DataCenter Architecture & Design

Julio Alba (jalba@brocade.com)
IP SE España
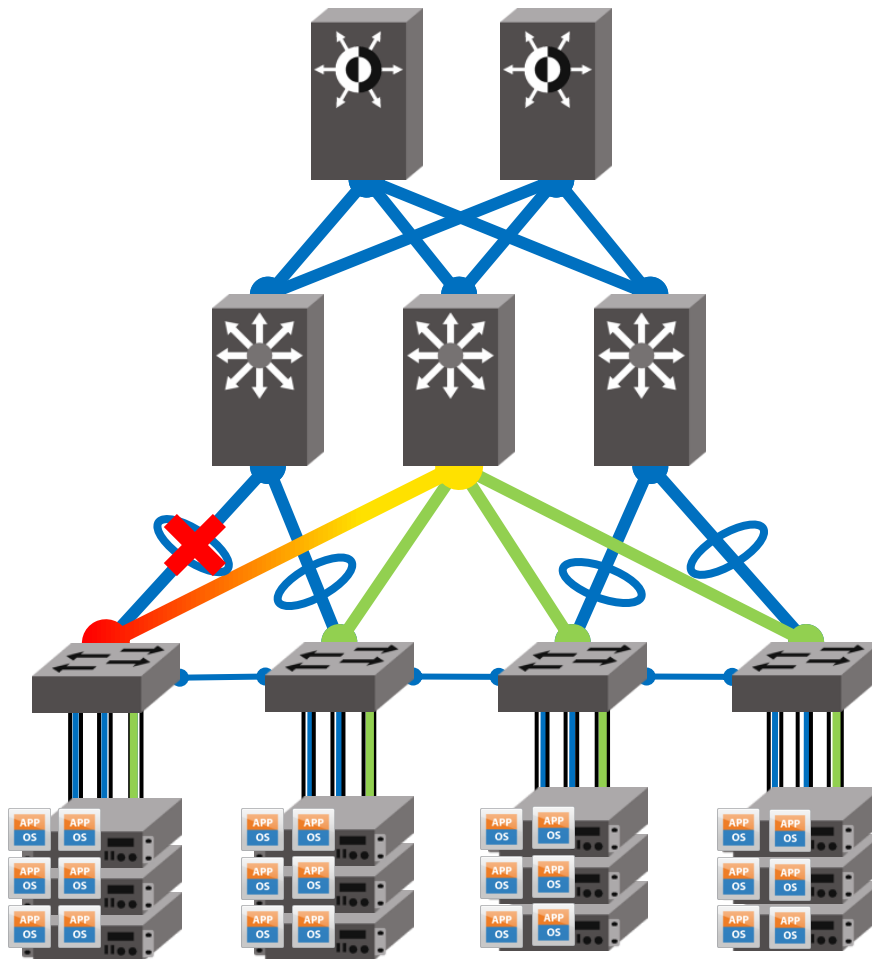
October 2010

BROCADE

Addressing Today's Challenges

Scaling Virtual Server Environments

Challenges Today

Layer 2: only 1 active path
- STP disables other paths
- Not "virtualization optimized"

Add Virtual Machines
- Add additional GbE connections
- Move to 10 GbE for simplicity and more performance
- Uplinks are stressed; need more connections in LAG

Increase utilization using MSTP (spanning tree per VLAN)
- Increases complexity
- Creates multiple single-path networks; limits sphere of mobility

Link failure
- STP reconvergence – network is down
- Broadcast storms stress network

Layer 3 as an alternative
- Greater complexity; higher cost
- VM mobility limited to rack

Imagine if…

- There was no requirement for STP in Layer 2 networks
- All paths in the networks were utilized with traffic automatically distributed
- Link failure did not result in a temporary outage and paths were always deterministic
- The network provided low latency, lossless transmission and could carry both IP and storage traffic, without compromise

Ethernet Fabric

1ˢᵗ Ethernet Fabric
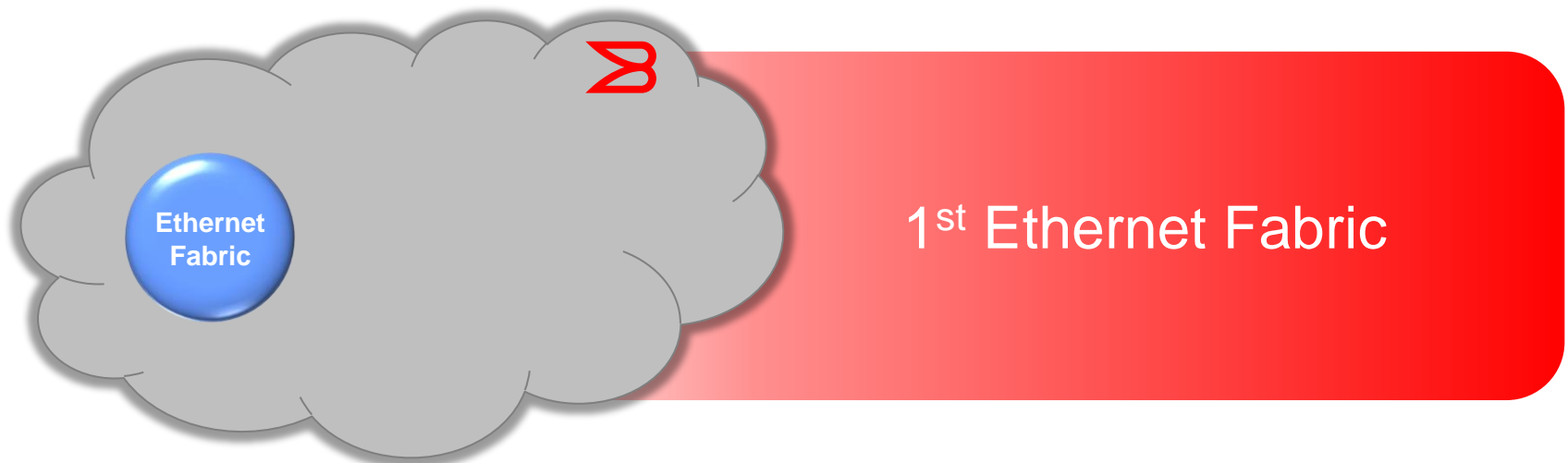
Virtual Machine Mobility

Challenges Today

L3 to Agg. Layer

L2 STP

Distributed vSwitch
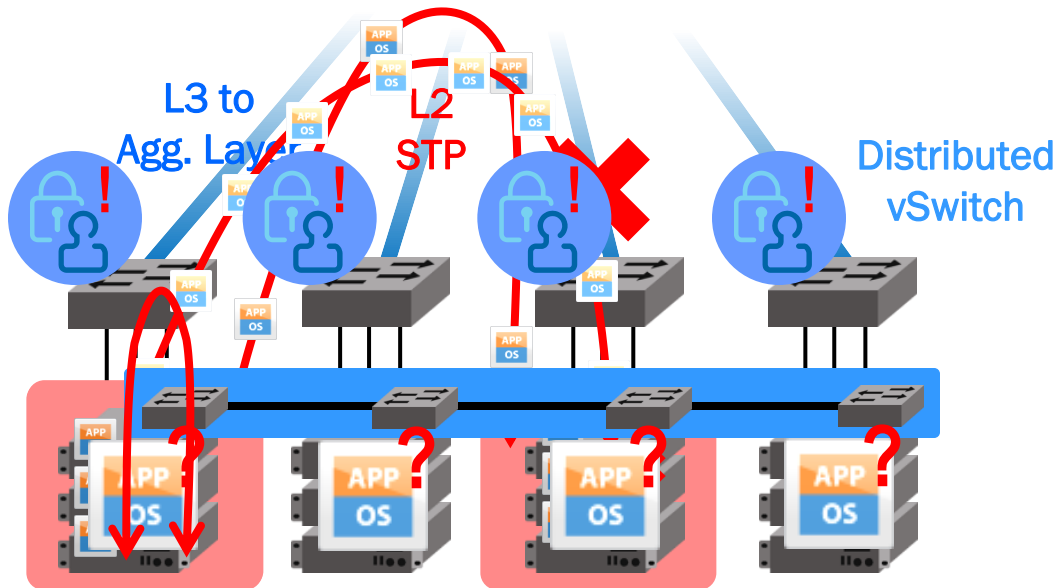
Limited sphere of mobility

- STP limits flexibility to a minimized, defined tree of switches
- L3 limits mobility to a single rack

VM migration can break network/application access

- Port setting information must be identical at destination

Map services (VLANs, QoS, security, etc.) to all physical ports

- Eases mobility, but undermines network and security best practices

Distributed Virtual Switch

- Addresses configuration needs
- Consumes server resources and still restricted by physical limits

Limited insight into where VMs are running
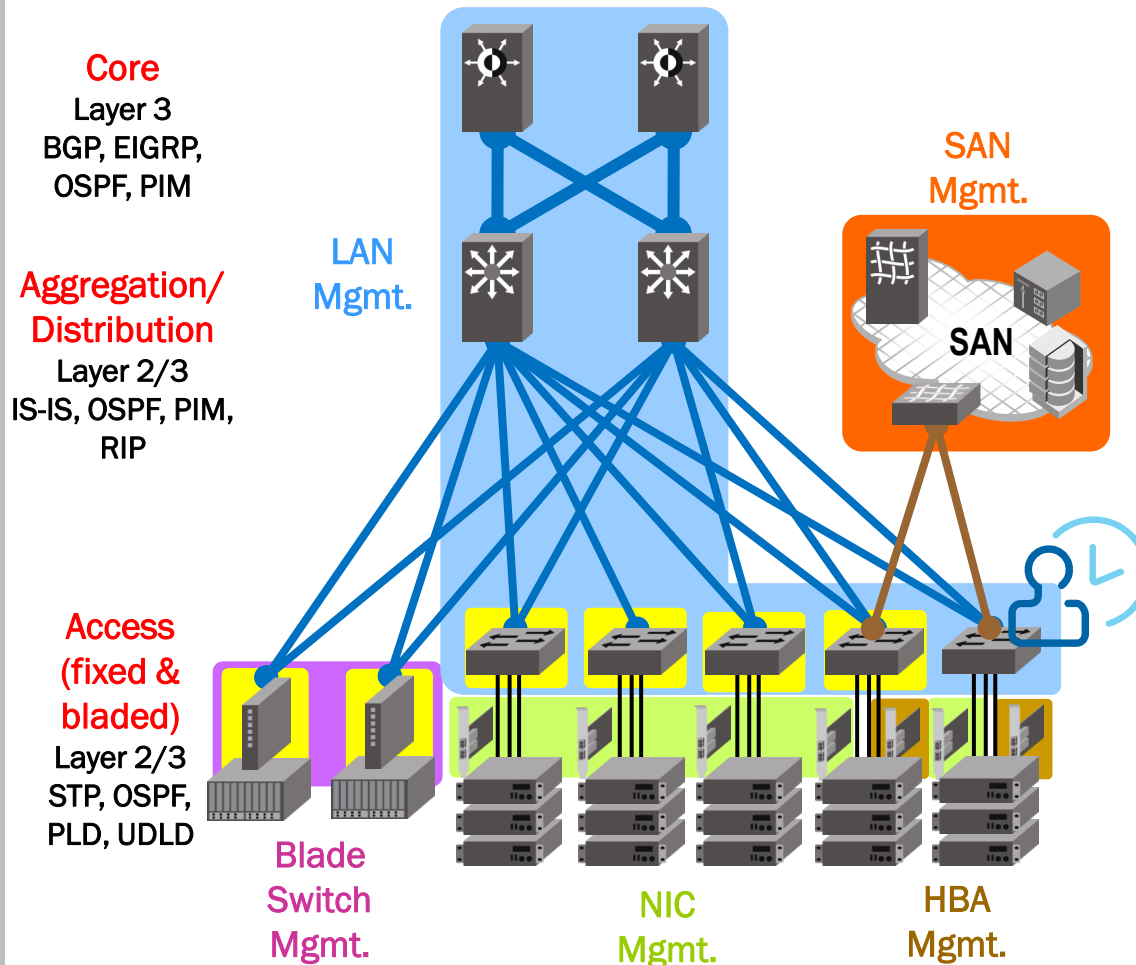
- VMs exist anywhere in the cluster

Imagine if...

- There were no physical barriers of VM migration

- Your network was aware of all VMs at all times

- Mobility did not come with a cost in compute resources

- You could leverage your entire server environment to maximize application performance and availability

Ethernet Fabric

Distributed Intelligence

1st Intelligent
Layer 2 Network

Network Management

Challenges Today

Core
Layer 3
BGP, EIGRP, OSPF, PIM

Aggregation/ Distribution
Layer 2/3
IS-IS, OSPF, PIM, RIP

Access (fixed & bladed)
Layer 2/3
STP, OSPF, PLD, UDLD

LAN Mgmt.

SAN Mgmt.

SAN

Blade Switch Mgmt.

NIC Mgmt.

HBA Mgmt.

Too many network layers
- Utilize many L2/L3 protocols

Lots of small-form-factor switches at the edge
- Each switch has to be managed
- Because of the number, they need to be aggregated

Configuration time when deploying new switches
- Switch has to be set up
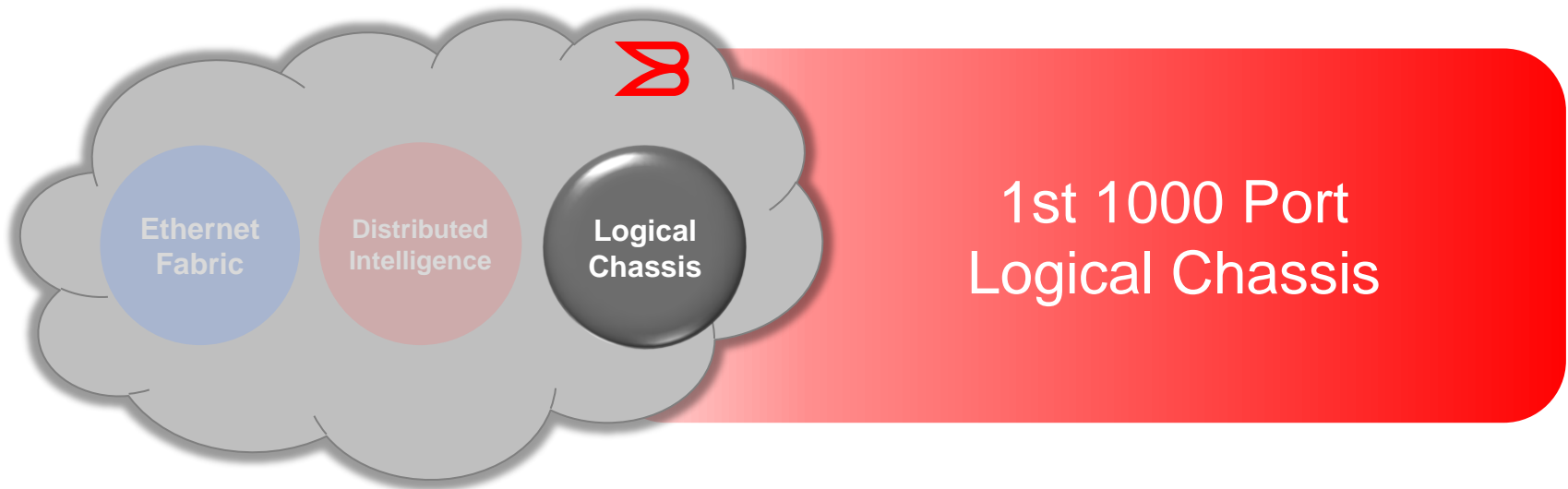- Network settings must be configured

Separate management tools for LAN, SAN, NICs/HBAs
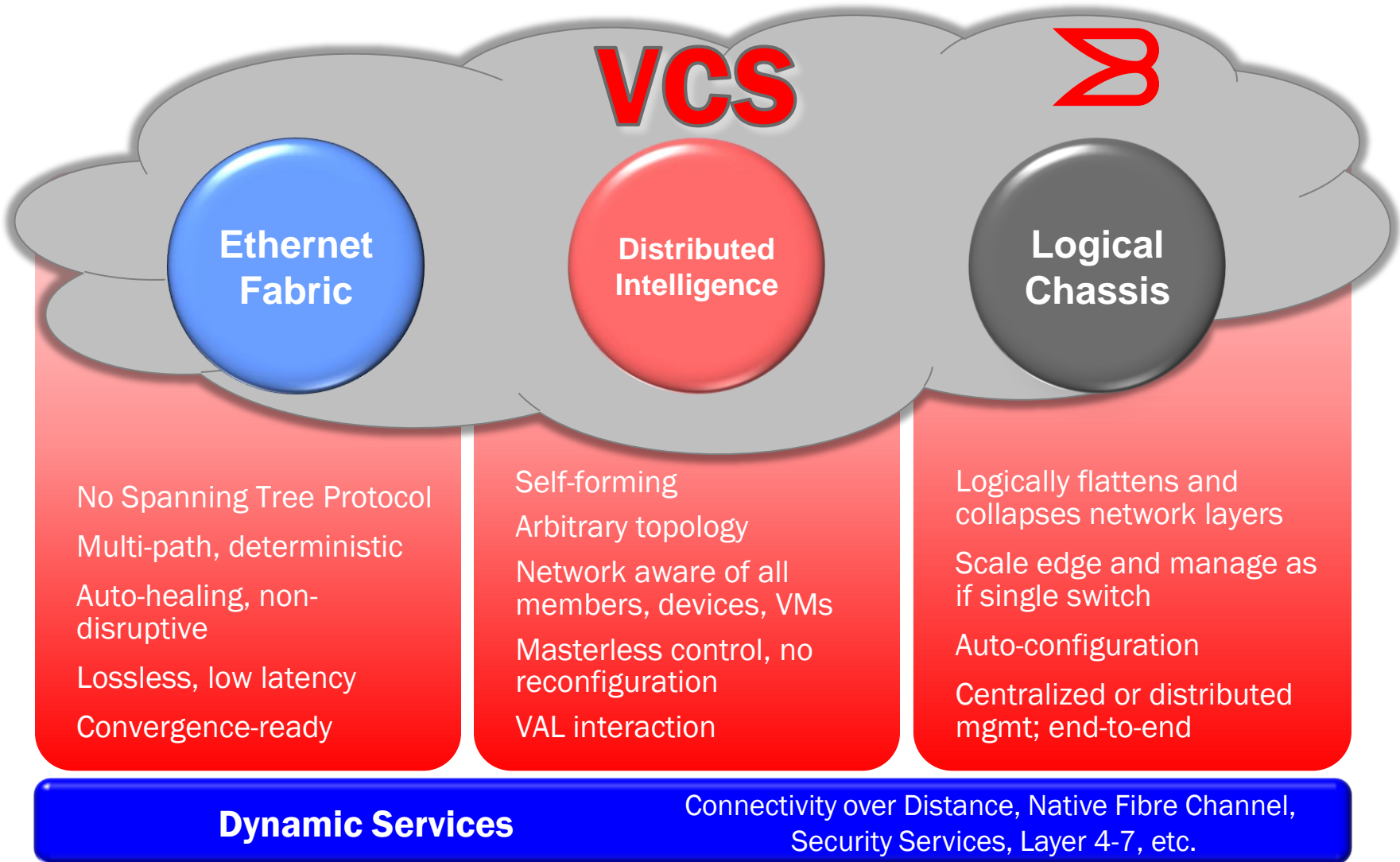- Management silos do not fit in a virtualized data center
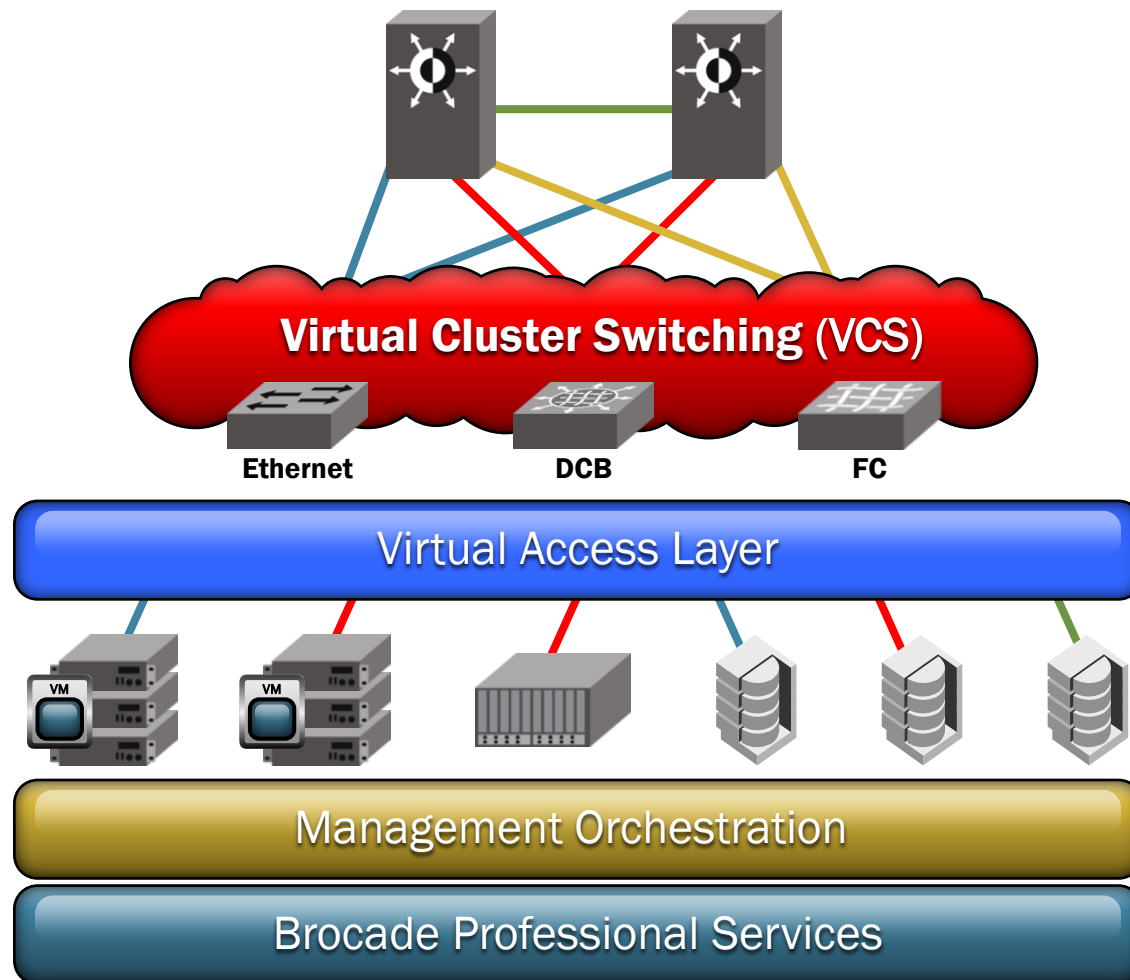- Drives up OpEx

Imagine if…

- You could logically eliminate a layer of the network

- You could connect 10, 20… edge switches and manage them as one

- You could scale the network without added complexity

- There was a common tool to manage all components of the SAN and LAN

Ethernet Fabric

Distributed Intelligence

Logical Chassis

1st 1000 Port
Logical Chassis

Virtual Cluster Switching (VCS)

VCS

Ethernet Fabric

- No Spanning Tree Protocol
- Multi-path, deterministic
- Auto-healing, non-disruptive
- Lossless, low latency
- Convergence-ready

Distributed Intelligence

- Self-forming
- Arbitrary topology
- Network aware of all members, devices, VMs
- Masterless control, no reconfiguration
- VAL interaction

Logical Chassis

- Logically flattens and collapses network layers
- Scale edge and manage as if single switch
- Auto-configuration
- Centralized or distributed mgmt; end-to-end

Dynamic Services   Connectivity over Distance, Native Fibre Channel, Security Services, Layer 4-7, etc.

Data Center Network Vision

- Collapse/simplify layered architecture

- Map to application needs

- Network innovation

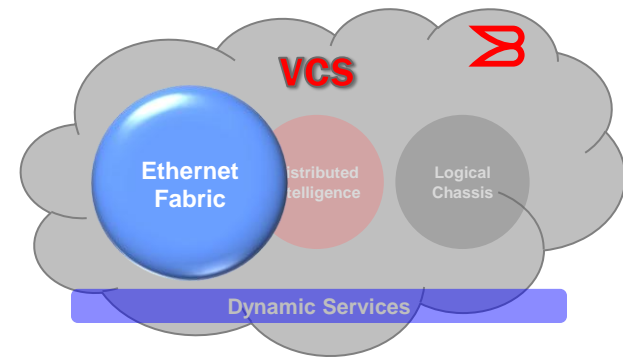 - Revolutionize Layer 2 connectivity (VCS)

  - Optimize VM performance and mobility (VAL)

  - Single pane of glass management

Virtual Cluster Switching (VCS) Details

Ethernet Fabric Details

- 1st true Ethernet fabric
  - Layer 2 technology

- Link speed agnostic

- Data Center Bridging (DCB)
  - Lossless, deterministic
  - Priority-based Flow Control (PFC)
  - Enhanced Transmission Selection (ETS)
  - Data Center Bridging Exchange (DCBX)

- Transparent Interconnection of Lots of Links (TRILL)
  - Active multi-path
  - Multi-hop routing
  - Highly available, sub-250ms link recovery

- LAN/SAN Convergence Ready
  - FCoE and iSCSI traffic

- Standards-based
  - Extends existing Ethernet infrastructure

Ethernet Fabric Details

What is a Fabric?

Data Center SAN
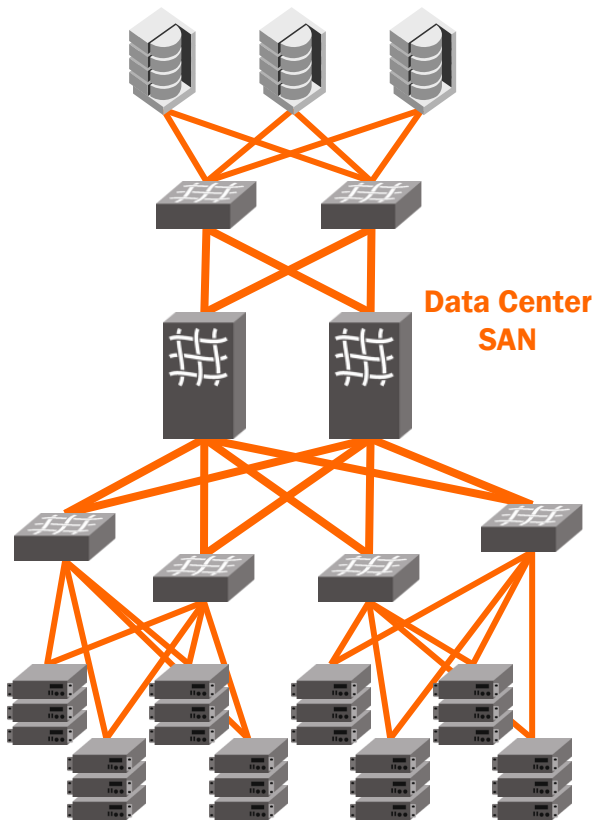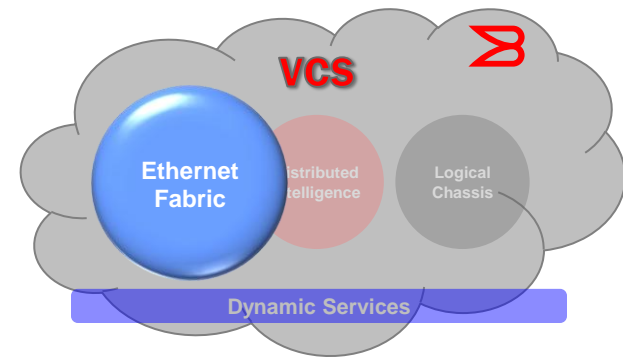
- Common fabric attributes
  - Switched network
  - Fabric members and devices connected always know about each other
  - All paths are available for high performance and high reliability
  - Traffic travels across the shortest path
  - Traffic can be routed from fabric to fabric

- Brocade is the expert in building data center fabrics
  - In 90+% of global 1000 data centers

Ethernet Fabric Details
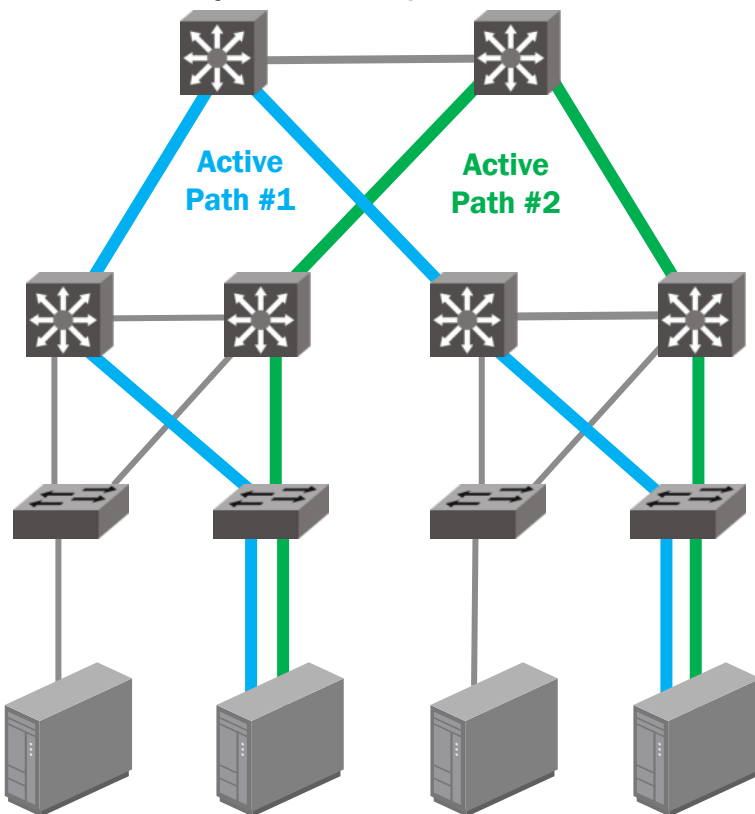## Data Center Bridging (DCB)
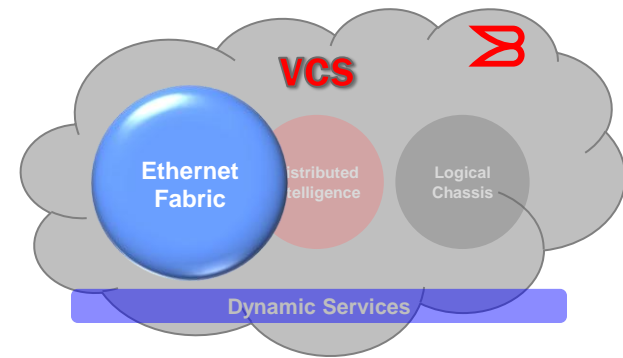
- Making Ethernet Lossless

- 802.1Qbb – Priority-Based Flow Control
  - PFC: Allows Identification and prioritization of traffic

- 802.1Qaz – Enhanced Transmission Selection/Data Center Bridging Exchange
  - ETS: Allows grouping of different priorities and allocation of bandwidth to PFC groups
  - DCBX: Discovery and initialization protocol to discover resources connected to DCB-enabled network

Ethernet Fabric Details
Transparent Interconnection of Lots of Links (TRILL)

Ethernet Fabric

Distributed Intelligence

Logical Chassis

Dynamic Services

Layer 2 Multiple Paths
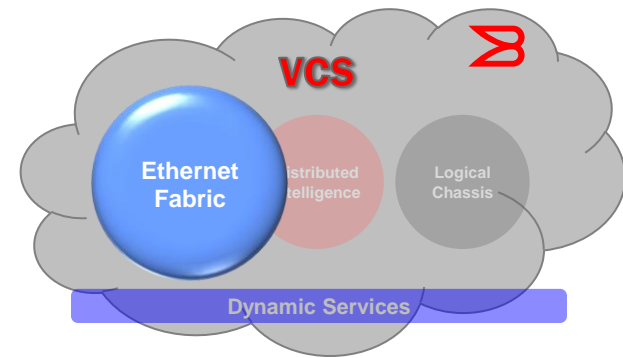
Active Path #1

Active Path #2

- Multi-path Layer 2 switching
  - All paths are active and traffic is distributed across all paths
  - Fully utilize all network bandwidth
- Establishes shortest paths through the Layer 2 network
- Uninterrupted response to link failures
- Backward-compatible and connects into existing infrastructures
- Delivers multiple hops for all traffic types (including FCoE)
 - Utilizes data center proven FSPF Link State Protocol

Ethernet Fabric Details
Convergence Ready

VCS

Ethernet Fabric

Distributed Intelligence

Logical Chassis

Dynamic Services

- Enables server I/O and end-to-end network convergence

Fewer cables

- Reduce number of server adapters, ports, cables and switch ports

Fewer adapters

- Reduce power consumption

- Increase speed and utilization of links

**Fewer switches**

- Simplify configurations and diagnostics
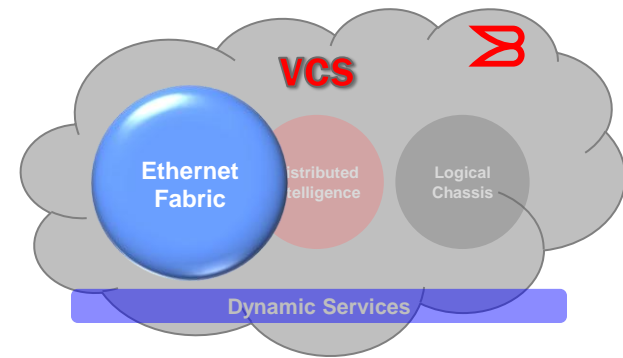
Top of Rack Configuration

SAN A

SAN B

LAN
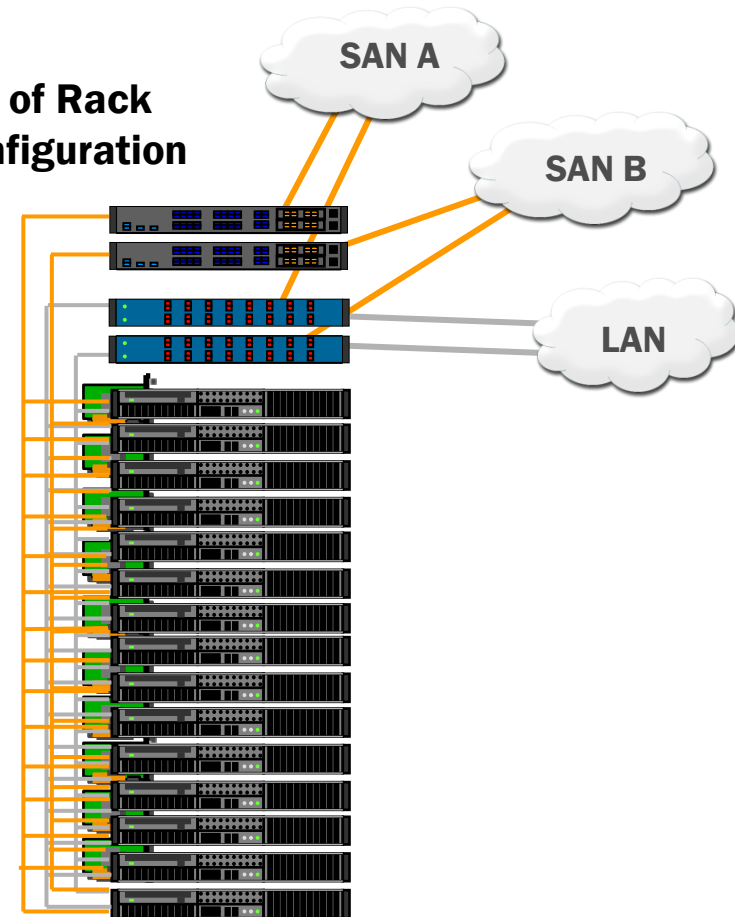
Distributed Intelligence Details
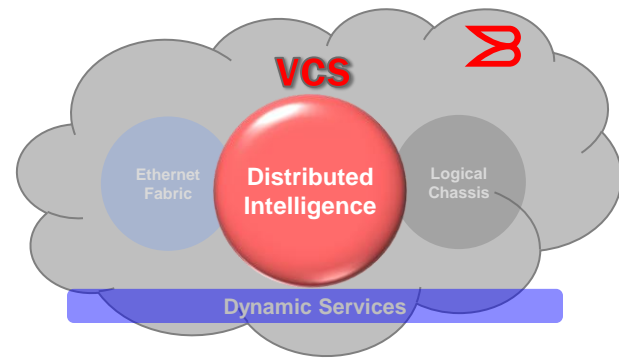
- ## Distributed Fabric Services
  - Fabric is self-forming
  - Information shared across all fabric members
  - Fabric is aware of all devices connected
- ## Masterless Control
  - Switch or link failure does not require full fabric reconvergence

- ## Shared Port Profiles information
  - Automatic Migration of Port Profiles (AMPP)
  - Enables seamless VM migration without compromise
- ## Optimized Virtual Access Layer
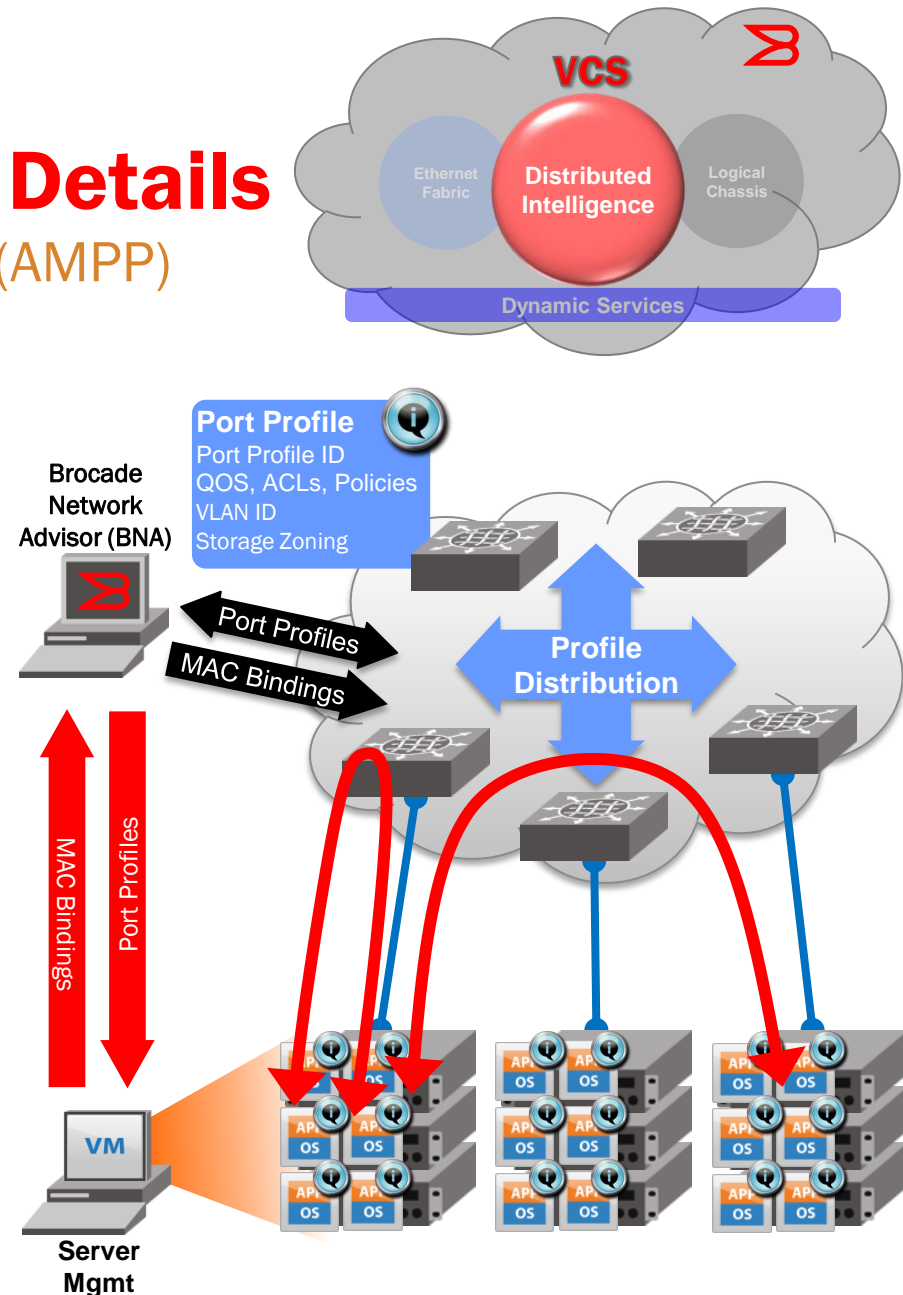 - VEPA; frees host resources from switching and policy enforcement
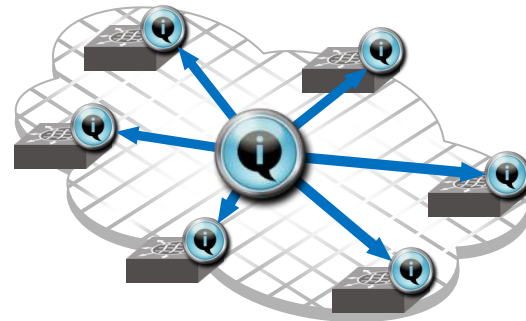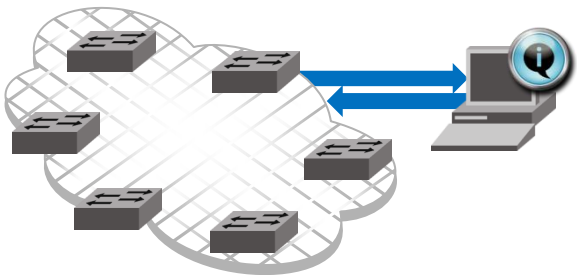
Distributed Intelligence Details
Automatic Migration of Port Profiles (AMPP)

❖ Allows VM to move with the network automatically reconfiguring

1. Port Profiles created, managed in fabric; distributed

2. Discovered by BNA; pushed to orchestration tools

3. Server admin binds VM MAC address to Port Profile ID

4. MAC address/Port Profile ID association pulled by BNA; sent to fabric

5. Intra- and inter- host switching and profile enforcement offloaded from physical servers

VCS

Ethernet Fabric

Distributed Intelligence

Logical Chassis

Dynamic Services

Brocade Network Advisor (BNA)

Port Profile
Port Profile ID
QOS, ACLs, Policies
VLAN ID
Storage Zoning

Port Profiles

MAC Bindings

Profile Distribution

MAC Bindings

Port Profiles

VM

Server Mgmt

Distributed Intelligence Details

Optimized Virtual Access Layer

- Today, access to the network lives in the virtual hypervisor
  - Consumes valuable host resources
- Virtual switch is offloaded to the physical switch
  - Eliminates the software switch; the advantages of a distributed virtual switch plus Distributed Intelligence
  - Leverages Virtual Ethernet Port Aggregator (VEPA) technology
- Virtual NICs are offloaded to the physical NIC
  - Leverages Virtual Ethernet Bridging (VEB) technology
- Host resources are freed up for applications
  - Gives 5-20% of host resources back to applications
- VMs have direct I/O with the network
 - Network simplicity; common access across entire VCS; network is managed in the network
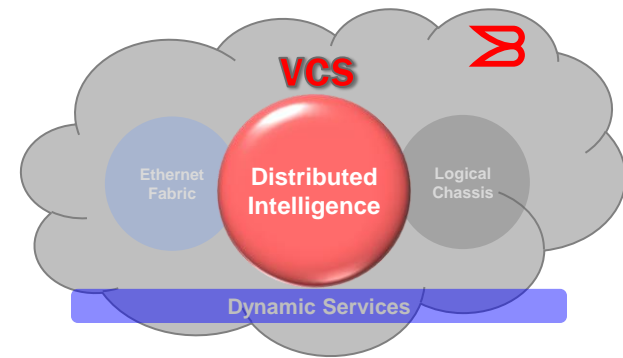
Virtual

Logical Chassis Details
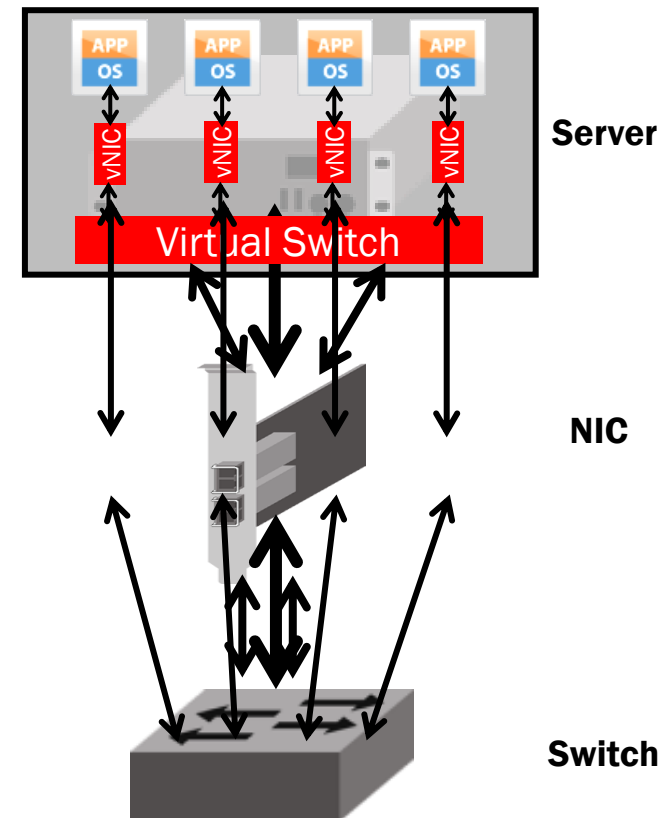
VCS — Ethernet Fabric, Distributed Intelligence, **Logical Chassis** — Dynamic Services
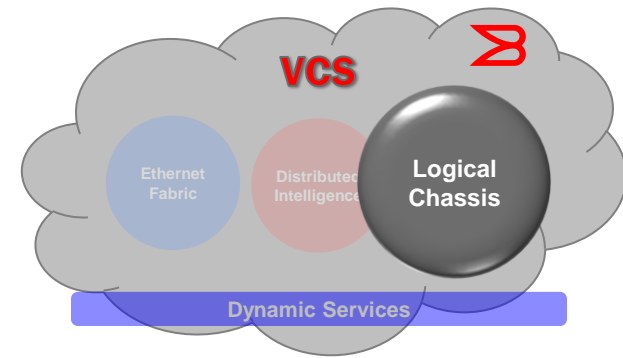
- Fabric auto-configures
  - Once VCS is enabled, no configuration necessary
- Fabric behaves/managed as a single logical chassis
  - Aggregation (or Core) layer sees one switch
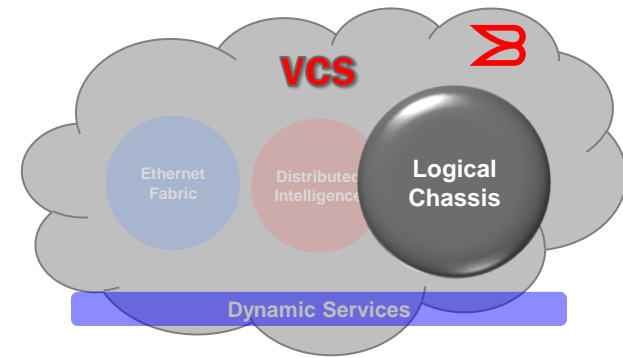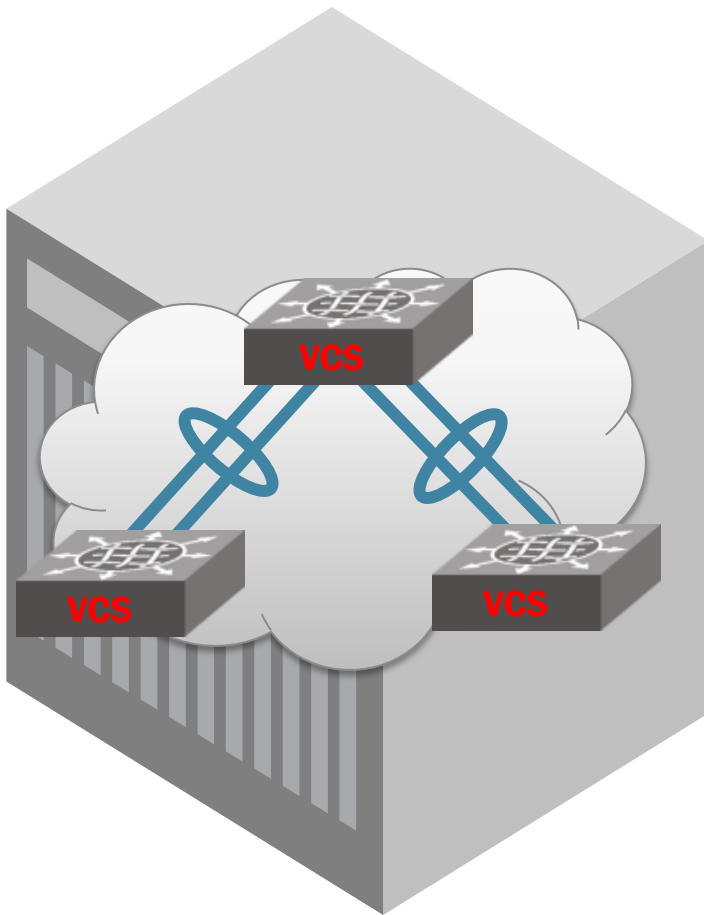 - Fabric members act like a blade in a chassis
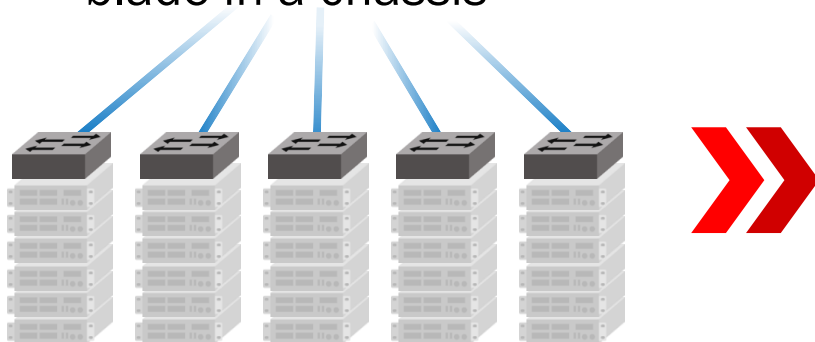
- Logically flattens and collapses network layers
  - Fabric is self-aggregating
  - Flexible fabric topologies
- Will scale to greater than 1000 device ports without added management
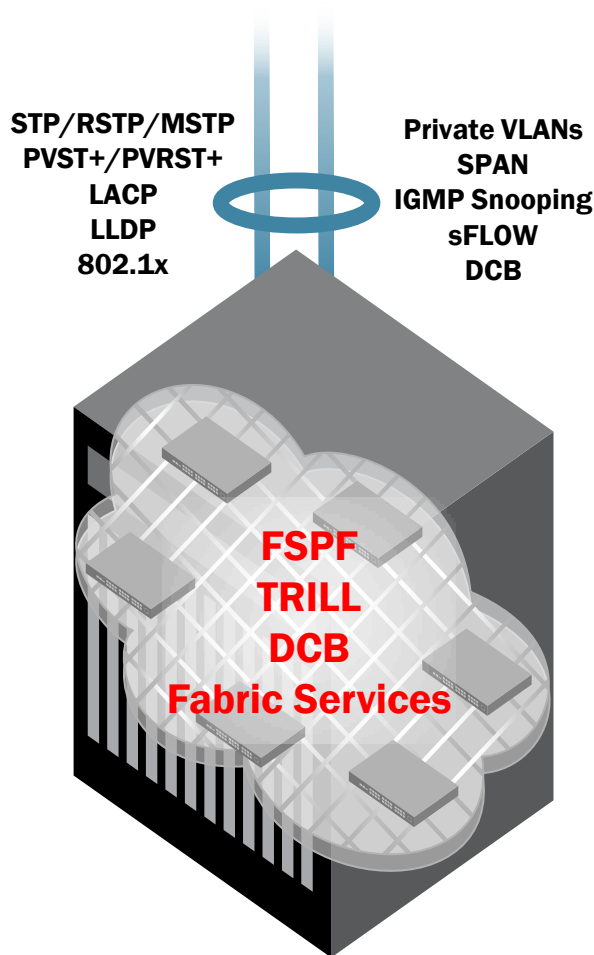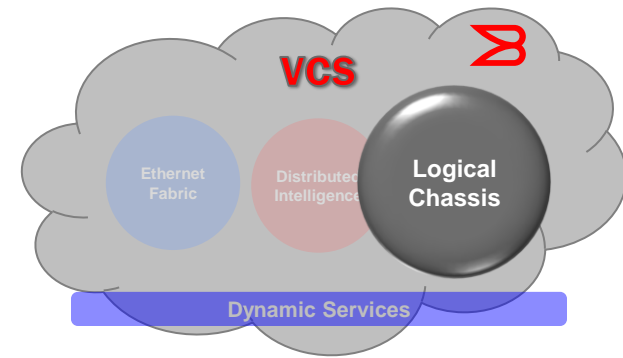
Logical Chassis Details
Auto-Configuration

- VCS simplified deployment, scalability, and management of the network

- Enable VCS on each switch

- Connect the switches

- Fabric automatically forms
  - Common configuration across all switches
  - vLAGs auto-configure

- Managed as a single logical chassis

Logical Chassis Details
Single Logical Switch Behavior

VCS

Ethernet Fabric — Distributed Intelligence — **Logical Chassis**

Dynamic Services

STP/RSTP/MSTP
PVST+/PVRST+
LACP
LLDP
802.1x

Private VLANs
SPAN
IGMP Snooping
sFLOW
DCB

**FSPF
TRILL
DCB
Fabric Services**

- VCS behaves like a single industry-standard Ethernet switch
  - VCS fabric members are like blades in a modular chassis

- Standards-based and closed protocols used within the fabric
  - FSPF, TRILL, Fabric Services, etc.

- Industry-standard protocols used to communicate outside the fabric
  - RSTP, LACP, 802.1x, sFLOW, etc.

Dynamic Services Details

Native Fibre Channel

Fabric Extension

Layer 4-7
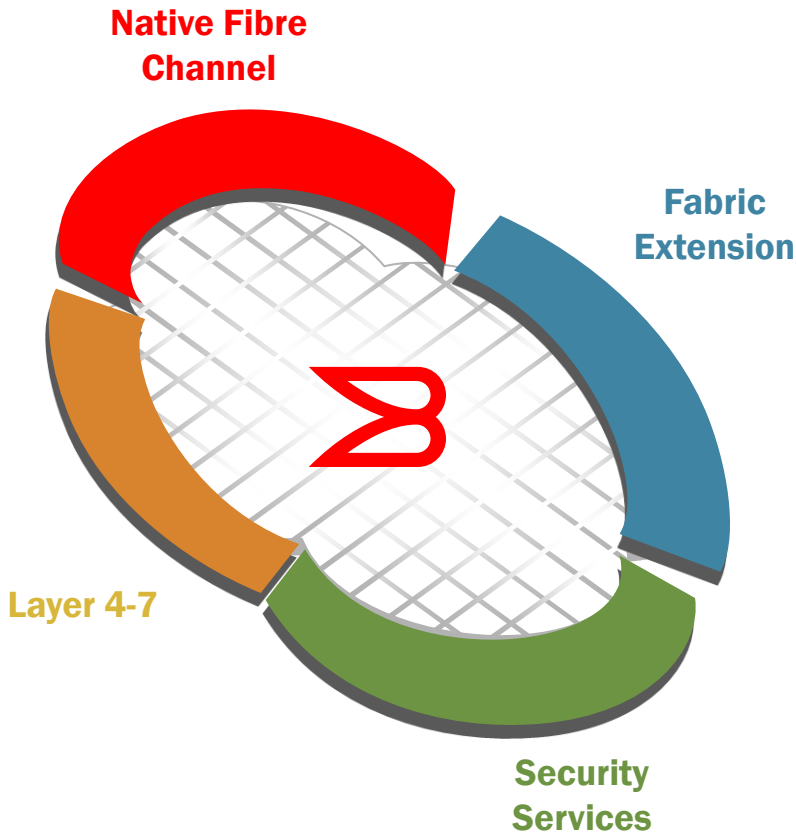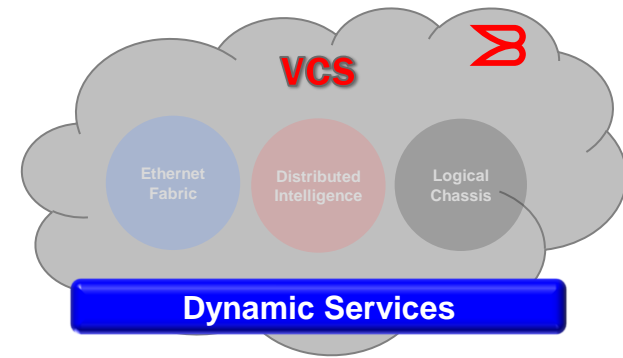
Security Services

- Add services into the VCS fabric
  - Extends the capabilities of VCS
  - Fabric extension, native Fibre Channel, security services, layer 4-7, etc.

- Purpose-designed hardware
  - Switches with unique functionality can be added to the VCS fabric
  - Like service modules in a chassis
  - Functionality available to the entire VCS fabric

VCS

Ethernet Fabric

Distributed Intelligence

Logical Chassis

Dynamic Services

Dynamic Services Details
Data Center to Data Center Connectivity
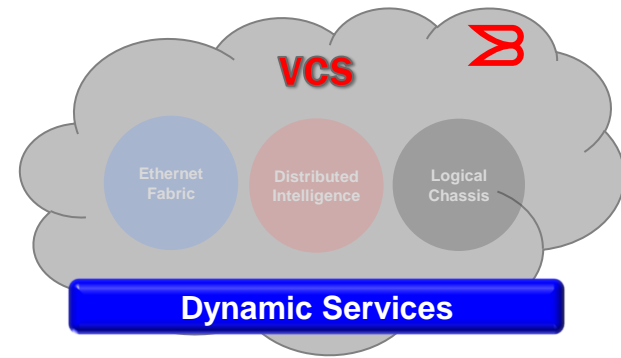
- Dynamic Service to connect Data Centers

  - Extend the layer 2 domain over distance

  - Maintains fabric separation while extending VCS services to secondary site (e.g. discovery, distributed configuration, AMPP)

- VCS Fabric Extension capabilities

  - Delivers high performance accelerated connectivity with full line rate compression

  - Secures data in-flight with full line rate encryption

  - Load balances throughput and provides full failover across multiple connections

Site A

Site B

VCS

VCS

Fabric Extension Service

Fabric Extension Service
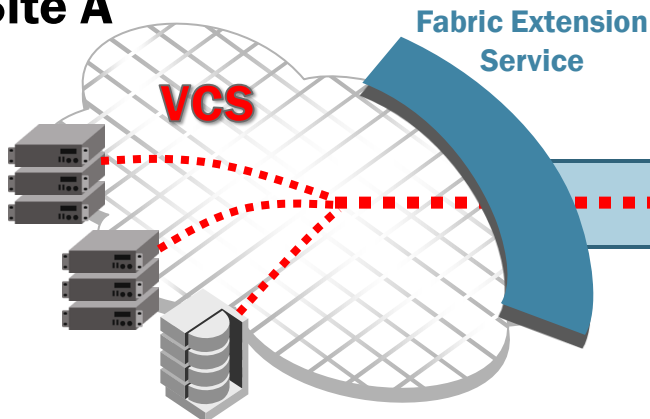
Public Routed Network

Encryption, Compression, Multicasting
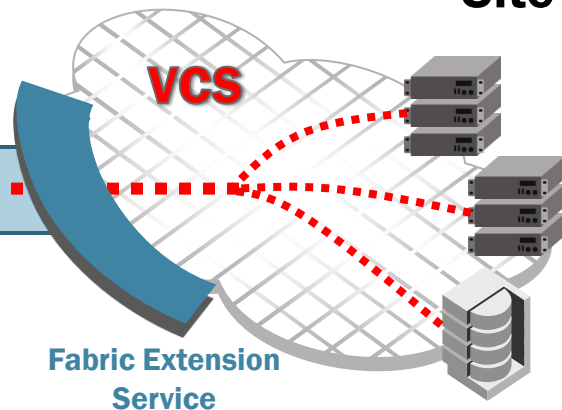
Dynamic Services Details

Native Fibre Channel Connectivity

Dynamic Services
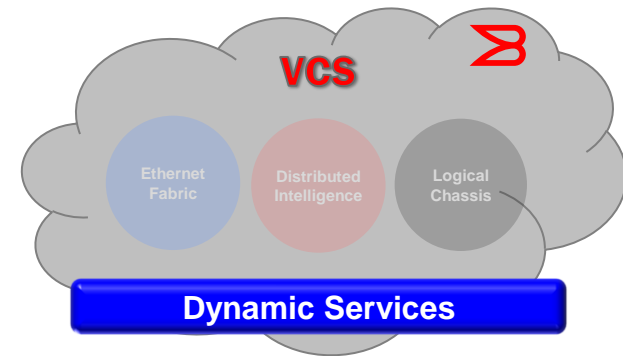
- Provide VCS Ethernet Fabric with native connectivity to FC storage
  - Connect FC storage locally
  - Leverage new or existing Fibre Channel SAN resources

- VCS Native Fibre Channel Capabilities
  - Adds Brocade's Fibre Channel functionality into the VCS fabric
  - 8 Gbps, 16 Gbps FC, frame-level ISL Trunking, Virtual Channels with QoS, etc.

LAN

VCS

Native Fibre Channel

FC Storage

Brocade DCX

FC SAN

FC Storage
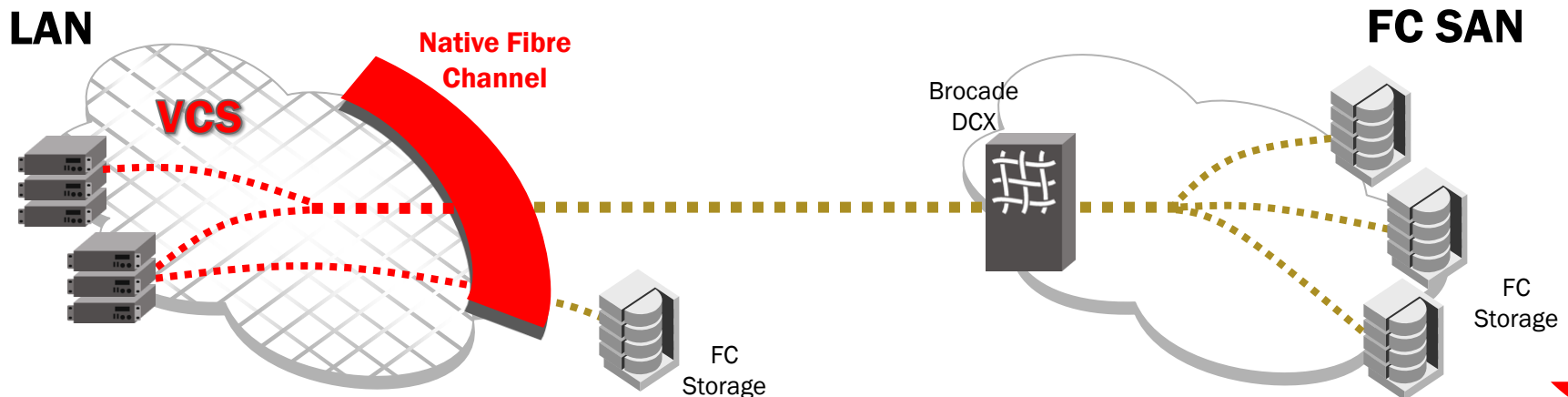
VCS architecture

VCS Use Case #1
1/10 Gbps Top-of-Rack Access – Architecture

Classic

WAN

MLX w/ MCT,
Cisco w/ vPC/VSS,
or other

Existing 1 Gbps
Access Switches

LAG

VDX

VDX

**2-switch
at ToR**

1 Gbps
Servers

1/10 Gbps
Servers

10 Gbps
Servers

Core

Aggregation
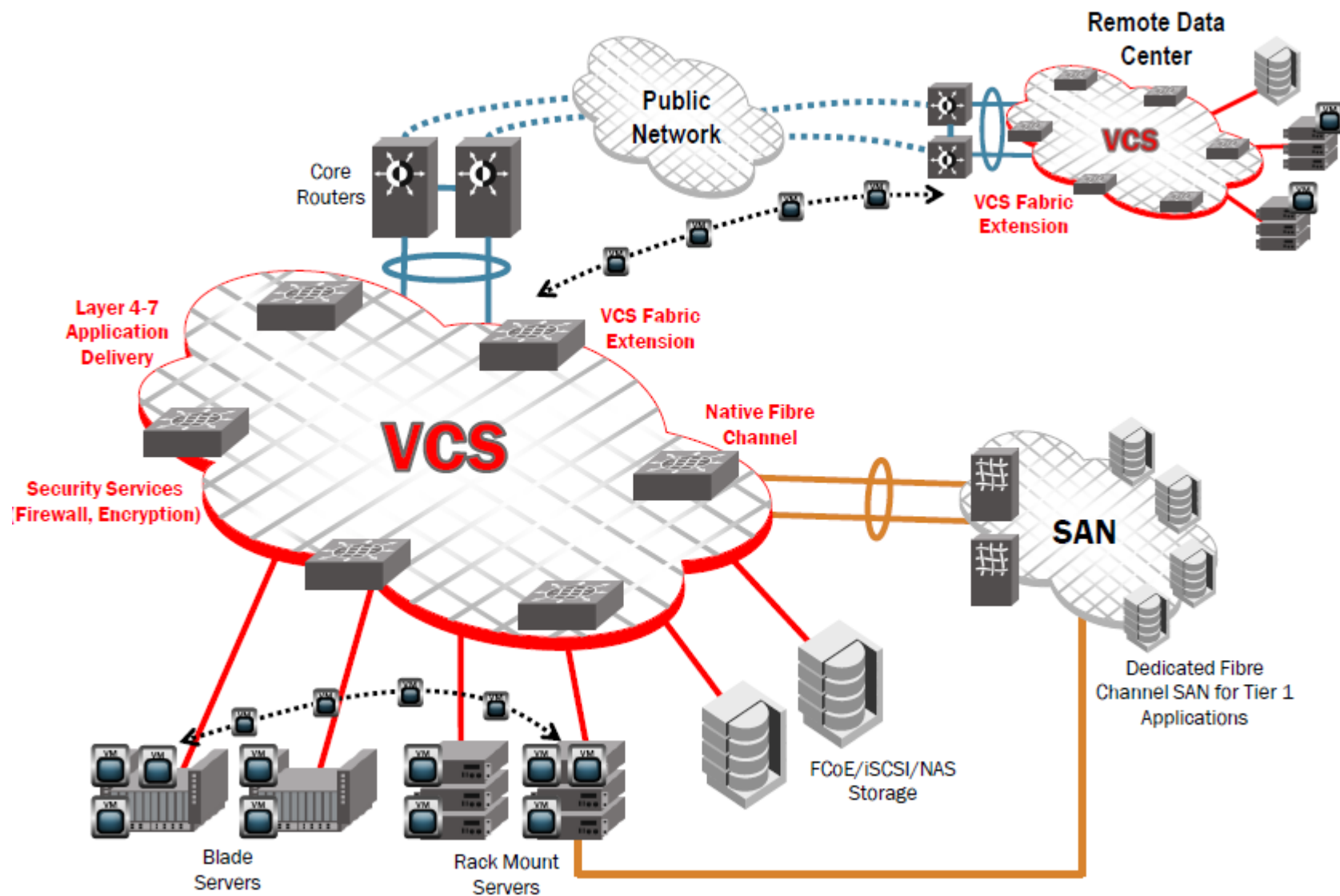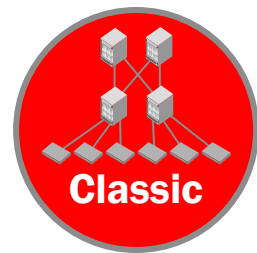
Access
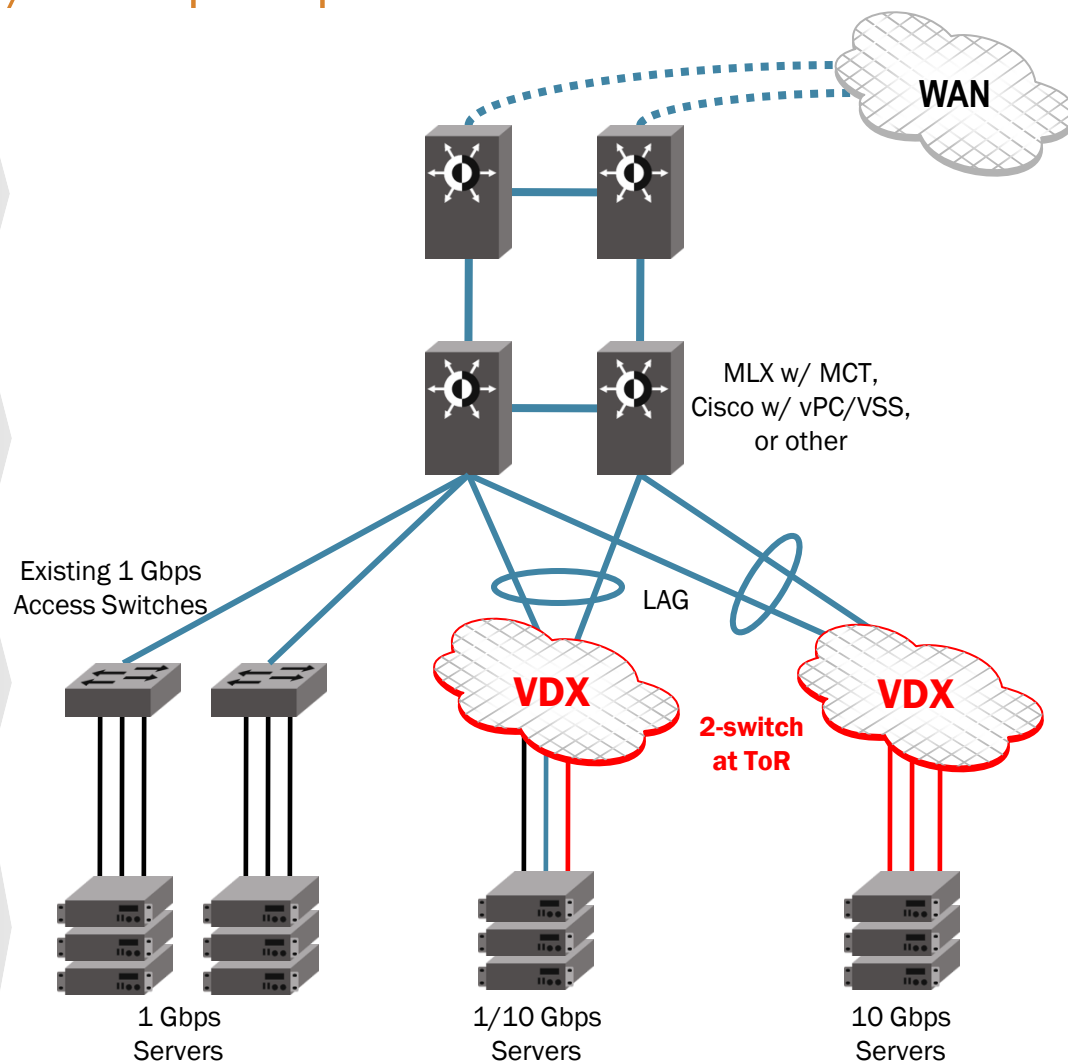
Servers

Preserves existing architecture
- Leverages existing core/agg
- Co-exists with existing ToR switches

Supports 1 and 10 Gbps server connectivity

Active-active network
- Load splits across connections

No single point failure
- Self healing

Fast link reconvergence

High-density access with flexible subscription ratios
- Supports up to 36 servers per rack with 4:1 subscription

VCS Use Case #1
1/10 Gbps Top-of-Rack Access – Layout

Core

Aggregation Switches at the End of Each Row

2 VDX switches at the Top of Each Rack

Servers with 1 Gbps or 10 Gbps Connectivity
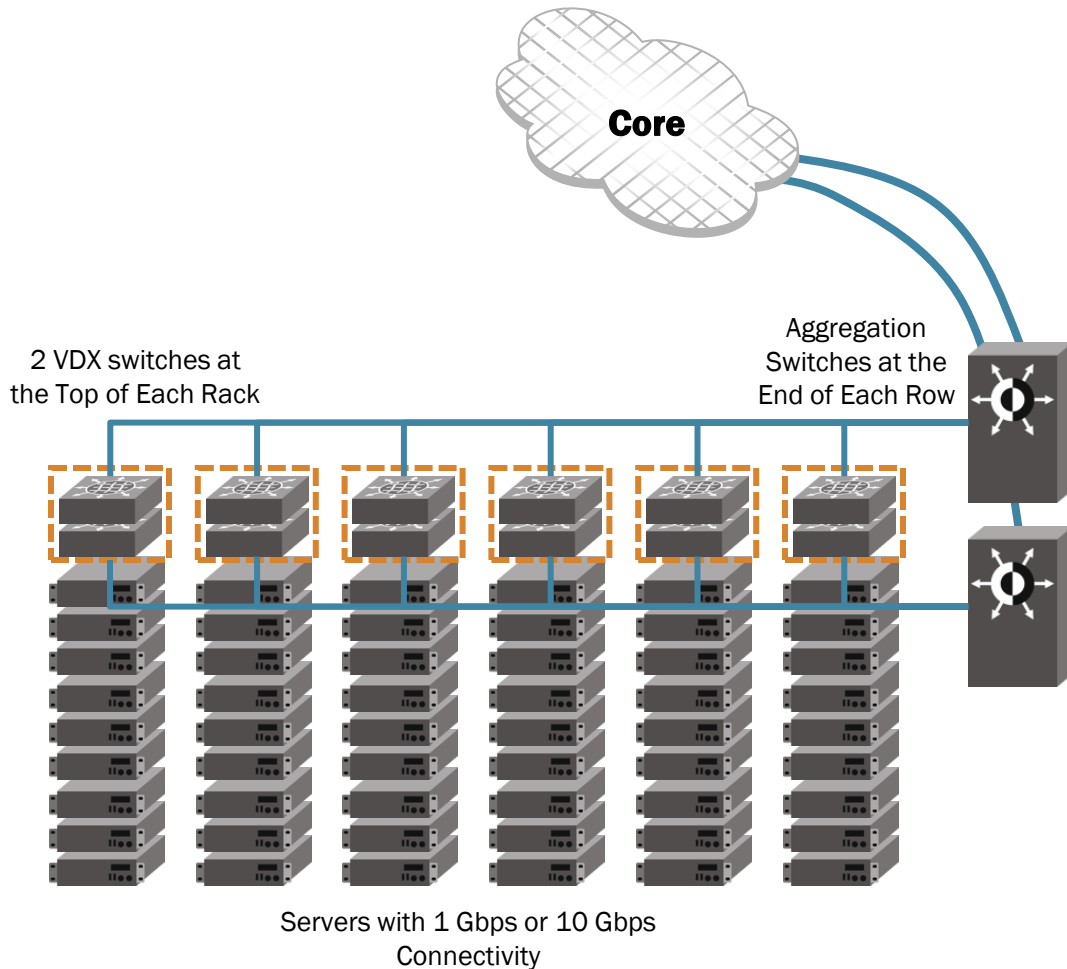
Preserves existing network architecture

Leverage VCS technology in stages

2 VDX switches in each server rack

Managed as a single switch

1 Gbps and 10 Gbps connectivity

Highly available; active/active

High performance connectivity to End-of-Row Aggregation

One virtual LAG to core for simplified management and rapid failover

VCS Use Case #3

10 Gbps Aggregation; 1 Gbps Top-of-Rack Access – Architecture

Classic

Core

Aggregation

Access

Servers

WAN

MLX w/ MCT,
Cisco w/ vPC/VSS,
or other

LAG

Scalable VCS Aggregation

ToR Switch Stack
(Brocade FCX or other)

Existing Access Switches

Existing 1 Gbps Servers

New 1 Gbps Servers
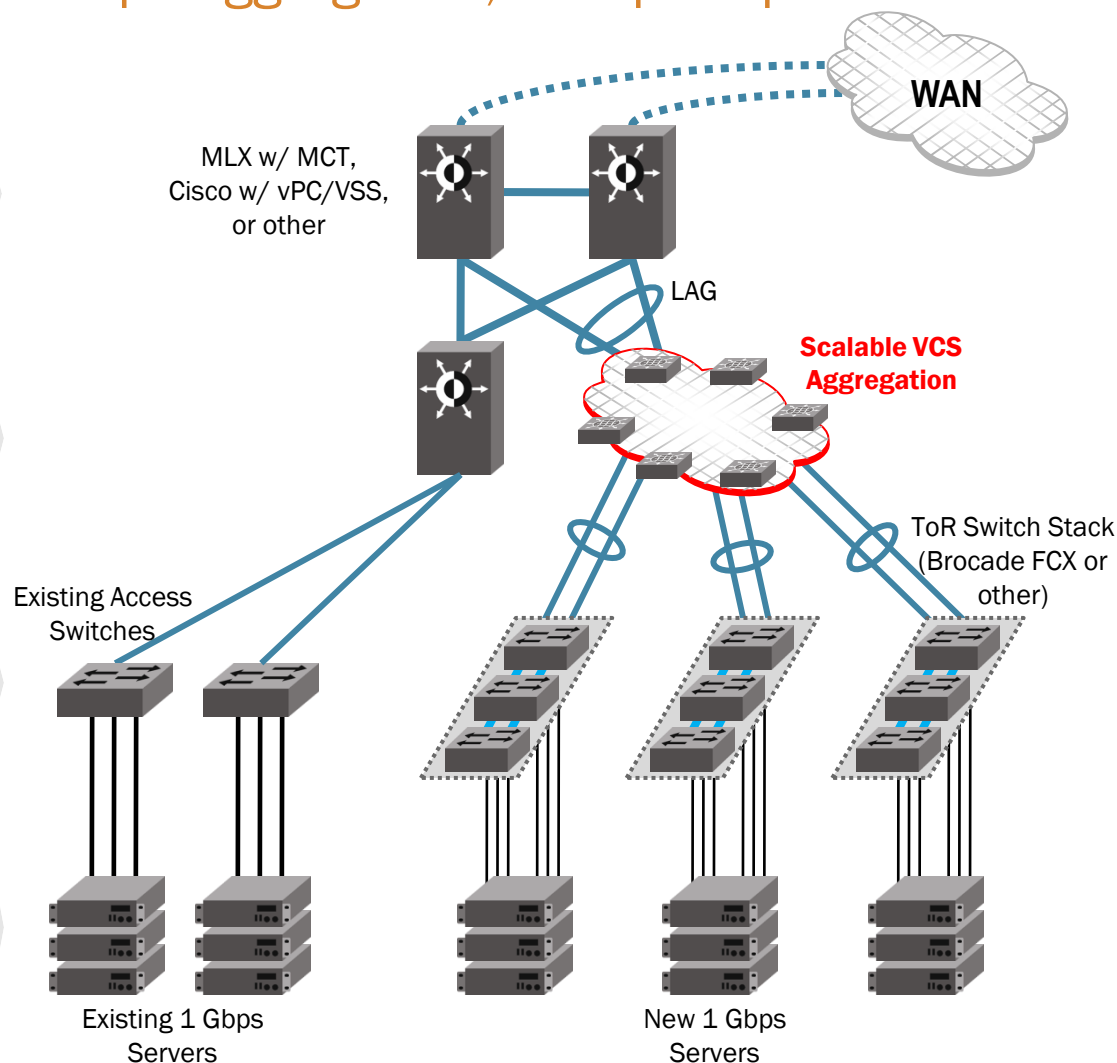
Low cost, highly flexible logical chassis at aggregation layer

- Building block scalability
- Per port price of a ToR switch
- Availability, reliability, manageability of a chassis
- Flexible subscription ratios

Ideal aggregator for 1 Gbps ToR switches

- Supports 900 servers in 25 racks, assuming 4 NICs per server

Optimized multi-path network

- No single point failure
- STP not necessary

VCS Use Case #3

10 Gbps Aggregation; 1 Gbps Top-of-Rack Access – Layout

Core

3-switch FCX stack (or other) at the Top of Each Rack

VCS Aggregation in Distribution Area

Servers with 1 Gbps Connectivity
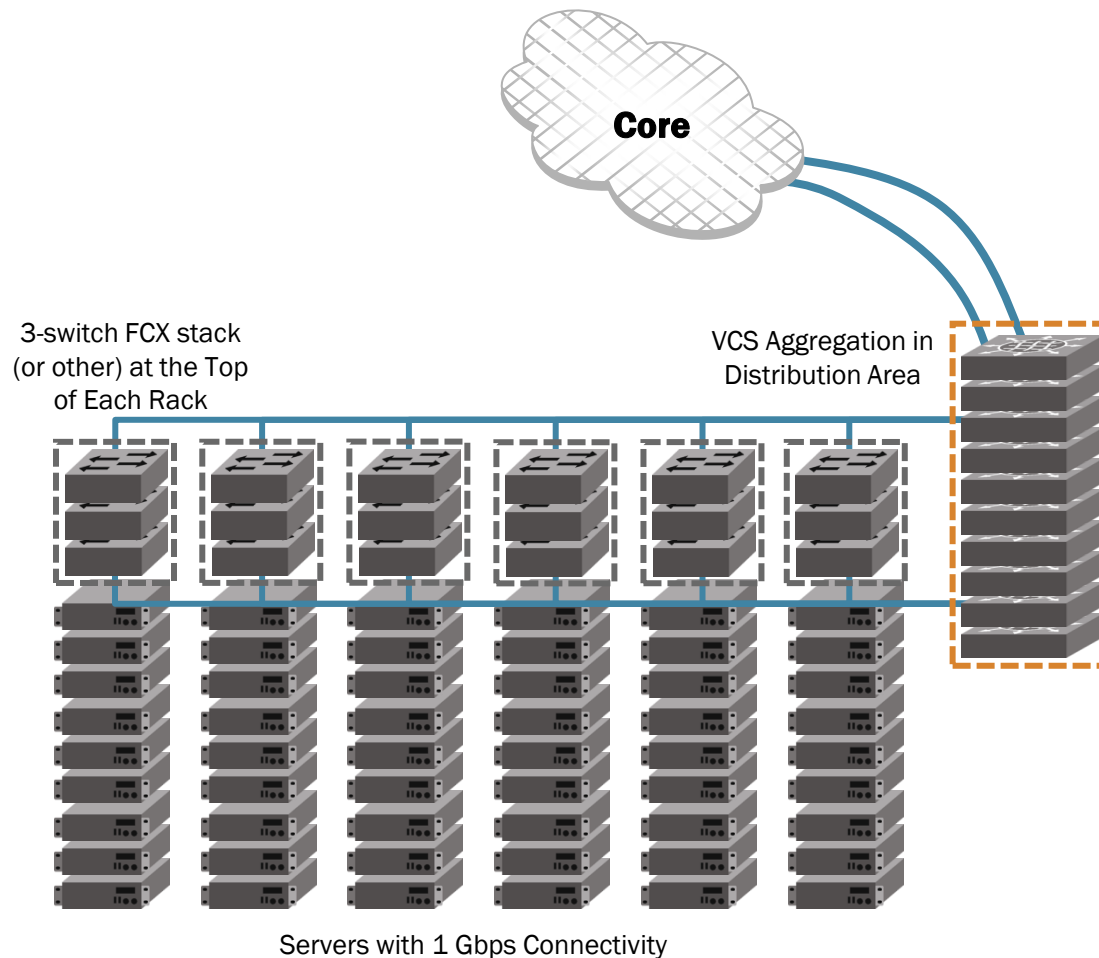
3-switch GbE stack in each rack

- Managed as a single switch
- Redundancy throughout network, without STP
- High density 10 Gbps LAG to VCS aggregation

Logical Chassis Aggregation Router in Distribution Area

- Build out aggregation as needed
- Supports 30 racks of servers

High performance, resilient connection to Core

- One LAG for simplified management and rapid failover

VCS Use Case #4

1/10 Gbps Access; Collapsed Network – Architecture
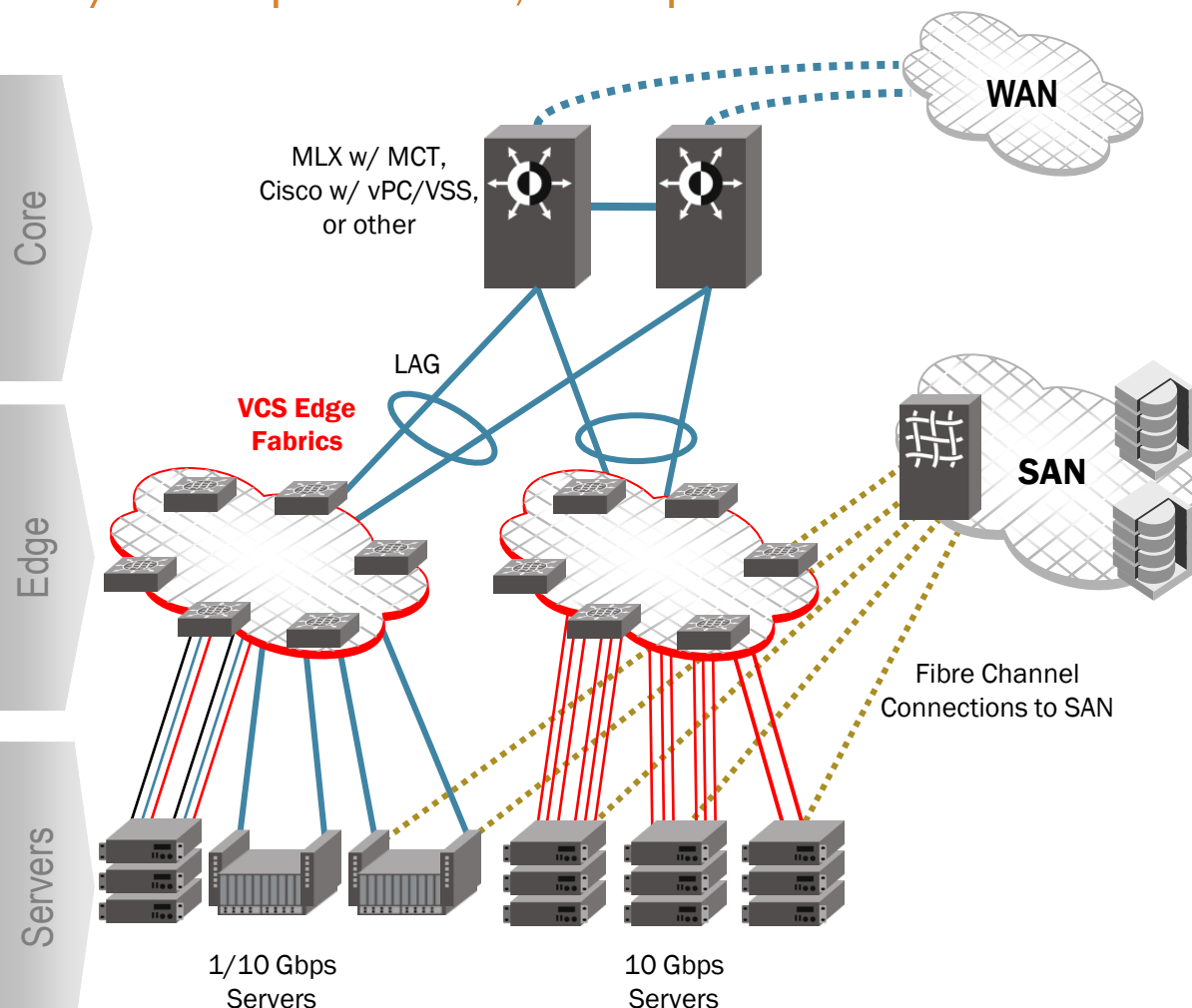
Flatter, simpler network design

- Logical two-tier architecture
- Ethernet fabrics at the edge

Greater layer 2 scalability/flexibility

- Increased sphere of VM mobility
- Seamless network expansion

Optimized multi-path network

- All paths are active
- No single point failure
- STP not necessary

WAN

MLX w/ MCT,
Cisco w/ vPC/VSS,
or other

Core

LAG

VCS Edge
Fabrics

SAN

Edge

Fibre Channel
Connections to SAN

Servers

1/10 Gbps
Servers

10 Gbps
Servers

VCS Use Case #4a
1/10 Gbps Access; Collapsed Network – Layout – ToR Mesh

Core

Horizontal Stacking Using ToR Mesh architecture

2 Fabric Members per Rack
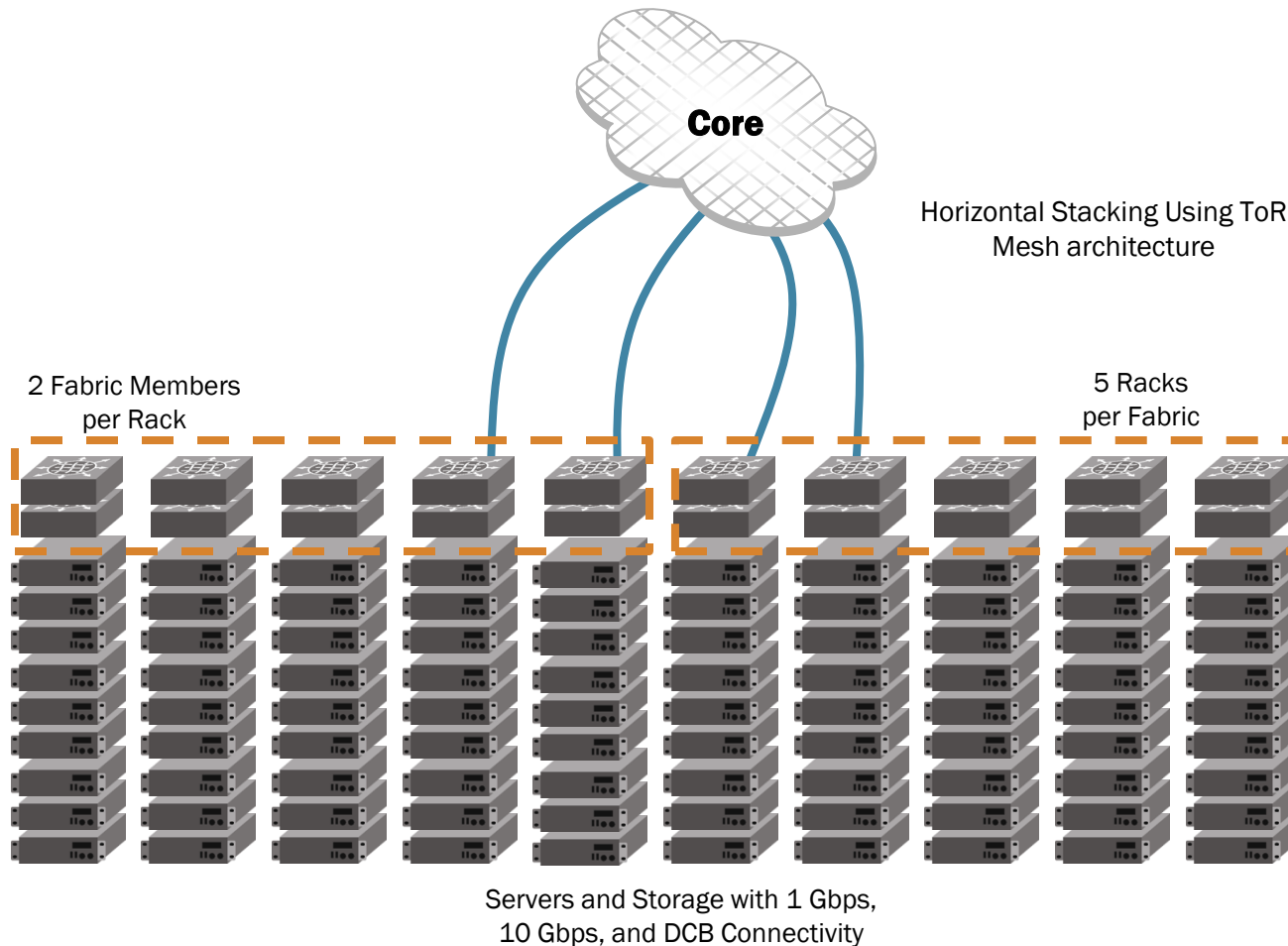
5 Racks per Fabric

Servers and Storage with 1 Gbps, 10 Gbps, and DCB Connectivity

2 VCS fabric members in each rack

- Dual connectivity into fabric for each server/storage array
- Low cost Twinax cabling in rack

Switches connected to peers across racks

- Low cost active optical cabling between top-of-rack switches
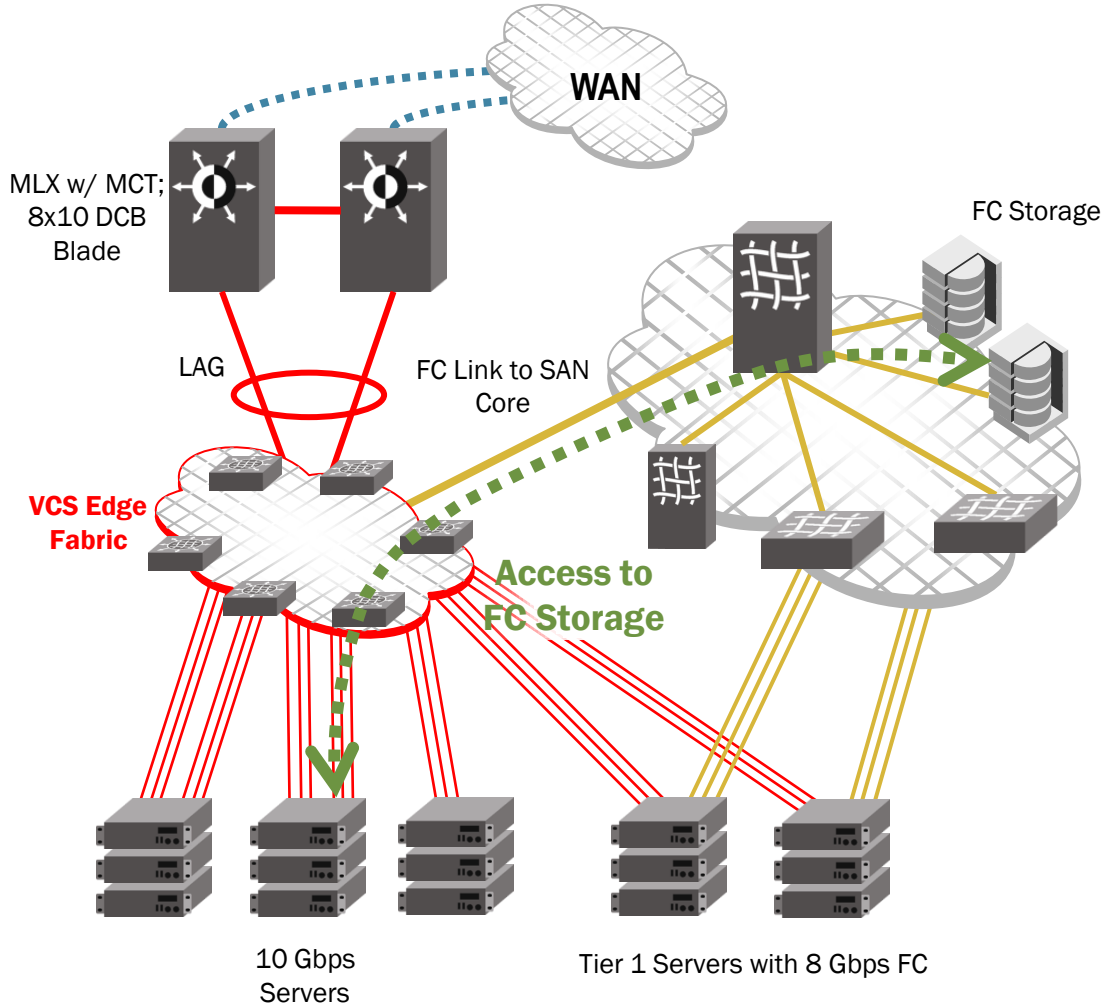- 1 VCS fabric per 5 racks of servers (assuming 36 servers per rack)

Fiber optic cabling only used for connectivity from edge VCS to core

- Single virtual LAG per fabric
- Reduced management and maximum resiliency

VCS Use Case #6
1/10 Gbps Access; Convergence + FC SAN – Architecture

Core

Edge

Servers

WAN

MLX w/ MCT;
8x10 DCB
Blade

FC Storage

LAG

FC Link to SAN
Core

**VCS Edge
Fabric**

**Access to
FC Storage**

10 Gbps
Servers

Tier 1 Servers with 8 Gbps FC

Leverage existing resources

Connect Ethernet fabrics into Fibre Channel SAN – new servers have access to existing storage

***Enabled through future VDX switch with native FC ports

Maximum storage flexibility

Fibre Channel, FCoE, iSCSI, NAS

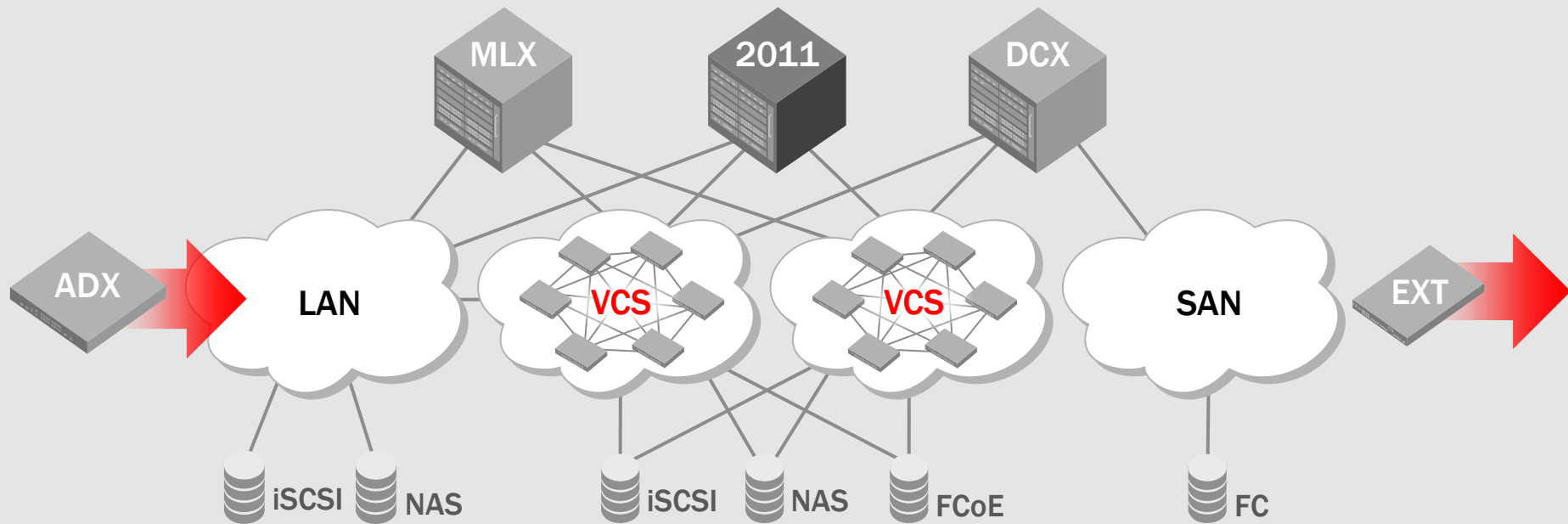Deploy the right storage technology without isolating it

Optimal performance, availability

No single point failure

Frame-level, hardware-based trunking between fabrics

Scaling and Extending the Data Center

Brocade VDX 6720

Brocade VDX 6720 Data Center Switches
Product Highlights

- **Built for the Virtualized Data Center**
  - Uses Brocade fabric switching ASICs
  - First switches to run new Brocade Network Operating System
  - Virtual Cluster Switching (VCS) fabric technology
  - Automatic Migration of Port Profiles (AMPP)

- **Best-In-Class Performance and Density**
  - 24 and 60 port models with Ports On Demand
  - Non-blocking, cut-through architecture, wire-speed
  - 600 ns port-to-port latency; 1.8 us across port groups

- **Environmental Flexibility**
  - 10 Gb and 1 Gb supported on every port
  - Direct-attached copper, active optical, and SFP optical connectivity options
  - Less than 17" switch depth and reversible front-to-back airflow

- **Enables Network Convergence**
  - Complete FCoE support, multi-hop
  - iSCSI DCB support

- **Highly Resilient and Efficient Design**
  - Hot code load and activation
  - Remote Lights Out Management
  - Simplistic design, optimal power efficiency

Data Center Access

Some Key Concepts...

ASICs, features, multihop...

- The ASIC inside of VDX 6720-24 and VDX 6720-60 is <u>eAnvil2</u>
  - 24 x 10/1GE ports & 8 x 8G FC Bridging ports
  - Supports TRILL, DCB, L2 and L3 features
  - **Cut-thru 600ns latency** switch chip

- Ethernet Fabric
  - vLAG (Similar to MLX MCT) – Sometime referred as internal VCS LAGs
  - AMPP
  - Hypervisor agnostic - VMWare and Hyper-V tested (but should not be any issue with others)
  - Multi-hop internal FCoE
 - Callisto-F with Native FC ports in roadmap

ISL Trunking
No license

Brocade ISL Trunking provides high link utilization, ease-of-use

- Frame-level, hardware-based trunking
- Frames are evenly distributed across links in the trunk
- Built into Brocade fabric switching ASIC
- ISL Trunks automatically form
    - Ports must belong to the same port group in the switch
- Once both switches are in VCS mode, multiple ISLs automatically form a trunk
- No configuration necessary

80 Gbps
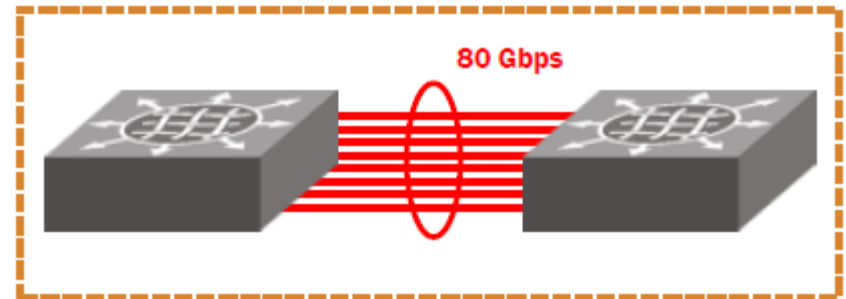
iSCSI DCB

Advantages

Provide deterministic delivery of iSCSI traffic, Maximize iSCSI throughput and Minimize TCP re-transmissions by eliminating congestive packet loss
Use DCB Ethernet Enhancements (PFC)(ETS)
Use DCBX

- Distribute DCB configuration to iSCSI devices
- PFC and ETS – existing
- iSCSI Priority – New TLV required

Switch advertises priority to be used for iSCSI

- Priority must be PFC enabled
- Advertisement of configuration only
- Switch will not verify or enforce iSCSI device compliance
- Requires that device supports the new TLV
- DCBX 1.01 compliant TLV
- Application Protocol ID = 3260
- Priority map indicates iSCSIpriority

Licenses

VDX 6720-24 (min 16 ports)
- VCS 2-node License (Default)
- VCS Multi-node License
- FCoE License
- **8 port POD(Ports on Demand) License**

VDX 6720-60 (min 40 ports)
- VCS 2-node License (Default)
- VCS Multi-node License
- FCoE License
- **10 port POD(Ports on Demand) License**

Sentinel implementation, allowing XML files to load licenses, future Temporal lic support

Brocade MLXe

Brocade MLXe Series

* **15.36 Tbps** fully Distributed Architecture

* **Lossless fabric**

* **Wire-speed routing** 7.6 Gpps IPv4/IPv6/MPLS

* **DCB** (Data Centre Bridging) ready

* **Industry-leading 100G** port density

* **Carrier-grade QoS**

* **NEBS** L3 compliant

* **Rear exhaust** on all models

* **High Availability design:**
  * ✓ Redundant management modules
  * ✓ Redundant switch fabrics
  * ✓ Redundant power supplies & fans
  * ✓ Hitless failover
  * ✓ Hitless software upgrades
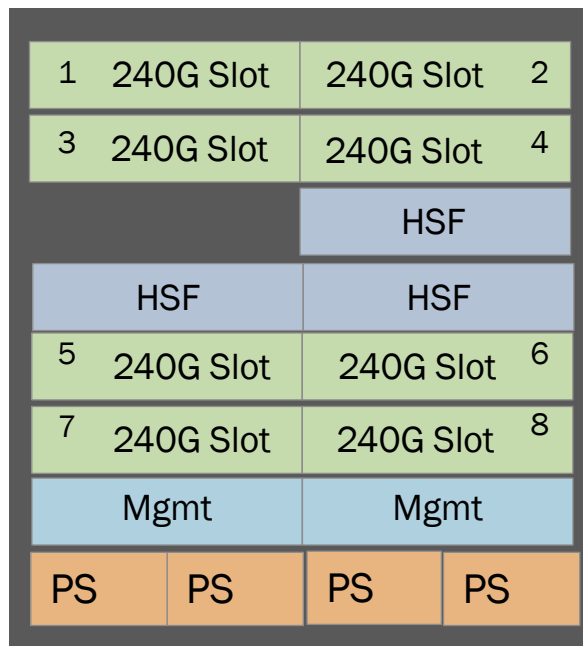 * ✓ Node/link failover of **<200msec**

* **Ideal for...**
  * ✓ High performance computing
  * ✓ Dense data centers
  * ✓ Very large-enterprise core

Brocade MLXe

MLXe Layout
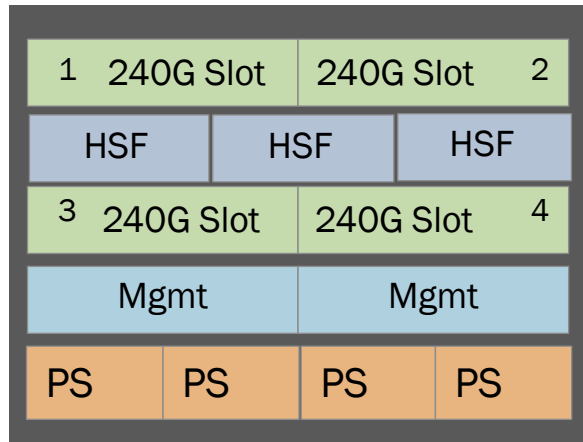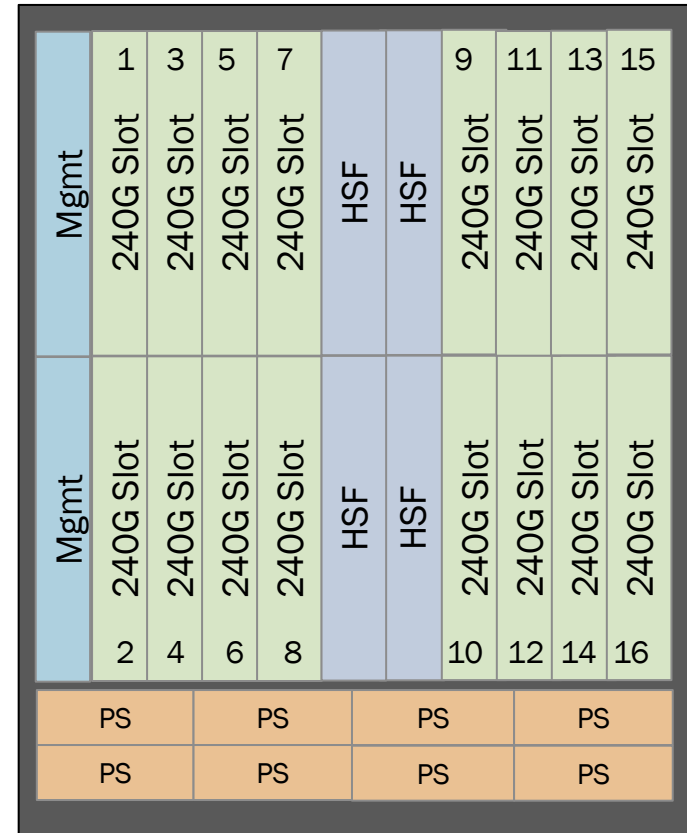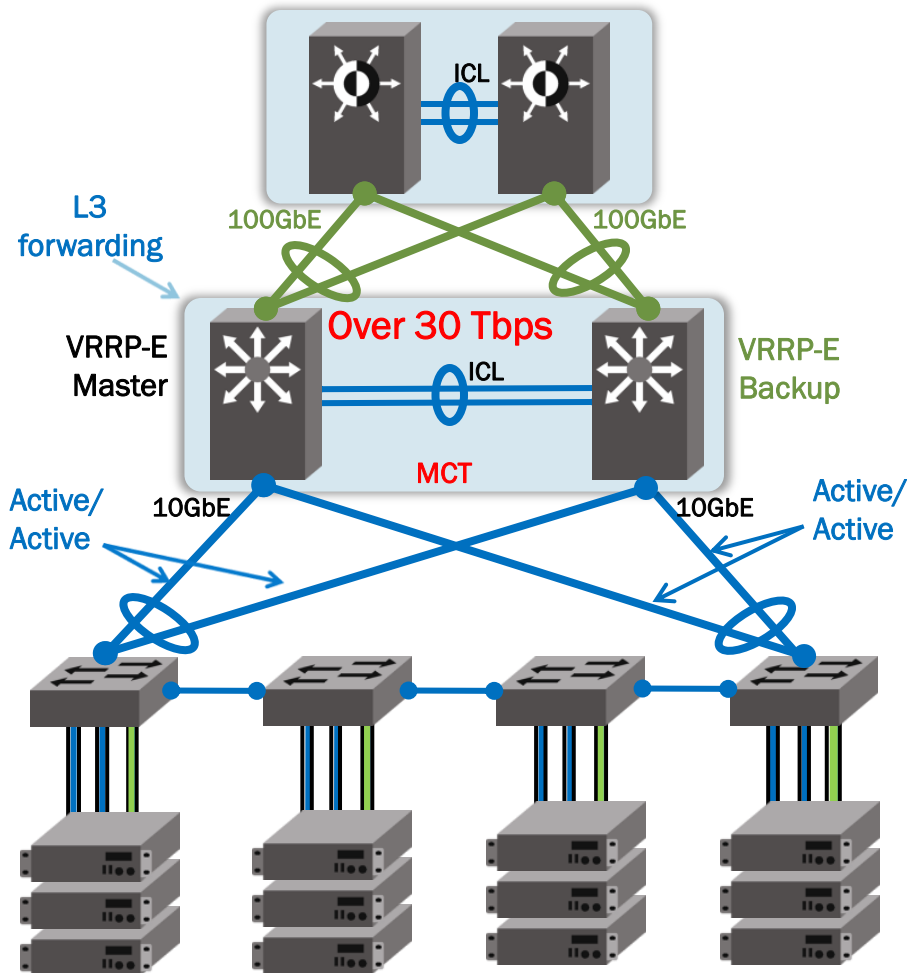

MLXe-4

MLXe-8

MLXe-16

Brocade MLXe Series

Simplified architecture & Operational Efficiency

- **All links active** (vs. active/ passive) and forwarding Layer 2/3 traffic

- **Highest resiliency** High resiliency: < 200ms link or node failover

- Over 30 Tbps switching capacity in Multi-Chassis for **investment protection**

- **32x100G wire-speed** ports for demanding networks

Brocade MLXe Series

Massively scalable Virtual Cluster Switching (VCS) Fabric

Over 30 Tbps Switching Capacity

ICL

MCT

↑ Layer 3
↓ Layer 2

Core

LAG   LAG

Brocade VCS

Access

Servers

| Standby
| Active
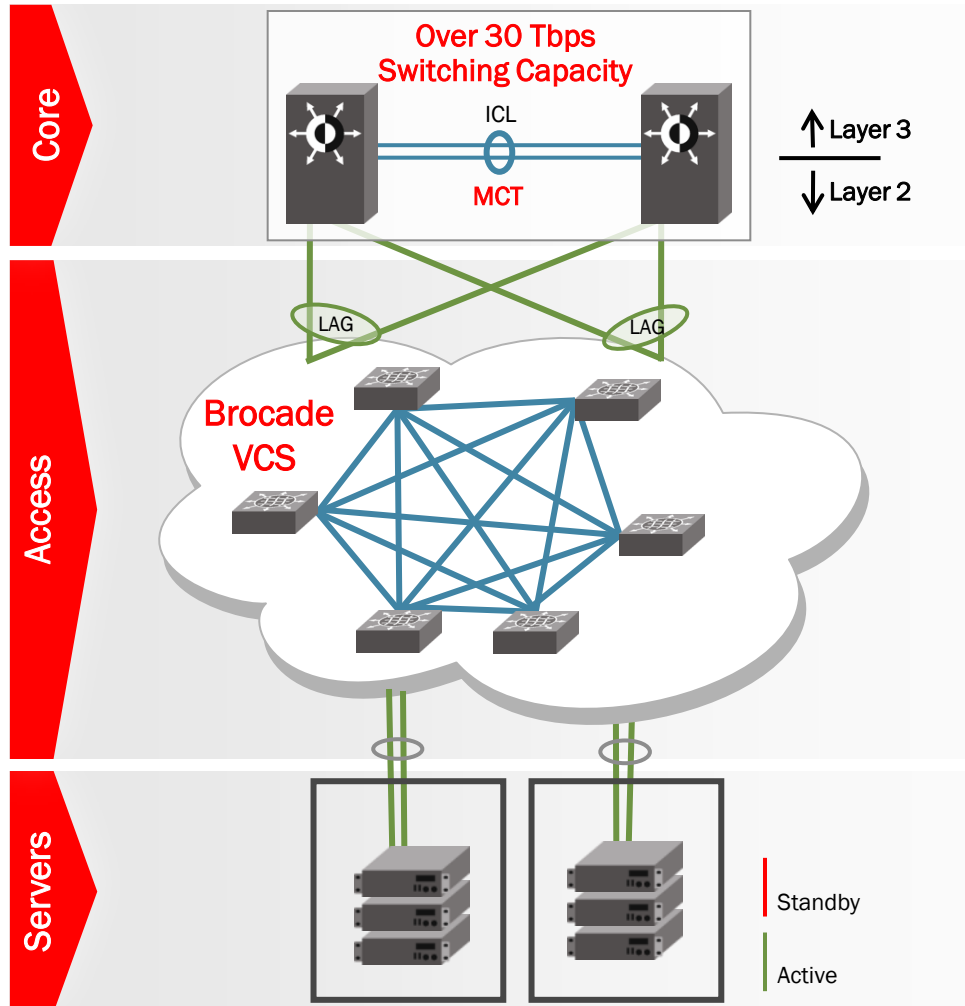
- **Easy to configure and manage**
  - Simplified architecture and scalable multipath Layer 2 domain
  - No Spanning Tree Protocol (STP) within Brocade VCS cloud or core
  - VM-aware infrastructure

- **Five times improvement**
  - Multipathing Layer 2 within Brocade VCS cloud and core

- **Two times improvement**
  - Full use of all network links

- **Investment protection**
  - Future-proof and convergence-ready DCB/FCoE architecture
  - Pay-as-you-grow model for server access

16 November 2010

Brocade MLXe Series

Collapsed VToR architecture with MLX-48T
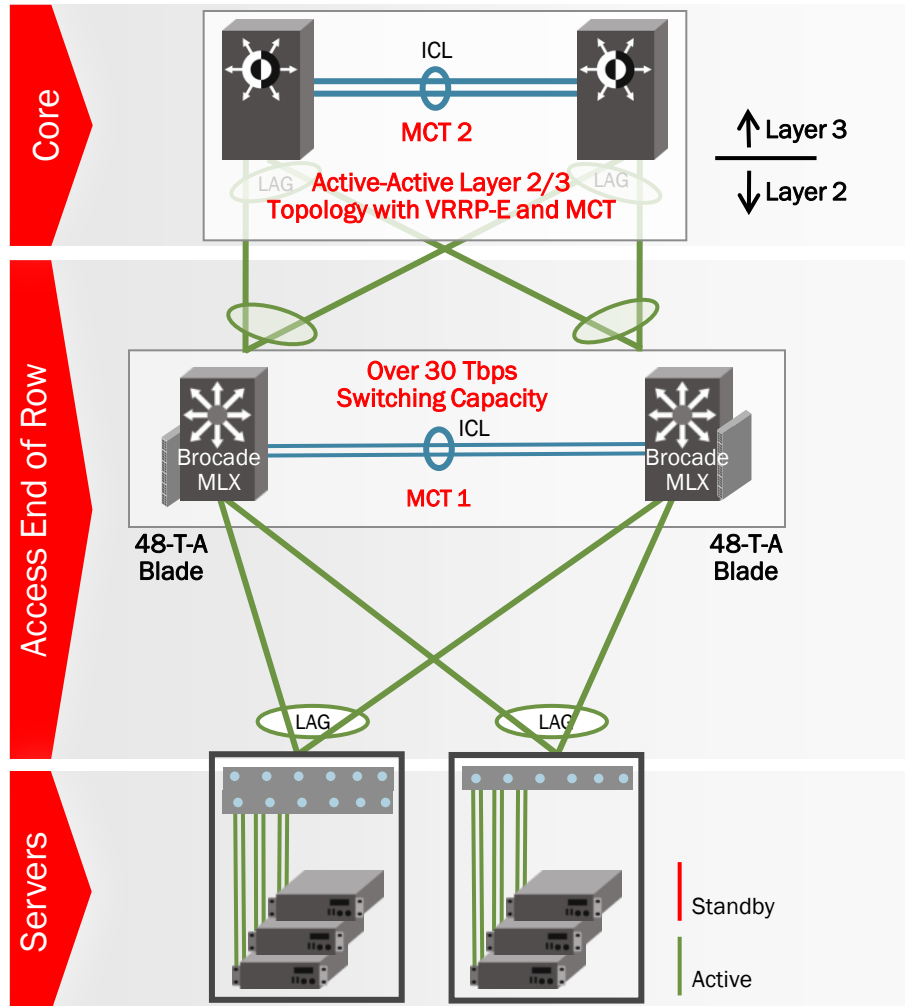
- ## Easy to configure and manage
  - Fewer network elements to manage
  - No STP from server to core
  - Single pane NMS

- ## Five times improvement
  - Deterministic sub-200 ms link and node failover from server to core
  - Collapsed access/aggregation for lower device failure and higher MTBF
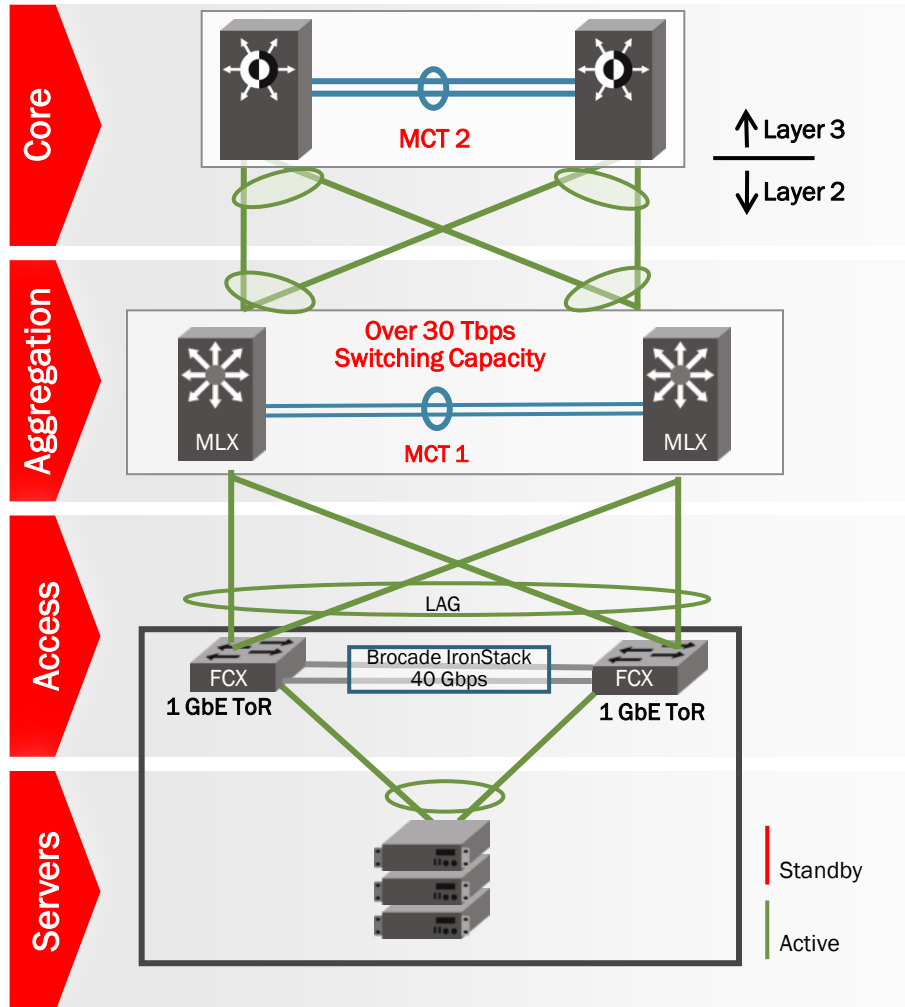
- ## Two times improvement
  - Active-active L2/3 topology with VRRP-E and MCT from server to core
  - Maximum VM mobility in IP hashing mode utilizing all links

- ## Investment protection
  - 1/10/100GbE scalable wire-speed connectivity options
  - 2 million MAC entries for large VM environments

Brocade MLXe Series

Extensible 1G FCX stack

Core
Aggregation
Access
Servers

MCT 2

↑ Layer 3
↓ Layer 2

Over 30 Tbps
Switching Capacity

MLX   MCT 1   MLX

LAG

FCX   Brocade IronStack
       40 Gbps   FCX
1 GbE ToR   1 GbE ToR

Standby
Active

- **Easy to configure and manage**
  - No STP from server to core
  - Single management of Brocade FCX

- **Five times improvement**
  - Deterministic sub-200 ms link and node failover from server to core
  - Hitless failover within the FCX stack

- **Two times improvement**
  - All links forward traffic from server to core
  - Over 30 Tbps switching capacity

- **Investment protection**
  - 1/10/100 GbE scalable wire-speed connectivity options
  - Compatible with third-party devices
  - Pay-as-you-grow model for server access

Brocade MLXe Series

Resilient 10G architecture with TI24/8000
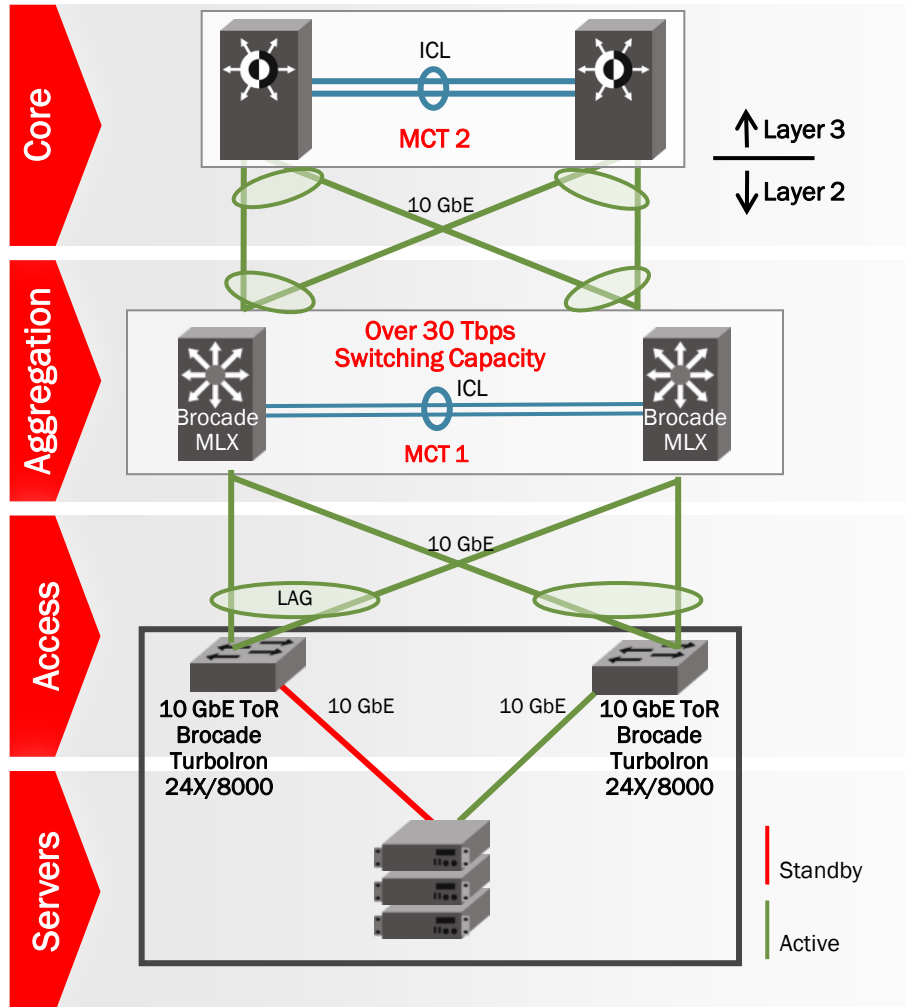

- **Easy to configure and manage**
  - No STP from access to core
  - Single pane NMS

- **Five times improvement**
  - Deterministic sub-200 ms link and node failover from access to core

- **Two times improvement**
  - All links forward traffic from access to core
  - Over 30 Tbps switching capacity
  - Non-blocking wire-speed 10 GbE

- **Investment protection**
  - 1/10/100 GbE scalable wire-speed connectivity options
  - Dual-speed 1/10 GbE with Brocade TurboIron
  - Server I/O consolidation FC and 10 GbE DCB/FCoE with Brocade 8000

Brocade MLXe Series

The Clear Choice

- **Unparalleled Scalability**
  - Uniquely differentiated offerings to fit multiple business needs
  - Flexible configuration options for more profitable services
  - Affordable Larger Scale Rollouts with reduced "interconnect tax"

- **Industry Leading Performance**
  - Highest density of line rate 1G & 100G interfaces
  - Line rate routing performance for both IPv4 and IPv6

- **Investment Protection**
  - Highly Programmable architecture that scales as you grow
  - Flexible migration paths to higher density configurations without forklifts
  - Simplified management. Virtualization ready.

- **Green**
  - Lowest energy cost per Gbps
  - Energy Efficient Front-to-Back airflow on highest density models

- **Lowest TCO**
  - Low CapEx and OpEx
  - Broad range of chassis sizes for deployment simplicity
  - Proven Reliability track record lowers risk

Winner

Brocade MLXe

NetIron MLX 48-T-A Overview

Product overview

- Dense 1 GbE interface module
- Used in data center aggregation, HPC clusters
- Ideal for end-of-row and middle-of-row data center aggregation architectures
- Aggregates thousands of servers and reduces multiple layers in the data center

Key differentiators

- Industry-leading 1 GbE capacity in a single router
- Lowest power draw per GbE port
- All the advanced capabilities of the NetIron MLX modules
- Advanced data center virtualization with multi-VRFs, VLANs, and MPLS/VPLS
- Advanced load balancing and resiliency at the data center access layer

Highlights

- 48-port 1 GbE interface module
  - Eight MRJ21 connectors
  - Six 1 GbE links per connector

- Part Number: NI-MLX-48-T-A

- Requires high-speed fan upgrade on NetIron MLX-16 (part # NIBI-16-FAN-EXH-A)

8x10GE-M Module

Market Segments	All
Benefits	High density 10G module for large scale network build-out; reduced CAPEX and OPEX
Platforms	MLX

Product Positioning

- High density wire-speed 10GE modules
- Leapfrog Cisco and Juniper to regain industry 10G leadership
  - 256 wire-speed 10GbE ports in a single MLX-32 router
- Significant investment protection – no forklift upgrades: Works on all MLX models

Hardware

- 8x10G-M
- New hSFM required

Competitive Differentiation:

- Industry leading 10G wire speed port density (256)
- Industry-leading power efficiency: < 31W per 10G port
- Converged Enhanced Ethernet (CEE) and H-QoS capable
- Extremely power efficient modules consuming ~42% less power consumption per 10GE than existing 4x10G
- Enhanced statistics for advanced services
- Deep buffers with Virtual Output Queues to accommodate large bursts (1GB per module)

Brocade FastIron CX Series Switches
Product highlights

- Highest PoE+ port density in a stackable design
  - Up to 48 PoE or 26 PoE+ ports in 1U
  - Up to 384 PoE or 208 PoE+ ports per stack
- Optimum flexibility and high availability
  - PoE+, non-PoE+ and 24 fiber ports models
  - All models support four 100/1000 MbE fiber uplinks
  - All models are field-upgradable to 2-port 10 GbE
  - Dedicated 64 Gbps stacking bandwidth (FDX)
  - Redundant, removable, load-sharing power supplies
  - Hot unit insertion/removal from the stack
  - Cross-unit link aggregation
  - Single IP management
- Advanced VoIP software features
  - Dynamic voice VLAN and QoS configuration
  - Dynamic power management through LLDP-MED
  - Robust security suite
  - sFlow for granular network traffic accounting
  - Support for variety of 802.3af and 802.3at devices
  - Support for full Layer 3 features and routing

Brocade Assurance
Limited Lifetime Warranty

Campus Access

Brocade FCX 624 and 648
## *Product highlights*

Data Center Access

- Purpose-built data center design
  - 24 or 48 10/100/1000 Mbps ports in a 1U form factor
  - Optional 4 ports of 10 GbE for high-speed uplinks
  - Optional 4 100/1000 Mbps fiber uplinks
  - Efficient SFP+ 10 GbE optics
- Optimal flexibility and reliability
  - Horizontal stacking to create one logical switch per row
  - Hot unit insertion/removal from the stack
  - Cross-unit link aggregation from the stack
  - Single-IP stack management
  - Dual removable and load-sharing power supplies
  - Reversible front-to-back airflow
  - Field replaceable fan unit with 4 redundant blowers
- Advanced software features
  - Robust and secure Brocade IronWare OS
  - sFlow for detailed network traffic accounting
  - Enterprise-class Layer 3 routing
  - Optional BGP routing
  - Network-wide management with Brocade IronView Network Manager

Brocade TurboIron 24X Switch
Product highlights
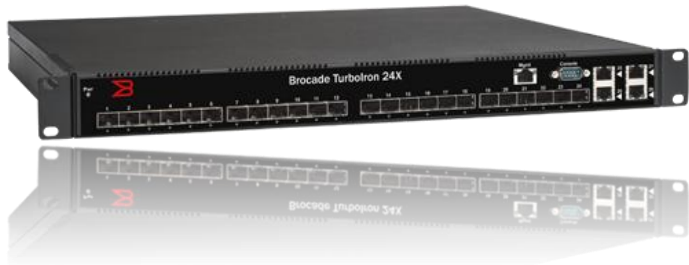
- Dual 10/1 GbE ToR and Aggregation
- 10 GbE HPCC and iSCSI SAN/NAS
- Blade Server Aggregation
- Collapsed Midmarket Aggregation and Core

Data center-class performance

- Data center modularization with 10 GbE Top-of-Rack (ToR) solution
- Up to 488 Gbps line rate, non-blocking performance
- Up to 24 10 GbE SFP+ ports in 1RU
- Cut-through architecture with ultra-low latency
- Front-to-back cooling

Greatest flexibility

- 24 1 GbE/10 GbE ports for seamless migration
- Four 10/100/1000 Mbps copper ports
- Redundant, removable, and load-sharing AC power supplies
- Hot-swappable triple-fan assembly

Advanced software features

- Advanced Layer 2/3 features
- Hardware-based security features and sub-second failover
- sFlow for detailed network traffic accounting

Operational efficiency

- Best-in-class power efficiency
- Rack space saving
- Brocade Assurance Limited Lifetime Warranty

# Brocade ServerIron ADX Application Delivery Controllers (ADCs)

How Did Brocade ADCs Become the Key to Virtual Server Provisioning?

- Leading performance and scalability
  - 70 Gbps Layer 4-7 throughput
  - 16 million Layer 4 transactions/sec
  - 120 million SYN attacks/sec DoS protection
  - 14 million DNS queries/sec
  - 320 Gbps switching

- Optimum flexibility
  - Fixed and chassis configurations with interchangeable modules

- Advanced functionality
  - Content switching and rewrite
  - Transparent cache switching
  - Hardware SSL acceleration
  - TCP/HTTP multiplexing
  - Multi-site redundancy using GSLB, FWLB
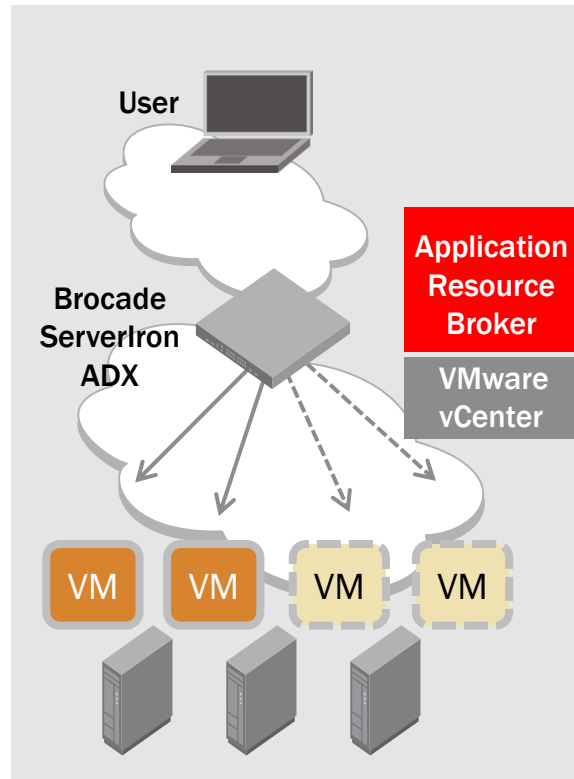 - VMware application provisioning
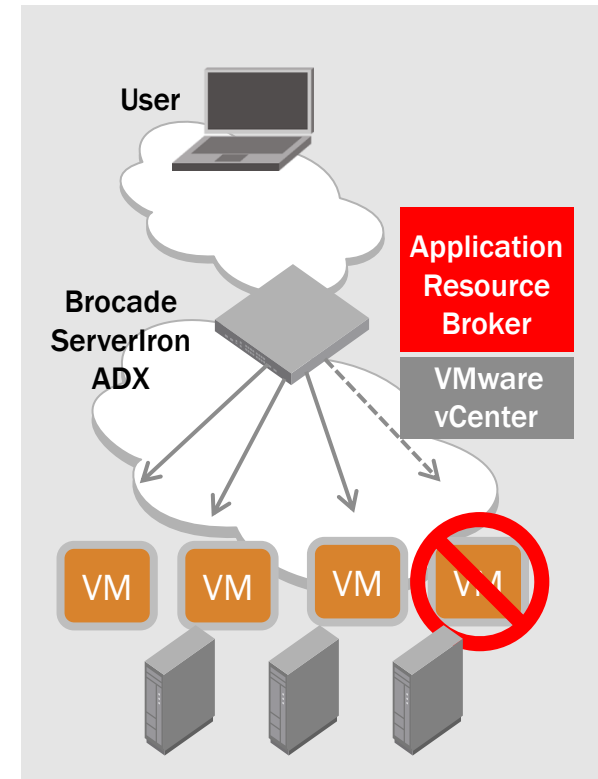
Brocade Application Resource Broker

Matching Data Center Capacity with End-User Demand in Real Time
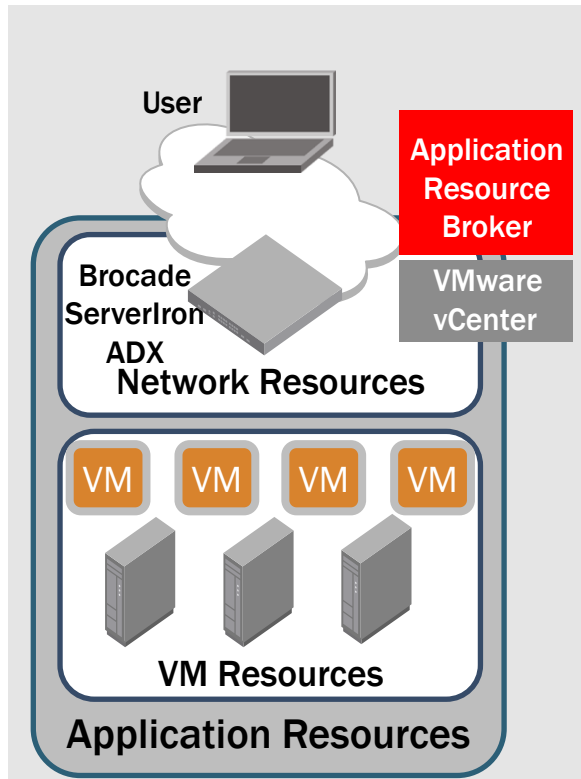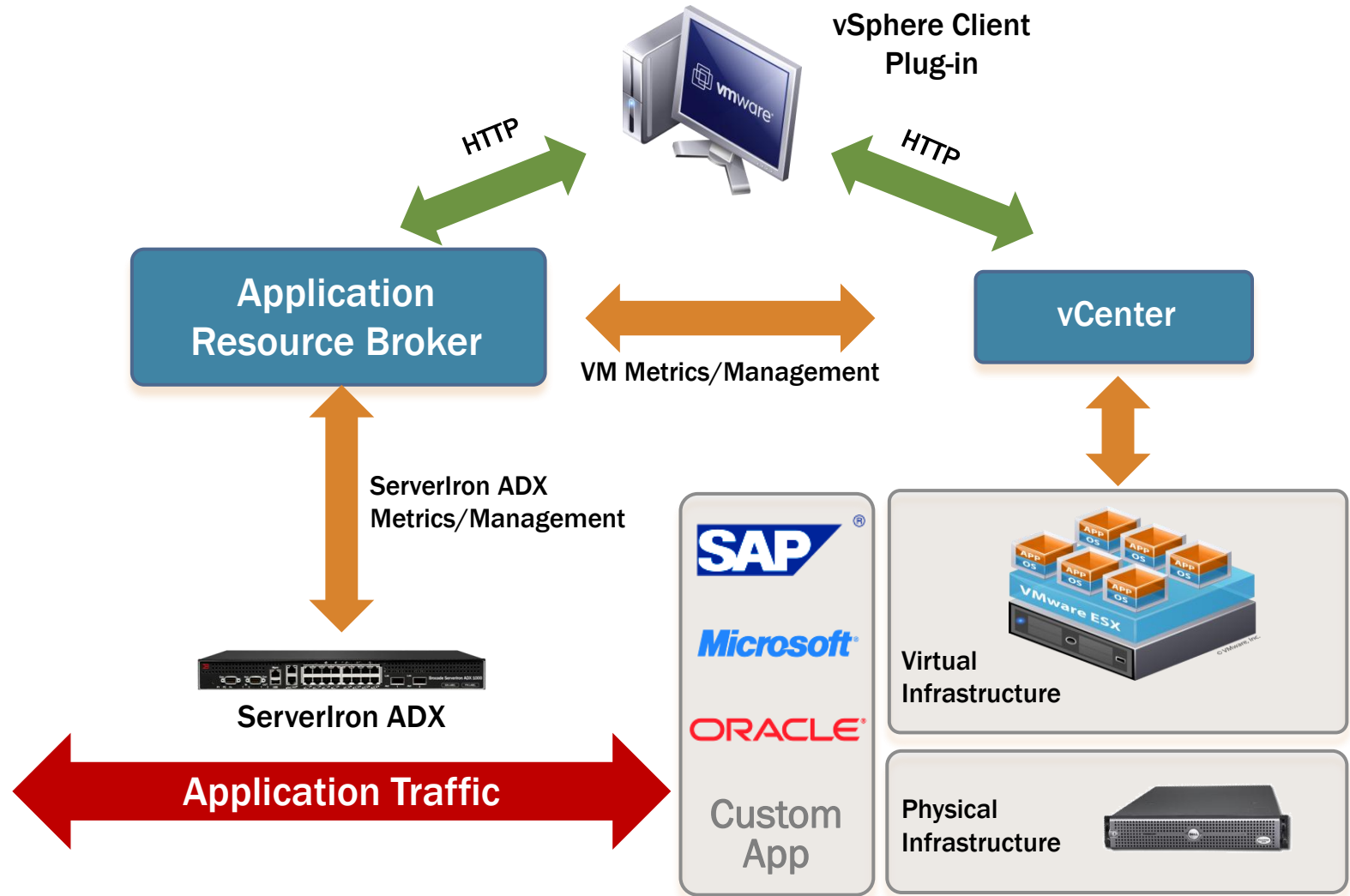

User Experience and VM Resource Monitoring

Resource Commissioning When Load Increases

Resource Decommissioning When Load Decreases

Brocade Application Resource Broker

Solution Architecture

vSphere Client Plug-in

HTTP

HTTP

Application Resource Broker

VM Metrics/Management

vCenter

ServerIron ADX Metrics/Management

ServerIron ADX

SAP

Microsoft

ORACLE

Custom App

Application Traffic

Virtual Infrastructure

VMware ESX

Physical Infrastructure

Brocade Network Advisor

End-to-End Service Orchestration with Leading Partner Products

- Open architecture with industry-standard APIs (SMI-S, Web Services, NETCONF, SNMP)

- Seamless integration with

  - Orchestration Frameworks

  - Security Partners

  - Service Delivery platforms

- VMware and Microsoft hypervisor plug-ins
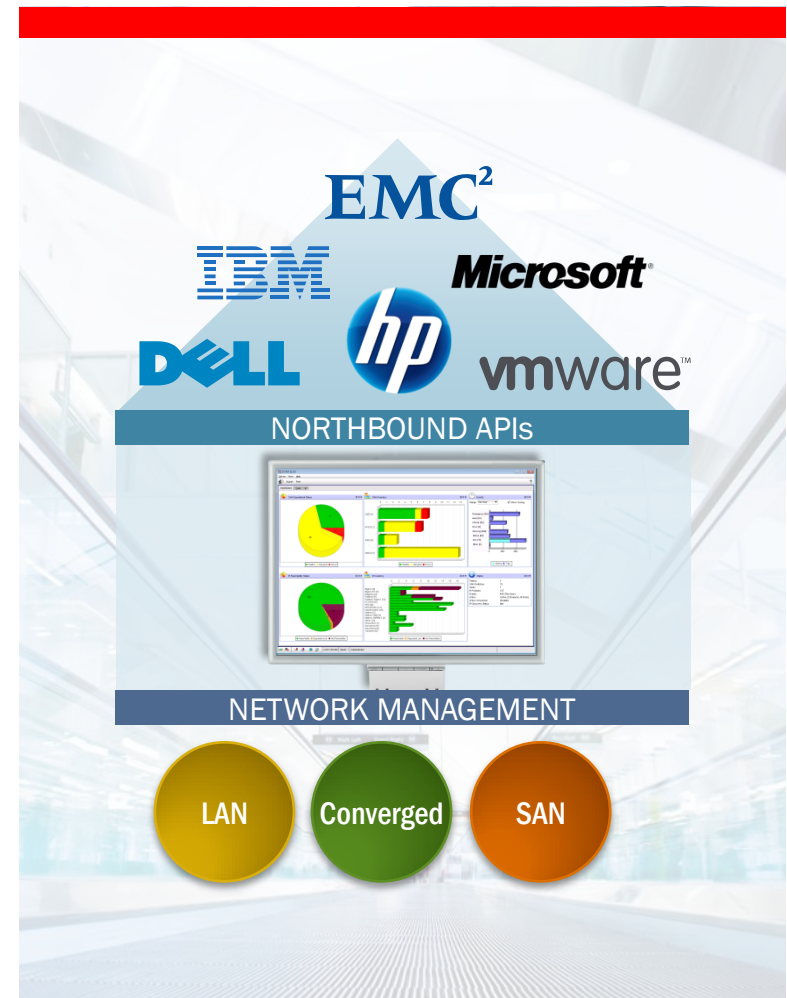
Brocade Network Advisor

Simplified Management for Data Center, Enterprise Campus and SP Networks

- Unified Network Management product for SAN, IP, Application Delivery, and Converged Networks

  - One management GUI across FC, IP/MPLS, FCoE protocols

  - Custom views based on Operator specialization

  - Flexible user management with Role Based Access Control

- Standards-based architecture

- Provides seamless integration with leading partner products