

What You Make Possible



Designing Cloud-Ready Multi Service Data Centres

BRKSPG-2664

Hotels and Data Centres

Question: What do they have in common?



Hotels and Data Centres

Answer: Both are Shared Infrastructures



Hotel Rooms are expected to have Secure Separation



Data Centres without Secure Separation look like hotel rooms with military sleeping quarters

Data Centres Deployed Following VMDC Guidelines Ensures Critical Workloads are Protected

Acronyms

- VMDC – Virtual Multi-Tenant Data Center
- ICS – Integrated Compute Stack
- Vblock – An ICS based on Cisco, EMC & VMWare components
- FlexPod – An ICS based on Cisco, NetApp & VMWare components
- HCS – Hosted Collaboration Solution. A Cisco software solution to provide rich voice & collaboration software in a cloud environment
- DCI – Data Center Interconnect.
- VPDC – Virtual Private Data Center
- HVD – Hosted Virtual Desktop

Agenda

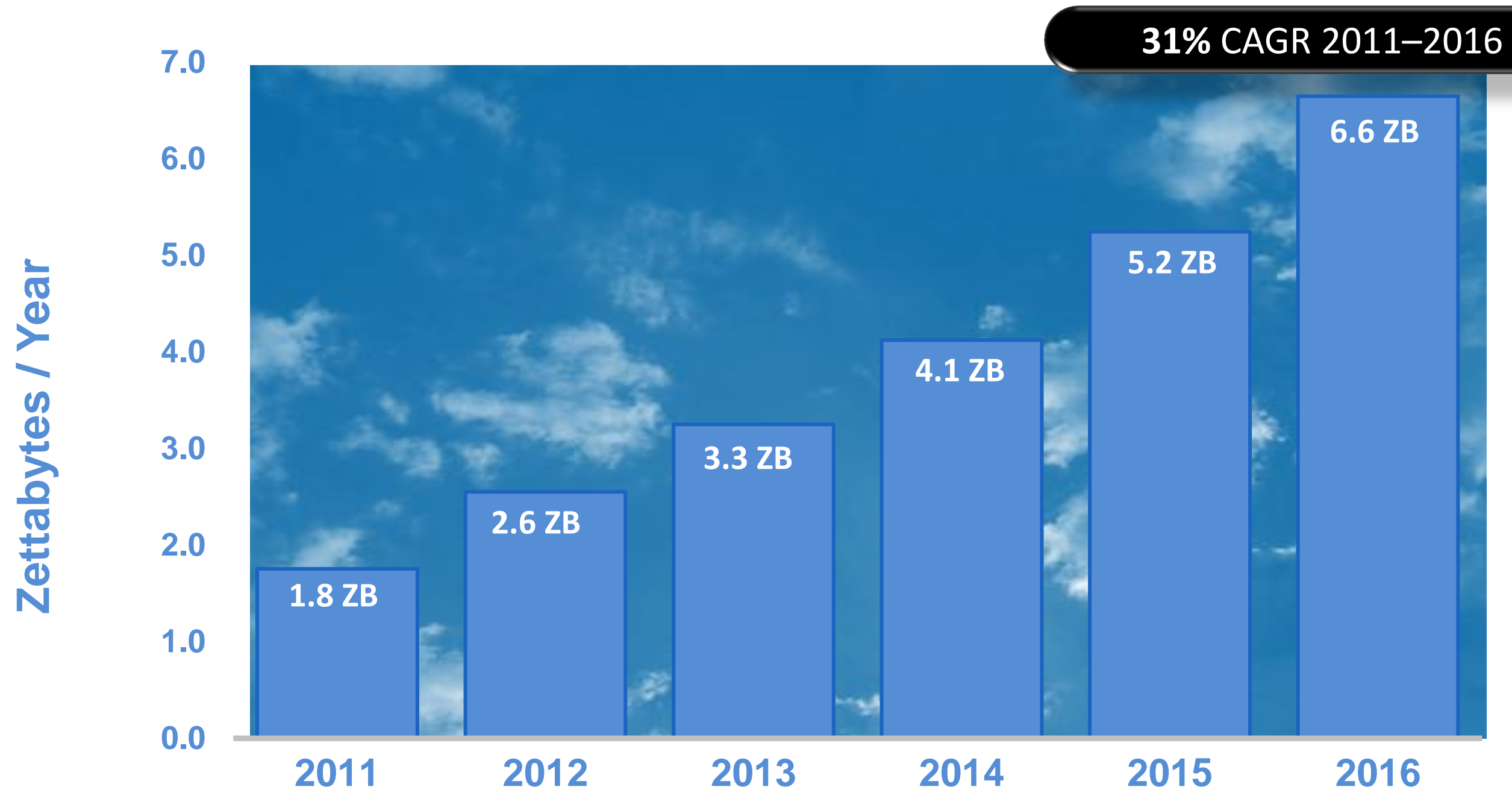
- Cloud Drivers and Introduction
- VMDC System Overview
- VMDC Physical Infrastructure
- VMDC Logical Infrastructure
- VMDC Infrastructure Updates
- VMDC Management and Automation
- VMDC Summary

Cloud Drivers and Introduction



Global Data Centre Traffic Growth

Data Centre Traffic Nearly Quadruples from 2011 to 2016

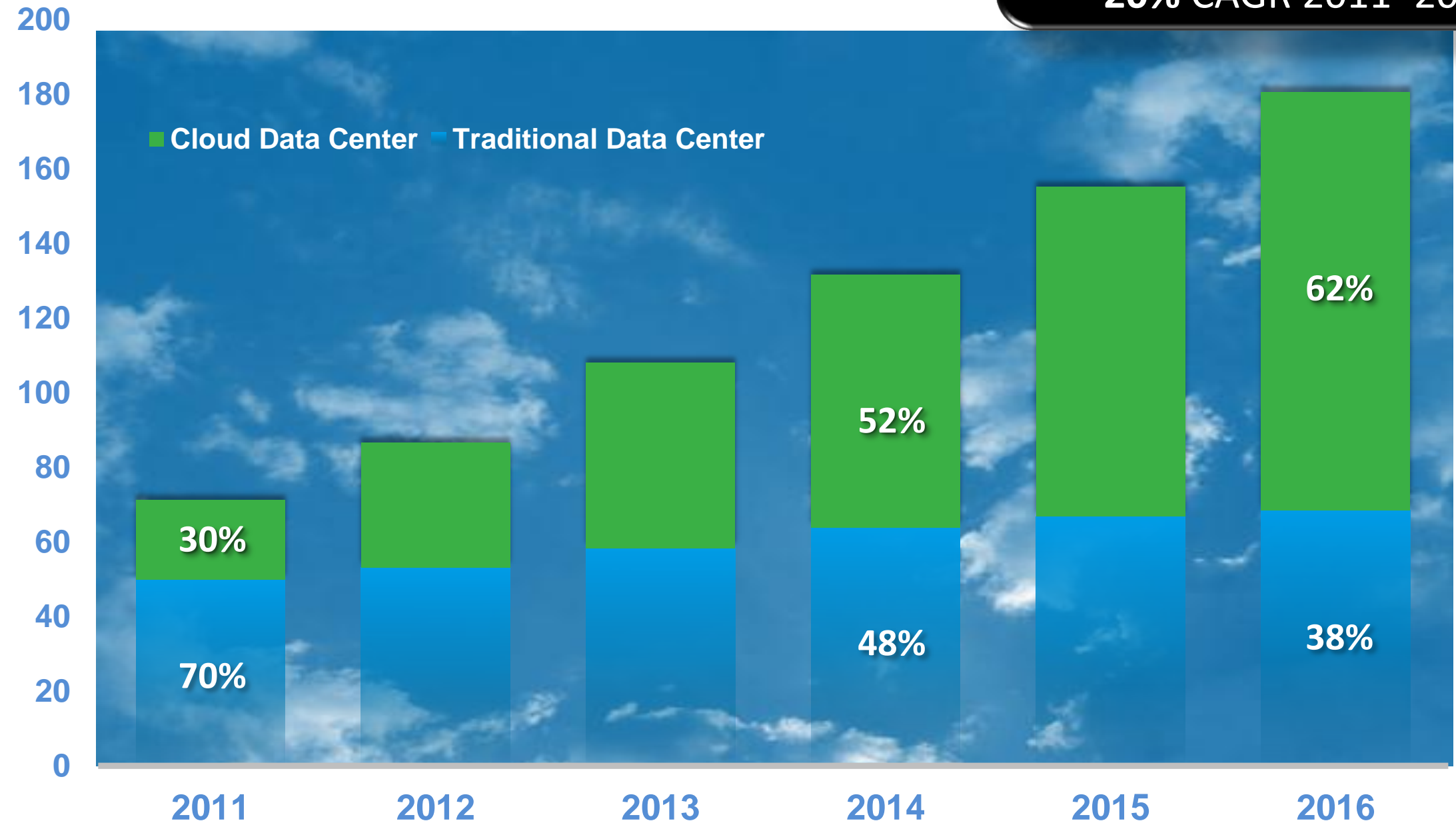


Workload Shift: Cloud vs. Traditional

Nearly Two-thirds of all Workloads Will Be Cloud-based by 2016

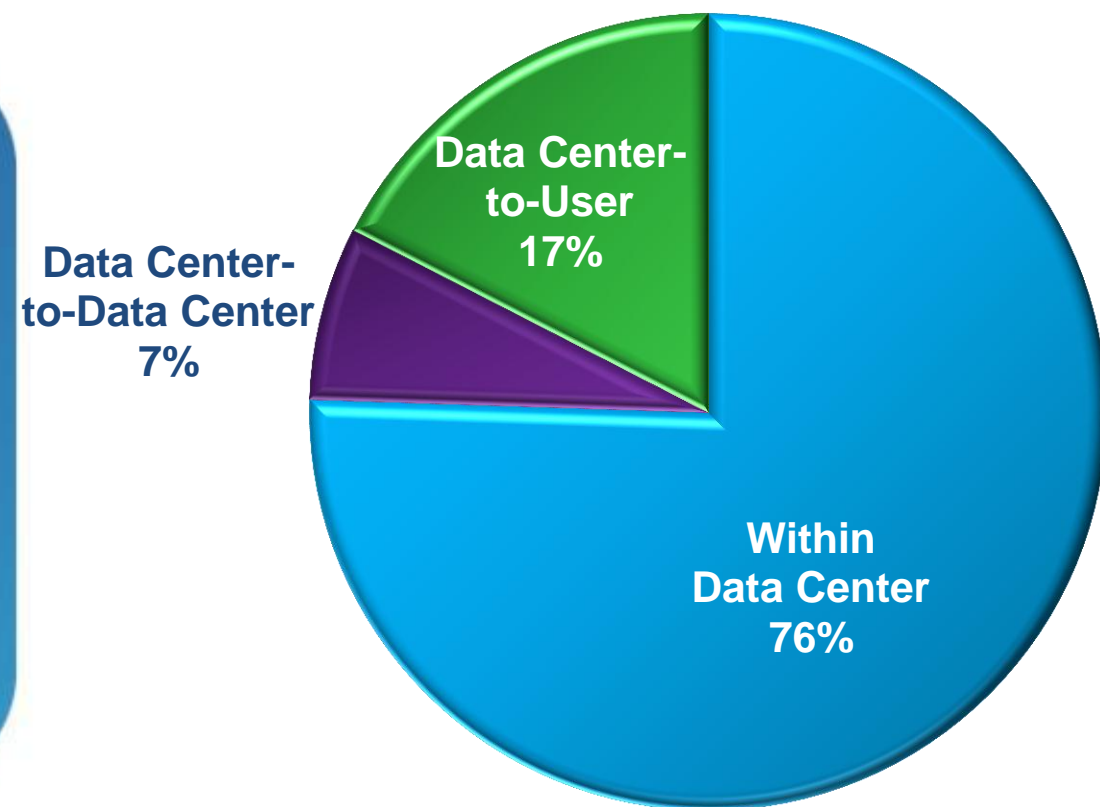
20% CAGR 2011–2016

Installed Workloads in Millions



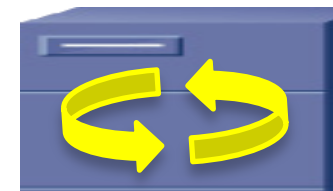
Global Data Centre Traffic by Destination

Most Data Centre Traffic Consistently Stays Within the Data Centre



A

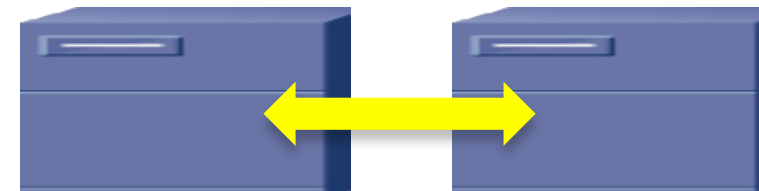
Within Data Centre (76%)



Storage, production and development data, authentication

B

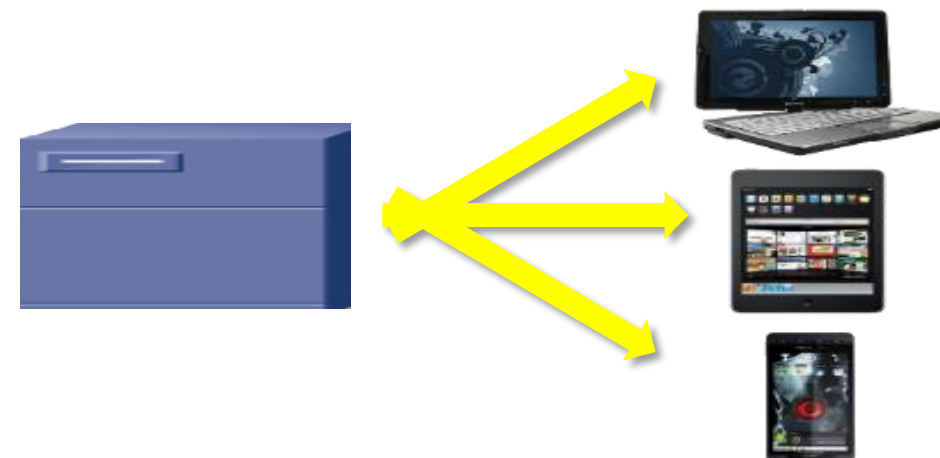
Data Centre-to- Data Centre (7%)



Replication, inter-database links

C

Data Centre-to-User (17%)



Cloud Adoption Drivers

The Challenge	Business Goals	IT Initiatives
<ol style="list-style-type: none">1. Grow revenue2. Lower overall operating costs3. Acquire/retain customers4. Drive new market offering or business practices5. Improve workforce productivity	<ol style="list-style-type: none">1. Improve IT efficiency2. Streamline/improve business processes3. Increase IT resources to drive business innovation4. Improve customer management capabilities	<p>“Raising the productivity of employees whose jobs can't be automated is the next great performance challenge.”</p> <p>McKinsey & Company, The 21st Century Organization, 2005</p>

Cisco's Cloud Strategy

Enabling Cloud Applications/Services by Uniquely Combining the Unified Data Centre and Cloud Intelligent Network

Tailored Solutions for **Building** Clouds




Enable customers to build and operate private, public or hybrid clouds

Rich Ecosystem of **Integrated** Solutions



Enable customers to deploy tested, best of breed solutions

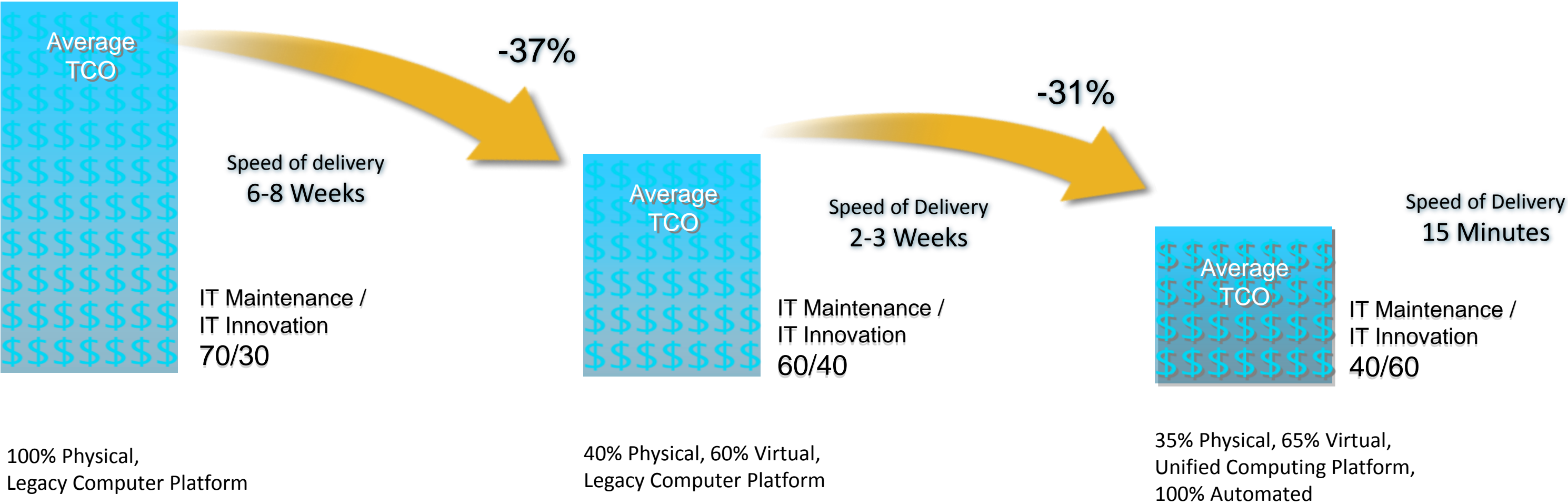
Innovative **Cloud** Services



Enable cloud services including people-centric collaboration and other applications

Cisco IT Case Study – “CITEIS”

Cisco IT Elastic Infrastructure Services (Internal Private Cloud)



Virtualisation

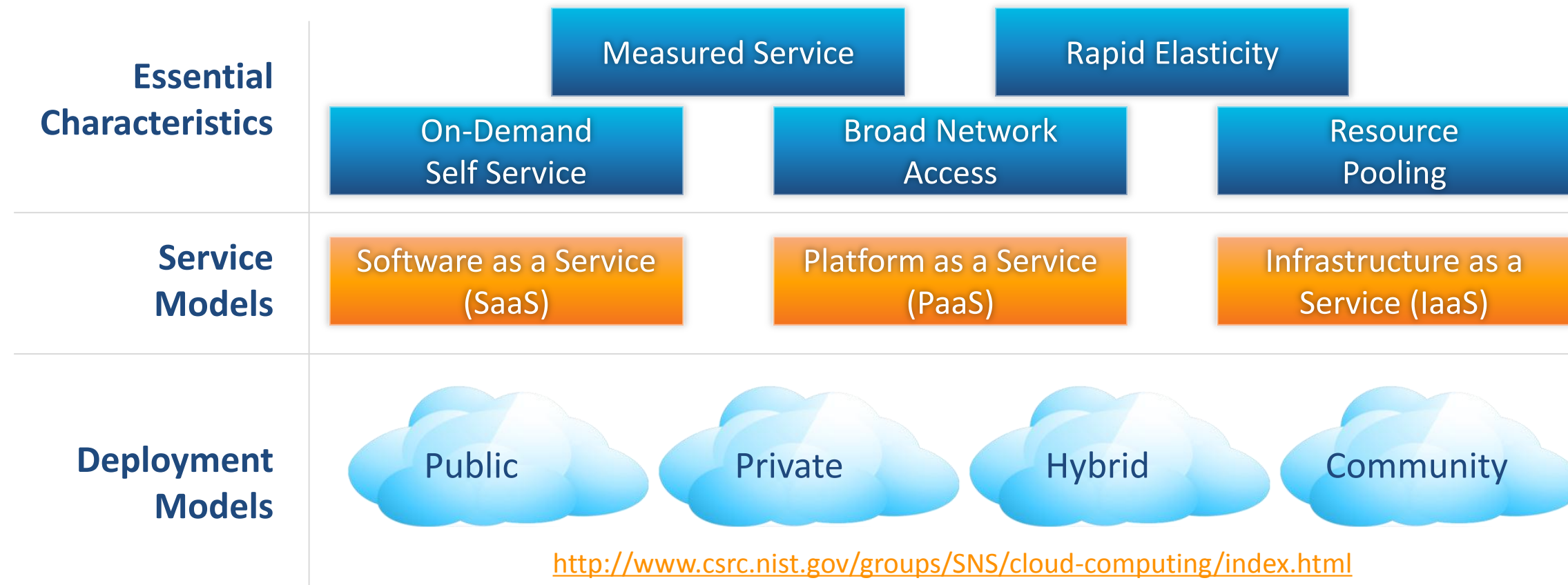
Unified Infrastructure and Automation



What is Cloud Computing?

Taxonomy Check

Visual Model of NIST's Working Definition of Cloud Computing



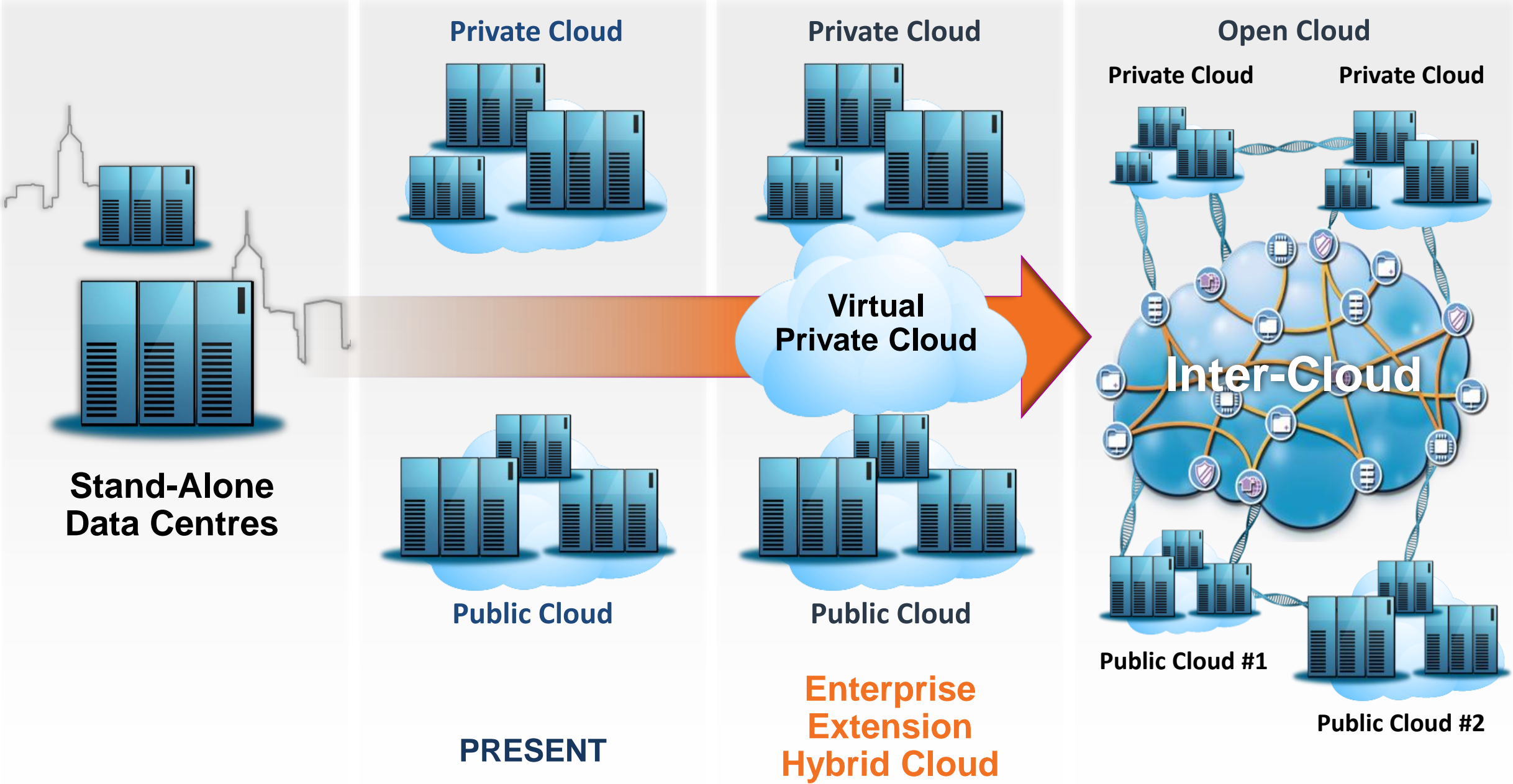
A Style of Computing Where Massively Scalable IT-Enabled Capabilities Are Delivered “as a Service” to Multiple External Customers Using Internet Technologies

Source: Gartner 2008

IT Resources and Services that Are Abstracted from the Underlying Infrastructure and Are Provided “On-Demand” and “At Scale”

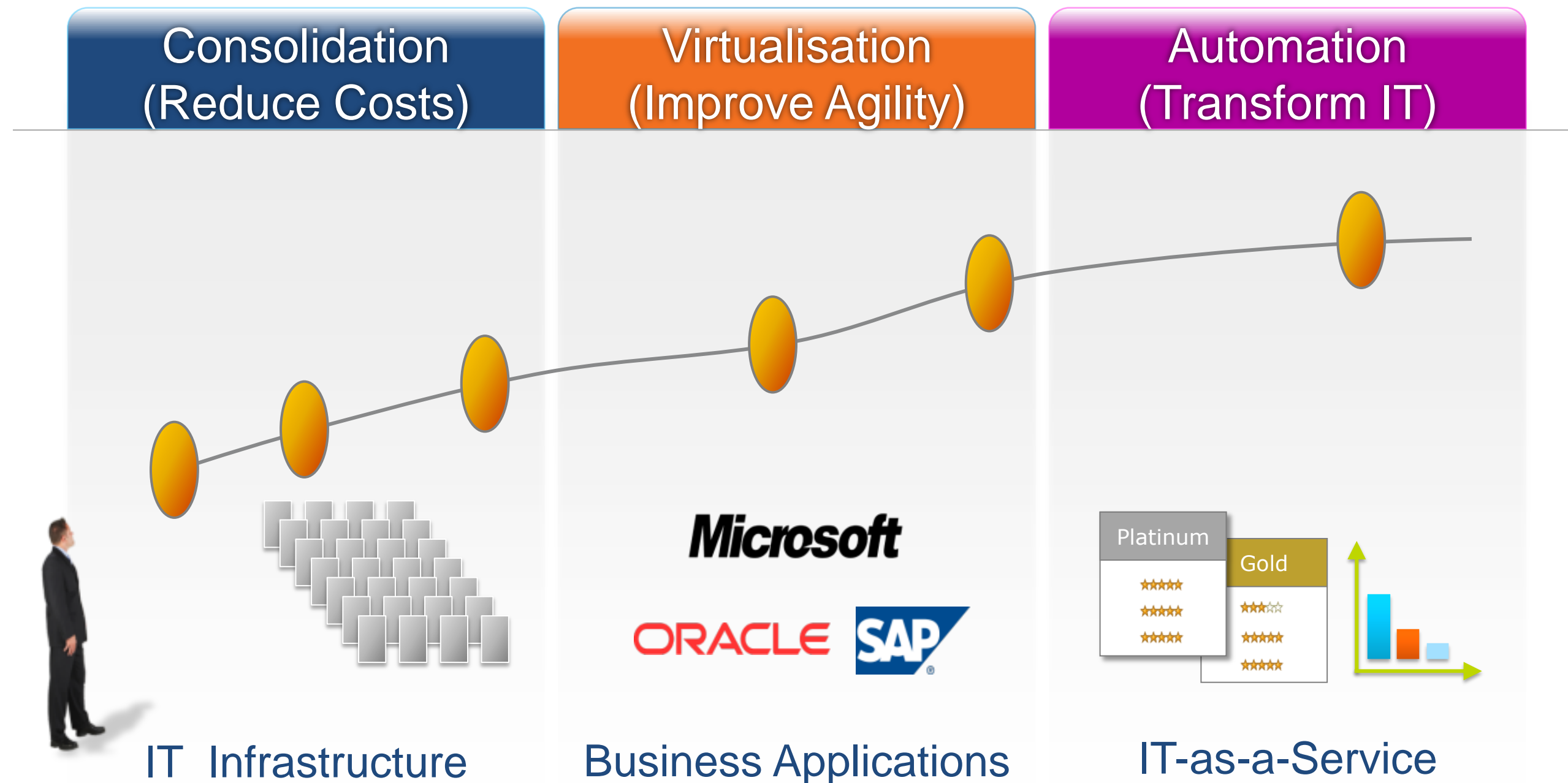
Cloud Deployment Models

Private, Public, Hybrid



The Journey to Cloud

Evolution of IT + Business Agility

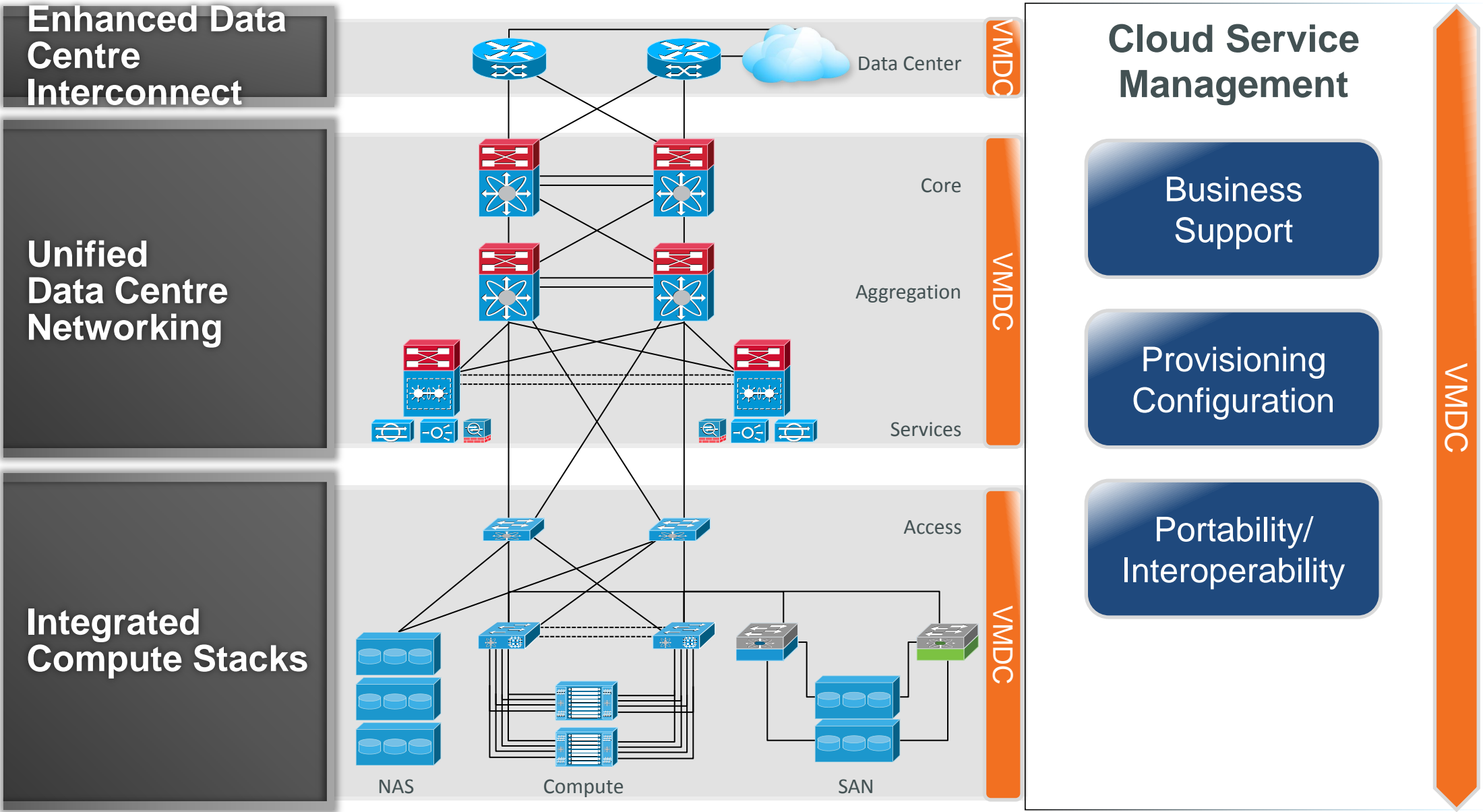


VMDC System Overview



Cisco Virtualised Multi-Tenant Data Centre

A Cloud Ready Data Centre Architecture



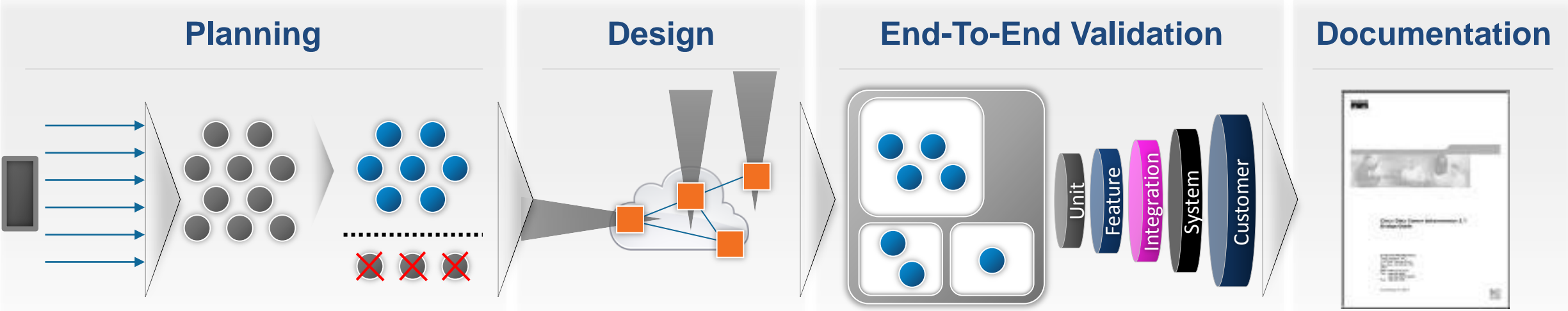
- Validated Design
- Comprehensive
- Modular
- Flexible Approach
- Reduced Risk
- Increased Flexibility
- Operational Efficiency
- Service Tiers

Cisco Validated Design Process

Innovation and Quality Through System Level Design and Validation



System Development Guidelines



Building a Multi-Service Infrastructure

Key Considerations

Modularity

Pod based design

Scalability framework for manageable increments

Predictable physical and cost characteristics

Streamline Turn-up of New Services

High Availability

Carrier Class Availability

Platform/Network/Hardware/Software Resiliency

Minimise the probability and duration of incidents

Focus on your business, not fighting fires

Secure Multi-tenancy

Shared Physical Infrastructure

Tenant Specific Resources

Use Cases

Comply with business policies

Differentiated Service Support

Design logical models around use cases

Services-oriented framework

Combines compute/storage/network

Resources are applied and tuned to meet needs

Service Orchestration

Dynamic application and reuse of resources

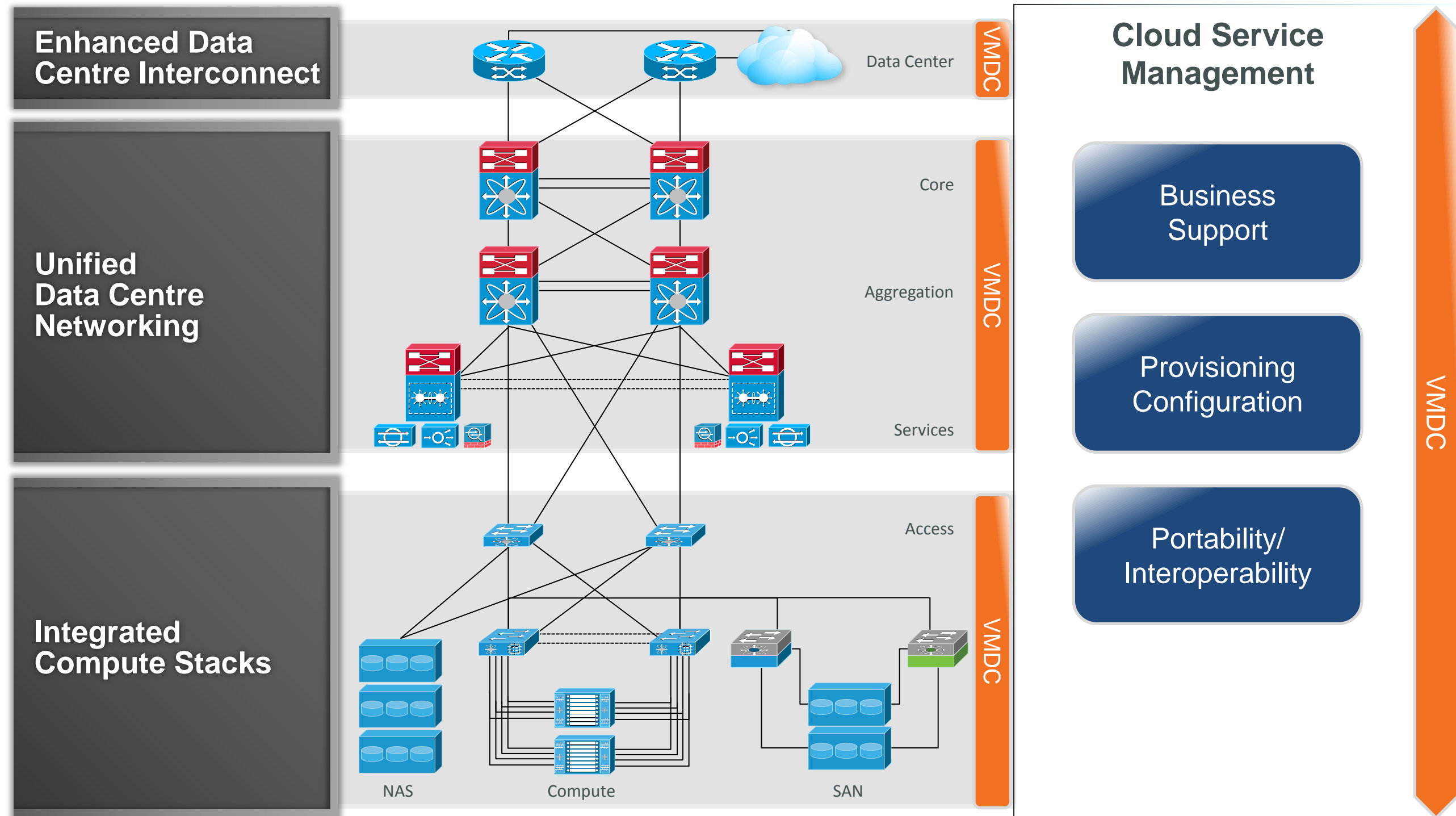
Automated service orchestration and fulfillment

Integration with Network Containers

Rapid Self Service IT

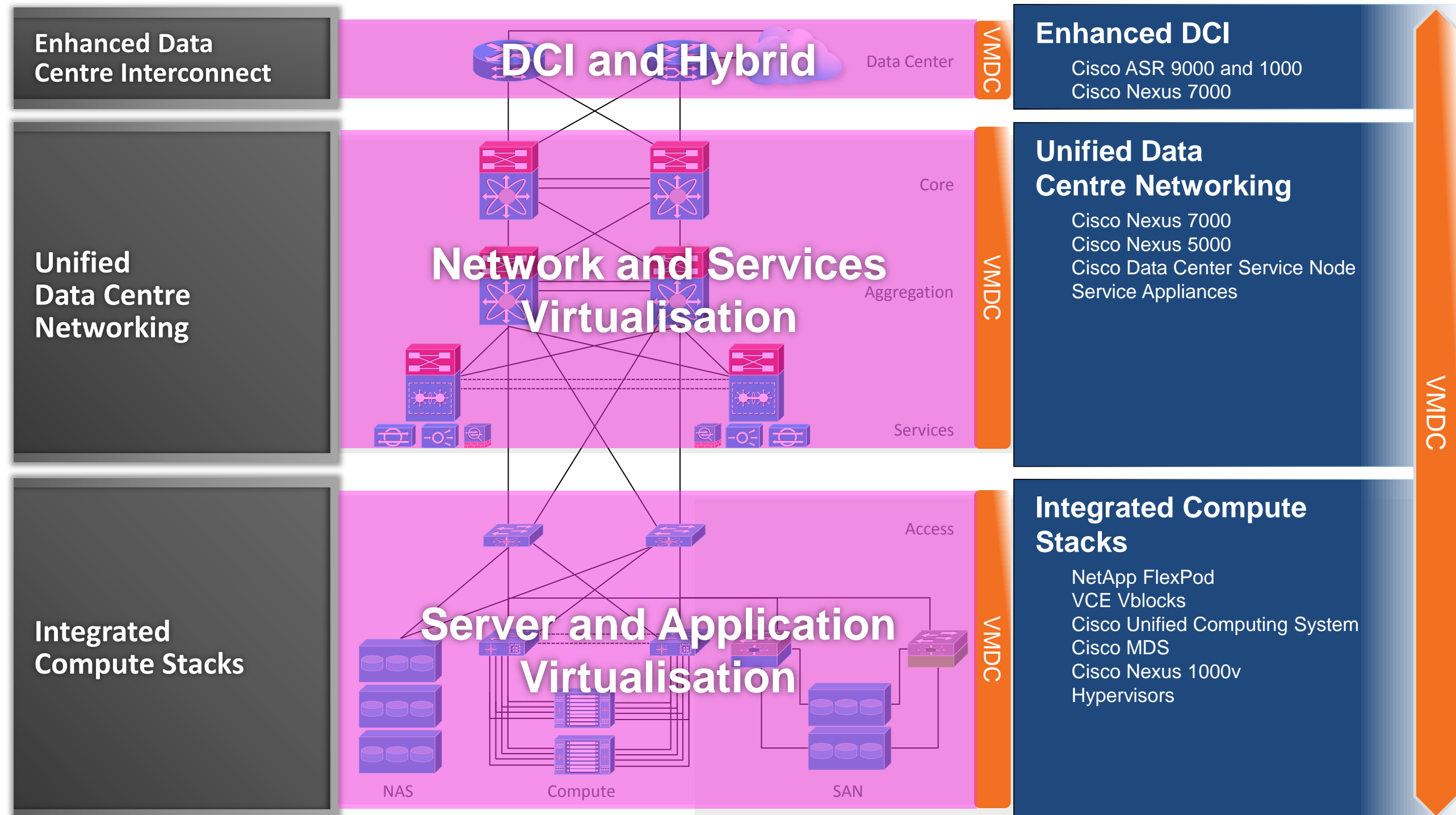
Cisco Virtualised Multi-Tenant Data Centre

Comprehensive, Modular, and Flexible Approach



Cisco Virtualised Multi-Tenant Data Centre

Comprehensive, Modular, and Flexible Approach



Challenges in Building and Maintaining Cloud

You need to have a plan!

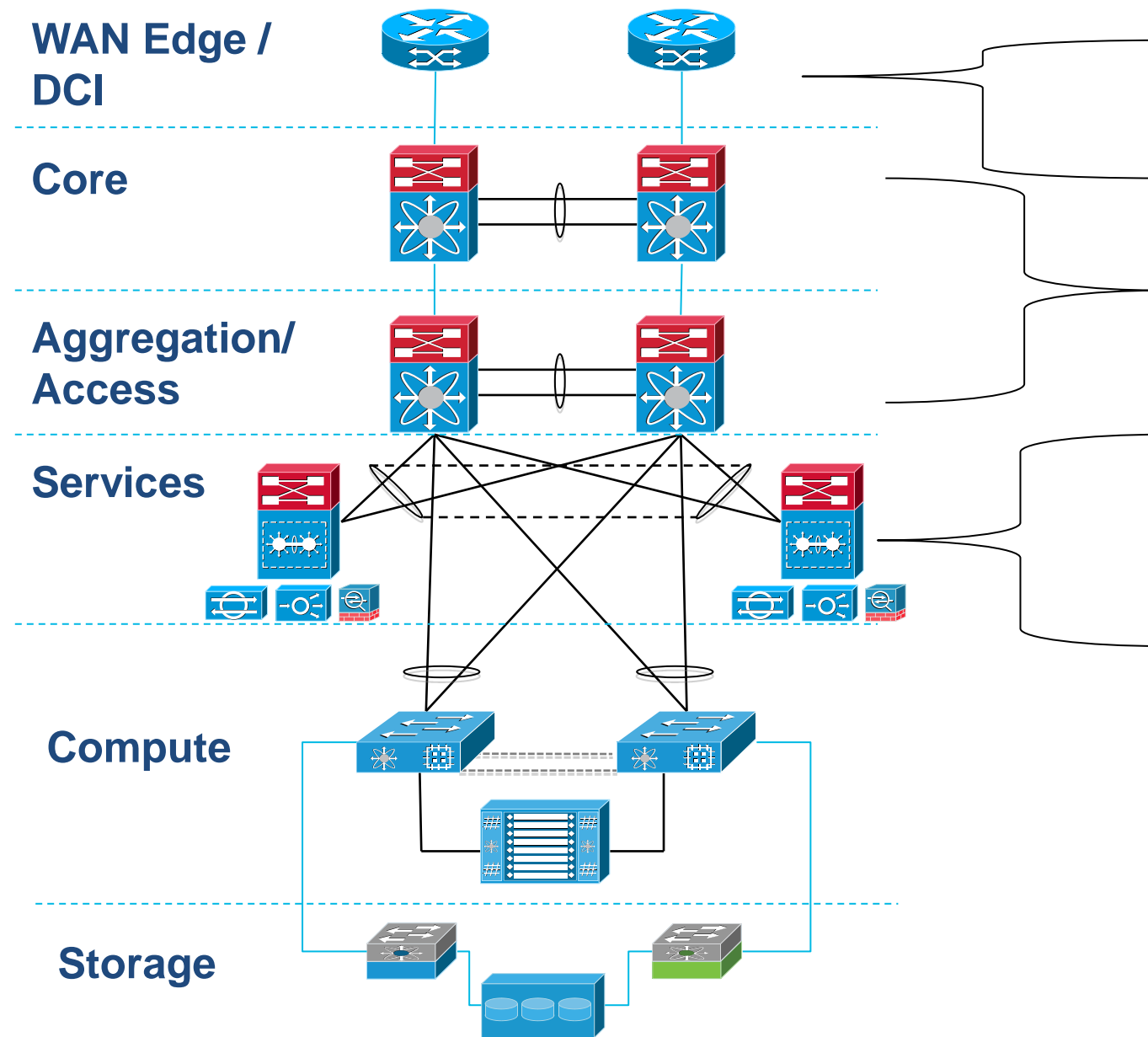
- Predictably grow the data centre
- Scale the data centre
- Secure the data centre from external and internal threats
- Protect the DC from HW and SW failures
- Establish virtual containers to be assigned to consumers with pre-defined service policy profiles
- Securely separate these virtual containers
- Connect the DC to other DCs
- Provision the DC
- Manage and Monitor the DC
- Provision virtual containers and assign to consumers
- Manage virtual containers
- Provide services for consumers of virtual containers

VMDC Physical Infrastructure



VMDC PoD Construct

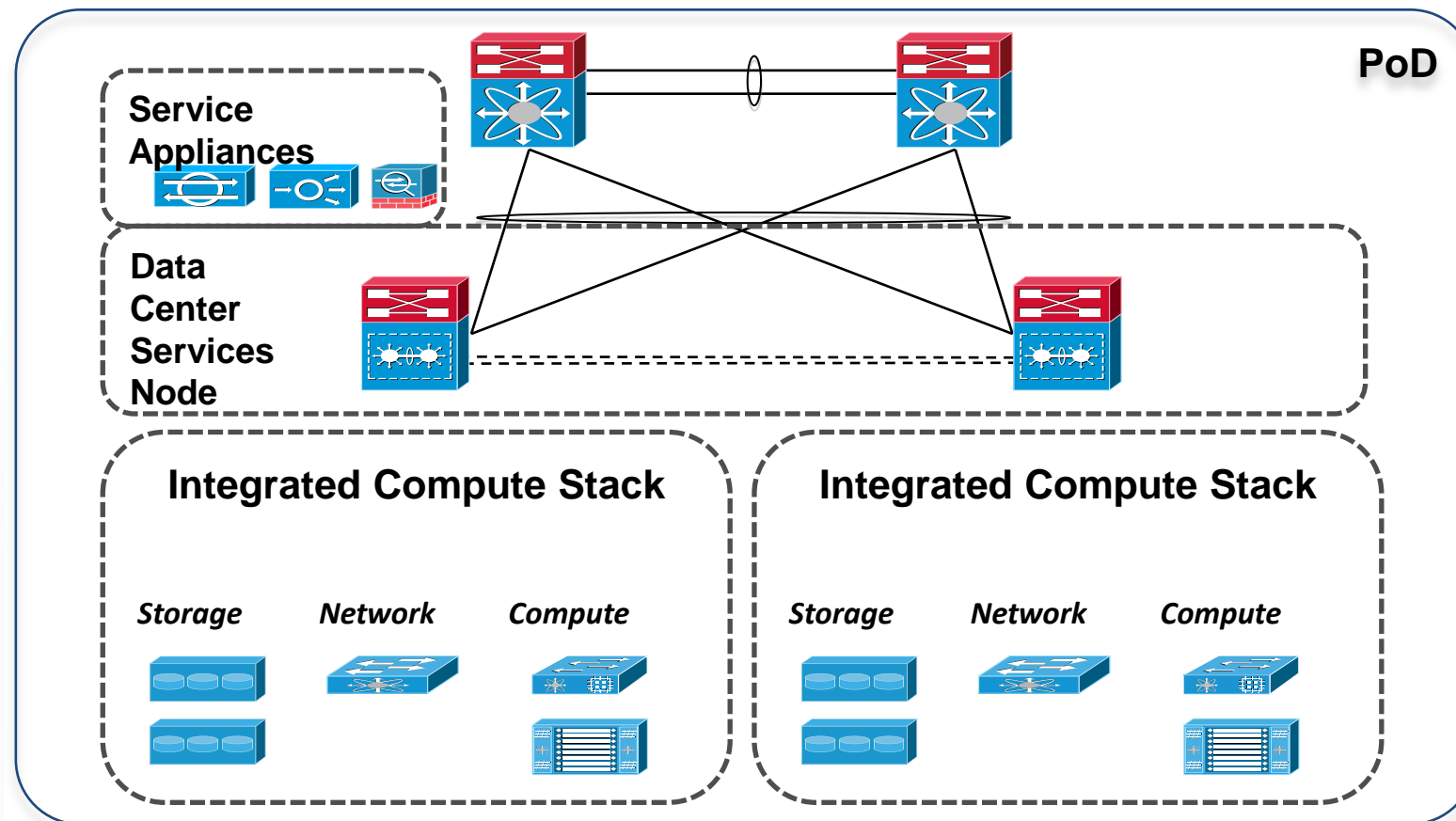
VMDC 2.2 Components



Component	SW Versions
ASR9000	XR 4.1.0
ASR1006	XE 3.4.0 15.1(3)S
Nexus 7010	NXOS 5.2.1
ASA5585-60X	8.4.2
ACE30	A 4.2.1
Cat 6509	IOS 12.2.33 SXJ
UCS 6140, B200	1.4(2b)
VSG	4.2(1)SV1(2) - VNMC: 1.2(1b)
Nexus 1000V	NXOS 4.2.1 SV1(1.4a)
VMware	vSphere 4.1 U1, ESXi
MDS9513	NXOS 5.0.4d

The Challenge:

How do I scale my data centre?



Point of Delivery (PoD)

*Architectural consistency
through a modular approach*

- Modular, tiered construct consisting of groupings of integrated compute stacks plus storage and networking infrastructure
- A single Pod can be deployed and operated by itself or connected together to other Pods to achieve scale
- VMDC validates 2 styles of Pods: Compact and Large

The Solution

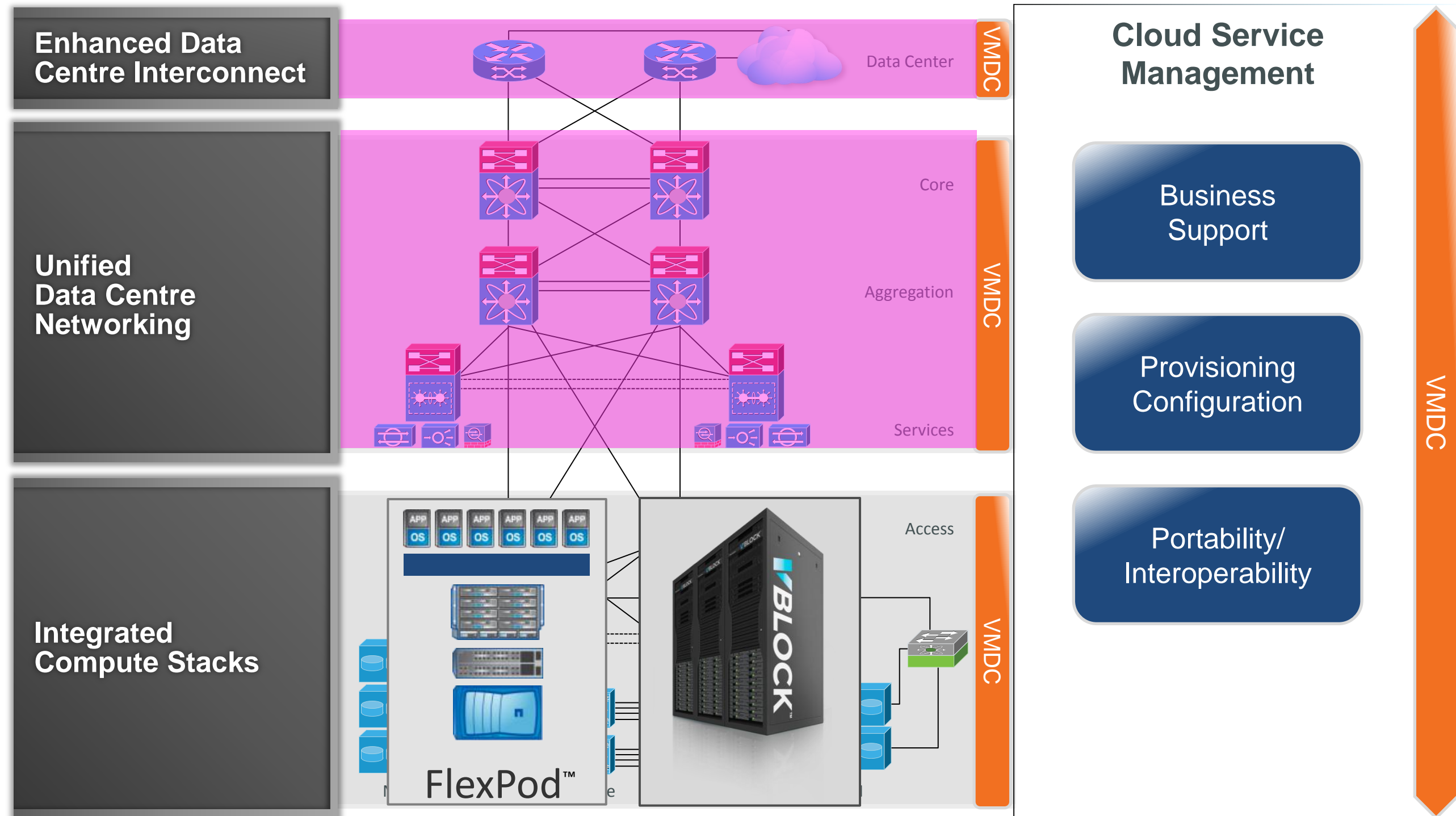
- Point of Delivery (POD)

Benefits

- Simplified capacity planning
- Ease of new technology adoption
- Consistent and efficient operation

Cisco Virtualised Multi-Tenant Data Centre

Scale the Compute with UCS and Integrated Compute Stacks



Scalable Compute: VMDC Supported ICS

VCE'S Vblock Family of Cloud Infrastructure Packages

Pre-Integrated and Supported Cloud Infrastructure

Focus teams on using infrastructure vs. assembling and supporting the individual components

Cloud Service Provider Operational Model

Provisioning, service delivery, chargeback, etc.

Accelerates the Shift to a Private Cloud Model

Less time debating, more time using



Vblock Series 700

Storage: **EMC Symmetrix Vmax**

Compute: Cisco UCS

Virtualisation: VMware

Orchestration:
Unified Infrastructure
Manager (UIM)

Vblock Series 700
model MX

Vblock Series 300

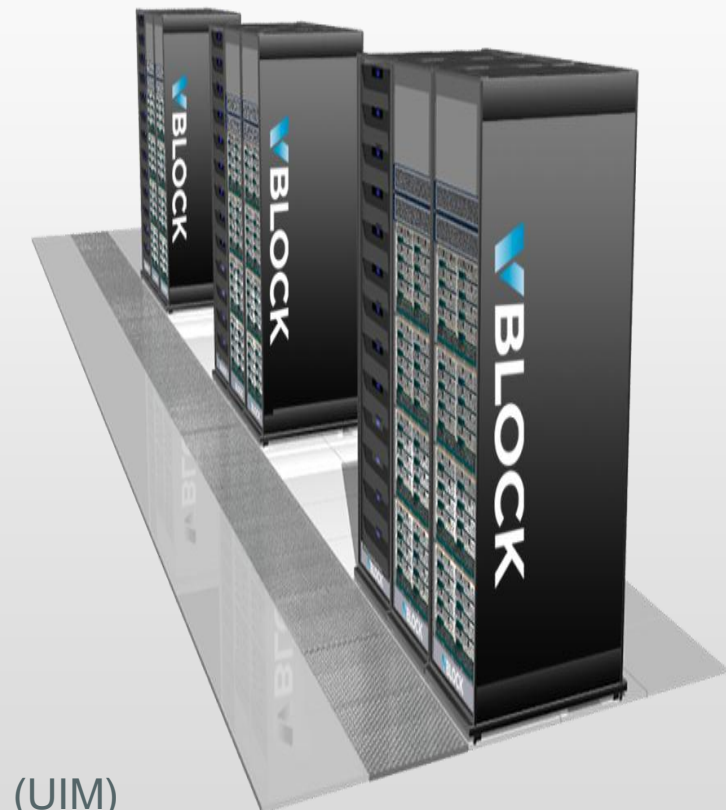
Storage: **EMC VNX**

Compute: Cisco UCS

Virtualisation: VMware

Orchestration: Unified
Infrastructure Manager (UIM)

Four Models



Scalable Compute: VMDC Supported ICS

Cisco and NetApp's FlexPod Reference Architecture



- Standard, pre-validated, best-in-class infrastructure building blocks
- Flexible: One platform scales to fit many environments and mixed workloads
- Add applications and workload
- Scale up and out
- Simplified management and repeatable deployments
- Design and sizing guides
- Services: Facilitate deployment of different environments

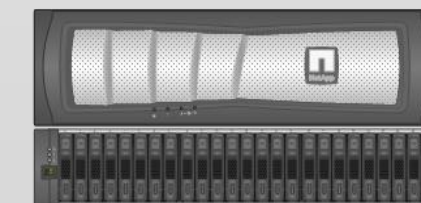
Cisco® UCS B-Series Blade Servers and UCS Manager



Cisco Nexus® 5000 Family Switches

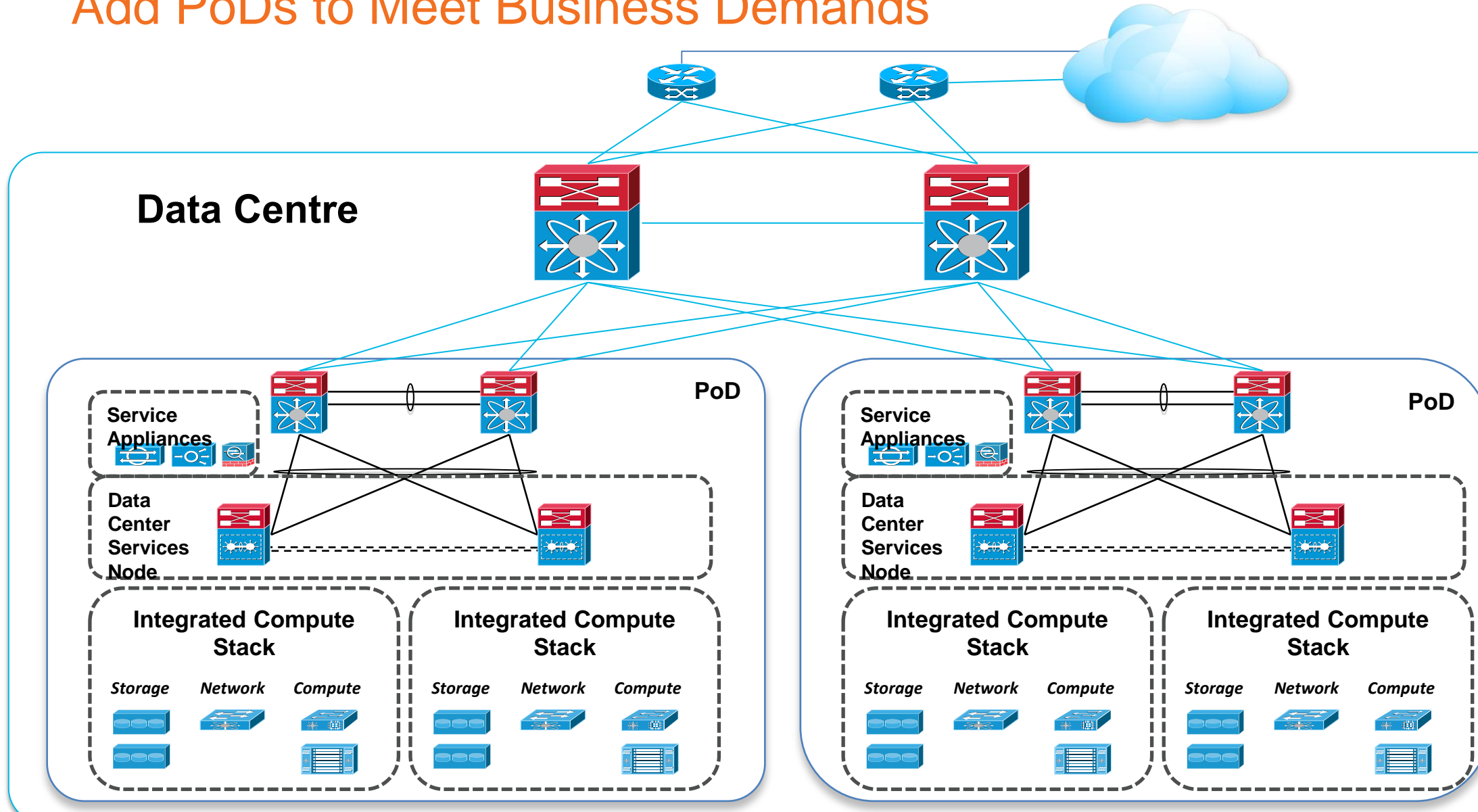


NetApp® FAS 10GE and FCoE



Scaling the Infrastructure

Add PoDs to Meet Business Demands



Key Factors to Consider

- **L2 Scale** - Virtual Machine Density, VMNics per VM, MAC Address Capacity, Cluster Scale, ARP Table Size, VLAN scale, Port Capacity, Logical Failure Domains L2 Control Plane
- **L3 Scale** – BGP Peering, HRSP Interfaces, VRF Instances, Routing Tables and Convergence, Services
- **Resource Oversubscription** – Network Compute, and Storage Oversubscription, Bandwidth per VM

The Solution

- PoD replication

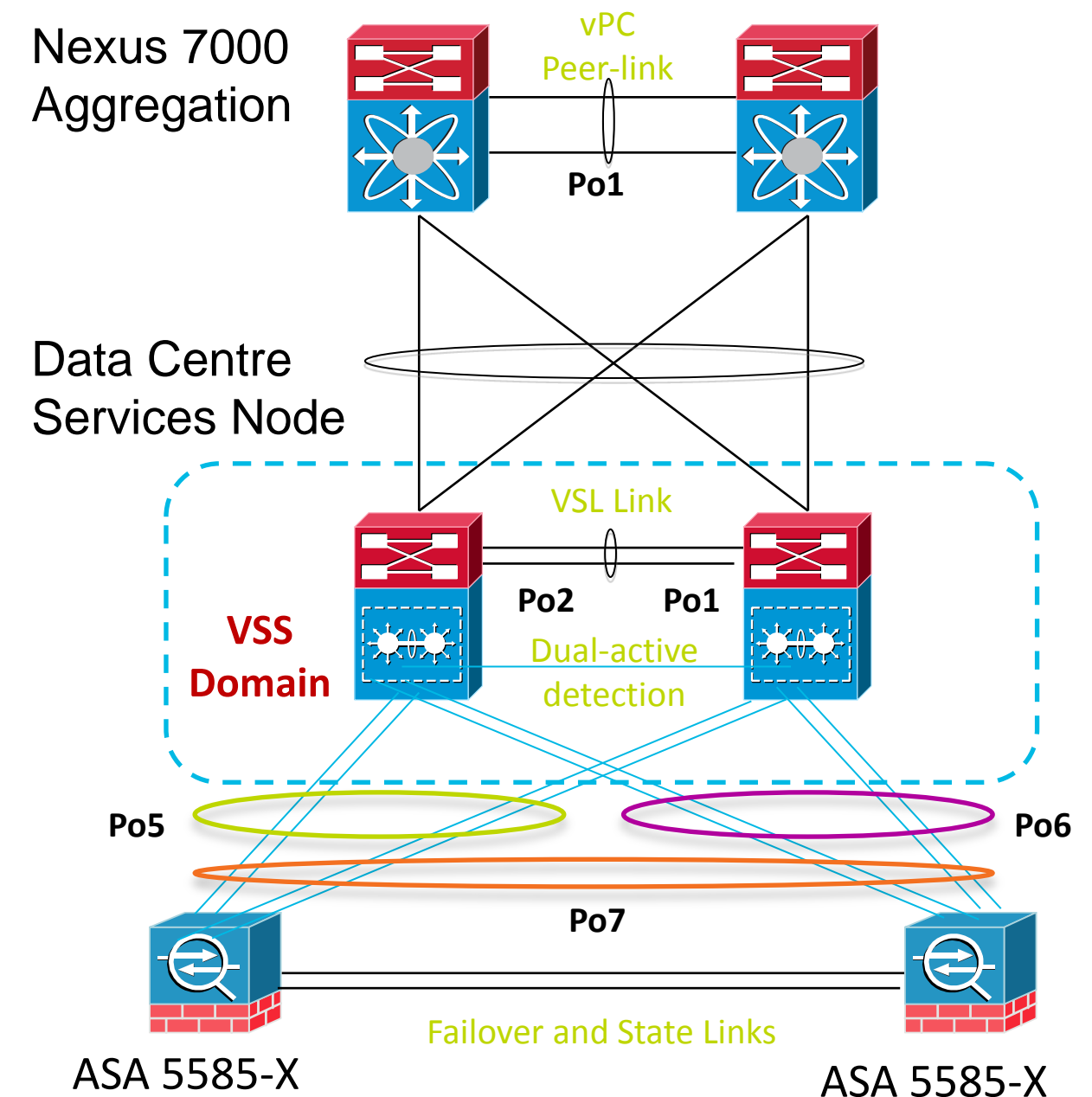
Benefits

- Optimise CAPEX savings while maintaining SLAs
- Predictable performance and scale based on building blocks
- Effective way to add separate application environments

VMDC Data Services Node Based Services

Unified Network Services

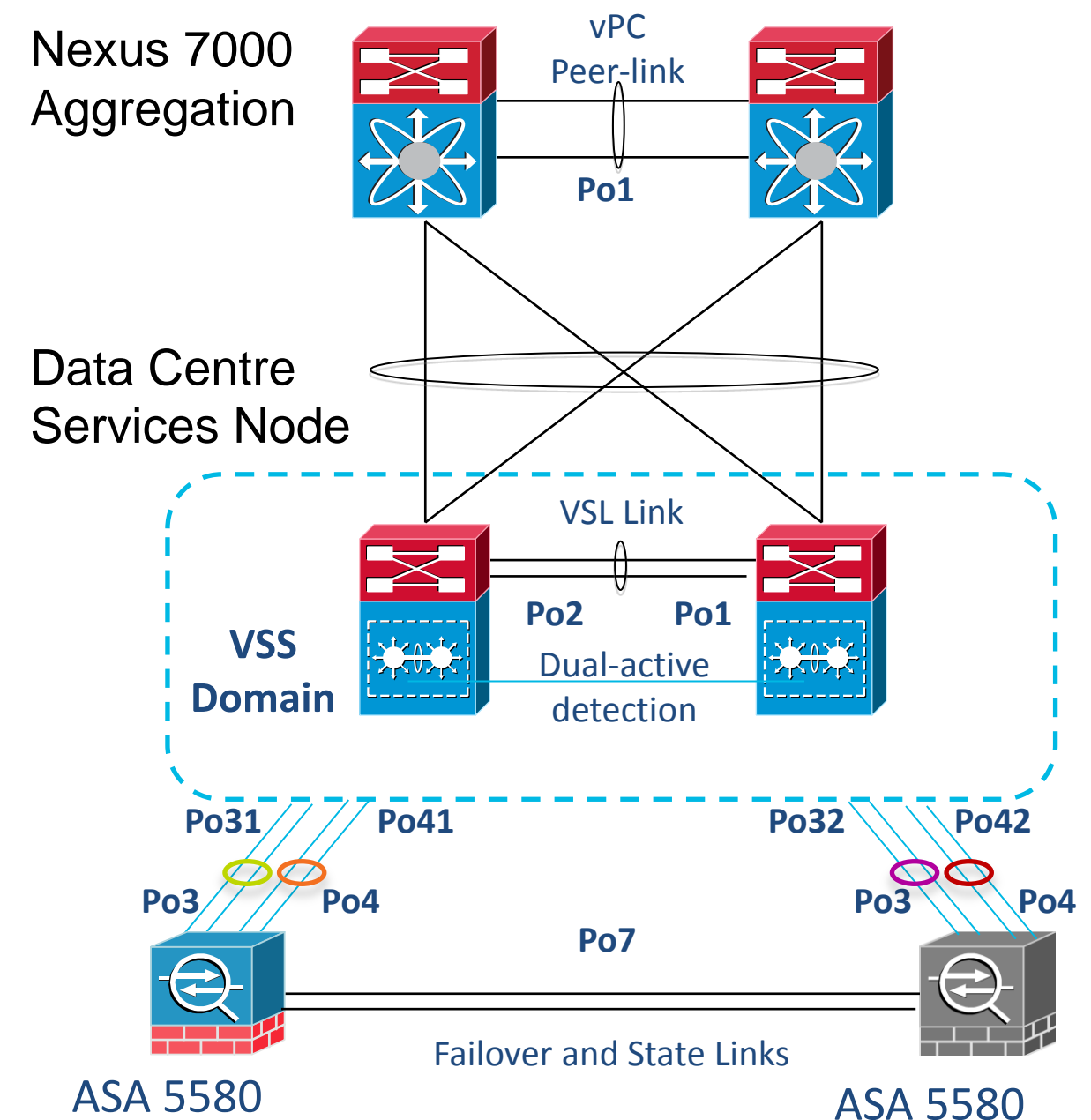
- Data Centre Services Node (DSN) supports both integrated service modules and service appliances
- Multi-Chassis Etherchannel (MCE) allows for availability and scalability of physical appliances
 - VSS MCE prefers local links optimising traffic flow
- ASA in active/active configuration mode
- ASA virtual context in routed mode and balanced



VMDC Appliance Based Services

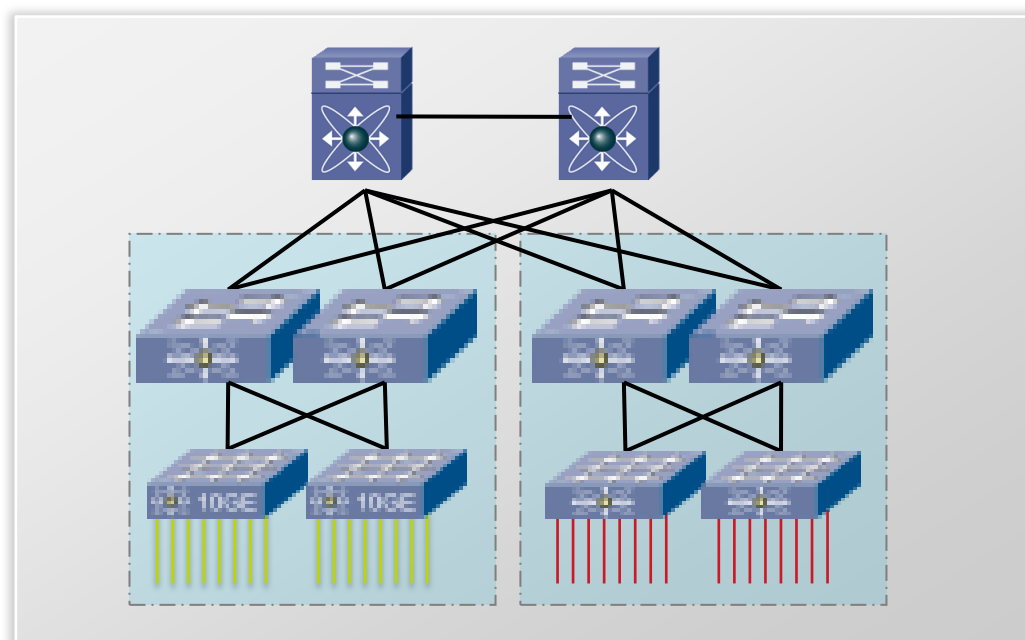
Unified Network Services

- ASA 5580 for VPN Services
- ASA 5580 supports remote access VPN access via
 - Cisco VPN Client software
 - SSL VPN via Cisco Secure Desktop or Cisco AnyConnect software
- ASA in active/standby mode
- ASA in single context mode to support VPN functionality
- Use Group VLAN ID or Tunnel Group to differentiate traffic
 - Policy maintained in ASA internal DB or AAA server



Network Scale Considerations

PoD Scalability



What Determines the Host Scale in a PoD?

- Aggregation—Number of PoDs
- Work-load domain
- Number of MAC address and VLANs
- Failure Domain
- Features to facilitate L2/L3 Boundary

Compute/VMware

- VM Density
- MAC per VM
- Logical Ports
- Virtual Switch

Network

- Total number of MAC Addresses
- Total number of ARP entries
- STP logical ports

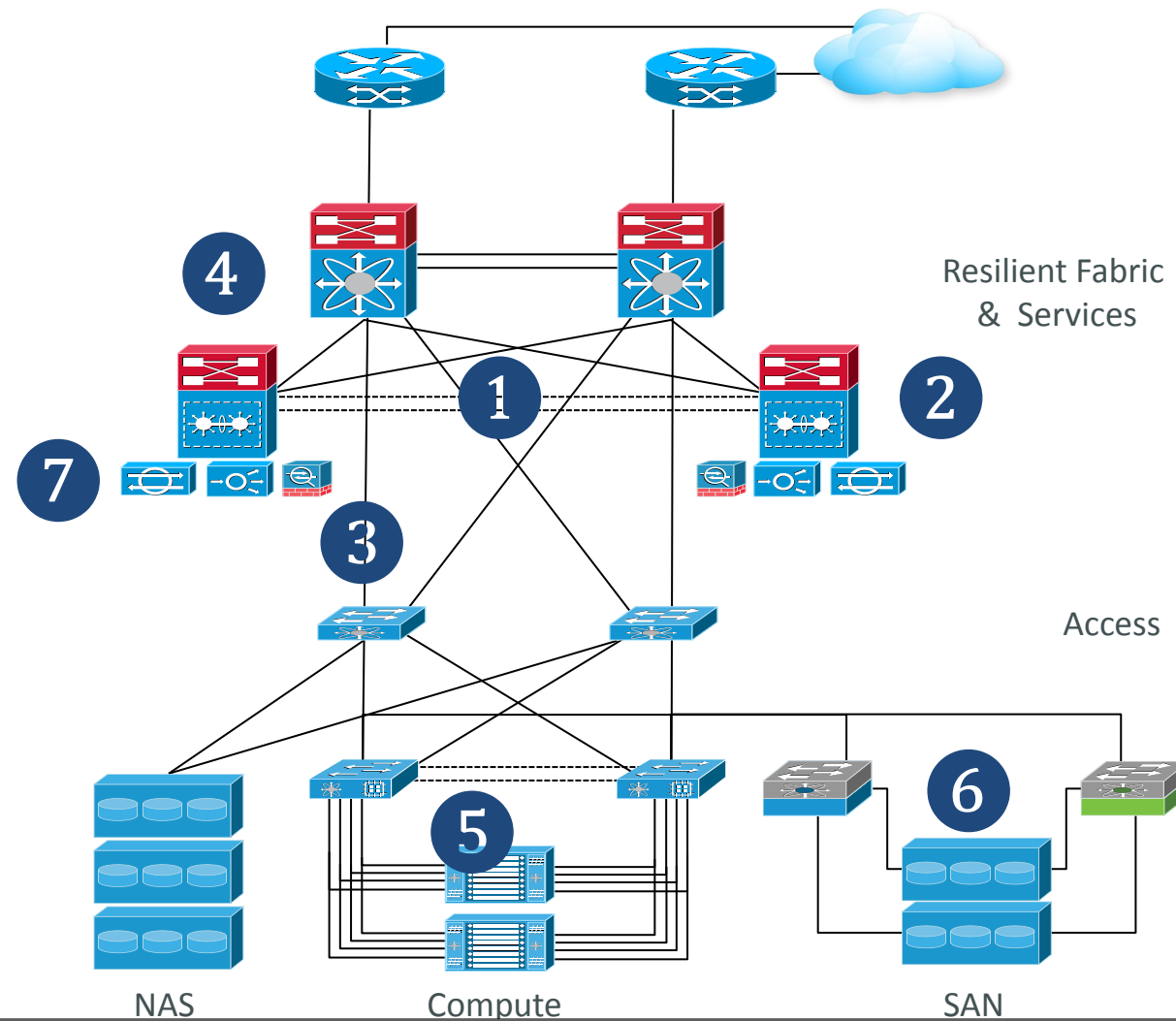
Storage

- Number of vFiler IP Space
- Number of VLANs supported
- Number of 10 Gig NICs

The Challenge:

How do I ensure high availability?

- Redundant links, nodes and paths, end to end plus:
- **L2 Redundancy** – ① vPCs, ② MEC, and ③ MAC-pinning
- **L3 Redundancy** - ④ HSRP, Non-stop forwarding, non-stop routing, LDP sync, MPLS graceful restart
- **Compute Redundancy** - ⑤ UCS end host mode, others (N1KV and MAC-pinning, Active/Standby Redundancy, Intra-Cluster HA)



- **Storage Redundancy** – ⑥ FC port channelling, multipathing software from VMware or SAN vendor
- **Services Redundancy** – ⑦ ASA, ACE redundancy
- **Routing Protocol Redundancy** - BGP, OSPF

The Solution

- End to end HA architecture

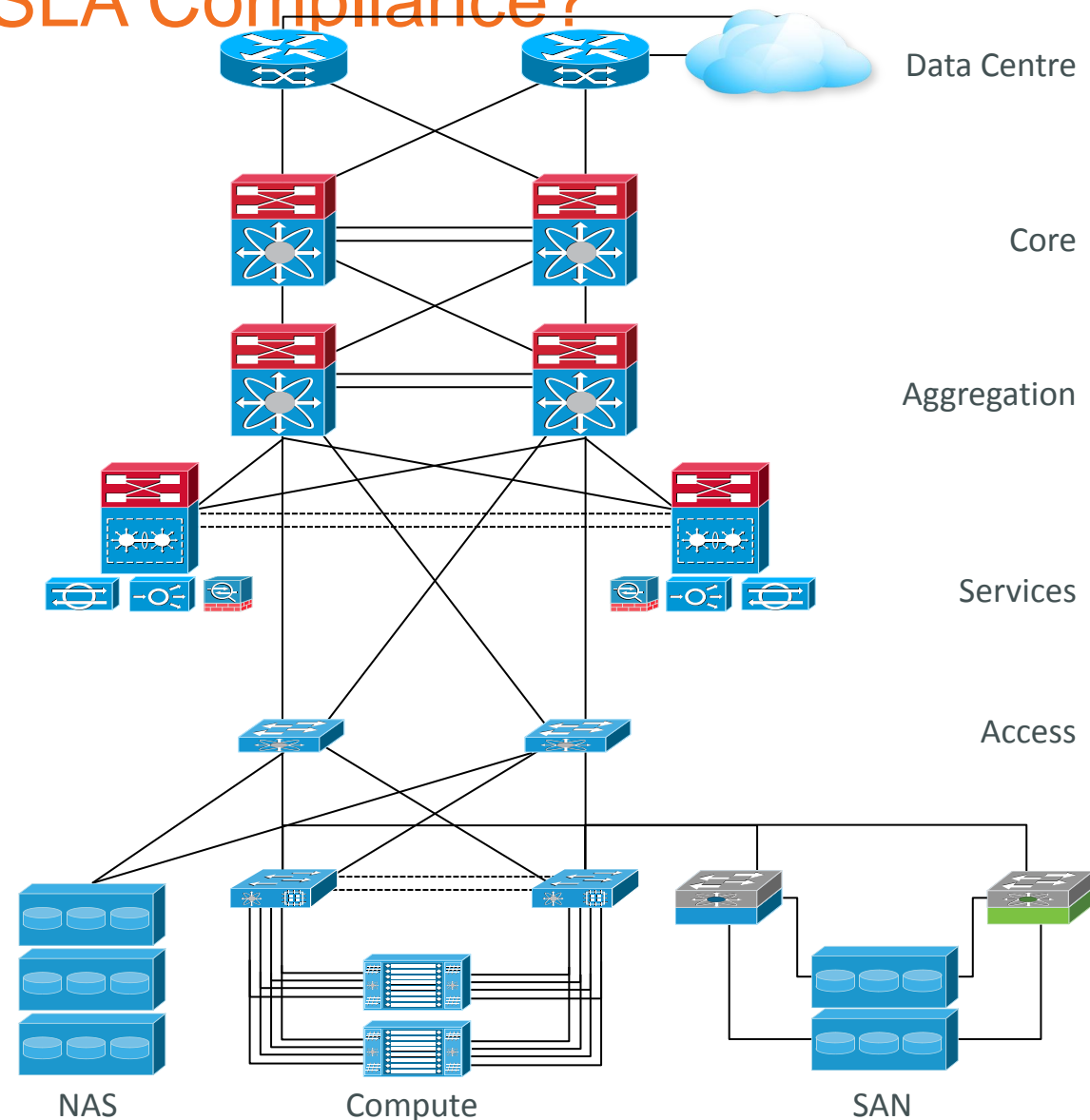
Benefits

- Maximise infrastructure uptime
- Comprehensive end to end architecture
- Focus on your business, not fighting fires

The Challenge:

How do I enable QoS for SLA Compliance?

- Define low latency traffic classes in this new multimedia service tier (i.e., VoIP bearer and video conference) are characterised by three metrics - bandwidth, delay, and availability.
- Support QoS across hybrid public/private domains



- **Traffic Classification and Marking - 1** It is a general best practice to mark traffic at the source-end system or as close to the traffic source as possible in order to simplify the network design.
- **Hierarchical QoS for Multi-Tenancy**
- **Queuing, Scheduling, and Dropping** – accounts for differences in queuing structures
- **Shaping and Policing**

The Solution

- Quality of Service

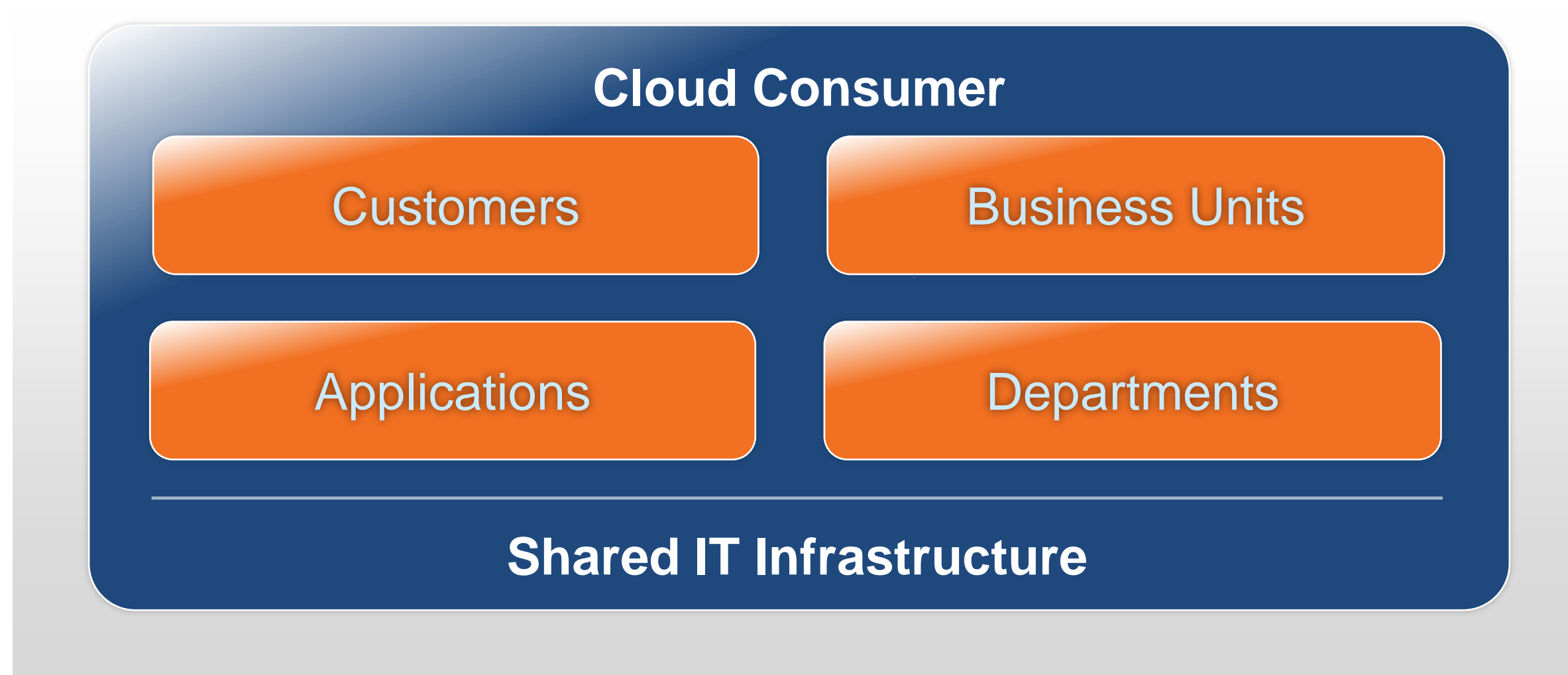
Benefits

- Supports applications with differing latency requirements
- Provides end to end QoS
- Supports QoS across hybrid public/private domains

VMDC Logical Infrastructure



Cloud Consumer Defining the Role

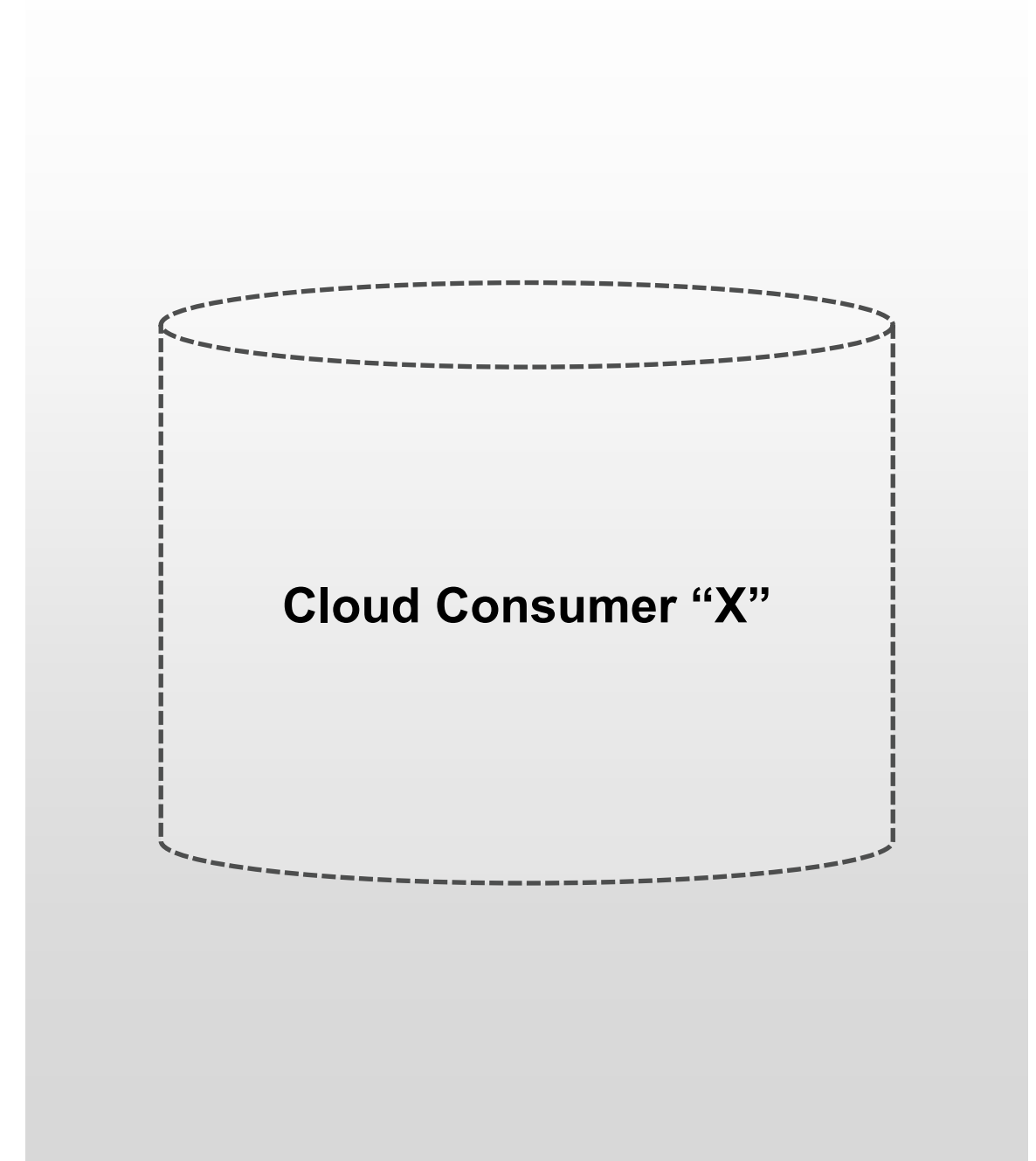


- Cloud consumers use shared infrastructure resources
- Each organisation must choose its approach to resource allocation and separation
- These policies define a form of multi-consumer or multi-tenancy

VMDC Consumer Models

Deployed as Containers

- Consumer models are logical constructs instantiated on the VMDC infrastructure
- Consumer models are customisable
- Consumer models must address application requirements
- Consumer models should be unaware of underlying technology
- Models will evolve as new technologies are introduced



VMDC Consumer Models

Addressing Application Requirements

- Network Requirements

- Session persistence
- High Availability
- Scalability
- Latency Mitigation
- Reliable transport

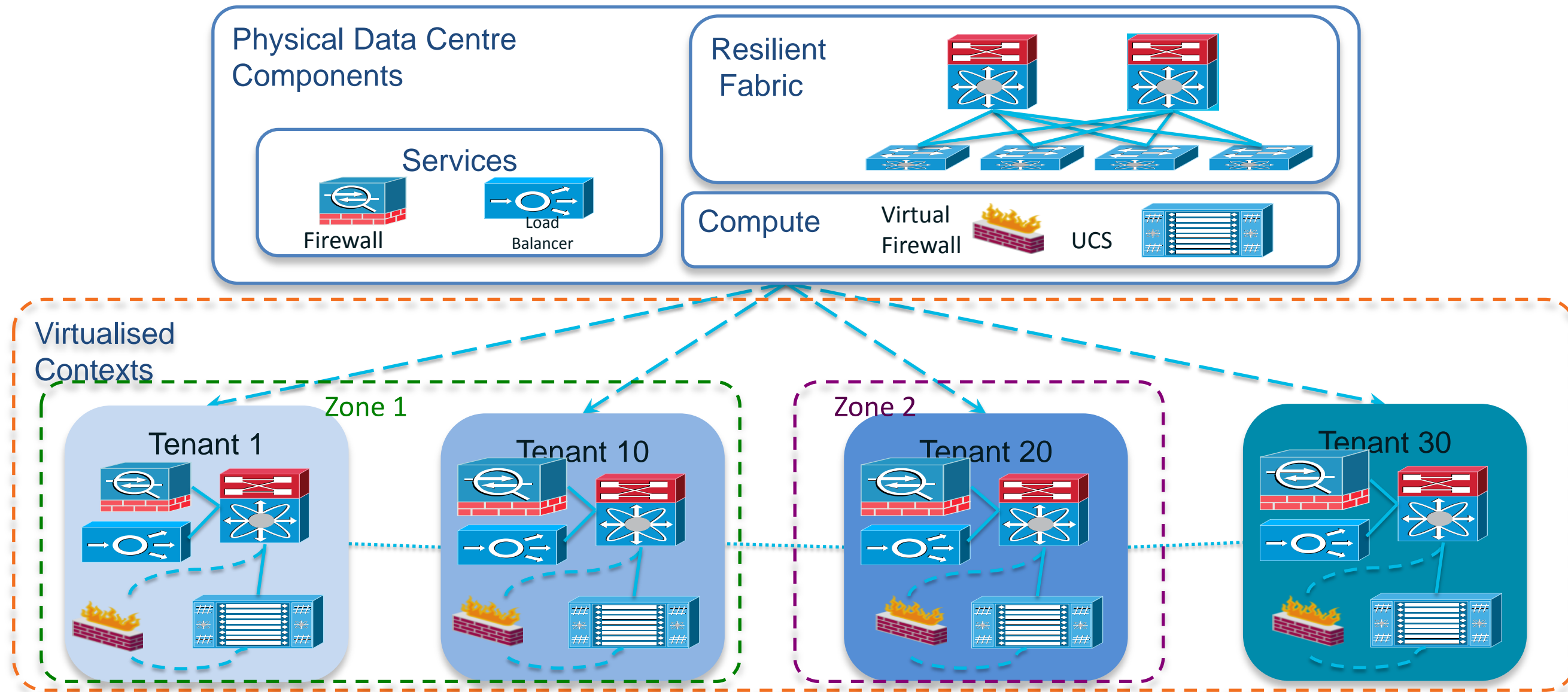
- Security Requirements

- Secure sessions with encryption may be required
- Each layer of the application stack authenticates data transport



The Challenge:

How do I create tenant (consumer) containers?



The Solution

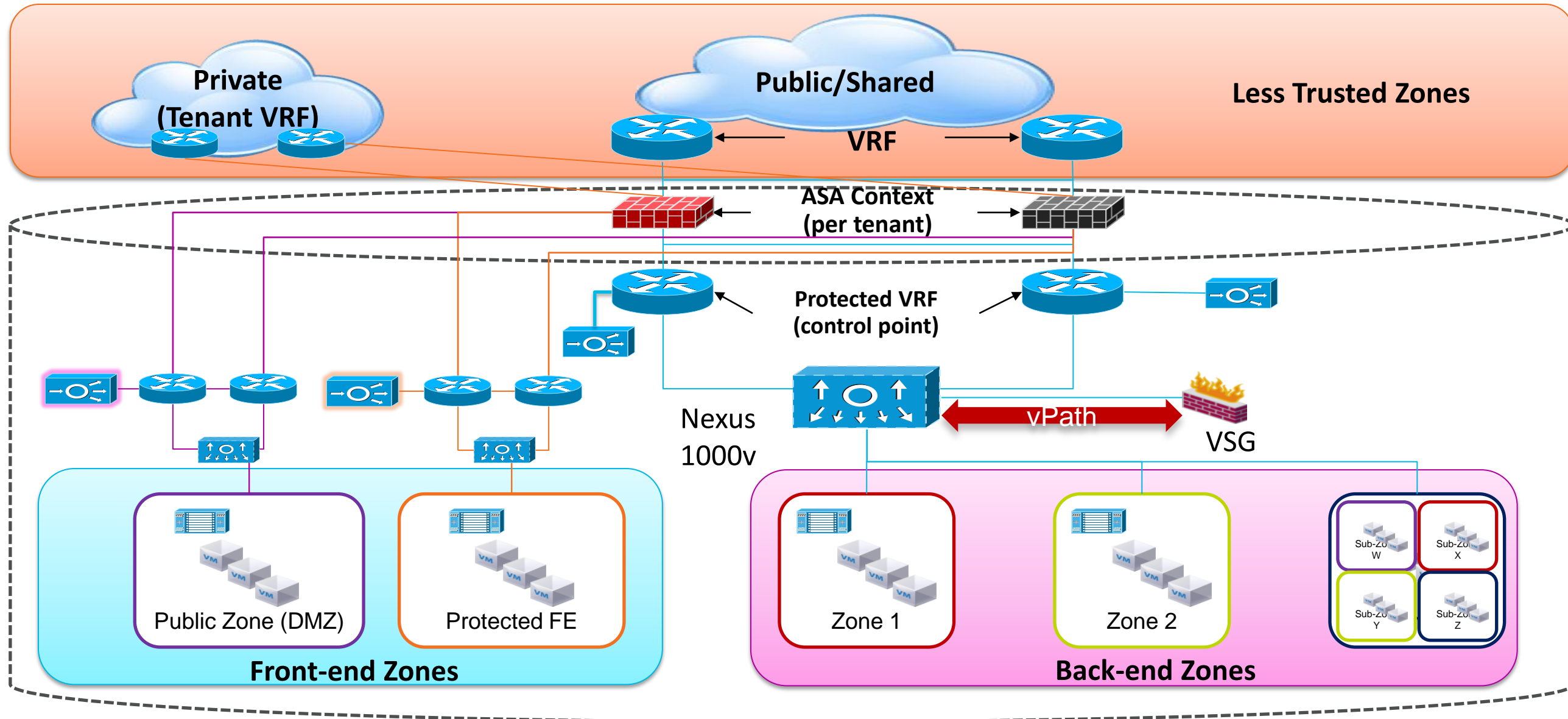
- Pre-defined and Automated Virtualised Containers

Benefits

- Quickly and securely onboard similar consumers
- Covers different levels of network services for a variety of needs
- Addresses varying security, QoS, and other requirements
- Solutions available to automate the process

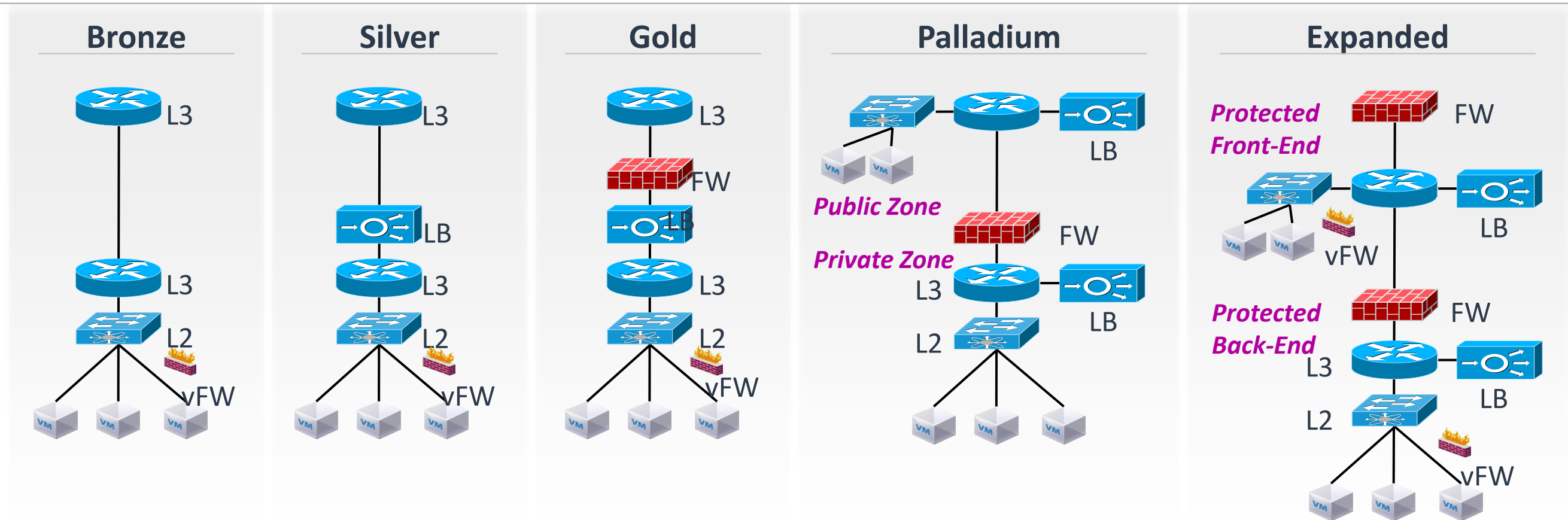
VMDC Container Model

Tiered Security in VMDC 2.2



VMDC Sample Containers

Flexible framework allows variations meet customer needs

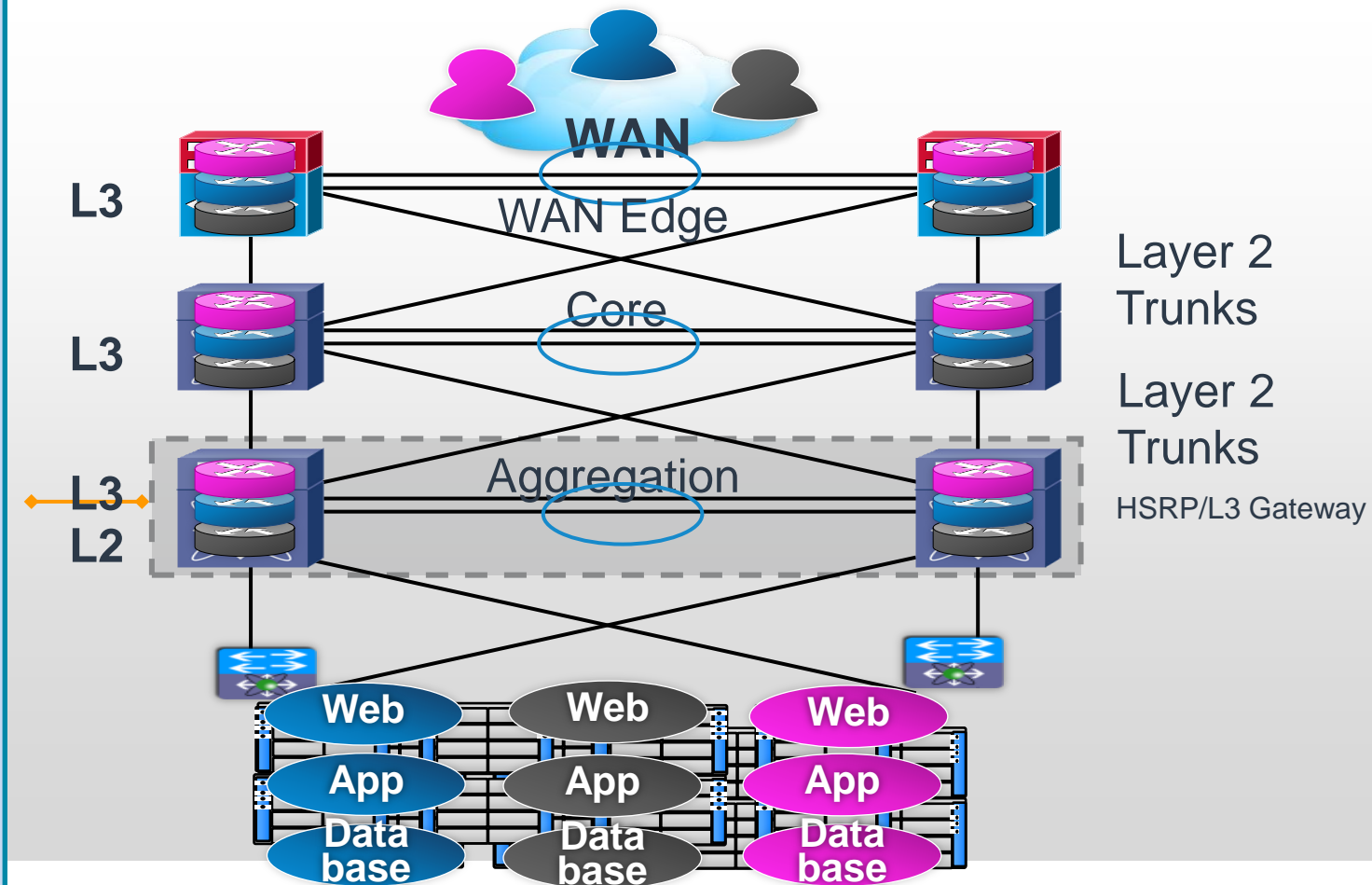


- Predefined containers provide examples for different types of deployments
- Automated provisioning and management logic for each container type is pre-defined in the Management and Orchestration software
- Customers can choose from existing models or define their own customised models

The Challenge:

How do I secure my containers?

- **Defence in Depth per consumer** (front end ASA, back end VSG)
- VRF-lite implemented at core and aggregation layers provides per tenant isolation at L3
- Separate dedicated per-tenant routing and forwarding tables insuring that no inter-tenant (server to server) traffic within the data centre will be allowed, unless explicitly configured



- VLAN IDs and the 802.1q tag provide isolation and identification of tenant traffic across the L2 domain
- **Compute Separation** (vNICs, VLANs, Port Profiles)
- **Storage Separation** (Cluster File System Mgmt, VSAN and FC Zoning, LUN Masking, vFilers)
- **Application Tier** (Network Centric, Logical and Physical segmentation with L2/L3 firewalling and security zoning)

The Solution

- Container service abstraction and right sizing

Benefits

- End to end secure separation across the data centre
- Overlapping IP addresses are allowed
- Automation tools to simplify deployment

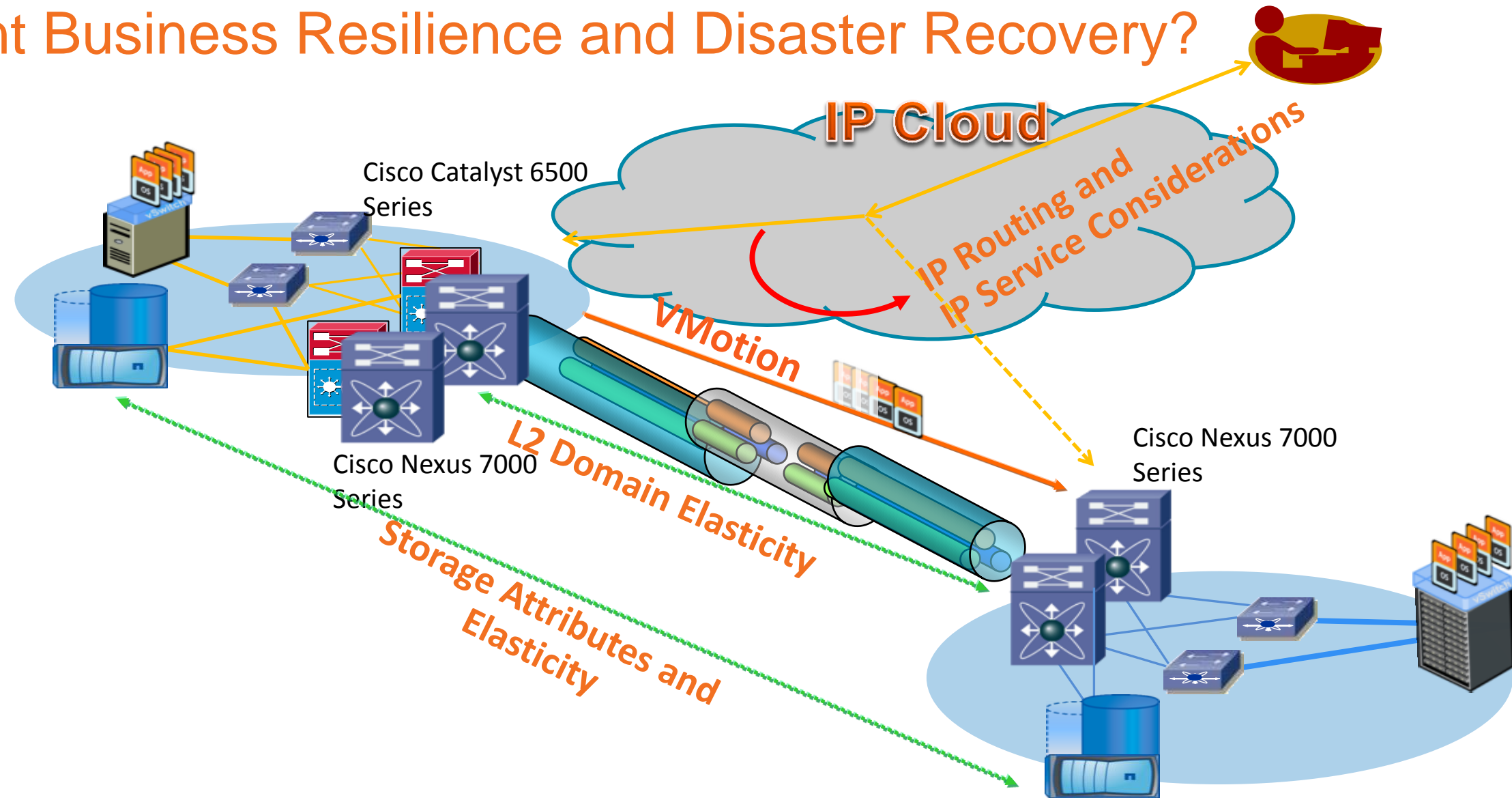
The Challenge:

How do I achieve efficient Business Resilience and Disaster Recovery?



Cisco's Data Centre Interconnect

- LAN Extensions: OTV, VPLS, EoMPLS,
- Path Optimisation LISP
- SAN Extensions NetApp's FlexCache EMC's VPLEX



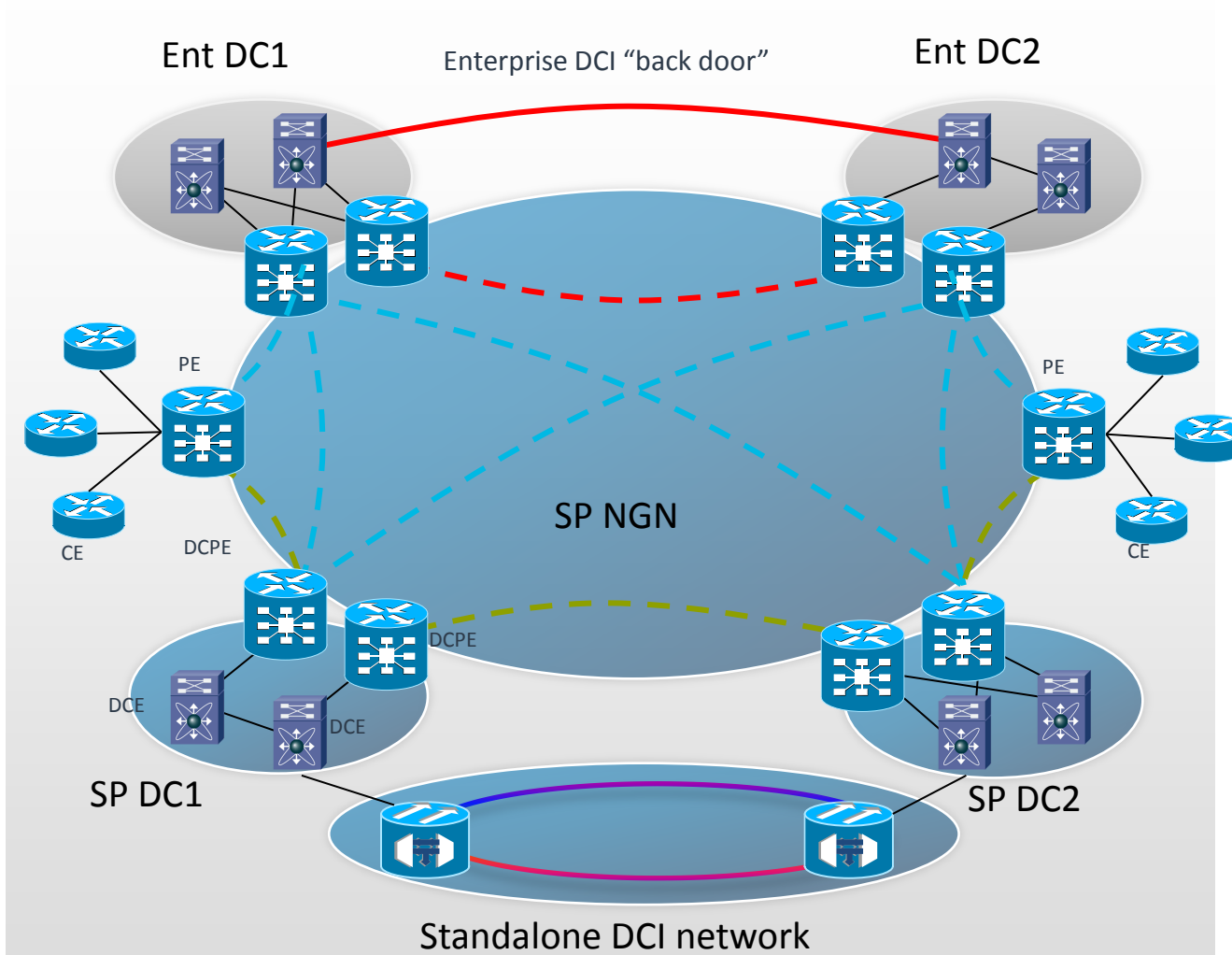
The Solution:

- Cisco DCI Solution enables new operational models for BR, DR and Multi-site operations

Benefits

- Workload balancing across data centres and clouds
- Proactive response to disruptions – mitigates risks of Approaching disasters, viz. hurricanes, floods, etc., Power grid maintenance, Data centre maintenance and migrations
- Planned events scheduled over a period of time
- Backup and Disaster Recovery aaS

Data Centre Interconnect



	Overlay Solution	PE-Based Solution
Ethernet	(e)TRILL / 802.1ad	
MPLS		VPLS, A-VPLS, EVPN, EoMPLS
IP	OTV, LISP, VXLAN	

- Interconnection Models:
 - Enterprise to Enterprise (E2E)
 - Enterprise to Service Provider (E2SP)
 - Service Provider to Service Provider (SP2SP)
- Overlay-Based Techniques
 - OTV, LISP, VXLAN
- Suitable for intra-Ent DC interconnect
 - NGN-Based DCI Solution:
 - Addresses E2SP for workload migration
 - Addresses SP2SP for regional or distributed data centres
- Standalone DCI Network
 - Provides interconnection between main SP DCs
 - Owned by SP DC team
 - Addresses SP2SP only
 - Very high bandwidth—packet/optical solution likely the most cost effective

For More Information Attend Session
BRKDCT-3060



VMDC Infrastructure Updates



VMDC 3.0 with FabricPath

New Infrastructure Designs

Simplified Network, Reducing Operating Expenses

- Switch addresses are assigned automatically
- A single control protocol
- Easily expanded in a plug and play manner
- Non-FabricPath switches can still be without STP

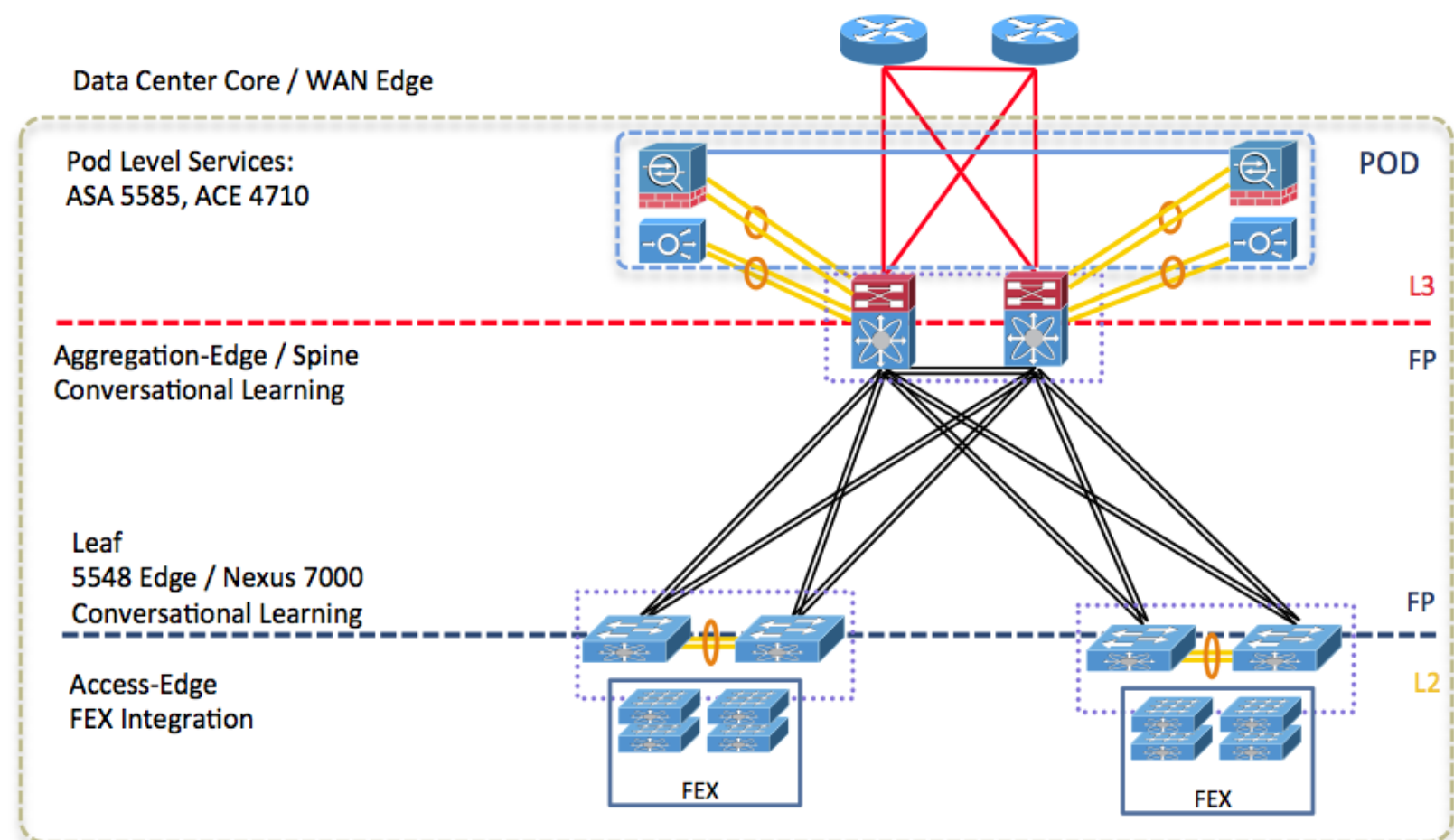
Reliability Based on Proven Technology

- Cisco FabricPath is built on top of IS-IS, an industry
- Loop prevention and mitigation is available in the data plane

Efficiency and High Performance

- 2.56 terabits per second (Tbps) of bandwidth between switches (16-way ECMP combined with 16-port 10-Gbps PortChannels)
- Lower Latency than Spanning Tree based solution
- Cisco FabricPath enables massive scalability of the L2 domain

VMDC 3.0- Design Option 1 Typical Data Center Topology Emulates legacy VMDC PoD designs

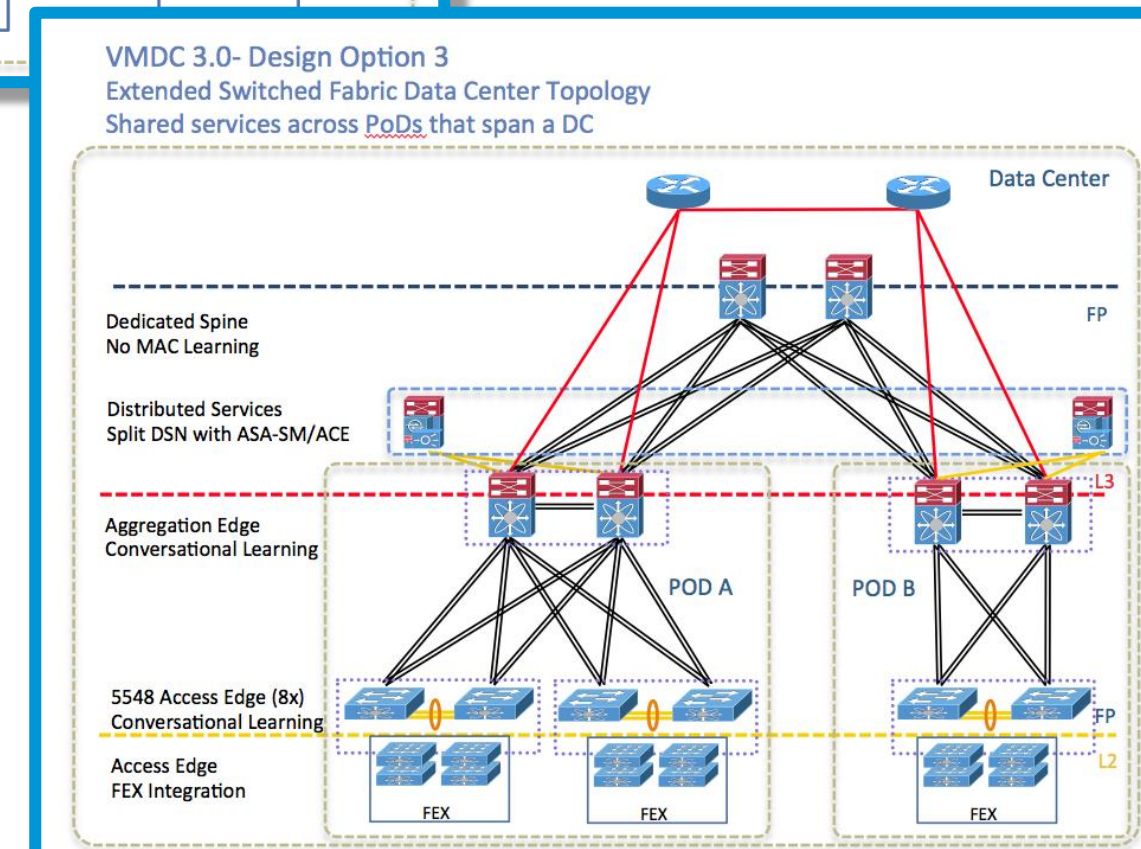
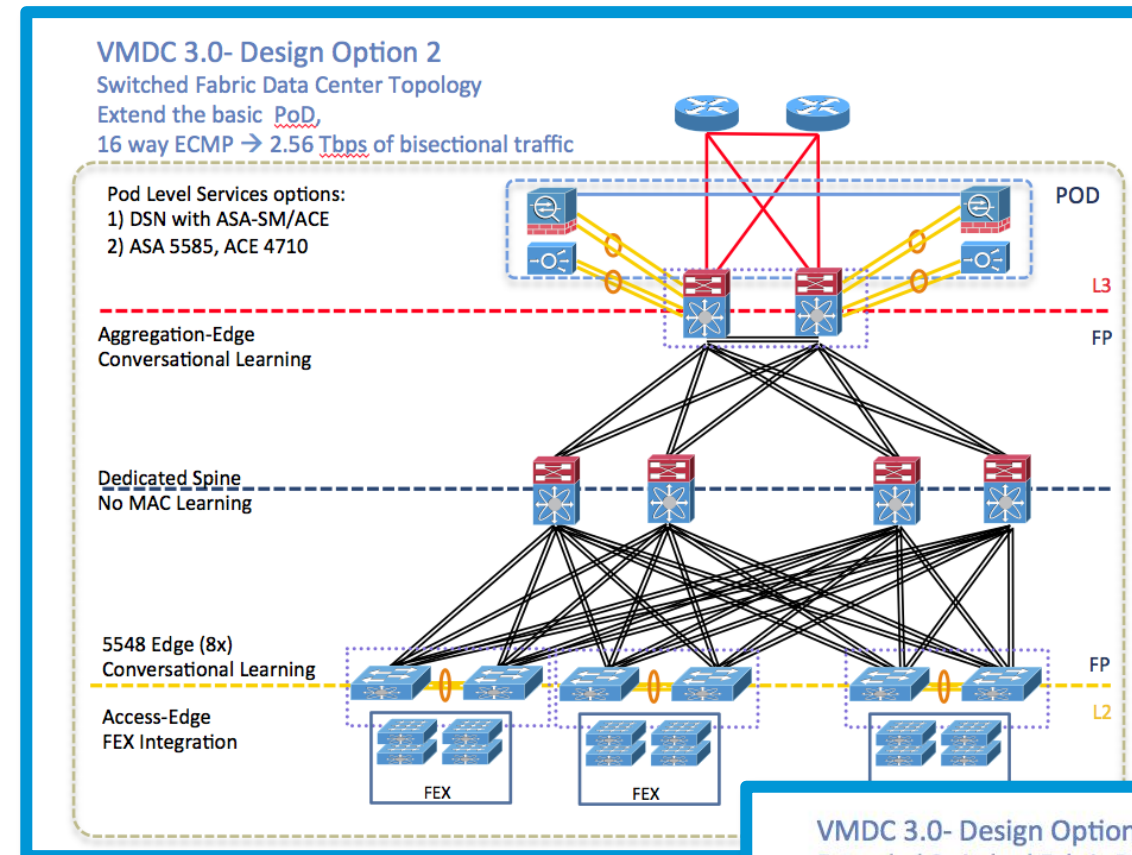


VMDC 3.0 with FabricPath

Design Options and Criteria

Design criteria included:

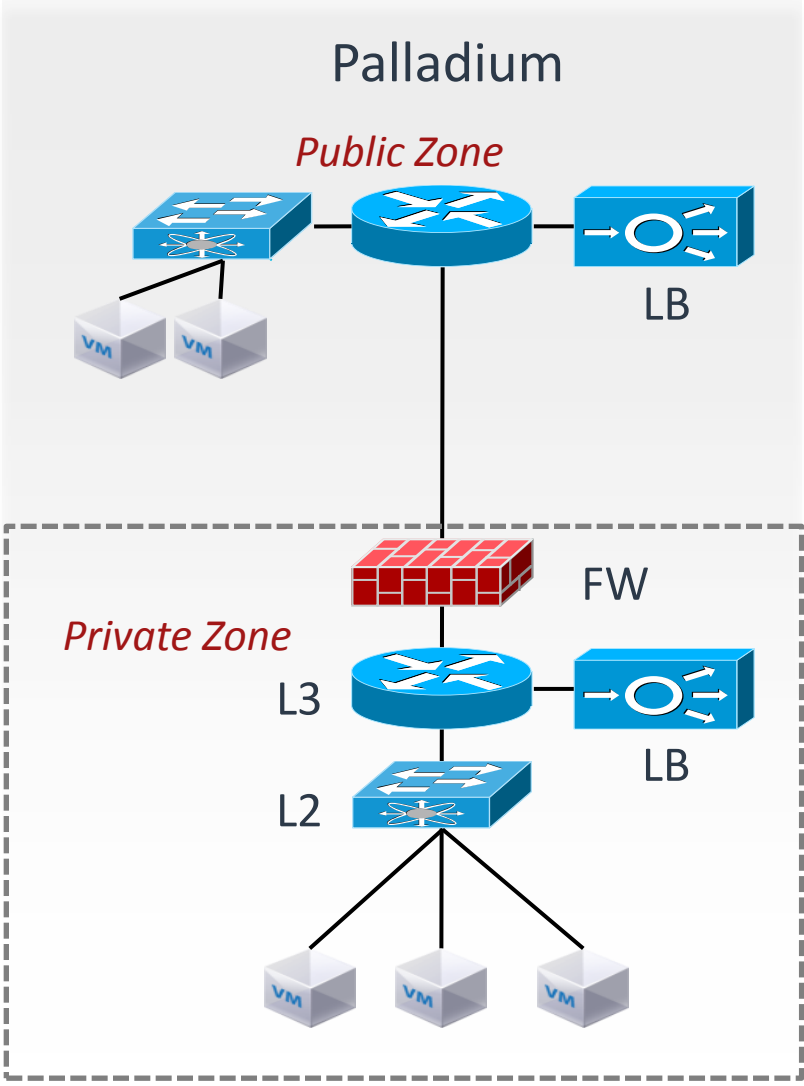
- Available FabricPath modules:
 - M1/F1 mixed VDC
 - M1/F2 split VDC
- VLAN scale: constrained by HSRP, GLBP
- MAC scale
- ARP learning rate
- Conversational MAC address learning
- Port Density
- Forwarding Paths
- Port-channel vs. single links
- VPC, VPC+ options
- QoS
- Distance (intra-PoD)



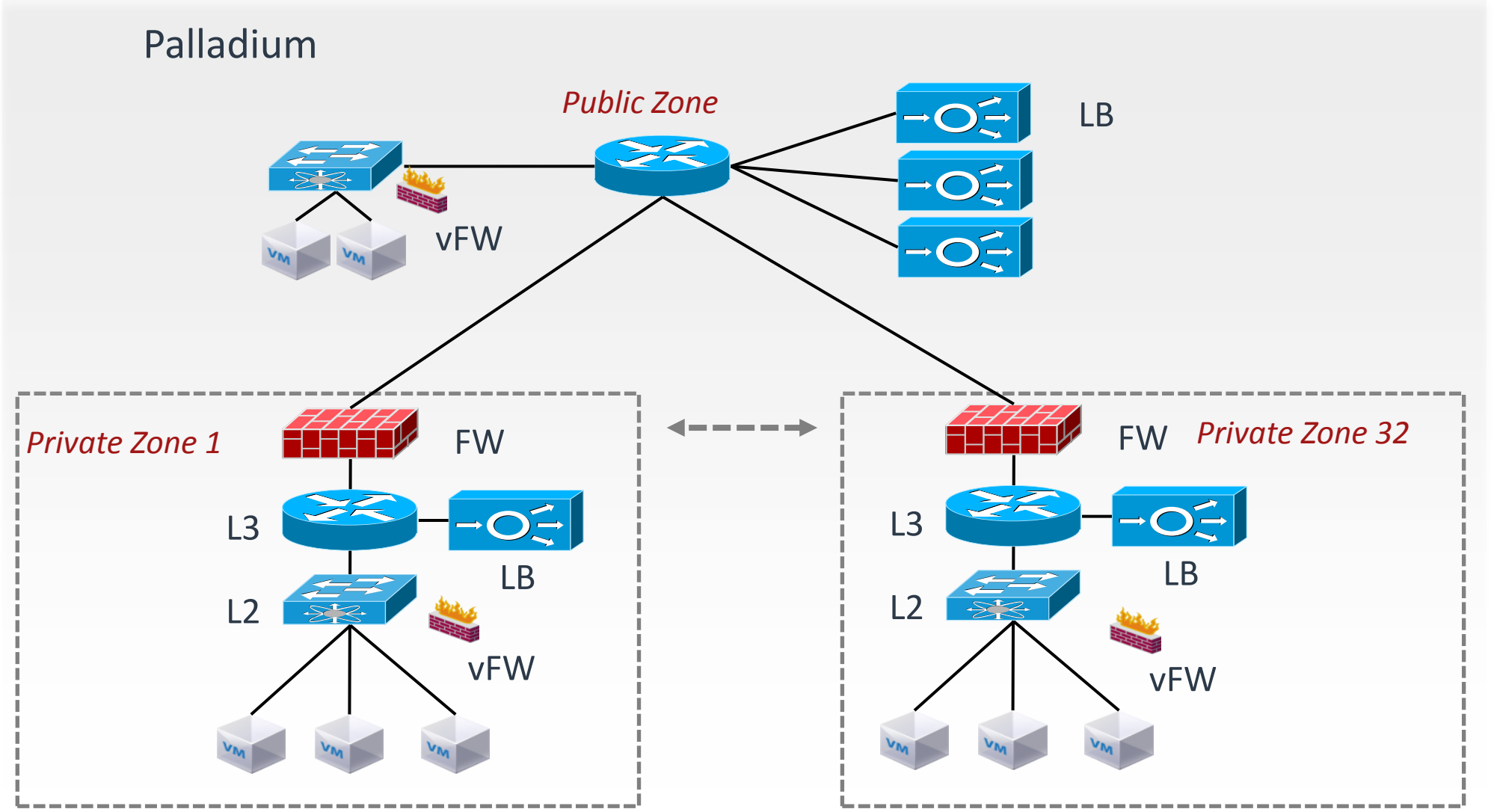
VMDC 3.0 Tenant Containers

What was validated

VMDC 2.1



VMDC 3.0

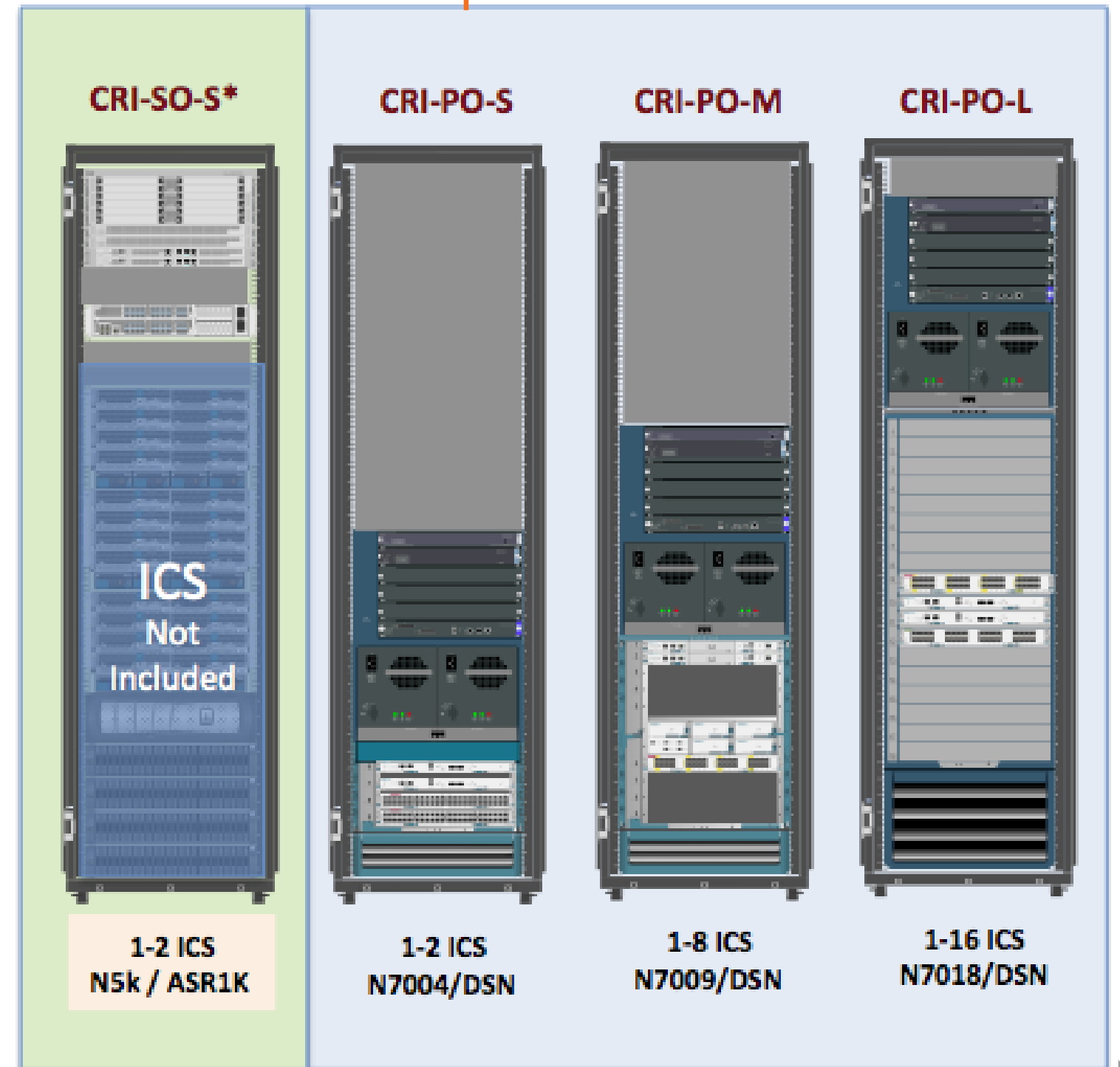


VMDC Cloud Ready Infrastructure

Pre-defined and Pre-Validated BOMs Sized to Meet Customer Requirements

- **Securely share common Cloud infrastructure**
 - Pre-Built Bill of Materials available as CCW templates
 - Secure separation between workloads
 - Shared network services
- **Ideal for initial Cloud deployments**
 - Starts small and provides incremental growth
 - Space optimised
- **Validated with Flexpod and Vblocks**
 - Evolve from Server Virtualisation to Cloud Ready Infrastructure
- **CRI-SO-S (Standard Offer, Small)**

Built on ASR1K and Nexus 5K
Integrated FW, VPN on ASR
- **CRI-PO-SML (Premium Offer, SML)**
 - Built on N7k and Physical appliances
 - Based on VMDC 2.2 architecture



Scalability with Price Performance

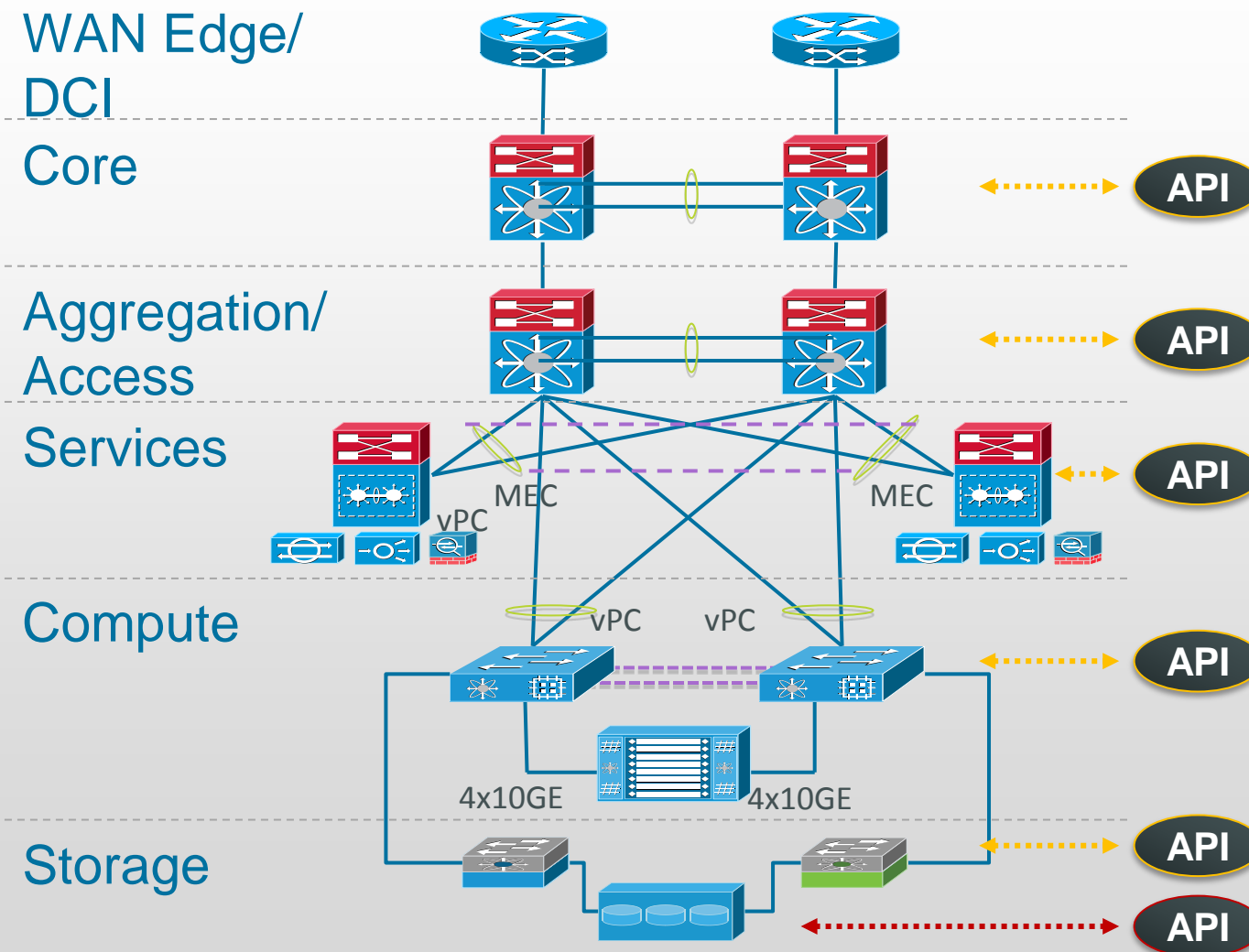
VMDC Management and Automation



The Challenge:

How do I manage, automate, and monitor service performance?

- VMDC offers an open management framework through a documented set of component APIs
- The VMDC open management solution provides flexibility
- Cisco offers domain element management and network specific offerings such as:
 - Cisco Network Services Manager (NSM)
 - Cisco Data Center Network Manager
 - Cisco UCS Manager



- Storage solutions vary by vendor
- An open framework expedites VMDC integration into existing management solutions and the development of new ones

The Solution

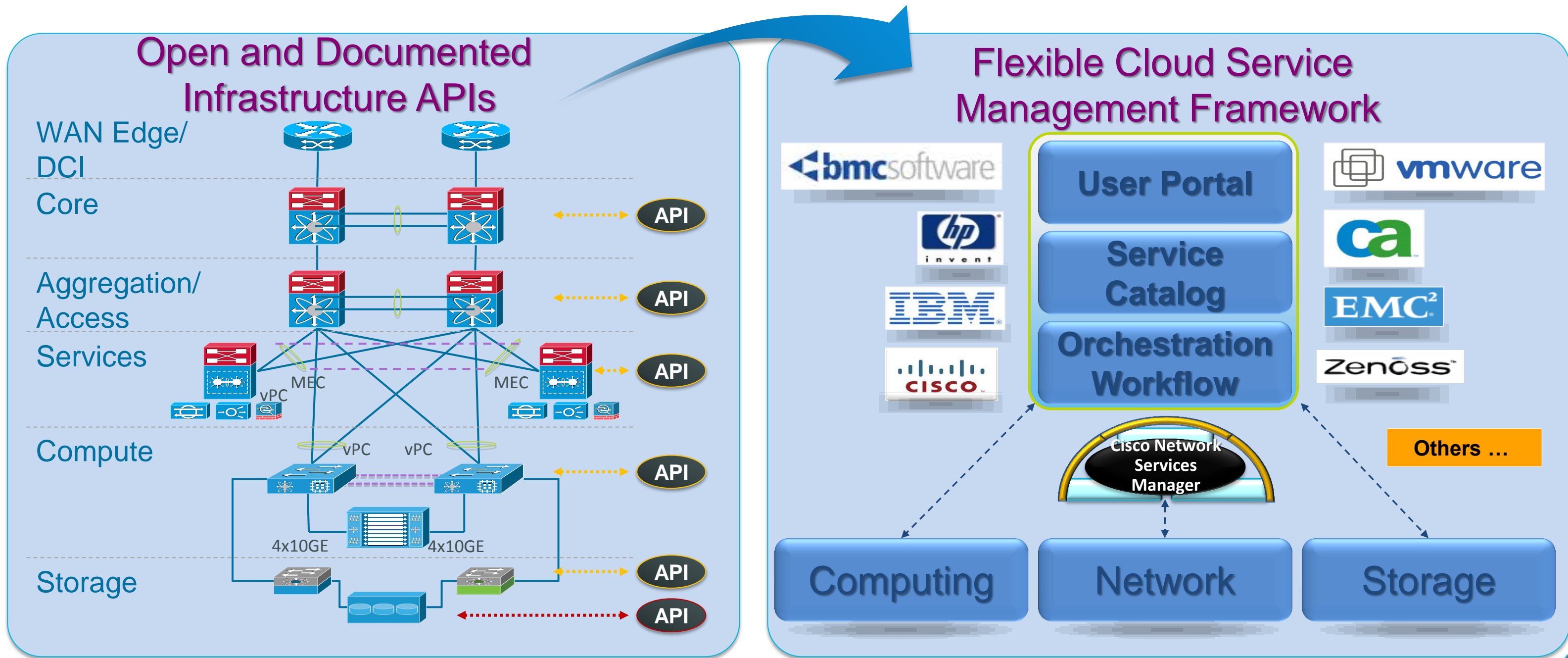
- Extensible, Open Management Framework
- Pre-Integrated Automation and

Benefits

- Simplifies and accelerates the **USE** of cloud services by providing capabilities to rapidly offer users cloud services
- This new management integrates with the existing IT environment

Cisco Unified Management Strategy

Customer Choice



Managing the Infrastructure

DCNM for LAN & SAN Data Centre Management

LAN and SAN Centric Dashboard

Visibility into a converged network fabric.

Enhanced Role Based Access Control

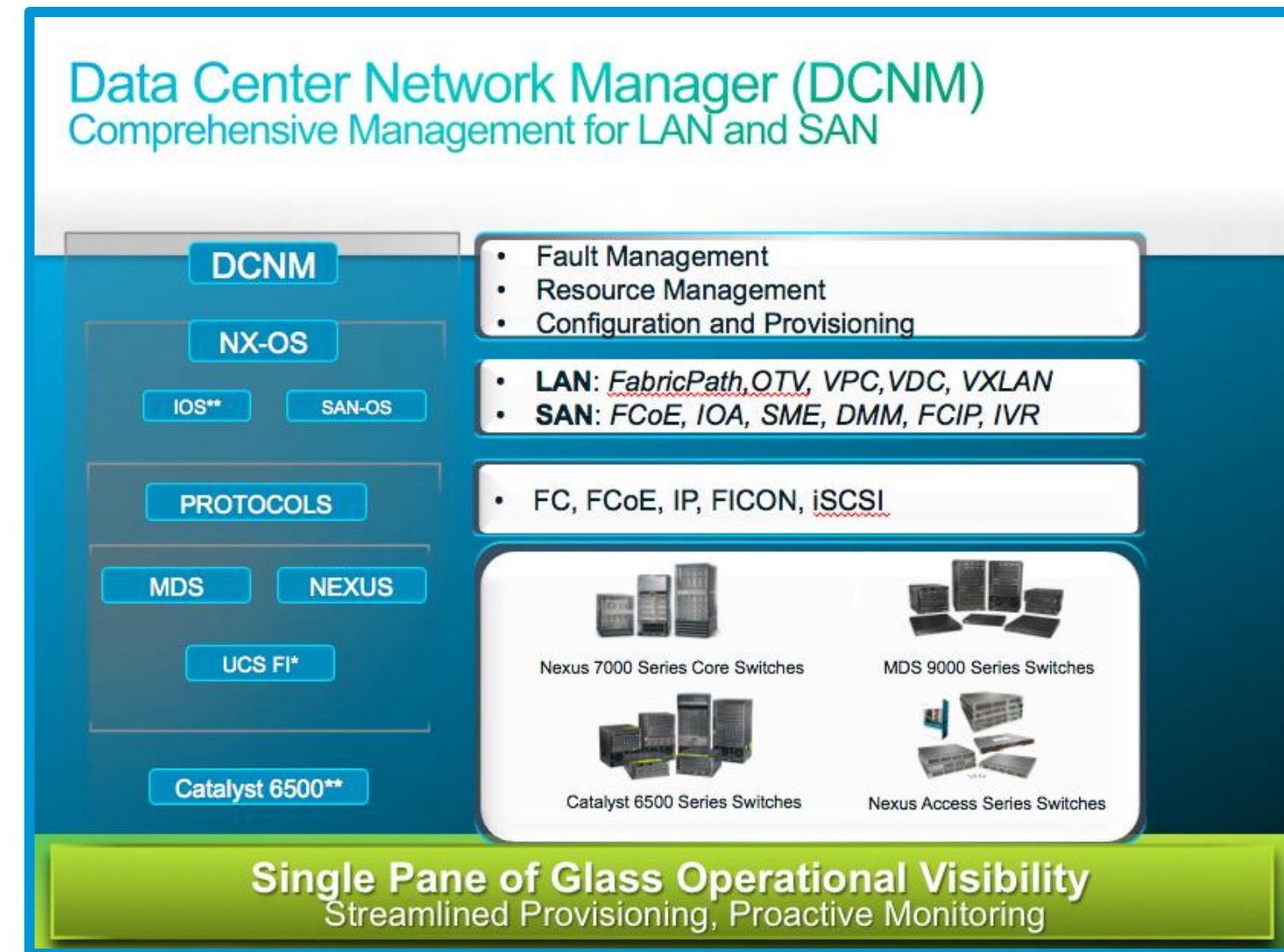
Full LDAP integration with Microsoft Active Directory.

Config and Provisioning Wizards

Simplify MDS and Nexus deployments

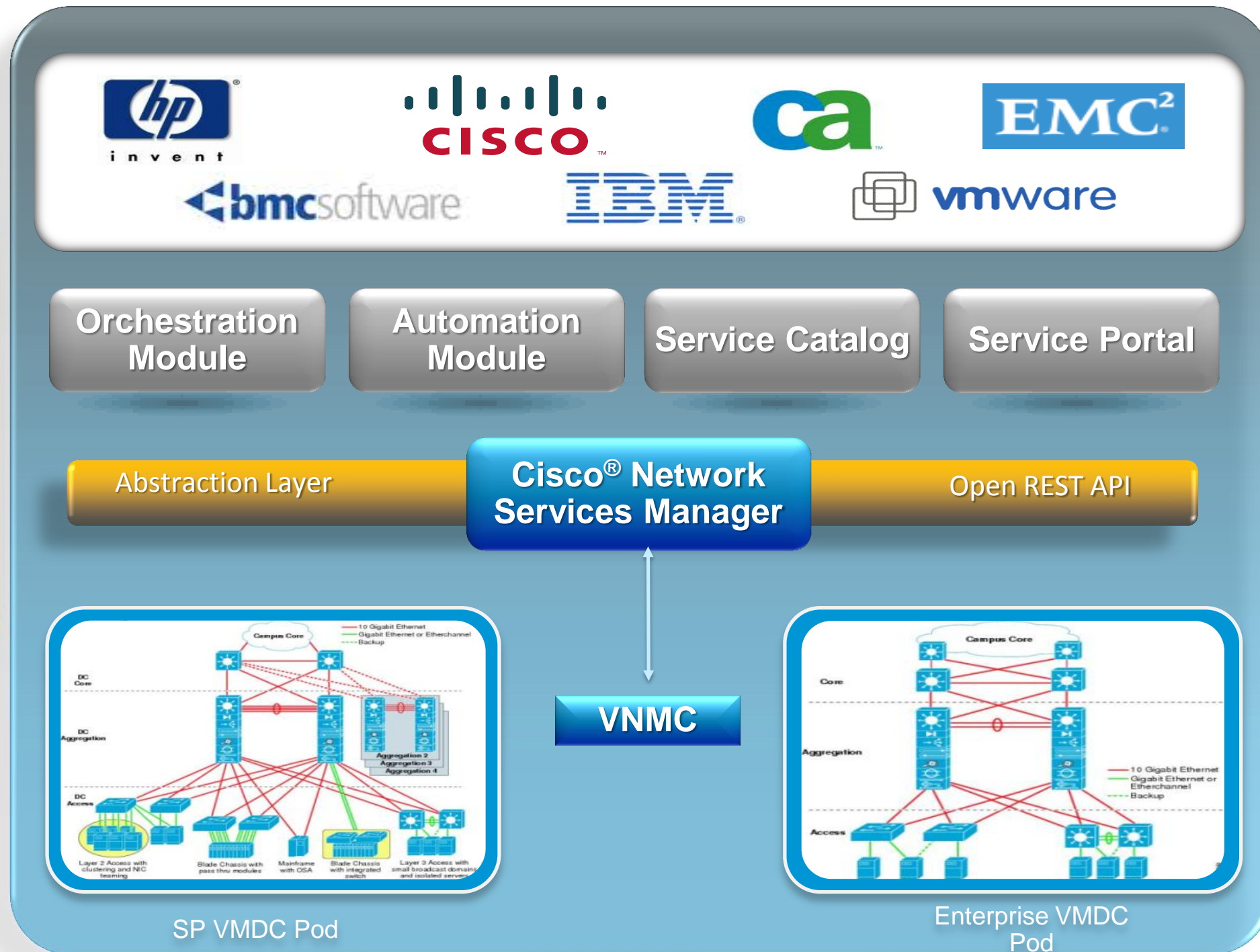
Capacity Manager

Port inventory tracking and utilisation



Orchestrating the Infrastructure

Cisco Network Services Manager

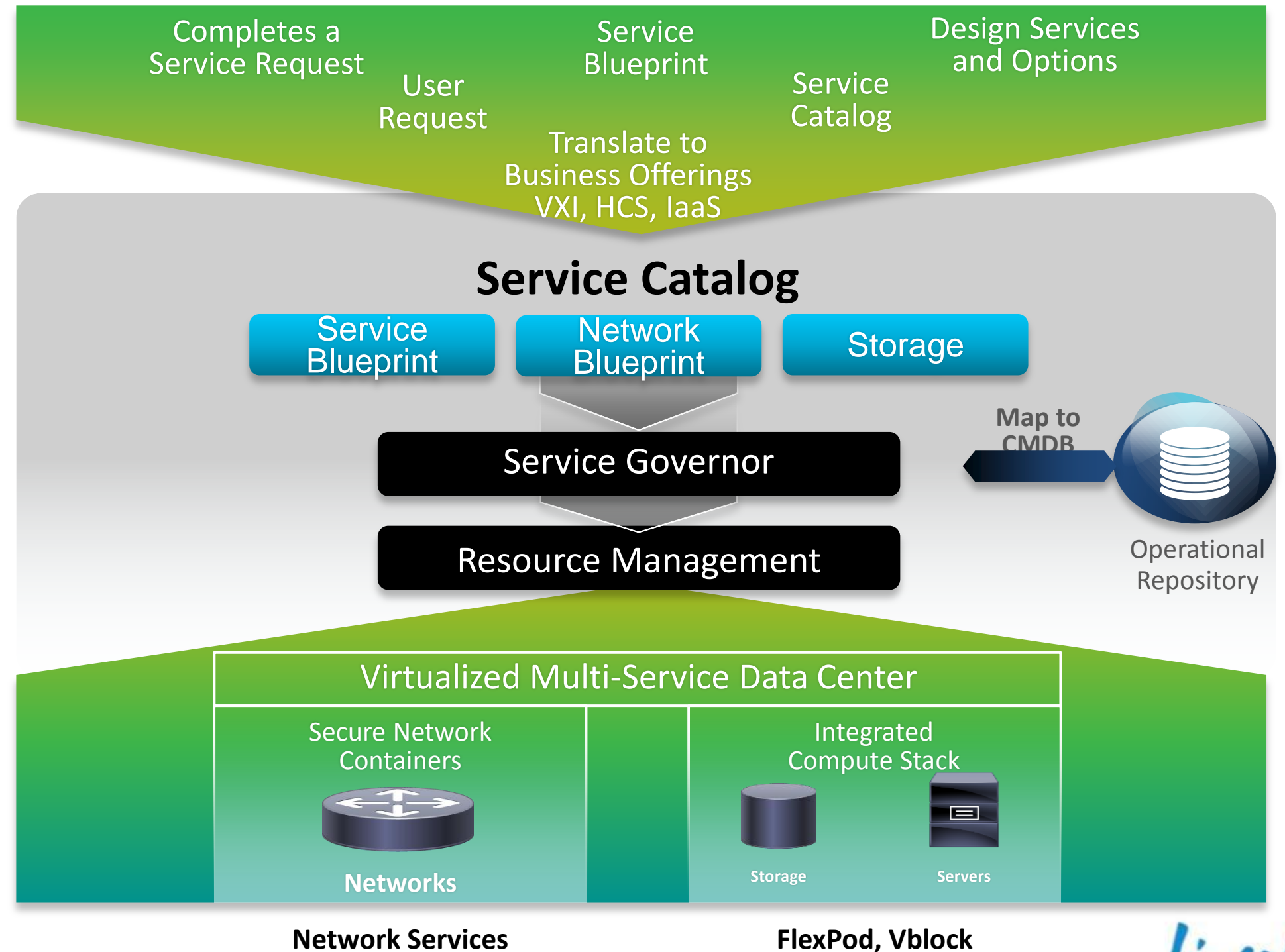


- Common Abstraction Layer
- Standardised API (contribution to OpenStack)
- Flexible, easily consumable interface (partnering with subscriber manager vendors)
- Fastest deployment and lowest operating costs for cloud

Automating the Service Deployments

BMC's CLM Workload Automation and Lifecycle Management

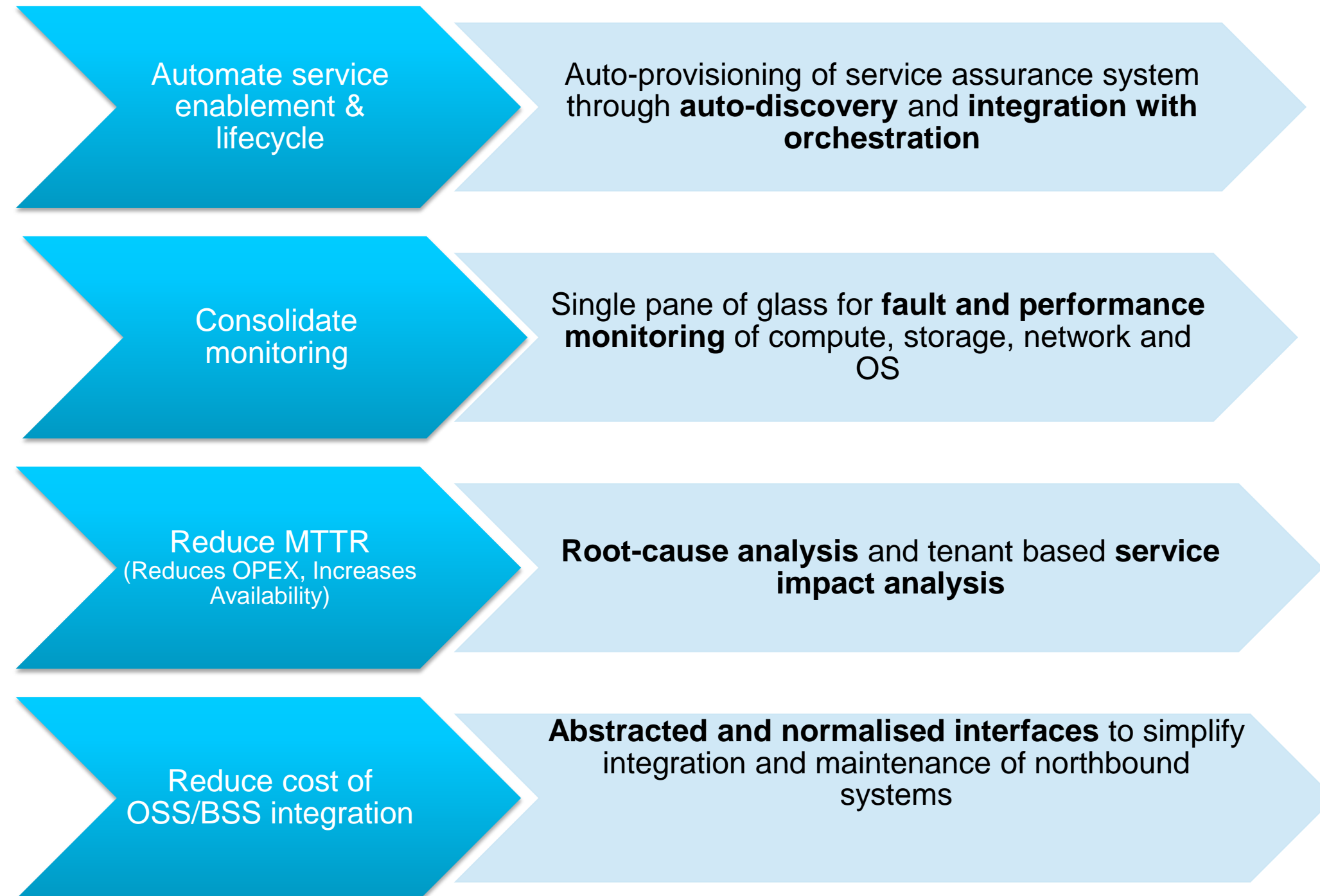
- Provides an end-to-end automated lifecycle management
- 2nd Generation Cloud Lifecycle Management Platform
- Integrated full-stack cloud services
- Intelligent placement of provisioned services
- Service-Catalog Platform for Automation, Orchestration, and Management
- “Day 2 management”—performance, compliance, security



Cloud Service Assurance

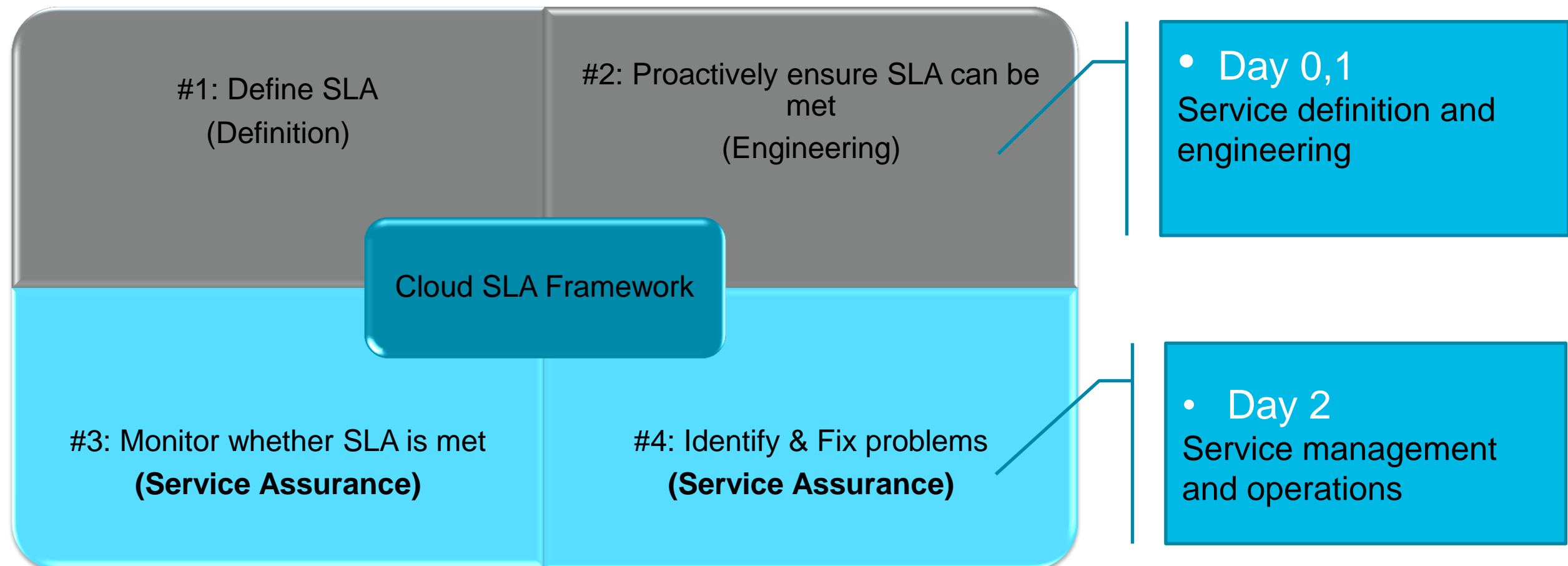
Key Objectives & Functions

For More Detail See
Session: BRKSPG-2681



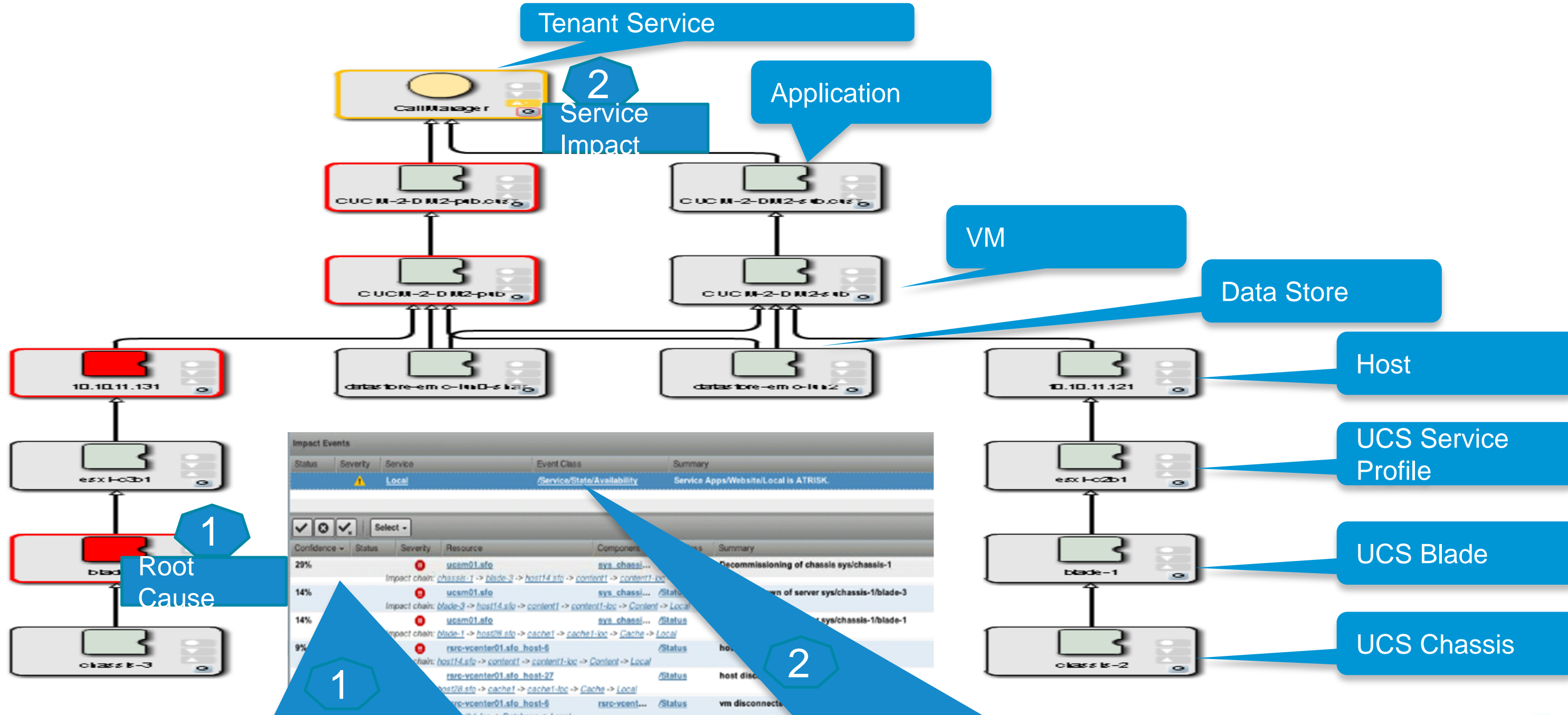
Service Level Assurance Framework Defined

We define broader **Cloud SLA Framework** with following objectives:



Cloud Service Assurance

Simplified Service Impact & Root Cause Analysis



Ranked probable root-cause events

Service Impact Events



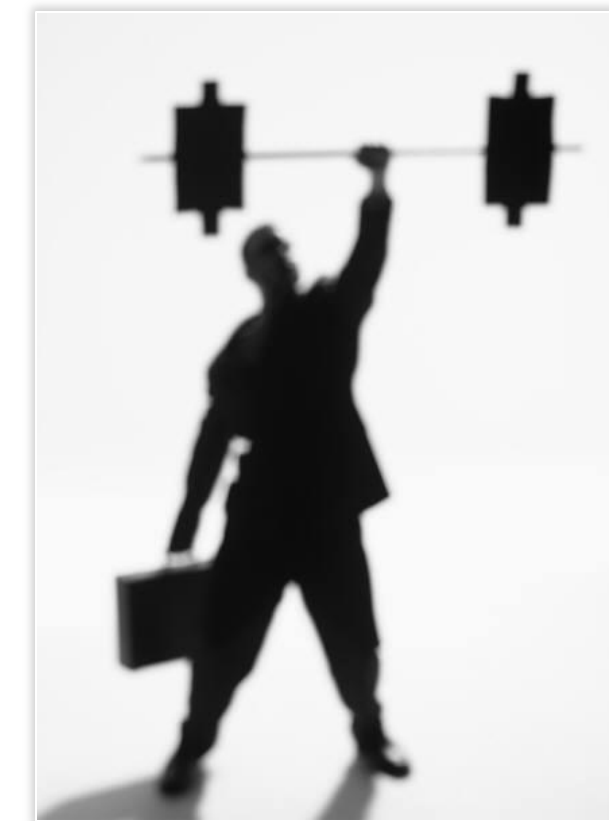
VMDC Summary



Summary

VMDC Strengths

- Defined System for today, evolving for tomorrow
 - Reduced complexity as system is characterised via validation efforts with supporting collateral
- Facilitates Automation
 - Resource pools encompassing network, compute and storage
- Facilitates onboarding of services
 - Hosted Collaboration, Hosted Virtual Desktop, BR/DR
- Facilitates platform hardening and automation of security operations such as
 - Configuration
 - Auditing
 - Patching
 - Response
- Facilitates operational compliance and certifications
- Availability
 - Resilient architecture that scales



Resources

- Virtualized Multi-Tenant Data Center (VMDC)
www.cisco.com/go/vmdc
- Data Center Interconnect
<http://www.cisco.com/go/dci>
- Unified Data Center (Cisco CloudVerse):
<http://www.cisco.com/go/cloudverse>
- Vblock:
<http://www.cisco.com/go/vblock>
- FlexPod:
<http://www.cisco.com/go/flexpod>
- BMC:
<http://www.cisco.com/go/bmc>

Q & A



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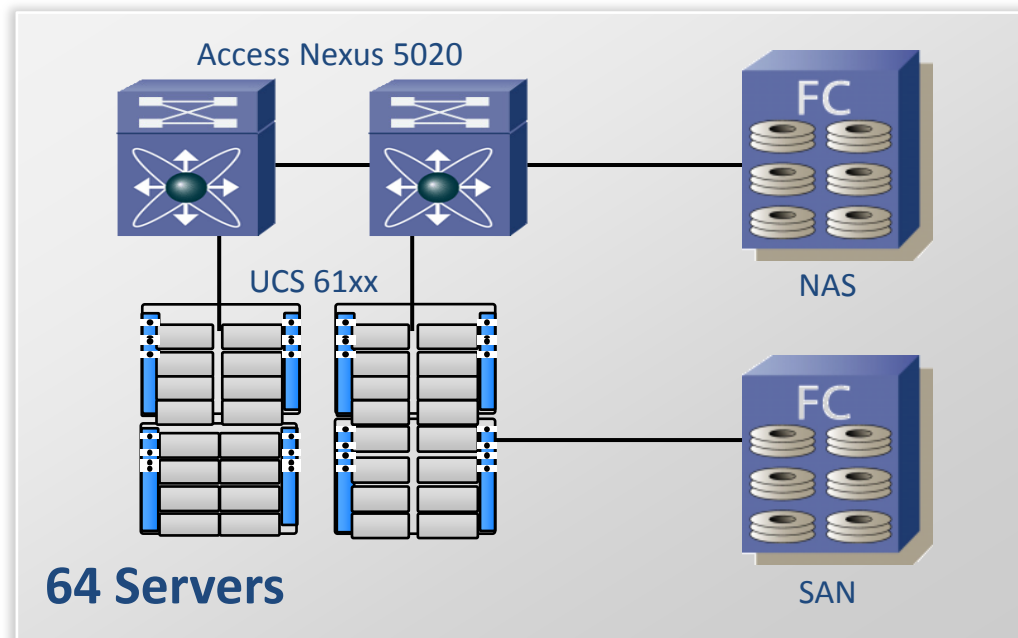


PoD Sizing Considerations

For Reference

- Network
 - Traffic throughput
 - Number of Tenants (VRFs), VLANs
 - Oversubscription factors
 - High Availability (redundant links)
 - Port and Line-card/Chassis density
 - Platform scalability (VRFs, VLANs, Interfaces)
 - Ratio of Service Tiers (Gold:Silver:Bronze)
- Security & L4-7 Services
 - Service Modules or Appliances
 - Type and Number of Services
 - Number of Virtual Contexts (Modules)
 - Number of VLANs tied to service modules
 - Application throughput
- Storage
 - SAN/NAS ports/links
 - Storage throughput, oversubscription, IOPS
 - Number of VSAN, Zones
 - Storage Array Density (disks, ports)
 - Distributed or Centralised Storage
- Compute
 - Number of VMs per tenant, per VLAN
 - VM to Core ratio, Memory size per VM
 - Number of links, oversubscription factors
 - Ratio of Service Tiers (Gold:Silver:Bronze)
 - Number of blades in a UCS cluster
 - Number of blades in a ESX cluster
 - Number of VMs per blade, per cluster, per Pod
 - VCenter limits on VM's, Servers, DataStores, Ports

Compact POD Sizing—VMDC



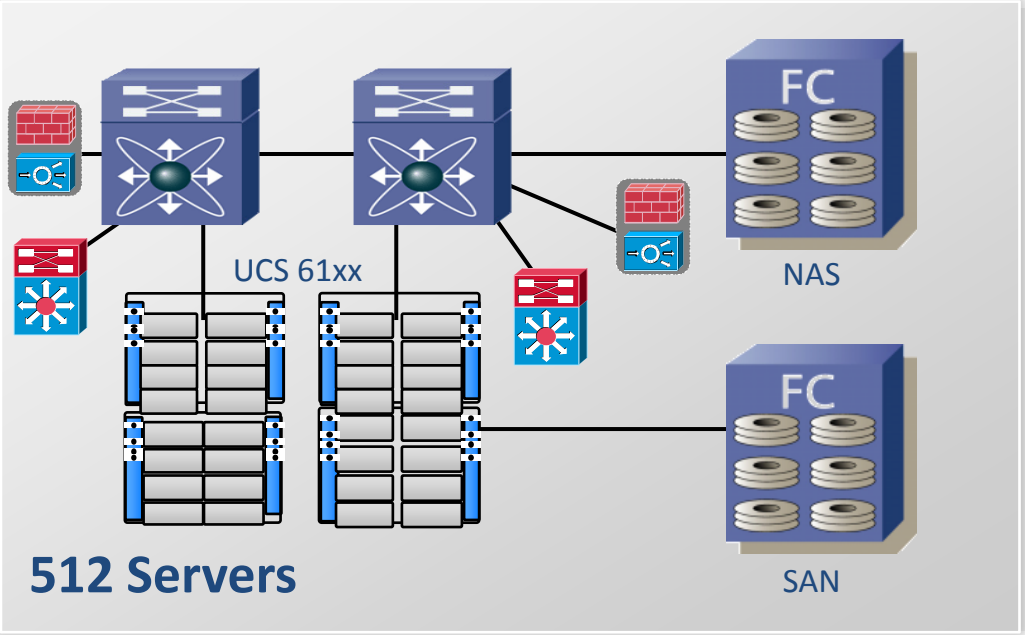
64 Server POD Characteristics

- 2 UCS clusters, each of 32 blades
- 64 x B200 Blade server at 96GB RAM
- 512 Cores
- 512 Gold VMs 1vCore per VM (1:1) ov
- 1024 Silver VMs 0.50vCore per VM (2:1) ov
- 2048 Bronze VMs 0.25vCore per VM(4:1) ov
- 5–8 VMs/VLAN

Combination of All Three Service Tiers in a POD

	Number of Cores	Number of VMs
Gold, 20%	102	102 (1:1 ov)
Silver, 30%	154	308 (2:1 ov)
Bronze, 50%	256	1024 (4:1 ov)
Total VMs		1434

Large POD Sizing—VMDC



512 Server POD Characteristics

- 8x8-chassis UCS systems (Vblock Type 2 Max)
- 8 blades/ESX cluster
- 512 x B200 Blade server at 96GB RAM
- 4096 Cores
- 816 Large VMs 1vCore per VM (1:1) ov
- 2464 Medium VMs 0.50vCore per VM (2:1) ov
- 8192 Small VMs 0.25vCore per VM (4:1) ov
- 5–9 VMs/VLAN
- 500–1000 tenants = 12–23 VMs/VLAN

Combination of All 3 Workload Types in a POD

	Number of Cores	Number of VMs
Large, 20%	802	816 (1:1 ov)
Medium, 30%	1232	2464 (2:1 ov)
Small, 50%	2048	8192 (4:1 ov)
Total VMs		11,472

