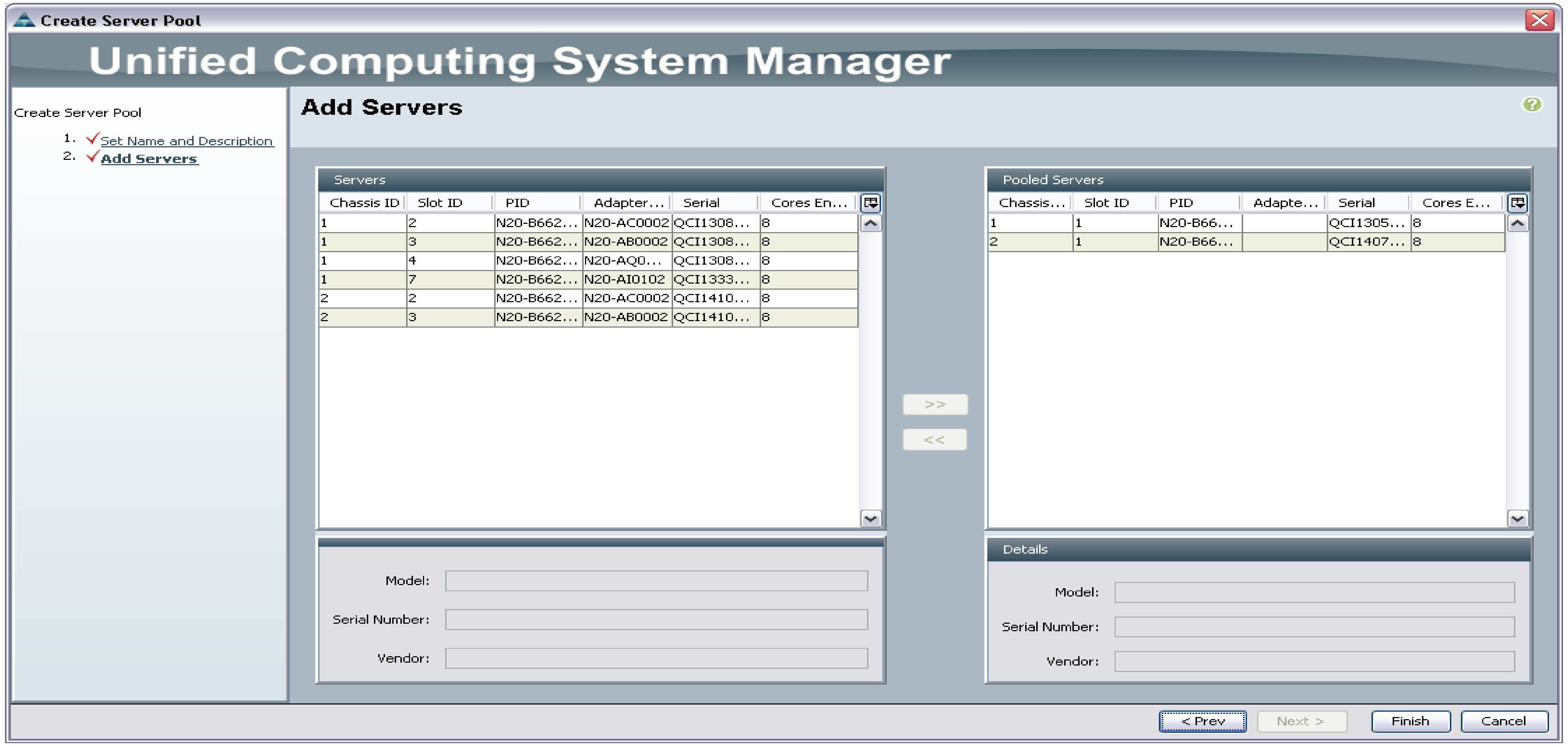
UCS Hardware Resources

Server Pools



- Method of pulling physical blades into server pool shown
- Can be any blade on any chassis, or rack-mount pooled together

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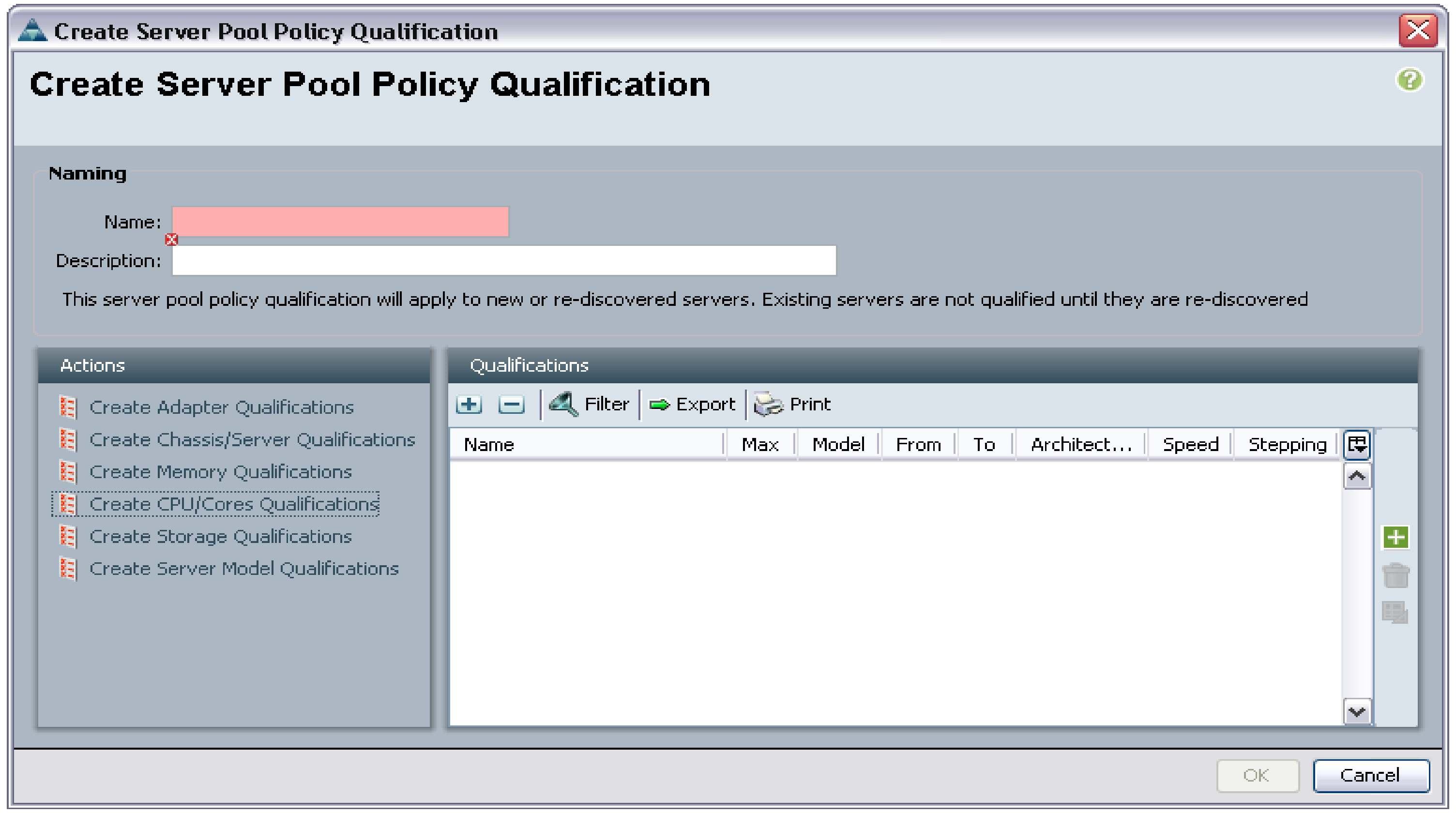
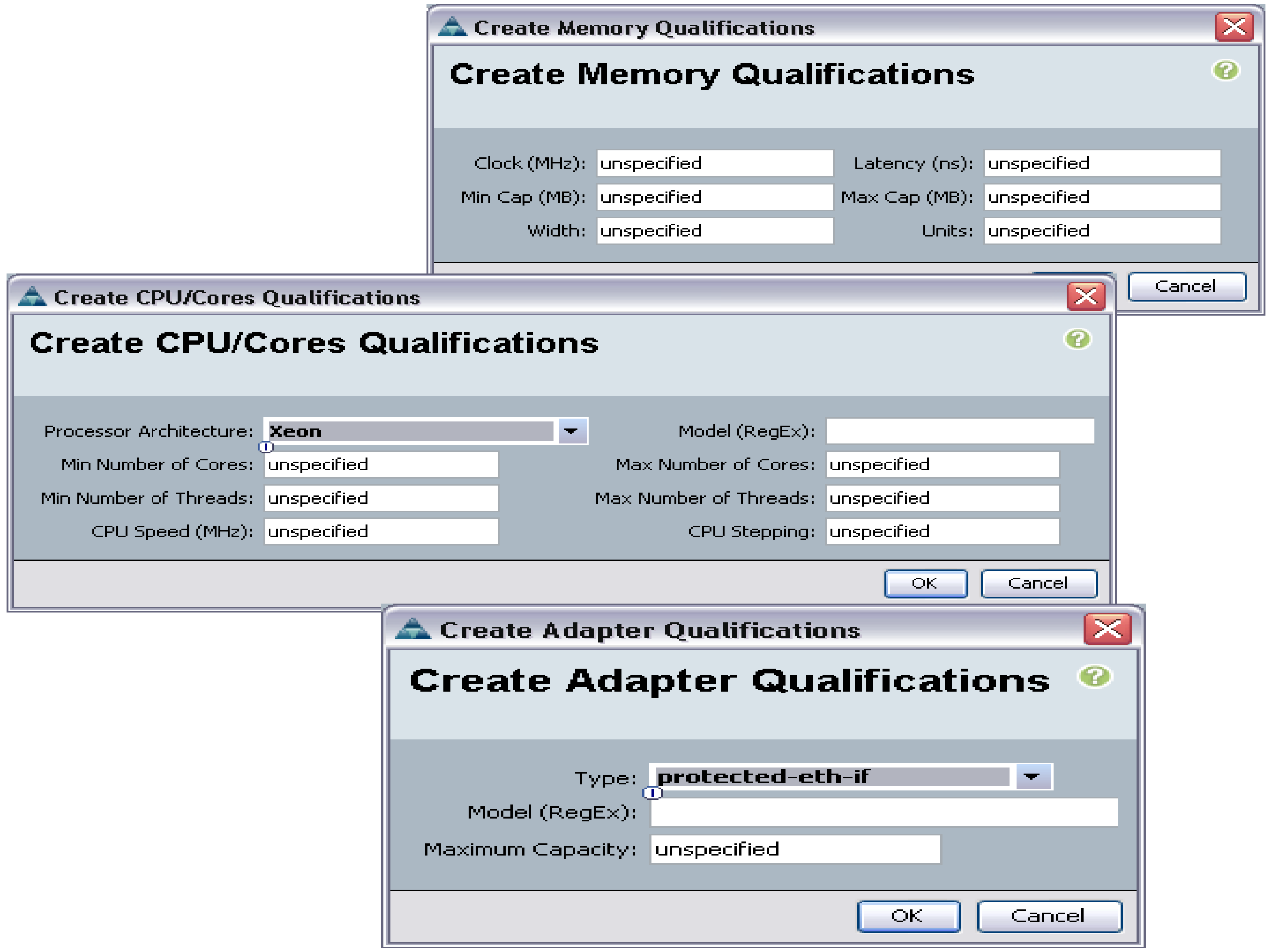
UCS Hardware Resources

Server Pool Qualification Policies





- As hardware added into UCS, it can be automatically added to pools to offer SLA's
  - By chassis/slot/organisation for ownership of hardware
  - Qualified by this policy, and made available to users as unconfigured device in the appropriate pool
- Method to select minimums for hardware pool candidates
- Server pool policy to map pools to minimal qualifiers

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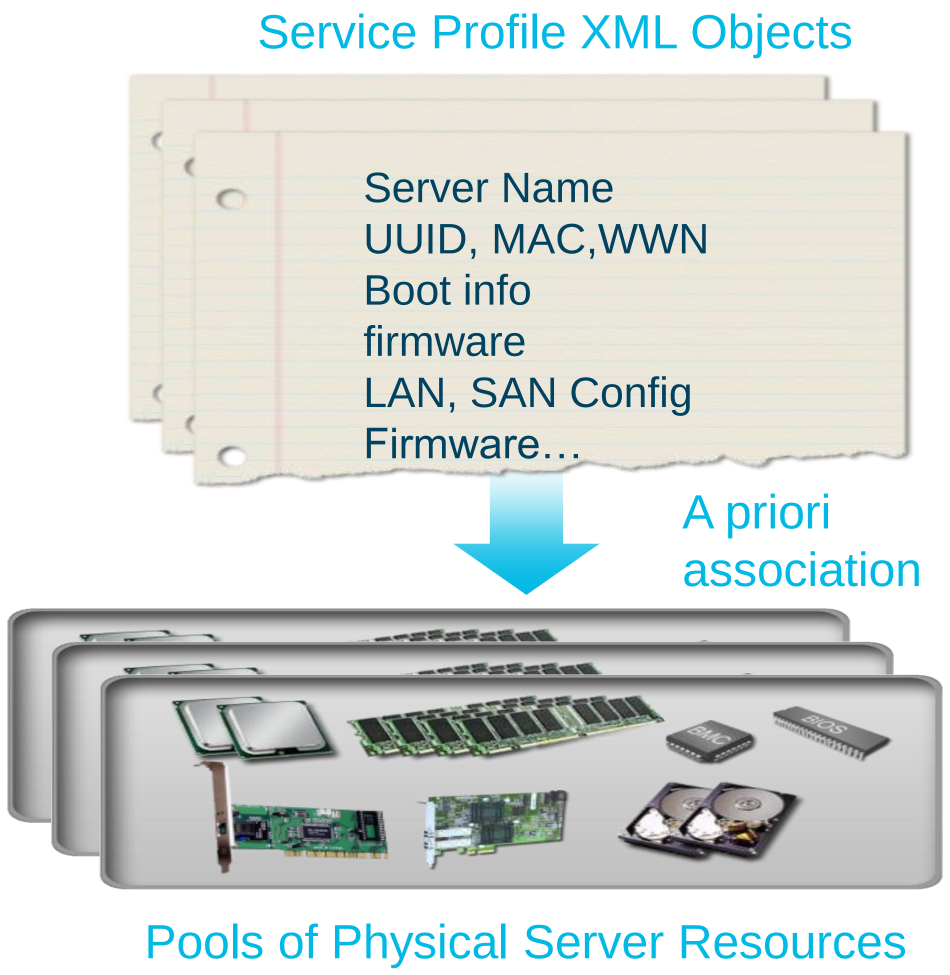
UCS Operations

Invoking a UCS Server



- If Single Profile and Single Compute Instance
  - Administrator or XML API invokes association
  - Administrator or XML API assigns server power state
  - Administrator or XML API stops server
  - Administrator of XML API dissolves association
- If Servers are Pooled
  - Administrator or XML API invokes association to pool
  - Administrator or XML API then functions as above
- If Service Profile Templates and Pools
  - Administrator or XML API defines number of servers required and the desired power states
  - UCS system, assigns profiles to available compute in the pool (which has been classified before the fact)
  - Administrator or XML API then administers individual servers as above, but configuration is bound to template

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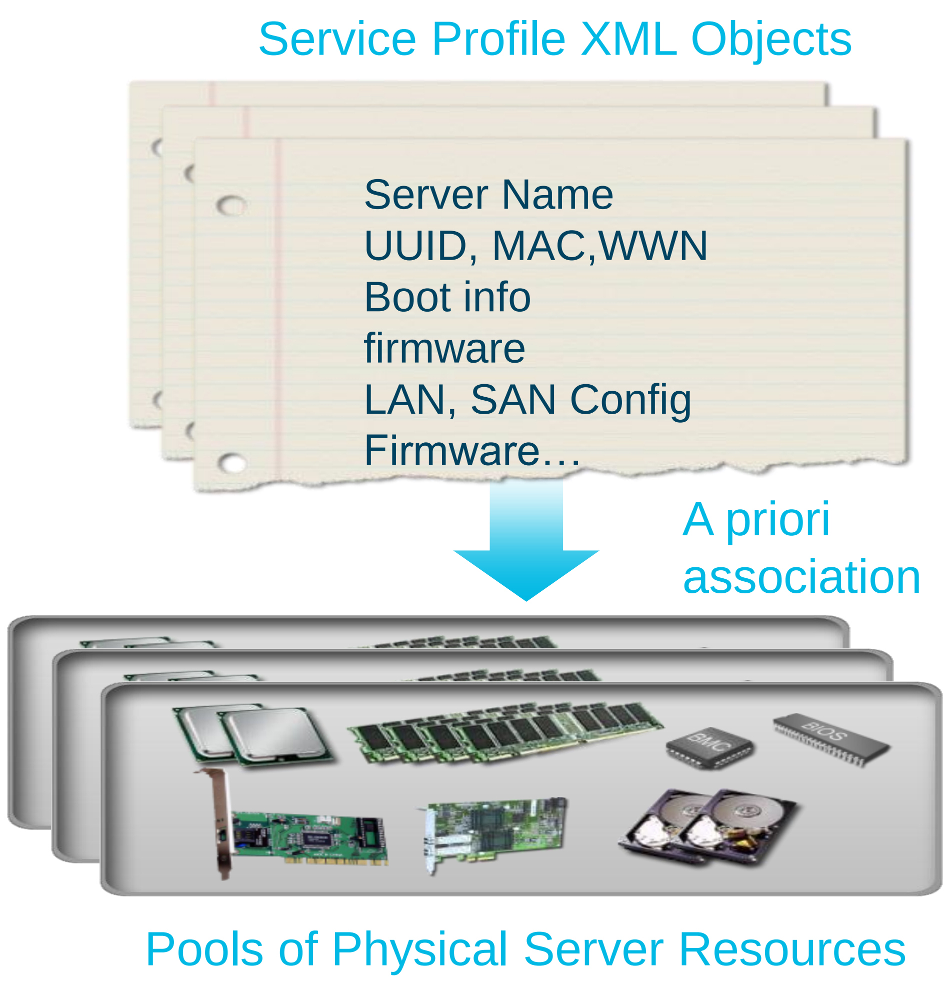
UCS Operations

Invoking a UCS Server (Continued)

- At profile assignment time
  - Blades take on configuration via processing node utility OS configuration run, LAN and SAN edge configured
- We are “informing” the stateless compute node of who it is, along with the network and SAN edge that the server connects to
- We have the XML object in the UCS database
  - Examinations of server configurations grouped
  - No CMDB interaction with bare-metal server
- With updating templates, we have a “bound” relationship where profiles are guaranteed to be matching the template
  - Audit the template, and show bound profiles
  - Reduced audit scope from a server hardware perspective



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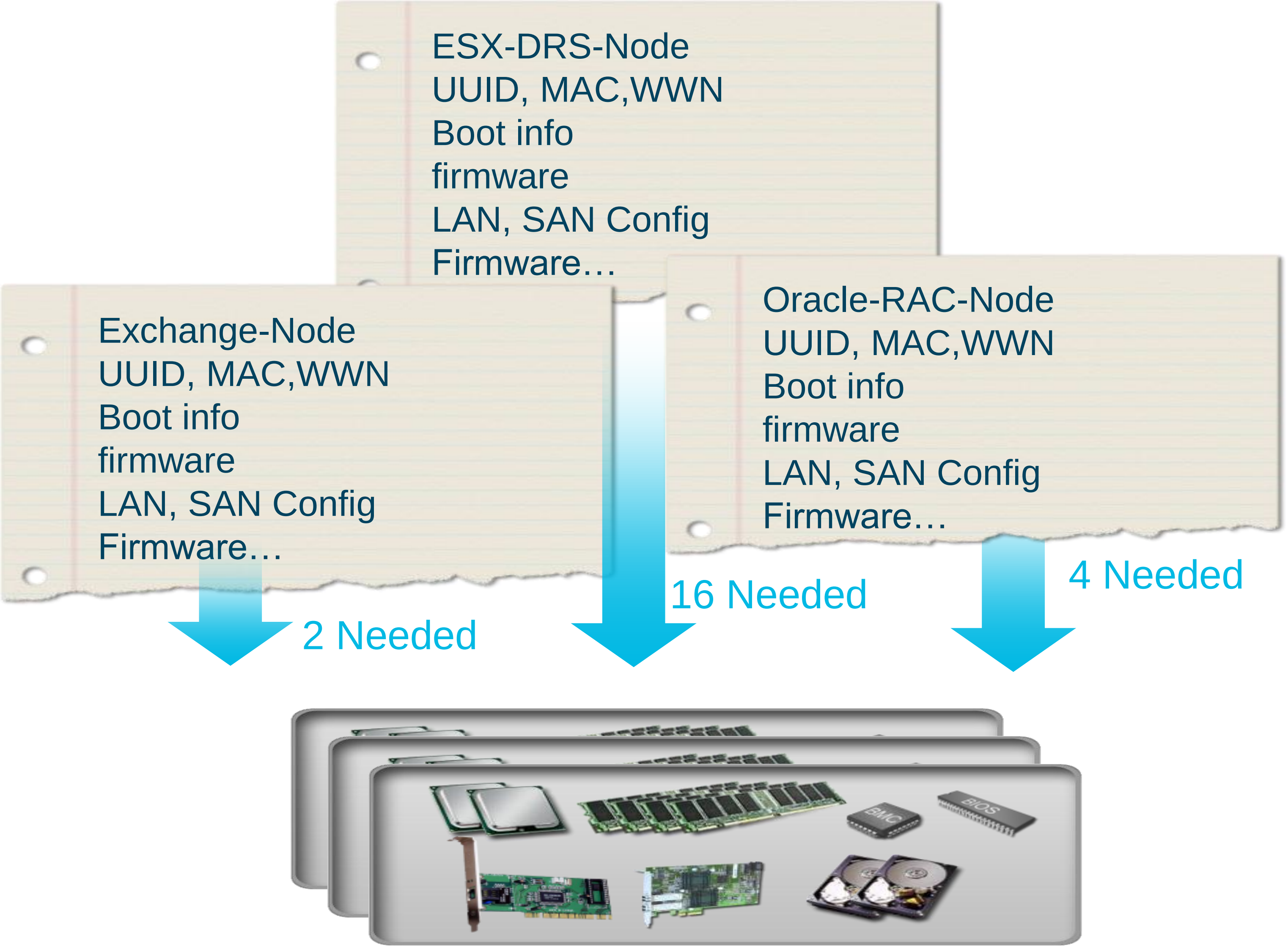
UCS Operations

Infrastructure Automation from Profiles or Templates

- Supports fast turnaround business requirements
- No need to maintain cache of servers for each service type
- Can assign business priority to each server
  - Temporarily disassociate lower priority services when compute needed
- Can assign project length to each server or group of servers
  - Can disassociate after sign-up period (and appropriate governance)
  - Make reclaimed compute available for other projects
  - Preservation of boot/data images (disk/LUN) needed if project restoral needed later
- Boundary for services is not a chassis or rack
  - Server Pools and Qualifications allow more intelligent infrastructure



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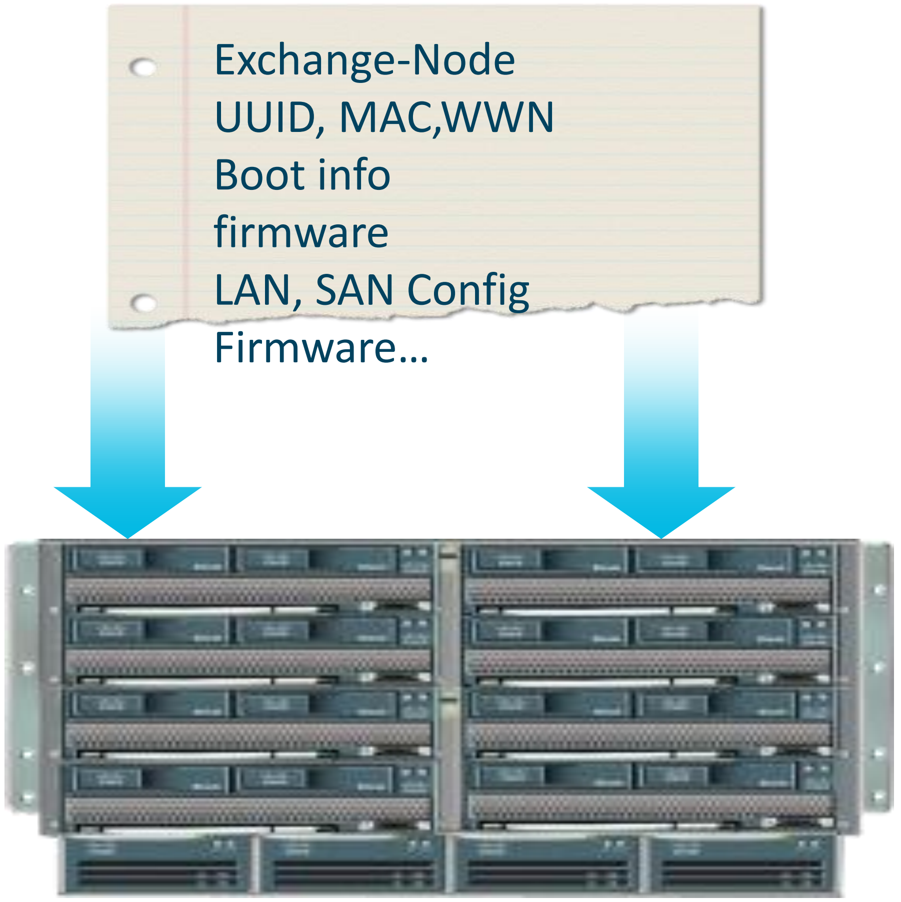
UCS Operations

Stateless Implies Server Mobility at Bare Metal

- Supports fast turnaround business service SLA
- No need to re-build servers
- Profile or Profiles can move from hardware to hardware within UCS without re-building
- Bring off-hours troubleshooting of hardware now in-hours when de-commission faulty hardware
- Easy to clone servers to scale



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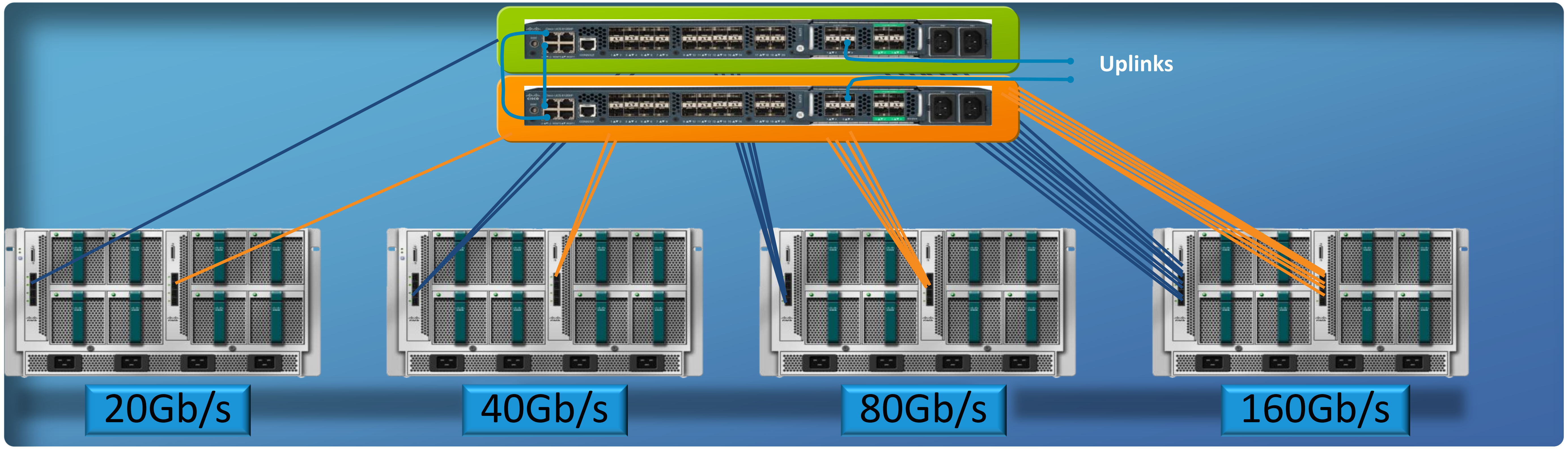
Network Abstraction

UCS Infrastructure

Intra-UCS Cabling and Licensing



- Wire Once Architecture – 20 chassis per UCS today, more coming
- All links can be active all the time
- Numbers and types of I/O adapters are not fixed on a given server (no rules on placements relative to backplane, types of cards, etc.)
- All servers can have storage access at no added costs (Stateless)
- Licensing on ports within FI (not tied to chassis directly)
- Infrastructure will not need to take licensed features into account (Stateless)

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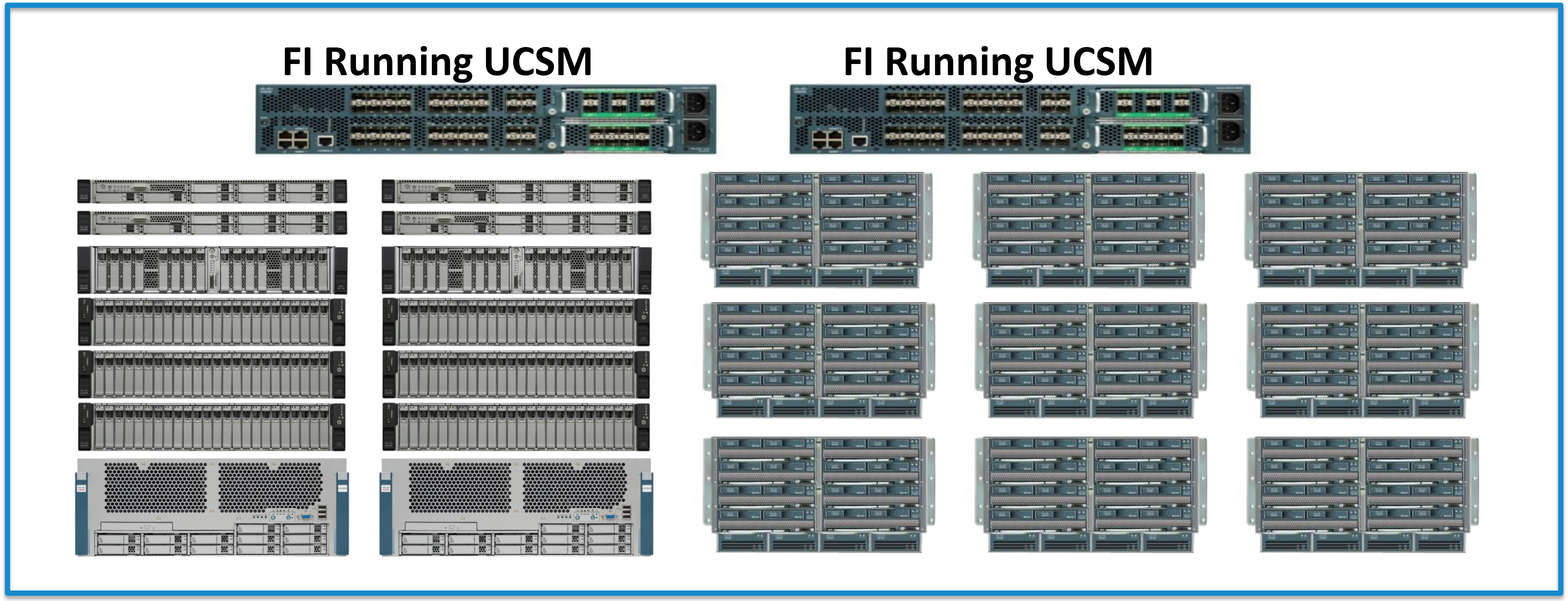
UCS Infrastructure



- Typical Infrastructure: Assign a business use to a chassis
  - Some chassis filled and requires new purchases of chassis, LAN I/O modules, SAN I/O modules, Management modules, Intra-DC cabling all required
  - Open capacity in other chassis are stranded
  - Leads to slower business turn-around
- With UCS, grouping of business functions can be virtual within array – or on Rack-Mounted arrays near-term – Single Management Entity for a UCS array

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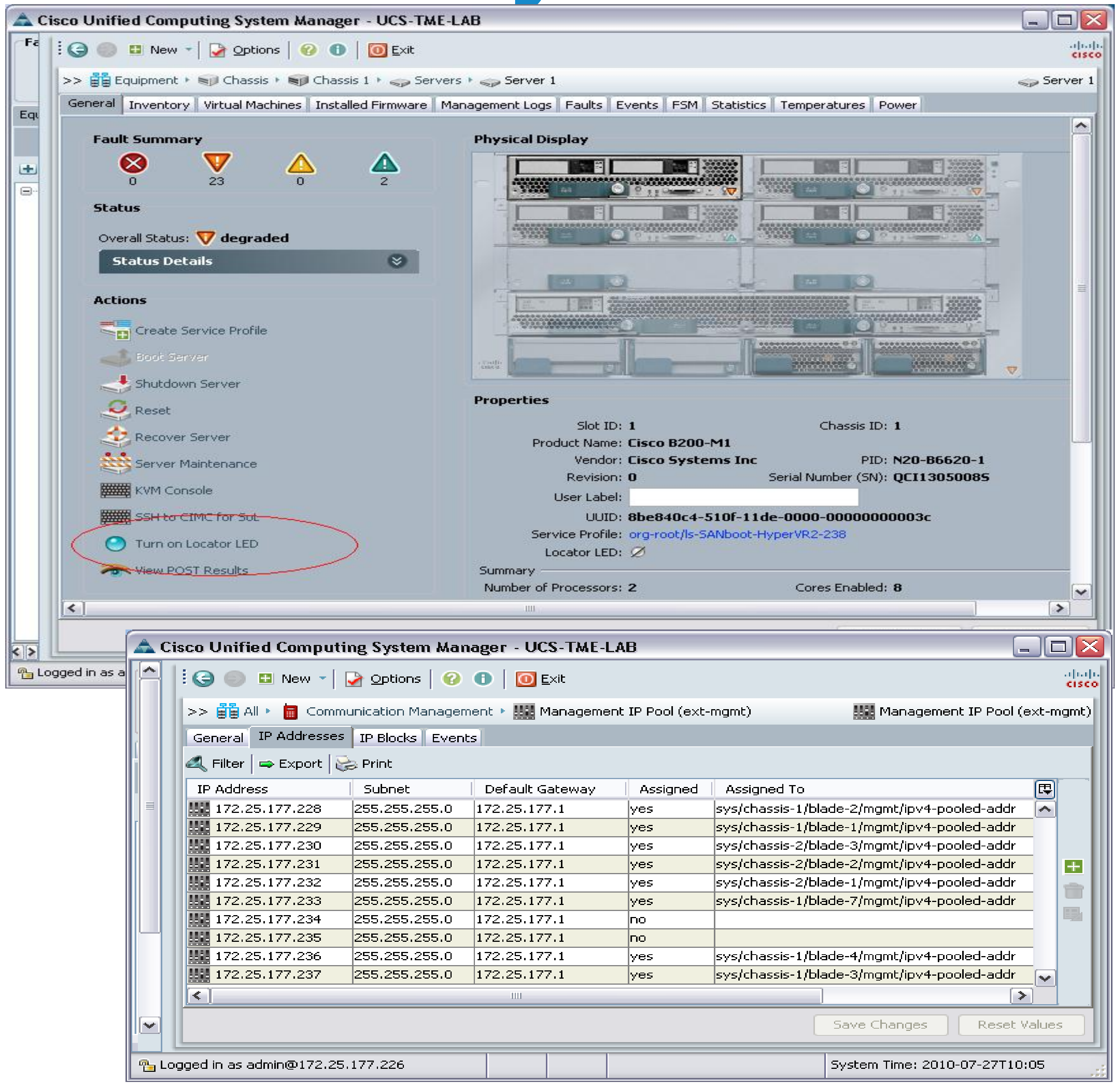
UCS Management Connectivity

Lights out Management

- There is no advantage in UCS to be in front of or near system
- All Field Replaceable Units (FRU) hot swappable
  - All have a LED “beacon” to indicate to facilities personnel item needing replacement
  - Greatly decrease IT engineering rolls onsite to DC
- KVM over IP supported
  - Integrated – not a licensable feature
  - Remote Media (.iso, CDROM, USB, virtual floppy)
  - Serial over LAN (also policy-based) for Linux terminal/console serial access – along with KVM for X session
  - KVM IP and MAC will be in service profile



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UCS Networking Basics

Different School of thought for I/O

- LAN and SAN access ports typically configured “along-side” peer server port configuration
  - With UCS the LAN and SAN access configuration is now part of the server configuration within the data model – yet managed by current LAN/SAN teams
- Virtual Machine adapters are typically one or two switching entities away from the network edge
  - With UCS the Networking Edge can reach directly to the Virtual Machine’s virtual adapter
- Legacy servers have “State” as NICs and HBAs are added to PCI slots
  - With UCS the existence, counts, types, identifiers, etc. of I/O cards can be imposed on a server – not just queried

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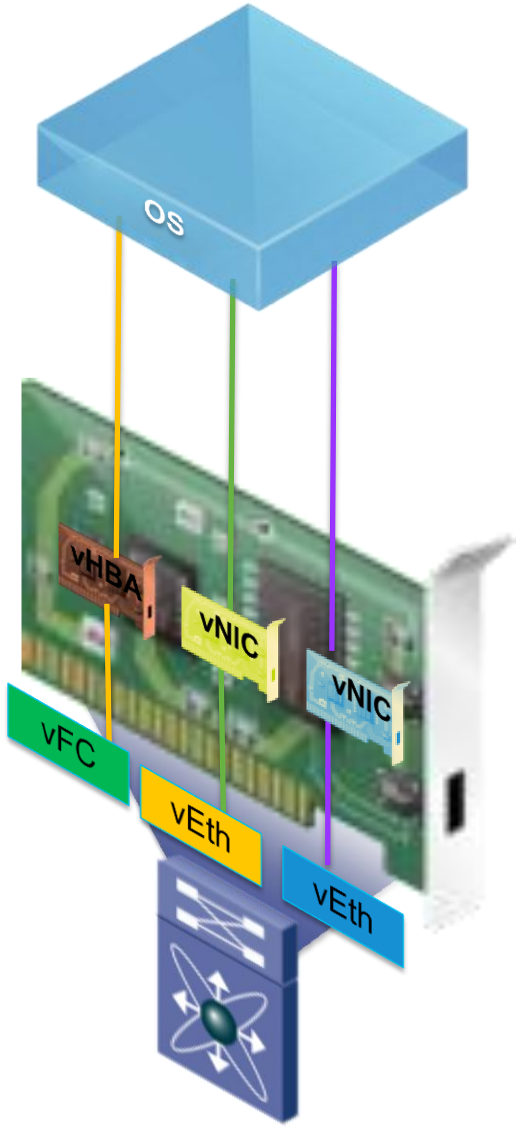
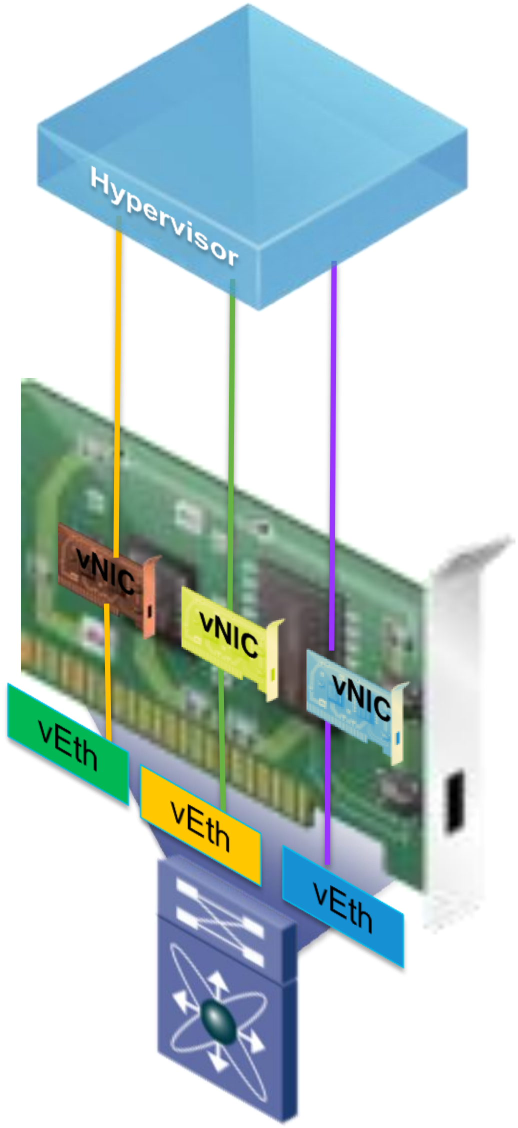
UCS Networking Basics

Adapter FEX



VM- FEX



OS See's Administratively definable (MAC, QoS, VLAN, VSAN, WWPN, etc.) Ethernet and Fibre Channel interfaces which connects to a Cisco virtual interface (VIF)

Hypervisor see's unconfigured (no MAC, VLAN, etc.) Ethernet interfaces which are configured by the external VMM and connects to a Cisco virtual interface (VIF)

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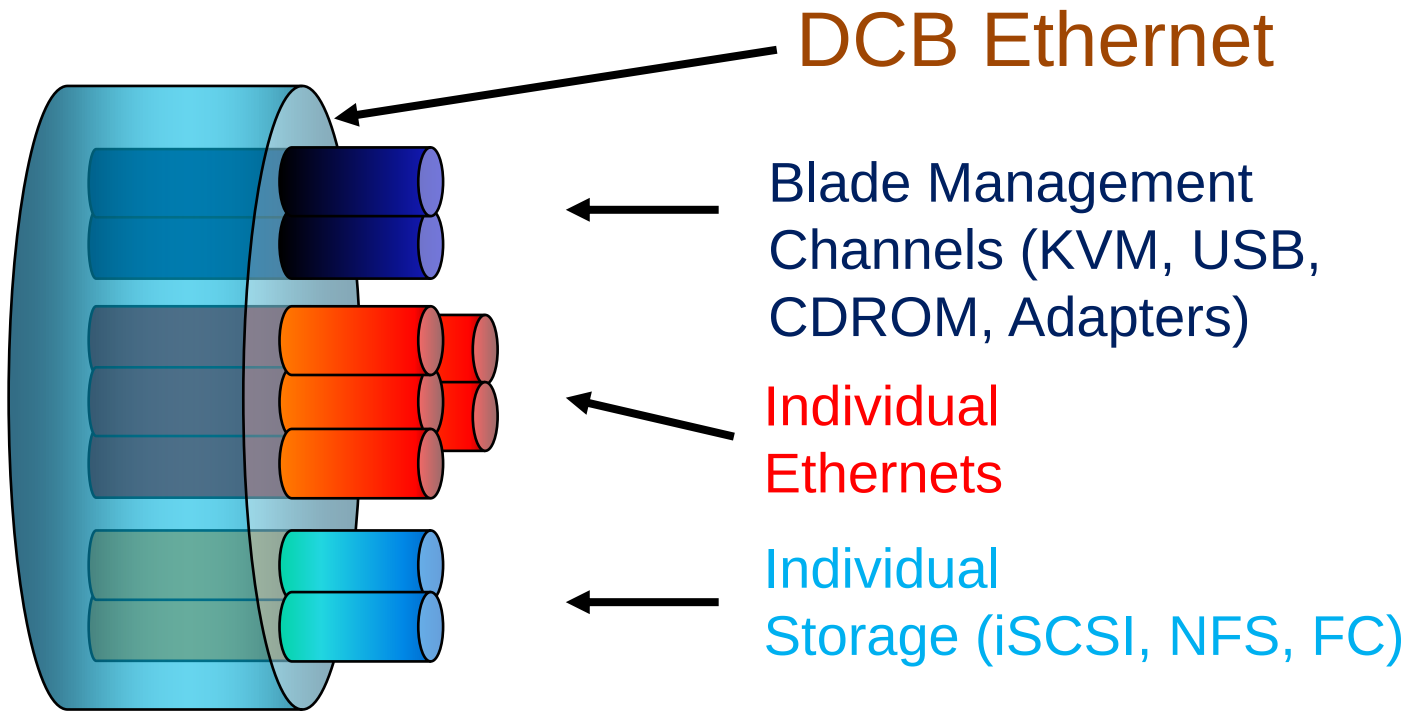
UCS Networking Basics

Virtualising the Switchports with Unified I/O

- Mapping of Ethernet and FC Wires over Ethernet
- Service Level enforcement
- Multiple data types (jumbo, lossless, FC)
- Individual link-states



- Fewer Cables
  - Multiple Ethernet traffic co-exist on same cable
- Fewer adapters needed
- Overall less power
- Interoperates with existing Models
  - Management remains constant for system admins and LAN/SAN admins
- Possible to take these links further upstream for aggregation

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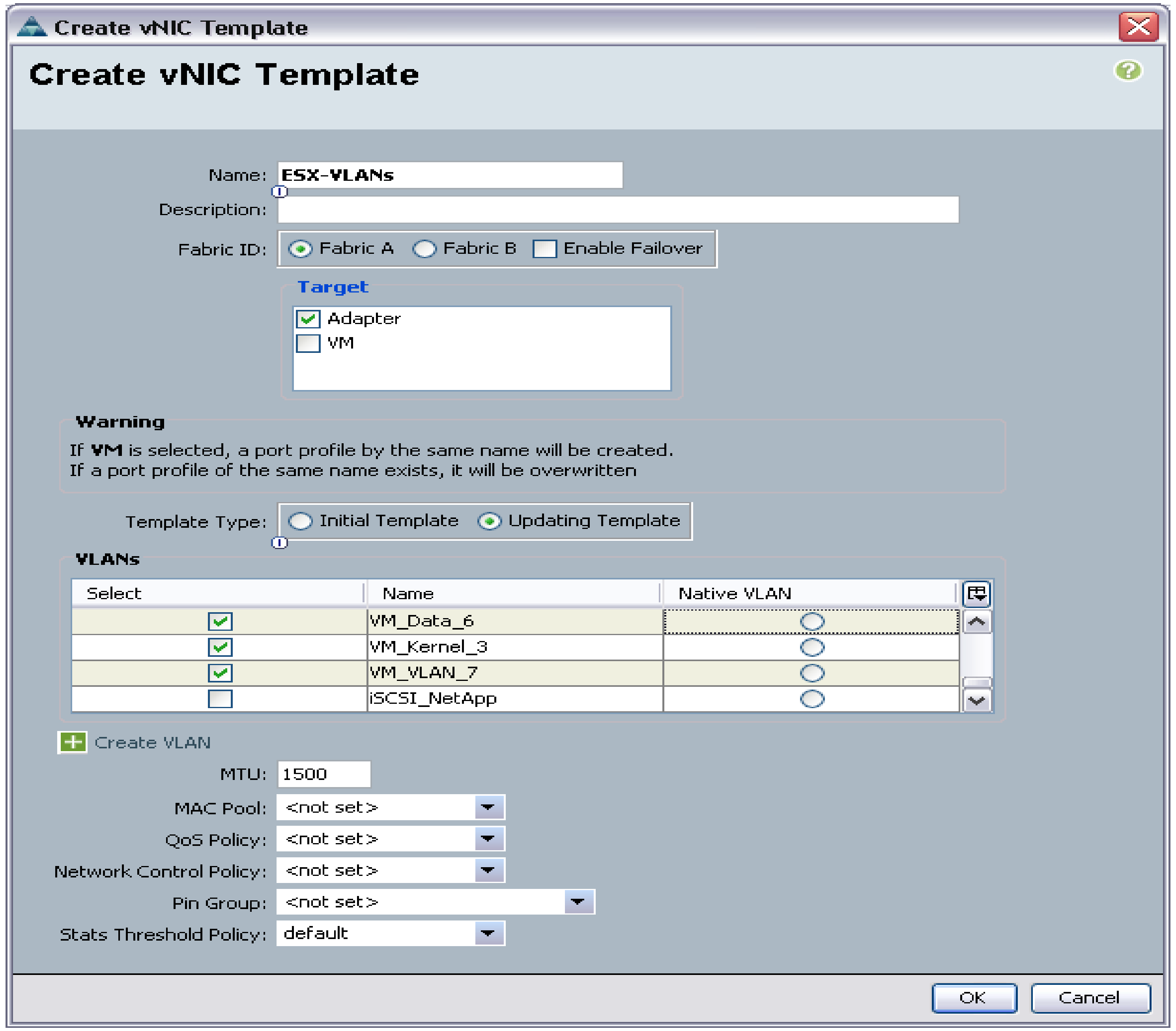
UCS Networking Basics

Network Team Defines Adapters and Connectivity Needs

- Centralised per Organisation/Root
  - Determine if Native VLAN only
  - If Trunk, if untagged allowed
  - VLANs on trunk
  - MTU for adapter
  - MAC Pool
  - QoS Policy (Minimums and max-bursts)
  - Presentation to outside world physical port
  - Statistics Treshold
- Adapter Templates Can be used as Initial or Updating Templates
- Tightly Controlled Policy
- Policy Managed by Network Administrator
  - Tied into Service Profile Templates
  - Tied into vNIC Templates
- Highly Automated Process to Add Connectivity to Server with Policy



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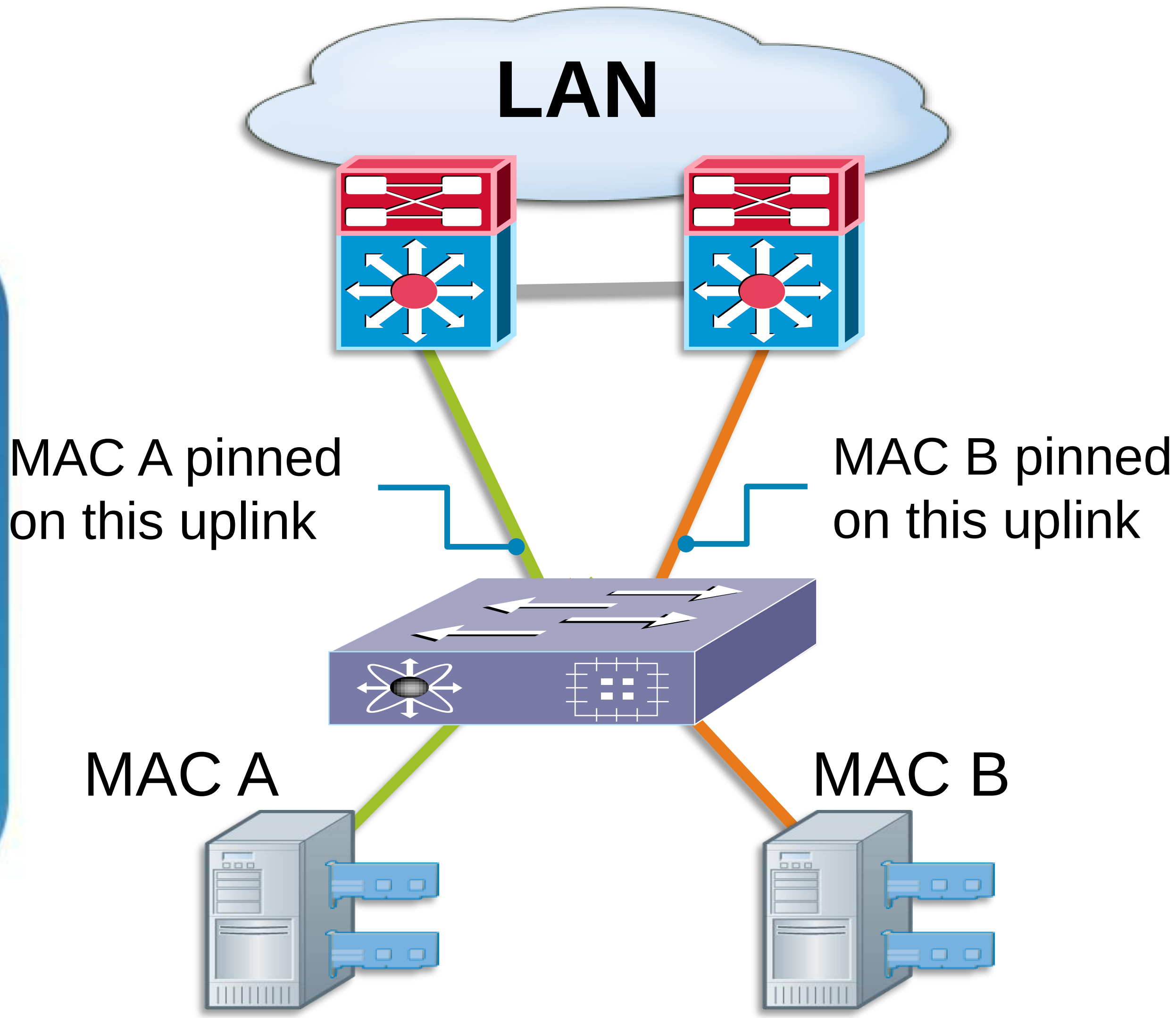
UCS Networking Basics

Ethernet End Host Mode



- Eliminates Need for Spanning Tree Protocol on Uplink Bridge Ports
  - Reduces CPU load on upstream switches
- Maintains MAC table for downstream servers only
  - Eases L2 MAC Table sizing in the Access Layer
- Allows Multiple Active Uplinks from UCS Fabric Interconnect to Network
  - Doubles effective bandwidth vs STP
- Prevents Loops by pinning a MAC Address to Only One Port or Port-Channel
- Upstream VSS/vPC for MCEC optional for all bandwidth usage
- Completely Transparent to Next Hop Switch
- Traffic on same L2 subnet switched locally

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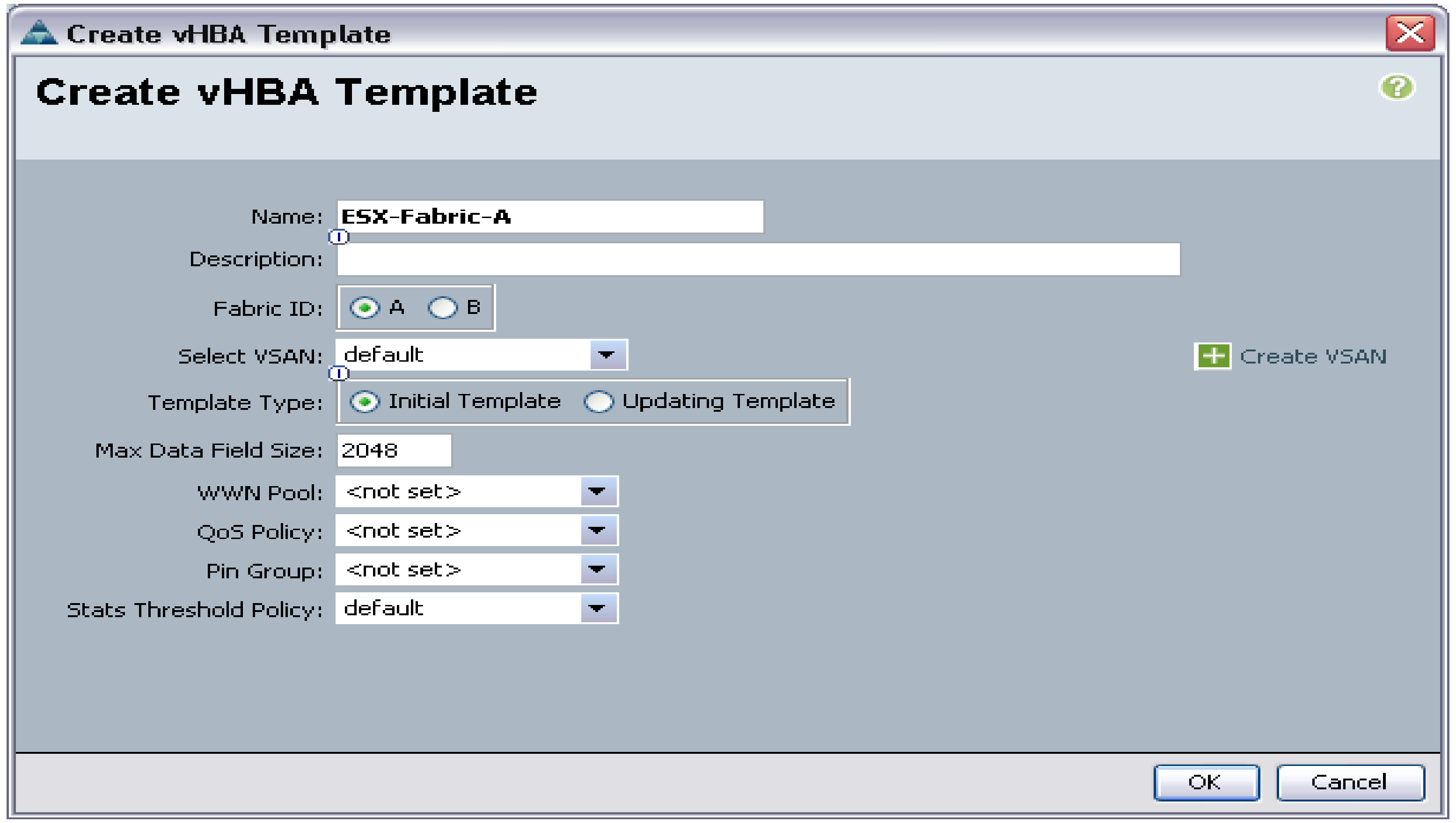
UCS Networking Basics

Storage Team Defines Adapters and Connectivity Needs

- Centralised per Organisation/Root
  - Determine vSAN
  - MTU for adapter
  - WWPN pool
  - QoS Policy (Minimums and max-bursts)
  - Presentation to outside world physical port
  - Statistics Treshold
- Adapter Templates Can be used as Initial or Updating Templates
- Tightly Controlled Policy
- Policy Managed by SAN Administrator
  - Tied into Service Profile Templates
  - Tied into vHBA Templates
- Highly Automated Process to Add SAN Connectivity to Server with Policy



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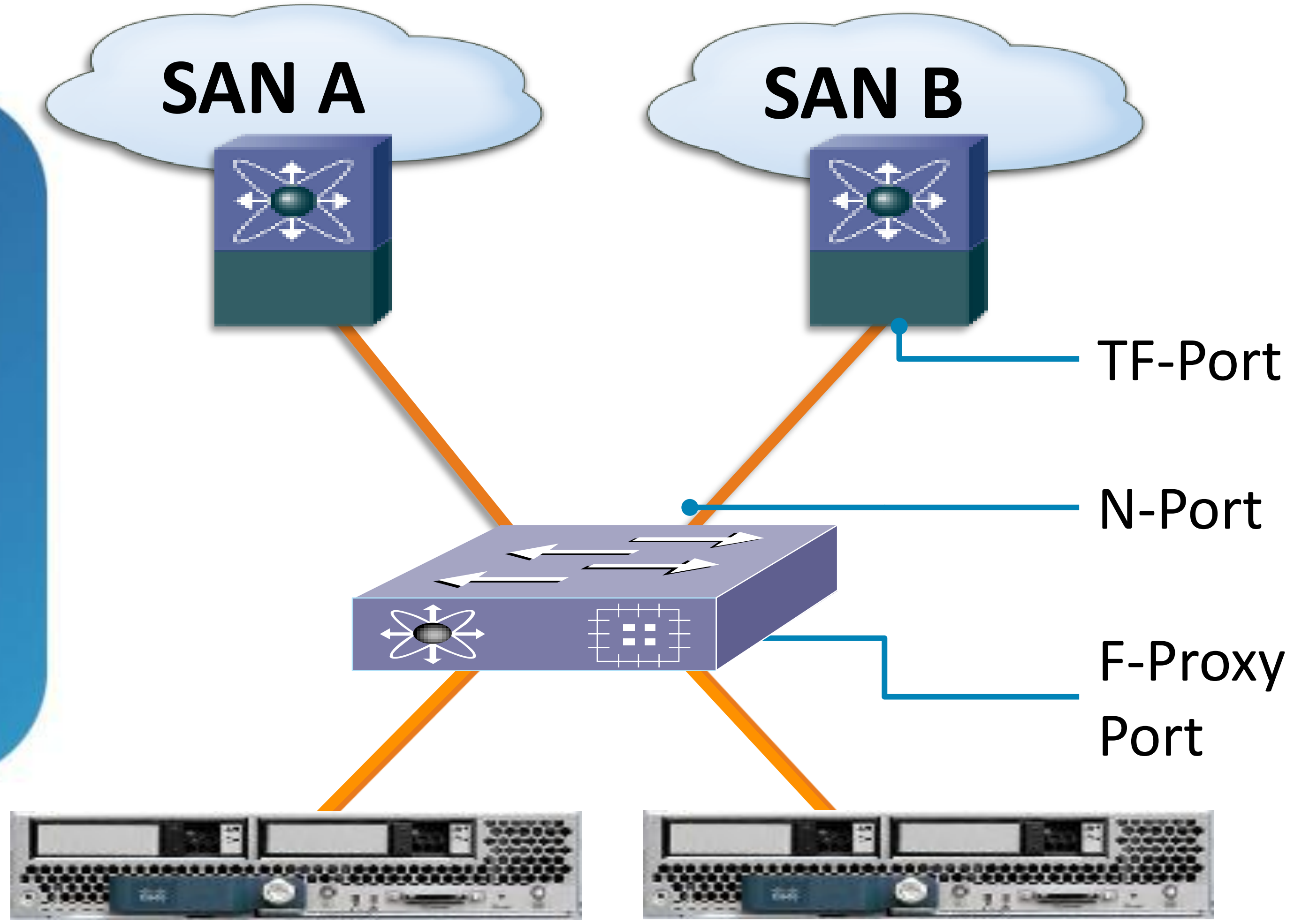
UCS Storage Basics

N-Port Virtualisation or for Storage



- Storage switch sees Fabric Interconnect as an FC endhost with many ports and many FC IDs assigned
- UCS Fabric Interconnects network facing ports function as N-ports or NPIV ports
- Server facing ports function as F-proxy ports
- Provides physical port level virtualisation of multiple FC end nodes to one F_Port off an FC Switch
  - Fabric Interconnect operates in N_Port Proxy Mode (not in FC Switch mode)
  - Simplifies multi-vendor interoperation
- Eliminates the FC domain on UCS Fabric Interconnect
- Simplifies management
- F-Port trunking and channelling supported
- FC Switched mode coming as option for locating disk out closer to servers

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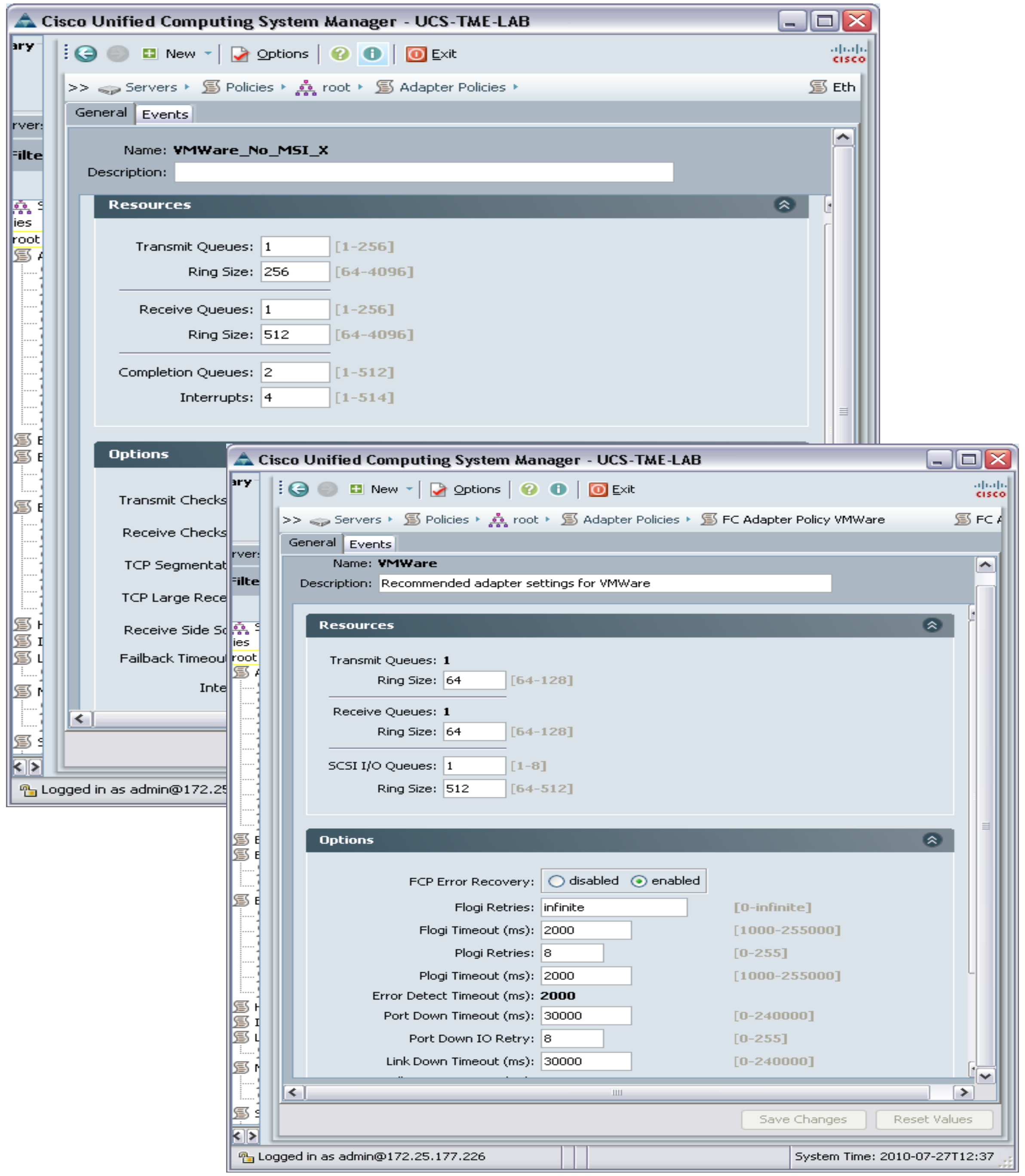
UCS Storage Basics

Example of Detail in Low Level Adapter Settings

- Centralised per Organisation/Root
- vNIC Settings
  - No need to interrupt server boot in Option ROM to customise settings
  - Interrupt coalescing and ring buffer sizing (among outhers) will not imply a need for customer to physically make modifications to servers as part of deployment
- vHBA Settings
  - No need to interrupt server boot in Option ROM to customise settings
  - HBA timers and retry counts (and others) will not imply a need for customer to physically make modifications to servers as part of deployment
- PCI Order (on Cisco VIC only) can be controlled in the presentation to the OS
  - Allows consistent connectivity as Ethernets are configured first



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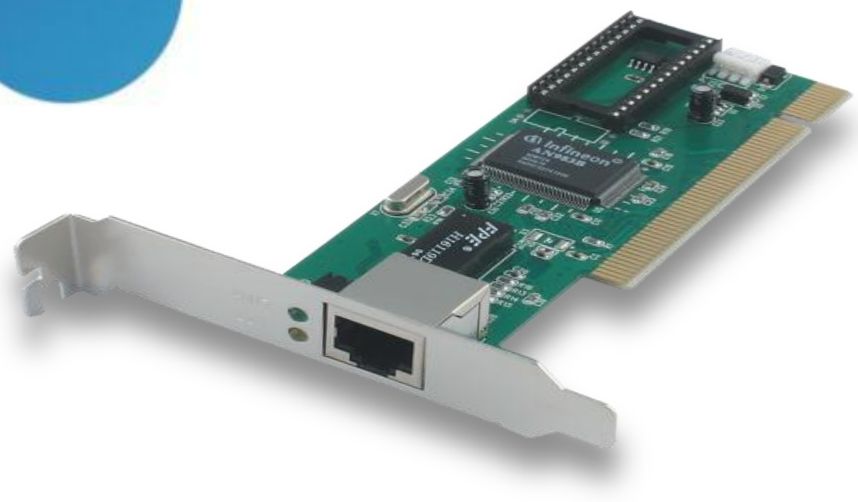
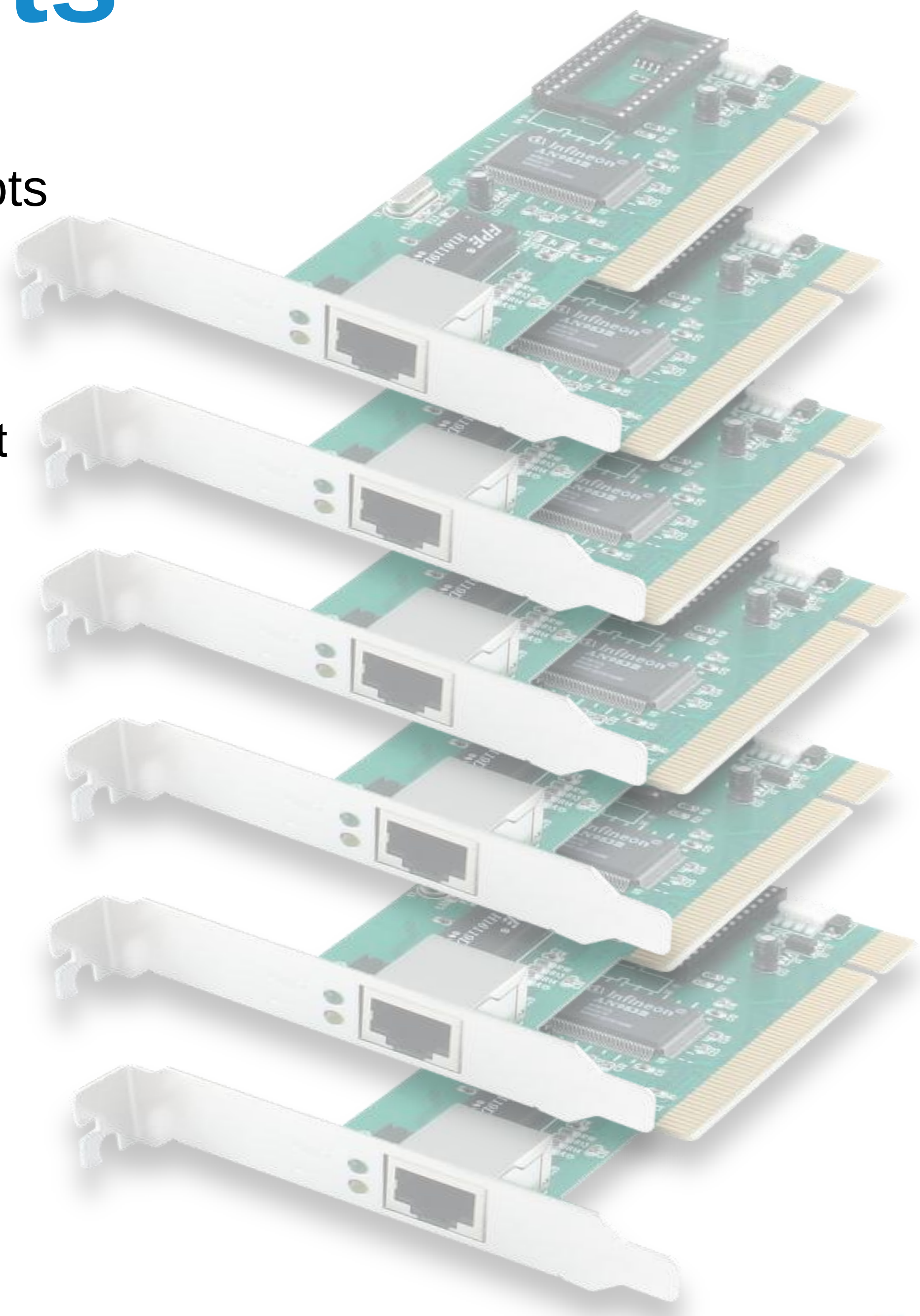
UCS Networking Components

Ethernet Adapter Virtualisation

- Run a quad-port GE or 10GE adapter into the PCI slots of a server
  - Easily filling the PCI capacity many times
- We are imposing “State” on the server by inserting cards at staging time
- Consumes an equal amount of ports on the DC switching infrastructure (and cables)
- Single-Root I/O Virtualisation is early attempt at adapter virtualisation
  - Maps memory buffer to present a new adapter
  - Locally switches traffic on the adapter directly
  - No per-virtual interface link-state
  - No Operating System support currently
  - No Rate-Shaping, QoS Marking, etc.





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UCS Storage Components

Storage Adapter Virtualisation

- Run a single-port or dual-port 1/2/4/8G FC HBA into the PCI slots of a server
  - Easily filling the PCI capacity many times when mixed with Ethernet
- We are imposing “State” on the server by inserting cards at staging time
- Consumes an equal amount of ports on the SAN switching infrastructure (and cables)
- Single-Root I/O Virtualisation is early attempt at adapter virtualisation
  - Not yet in mainstream discussion on the FC side

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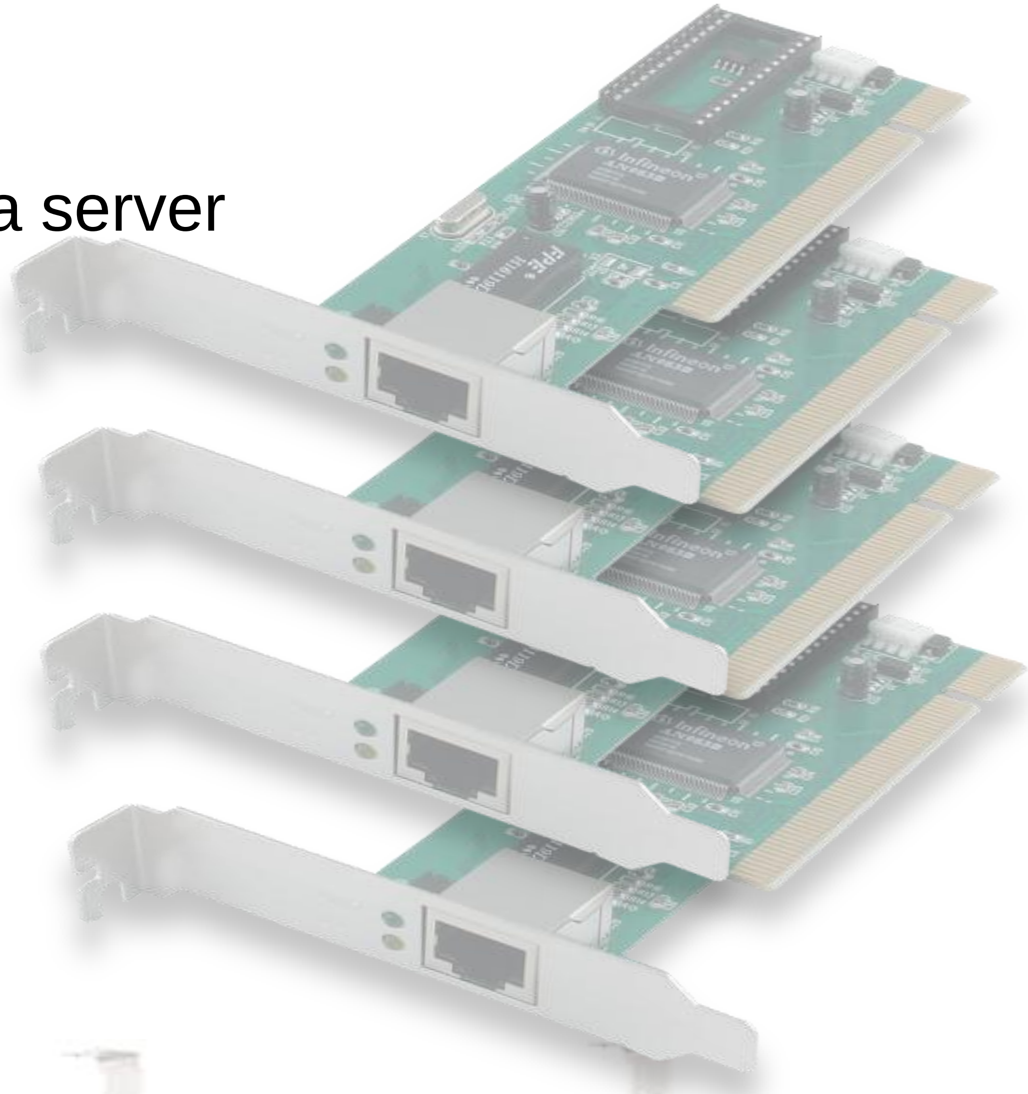
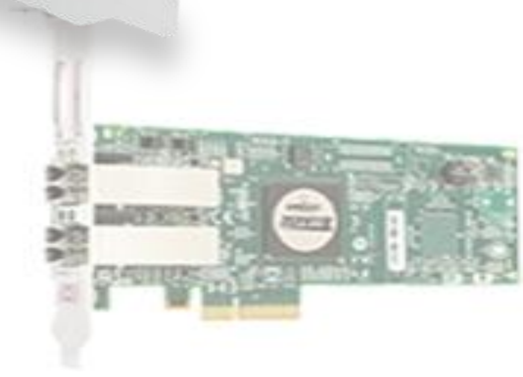
UCS Adapter Virtulisation

Unified I/O within UCS



- Run a Virtual Interface Card PCI slots of a server
- We are not imposing “State” on the server
- Consumes far fewer ports on the DC switching infrastructure (and cables)
- NOT Single-Root I/O Virtualisation
- PCI Bus Structure Virtualisation
  - Virtualise Adapters and PCI-PCI Bridges
  - No Locally Traffic Switching to Manage
  - Per-virtual interface link-state
  - Operating System support if they support PCI
  - Rate-Shaping, QoS Marking, etc. per Virtual Interface
  - UCS sends only VLANs and VSANs to Virtual Interface as Needed – to ease L2 scale in designs



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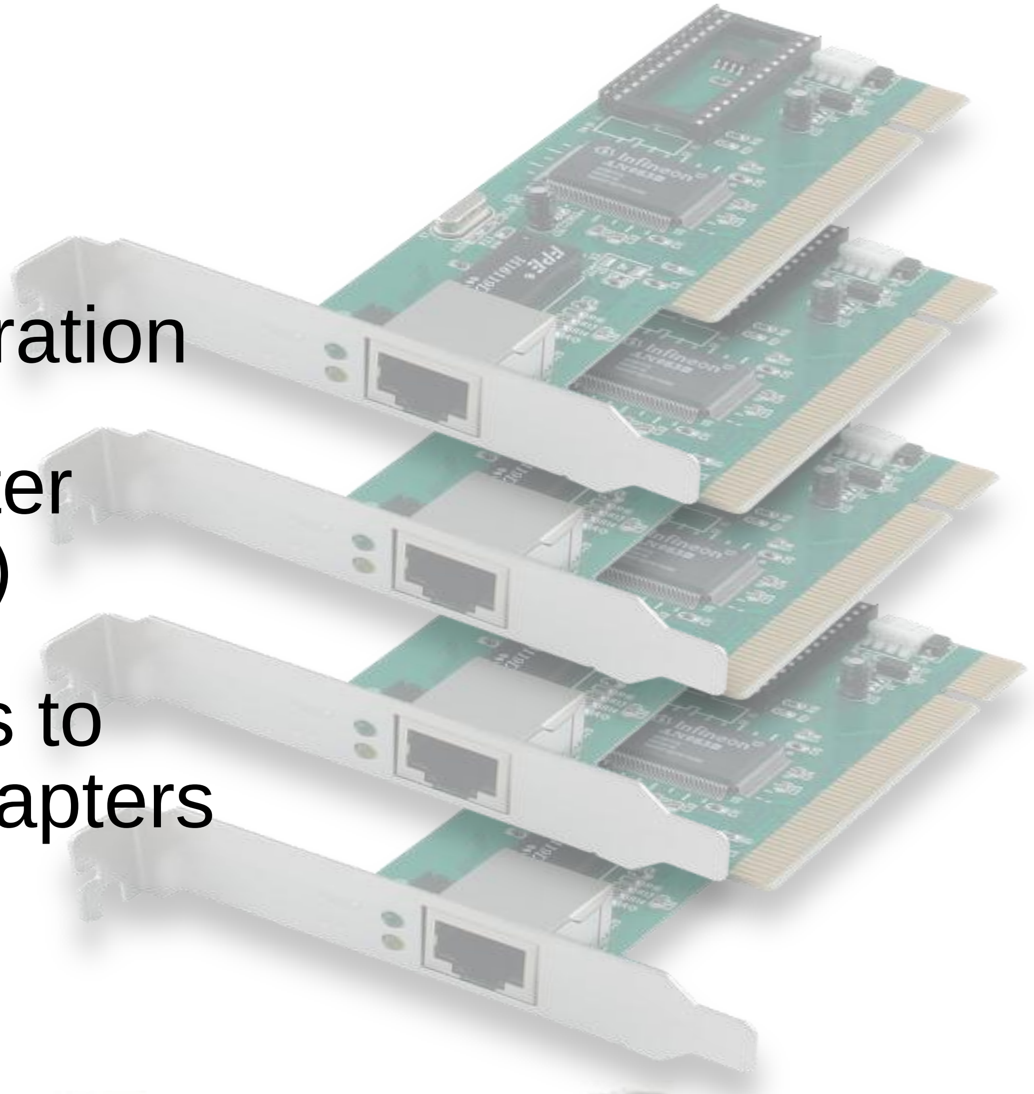
UCS Adapter Virtualisation

Unified I/O within UCS (Continued)

- Central Administration can group definitions and updates to configuration
- 128 Maximum interfaces on adapter today (58 today possible with OS')
- Possible for system administrators to now directly define many more adapters

  No 802.1q tagging to servers

  No qualifications, install, and configuration of Broadcom ACS or Intel PROset tools
- Enabler of stateless and highly automated configuration of I/O



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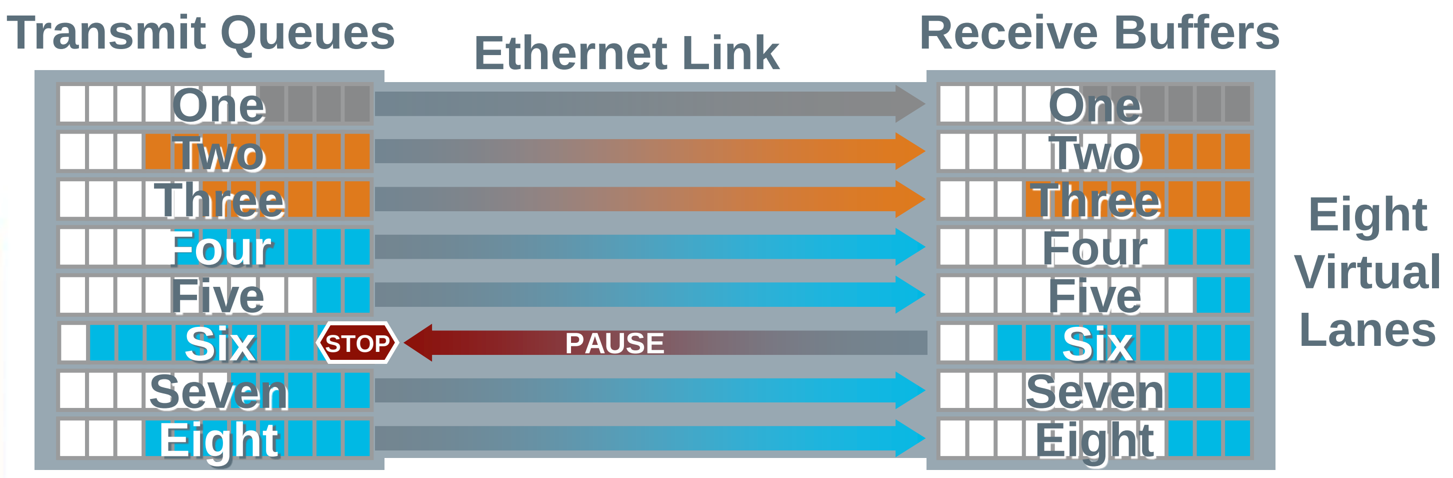
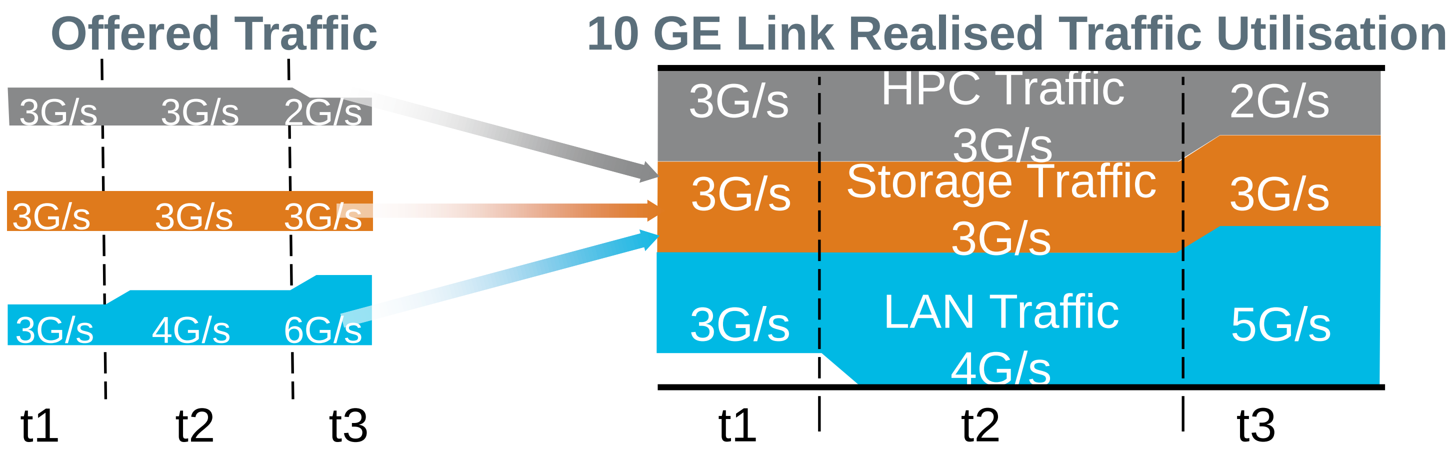
UCS Traffic Managment

Unified I/O and QoS within UCS

- Priority Flow Control



- COS BW Management



- *Enables lossless Fabrics for each class of service*
- *PAUSE sent per virtual lane when buffers limit exceeded*

- *Enables Intelligent sharing of bandwidth between traffic classes control of bandwidth*
- *802.1Qaz Enhanced Transmission*

- Among the tools used are aggregate shapers at the vNICs (VIC), ETS, Policers at the switch for each vNIC.

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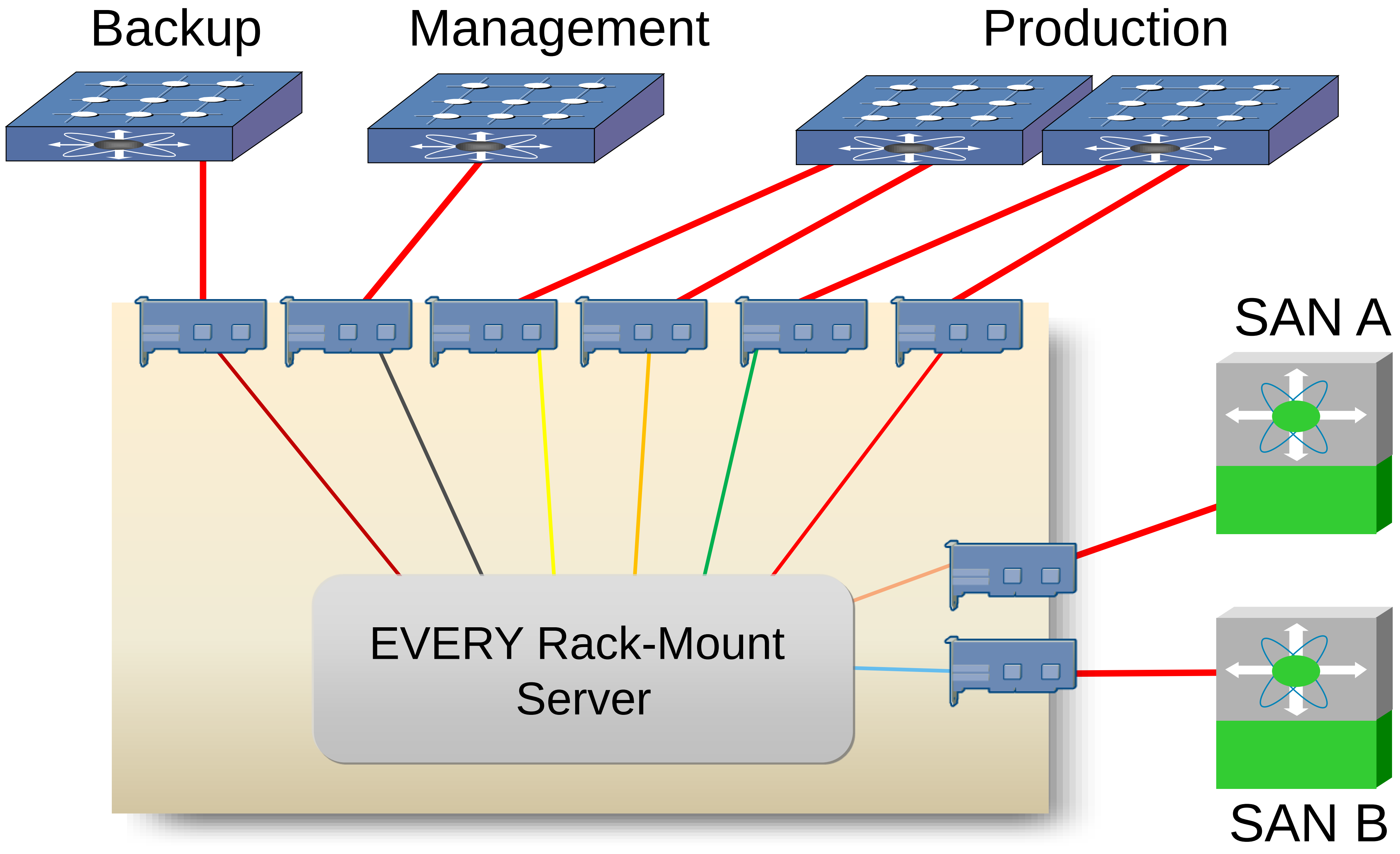
UCS Unified I/O Advantages

Unified I/O within the DC

- Proliferation of NIC and HBA devices, cables, ports as servers are added



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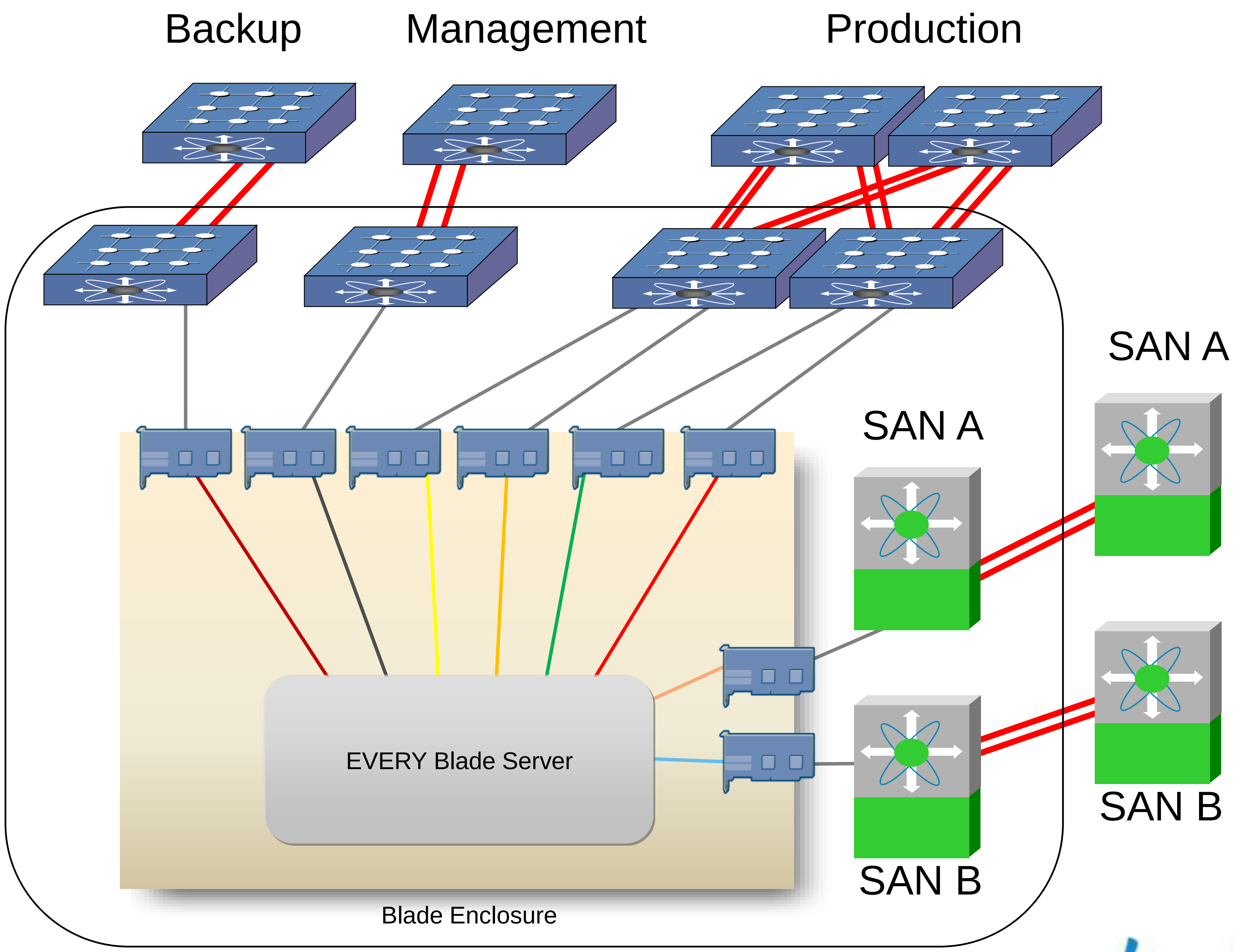
UCS Unified I/O advantages

- Proliferation of NIC and HBA devices
- Proliferation of upstream cables, ports as servers are added



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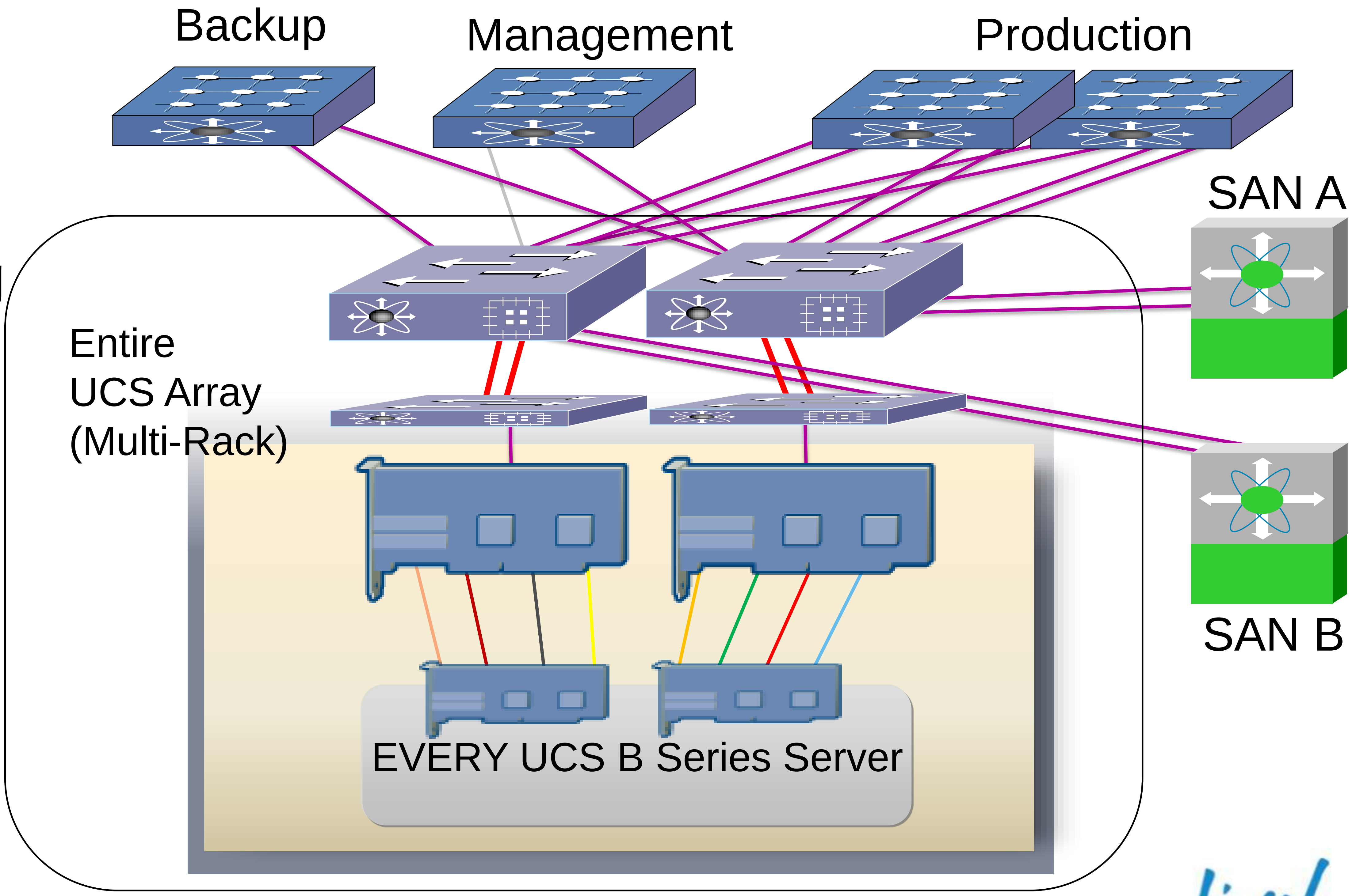
UCS Unified I/O Advantages

New Cabling Model

- As Servers are added, the cabling remains constant, yet the management model can appear the same



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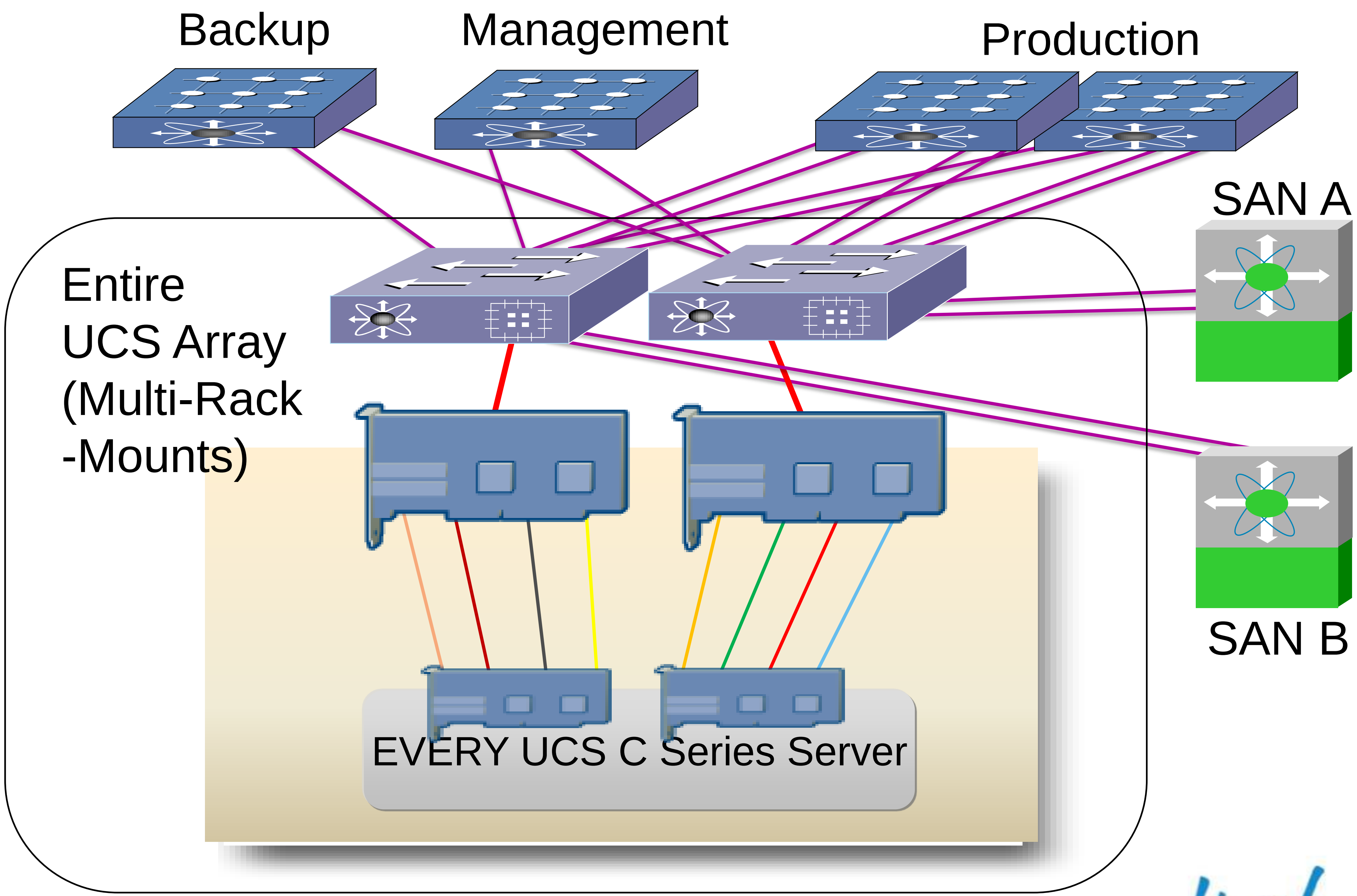
UCS Unified I/O advantages

New Cabling Model

- As Servers are added, the cabling remains constant, yet the management model can appear the same
- Down to goal of 1 cables per server



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Data Network Connectivity and UCS

Where is the Server/Network Boundary?

- Traditional DC designs have Access Layer
  - Middle of Row modular switching
  - End of Row modular switching
  - Top of Rack fixed switching
  - Many touches at this layer as traditional server infrastructure is administered
- Traditional DC designs have Aggregation Layer
  - Centralised modular switching
  - Services layer for common network services
- With UCS, Access Layer is now ToR
  - Networking setup on UCS for blades and VM's (100's of Servers)
  - NX-OS manageability for visibility
  - UCSM configurability of network attributes
  - Far fewer touches of the access layer switching – this is rolled into the server adapters
- Aggregation Layer unchanged

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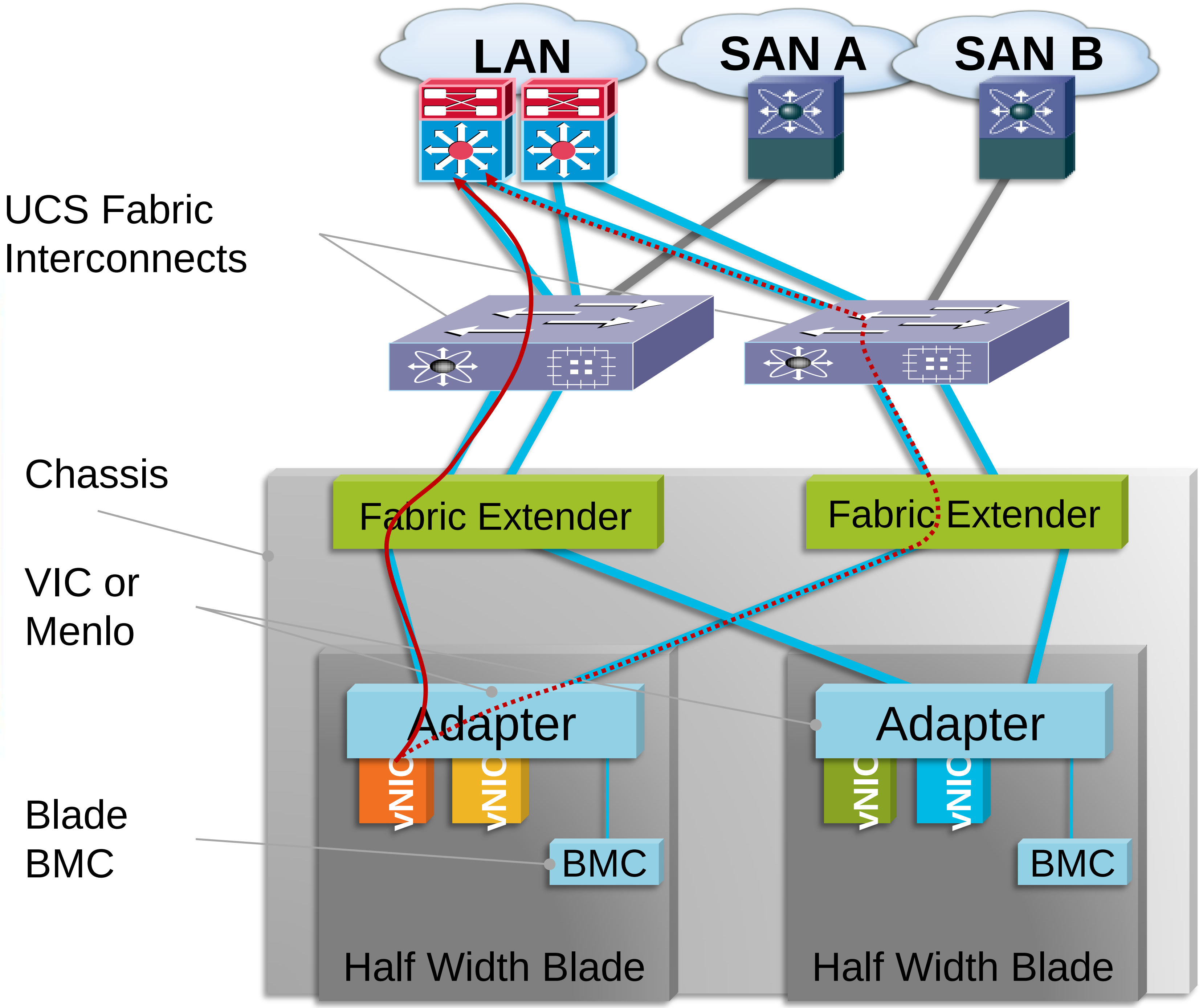
Data Network Connectivity and UCS

Fabric Failover with Blade Servers



- Two Fabric Interconnects in the system going to two FEX in each chassis

Fabric Based LAN vNIC Failover:

- OS sees single or multiple vNICs
- IO Fabric provides Active-Passive Failover per server adapter
- No Teaming Driver to qualify, install, and configure (Broadcom ACS, Intel PROset, RHEL Bonding, etc.)
- Failover happens under OS layer
- Eliminate half of server adapters and network ports

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Storage Network Connectivity and UCS

Where is the SAN Boundary?

- Traditional DC designs have dual SAN Access
  - Edge modular switching
  - Edge fixed switching
  - Collapsed Core modular switching
  - Many touches at this layer as traditional server infrastructure is administered
- Traditional DC designs have dual SAN Core Layer
  - Core modular switching
  - Services layer for common SAN services
- With UCS, SAN Edge Layer is now ToR
  - SAN Edge configuration setup on UCS for blades and VM’s (100’s of Servers)
  - NX-OS manageability for visibility
  - UCSM configurability of SAN attributes
  - Far fewer touches of the SAN switching – this is rolled into the server adapters
- Core Layer unchanged (with exception of NPIV enablement) and multi-vendor

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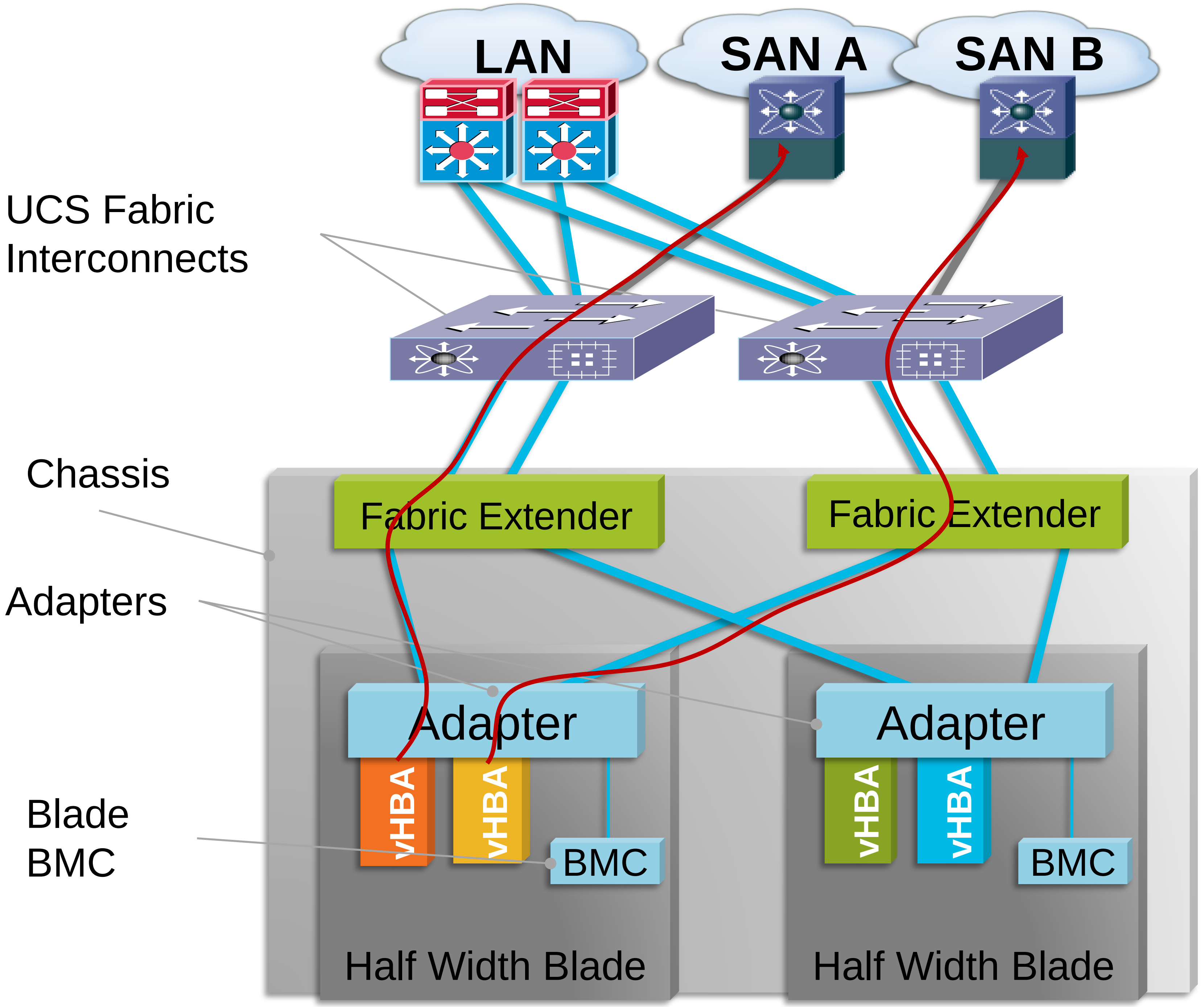
Storage Network Connectivity and UCS

SAN Multipathing



- Two Fabric Interconnects in the system going to two FEX in each chassis
- All links are active
- **SAN Multi-Pathing Failover:**
- OS sees multiple vHBAs
- IO Fabric provides no failover per server adapter
- No new FLOGI issued on other fabric than where originally designed
- Typically, OS vendors want customers to disable multipath during installs
- Add multipathing and driver after initial install

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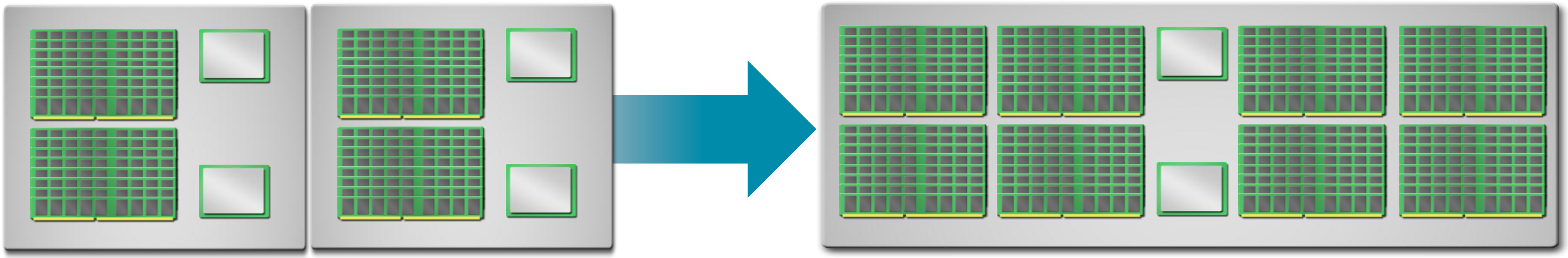
Innovative Technologies

Savings with Cisco Memory Extension

Enterprise Software Licesning



	Capacity/ Cores			
$40,000	384GB/32	$640k	N/A	N/A
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
$40,000	192GB/8	$160k	$960k	75%
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
$40,000	384GB/8	$160k	$960k	75%

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UCS Memory Expansion

- Get 48 DIMMs on a 2 Socket Server for higher memory applications
- All memory running at 1333MHz
- Combinations of 2,4,8 GB for wide array up to 384G in 2 socket footprint
- More VM’s into existing server footprint inside customer Data Centres
  - Extend the life of legacy DC builds
  - Push out needs for new DC builds

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VN-TAG: Industry Pre-standard Implementation

- IEEE 802.1BR and VN-TAG
  - Same architecture and logic
  - Minor frame format difference
- Future platforms will support both formats
  - Backward compatibility guaranteed
  - Interoperability even easier

VN-TAG frame format (6 bytes)

direction indicates to/from adapter

source virtual interface indicates frame source

– looped indicates frame came back to source adapter

destination virtual interface dictates forwarding

– pointer helps pick specific destination vNIC or vNIC list

Link local scope

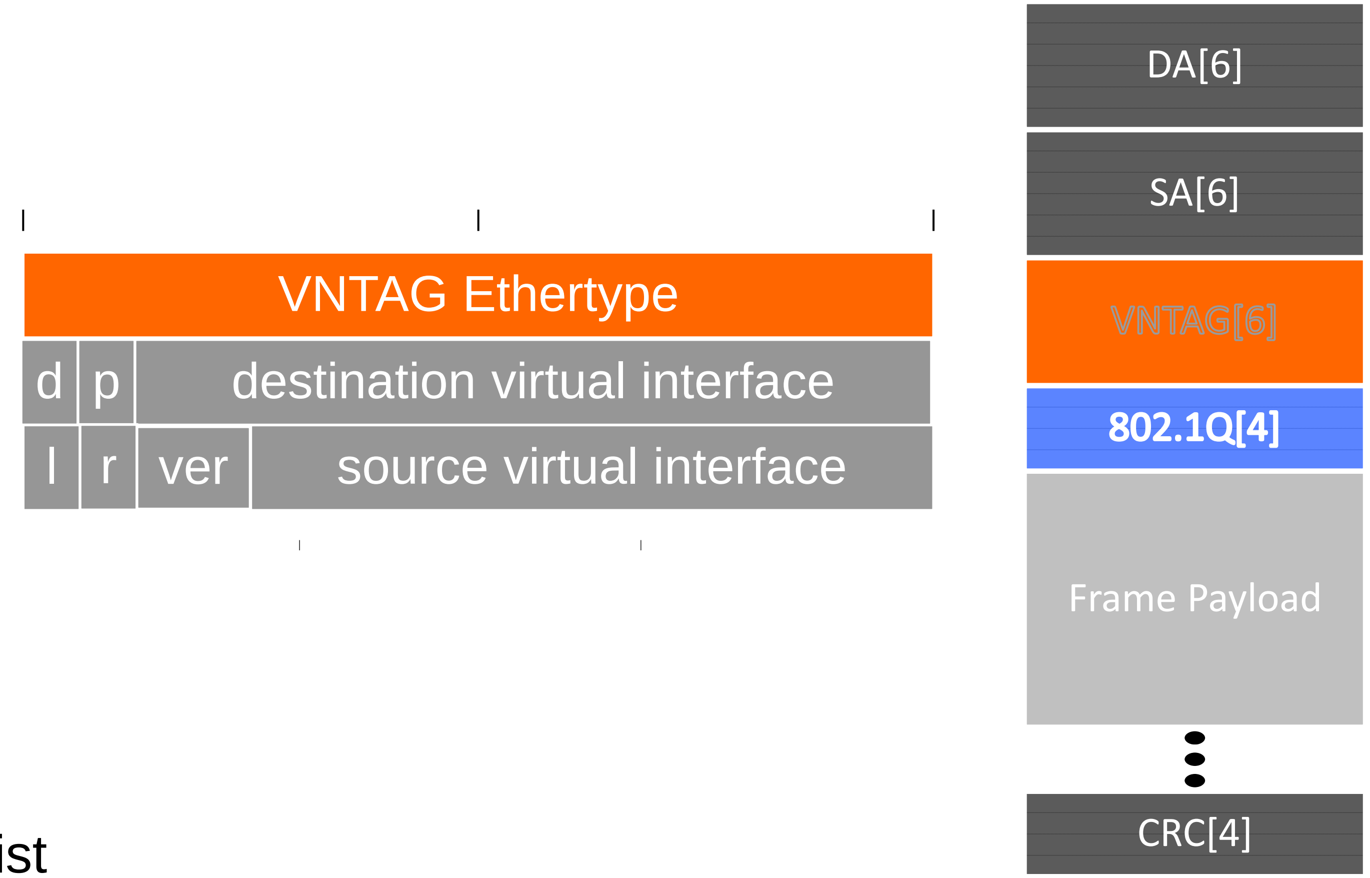
– Rooted at Virtual Interface Switch

– 4096 virtual interfaces

– 16,384 Virtual interface lists

Coexists with VLAN (802.1Q) tag

– 802.1Q tag is mandatory to signal data path priority



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IEEE 802.1BR: Bridge Port Extension

Fully specifies a Port Extender (FEX Equivalent)

- Extends ports of a switch to lower entities in a network

Port Extenders are not individually managed

- Their ports become ports of the controlling switch

Cascading Port Extenders

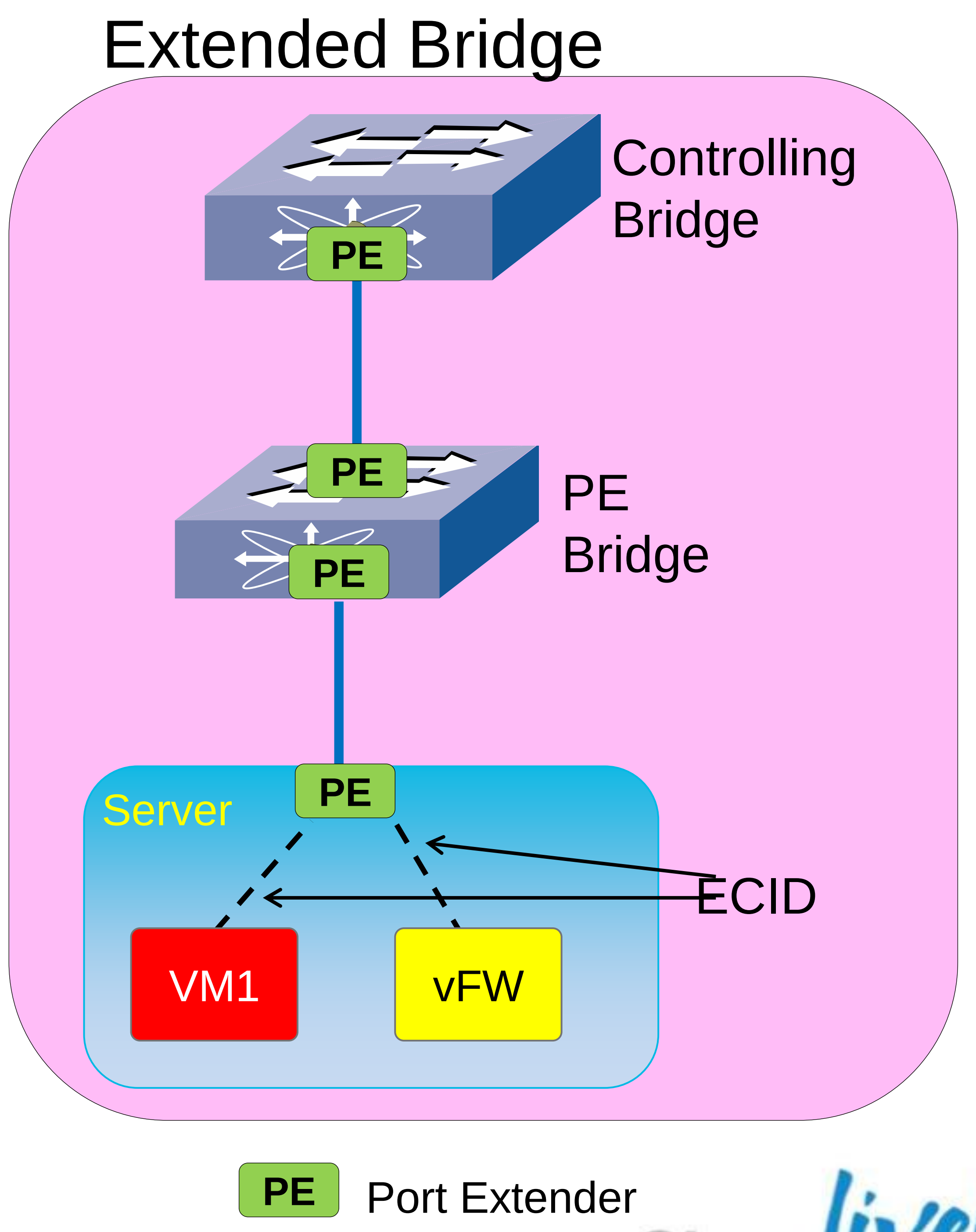
- Allows one to choose the appropriate controlling switch
- Frame replication supported for efficient multicast / flooding

Traffic from each "Extended Port" is reliably segregated to an E-channel and identified by a tag containing an E-channel identifier (ECID)

- Does not require prior knowledge of MAC addresses; switch performs standard learning functions
- Works with all devices including VEBs, VEPAs, individual VMs, physical services, and devices providing transparent services
- E-Tag size = 8 Bytes

Controlling Bridge + PE = Extended Bridge

- Single Point of Management



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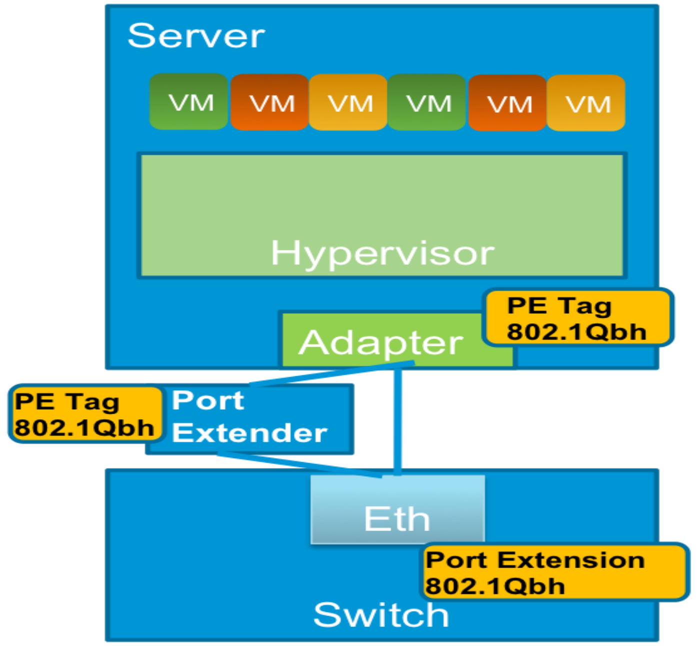
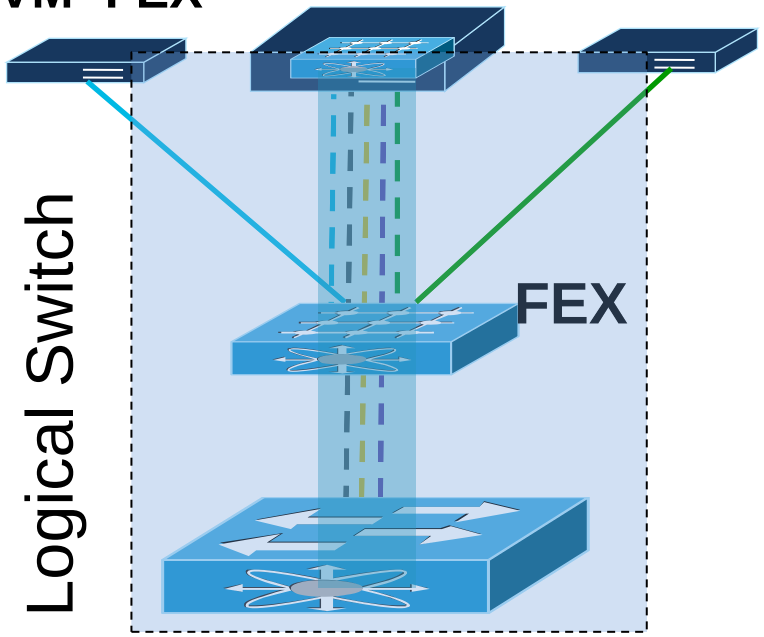
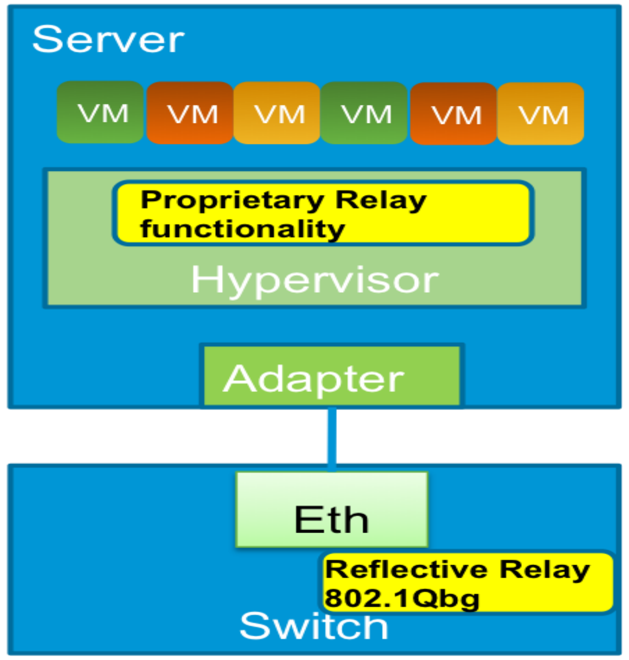
Cisco FEX Architecture Advantage



VM- FEX



Switch



FEX based on IEEE 802.1BR

- ✓ Ease of management: one switch manages all Port Extenders (adapters/switches/virtual interfaces)
- ✓ Supports cascading of Port Extenders (multi-tier, single point of management)
- ✓ Virtual Machine aware FEX
  - ✓ Secure: ACLs based on VN-TAG
  - ✓ Scalable: Mcast and Bcast replication performed in HW at line rate
  - ✓ Efficient: no impact to server CPU

VEPA based on IEEE 802.1Qbg

- ✕ Management complexity: each VEPA is an independent point of management
- ✕ Doesn't support cascading

Reflective Relay (used in basic VEPA)

- ✕ Vulnerable: ACLs based on source MAC (can be spoofed)
- ✕ Resource intensive: Hypervisor component consumes CPU cycles

Multichannel (used in advanced VEPA)

- ✕ Even more components to manage
- ✕ Inefficient bandwidth : separate copy of each Mcast and Bcast packets on the wire

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UCS VM-FEX

VM-FEX Technology

- Virtualise the network end-point to match with the virtualised adapter on the VM
    - More than Just a Single Fabric Layer
- Define policy groupings (called port-profiles) including things like:
    - VLAN(s) Membership
    - Policing Rate
    - CoS Marking for minimum service guarantee’s
    - What Physical Ports to use for Upstream Communications
    - MAC Security
- Method to publish port-profiles to VMware (and Linux KVM) administrators for their autonomous use within their VM’s

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UCS VM-FEX

What does VM-FEX change?

- Each Virtual Machine vNIC now “connected” to the data network edge
- 1:1 mapping between a virtual adapter and the upstream network port
- Helps with Payment Card Industry (example) requirements for VMs to have separate adapter (no soft switches)
- As Virtual Machines move around infrastructure, the network edge port moves along with the virtual adapter

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UCS VM-FEX

Who Manages the Virtual Access Layer?

- If we are using VN-Link, we have multiple options
- Network team can utilise Nexus 1000V to manage up to 64 ESX hosts
  - Any UCS adapter type – including the VIC
  - VSM and Nexus 1010 to setup VM networking policy
- Network team can utilise VN-Link in Hardware on the VIC
  - VM tab in UCSM to setup VM networking policy
- Key Results Here
  - No requirement to manage vSwitches or VLAN tags on Servers
  - No requirement to manage Blade Chassis enclosure switches
  - Server administrators can invoke services without coordination each time with Network and Storage Teams
  - Management operations of Virtualised infrastructure maps to current physical infrastructure
  - Infrastructure automation becomes simpler as policy is centrally defined

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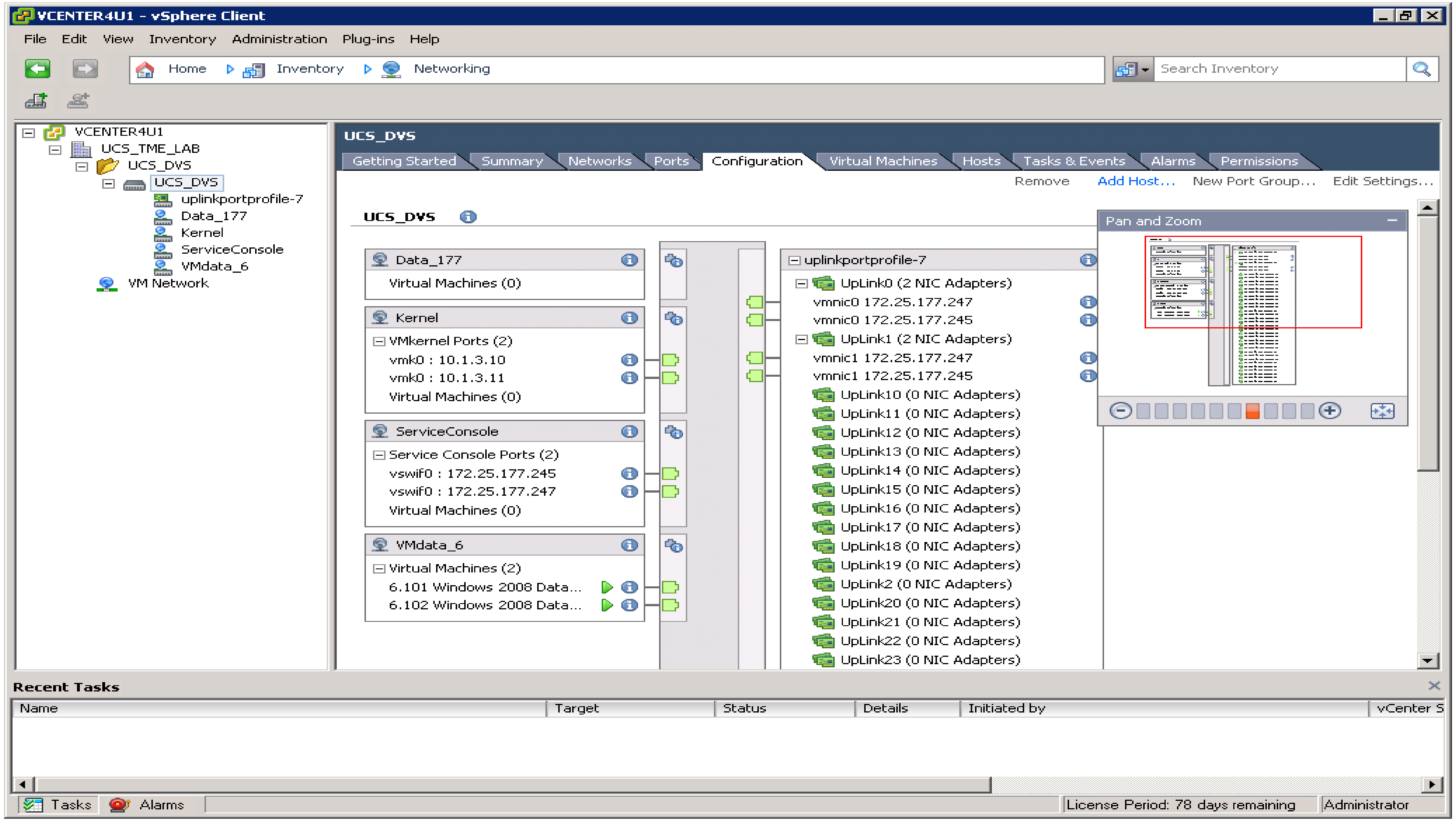
VMware VM-FEX View



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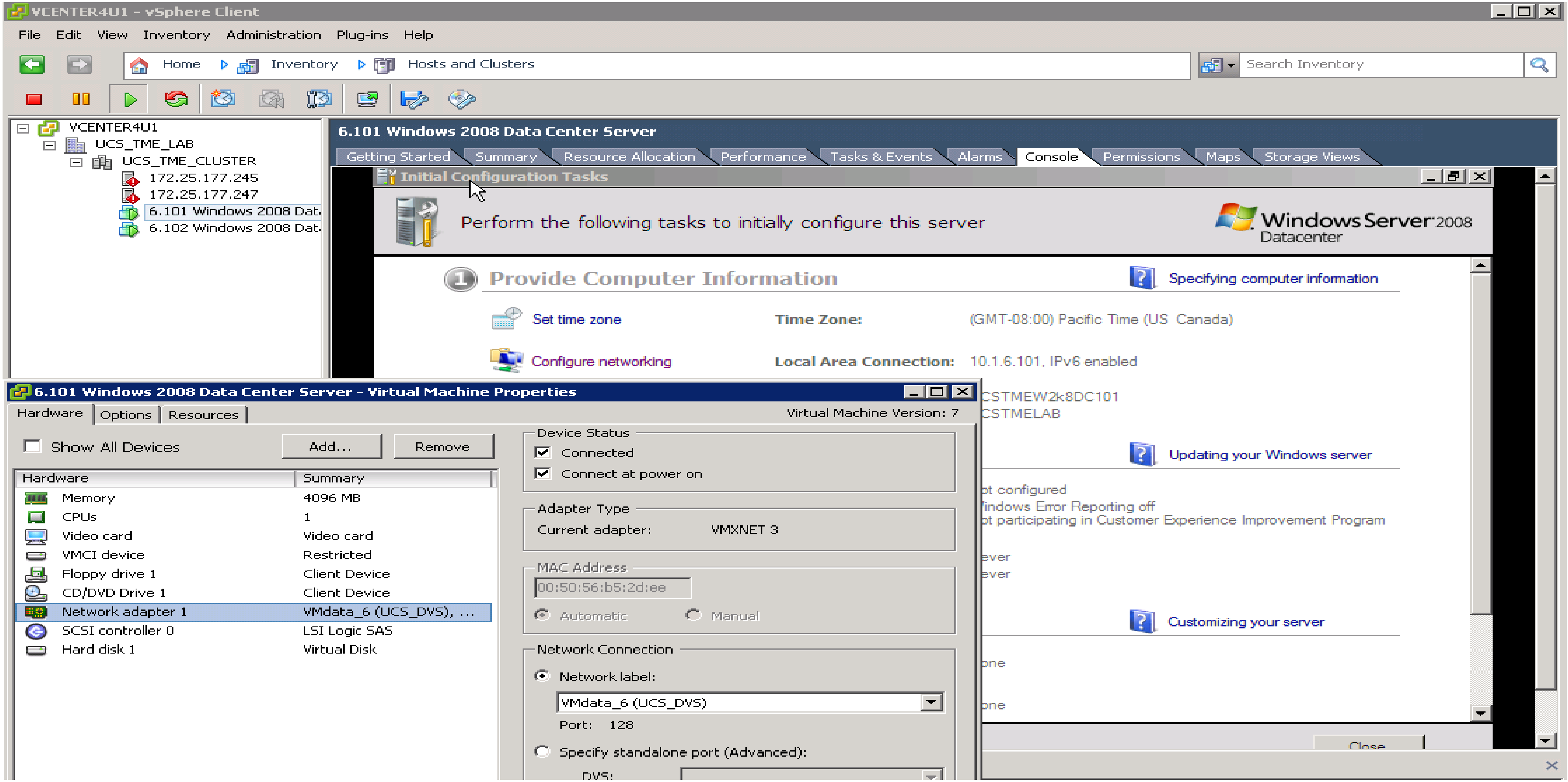
View from the VM Settings



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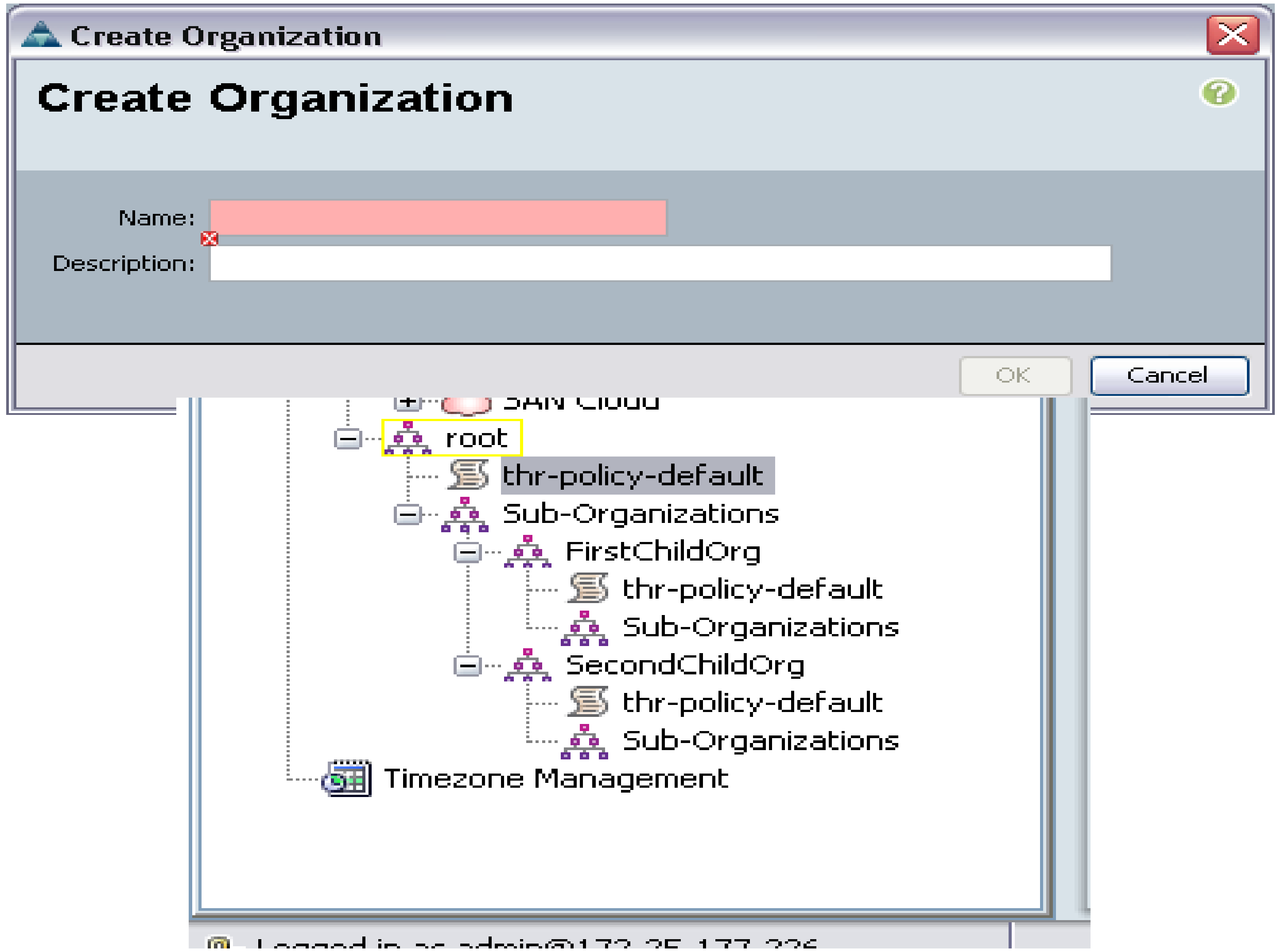
Multi-Tenancy & Security

Security Considerations in UCS

Defining Organisations and Sub-Organisations



- First fundamental multi-tenancy unit is an organisation
  - Maximum is only based on resources
- Organisations are logical divisions of resources and policy
- Can be tiered with sub-organisations
  - 5 levels deep maximum

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Security Considerations in UCS

What do Organisations Define?

- Many things shown to this point can be sub-divided into organisational boundaries including:
  - Server Pools
  - Server Pool Qualifications
  - Service Profile Templates
  - vHBA Templates
  - vNIC Templates
  - WWNN Pools
  - WWPN Pools
  - MAC Pools
  - QoS Policy
  - Network Control Policy
  - Flow Control Policy
  - Dynamic vNIC Connection Policy
  - UUID Pools
  - Ethernet Adapter Policy
  - FC vHBA Policy
  - Boot Policy
  - Host Firmware Policy
  - Management Firmware Policy
  - Local Disk RAID Policy
  - Scrub Policy
  - BIOS Settings Policy
  - BIOS Defaults Policy

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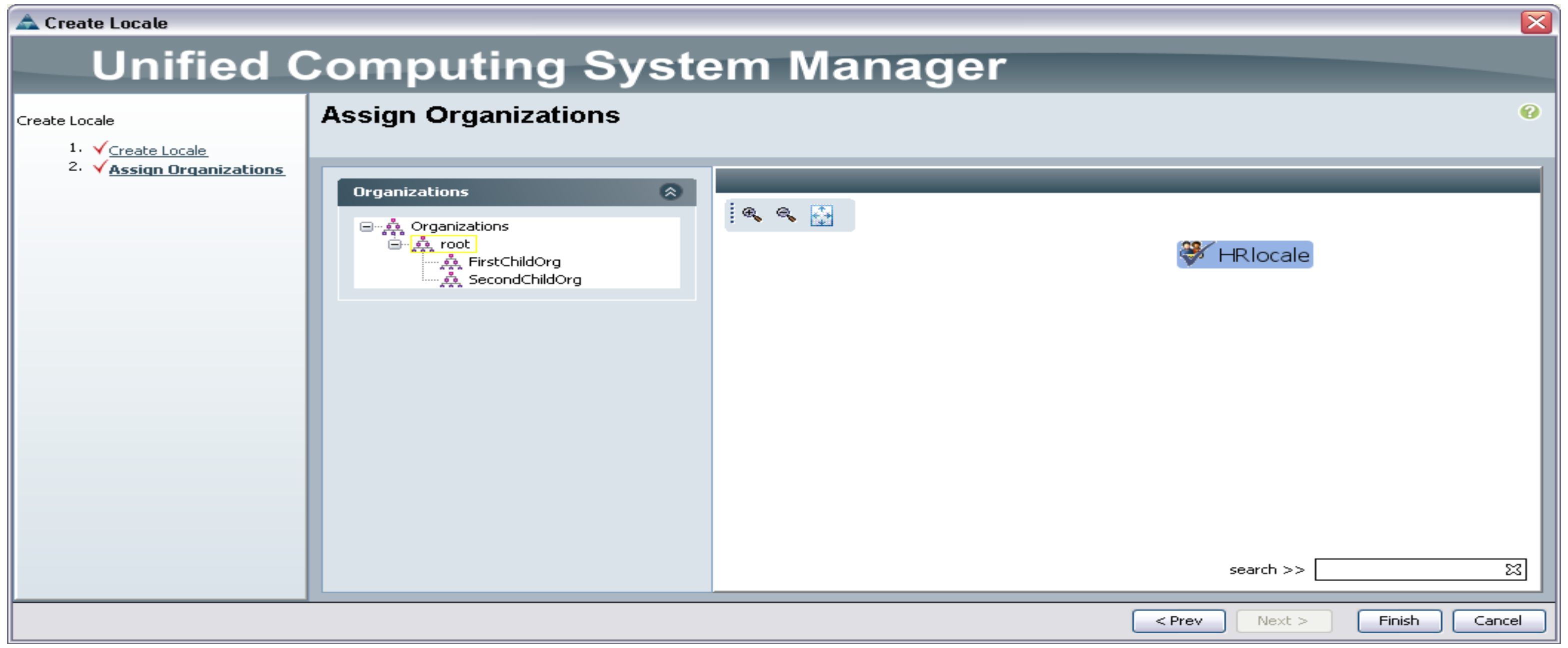
Security Considerations in UCS

What do Locale's Define

- Management of Organisation or Groups of Organisations
  - Assign the behaviour of all the components listed prior
- Granular management of servers:
  - Business unit
  - Functional grouping (virtualisation,etc.)
  - Location
- Applies to entire UCS fabric
  - Allows a segmentation of management responsibilities for the respective components
  - Potentially reduce audit scope



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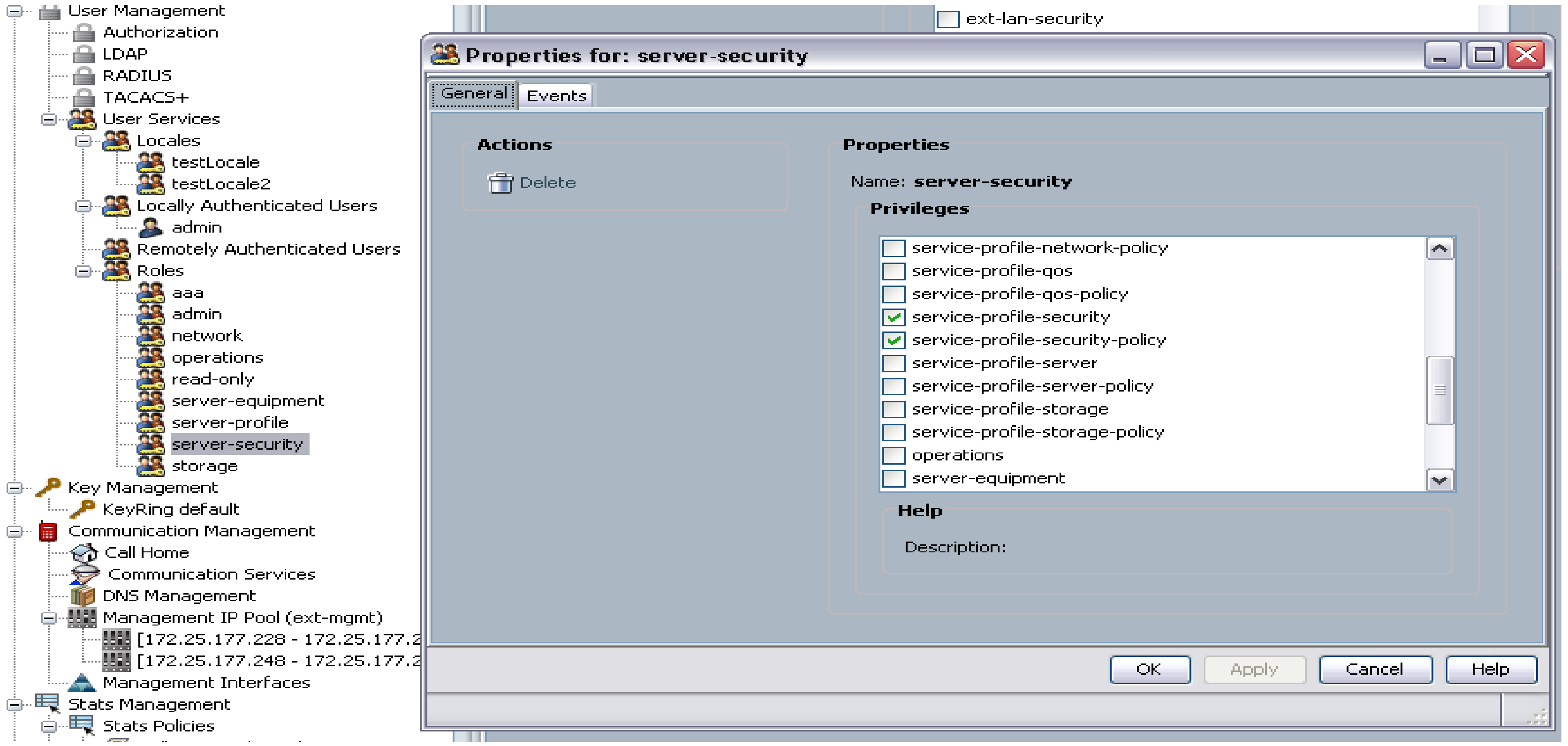
Security Considerations in UCS

Defining Users and Roles



- Roles exist to define priveledges
  - System has defaults
- Administrator can define custom roles to match their business

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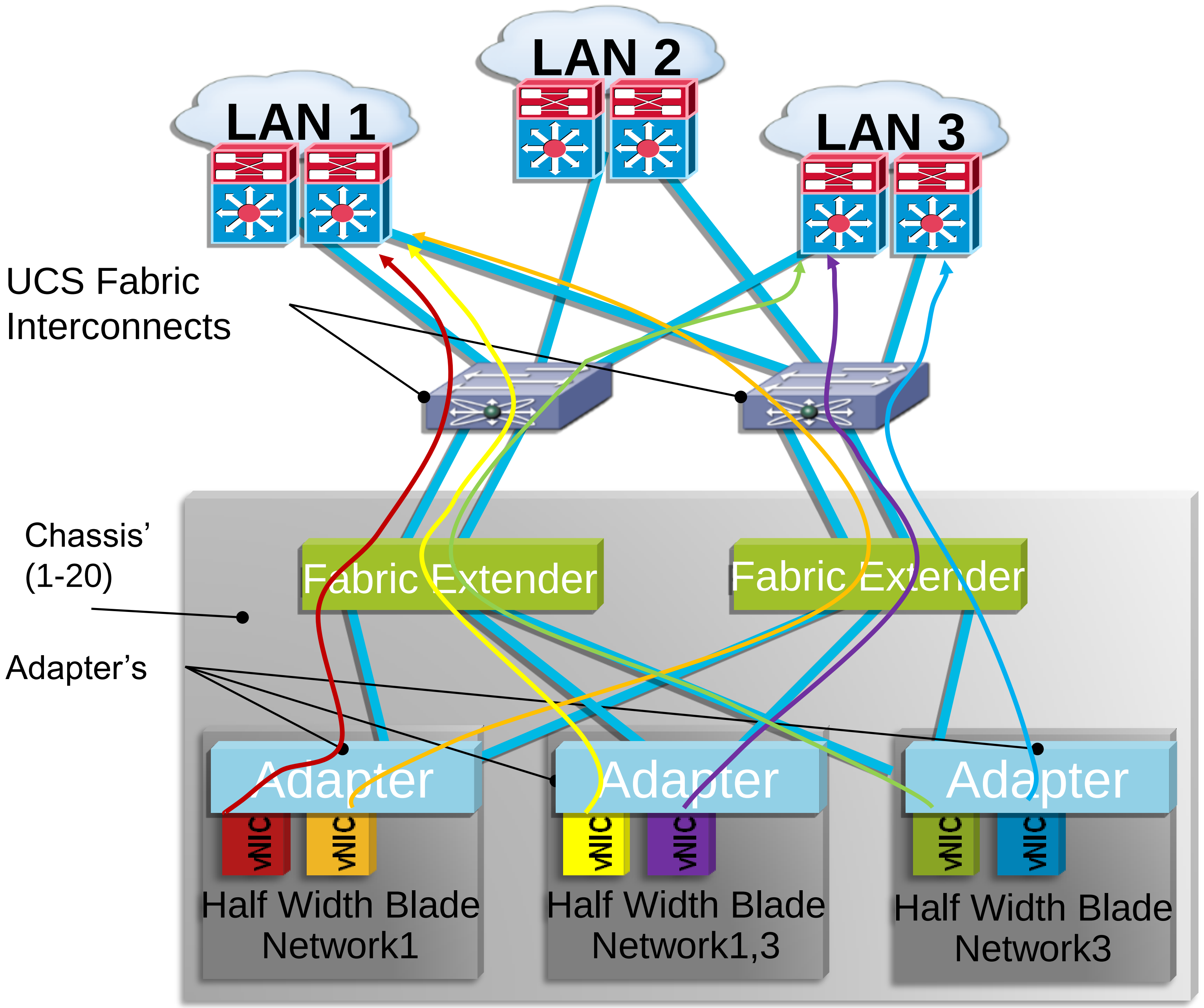
Security Considerations in UCS

UCS Security sone Segmentation



- Fabric Interconnects are NOT simple data switches
- VLANs that have a configured listening port to only pass upstream on that port also (Pruning)

Dis-Joint Upstream Networks to Rack Mount, Bladed, and direct to Virtual Machines:

- VLAN uplink pinning selections are tied into appropriate upstream network
- Each adapter will receive only needed traffic on the VLANs part of the L2 domain
- **SIMPLE procedure to directly attach Fabric Interconnects to multiple LAN segments now, and tie vNICs to new pin-groups**

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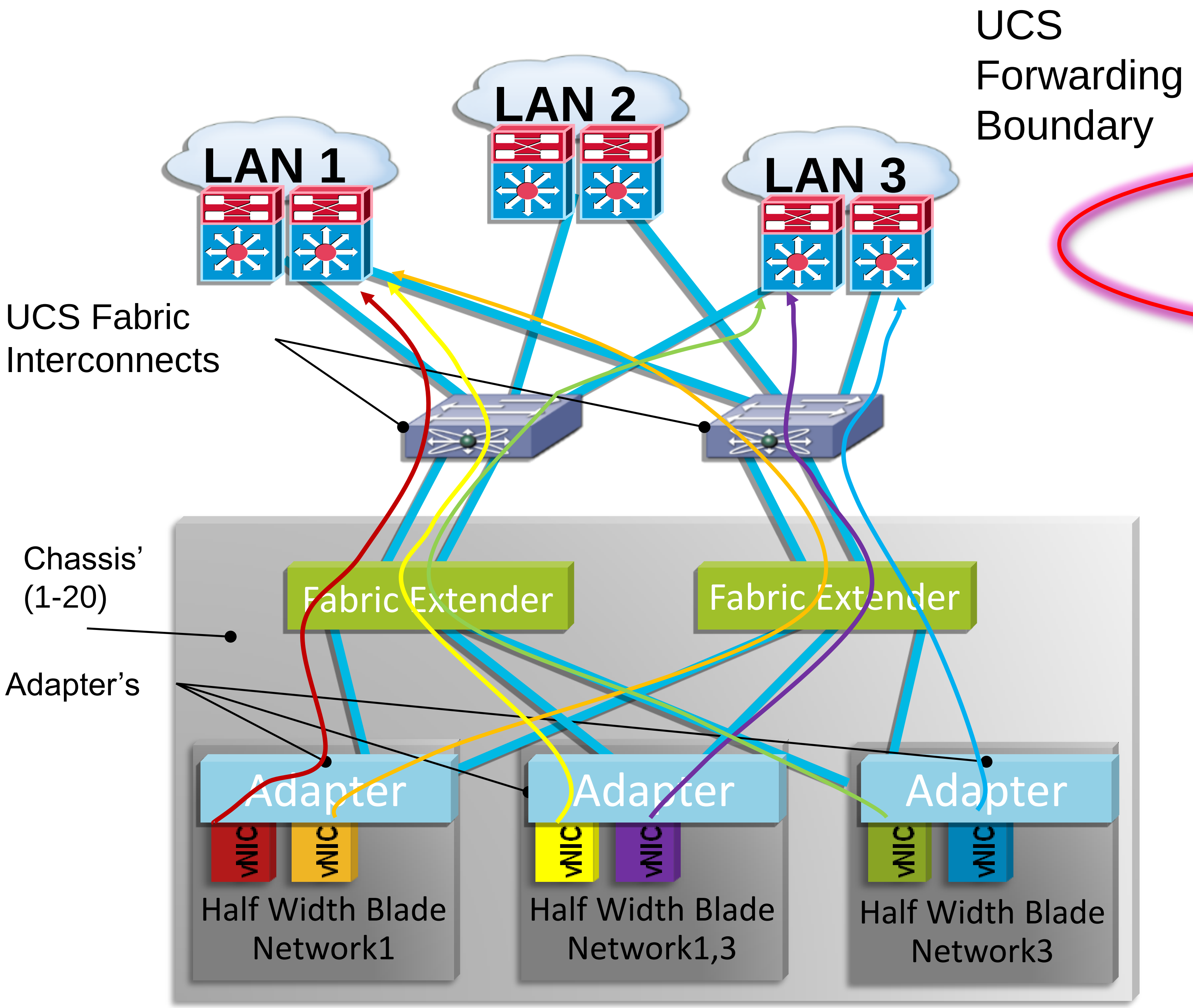
Security Considerations in UCS

UCS Security Zone Segmentation



VLAN List	Uplink Group	Server Interface List
10,11,12…	E1/1,E1/2	Blade1 NIC0 & NIC1, Blade 2 NIC0
20,21,22…	E1/10,E1/11	None
30,31,32…	E1/20,E1/21	Blade 2 NIC1, Blade 3 NIC0 & NIC1
501	FC0,FC1	Blade 1 vHBA0, Blade 2 vHBA0

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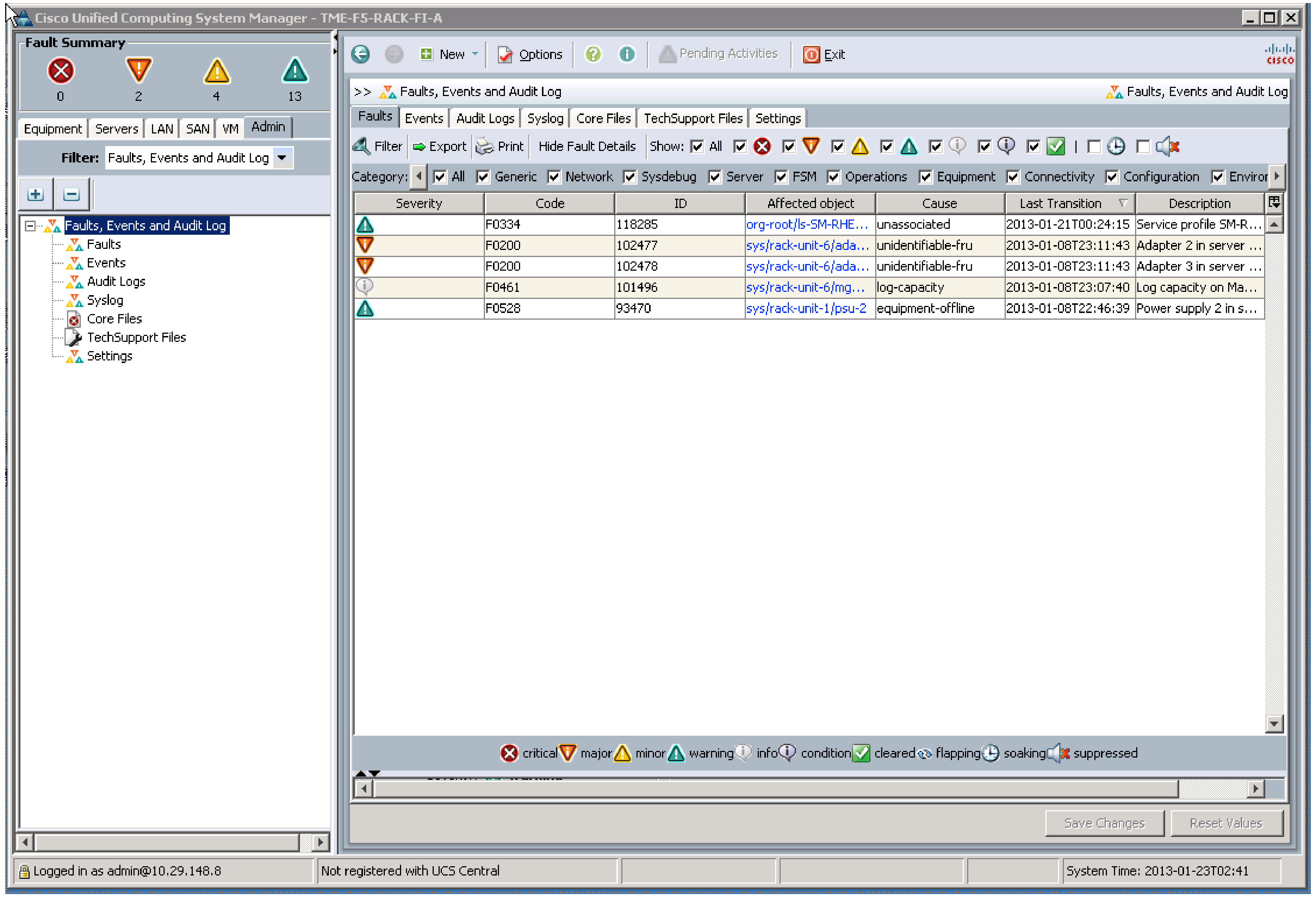
Monitoring & Fault Alerting

UCS Monitoring and Alerting

System Faults

- UCSM Aggregates Faults and events for all integrated components.
- System database is the source of all fault information.
- When faults are triggered the fault information can be sent out via Syslog and SNMP



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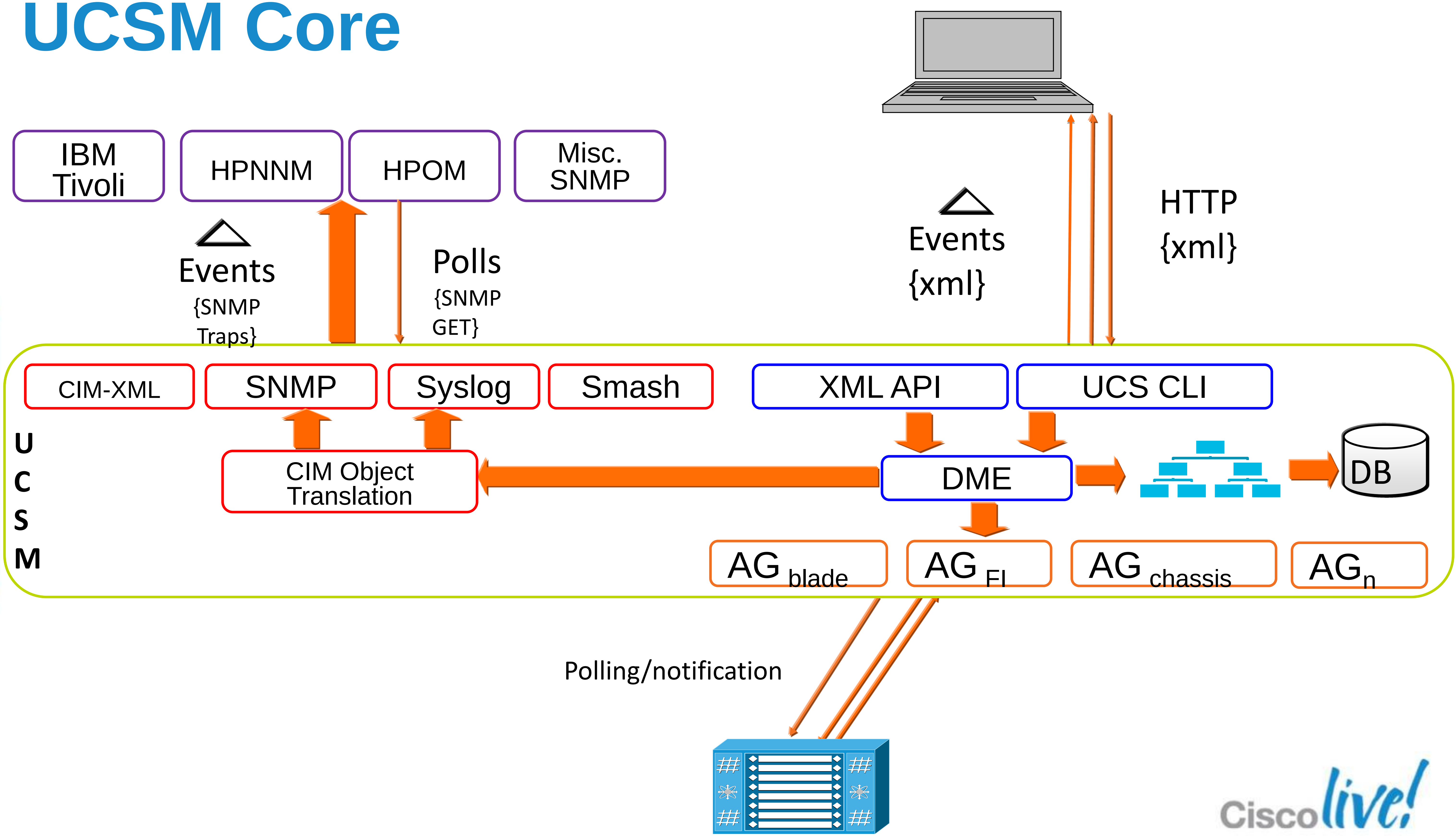
UCSM Core



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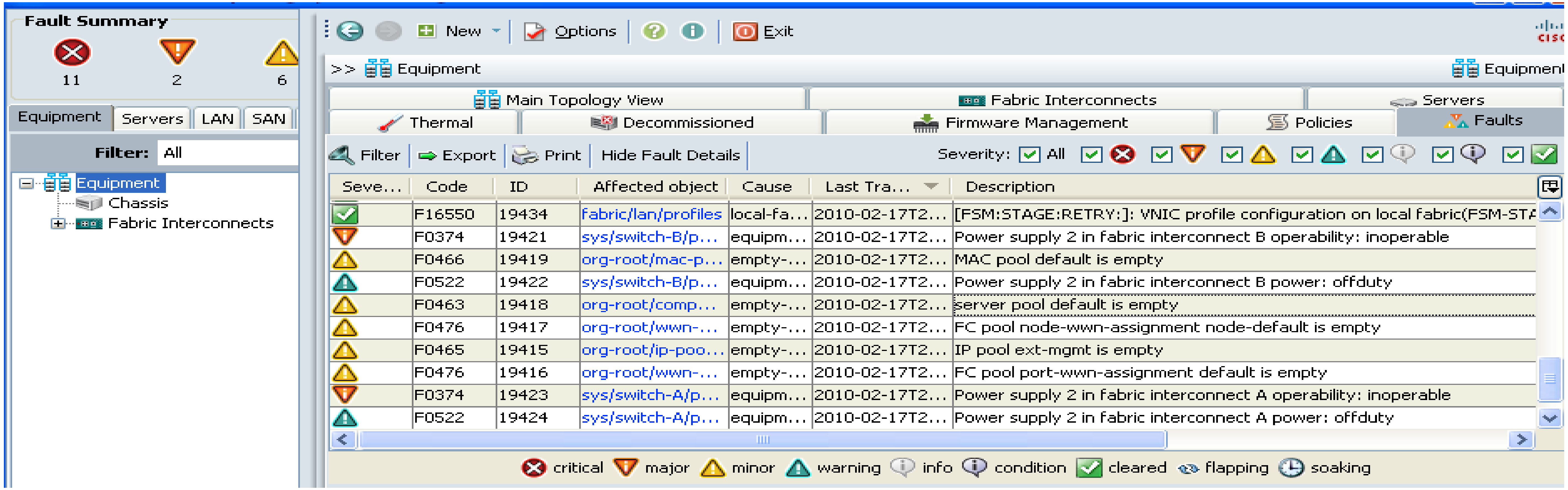
UCS Faults

A Fault is an abnormal condition or defect at the component, equipment, or sub-system level which may lead to a failure



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How UCSM Severity Mapped to Syslog Level

UCSM Severity	Syslog level (v1.3 and prior)	Syslog level (v1.4 and beyond)
info	Info	Info
warning	warning	notifications
minor	error	warnings
major	error	error
critical	critical	critical

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UCSM Fault MIB Sub Tree

- Unified Computing Private MIB
  - MIB registered under enterprises.cisco.ciscoMgmt.719
- One fault table and two traps
- Trap contains all the fault details to identify the nature and cause of the fault
- Switch Networking MIBs continue to be supported
- SNMP configuration
  - SNMP enabled/disabled
  - SNMPv3 users
  - Trap Recipients

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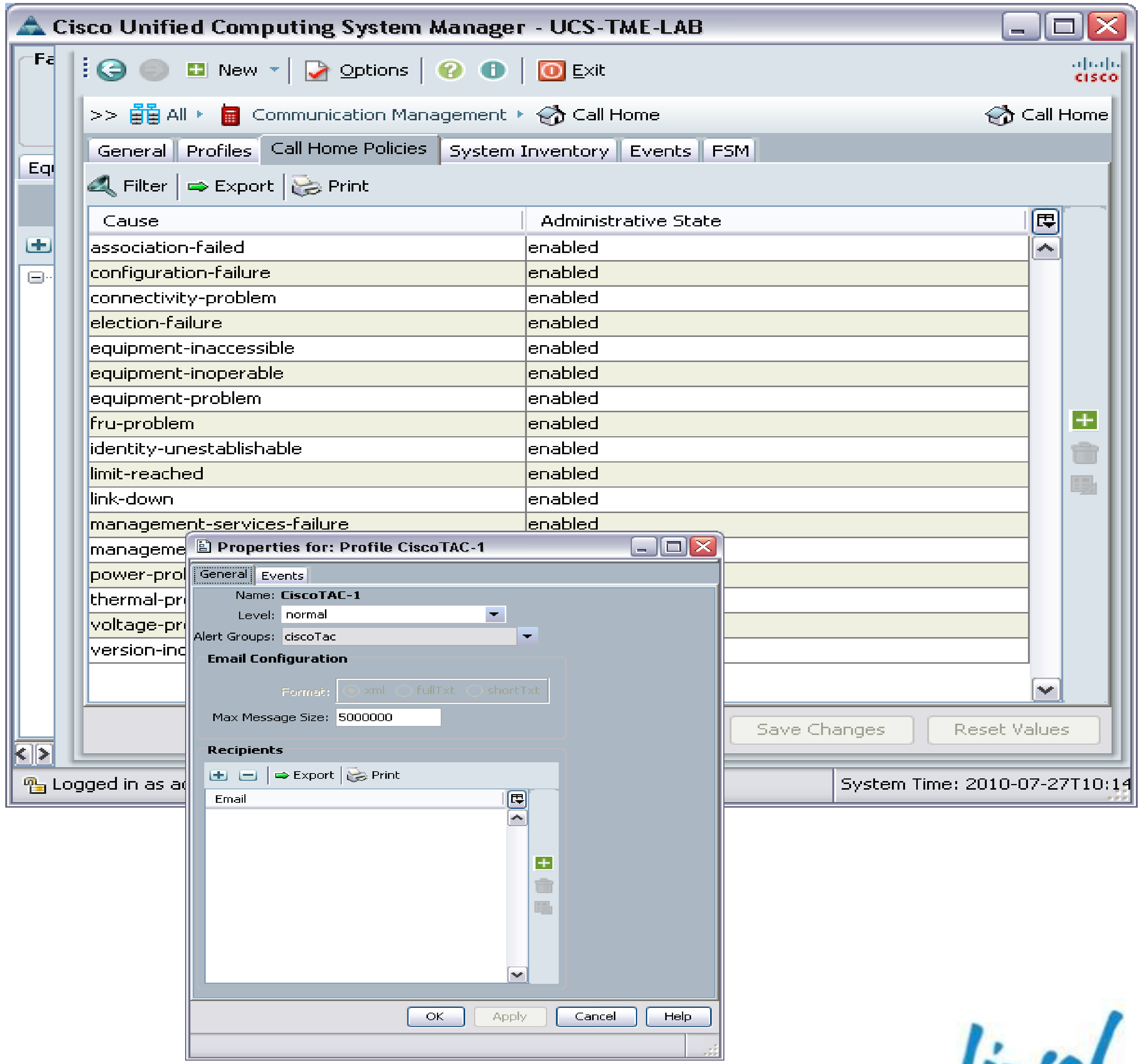
UCS Monitoring and Alerting

Failure Analysis and Pro-active Support Cases

- Smart Call-Home functionality
    - Similar to MDS and Nexus mechanisms
- Alert when thresholds are crossed
    - Thresholds set per organisation for servers
    - Thresholds on UCS infrastructure central
    - Error rates indication of impending component failure
    - SNMP traps
    - Syslog facility
- Call-Home event raised to Cisco support
    - Pro-actively open support cases automatically
    - RMA defective hardware
    - Notification of customer via email and facilities above
    - Customer can disable problem server, if profile in a pool, it will reassociate to other server and boot



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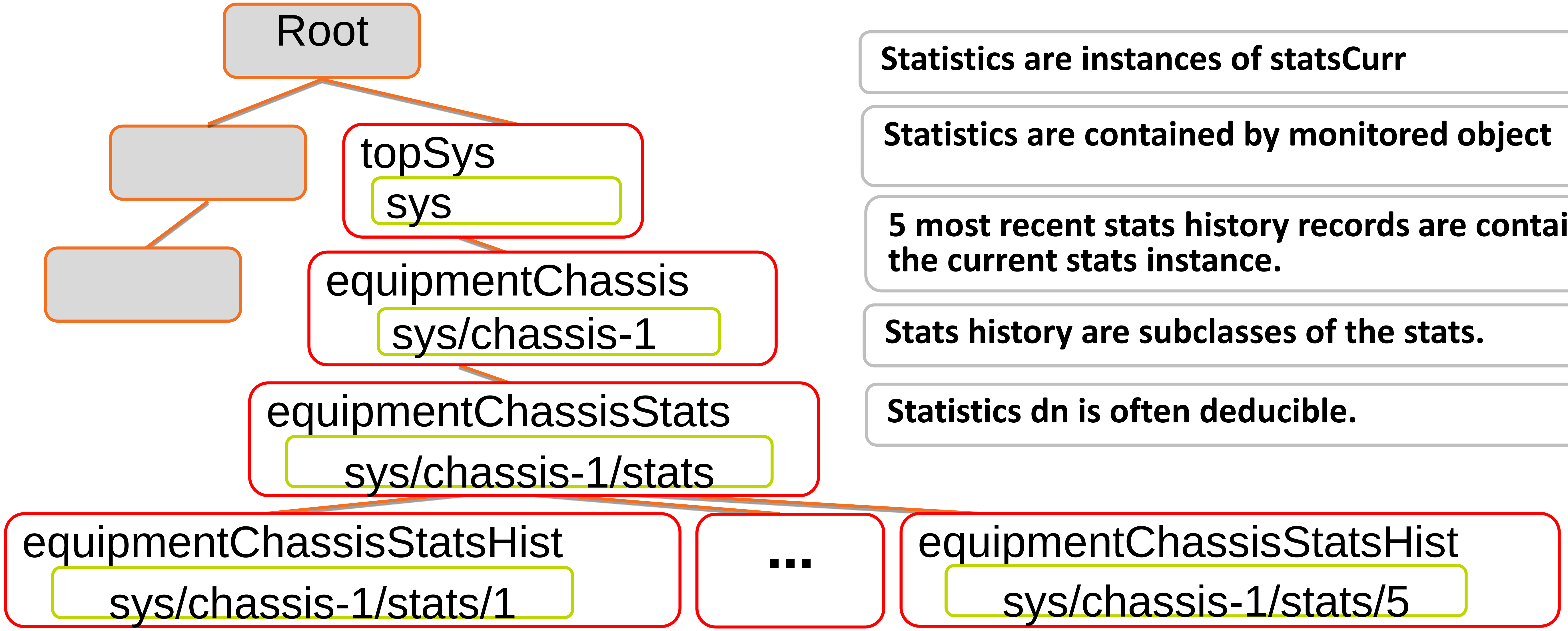
UCSM Statistics



Statistics are instances of statsCurr

Statistics are contained by monitored object

5 most recent stats history records are contained by the current stats instance.

Stats history are subclasses of the stats.

Statistics dn is often deducible.

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Stats Collection Policy

A Systemwide Set of Stats Collection Policies
(One per Application Domain) Allow Configuration of Collection and Reporting Intervals.

- Domains: **adapter, chassis, host, port, server**

When a Collection Interval Is Changed, the reportingInterval Is Restarted

- **collectionInterva**l: frequency that endpoints will send stats updates to DME
- **reportingInterval**: frequency that DME will report stats updates to external collectors and update stats history

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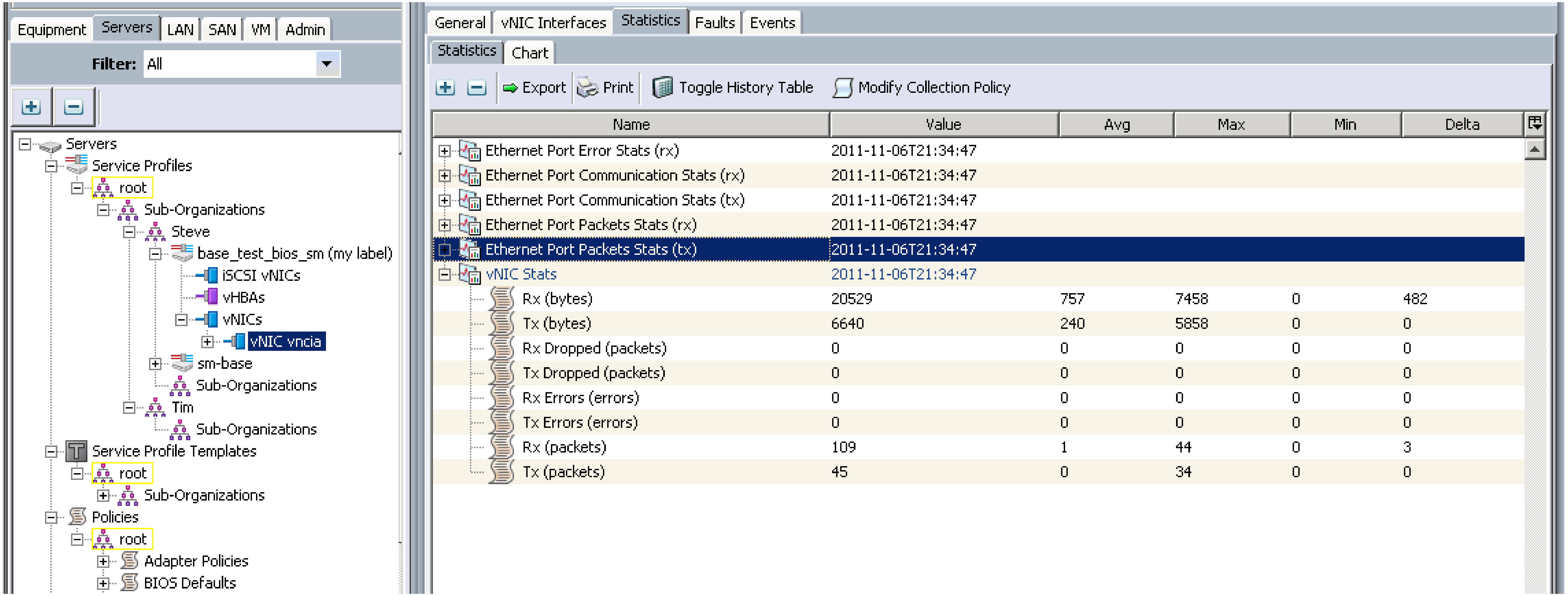
Network Statistics in UCSM

Server to IOM vNIC Port Statistics



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Summary

What we have covered

- UCS Architecture abstracts the server from the hardware which provides elasticity for infrastructure
- Unified I/O and network abstraction reduces the number of cables required to connect to the infrastructure and allows flexibility for connectivity
- Cisco innovation is fundamental in building UCS and emerging virtualisation technologies.
- UCS provides secure multi-tenancy support
- Because UCSM is central to all infrastructure it provides a centralised fault monitoring, alerting, and statistics gather interface with call-home capabilities

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