Ethernet Fabrics 101

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Networking is Evolving
What’s this?
Network Characteristics

- Cost
- Link Redundancy
- Hardware Redundancy
- Software Redundancy
- Configuration Complexity

Is the traditional way still the right way?
Bisectional Flow Characteristics

- Bandwidth
- Latency
- Flow Size

Is the traditional way still the right way?
Networking 101

**OSI**
- Physical
- Datalink
- Network
- Transport
- Session
- Presentation
- Application

**TCP/IP Stack**
- Ethernet
- WLAN
- Internet Protocol
- Logical Link Control
- TCP
- UDP
- TFTP
- VXLan
- SNMP
- HTTP
- FTP
- SSH

**TCP/IP Model**
- Physical
- Network
- Internetwork
- Transport / Session
- Application
Three Key Terms

Router    Switch    Bridge

Let’s define our terms!

Can we route at Layer-2?

RBridge
Hardware Overview
VDX Family of Switches

VDX 8770
VDX8770 Details

- Industry Leading Chassis
  - 4 I/O Slot Version
  - 8 I/O Slot Version
  - Redundant Management
    - With Hypervisor
  - N+N Fan Redundancy
  - N+N Power Redundancy
  - 3,000ns Latency***

- Available Modules
  - 48x1G SFP
  - 48x10G SFP+
  - 48x10GBaseT
  - 12x40G QSFP+
  - 27x40G QSFP+**
  - 6x100G CFP2

**This module is not line rate
***Not including 10GBASE-T

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VDX Family of Switches

VDX 6940
VDX8940 Details

• VDX6790-36Q
  – 36 QSFP+ Ports
  • Either 1x40 or 4x10
  – 1 Rack Units
  – 700ns Latency

• VDX6790-144S
  – 96x10G SFP+ Ports
  – 12x40G QSFP+ or 4x100G QSFP+
  – 2 Rack Units
  – 700ns Latency
VDX Family of Switches

VDX 6740
VDX6740 Details

- **VDX6740**
  - 48x10G SFP+
  - 4x40G QSFP+
  - 1 Rack Unit
  - 850ns Latency

- **VDX6740T & VDX6740T-1G**
  - 48x10GBaseT or 1GBaseT
  - 4x40G QSFP+
  - 1 Rack Unit
  - 3,000ns Latency

**THIS MODULE IS NOT LINE RATE**
Intro to Ethernet Fabrics

Building a Useful Routed Topology
An Overview of Link State Routing

1. Identify each Node / Network
2. Form Adjacencies
3. Share Link-State Information
4. Run Dijkstra’s Algorithm

Brocade’s Virtual Cluster Switching (VCS) uses the Fabric Shortest Path First (FSPF) routing protocol.
Node / Network Identification

• In Ethernet Fabrics, the terms “Node” and “Network” can be used interchangeably.

• In FSPF, each node has a unique “World Wide Name” or “WWN”.
  – Generally this is transparent to the operator.
  – FSPF was originally designed for Fibre Channel Networks.

• Each node also gets an “RBridge ID” or “Nickname”.
  – This is configurable.
  – Used by TRILL
Forming Adjacencies

1. There are two types of ports:
   – Edge Ports
   – ISL Ports

2. ISL Characteristics
   – Must be Point-to-Point
   – Must have a link speed of 10G or greater

3. Connection Process
   – Primitives
   – Hellos
   – Fabric Joining
Forming Adjacencies

1. There are two types of ports:
   - Edge Ports
   - ISL Ports

2. ISL Characteristics
   - Must be Point-to-Point
   - Must have a link speed of 10G or greater

3. Connection Process
   - Primitives
   - Hellos
   - Fabric Joining

How do we protect against duplicate RBridge IDs?

Adjacencies are only formed if the RBridges have the same VCSID.
Sharing Link State Information

1. Each RBridge shares its own link-state information with all the other RBridges.
2. After synchronization, each RBridge has a full understanding of the Fabric topology.
3. Each link is assigned a cost, based on bandwidth.
Sharing Link State Information

1. Each RBridge shares its own link-state information with all the other RBridges.
2. After synchronization, each RBridge has a full understanding of the Fabric topology.
3. Dijkstra’s algorithm is run
   – This algorithm is run every time a topology change occurs
Sharing Link State Information

1. Each RBridge shares its own link-state information with all the other RBridges.
2. After synchronization, each RBridge has a full understanding of the Fabric topology.
3. Dijkstra’s algorithm is run – This algorithm is run every time a topology change occurs.

We now know where the RBridges are... how does this help us?
Some Useful FRP Commands

Configuring Fabric Routing Protocol
RBridge-5# **vcs vcsid 8192 rbridge-id 239 logical-chassis enable**
Configuring Fabric Routing Protocol

**Viewing Inter-Switch Links**

RBridge-5# `show fabric isl rbridge-id 3`

Rbridge-id: 3  #ISLs: 4

<table>
<thead>
<tr>
<th>Src Index</th>
<th>Src Interface</th>
<th>Nbr Index</th>
<th>Nbr Interface</th>
<th>Nbr-WWN</th>
<th>BW</th>
<th>Trunk</th>
<th>Nbr-Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>Te 3/0/42</td>
<td>109</td>
<td>Te 7/0/46</td>
<td>10:00:50:EB:1A:61:5D:6A</td>
<td>40G</td>
<td>Yes</td>
<td>&quot;RBridge-7&quot;</td>
</tr>
<tr>
<td>108</td>
<td>Te 3/0/45</td>
<td>104</td>
<td>Te 101/0/41</td>
<td>10:00:50:EB:1A:A4:19:D8</td>
<td>30G</td>
<td>Yes</td>
<td>&quot;RBridge-101&quot;</td>
</tr>
<tr>
<td>112</td>
<td>Fo 3/0/49</td>
<td>113</td>
<td>Fo 13/0/50</td>
<td>10:00:50:EB:1A:AE:97:EC</td>
<td>40G</td>
<td>Yes</td>
<td>&quot;RBridge-13&quot;</td>
</tr>
<tr>
<td>113</td>
<td>Fo 3/0/50</td>
<td>112</td>
<td>Fo 17/0/49</td>
<td>10:00:50:EB:1A:E7:43:E8</td>
<td>40G</td>
<td>Yes</td>
<td>&quot;RBridge-17&quot;</td>
</tr>
</tbody>
</table>

RBridge-5#
RBridge-5# `vcs vcsid 8192 rbridge-id 239 logical-chassis enable`

RBridge-5# `show fabric isl rbridge-id 4`

Rbridge-id: 4  #ISLs: 3

<table>
<thead>
<tr>
<th>Index</th>
<th>Interface</th>
<th>Nbr Index</th>
<th>Interface</th>
<th>Nbr-WWN</th>
<th>BW</th>
<th>Trunk</th>
<th>Nbr-Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>104</td>
<td>Te 4/0/41</td>
<td>108</td>
<td>Te 2/0/45</td>
<td>10:00:50:EB:1A:A4:29:AC</td>
<td>40G</td>
<td>Yes</td>
<td>&quot;RBridge-2&quot;</td>
</tr>
<tr>
<td>112</td>
<td>Fo 4/0/49</td>
<td>113</td>
<td>Fo 11/0/50</td>
<td>10:00:50:EB:1A:A4:2B:98</td>
<td>40G</td>
<td>Yes</td>
<td>&quot;RBridge-11&quot;</td>
</tr>
<tr>
<td>113</td>
<td>Fo 4/0/50</td>
<td>112</td>
<td>Fo 16/0/49</td>
<td>10:00:50:EB:1A:DE:35:08</td>
<td>40G</td>
<td>Yes</td>
<td>&quot;RBridge-16&quot;</td>
</tr>
</tbody>
</table>

RBridge-5# `show fabric route topology dest-rbridge-id 101 src-rbridge-id 4`

<table>
<thead>
<tr>
<th>RB-ID</th>
<th>RB-ID</th>
<th>Index</th>
<th>Interface</th>
<th>ECMP</th>
<th>Grp</th>
<th>Hops</th>
<th>Cost</th>
<th>Index</th>
<th>Interface</th>
<th>BW</th>
<th>Trunk</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>101</td>
<td>112</td>
<td>Fo 4/0/49</td>
<td>14</td>
<td>4</td>
<td>2000</td>
<td>113</td>
<td>Fo 11/0/50</td>
<td>40G</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>104</td>
<td>Te 4/0/41</td>
<td>14</td>
<td>4</td>
<td>2000</td>
<td>108</td>
<td>Te 2/0/45</td>
<td>40G</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RBridge-5#
Link State Routing - FAQ

- Does FSPF support Equal Cost Multi-Path?
- Is the FSPF protocol publically defined?
- Is the FSPF MIB publically defined?
- What configuration options are available to me?
- Can I change the WWN to RBridge ID mapping?

More Questions?
Bifurcated Ring Topology
48-Switch Bisected Ring
Bisected Ring Overview

- **Theory**
  - Essentially a two-dimensional toroidal mesh.
    - Includes a “Master Ring”, that connects all the switches.
    - Includes several “Shortcut Rings”, that bisect the “Master Ring”.

- **Practical Application**
  - The network is divided into four “Quadrants”.
    - A, B, C and D.
  - The “Quadrants” are deployed as evenly as possible.
    - No quadrant should ever have more than one more switch than any other quadrant.
  - “Peer” switches in each quadrant are interconnected with Shortcut Rings.
    - i.e. A1 connects to B1, C1 and D1.
    - There are three patterns for the Shortcut Rings.
In the case of MOC, the “Master Ring” is made up of 4x10G “Brocade Trunks”. Each trunk supports up to 40-Gbps in each direction.

Packets are sprayed across the member links resulting in a relatively even distribution of traffic. Packet sequence within each micro-flow is maintained by the ASICs on either end using proprietary technology.
Shortcut Rings
(Pattern A)
Shortcut Rings (Pattern A)
Shortcut Rings (Pattern B)
Shortcut Rings (Pattern B)
Shortcut Rings
(Pattern C)
Shortcut Rings
(Pattern C)
The Compete Topology
Incremental Build Out
1 Switch
Incremental Build Out
2 Switches
Incremental Build Out
3 Switches
Incremental Build Out
4 Switches
Incremental Build Out
5 Switches
Incremental Build Out
6 Switches
Incremental Build Out
8 Switches
Incremental Build Out
9 Switches
Incremental Build Out
10 Switches
Incremental Build Out
11 Switches
Incremental Build Out
12 Switches
Incremental Build Out
13 Switches
Incremental Build Out
14 Switches
Incremental Build Out
15 Switches
Incremental Build Out
16 Switches
Incremental Build Out
18 Switches
Incremental Build Out
19 Switches
Incremental Build Out
20 Switches
Incremental Build Out
21 Switches
Incremental Build Out
23 Switches
Incremental Build Out
24 Switches
Incremental Build Out
25 Switches
Incremental Build Out
26 Switches
Incremental Build Out
27 Switches
Incremental Build Out
28 Switches
Incremental Build Out
29 Switches
Incremental Build Out
30 Switches
Incremental Build Out
31 Switches
Incremental Build Out
32 Switches
Incremental Build Out
33 Switches
Incremental Build Out
34 Switches
Incremental Build Out
35 Switches
Incremental Build Out
36 Switches
Incremental Build Out
37 Switches
Incremental Build Out
38 Switches
Incremental Build Out
39 Switches
Incremental Build Out
40 Switches
Incremental Build Out
41 Switches
Incremental Build Out
42 Switches
Incremental Build Out
43 Switches
Incremental Build Out
44 Switches
Incremental Build Out
45 Switches
Incremental Build Out
46 Switches
Incremental Build Out
48 Switches
21-Node Cluster
Both switches exist in the same rack.
Introduction to Ethernet Name Services

- FSPF tells us where the RBridges are... but how do I know where my end-stations connect?
- How many places can a “MAC address live?”
RBridge-5# `show mac-address-table`

<table>
<thead>
<tr>
<th>VlanId</th>
<th>Mac-address</th>
<th>Type</th>
<th>State</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>02e0.522f.8801</td>
<td>System</td>
<td>Remote</td>
<td>XX VR1/X/X</td>
</tr>
<tr>
<td>100</td>
<td>50eb.1aa4.19db</td>
<td>System</td>
<td>Remote</td>
<td>XX 101/X/X</td>
</tr>
<tr>
<td>100</td>
<td>50eb.1ade.b077</td>
<td>System</td>
<td>Remote</td>
<td>XX 103/X/X</td>
</tr>
<tr>
<td>101</td>
<td>50eb.1aa4.19db</td>
<td>System</td>
<td>Remote</td>
<td>XX 101/X/X</td>
</tr>
<tr>
<td>125</td>
<td>02e0.52f0.2f01</td>
<td>System</td>
<td>Remote</td>
<td>XX VR1/X/X</td>
</tr>
<tr>
<td>125</td>
<td>50eb.1aa4.19db</td>
<td>System</td>
<td>Remote</td>
<td>XX 101/X/X</td>
</tr>
<tr>
<td>125</td>
<td>50eb.1ade.b077</td>
<td>System</td>
<td>Remote</td>
<td>XX 103/X/X</td>
</tr>
<tr>
<td>250</td>
<td>02e0.52cc.cd01</td>
<td>System</td>
<td>Remote</td>
<td>XX VR1/X/X</td>
</tr>
<tr>
<td>250</td>
<td>50eb.1aa4.19db</td>
<td>System</td>
<td>Remote</td>
<td>XX 101/X/X</td>
</tr>
<tr>
<td>250</td>
<td>50eb.1ade.b077</td>
<td>System</td>
<td>Remote</td>
<td>XX 103/X/X</td>
</tr>
<tr>
<td>1027</td>
<td>02e0.52f1.cd01</td>
<td>System</td>
<td>Remote</td>
<td>XX VR1/X/X</td>
</tr>
<tr>
<td>1027</td>
<td>50eb.1aa4.19db</td>
<td>System</td>
<td>Remote</td>
<td>XX 101/X/X</td>
</tr>
<tr>
<td>1027</td>
<td>50eb.1ade.b077</td>
<td>System</td>
<td>Remote</td>
<td>XX 103/X/X</td>
</tr>
<tr>
<td>1044</td>
<td>02e0.5216.cd01</td>
<td>System</td>
<td>Remote</td>
<td>XX VR1/X/X</td>
</tr>
<tr>
<td>1044</td>
<td>50eb.1aa4.19db</td>
<td>System</td>
<td>Remote</td>
<td>XX 101/X/X</td>
</tr>
<tr>
<td>1044</td>
<td>50eb.1ade.b077</td>
<td>System</td>
<td>Remote</td>
<td>XX 103/X/X</td>
</tr>
</tbody>
</table>

Total MAC addresses : 16

RBridge-5#
Frame Forwarding
A Basic Network

Step 1 – Billy sends a packet to Susie

Does RB 1 know about Susie? Who is the next hop? (RB 2)
A Basic Network

Step 2 – RB 1 puts a TRILL header on the packet, and forwards it to RB 2
A Basic Network

Step 3 – RB 2 changes the MAC addresses, and forwards it to RB 4
A Basic Network

Step 4 – RB 4 pops the TRILL header, and forwards the packet to Susie.

Does RB 1 know about Susie?
Who is the next hop? (RB 2)
The TRILL Header

RFC 6325

Figure 5: TRILL Header

V = Version – 2-bit – Currently “00”
R = Reserved – 2-bit – Currently “00”
M = Multi-Destination – 1-bit – 1=Multicast
Op-Length – 5-bit – How long is the options field?
The TRILL Header

RFC 6325

---

<table>
<thead>
<tr>
<th>V</th>
<th>R</th>
<th>M</th>
<th>Op-Length</th>
<th>Hop Count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5: TRILL Header

Hop Count = Expected Distance
Egress RBridge Nickname
Ingress RBridge Nickname
Options
The BUM Tree

Broadcast / Unknown Unicast / Multicast
Building a Multicast Tree

- One RBridge is the root of the BUM tree.
- A loop-free, shortest path tree is formed to all R Bridges.
- When a BUM frame is received, it is flooded out all other ISL ports on the tree.
- It’s also flooded out of edge ports as appropriate.
RBridge-5# `show fabric route multicast all`

No. of nodes in cluster: 21

Root of the Multicast-Tree

```
Rbridge-id: 2
Mcast Priority: 1
Enet IP Addr: 0.0.0.0
WWN: 10:00:50:eb:1a:a4:29:ac
Name: RBridge-2
```

<table>
<thead>
<tr>
<th>Src-Index</th>
<th>Src-Port</th>
<th>Nbr-Index</th>
<th>Nbr-Port</th>
<th>BW</th>
<th>Trunk</th>
</tr>
</thead>
<tbody>
<tr>
<td>109</td>
<td>Te 101/0/46</td>
<td>105</td>
<td>Te 104/0/42</td>
<td>40G</td>
<td>Yes</td>
</tr>
<tr>
<td>115</td>
<td>Fo 101/0/52</td>
<td>114</td>
<td>Fo 103/0/51</td>
<td>40G</td>
<td>Yes</td>
</tr>
<tr>
<td>114</td>
<td>Fo 102/0/51</td>
<td>115</td>
<td>Fo 103/0/52</td>
<td>40G</td>
<td>Yes</td>
</tr>
<tr>
<td>108</td>
<td>Te 103/0/45</td>
<td>104</td>
<td>Te 19/0/41</td>
<td>40G</td>
<td>Yes</td>
</tr>
</tbody>
</table>

***SNIP***
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# fabric route mcast rbridge-id 101 priority 10
RBridge-5(config-rbridge-id-101)# end
RBridge-5# show fabric route multicast all

No. of nodes in cluster: 21

Root of the Multicast-Tree
==================================
Rbridge-id: 101
Mcast Priority: 10
Enet IP Addr: 0.0.0.0
WWN: 10:00:50:eb:1a:a4:19:d8
Name: RBridge-101

<table>
<thead>
<tr>
<th>Src-Index</th>
<th>Src-Port</th>
<th>Nbr-Index</th>
<th>Nbr-Port</th>
<th>BW</th>
<th>Trunk</th>
</tr>
</thead>
</table>

***SNIP***
L1 & L2 ECMP

Equal Cost Multipath
The ECMP Challenge

Packets can arrive in any order and TCP will re-sequence them.

Packets arriving out of sequence destroy network performance!!!!
An ECMP Example

How can I identify a flow?
How do I select the next-hop RBridge?
Which link should I use?
Won't there be interference?
A Seven Tuple Hash

- Source Port
- Destination Port
- L4 Protocol
- Source IP
- Destination IP
- Source MAC
- Destination MAC

Note: The amount of bandwidth available to a flow is limited (in part) by the amount of bandwidth available in the egress path.
Brocade Trunks
Physical Redundancy

A Quick Review
What Happens If...

An RBridge Failed
Logical Chassis

Centralized vs. Distributed
Chassis vs. Fixed Form Factor

Why would I use one over the other?

- **Chassis Attributes**
  - Expensive
  - Central Physical Form Factor
  - Redundant Management
  - Single Control Plane
  - Single Configuration Point
  - Simple Hardware Replacement

- **Fixed Form Factor Attributes**
  - Less Expensive
  - Distributed Form Factor
  - Integrated Management
  - Multi-Control Plane
  - Multi-Configuration Point
  - Complex Hardware Replacement
Logical Chassis
An effort to support the best of breed.

• Chassis Attributes
  – Expensive
  – Central Physical Form Factor
  – Redundant Management
  – Single Control Plane
  – Single Configuration Point
  – Simple Hardware Replacement

• Fixed Form Factor Attributes
  – Less Expensive
  – Distributed Form Factor
  – Integrated Management
  – Multi-Control Plane
  – Multi-Configuration Point
  – Complex Hardware Replacement
Handling a Common Configuration

Many configuration must be done on the Principal Switch!

The Principal Switch is elected on an “as needed” basis.

The Principal Switch is the guardian of the configuration file.

Any RBridge may become the Principal switch.
RBridge-5# **configure terminal**
Entering configuration mode terminal
RBridge-5(config)# **rbridge-id 5**
RBridge-5(config-rbridge-id-5)# **logical-chassis principal-priority 2**
RBridge-5(config-rbridge-id-5)# **end**
RBridge-5# **logical-chassis principal switchover**
This operation will trigger logical-chassis principal switchover. Do you want to continue? [y/n]: **y**
RBridge-5# **show fabric all**

VCS Id: 101
Config Mode: Distributed

<table>
<thead>
<tr>
<th>Rbridge-id</th>
<th>WWN</th>
<th>IP Address</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>*** SNIP ***</td>
<td>5 10:00:50:EB:1A:A4:0B:C0</td>
<td>172.16.1.224</td>
<td>&gt;=&quot;RBridge-5&quot;*</td>
</tr>
<tr>
<td>*** SNIP ***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Fabric has 21 Rbridge(s)

RBridge-5#
Redundant Management vs. Distributed Control Plane

- Each RBridge runs its own control plane.
- Each RBridge has an internal hypervisor with redundant “management modules”.
- By default, SW/0 is “Primary” and SW/1 is “Standby”.
- In the event of a software crash, a failover will occur.
RBridge-5# **show version**

Network Operating System Software
Network Operating System Version: 5.0.1
Copyright (c) 1995-2014 Brocade Communications Systems, Inc.
Firmware name: 5.0.1d
Build Time: 17:53:30 Jun 12, 2015
Install Time: 16:49:09 Sep 29, 2015
Kernel: 2.6.34.6

BootProm: 1.0.1
Control Processor: e500mc with 4096 MB of memory

<table>
<thead>
<tr>
<th>Slot</th>
<th>Name</th>
<th>Primary/Secondary Versions</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW/0</td>
<td>NOS</td>
<td>5.0.1d</td>
<td>ACTIVE*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0.1d</td>
<td></td>
</tr>
<tr>
<td>SW/1</td>
<td>NOS</td>
<td>5.0.1d</td>
<td>STANDBY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0.1d</td>
<td></td>
</tr>
</tbody>
</table>

RBridge-5#
Replacing a failed RBridge

• Find the WWN of the new RBridge.
  – Either use the “show fabric all” command, or look at the plastic tag on the physical switch.

• Map the new WWN to the RBridge ID
  – From the Principal Switch, run the “vcs replace rbridge-id <rbridge-id>” command. You will be challenged for the WWN of the new switch.

• Connect the new RBridge to the ethernet fabric.

• Run the: “vcs vcsid <value> rbridge-id <value> logical-chassis enable” command on the new RBridge.
Configuring VLANs
VLANs in VCS

- All VLANs are automatically distributed to all RBridges.
  - Inter-Switch Links are automatically configured as “VLAN Trunk” ports that carry all VLANs.
  - All VLANs share a common BUM tree.
- VLANs are globally configured.
- Interfaces must also be configured.
  - VLAN Trunk Ports
  - VLAN Access Ports
RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# interface vlan 2001
RBridge-5(config-Vlan-2001)# description VLAN_Description
RBridge-5(config-Vlan-2001)# end
RBridge-5# show vlan 2001

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Name</th>
<th>State</th>
<th>Ports</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>(F)</td>
<td>FCoE</td>
<td>(u)</td>
<td>Untagged</td>
<td>(F)</td>
</tr>
<tr>
<td>(R)</td>
<td>RSPAN</td>
<td>(c)</td>
<td>Converged</td>
<td>(R)</td>
</tr>
<tr>
<td>(T)</td>
<td>TRANSSPARENT</td>
<td>(t)</td>
<td>Tagged</td>
<td>(T)</td>
</tr>
</tbody>
</table>

======== ======== ============ ===============
2001 VLAN2001 INACTIVE (no member port)

RBridge-5#
Interface Configurations
Default Configuration

RBridge-5# show running-config interface ten 3/0/1
interface TenGigabitEthernet 3/0/1
  fabric isl enable ← Can be an ISL
  fabric trunk enable ← Can be part of a Brocade Trunk
  no shutdown
!
RBridge-5#
Access Port Configuration

RBridge-5# configure terminal
RBridge-5(config)# interface TenGigabitEthernet 3/0/1
RBridge-5(conf-if-te-3/0/1)# switchport
RBridge-5(conf-if-te-3/0/1)# switchport mode access
RBridge-5(conf-if-te-3/0/1)# switchport access vlan 2001
RBridge-5(conf-if-te-3/0/1)# do show run int ten 3/0/1

interface TenGigabitEthernet 3/0/1
  fabric isl enable
  fabric trunk enable
  switchport
  switchport mode access
  switchport access vlan 2001
  spanning-tree shutdown
  no shutdown
!
RBridge-5(conf-if-te-3/0/1)#
VLAN Trunk Port Configuration

RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# int ten 3/0/1
RBridge-5(conf-if-te-3/0/1)# switchport
RBridge-5(conf-if-te-3/0/1)# switchport mode trunk
RBridge-5(conf-if-te-3/0/1)# switchport trunk allowed vlan ?
Possible completions:
  add Allow these VLANs to Xmit/Rx through the Layer2 interface
  all  Allow all Dot1Q VLANs to Xmit/Rx through the Layer2 interface
  except Allow all VLANs except this vlan range to Xmit/Rx through the Layer2 interface
  none  Allow no Dot1Q VLANs to Xmit/Rx through the Layer2 interface
  remove Remove a VLAN range that Xmit/Rx through the Layer2 interface
RBridge-5(conf-if-te-3/0/1)# switchport trunk allowed vlan all
RBridge-5(conf-if-te-3/0/1)# end
RBridge-5#
Virtual LAGs
Virtual LAGs

- Essentially a multi-port edge link.
- Link can be distributed across up to four RBridges.
- No topology restrictions.
- What happens if the switches lose contact with each other?
Configuring a VLAG

RBridge-5# **show running-config interface Port-channel 1**
interface Port-channel 1
  vlag ignore-split
  mtu 9216
  description Port_Channel_to_CSAIL_Switch
  switchport
  switchport mode access
  switchport access vlan 10
  spanning-tree shutdown
  speed 10000
  no shutdown
!
RBridge-5#
Adding an Interface to a VLAG

RBridge-5(config)# int ten 3/0/1
RBridge-5(conf-if-te-3/0/1)# no switchport
RBridge-5(conf-if-te-3/0/1)# channel-group 1 mode ?
Possible completions:
  active    Enable initiation of LACP negotiation on a port
  on        Enable static link aggregation on this port
  passive   Disable initiation of LACP negotiation on a port
RBridge-5(conf-if-te-3/0/1)# channel-group 1 mode active type ?
Possible completions:
  brocade    Brocade LAG
  standard   Standards based LAG
RBridge-5(conf-if-te-3/0/1)# channel-group 1 mode active type standard
RBridge-5(conf-if-te-3/0/1)# no shutdown
Useful Troubleshooting Commands

• show port-channel <value>
• show port-channel detail
• show int port-channel <value>

**NOTE:** The most common reason why your port-channel won’t come up is a speed mismatch between the port-channel and the physical interfaces.
Routing 101
Routing on a Switching Platform

Routing is not distributed across the system, but is configured on each RBridge.
Configuring a Routed Interface

RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# interface vlan 2001
RBridge-5(config-Vlan-2001)# exit
RBridge-5(config)# rbridge-id 3
RBridge-5(config-rbridge-id-3)# interface ve 2001
RBridge-5(config-rbridge-Ve-2001)# ip addr 172.24.100.1/24
RBridge-5(config-rbridge-Ve-2001)# no shutdown
RBridge-5(config-rbridge-Ve-2001)# end
RBridge-5#
VRRPe
Virtual Router Redundancy Protocol Extended
What is VRRP-e

- A modification of the IETF “VRRP” standard.
- Two (or more) physical routers provide services for a virtual router.
- If one router fails, the other router takes over.
- High availability is achieved.

With “short-path-forwarding” enabled, even the backup routers can forward traffic.
Configuring VRRP-extended

RBridge-5# configure terminal
Entering configuration mode terminal
RBridge-5(config)# rbridge-id 3
RBridge-5(config-rbridge-id-3)# protocol vrrp-e
RBridge-5(config-rbridge-id-3)# interface ve 2001
RBridge-5(config-rbridge-Ve-2001)# vrrp-extended 1
RBridge-5(config-vrrp-extended-group-1)# advertise-backup
RBridge-5(config-vrrp-extended-group-1)# short-path-forwarding
RBridge-5(config-vrrp-extended-group-1)# virtual-ip 172.24.100.2
RBridge-5(config-vrrp-extended-group-1)# enable
RBridge-5(config-vrrp-extended-group-1)# end
RBridge-5#
Useful Troubleshooting Commands

- `show vrrp rbridge-id <value>`
- `show vrrp summary rbridge-id <value>`
- `show vrrp detail rbridge-id <value>`
Types of Virtual Fabrics

• Transport Virtual Fabric
  – Allows multiple VLANs to be carried across a single Virtual Fabric.
  – Great for dragging a tenants VLANs across a network.
  – Eliminates the need to coordinate VLANs between tenants.

• Service Virtual Fabric
  – Allows a single VLAN to be carried without the need to de-conflict.
  – Allows VLAN numbers to be changed in flight.
  – Maps well to Virtual Fabric Extension

Both technologies leverage “Fine Grain Labeling”, in RFC 7172
FGL Leverages the Options field of the TRILL header to expand the VLAN ID Space
Configuring Service Fabrics

interface TenGigabitEthernet 3/0/1
  switchport
  switchport mode trunk
  switchport trunk allowed vlan add 2,3100
  switchport trunk allowed vlan add 7000 ctag 3500
  no shutdown
Configuring Transport Fabrics

```conf
interface Vlan 6050
    transport-service 2
    spanning-tree shutdown

interface TenGigabitEthernet 1/4/23
    switchport
    switchport mode trunk
    switchport trunk allowed vlan add 5050 ctag 50-59
```
Virtual Fabric Extension
VF Extension Overview

- Used to extend a Broadcast Domain between locations.
- Uses a VXLAN tunnel:
  - Unencrypted
  - Unprotected
  - Line Rate
- Can be used across a routed infrastructure.
Configuring Virtual Fabrics

VRRPe Configuration

rbridge-id 1
   interface Ve 200
      ip mtu 9018
      ip proxy-arp
      ip address 20.20.20.1/24
      vrrp-extended-group 200
         virtual-mac 02e0.5200.00xx
         virtual-ip 20.20.20.3
         advertisement-interval 1
         enable
         no preempt-mode
         short-path-forwarding
!
   no shutdown

rbridge-id 2
   interface Ve 200
      ip mtu 9018
      ip proxy-arp
      ip address 20.20.20.2/24
      vrrp-extended-group 200
         virtual-mac 02e0.5200.00xx
         virtual-ip 20.20.20.3
         advertisement-interval 1
         enable
         no preempt-mode
         short-path-forwarding
!
   no shutdown
Configuring Virtual Fabrics
Overlay Gateway Configuration

overlay-gateway Extension1
  type layer2-extension
  ip interface Loopback 2
  attach rbridge-id add 1-2
  map vlan vni auto
  site Datacenter2
    ip address 3.3.3.1
    extend vlan add 1-100
  activate

Useful Troubleshooting Commands
• show vlan brief
• show tunnel
• show mac
Automatic Migration of Port Profiles

- Used to automatically configure a port based on who is connected.
  - VLAN
  - Security
  - Quality of Service
  - FCoE
- Connected device is identified by MAC address.
- Can be interfaces with vCenter for automatic configuration.
- Can also be integrated with OpenStack.
Creating a Profile

VDX# configure terminal
VDX(config)# port-profile <profile-name>
VDX(config...)# vlan-profile
VDX(config... ...)# switchport
VDX(config... ...)# THE REST OF THE SWITCHPORT COMMANDS
VDX(config... ...)# no shut
VDX(config... ...)# end
VDX#
Associate a MAC to a Profile

VDX# configure terminal
VDX(config)# port-profile <profile-name> static <mac>
VDX(config)# end
VDX#
Enable a Profile

VDX# configure terminal
VDX(config)# port-profile <profile-name> activate
VDX(config)# end
VDX#
Enable AMPP on an Interface

VDX# `configure terminal`
VDX(config)# `interface <type> <interface>`
VDX(config#)# `port-profile-port`
VDX(config#)# `mtu 9216`
VDX(config#)# `end`
VDX#
Automating AMPP with vCenter

VDX(config)# vcenter <name> url https://<address>
username <name> password <password>
VDX(config)# vcenter <name> activate
VDX(config)#
NSX Integration
NSX Gateway Overview

- Limit of 8 R Bridges in the fabric.
- Can be used to translate between VXLAN and VLAN.
- Can be receive coordinate automatically with the NSX Controller.

Pre-Work

- Create a client certificate and share with NSX
- Configure a VCS Virtual IP Address
Configuring NSX Gateway

```
overlay-gateway nsx_gateway
    attach rbridge-id 1,2
    type nsx
    ip interface ve 10 vrrp-extended-group 100
    attach vlan 5,14-17
    activate

nsx-controller profile 1
    ip address 10.1.2.3
    reconnect-interval 40
```
Thank You