What You Make Possible
Agenda

- Introduction to FabricPath
- FabricPath Concepts
- FabricPath Technology
- FabricPath vs Trill
- FabricPath Designs
- Conclusion
Introduction to FabricPath
Can you summarize the added value of FabricPath?

Do you want a detailed explanation or “we replaced STP with IS-IS”?

I’m a Layer 3 guy

We replaced STP with IS-IS!

By Francois Tallet
Why Layer 2 in the Data Centre?

- Some Applications / Protocols rely on the functionality
- Simple, plug and play
- Addressing constraints
- Allows easy server provisioning
- Allows virtual machine mobility
Current Data Centre Design

- L2 benefits are limited to a single POD
Current Data Centre Design

- We could extend STP to the whole network
Typical Limitations of L2

- Local STP problems have network-wide impact, troubleshooting is difficult
- STP convergence is disruptive
- Flooding impacts the whole network
- STP provides limited bandwidth (no load balancing)
- Tree topologies introduce sub-optimal paths
- MAC address tables don’t scale
Cisco FabricPath Goal

“FabricPath brings Layer 3 routing benefits to flexible Layer 2 bridged Ethernet networks”
FabricPath: An Ethernet Fabric

Turn the Network into a Fabric

- Connect a group of switches using an **arbitrary** topology
- With a simple CLI, aggregate them into a Fabric:

  ```
  N7K(config)# interface ethernet 1/1
  N7K(config-if)# switchport mode fabricpath
  ```

- No STP inside. An open protocol based on L3 technology provides Fabric-wide intelligence and ties the elements together.
Optimal, Low Latency Switching
Shortest Path Any-to-Any

- Single address lookup at the ingress edge identifies the exit port across the fabric
- Traffic is then switched using the shortest path available
- Reliable L2 and L3 connectivity any to any (L2 as if it was within the same switch, no STP inside)
High Bandwidth, High Resiliency

Equal Cost Multi-Pathing

- Multi-pathing (up to 256 links active between any 2 devices)
- Traffic is redistributed across remaining links in case of failure, providing fast convergence
### Scalable Conversational MAC Learning

- Per-port MAC address table only needs to learn the peers that are reached across the fabric.
- A larger number of hosts can be attached to the fabric.

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>e1/1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>B</td>
<td>s8, e1/2</td>
</tr>
</tbody>
</table>

```
FabricPath
```

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>s1,e1/1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>B</td>
<td>e1/2</td>
</tr>
</tbody>
</table>
Layer 2 Integration

VPC+

- Allows extending VLANs with no limitation (no risks of loop)
- Devices can be attached active/active to the fabric using IEEE standard port channels and without resorting to STP
Edge Device Integration
Hosts Can Leverage Multiple L3 Default Gateways

- Hosts see a single default gateway
- The fabric provide them transparently with multiple simultaneously active default gateways
- Allows extending the multipathing from the inside of the fabric to the L3 domain outside the fabric
Layer 3 Integration
XL Tables, SVIs Anywhere

- The fabric provides seamless L3 integration
- An arbitrary number of routed interfaces can be created at the edge or within the fabric
- Attached L3 devices can peer with those interfaces
- The hardware is capable of handling million of routes
FabricPath Concepts
**FabricPath Terminology**

**FP Core Ports**

**Spine Switch**

**Leaf Switch**

**CE Edge Ports**

**FabricPath (FP)**

**Classical Ethernet (CE)**

### Terminology

- **Classical Ethernet (CE)**
  - S10
  - S20
  - S30
  - S40
  - S100
  - S700
  - S800
  - 1/1
  - 1/2

- **FabricPath (FP)**

- **FP Core Ports**

- **CE Edge Ports**
New Data Plane

- The association MAC address/Switch ID is maintained at the edge
- Traffic is encapsulated across the Fabric
MAC addresses are not carried or redistributed into the Control Plane
The Control plane determines fabric topology and switch reachability
**Topology:** A group of links in the Fabric.

By default, all the links are part of topology 0.

- A VLAN is mapped to a unique topology
- Other topologies can be created by assigning a subset of the links to them.
- A link can belong to several topologies

Topologies can be used for migration designs (i.e. VLAN localisation, VLAN re-use), traffic engineering, security etc…
Equal Cost Multipathing
Traffic Forwarded Based on a Routing Table

FabricPath Routing Table

<table>
<thead>
<tr>
<th>Switch</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>S10</td>
<td>L1</td>
</tr>
<tr>
<td>S20</td>
<td>L2</td>
</tr>
<tr>
<td>S30</td>
<td>L3</td>
</tr>
<tr>
<td>S40</td>
<td>L4</td>
</tr>
<tr>
<td>S200</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>S800</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

S100: CE MAC Address Table

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1/1</td>
</tr>
<tr>
<td>B</td>
<td>S800</td>
</tr>
</tbody>
</table>
Multicast Traffic
Load Balancing on a Per-tree Basis

- IS-IS computes several trees automatically
- Location of the root switches can be configured
- Multicast traffic is pinned to a tree at the edge

Ingress switch for FabricPath decides which “tree” to be used and add tree number in the header
VLAN Pruning By Design

Automatically Handled by IS-IS

FabricPath
**VPC+**

Virtual Port Channel in FabricPath Environment

- Allows non FabricPath capable devices to connect redundantly to the fabric using port channels
- Configuration virtually identical to standard VPC
- Provides active/active HSRP
VPC+ Technical Challenges

• Mac address flapping on S300
• Single path to A
VPC+ Virtual Switch

- A consistently associated to S1
- Multipathing to A

### S800: CE MAC Address Table

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1/2</td>
</tr>
<tr>
<td>A</td>
<td>S1</td>
</tr>
</tbody>
</table>
Sub-Switch ID
Identifies a VPC off a Virtual Switch

Diagram showing the routing of packets from Switch ID S800 to S1.22, with sub-switch ID 22. The diagram includes a breakdown of Endnode ID, Switch ID, and LID fields in the FabricPath protocol.
Anycast FHRP

- **Split VLANs**
  - Some polarisation
  - Inter-VLAN traffic can be suboptimal

- **GLBP**
  - Host is pinned to a single gateway
  - Less granular load balancing

- **Anycast FHRP**
  - All active paths
  - Available in the future for routing
FabricPath Technology
FabricPath Control Plane
Control Plane Operation
Plug-N-Play L2 IS-IS is Used to Manage Forwarding Topology

- Assigned switch addresses to all FabricPath enabled switches automatically (no user configuration required)
- Compute shortest, pair-wise paths
- Support equal-cost paths between any FabricPath switch pairs

FabricPath Routing Table

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<td>L3</td>
</tr>
<tr>
<td>S40</td>
<td>L4</td>
</tr>
<tr>
<td>S200</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>S800</td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

Plugin-N-Play L2 IS-IS is used to manage forwarding topology.
Display IS-IS View of Routing Topology

Show FabricPath Isis Route

```
S100# sh fabricpath isis route
Fabricpath IS-IS domain: default MT-0
Topology 0, Tree 0, Swid routing table
10, L1
  via port-channel10, metric 20
20, L1
  via port-channel20, metric 20
30, L1
  via port-channel30, metric 20
40, L1
  via port-channel40, metric 20
200, L1
  via port-channel30, metric 40
  via port-channel40, metric 40
  via port-channel20, metric 40
  via port-channel10, metric 40
300, L1
  via port-channel30, metric 40
  via port-channel40, metric 40
  via port-channel20, metric 40
  via port-channel10, metric 40
S100#
```
FabricPath Multidestination Trees

- Multidestination traffic constrained to loop-free trees touching all FabricPath switches
- Root switch elected for each multidestination tree in the FabricPath domain
- Network-wide identifier (Ftag) assigned to each loop-free tree
- Support for multiple multidestination trees provides multipathing for multi-destination traffic
  - Two multidestination trees supported in NX-OS release 5.1
Multidestination Trees and Role of the Ingress FabricPath Switch

- Ingress FabricPath switch determines which tree to use for each flow
- Other FabricPath switches forward based on tree selected by ingress switch
- Broadcast and unknown unicast typically use first tree
- Hash-based tree selection for IP multicast, with several configurable hash options

**Multidestination Trees on Switch 100**

<table>
<thead>
<tr>
<th>Tree</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L1</td>
</tr>
<tr>
<td>2</td>
<td>L1,L2,L3,L4</td>
</tr>
</tbody>
</table>
Display IS-IS View of Multidestination Trees

Show FabricPath Isis Trees

S100# sh fabricpath isis trees multidestination 1
Fabricpath IS-IS domain: default
Note: The metric mentioned for multidestination tree is from the root of that tree to that switch-id

MT-0
Topology 0, Tree 1, Swid routing table
10, L1
via port-channel1, metric 0
20, L1
via port-channel2, metric 20
30, L1
via port-channel3, metric 20
40, L1
via port-channel4, metric 20
100, L1
via port-channel1, metric 10
200, L1
via port-channel2, metric 10

S100#
FabricPath Data Plane
FabricPath versus Classic Ethernet Interfaces

Classic Ethernet (CE) Interface
- Interfaces connected to existing NICs and traditional network devices
- Send/receive traffic in 802.3 Ethernet frame format
- Participate in STP domain
- Forwarding based on MAC table

FabricPath Interface
- Interfaces connected to another FabricPath device
- Send/receive traffic with FabricPath header
- No spanning tree!!!
- No MAC learning
- Exchange topology info through L2 ISIS adjacency
- Forwarding based on ‘Switch ID Table’
**FabricPath Encapsulation**

16-Byte MAC-in-MAC Header

- **Switch ID** – Unique number identifying each FabricPath switch
- **Sub-Switch ID** – Identifies devices-hosts connected via VPC+
- **LID** – Local ID, identifies the destination or source interface
- **Ftag** (Forwarding tag) – Unique number identifying topology and/or distribution tree
- **TTL** – Decrement at each switch hop to prevent frames looping infinitely
FabricPath Unicast Forwarding

Control plane:
- **Routing table** – FabricPath IS-IS learns switch IDs (SIDs) and builds routing table
- **Multidestination trees** – FabricPath IS-IS elects roots and builds multidestination forwarding trees

Data plane:
- **MAC table** – Hardware performs MAC table lookups to determine destination FabricPath switch (unicast) or to identify multidestination frames
- **Switch table** – Hardware performs destination SID lookups to forward unicast frames to other switches
- **Multidestination table** – Hardware selects multidestination tree to forward multidestination frames through network fabric
Unicast with FabricPath
Forwarding Decision Based on ‘FabricPath Routing Table’

- Support more than 2 active paths (up to 16) across the Fabric
- Increase bi-sectional bandwidth beyond port-channel
- High availability with N+1 path redundancy
Conversational Learning
Unknown Unicast

S100: CE MAC Address Table
<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S200: CE MAC Address Table
<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S300: CE MAC Address Table
<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1/2</td>
</tr>
<tr>
<td>A</td>
<td>S100</td>
</tr>
</tbody>
</table>

Classic Ethernet

FabricPath

Lookup B: Miss
Don’t learn

Lookup B: Hit
Learn source A

S100

A → B

S100 → M

1/1

B

1/2

A → B

S10

S20

S30

S40

S100

S700

S800

S300

Conversational Learning
Unknown Unicast
Conversational Learning
Unknown Unicast

Classical Ethernet

S100: CE MAC Address Table

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1/1</td>
</tr>
<tr>
<td>B</td>
<td>S800</td>
</tr>
</tbody>
</table>

S200: CE MAC Address Table

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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</table>

S300: CE MAC Address Table

<table>
<thead>
<tr>
<th>MAC</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1/2</td>
</tr>
<tr>
<td>A</td>
<td>S100</td>
</tr>
</tbody>
</table>

FabricPath

Lookup A: Hit
Learn source B

Lookup A: Hit
Send to S100

S300: FabricPath Routing Table

<table>
<thead>
<tr>
<th>IF</th>
<th>MAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L1, L2, L3, L4</td>
</tr>
</tbody>
</table>

Conversational Learning
FabricPath Forwarding: Broadcast

Tree # | IF
--- | ---
1 | L1, L5, L9

Tree # | IF
--- | ---
1 | L1, L2, L3, L4

L2 Fabric

No Learning on Remote MAC since Destination MAC is unknown
Multicast Forwarding
FabricPath IP Multicast

- **Control plane:**
  - Build several multidestination trees
  - Run IGMP snooping on FabricPath edge switches
  - Advertise receivers location with dedicated LSPs

- **Data plane (hardware):**
  - **Selects which multidestination tree** for each flow based on hash function
  - Forward traffic along selected tree
Multicast Trees Determination

- Switch with highest priority value becomes root for primary tree
  - Highest system ID, then highest Switch ID value, in case of a tie
- Primary root designates different secondary root(s) ensuring path variety.
Multicast Tree Pruning

- IS-IS Group Membership LSPs contain multicast forwarding information

Switches interested in G1 VLAN 10
- S200
- S100

GM-LSPs
- Root for Tree 1
- S10
- S20
- S30
- S40

IGMP snooping
- Rcvr-G1
- Src-G1
- S100

FabricPath
- S200
- S800
Multicast Load Balancing
Multicast Data Plane Step by Step

Packet data → Hash → Ftag 1 → Data Traffic

FabricPath MAC Table

<table>
<thead>
<tr>
<th>Ftag (Tree)</th>
<th>VLAN</th>
<th>Group</th>
<th>IFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>G1</td>
<td>po10</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>G1</td>
<td>po40, po50</td>
</tr>
</tbody>
</table>

FabricPath Multicast Trees

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Ftag (Tree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

Ftag: Forwarding tag – Unique 10-bit number identifying topology and/or distribution tree.

Rcvr-G1

Src-G1

FabricPath MAC Table

<table>
<thead>
<tr>
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<th>VLAN</th>
<th>Group</th>
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</tr>
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<tbody>
<tr>
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<td>po10</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>G1</td>
<td>po100, po200</td>
</tr>
</tbody>
</table>
FabricPath v.s TRILL
Transparent Interconnection of Lots of Links (TRILL)

- IETF standard for Layer 2 multipathing
- Driven by multiple vendors, including Cisco
- TRILL now officially moved from Draft to Proposed Standard in IETF
- Proposed Standard status means vendors can confidently begin developing TRILL-compliant software implementations
- Cisco FabricPath capable hardware is also TRILL capable

http://datatracker.ietf.org/wg/trill/
FabricPath vs. TRILL Overview

<table>
<thead>
<tr>
<th>Feature</th>
<th>FabricPath</th>
<th>TRILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame routing (ECMP, TTL, RPFC etc...)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>vPC+</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>FHRP active/active</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Multiple topologies</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Conversational learning</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Inter-switch links</td>
<td>Point-to-point only</td>
<td>Point-to-point OR shared</td>
</tr>
</tbody>
</table>

- FabricPath will provide a TRILL mode with a software upgrade (hardware is already TRILL capable)
- Cisco will push FabricPath specific enhancements to TRILL
FabricPath vs. TRILL: Encapsulation

FabricPath Routing Table

<table>
<thead>
<tr>
<th>Switch</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>S3</td>
<td>L1</td>
</tr>
</tbody>
</table>

TRILL Routing Table

<table>
<thead>
<tr>
<th>Switch</th>
<th>IF</th>
<th>Mac @</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3</td>
<td>L1</td>
<td>m2</td>
</tr>
<tr>
<td>S4</td>
<td>L1</td>
<td>m4</td>
</tr>
</tbody>
</table>

End-to-End vs. Hop-by-Hop
FabricPath vs. TRILL:
Multipathing

- End-to-end multipathing (L2 edge, Fabric, L3 edge) provides resiliency and fast convergence
FabricPath vs. TRILL:
FabricPath Multiple Topologies

- **Topology**: A group of links in the Fabric.
- By default, all the links are part of topology 0.
- Other topologies are created by assigning a subset of the links to them.
- A link can belong to several topologies.
- A VLAN is mapped to a unique topology.
- Topologies are used for VLAN pruning, security, traffic engineering etc…
FabricPath vs. TRILL:

FabricPath Simple STP Interaction

- The Fabric looks like a single bridge:
  - It sends the same STP information on all edge ports
  - It expects to be the root of the STP for now (edge ports will block if they receive better information)

- **No BPDUs** are forwarded across the fabric
- An optional mechanism allows propagating TCNs if needed
Summary – FabricPath Technology

- **Bandwidth**
  - Multi pathing (ECMP)
  - Optimal paths

- **Scale**
  - Conversational MAC Learning
  - Efficient Flooding
  - Multiple Topologies

- **Transparent to Existing Systems**
  - VPC+
  - Edge Routing Integration
FabricPath Network Designs
Benefits of FabricPath Designs

- Configuration simplicity
- Independence from / elimination of Spanning-Tree Protocol
- Deterministic throughput and latency
- Multi-way load-sharing for unicast and multicast at Layer 2
- Direct/optimised communication paths
- “VLAN anywhere” providing flexibility, L2 adjacency, and VM mobility
- Layer 2 domain scalability (ARP, MAC)
- Loop mitigation (TTL, RPF checks)
- Better stability and convergence characteristics
FabricPath Flexibility
The Network Can Evolve with no Disruption

- Need more edge ports? → Add more leaf switches
- Need more bandwidth? → Add more links and spines
Routing at Aggregation
Two Spine Design

- Simplest design option
- Extension of traditional aggregation/access designs

Immediate benefits:
- Simplified configuration
- Removal of STP
- Traffic distribution over all uplinks without VPC port-channels
- Active/active gateways
- “VLAN anywhere” at access layer
- Topological flexibility
  - Direct-path forwarding option
  - Easily provision additional access↔aggregation bandwidth
  - Easily deploy L4-7 services
  - Option for VPC+ for legacy access switches
Routing at Aggregation

Anycast FHRP

- Anycast FHRP between agg switches
- L2/L3 boundary
- Routed traffic spread over spines based on ECMP

GWY MAC A → L1, L2, L3, L4

- SVI
- GWY IP X
- GWY MAC A

L3

FabricPath

- Layer 3 Link
- Layer 2 CE
- Layer 2 FabricPath

Hosts resolve shared VIP to shared VMAC

All Anycast FHRP forwarders share same VIP and VMAC

- GWY MAC A → L1, L2, L3, L4
Centralised Routing

Leaf switches each have “personality” – most for server access…

…but some for Layer 3 services (routing) and/or L4-7 services (SLB, FW, etc.)

Layer 3 Link
Layer 2 CE
Layer 2 FabricPath

Server access leaf switches

FabricPath spine

Layer 3 services leaf switches

L2/L3 boundary
Centralised Routing
FabricPath-Connected Leaf

FabricPath spine with F1 or F2 modules provides transit fabric (no routing, no MAC learning)

FabricPath core ports provided by F1 or F2 modules

Run VPC+ for active/active HSRP

VPC+

L2/L3 boundary

All VLANs available at all access switches

SVIs for all VLANs on leaf L3 services switch pair (provided by M1 or F2 modules)

SVIs for all VLANs on leaf L3 services switch pair (provided by M1 or F2 modules)
Centralised Routing
FabricPath-Connected Leaf
Distributed Routing
Selective VLAN Extension

Most VLANs terminated directly at access switch pair

Some VLANs extended into FabricPath

VPC+ for active/active HSRP at access pair

Dedicated VLAN for transit routing

VPC+ for active/active HSRP at access pair

L2/L3 boundary for extended VLANs can follow any “Routing at Aggregation” or “Centralised Routing” design options

FabricPath

Distributed Routing
Selective VLAN Extension

Most VLANs terminated directly at access switch pair

Some VLANs extended into FabricPath

VPC+ for active/active HSRP at access pair

Dedicated VLAN for transit routing

VPC+ for active/active HSRP at access pair

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FabricPath

Distributed Routing
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FabricPath

Distributed Routing
Selective VLAN Extension

Most VLANs terminated directly at access switch pair

Some VLANs extended into FabricPath

VPC+ for active/active HSRP at access pair

Dedicated VLAN for transit routing

VPC+ for active/active HSRP at access pair

L2/L3 boundary for extended VLANs can follow any “Routing at Aggregation” or “Centralised Routing” design options

FabricPath
Distributed Routing
Selective VLAN Extension

INTER-VLAN TRANSIT ROUTING (access-local VLANs)

SVI 10
SVI 20

SVI 10
SVI 20

SVI 40
SVI 50

SVI 10
SVI 20

SVI 10
SVI 20

SVI 30

SVI 100

SVI 100

SVI 100

VPC+

Rack 1 VLAN 10
Rack 2 VLAN 20
Rack 3 VLAN 30
Rack 4 VLAN 40
Rack 5 VLAN 50
Rack 6 VLAN 30

FabricPath

Layer 2 CE
Layer 2 FabricPath

L3
Distributed Routing
Selective VLAN Extension

INTER-VLAN TRANSIT ROUTING
(extended VLAN to access-local VLAN)
VMDC 3.0 Typical DC Topology
VMDC 3.0 – Extended DC Topology
vPC to FabricPath Migration in a Single POD

Whitepaper:
Conclusion

- FabricPath is simple, keeps the attractive aspects of Layer 2
  - Transparent to L3 protocols
  - No addressing, simple configuration and deployment

- FabricPath is efficient
  - High bi-sectional bandwidth (ECMP)
  - Optimal path between any two nodes

- FabricPath is scalable
  - Can extend a bridged domain without extending the risks generally associated to Layer 2 (frame routing, TTL, RPFC)
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