



The Power of We™

Comparing Ethernet Network Fabric Technologies

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AVAYA

Technology Battles...

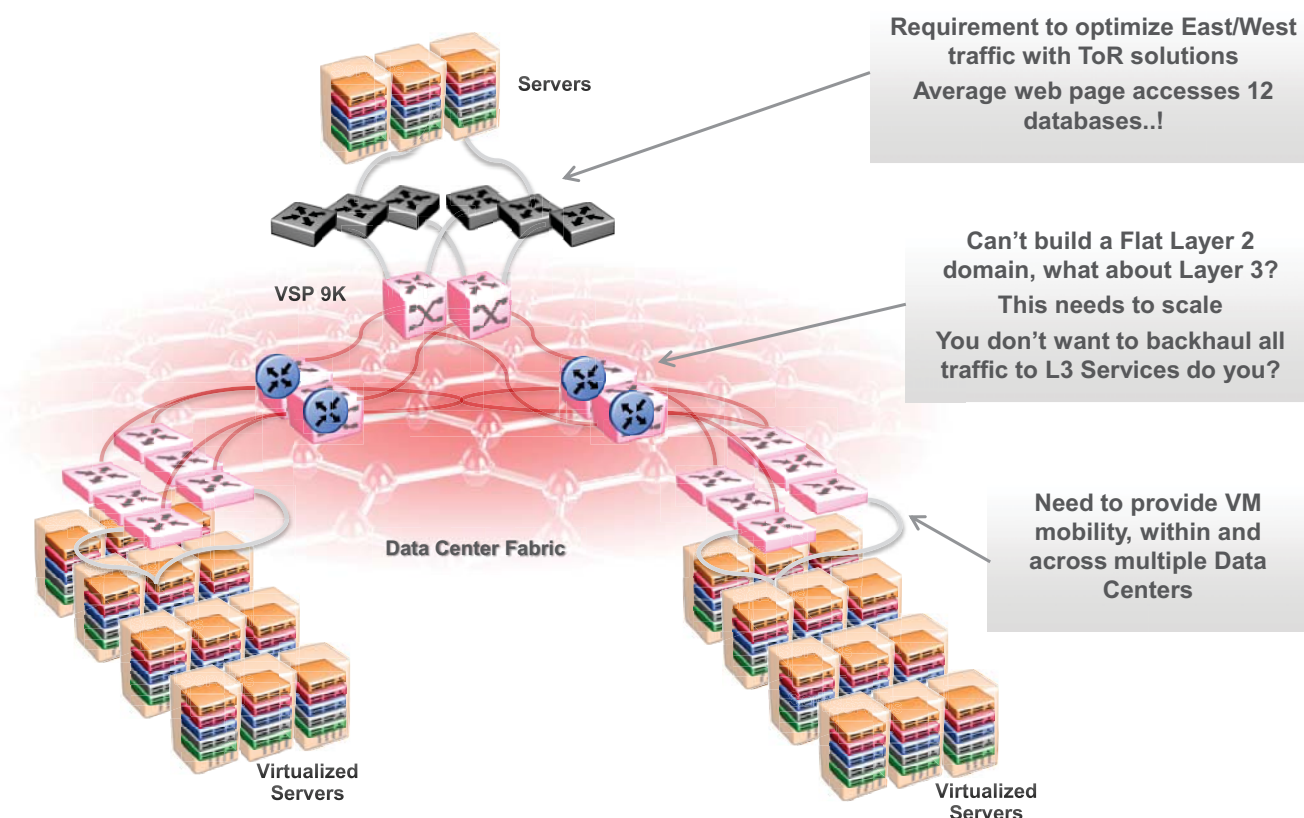
- ▶ When was the last time..?
 - Remember Token Ring, ATM, 100VG-AnyLAN, FDDI, Arcnet, Ethernet...
 - Banyan Vines, Appletalk, IPX/SPX, IP...
- ▶ And, for the record...Ethernet and IP won...☺
- ▶ But does the best technology always win..?
 - History would say not always...
 - Beta versus VHS
 - OS2 versus Windows
 - StreetTalk versus Active Directory
 - Mainframes versus Distributed Architecture

WILL IT BE THE SAME AGAIN..?

What Problems do We Have..?

- ▶ All sorts of topology limitations
 - # of hops
 - No support for rings
 - Loops disasters
- ▶ Spanning Tree loop prevention taking on a new personality to achieve higher resiliency, Active/Standby model
- ▶ Multicast dependency on Routing Protocol, and stability & scalability limitations
- ▶ Device-based configurations
 - Human-induced errors bringing business down (the “Oh Shift Key”)
- ▶ MAC explosion issues
- ▶ Slow convergence in most deployments
- ▶ Long time-to-service (days, weeks, months)
- ▶ Unicast & Multicast service offerings
- ▶ VLANs don't scale (4k), Q-in-Q helped, but...

Why the Hype About Fabrics..?



Goals of Fabric Technologies

- ▶ **Plug & play services** enabled by end-point provisioning
- ▶ **Operational simplicity (Remember this)**
- ▶ Increased **network uptime**
- ▶ **Predictable** network behavior
- ▶ Optimal **bandwidth & resource utilization**
- ▶ Maximum network **design flexibility**
- ▶ Immune to **human-induced-errors**
- ▶ Must be optimized for **Ethernet, IP, & Multicast**



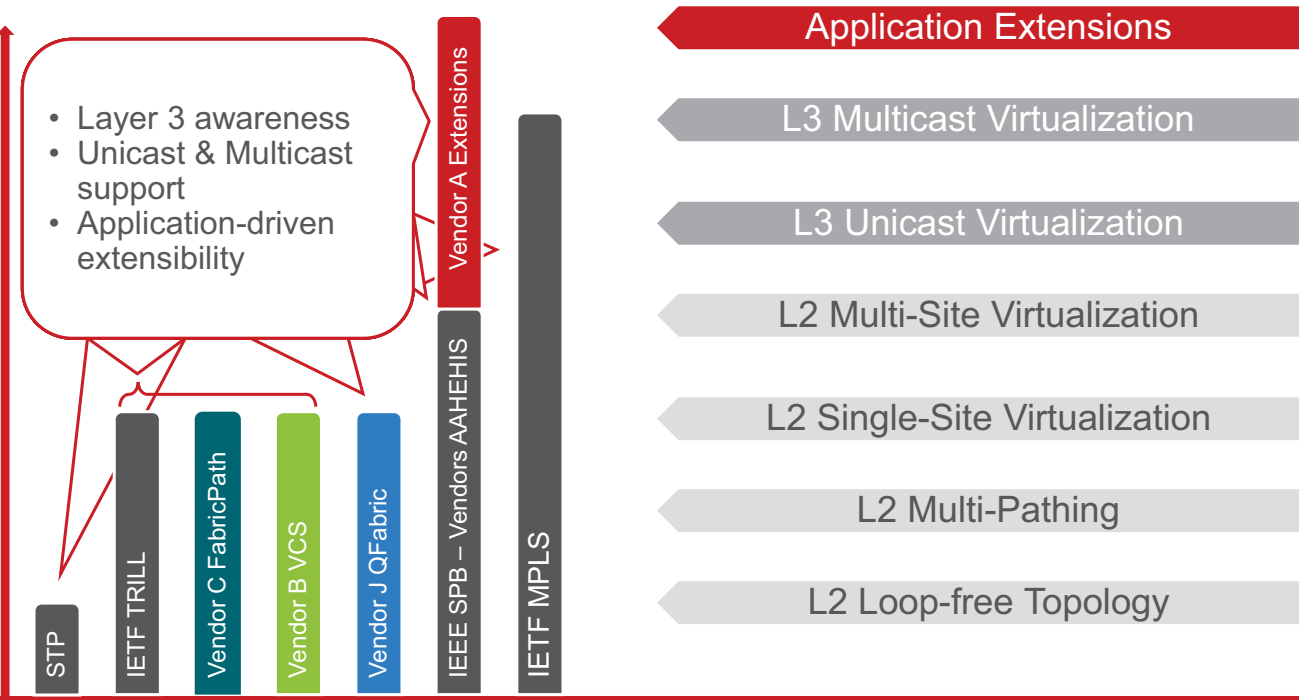
NOT ALL FABRICS ARE CREATED EQUAL...

What are the Choices..?

- ▶ IEEE SPB (Shortest Path Bridging) & IETF RFC 6329
- ▶ IETF TRILL (Transparent Interconnection of Lots of Links)
- ▶ FabricPath
- ▶ QFabric
- ▶ MC-LAG (Multi-Chassis Link Aggregation Group)
 - Sorry, but this one doesn't cut it...
 - Vendor A = SMLT/RSMLT (2001)
 - Vendor C = VSS/VDC (2007)
 - Vendor H = IRF (2008)
 - Vendor E = MC-LAG (2010)
 - Vendor J = Virtual Chassis
 - Vendor B = ..?

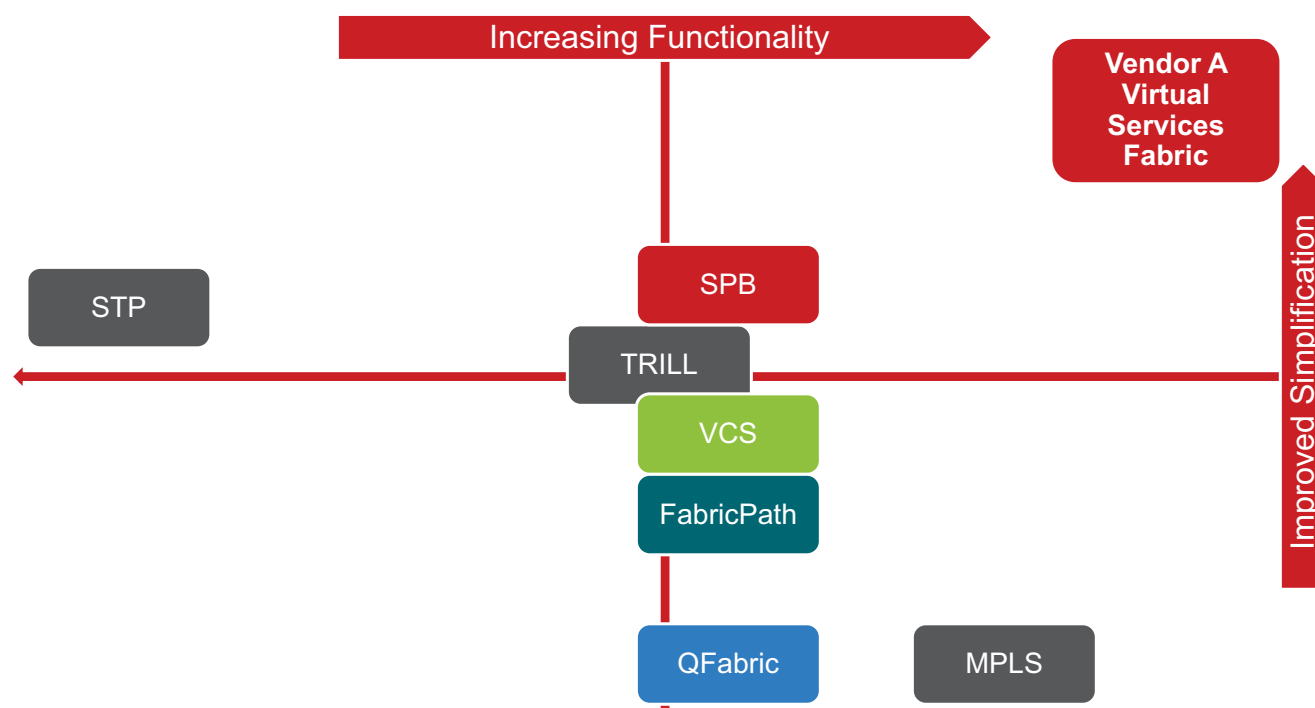
That all depends on how you qualify the question...

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But what if you can have both...

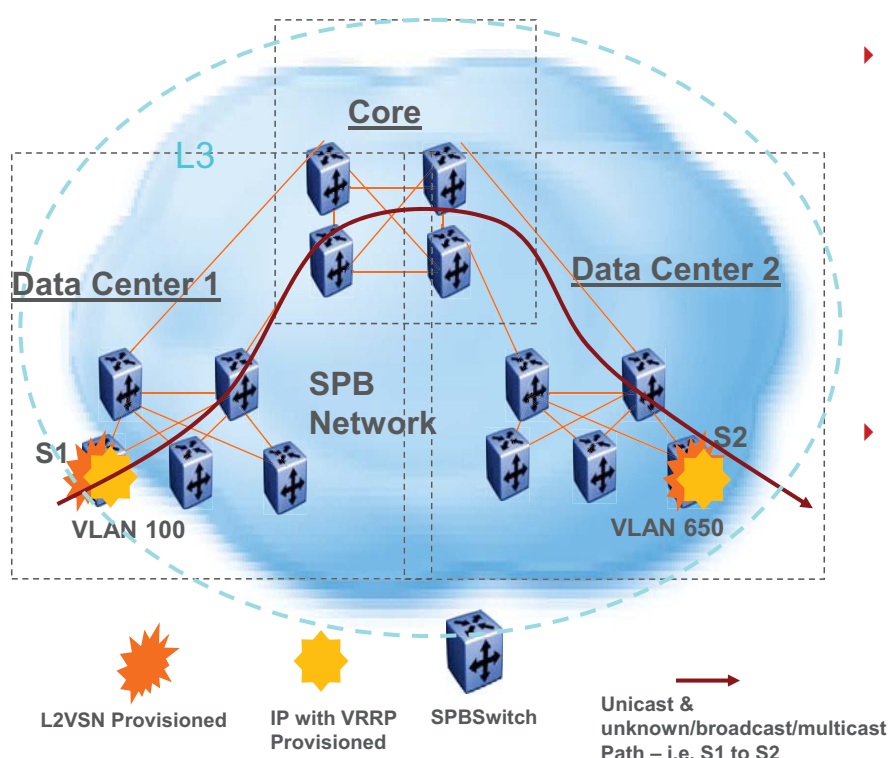
But what if you can have both...



Data Center Virtualization Characteristics

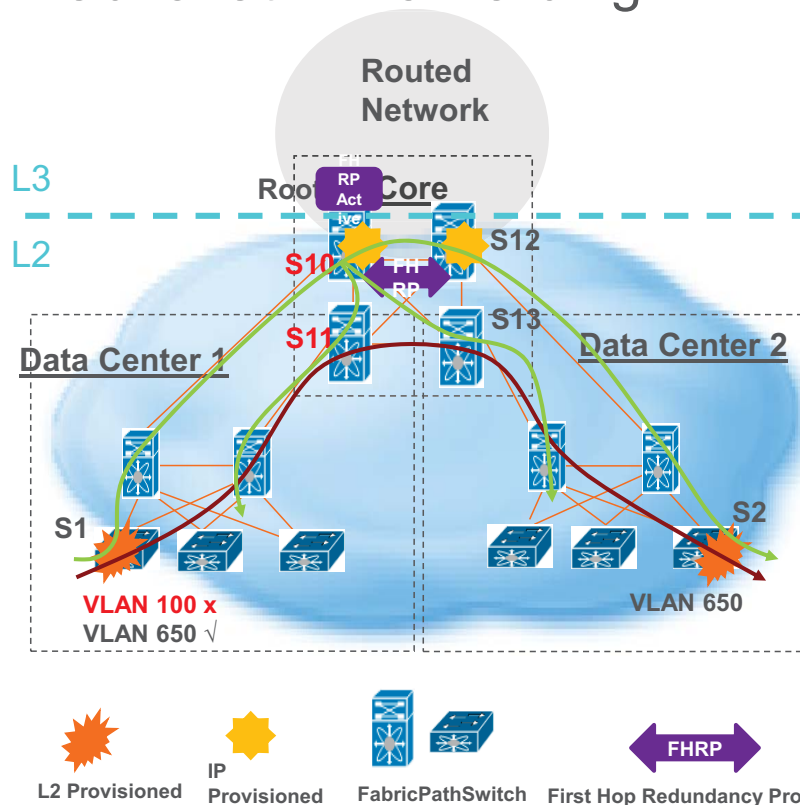
	SPB	TRILL	QFabric	FabricPath
Standard	Yes, IEEE 802.1aq Yes, IETF – RFC 6329	IETF Draft	No, Proprietary	No, Proprietary
Global Service Virtualization	16m I-SIDs	4k VLANs	4K VLANs	4K VLANs
L2 Multi-Path	ECT & ECMP (with new draft)	ECMP	Proprietary	ECMP
VPN TLV	Standard IS-IS with new TLVs mapped to ISID	New IS-IS instance with new TLVs with VLAN mapping	None – uses proprietary mapping	New IS-IS instance with new TLVs with VLAN mapping
Multicast	Source Trees, Service-based	Shared Trees with Root Bridges, not Service-based	Service-based, but limited to QFabric	Shared Trees with Root Bridges, not Service-based
IS-IS	No base change, just new TLVs	Changed base protocol w/ new PDUs and several new TLVs	Proprietary	Changed base protocol w/ new PDUs and several new TLVs
Forwarding	Deterministic and congruent for both directions	Non-deterministic	Proprietary	Non-deterministic
OAM	802.1ag & Y.1731 deployed for years	Requires new standards to be created	Proprietary	Requires new proprietary protocols to be created
Extensibility	L2 Virtualization IPv4 L3 Virtualization Multicast Virtualization IPv6 Virtualization PBB, PBB-TE	Limited to L2 Virtualization with 4k VLANs	Spans only 100 meter in diameter, requires VPLS for extension across Data Centers	Limited to L2 virtualization with 4k VLANs

SPBM - Forwarding



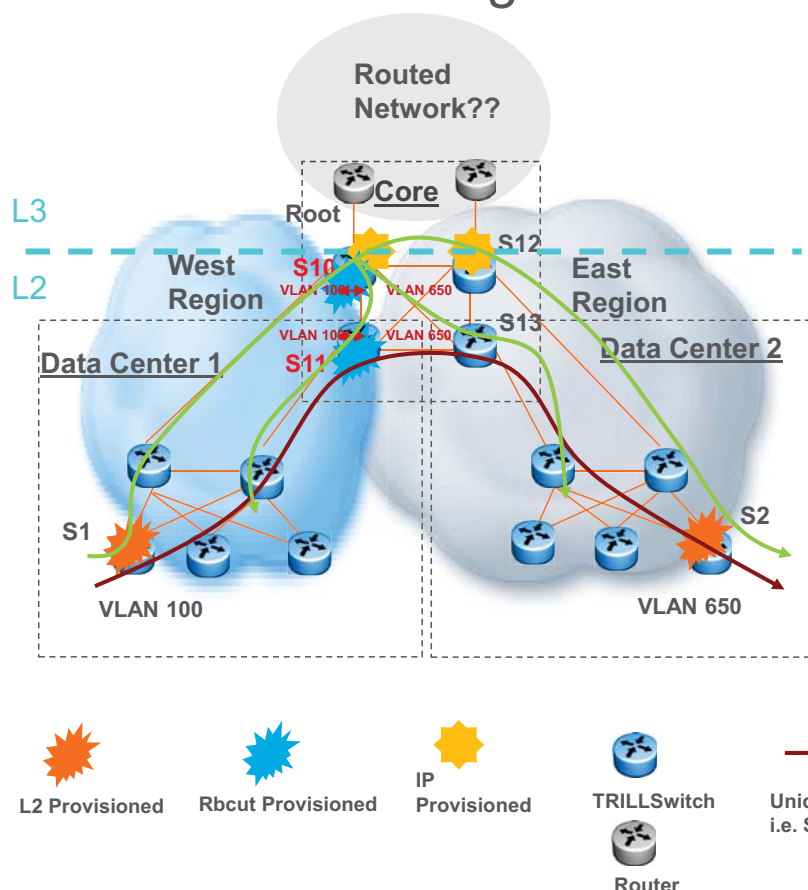
- ▶ Diagram on left illustrates connecting two data centers via SPB
- ▶ To provide L2 connectivity between Data Center 1 and Data Center 2 with IP forwarding and redundancy, all we have to do is:
 - Create an L2VSN on S1 and S2 to provide L2 connectivity
 - Any VLAN ID can be used on S1 and S2 as the service is identified by the I-SID
 - On the VLAN provisioned on S1 and S2, add an local IP address on the same subnet and enable IP VRRP
- ▶ In summary, we only need to touch two switches to provision this service (S1 and S2) and we accomplish
 - L2 MAC learning between S1 and S2
 - IP forwarding from anywhere in the network to/from Data Center 1 and Data Center 2
 - Full IP resilience between Data Center 1 and Data Center 2 via VRRP

FabricPath - Forwarding



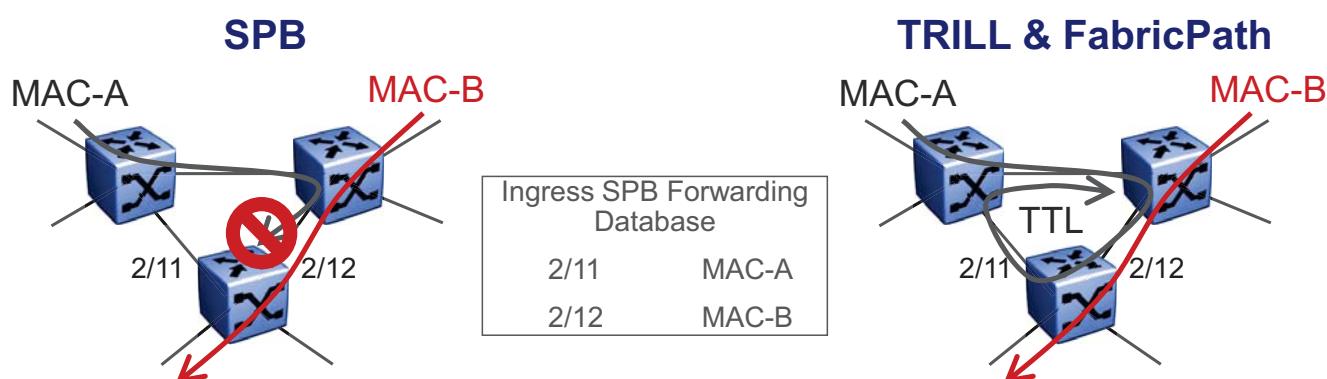
- ▶ Cannot use different VLAN IDs at edge
- ▶ IP is separated from FabricPath; needs external routers and ether M1 module or F2 module in Nexus 7000
 - Restricted to F series of modules for FabricPath
 - IP cannot be extended to edge, but, to core
 - If F1 module is used, M1 module must be installed to perform IP networking from FabricPath to IP – MAC table must be duplicated from F1 to M1 modules
 - Need to run FHRP for IP redundancy to routed core
- ▶ Unknown/broadcast/multicast traffic flow based on root bridge selection while unicast flow is based on shortest path

TRILL - Forwarding



- ▶ Diagram on left illustrates connecting two data centers via TRILL
- ▶ Assuming we have need to have L2 connectivity between VLAN 100 in Data Center 1 to VLAN 650 in Data Center 2
 - On all Rbridges connecting the two regions (S10 & S11), one must manually map the VLANs
 - i.e. East VLAN 100 → West VLAN 650 to allow, for example, a TRILL frame with an Inner.VLAN of 100 received by S10 in the West region to be forward with an Inner.VLAN changed to 650 to the East region
- ▶ Unknown/broadcast/multicast traffic flow based on root bridge selection while unicast flow is based on shortest path
- ▶ As there is no support for IP with TRILL, some sort of mapping between the TRILL network and IP network must be accomplished most likely via S10 and S12

Loop Handling...



- ▶ SPB's RPFC (Reverse Path Forwarding Check) does not allow loops
 - Prevents loops before they begin
- ▶ TTL allows loop, and then discards it after value reaches 0
 - Give up on the problem, dimensioning the crater..

WHICH ONE WOULD YOU SELECT..?

Native IP Support – Somewhat Important...

- ▶ SPBM supports Native IP (IP Shortcuts)
 - No IGP protocols, simple as re-distributing local interfaces into IS-IS
 - Can also import/export external protocols (static, RIP, OSPF, BGP)
- ▶ IP is not native to either TRILL or FabricPath
 - In order to support IP, FabricPath uses specific hardware
 - IP is not supported natively, but outside of FabricPath
- Next generation networks....
 - It's all about IP and Ethernet, isn't it?

Management

► OAM

– SPB

- SPB supports IEEE 802.1ag Connectivity Fault Management (CFM)
 - Offers true end-to-end testing (ping, traceroute, tracertree)
- Multi-vendor OA&M (I2ping & I2traceroute) also demonstrated
- <http://ieee802.org/1/files/public/docs2011/aq-ashwood-smith-spbm-3rd-interop-0718-v01.pdf>

– FabricPath

- Pong – L2 Ping and L2 Traceroute
 - Requires the Enhanced Layer 2 Package (N7K-EL21K9) license

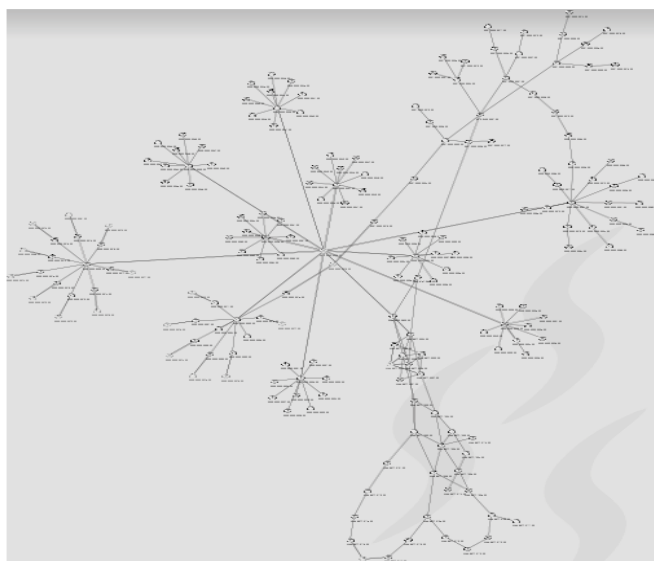
– TRILL

- No end-to-end testing yet, IETF drafts

– QFabric

- Proprietary

Cross-Industry Interoperability



Highlights

- Large-scale network modelling
- 6 Implementations
- 5 Vendors
- 10 real Switches
- 1 high-end tester
- 1 passive network viewer (via NNI)
- 1 LINUX/Quagga emulator

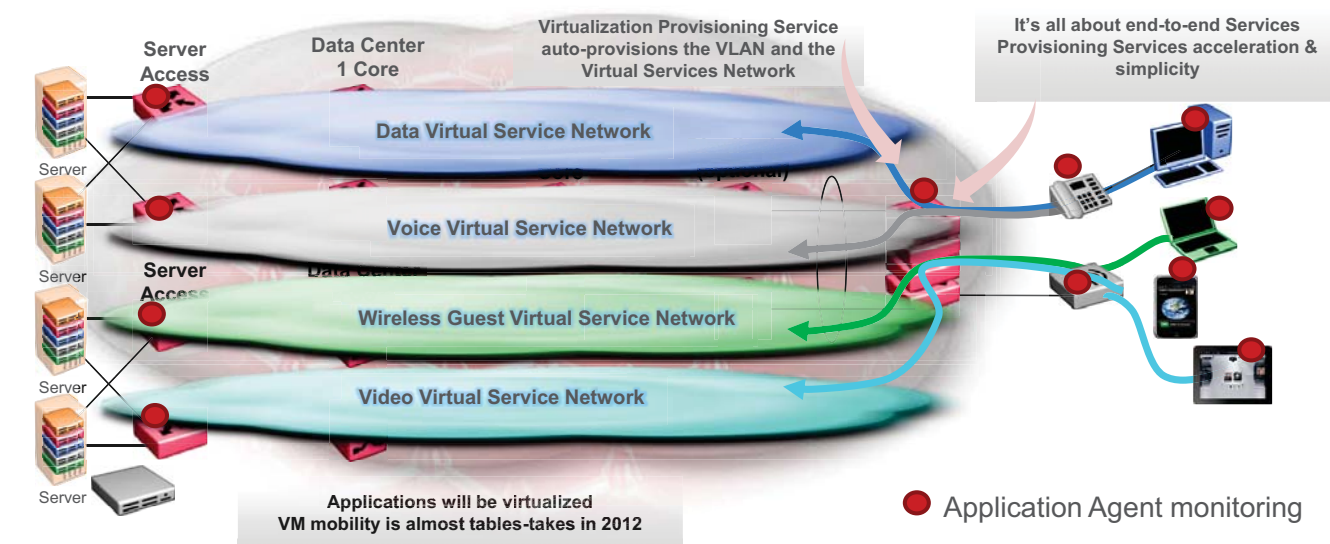
```
<ottawa-6>spb status
```

```
SPB Status:
```

```
mode SPBM, nodes 187, links 412, adj 6, ufib 372, mfib 45
```

Food For Thought...

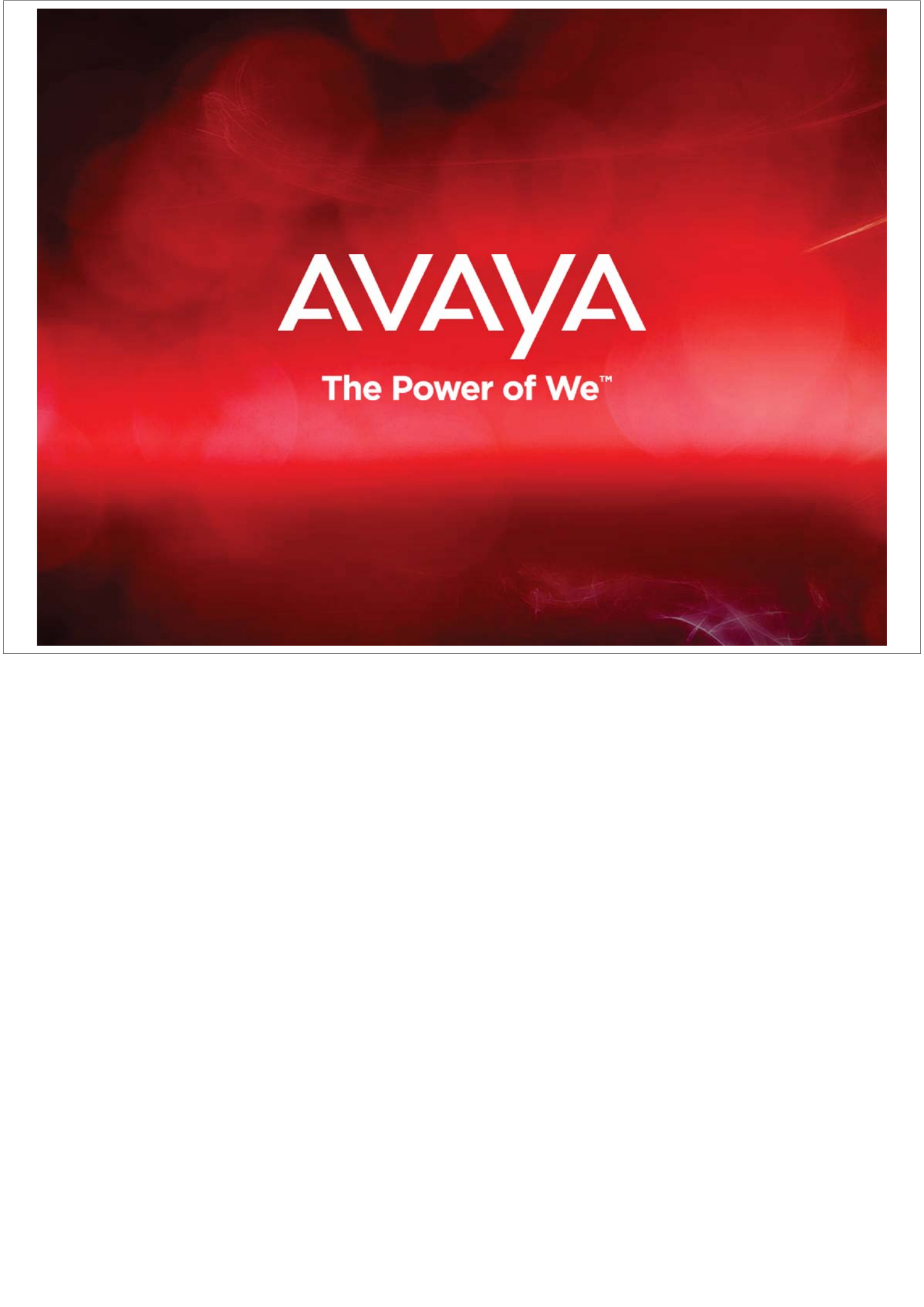
- ▶ What really matters..? Users and Applications; do we all agree on that..?
- ▶ Why only focus in Data Centers..? Why not extend the Fabric closer to where Apps are used..?
- ▶ Isn't VDI just a real-time App with a new personality..?



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In Summary

- ▶ SPB: IEEE 802.1aq Shortest Path Bridging & IETF RFC 6329
 - Deployed in carriers and enterprises around the world
 - SPB creates an end-to-end virtual Ethernet
 - SPB is L3-capable, and optimized for IP and Multicast
 - SPB has successfully demonstrated multi-vendor interoperability
- ▶ FabricPath
 - No standards, proprietary implementation, some HW dependencies
- ▶ TRILL
 - TRILL is the IETF attempting to **reinvent** IEEE protocols
- ▶ QFabric
 - A proprietary architecture commitment
- ▶ Remember
 - Simplicity, Inter-operability, Agility, Flexibility, TTS (Apps/users), Business Continuity, Scalability !!!!

The image features the Avaya logo in white, bold, sans-serif capital letters. The 'y' in 'AVAYA' is stylized with a diagonal slash. Below the logo is the tagline 'The Power of We' in a smaller, white, sans-serif font, followed by a trademark symbol (TM). The background is a vibrant red with a subtle, abstract pattern of light and dark red fibers or smoke, creating a sense of depth and movement.

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The Power of We™