Next-Generation Datacenters solutions

The Software Defined Networking and Software Defined Datacenter era

XNet®
dátové komunikácie

X-NET SPOL. S R.O.

PREDSTAVENIE SPOLOČNOSTI

X-NET = Riešenia

X-NET je systémový integrátor zaoberajúci sa info-komunikačnými riešeniami s pridanou hodnotou a komplexnými službami v oblasti bezpečnosti sietí a informačných aktív, vrátane širokého portfólia produktov podporujúcich jednotlivé riešenia.
Spoločnosť zároveň poskytuje manažované služby, monitoring, cloud computing, kompletný outsourcing IT infraštruktúr, služieb a procesov.

Spoločnosť X-NET je certifikovaným partnerom Juniper Networks kategórie Select.

BUILD/RE-BUILD THE DATA CENTER

DÁTOVÉ CENTRUM

Dátové centrum je zariadenie používané na prevádzku počítačových systémov a súvisiacich komponentov, ako sú telekomunikácie a systémy pre ukladanie dát.
To všeobecne zahŕňa redundantné alebo záložné zdroje, redundantné dátové komunikačné spojenie, kontroly „životného“ prostredia (napr. klimatizácia, potlačenie požiaru) a bezpečnostné zariadenie.

Základné rozdelenie:

- interné – poskytujú služby pre vlastnú organizáciu
- externé – poskytujú služby pre externé subjekty

Služby:

- **Housing** - prenájom technologickej plochy s garantovanými parametrami
  - rack housing, prenájom priestoru na vlastný rack
  - server housing, teda prenájom priestoru v racku so zabezpečením nepretržitého napájania, chladenia a všetkých atribútov bezpečnosti
- **Cloud Computing** - prevádzka IT bez nákupu vlastného HardWare
  - **IaaS** (Infraštruktúra ako služba)
  - **PaaS** (Platforma ako služba)
  - **SaaS** (Softvér ako služba)
  - **Prevádzka dátových úložísk** – Storage (backup)

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PROGNÓZA

Gartner vyhlásil, že v IT prostredí je priemerný ročný nárast (Average Annual Growth Rate - AAGR)

10% v oblasti vyťaženia serverov
20% požiadavky na napájanie zariadení
35% zaťaženie siete

a až 50% tvorí nárast požiadaviek na úložné systémy (storage).

!!! ROČNÝ NÁRAST !!!

To je kladie veľké požiadavky na hľadanie optimálnych modelov fungovania najmä z dôvodu potreby úspory nákladov.

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RIEŠENIE

Riešenie ktoré je v súčasnosti ponúkané je budovanie tzv. „Cloud“ Data Centier.

- V oblasti sieťových technológií sa optimalizuje topológia (3-Tier -> 2-Tier), zjednocujú a virtualizujú sa sieťové elementy
- V oblasti správy sa automatizuje konfigurácia, jednotlivé sieťové elementy sa logicky zlučujú (napr. Virtual Chassiss), používa sa programovacie rozhranie (REST-API) na ovládanie
  Zavadzajú sa pojmy **Software Defined Networking**, **Automation** a **Orchestration**.
  - Automation helps eliminate repeatable manual tasks through scripts or other software tools
  - Orchestration is an extension of automation that groups automated tasks into coordinated workflows.

- V oblasti bezpečnosti sa virtualizuje a bezpečnostné pravidlá sú zviazané s virtuálnymi servermi (Micro-segmentation).

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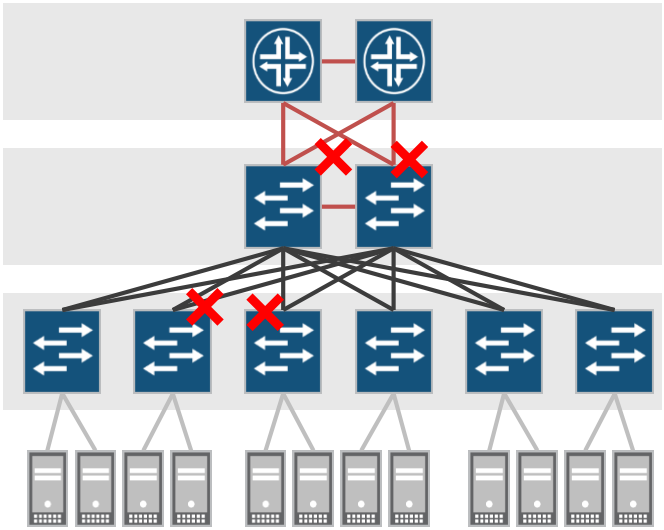
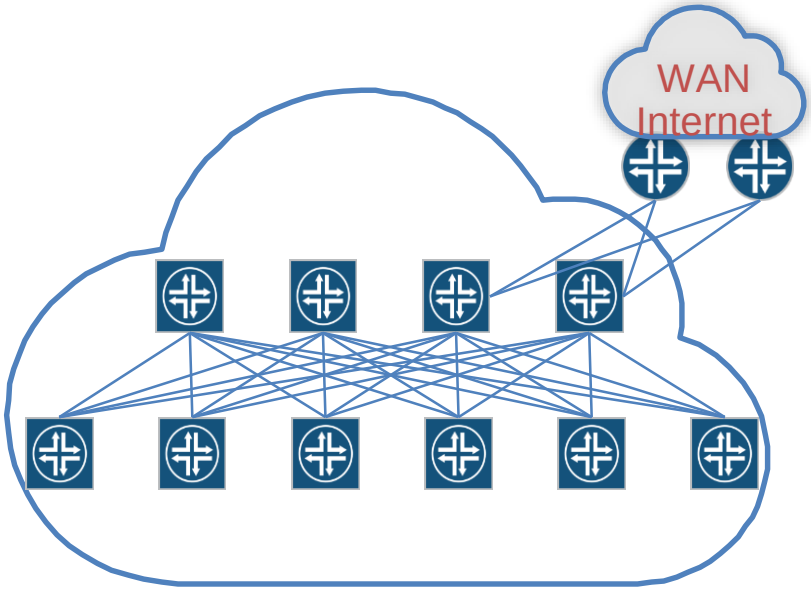
TOPOLÓGIA– NOVÝ 2 VRSTVOVÝ MODEL

Pôvodná Topológia– 3 vrstvový model



Nová Topológia– 2 vrstvový Spine-Leaf model



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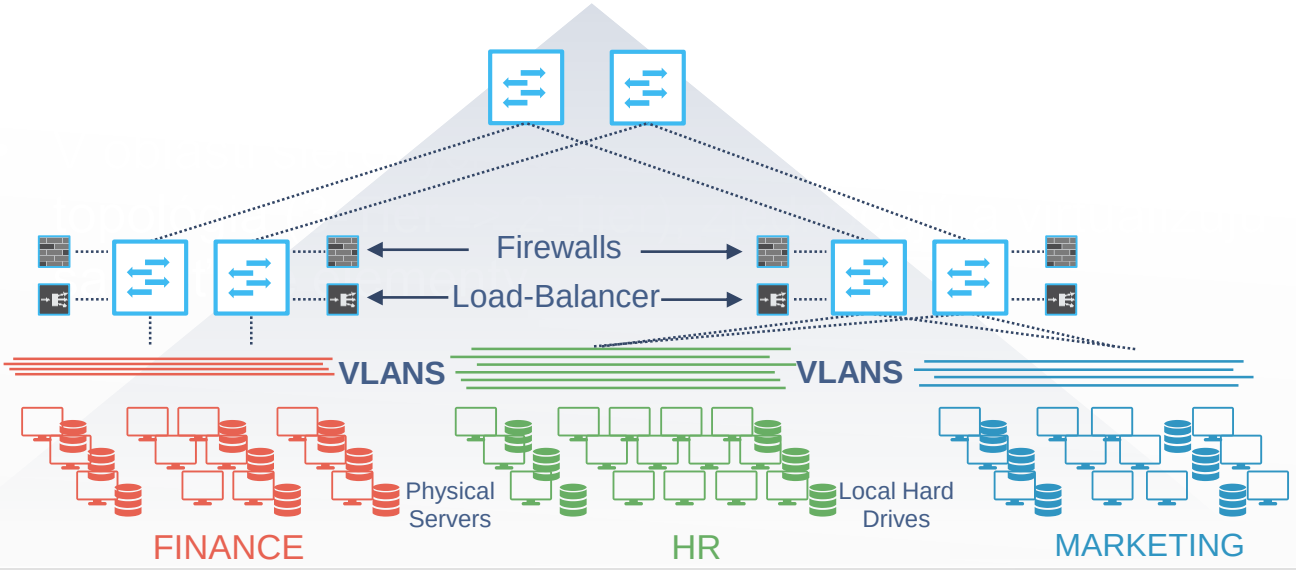
SÚČASNÝ „HW“ MODEL

- Zdroje sú oddelené
- Sieťové prostriedky sú fyzických zariadenia
- Správa a implementácia nie je automatizovaná
- Správa prostriedkov je decentralizovaná
- Bezpečnosť je riešená dodatočne



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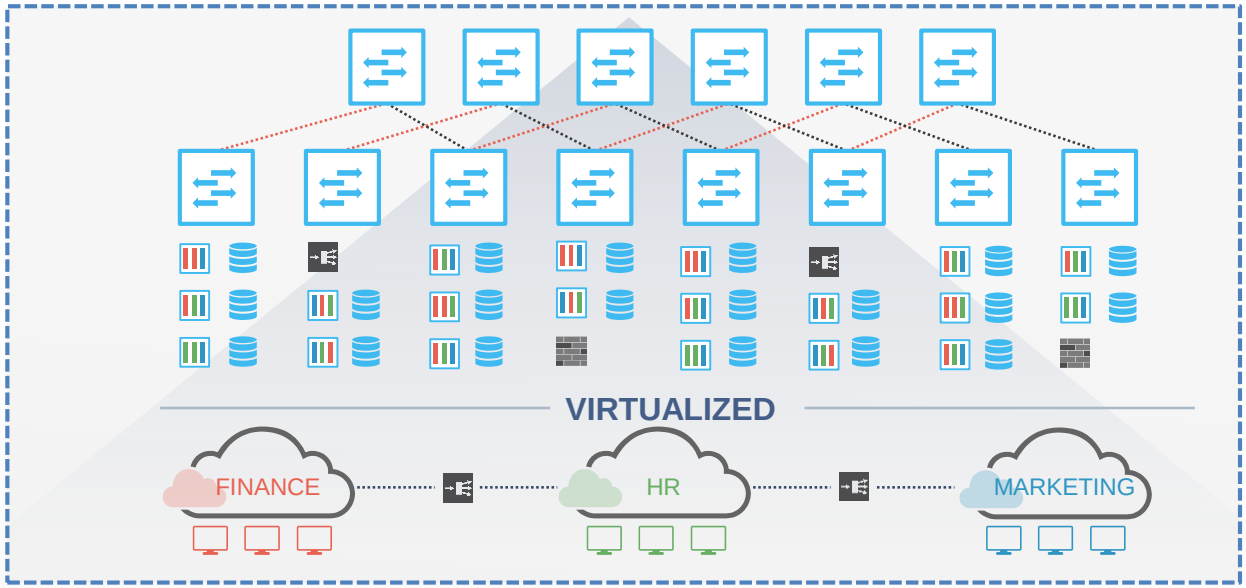
NOVÝ „CLOUD“ MODEL

- Zdroje sú zlučované do celkov
- Sieťové služby sú virtualizované a distribuované
- Presuny a zmeny sú plne automatizované
- Správa je plne automatizovaná
- Bezpečnosť je integrovaná



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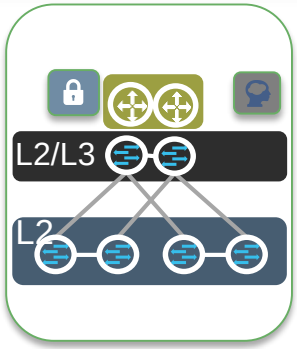
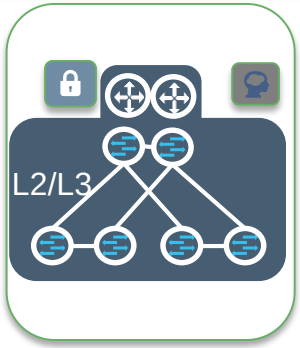
CLOUD NETWORKING ARCHITECTURES

Multi-Tier MC-LAG



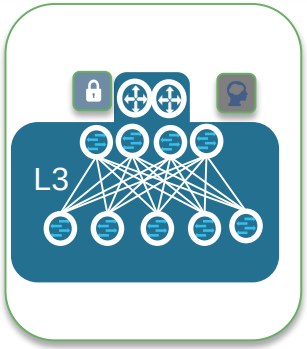
- VLAN anywhere
- MC-LAG
- MAC mobility
- Operational simplicity

Ethernet Fabric



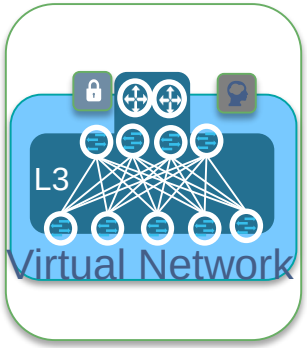
- L2 and L3 agnostic
- Centralized management
- Plug & play provisioning
- Integrated monitoring

IP Fabric



- Layer 3 Routing
- ECMP for load balancing
- No Layer 2 sprawl
- Extremely high scale

IP Fabric with Overlay



- IP underlay fabric
- VXLAN, EVPN, etc overlay
- Isolated data plane
- Emerging technologies

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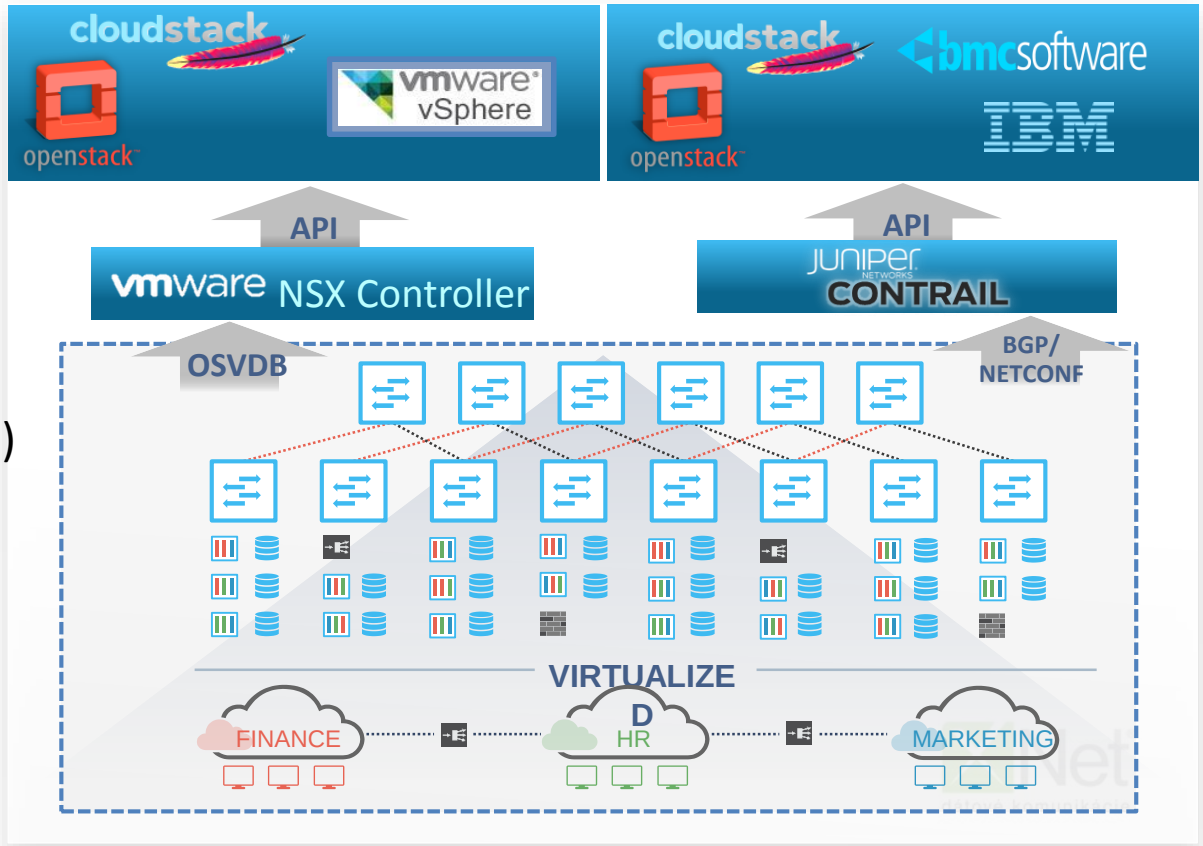
NOVÝ „CLOUD“ MODEL

V oblasti správy sa automatizuje konfigurácia, jednotlivé sieťové elementy sa logicky zlučujú (napr. Virtual Chassiss), používa sa pogramovacie rozhranie (API) na ovládanie

Základné komponenty sú:

- fyzické zariadenia
  - servery
  - storage
  - sieťové prvky
- fyzické prepojenia
- protokoly (logické prepojenia)
- automatizácia (API)
- riadenie (Orchestration Controller)



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NETWORK VIRTUALIZATION (NV)

Network virtualization (NV) products enable customers to create logical, virtual networks that can be managed regardless of the underlying networking hardware used.
This is known as “disaggregation” where the network control function is abstracted to software that does not necessarily have to be integrated with networking hardware hardware.

The concept of virtualization started in the data center or “cloud” boom in the server world, when cloud providers needed a way to split up the computing power of servers with software, to be used by different users. NV takes the concept to the networking world, so that connectivity can be sliced up into virtual networks and services using software.

The services that can be delivered on a virtual network include L2 and L3 services like switching and routing, as well as L4-7 services including firewalls, server load-balancing, and virtual private networks.
One of the main advantages of NV products is they enable more centralized control over networks.

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DATA CENTER INTERCONNECT

CLOS NETWORK

A Clos network is a type of non-blocking, multistage switching architecture that reduces the number of ports required in an interconnected fabric.

Clos networks are named after Bell Labs researcher Charles Clos, who proposed the model in 1952 as a way to overcome the performance- and cost-related challenges of electromechanical switches then used in telephone networks. Clos used mathematical theory to prove that achieving non-blocking performance in a "switching array" (now known as a fabric) was possible if the switches were organized in a hierarchy. Prior to Clos' discovery, engineers trying to achieve any-to-any connectivity with non-blocking performance required them to design networks in which the number of crosspoints -- electromechanical relay mechanisms in cross-bar switches -- had to equal the number of inputs multiplied by the number of outputs (known as n-squared).

Although electromechanical switching has given way to newer switching technologies, Clos networks have resurfaced in the design of high-performance switches in data center fabrics because of the efficiency gains they offer. In a modern context, a Clos network provides non-blocking performance in an interconnected Ethernet switch fabric without the need for n-squared ports.

DATA CENTER INTERCONNECT

CLOS NETWORK

Transparent Interconnect of Lots of Links (TRILL) is a layer-2 data center protocol that creates flat networks on top of a layer-3 routed network for the purposes of simplified server networking. TRILL allow for multiple paths to be used in a redundant Clos Network architecture and removes the need for spanning tree protocol and its blocked alternative links.
Many vendors have implemented their own versions of TRILL.

Cisco's implementation of FabricPath is an extension of the TRILL standard. Cisco data center switches like Nexus 7000 switches are connected in a Clos network to Nexus 5000 and/or Nexus 2000 switches and FabricPath can be run within that data center and to connect to other data centers.

Juniper's QFabric System is actually not TRILL-based, but instead utilizes an interior fabric protocol developed by Juniper that is based on IEEE RFC1142, otherwise known as the IS-IS routing protocol. QFabric Nodes are interconnected to form a fabric that can utilize multiple redundant uplinks for greater performance and reliability.

Brocade Virtual Cluster Switching (VCS) Fabric is their implementation of the TRILL standard that allows for a Clos network topology to utilize multiple link.

Arista Spline architecture where the terms leaf and spine are combined into a new word that represents a collapsed architecture that uses a single tier.

DATA CENTER INTERCONNECT

JUNIPER OPENCLOS

OpenClos is a Python script library that helps you automate the design, deployment, and maintenance of a Layer 3 IP fabric built on Border Gateway Protocol (BGP).

To create an IP fabric that uses a spine and leaf architecture, the script generates configuration files for the devices in the fabric and uses zero-touch provisioning (ZTP) to push the configuration files to the devices. You can tailor the IP fabric to your network environment by adjusting values in the template files that are associated with the script.

When you execute the script, it automatically generates values for the following device configuration settings within the IP fabric:

- **Interface Assignments**
  - IP addressing
  - Loopback addressing
  - Subnet masks and prefixes
  - Point-to-point (PTP) links
  - Server VLAN ID
  - Integrated routing and bridging (IRB) interface assignment
- **Control Plane**
  - BGP autonomous system numbers (ASN)
  - BGP import policy
  - BGP export policy
  - BGP peer group design
  - BGP next-hop self
- **High Availability**
  - Bidirectional Forwarding Detection (BFD) intervals
  - BFD multipliers
  - Ethernet operations, administration, and management (OAM)

https://github.com/Juniper/OpenClos

DATA CENTER INTERCONNECT

SPINE-AND-LEAF ARCHITECTURE

With Layer 2 segments extended across all the pods, the data center administrator can create a central, more flexible resource pool that can be reallocated based on needs. Servers are virtualized into sets of virtual machines that can move freely from server to server without the need to change their operating parameters.

With virtualized servers, applications are increasingly deployed in a distributed fashion, which leads to increased east-west traffic. This traffic needs to be handled efficiently, with low and predictable latency. However, vPC can provide only two active parallel uplinks, and so bandwidth becomes a bottleneck in a three-tier data center architecture. Another challenge in a three-tier architecture is that server-to-server latency varies depending on the traffic path used.

A new data center design called the Clos network–based spine-and-leaf architecture was developed to overcome these limitations. This architecture has been proven to deliver the high-bandwidth, low-latency, nonblocking server-to-server connectivity.

Spine-and-Leaf Architecture

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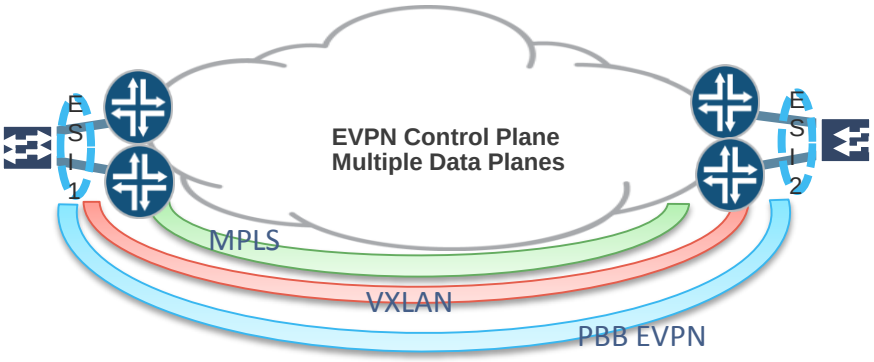
DATA CENTER INTERCONNECT

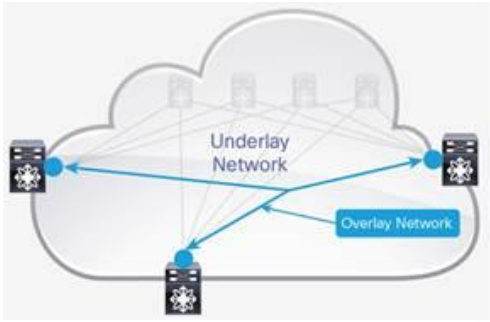
OVERLAY NETWORK

Modern virtualized data center fabrics must meet certain requirements to accelerate application deployment and support DevOps needs. For example, fabrics need to support scaling of forwarding tables, scaling of network segments, Layer 2 segment extension, virtual device mobility, forwarding path optimization, and virtualized networks for multitenant support on shared physical infrastructure.

Interest in overlay networks has also increased with the introduction of new encapsulation frame formats specifically built for the data center.
These formats include Virtual Extensible LAN (VXLAN), Network Virtualization Using Generic Routing Encapsulation (NVGRE), Transparent Interconnection of Lots of Links (TRILL), and Location/Identifier Separation Protocol (LISP).

Network overlays are virtual networks of interconnected nodes that share an underlying physical network, allowing deployment of applications that require specific network topologies without the need to modify the underlying network





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DATA CENTER INTERCONNECT

DATA CENTER GLOSSARY

Fabric - Interconnection of network nodes using one or more network switches that function as a single logical entity.

Control plane - Virtual network path used to set up, maintain, and terminate data plane connections.

Data plane - Virtual network path used to distribute data between nodes.

Data center bridging - DCB. Set of IEEE specifications that enhances the Ethernet standard to enable it to support converged Ethernet (LAN) and Fibre Channel (SAN) traffic on one Ethernet network.
DCB features include priority-based flow control (PFC), enhanced transmission selection (ETS), Data Center Bridging Capability Exchange protocol (DCBX), quantized congestion notification (QCN).

Data Center Bridging Capability Exchange protocol - DCBX. Discovery and exchange protocol for conveying configuration and capabilities among neighbors to ensure consistent configuration across the network. It is an extension of the Link Layer Data.

Ethernet VPN - EVPN. Type of VPN that enables you to connect a group of dispersed customer sites by using a Layer 2 virtual bridge. As with other types of VPNs, an EVPN comprises customer edge (CE) devices (routers or switches) connected to provider edge (PE) devices. The PE devices can include an MPLS edge switch that acts at the edge of the MPLS infrastructure.

VXLAN - Virtual Extensible LAN. A network virtualization protocol defined in RFC 7348 for running an overlay network on a Layer 3 infrastructure in order to connect multiple Layer 2 networks across Layer 3 connections.

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DATA CENTER INTERCONNECT

DATA CENTER GLOSSARY

VPLS (virtual private LAN service), offers a “switch in the cloud” style service. VPLS provides the ability to span VLANs between sites.

Virtual Extensible LAN (VXLAN) is a network virtualization technology that attempts to improve the scalability problems associated with large cloud computing deployments. It uses a VLAN-like encapsulation technique to encapsulate MAC-based OSI layer 2 Ethernet frames within layer 4 UDP packets. VXLAN endpoints, which terminate VXLAN tunnels and may be both virtual or physical switch ports, are known as VXLAN tunnel endpoints (VTEPs).

VXLAN is an evolution of efforts to standardize on an overlay encapsulation protocol. It increases scalability up to 16 million logical networks and allows for layer 2 adjacency across IP networks. Multicast or unicast with HER (Head-End Replication) is used to flood BUM (broadcast, unknown destination address, multicast) traffic.

The VXLAN specification was originally created by VMware, Arista Networks and Cisco. Other backers of the VXLAN technology include Huawei, Broadcom, Citrix, Pica8, Cumulus Networks, Dell, Mellanox, FreeBSD, OpenBSD, Red Hat, Joyent, and Juniper Networks.

VXLAN was officially documented by the IETF in RFC 7348.

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VXLAN ENCAPSULATION FORMAT

VXLAN flood-and-learn technology complies with the IETF VXLAN standards (RFC 7348), which defined a multicast-based flood-and-learn VXLAN without a control plane. The original Layer 2 frame is encapsulated with a VXLAN header and then placed in a UDP-IP packet and transported across an IP network.

Underlay Network

The VXLAN flood-and-learn spine-and-leaf network uses Layer 3 IP for the underlay network. Underlay IP multicast is used to reduce the flooding scope of the set of hosts that are participating in the VXLAN segment. Each VXLAN segment has a VXLAN network identifier (VNID), and the VNID is mapped to an IP multicast group in the transport IP network. Each VTEP device is independently configured with this multicast group and participates in PIM routing. The multicast distribution tree for this group is built through the transport network based on the locations of participating VTEPs. The requirement to enable multicast capabilities in the underlay network presents a challenge to some organizations because they do not want to enable multicast in their data centers or WANs.

Overlay Network

The VXLAN flood-and-learn spine-and-leaf network doesn’t have a control plane for the overlay network. The Layer 2 overlay network is created on top of the Layer 3 IP underlay network by using the VTEP tunneling mechanism to transport Layer 2 packets. The overlay network uses flood-and-learn semantics.

DATA CENTER INTERCONNECT

LAYER 3 FABRICS

Most enterprises that host data centers are looking to increase resiliency and also support new technologies such as VMware NSX that allow them to deploy applications, servers, and virtual networks within seconds.

Layer 3 Fabrics allow them to support better uptime, performance, and newer cloud infrastructures such as VMware NSX. In order to maintain the large scale required to host thousands of servers, the use of a multi-stage Clos architecture is required.
Such an architecture allows the physical network to scale beyond the port density of a single switch.

The most common designs in a multi-stage Clos architecture are a 3-stage and 5-stage network. A Layer 3 Fabric uses Layer 3 protocols and multi-stage Clos architecture to achieve this. This enables the physical network to scale beyond the port density of a single switch.

The most common designs for a multi-stage Clos architecture are 3-stage and 5-stage networks that use the spine-and-leaf topology. Layer 3 Fabrics use BGP as the control plane protocol to advertise prefixes, perform traffic engineering, and tag traffic

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DATA CENTER INTERCONNECT

VXLAN MP-BGP EVPN

VXLAN flood-and-learn technology complies with the IETF VXLAN standards (RFC 7348), which defined a multicast-based flood-and-learn VXLAN without a control plane. The original Layer 2 frame is encapsulated with a VXLAN header and then placed in a UDP-IP packet and transported across an IP network.

To overcome the limitations of flood-and-learn VXLAN, VXLAN MP-BGP EVPN spine-and-leaf architecture uses Multiprotocol Border Gateway Protocol Ethernet Virtual Private Network, or MP-BGP EVPN, as the control plane for VXLAN. This technology provides control-plane and data-plane separation and a unified control plane for both Layer 2 and Layer 3 forwarding in a VXLAN overlay network.

Underlay Network

The VXLAN MP-BGP EVPN spine-and-leaf architecture uses Layer 3 IP for the underlay network.

Overlay Network

The VXLAN MP-BGP EVPN spine-and-leaf architecture uses MP-BGP EVPN for the control plane for the VXLAN overlay network.

https://www.juniper.net/techpubs/en_US/junos16.1/topics/topic-map/sdn-vxlan.html

http://www.cisco.com/c/en/us/products/collateral/switches/nexus-7000-series-switches/white-paper-c11-737022.html

DATA CENTER INTERCONNECT

TYPES OF LAYER 2 MPLS VPNS

BGP-based

The BGP-based type is based on a draft specification by Kireeti Kompella, from Juniper Networks. It uses the Border Gateway Protocol (BGP) as the mechanism for PE routers to communicate with each other about their customer connections. Each router connects to a central cloud, using BGP. This means that when new customers are added (usually to new routers), the existing routers will communicate with each other, via BGP, and automatically add the new customers to the service.

LDP-based

The second type is based on a draft specification by Chandan Mishra from Cisco Systems. This method is also known as a Layer 2 circuit. It uses the Label Distribution Protocol (LDP) to communicate between PE routers. In this case, every LDP-speaking router will exchange FECs (forwarding equivalence classes) and establish LSPs with every other LDP-speaking router on the network (or just the other PE router, in the case when LDP is tunnelled over RSVP-TE), which differs from the BGP-based methodology. The LDP-based style of layer 2 VPN defines new TLVs and parameters for LDP to aid in the signaling of the VPNs.

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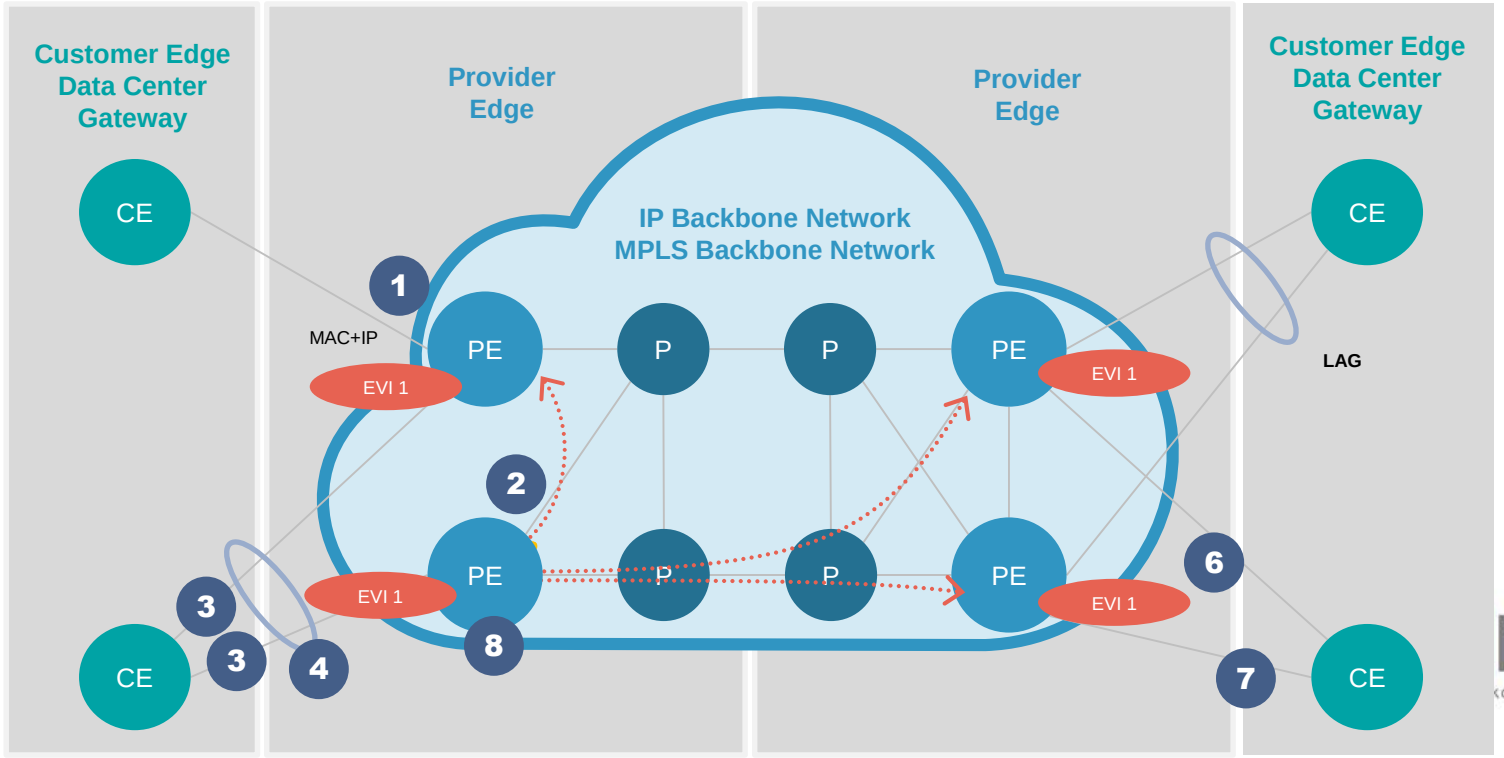
DATA CENTER INTERCONNECT

EVPN CONCEPTS

1. **Data Plane Learning**
   Dynamic or Static (Provisioned)
2. **Control Plane Learning**
   PEs Advertise MAC addresses and Next Hops from connected CEs using MP-BGP
3. **Ethernet Segment Identifier (ESI)**
   Unique to all links that connect CE to PE
4. **All-Active Redundancy Mode**
   Multi-homed, Multiple Active PEs
5. **Ethernet Tag**
   Broadcast Domain (VLAN) for EVPN
6. **EVPN Instance (EVI)**
   Identifies a VPN
7. **Single-Active Redundancy Mode**
   Multi-homed, One Active PE
8. **MAC-VRF**
   Virtual Routing & Forwarding table for MAC addresses on PEs per EVI



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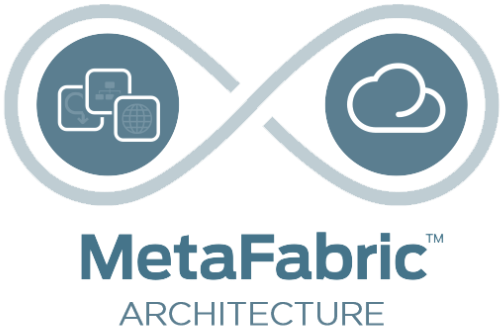
METAFABRIC ARCHITECTURE



The Juniper architecture for next-generation data centers that simplifies and accelerates the deployment and delivery of applications within and across multiple data center locations.

MetaFabric creates coherent networks within and between data centers by providing:

- Architecture that is tailored to the needs of the network
- Validated designs to use as a starting point
- Flexible building blocks
- Simplified management and orchestration
- Open architecture that allows integration of third party vendors

With MetaFabric, costs go down while agility and flexibility go up, and top notch security is integrated into the network. Network services are virtualized and distributed, and changes to the network are automated for greatest efficiency and minimized impact on business. Best of all, interoperability and scalability are ensured.

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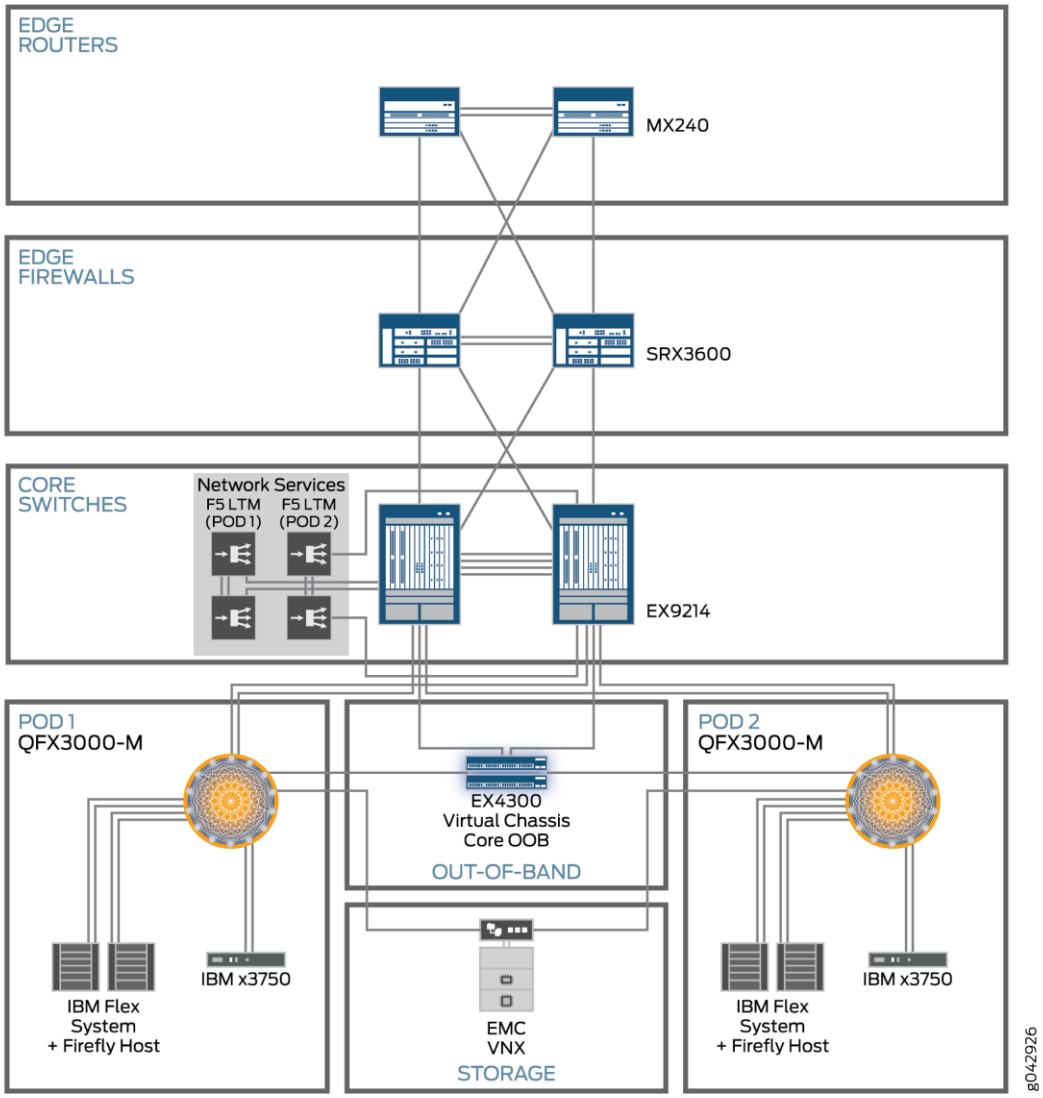
BUILD/RE-BUILD THE DATA CENTER

METAFABRIC ARCHITECTURE 1.0



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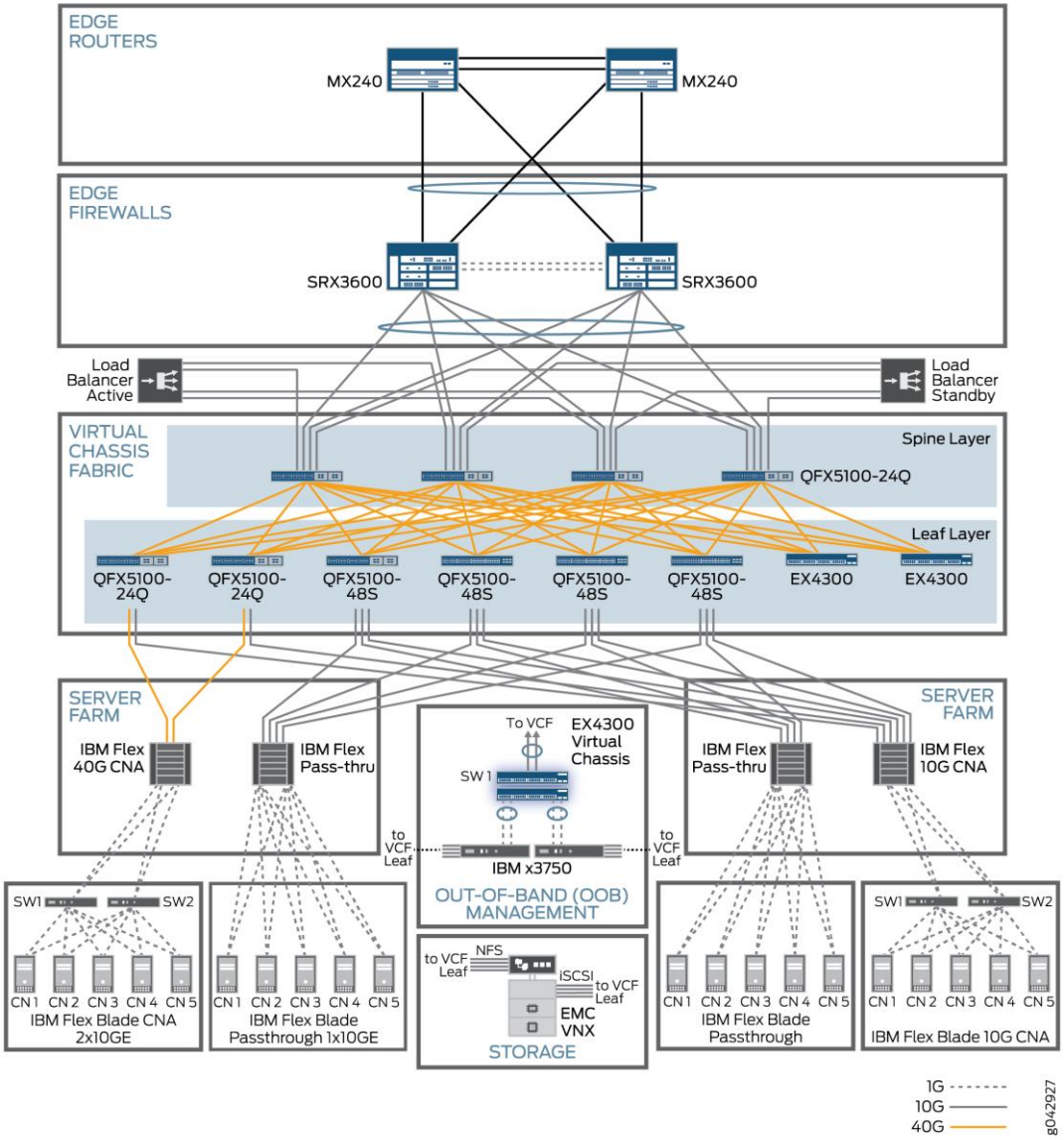
METAFABRIC ARCHITECTURE 1.1



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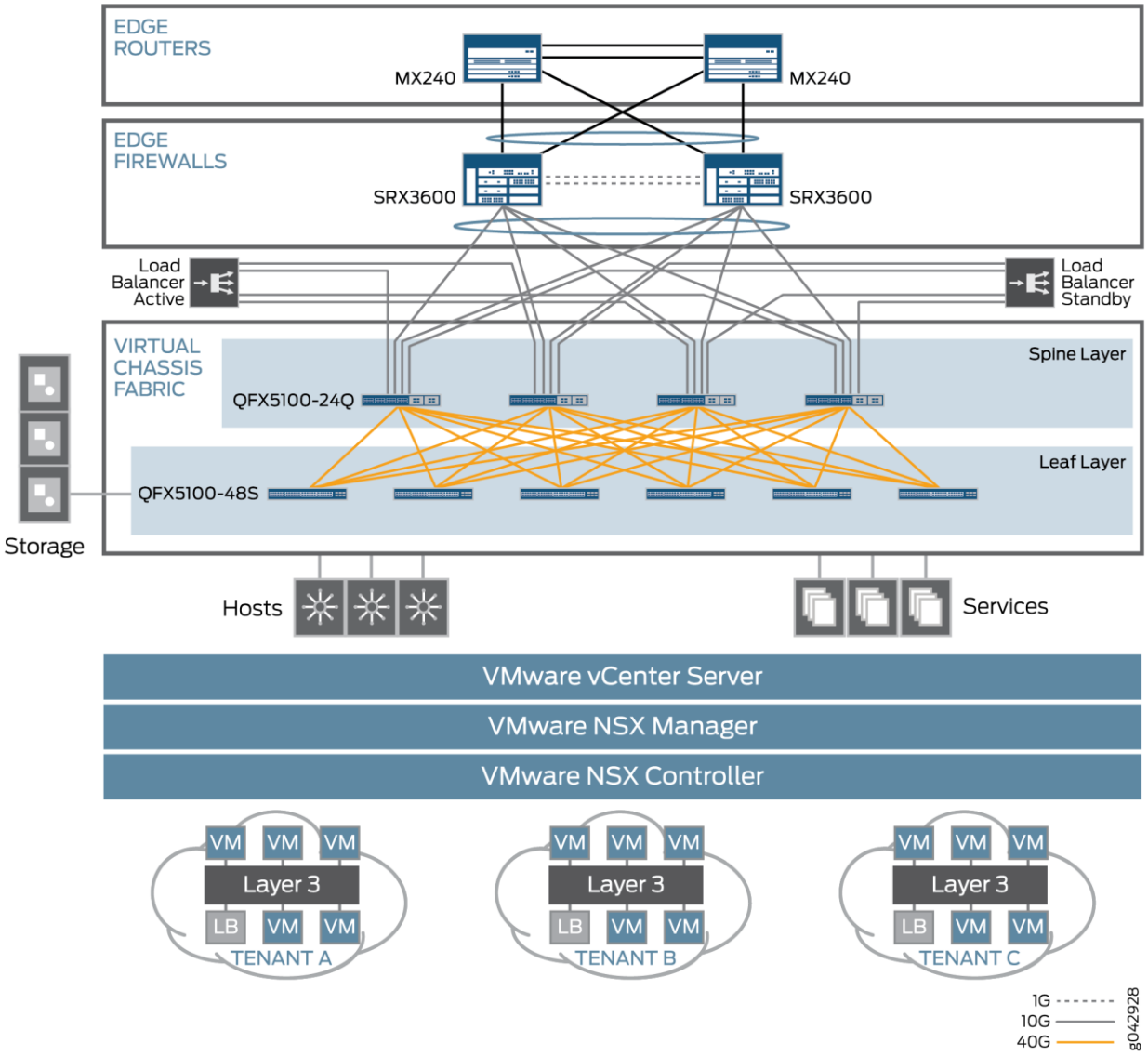
METAFABRIC ARCHITECTURE 2.0



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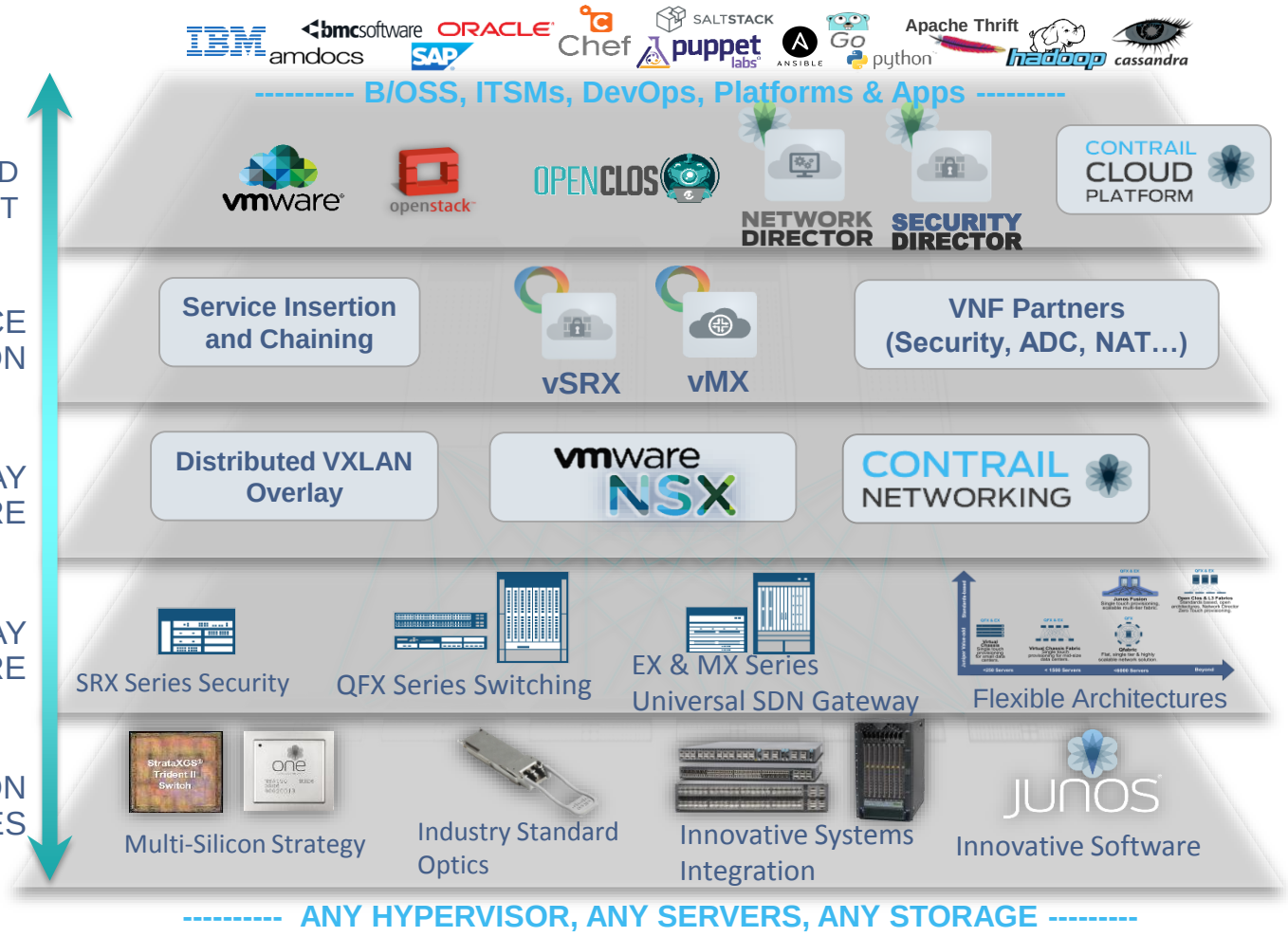
BUILD/RE-BUILD THE DATA CENTER

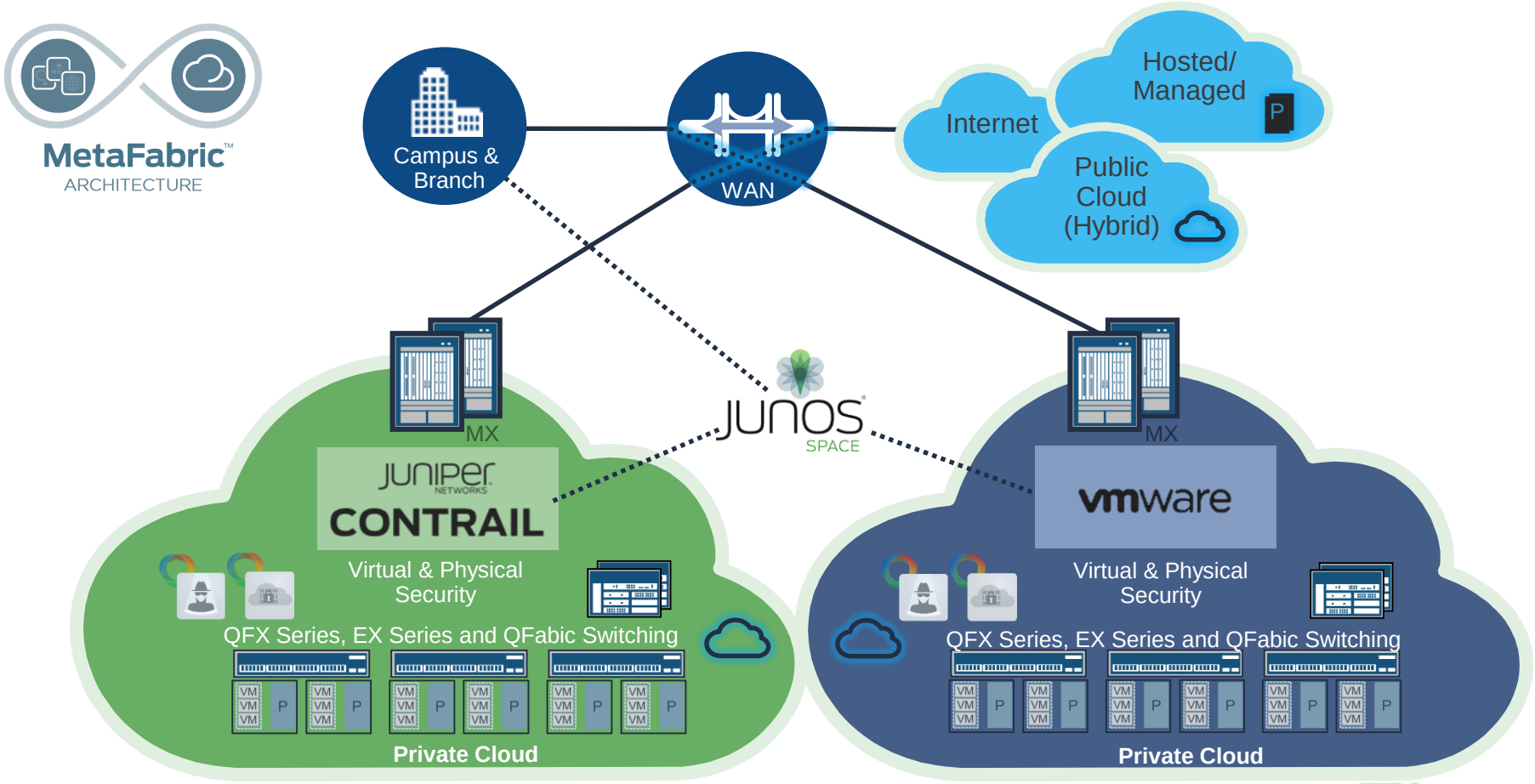
METAFABRIC: THE BEST OVERLAY FOR ANY UNDERLAY, THE BEST UNDERLAY FOR ANY OVERLAY

MetaFabric™ ARCHITECTURE



BUILD/RE-BUILD THE DATA CENTER

MULTI-DATA CENTER, MULTI-CLOUD, ONE NETWORK



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DATA CENTER INTERCONNECT

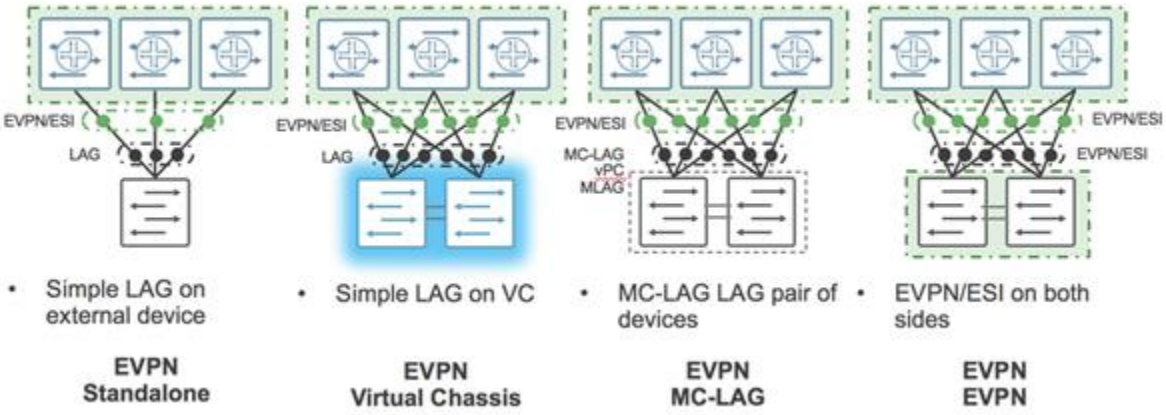
MC-LAG IS DEAD, LONG LIVE EVPN MULTI-HOMING

“How can I configure MC-LAG with EVPN to provide multi-homing?”

the answer, I tell them, is simple: you don’t need to. EVPN is a superset of MC-LAG, and it natively integrates multi-homing. It’s like the better, standard version of MC-LAG that we’ve been waiting for.

EVPN, either with VXLAN or MPLS encapsulation, natively provides N-Way multi-homing by creating the same Ethernet Segment Identifier (ESI) on multiple devices. An ESI is configured on a per-interface basis; all interfaces configured with the same ESI, on any devices within the same EVPN domain, appear as part of the same L2 segment or LAG. On top of an ESI, it’s also possible to configure LACP to provide better fault detection.

Nothing special is required for an ESI, just a LAG or MC-LAG, with or without LACP. Anything can be connected to an ESI: servers, switches, Virtual Chassis configurations, firewalls, load balancers, routers—there are no restrictions. If needed, you can even inter-connect two EVPN instances with an EVPN/ESI on both sides.



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SOFTWARE DEFINED NETWORKING

SOFTWARE-DEFINED NETWORKING (SDN)

is an architecture purporting to be dynamic, manageable, cost-effective, and adaptable, seeking to be suitable for the high-bandwidth, dynamic nature of today's applications. SDN architectures decouple network control and forwarding functions, enabling network control to become directly programmable and the underlying infrastructure to be abstracted from applications and network services.

SDN was commonly associated with the OpenFlow protocol (for remote communication with network plane elements for the purpose of determining the path of network packets across network switches) since the latter's emergence in 2011.
Since 2012, however many companies have moved away from OpenFlow, and have embraced different techniques.

https://en.wikipedia.org/wiki/Software-defined_networking

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(SDN) OPEN FLOW ALTERNATIVES

Cisco has also introduced an alternative protocol to OpenFlow, called OpFlex, which was announced at the Interop conference in April 2014. Seeing limitations in OpenFlow's approach, Cisco created OpFlex as an alternative.

Difference in Cisco OpenFlow and OpFlex Control Plane Approaches

There are two main approaches to the SDN control plane on the market right now – Imperative and Declarative:

- **Imperative** describes a centralized SDN Controller that acts as the brains for the SDN environment; the controller receives requests from applications, via a northbound application program interface (API), and dictates downstream to the forwarding plane how the switches/routers need to be configured to answer the needs of the application. There is the potential for the centralized controller to become a bottleneck and a single point of failure in the network, which different implementations attempt to address.

- **Declarative** describes a model where the SDN Controller declares what the application needs and sends that message to the network fabric for the switches and routers to determine how to meet the application's requirements. A declarative control plane allows for more distributed intelligence; it sets a central policy, but gives power to network nodes to make more decisions about how to execute said policies.

OpenFlow supports an Imperative control plane, with no control/intelligence embedded in the data path. Instead, the SDN Controller provides all the instructions to the switches/routers and tells them how to move packets.

OpFlex supports a Declarative control plane, focusing on centralizing the policy and then pushing out some of the intelligence to the data path. Cisco's Application Centric Infrastructure (ACI) and Application Policy Infrastructure Controller (APIC) support this approach.

SOFTWARE DEFINED NETWORKING

SDN COMPETITION LANDSCAPE

- Not limited to usual networking suspects
  - HW and SW pure players in the game
- Very Fragmented in each segment
  - Ripe for consolidation

SOFTWARE DEFINED NETWORKING

SDN COMPETITION LANDSCAPE

- Big Switch Networks Big Cloud Fabric
- Brain4Net: B4N Controller
- Brocade: Brocade SDN Controller
- Ciena: Blue Planet SDN/NFV Orchestration Platform
- Cisco Systems: Cisco Application Policy Infrastructure Controller (APIC)
- Coriant: Coriant Transcend SDN Solution
- Dell: Dell Active Fabric Manager
- ECI: LightCONTROL
- Extreme Networks: Extreme Networks OneController
- Fujitsu: Virtuora Network Controller
- Hewlett Packard Enterprise (HPE): HPE Carrier SDN
- Hewlett Packard Enterprise: HPE Distributed Cloud Networking (DCN)
- Huawei: Huawei Agile Controller
- Inocybe Technologies: Inocybe Open Networking Platform
- ***Juniper Networks: Juniper Contrail Networking**
- Midokura: Midokura Enterprise MidoNet
- NEC ProgrammableFlow Controller PF6800
- Open Networking Foundation (ONF): Atrium
- Open Networking Lab (ON.LAB): Open Network Operating System (ONOS)
- OpenDaylight Project: Beryllium (Be)
- Plexxi Inc: Plexxi Control
- Sonus Networks: VellOS

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SOFTWARE DEFINED NETWORKING

CONTRAIL CONTROLLER

OPENCONTRAIL

CONTRAIL IS …

- Juniper's open-source Cloud Network Automation initiative (Apache v2)
- Built using standards-based protocols for interoperability

Provides all components for network virtualization → Overlay networks to

- VMs
- Linux Containers
- Bare Metal Servers

API driven → to enable Automation

- Implements OpenStack Neutron API, Amazon EC2 VPC API, etc.
- Offers APIs to apps/ orchestration systems to configure & monitor the system.

Built as a scalable, performant, resilient, and carrier-grade network platform for Cloud infrastructure

… For more information → do visit our site at opencontrail.org

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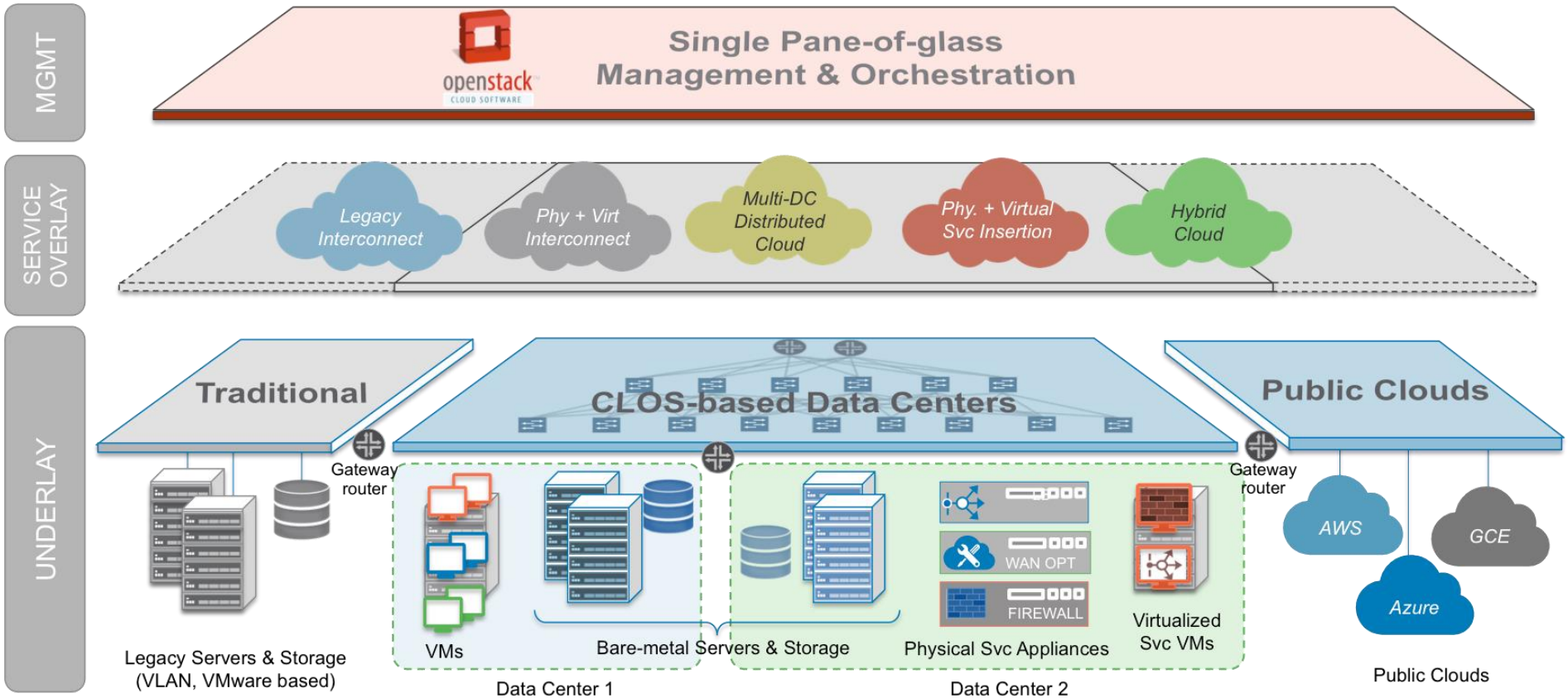
SOFTWARE DEFINED NETWORKING

CONTRAIL CONTROLLER



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SOFTWARE DEFINED NETWORKING

CONTRAIL DEMO VIDEOS

PRODUCT CAPABILTIIES - DEMO VIDEOS

- **Bare Metal Integration through multi-vendor TOR integration** → https://www.youtube.com/watch?v=PjkNt0yV3H0
- **IPv6 DVR (Distributed Virtual Router)** → https://www.youtube.com/watch?v=RLO0uIXbDxo
- **OpenStack Neutron at Scale** → https://www.youtube.com/watch?v=xN0rXHD_dqk
- **P + V Service Chaining** → https://www.youtube.com/watch?v=a9HqC9x6KTg
- **Multi-hypervisor, Docker Integration** → https://www.youtube.com/watch?v=x2n5Q_ycx6o
- **vRouter DPDK Demo** → https://www.youtube.com/watch?v=ZGiQJrKoDQM
- **Physical + Overlay Correlation** → https://www.youtube.com/watch?v=B8aHoY—1Zs

USE CASE - DEMO VIDEOS

- **DDoS Protection (Contrail + DDoS Secure)** → http://www.youtube.com/watch?v=TnvCea4fil4
- **NFV through Contrail (this is the Internet / Firewall NFV aka. vCPE)** → http://www.youtube.com/watch?v=_64no8P2vUw
- **Contrail - Elastic cloud - IT as a Service** → http://www.youtube.com/watch?v=9g3EWV8X64s
- **SSLVPN on Contrail** → http://www.youtube.com/watch?v=vfZfdH4kkV4
- **Caching as a Service (Junos Content Encore on Contrail** → https://www.youtube.com/watch?v=-_NtC34wcRw
- **Hybrid Cloud** → https://www.youtube.com/watch?v=uC7nMW5PXdg

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