Project Data Center Use cases

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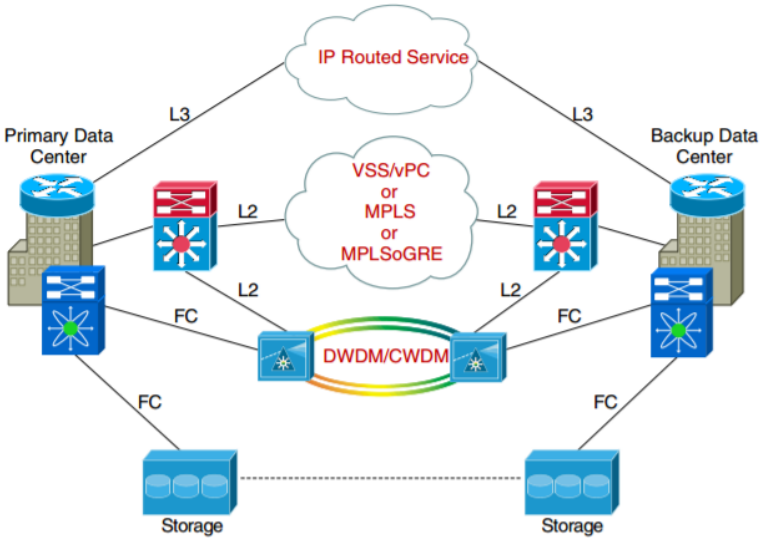
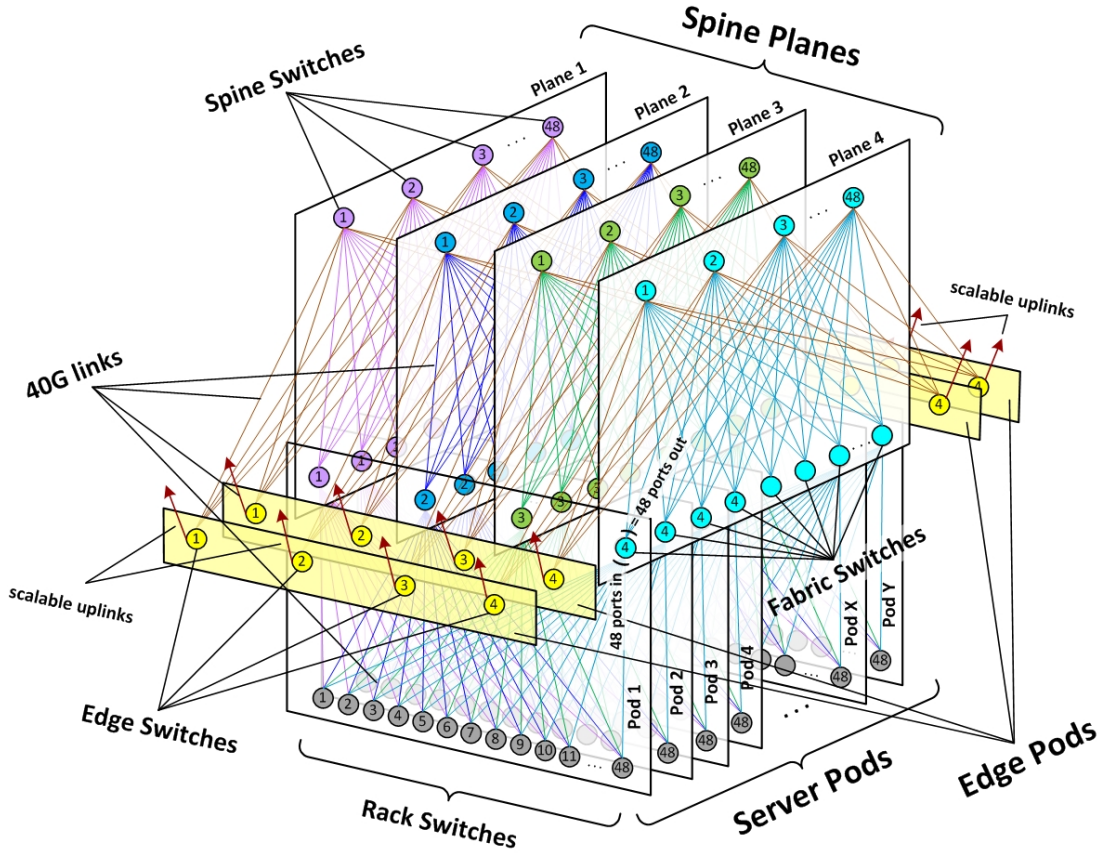
Data Center Interconnect options



Large Data Center Visualization



Introduction

This document is the customer focused and intended as “Use Cases” and System Test plan for Delta Network Switch use in Data Center (DC).

This plan will be reviewed and approved to assure completeness of the testing and to determine the testing schedule. Once testing starts, all test cases can be managed in this plan or within a test case management system. The test results review will become the final validation of the test plan along with any other exit criteria.

1.1 Problem being solved

Hyperscale data centers have architectures that are designed to provide a single, massively scalable compute architecture. The architecture is typically made up of small, individual servers, called nodes that provide compute, storage and networking. These nodes are then clustered together and managed as if they were a single entity. Nodes are typically deployed from inexpensive, off the shelf servers

The idea behind building hyperscale architectures is to start small in order to keep upfront investments as low as possible. This is achieved through simple topologies, which are easy to replicate and expand with manageable cost

Data centers in general are focused around speeds and feeds and scale, often with zero trust security between all subscribers. TOR switches act as Virtual Tunnel End Points (VTEP) with large number of overlapping IP address segments assigned to various subscribers. Low latency and high through put with security and scale are a must. Very little routing and switching feature beyond VxLAN, QoS, ACL and security are not critical to data centers.

Data centers are generally connected via IP in case of VxLAN or VPLS/EoMPLS for traditional L2. Focus of our use cases are on VxLAN plus L3 overlay for DC interconnect

High availability is achieved through traffic management and multiple paths, with ECMP and simple network configuration

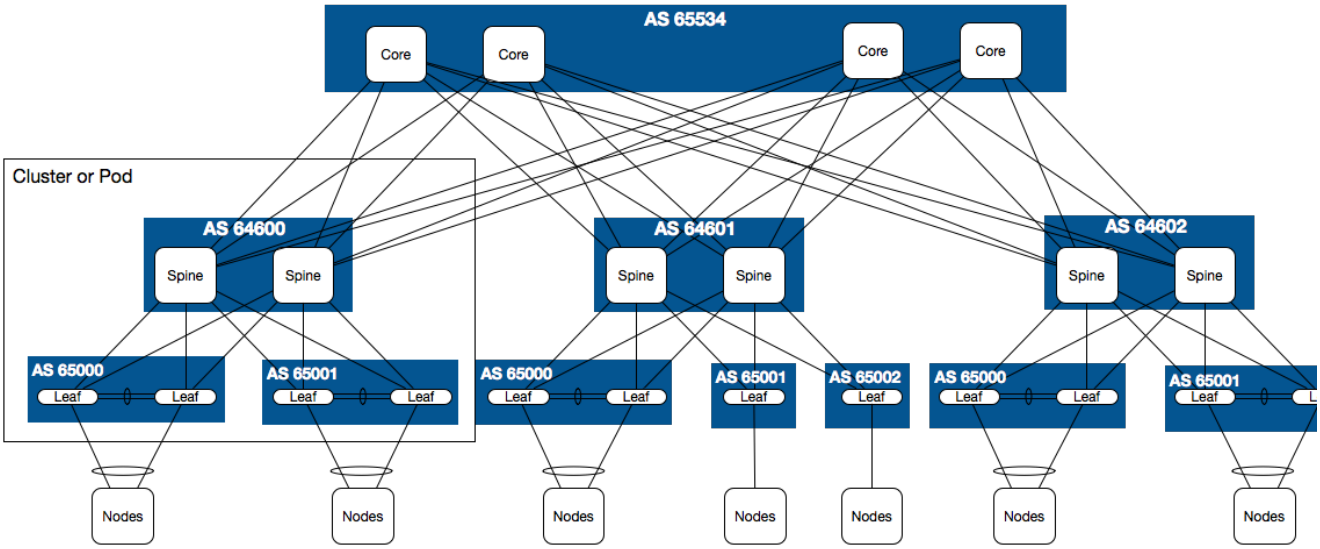
1.2 Benefits

Once use cases are performed on a combination of white-box switch and NOS, boundaries of operations are known and the combination would be more suited for POC and customer trials, and eventually roll out as a system

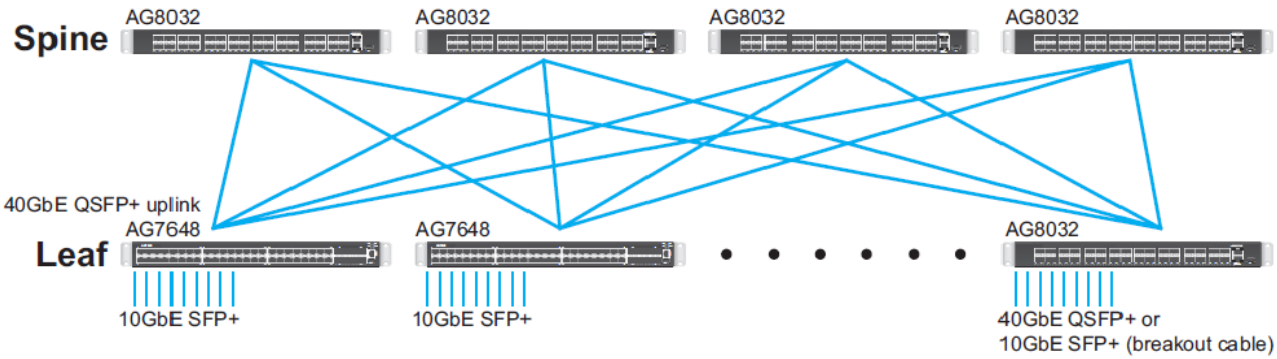
These use cases can be automated and in the future turned over to external entities to perform the qualification on our behalf as NOS and interoperability certification.

Test Topology and Approach

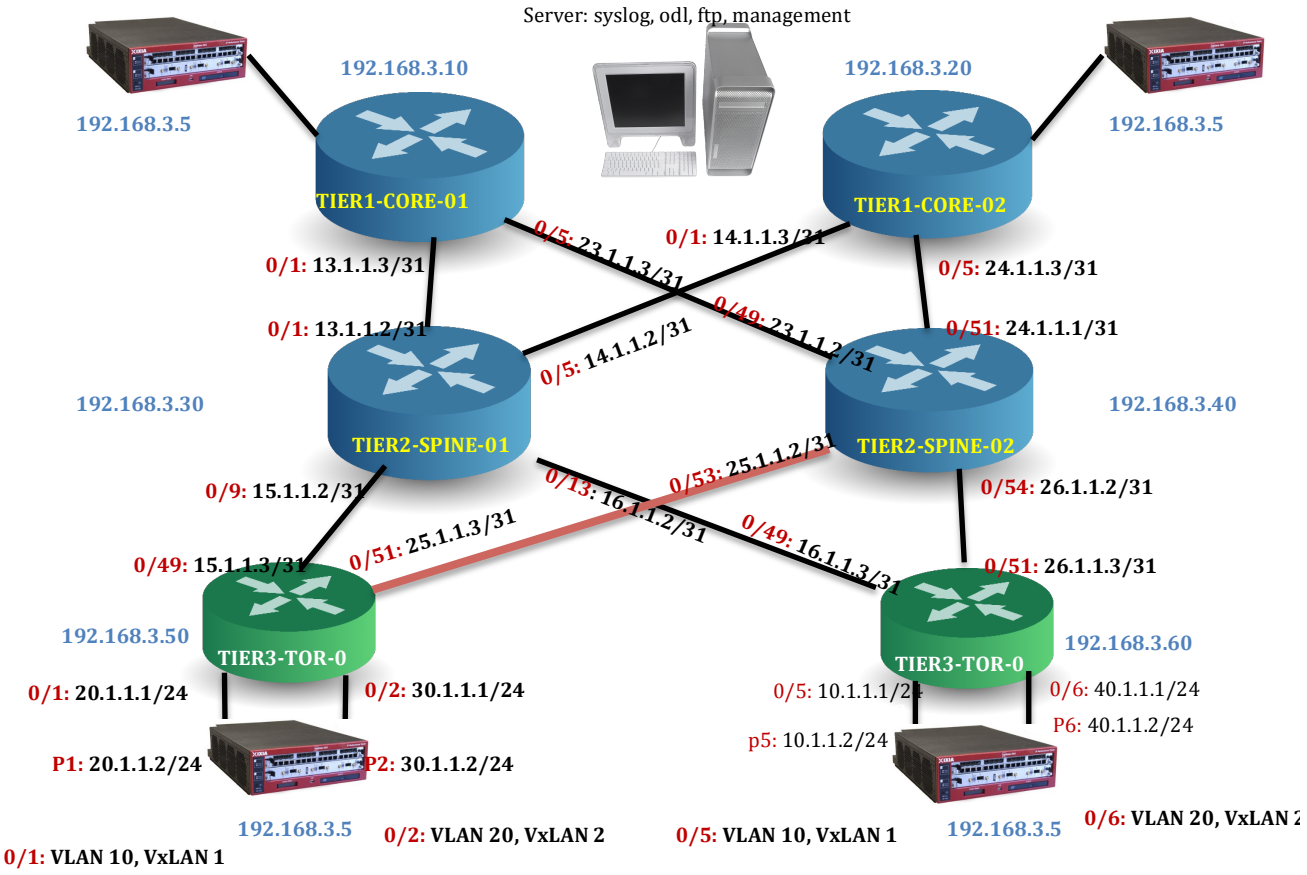
1.1 Use case logical topology



1.2 Three Tier DC topology with Delta Network Delta Network switch



1.3 Lab topology (simulating a cluster or POD)



1.4 Scope

Scope of this document includes limited interoperability with other Vendors granted that we could secure their gear and or have access to their NOS to run on a server or our switch in a VM. All configuration and bring up would be layered at the beginning and verified and all tests would be performed on running system

Native RFC2544 Throughput and Latency for IPv4/IPv6 and Multicast throughput latency are covered by DevTest team in Taipei. RFC2544 in scaled setup across sample subscriber are in scope. Basic functionality test are also covered by NOS supplier and Taipei team and will not be performed in this plan. Fully loaded system and link length and phy validation would be done in Taipei as well

Our test would be with the sample customer use cases at simulated full scale. Following is a list of technology areas covered in

- Provider overlay (EoR, Spine) Basic switch maintenance and bring up
    - Install and provision via USB and FTP
    - Auto install and provisioning via ZTP
    - Continuous Auto configuration via Ansible/Puppet
- Multi-tenant VxLAN - VTEP at the ToR and redundant overlay L3 network
    - eBGP to hide internal infra with VPN for subscriber network connectivity
    - NVGRE, LLDP, VLAN (based on NOS support)
    - ACL (Zero Trust Security), QoS (Simulated Voice, Data, Video), IGP + MPLS/LDP/RSVP with TE
    - ECMP, BFD and mesh network
        - Loss-less traffic with link failure
        - Re-convergence and recover with full path failure
        - Repeat link flap with traffic re-engineering
- Flow-based control (Layer-2 / Layer-3 and OpenFlow simultaneously based on supported NOS)
- Management and monitoring through CLI, NETCONF, RESTConf.

- Hosted Virtual customer and customer's edge
- Simulate large VxLan network through IXIA along with 4 hosted networks with overlapping addresses across the spine and core
- Add EVPN with EVI for VxLAN and tenants point to point
- RFC2544 NDR via 10G across two subscribers in parallel
- Tiered workload, simulated traffic patterns (IMIX through different tenants)
    - Simulated Multicast/unicast traffic
    - Bursty traffic SAN + DFS via multiple tenants

1.5 Equipment needed

Use	Platform	Quantity

ToR: 10G downlink/40G uplink	AG7648	2
Spine: 40G downlink/100G uplink	AG9032	2
Core: 100G downlink/100G uplink	AGC7648	2
Traffic Gen	IXIA - 10G and 100G links	
Server: Syslog, Terminal, …	Virtual Machine	1
Server: OpenFlow controller	Virtual Machine	1
Broadcom ICOS 3.2.x +	Target NOS for white-box	
Ipinfusion 1.2.1.x + OCNOS-DC-MPLS-ZEBM	2nd Target NOS for white-box	Optional not parallel to ICOS

1.6 Execution and Results

Tests will be executed manually with results captured in a Test Information Management System (if one exists). All defects found during testing will be recorded and tracked in Defect Tracking System with following severities:

- **S1**: defect impacting system functionality and requires intervention to recover and has no workaround
- **S2**: defect impacting system functionality and requires intervention to recover but has a workaround to avoid or recover
- **S3**: defect impacting system functionality, but does not require intervention to recover and has a workaround
- **S4**: defect does not impact functionality, but it is critical to be addressed
- **S5**: Cosmetic defects, in spelling, look and feel

On completion of testing documentation of the results will be archived for future references. Test scenarios can be used as use cases externally

1.7 Deliverables

The following deliverables are required for this level of testing:

- Detailed Test Plan (this document)
- Individual Test Case Results
- Saved IXIA sessions and automated scripts in Python at conclusion of test and validation
- Executive Summary and DDTS Reports
- White-paper/MOP as applicable

1.8 Test Background Scale:

Target switch	Feature	Parameters	Per box Scale
~~Spine/Core~~	~~OSPF V2~~		~~100 K (/16 subnet)~~
~~Spine/Core~~	~~OSPF V3~~		~~2 K~~
Spine/Core	Mcast routes		4 K
Spine/Core	BGP peers		60
Spine/Core	BGP routes		600K
Spine/Core	iBGP – (Private ASN 64512- 65534)		1022
~~Spine/Core~~	~~MPLS (head/mid/tail)~~	~~LDP/RSVP~~	~~20 K~~
~~ToR/Spine~~	~~VPC~~		~~600~~
ToR/Spine	VLAN		10 K
ToR/Spine	Simulated Tenants (VxLAN ID)		10 K
ToR/Spine	NVGRE (swap with VxLAN not concurrent)		10 K
~~ToR/Spine~~	~~EVPN (EVi)~~		~~10 K~~

Senario 1 – Provider overlay and edge

Title	Description	Procedure	Pass/Fail	Platform	Test ID

Bring up	Bring up one core switch through flash install and add licenses	Console connect and boot the box. Press DEL and select ONIE install. During ONIE discovery
		
		Stop discovery process
		`# onie-discovery-stop`
		Install image
		`# mkdir /mnt/usb`
		`# mount /dev/sdb1 /mnt/usb`
		`# onie-nos-install /mnt/usb/[installer-image]`
		Install licenses (based on NOS)
		`# license get /mnt/usb/[license-file.bin]`
			New image is booted and version validated		

Bring up	Bring up 2nd core via FTP/HTTP install and add licenses	Stop discovery process
		`# onie-discovery-stop`
		Configure management interface
		`# ifconfig eth0 10.1.1.10 netmask 255.255.255.0 up`
		Install image
		`# onie-nos-install ftp://[ftp-server-path]/[installer-image]`
		Install licenses (based on NOS)
		`# license get ftp://[ftp-server-path]/[license-file.bin]`
			New image is booted and version validated		

Bring up	Bring up switch through DHCP and ZTP. Install image, license and base config	Please see Appendix A	DHCP address is picked up and image is loaded		

Bring up	Configure management interfaces	Configure management port for each switch with an IP address in 192.168.x.x segment
		`# serviceport protocol none`
		`# serviceport ip` *`ipaddress netmask`* `[`*`gateway`*`]`			

Bring up	Configure IP address for interfaces connected	Go into config mode and configure IP address and netmask for the interfaces connected to adjacent switches Please see config details in appendinx B	Once all the connected interfaces are done. Ping ip addresses across to verify that they are all reachable		
Bring up	Configure BGP peering on all switches	See appendix B for router config			

Bring up	Configure IXIA	Configure IXIA and bring up IGP, BGP, MPLS head/tail for the scale plan. Start traffic flow for target tenants. Validate peers, routes, labels and traffic are up • VxLAN IP segments 10.x.x.x (or NVGRE) • NAT at PE to hide internal segments • BGP and external addresses 192.168.x.x. • MPLS labels and RSVP label push and pop at IXIA and forwarded through UUT • VLAN segments to scale • BGP ECMP across multiple links NOTE: for MPLS LDP and RSVP have to use OcNOS	All scaled simulated sessions are up and traffic flowing		
Bring up	Monitoring Traffic from IXIA	Start IMIX traffic through two tenant network. One monitor line rate	Traffic running with 0 drop		
Bring up	DSCP and Diffserve tag	Create tagged traffic via IXIA and start traffic through one Tenant	Marked traffic get higher priority		

Bring up	Mcast traffic, single source multiple receivers	Simulate Mcast traffic, one source multiple receiver on a single tenant	Validate traffic flow		
Bring up	Set up syslog to the external server	`Configure syslog with 'logging syslog' (dependant on the NOS)`	Verify that syslog messages are sent to the log server		
Bring up	Set up NETCONF	NETCONF is dependant on the NOS support. No particular configuration, have to make sure NETCONF yang additions are loaded on the management system used	Get the running config via management device and validate it is reachable		
Bring up	Set up RESTapi	RESTapi is dependant on the NOS support. No particular configuration, have to make sure lighttpd is running on the switch with 'show process proc-list'	If you are using chrom postman or curl command line login via admin and validate you get "ok" response		

Bring up	Setup Flow Controller on the server	Open source base Beacon as an example. Instructions are: https://openflow.stanford.edu/display/Beacon/Home How to setup video at: https://openflow.stanford.edu/display/Beacon/Quick+Start `# openflow enable` Verify the OpenFlow configuration with the following command: (Routing) # show openflow			
Bring up	Setup ftp and http on your server for install scenarios	See Appendix A			

Scenario 2 – Hosted Virtual customer and customer's edge

Note: All these test must be performed with scale and configured above running.
Source of event samples are operations and:
http://research.microsoft.com/en-us/um/people/navendu/papers/sigcomm11netwiser.pdf

Title	Description	Procedure	Pass/Fail	Platform	Test ID
Config	Configure VxLAN (or NVGRE) via CLI	Configure a new host in a controlled tenant via CLI	Validate with show commands		
Config	Configure VxLAN (or NVGRE) via NETCONF or RESTapi depending on OS	Configure a new host in a controlled tenant via NETCONF or RESTapi depending on OS	Validate with show commands		
Config	Change configuration of a host via Puppet agent	Change host Vlan for a tenant via puppet	Verify via CLI		

Config	Change configuration of a host via Ansible	Change host Vlan back for a tenant via Ansible play book
		
		Edit: /etc/ansible/hosts
		
		[ICOS]
		host1 host=192.168.3.10
		port=22 username=admin
		password=broadcom
		
		[local]
		localhost
		ansible_connection=local
		
		Ping via Ansible to make sure you are connected from the UNIX server:
		
		# ansible ICOS -m ping
		ocnos1 | SUCCESS => {
		"changed": false,
		"ping": "pong"
		}
		
		Create a playbook on Ansilbe control server
		See examples in:
		http://docs.ansible.com/ansible/ops_command_module.html
		
		Execute play book from UNIX controller box
		# ansible-playbook <name>.yml
			Verify via CLI		

Access Control	Setup Access control to permit access to web services	Setup access control to block all server access and open web access control only Add configuration over base config in Appendix B `# access-list 10-99 {remark comment} | {[sequence-number]} [rule 1-1023] {deny | permit} {every | srcip srcmask } [log] [time-range time-range-name][assign-queue queue-id] [{mirror | redirect} slot/port] [redirectExtAgent agent-id] [rate-limit rate burstsize]`	Validate traffic to web only and block otherwise		

Access Control	Setup QoS policy range of vlans for a tenant.
	Set Commited Information Rate (CIR)
		Add configuration beyond base config in Appendix B
		`# class-map ucast`
		`# match vlan 10 - 110`
		`# exit`
		`# policy-map ucastpolicy`
		`# class ucast`
		`# police cir percent 70 pir percent 80`
		`# exit`
		`# interface xe45`
		`# service-policy type qos input ucastpolicy`
		`# exit`
			Validate high priority traffic is forwarded in congestion rate limit is applied as configured		

Events	Bring down a redundant link on TOR towards spine	Bring down a redundant link on TOR towards spine. Validate ECMP functionality and traffic flow # config t # interface … # shutdown	Validate with Traffic Gen. Validate configured routes and tunnels		
Events	Bring down a redundant link on Spine towards core	Bring down a redundant link on Spine towards core. Validate ECMP functionality and traffic flow	Validate with Traffic Gen. Validate configured routes and tunnels		
Events	Bursty traffic	Generate line rate bursty traffic from a host in a VM. Validate ODL detects and no other impact comes from this traffic	Validate nothing is impacted due to burst of traffic		
Event	Link Flap	Flap a link 10 times, simulating a drastic event on a link from TOR to spine # config t # interface … # shutdown # no shut	ECMP should handle traffic flow		
Event	Upgrade/Reload a redundant node	Upgrade or power down a TOR with ECMP with traffic flowing # reload	Validate traffic flows through redundant pair		
Event	Route withdraw	On the overlay network simulate route withdraw from IXIA. Re-advertise the routes.	This routing change should not impact traffic on UUT tenents and traffic		
Event	Hot swap poswer module	Simulate hot swap of redundant power module on TOR, Spine and core	This should not impact operations		

Event	Exceeding operating temp: 0-40	Block the fan airflow to increase the operating temp	? Validate alarms are generated and in extended perios switch is shut down		

References

IXIA IxNetwork for even simulation:
https://www.ixiacom.com/products/ixnetwork
Data Center Interconnect (DCI) trends and protocols:
http://www.tmcnet.com/tmc/whitepapers/documents/whitepapers/2015/11138-data-center-interconnect-market-trends-requirements.pdf

Test findings

- Detail configurations are provided in Appendix to allow replication of these tests
- At high scale, 100 clients per VxLAN per site, total of 400 concurrent sessions with traffic, switch console gets very slow and at times non-responsive
- With 40 concurrent sessions and traffic overall system was stable and ran for several days without an issue
- BGP simulation at spine did not have any impact of VxLAN on ToR.
- Tests need to be repeated with combination of IPv4 and IPv6 and pure IPv6
- Network telemetry and visibility is lacking in this space. CLI show limited amount of data with respect to sessions. ARP table and overall traffic flow are the best means to monitor session at this time

Appendix A – Zero Touch Provisioning (ZTP) through DHCP

You can provide image path, license file and base configuration to an Delta Products switch via DHCP server for ZTP. Here are the steps to accomplish that through open source software: 1- Install Ubuntu on your server: https://help.ubuntu.com/community/Installation/FromUSBStick

2- Configure eth0 and ip addresses for basic networking via Ubuntu Gui or ifconfig. Gui is easiest but CLI is also possible: https://help.ubuntu.com/community/NetworkConfigurationCommandLine/Automatic

3- Install vsftpd (if you plan to install to go through ftp) or Apache (if you plan to install through http) and configure the file path https://help.ubuntu.com/lts/serverguide/ftp-server.html https://help.ubuntu.com/lts/serverguide/httpd.html

4- Transfer the Network Operating System (NOS), license file and base configuration file to the server above

5- Install isc-dhcp-server and configure basic DHCP services.

6- Add ZTP options to /etc/dhcp/dhcpd.conf similar to following (note that red items need to match the path to the files in your system:

```
# Zero Touch for Agema ONIE
option ocnos-provision-url code 250 = text;
option ocnos-license-url code 251 = text;
option broadcast-address 192.168.3.255;
option routers 192.168.3.10;
# two nodes defined as Leaf_01_device and Leafe_02_device
range 192.168.3.1 192.168.3.254;
    host Leaf_01_device {
        hardware ethernet 00:18:23:30:8d:00;
        fixed-address 192.168.3.10;
        option default-url "ftp://192.168.3.124/images/ipinfusion/1.2.1/AG_8032-OcNOS-1.2.1.91-DC_MPLS_ZEBM-S0-P0-installer";
        option ocnos-license-url "ftp://192.168.3.124/images/ipinfusion/licenses/triallicense-001823308D00-20161018-60D-T3.bin";
        option ocnos-provision-url "ftp://192.168.3.124/images/ipinfusion/configs/leaf-01.conf";
        }
    host Leaf_02_device {
        hardware ethernet 00:18:23:30:8f:e6;
        fixed-address 192.168.3.20;
        option default-url "ftp://192.168.3.124/images/ipinfusion/1.2.1/AG_8032-OcNOS-1.2.1.91-DC_MPLS_ZEBM-S0-P0-installer";
        option ocnos-license-url "ftp://192.168.3.124/images/ipinfusion/licenses/triallicense-001823308FE0-20161018-60D-T3.bin";
        option ocnos-provision-url "ftp://192.168.3.124/images/ipinfusion/configs/leaf-01.conf";
        }
}
```

7- Restart the DHCP server: sudo service isc-dhcp-server restart

8- Connect to serial console port of the router

9- Reboot – During boot press “Delete” when you are prompted and get into ONIE

10- From the ONIE menu, either select uninstall OS and boot. Or just select Boot

Appendix B – Router running configurations

```
hostname TIER1-CORE-01
ip resilient-hashing

!Current Configuration:
!
!System Description "Broadcom Trident2 56850 AG8032PL System - 32 40G
QSFP, 3.2.1.4, Linux 3.5.0-23-generic, <not found>"
!System Software Version "3.2.1.4"
!System Up Time              "0 days 0 hrs 38 mins 44 secs"
!Cut-through mode is configured as disabled
!Additional Packages         BGP-4,QOS,Multicast,IPv6,Routing,Data Center
!Current System Time: Dec 12 11:42:56 2016
!
vlan database
exit

configure
ip routing
line console
```

```
exit

line telnet
exit

line ssh
exit

ip vrf "management"
exit

!
interface loopback 0
no shutdown
ip address 10.0.0.10 255.255.255.255
exit


interface 0/1
no shutdown
routing
ip address 13.1.1.3 255.255.255.254
exit



interface 0/5
no shutdown
routing
ip address 23.1.1.3 255.255.255.254
exit
```

```
router ospf
exit
router ospf vrf "management"
exit
ipv6 router ospf
exit
router bgp 65534
bgp router-id 10.0.0.10
maximum-paths 24
neighbor 13.1.1.2 remote-as 64601
neighbor 13.1.1.2 fall-over bfd
neighbor 23.1.1.2 remote-as 64601
neighbor 23.1.1.2 fall-over bfd
redistribute connected
address-family ipv4 vrf "management"
exit
address-family vpnv4 unicast
exit
address-family ipv6
exit
exit
exit
```

```
hostname TIER1-CORE-02
ip resilient-hashing

!Current Configuration:
!
!System Description "Broadcom Trident2 56850 AG8032PL System - 32 40G
QSFP, 3.2.1.4, Linux 3.5.0-23-generic, 2015.05-dirty"
!System Software Version "3.2.1.4"
!System Up Time          "0 days 0 hrs 37 mins 6 secs"
!Cut-through mode is configured as disabled
!Additional Packages     BGP-4,QOS,Multicast,IPv6,Routing,Data Center
!Current System Time: Oct    4 07:42:25 2013
!
vlan database
exit

configure
ip routing
line console
exit

line telnet
exit

line ssh
exit

!
interface loopback 0
no shutdown
ip address 10.0.0.20 255.255.255.255
exit
```

```
interface 0/1
no shutdown
routing
ip address 14.1.1.3 255.255.255.254
exit



interface 0/5
no shutdown
routing
ip address 24.1.1.3 255.255.255.254
exit


router ospf
exit
ipv6 router ospf
exit
router bgp 65534
bgp router-id 10.0.0.20
maximum-paths 24
neighbor 14.1.1.2 remote-as 64601
neighbor 14.1.1.2 fall-over bfd
neighbor 24.1.1.2 remote-as 64601
neighbor 24.1.1.2 fall-over bfd
redistribute connected
address-family vpnv4 unicast
exit
address-family ipv6
```

```
exit
exit
exit
```

```
hostname TIER2-SPINE-01
ip resilient-hashing


!Current Configuration:
!
!System Description "Broadcom Trident2 56850 AG8032PL System - 32 40G
QSFP, 3.2.1.4, Linux 3.5.0-23-generic, <not found>"
!System Software Version "3.2.1.4"
!System Up Time              "2 days 3 hrs 54 mins 2 secs"
!Cut-through mode is configured as disabled
!Additional Packages         BGP-4,QOS,Multicast,IPv6,Routing,Data Center
!Current System Time: Dec 14 15:04:02 2016
!
vlan database
exit

configure
ip routing
line console
exit

line telnet
exit

line ssh
exit

spanning-tree mode rstp
!
interface loopback 0
no shutdown
```

```
ip address 10.0.0.30 255.255.255.255
exit


interface 0/1
no shutdown
routing
ip address 13.1.1.2 255.255.255.254
exit



interface 0/5
no shutdown
routing
ip address 14.1.1.2 255.255.255.254
exit



interface 0/9
no shutdown
routing
ip address 15.1.1.2 255.255.255.254
exit



interface 0/13
no shutdown
routing
ip address 16.1.1.2 255.255.255.254
```

```
exit


router ospf
exit
ipv6 router ospf
exit
router bgp 64601
bgp router-id 10.0.0.30
maximum-paths 24
neighbor 13.1.1.3 remote-as 65534
neighbor 13.1.1.3 fall-over bfd
neighbor 14.1.1.3 remote-as 65534
neighbor 14.1.1.3 fall-over bfd
neighbor 15.1.1.3 remote-as 65500
neighbor 15.1.1.3 fall-over bfd
neighbor 16.1.1.3 remote-as 65501
neighbor 16.1.1.3 fall-over bfd
redistribute connected
address-family vpnv4 unicast
exit
address-family ipv6
exit
exit
exit
```

```
hostname TIER2-SPINE-02
ip resilient-hashing


!Current Configuration:
!
!System Description "Broadcom Trident2 56854 AG7648 System - 48 10G
SFP+ and    6 40G QSFP+, 3.2.1.4, Linux 3.5.0-23-generic, 201412130048"
!System Software Version "3.2.1.4"
!System Up Time                "2 days 3 hrs 40 mins 28 secs"
!Cut-through mode is configured as disabled
!Additional Packages        BGP-4,QOS,Multicast,IPv6,Routing,Data Center
!Current System Time: Dec 15 06:13:23 2016
!
vlan database
exit

configure
ip routing
line console
exit

line telnet
exit

line ssh
exit

spanning-tree mode rstp
!
interface loopback 0
no shutdown
```

```
ip address 10.0.0.40 255.255.255.255
exit


interface 0/49
no shutdown
routing
ip address 23.1.1.2 255.255.255.254
exit



interface 0/51
no shutdown
routing
ip address 24.1.1.2 255.255.255.254
exit



interface 0/53
no shutdown
routing
ip address 25.1.1.2 255.255.255.254
exit



interface 0/54
no shutdown
routing
ip address 26.1.1.2 255.255.255.254
```

```
exit


router ospf
exit
ipv6 router ospf
exit
router bgp 64601
bgp router-id 10.0.0.40
maximum-paths 24
neighbor 23.1.1.3 remote-as 65534
neighbor 23.1.1.3 fall-over bfd
neighbor 24.1.1.3 remote-as 65534
neighbor 24.1.1.3 fall-over bfd
neighbor 25.1.1.3 remote-as 65500
neighbor 25.1.1.3 fall-over bfd
neighbor 26.1.1.3 remote-as 65501
neighbor 26.1.1.3 fall-over bfd
redistribute connected
address-family vpnv4 unicast
exit
address-family ipv6
exit
exit
exit
```

```
hostname TIER3-TOR-01
ip resilient-hashing


!Current Configuration:
!
!System Description "Broadcom Trident2 56854 AG7648 System - 48 10G
SFP+ and    6 40G QSFP+, 3.2.1.4, Linux 3.5.0-23-generic, 201412130048"
!System Software Version "3.2.1.4"
!System Up Time                "3 days 3 hrs 24 mins 31 secs"
!Cut-through mode is configured as disabled
!Additional Packages        BGP-4,QOS,Multicast,IPv6,Routing,Data Center
!Current System Time: Dec 16 06:07:00 2016
!
vlan database
vlan 10,20
set igmp 10
set igmp 20
vlan routing 10 1
vlan routing 20 2
exit

configure
ip routing
vxlan enable
vxlan 1 source-ip 10.0.0.50
vxlan 1 vtep 10.0.0.60
vxlan 2 source-ip 10.0.0.50
vxlan 2 vtep 10.0.0.60
line console
exit
```

```
line telnet
exit

line ssh
exit

spanning-tree mode rstp
!
set igmp
ip igmp
ip pim sparse
ip pim rp-address 192.168.10.4 225.0.0.0 240.0.0.0
ip multicast
interface loopback 0
no shutdown
ip address 10.0.0.50 255.255.255.255
exit


interface 0/1
no shutdown
vlan pvid 10
vlan participation exclude 1
vlan participation include 10
routing
ip address 10.1.1.1 255.255.255.0
exit



interface 0/2
no shutdown
```

```
vlan participation exclude 1
vlan participation include 20
vlan tagging 20
routing
ip address 30.1.1.1 255.255.255.0
exit



interface 0/49
no shutdown
routing
ip address 15.1.1.3 255.255.255.254
exit



interface 0/51
no shutdown
routing
ip address 25.1.1.3 255.255.255.254
exit



interface vlan 10
no shutdown
routing
ip address 192.168.10.4 255.255.255.0
ip ospf area 0
ip igmp
ip igmp version 2
```

```
ip pim
exit



interface vlan 20
no shutdown
routing
ip address 192.168.20.4 255.255.255.0
ip ospf area 0
ip igmp
ip igmp version 2
ip pim
exit


router ospf
router-id 10.0.0.50
exit
ipv6 router ospf
exit
router bgp 65500
bgp router-id 10.0.0.50
maximum-paths 24
neighbor 15.1.1.2 remote-as 64601
neighbor 15.1.1.2 allowas-in 3
neighbor 15.1.1.2 fall-over bfd
neighbor 25.1.1.2 remote-as 64601
neighbor 25.1.1.2 fall-over bfd
redistribute connected
address-family vpnv4 unicast
exit
```

```
address-family ipv6
exit
exit
exit
```

```
hostname TIER3-TOR-02
ip resilient-hashing


!Current Configuration:
!
!System Description "Broadcom Trident2 56854 AG7648 System - 48 10G
SFP+ and    6 40G QSFP+, 3.2.1.4, Linux 3.5.0-23-generic, 201412130048"
!System Software Version "3.2.1.4"
!System Up Time                "3 days 3 hrs 24 mins 31 secs"
!Cut-through mode is configured as disabled
!Additional Packages        BGP-4,QOS,Multicast,IPv6,Routing,Data Center
!Current System Time: Dec 17 06:01:15 2016
!
vlan database
vlan 10,20
set igmp 10
set igmp 20
vlan routing 10 1
vlan routing 20 2
exit

configure
ip routing
vxlan enable
vxlan 1 source-ip 10.0.0.60
vxlan 1 vtep 10.0.0.50
vxlan 2 source-ip 10.0.0.60
vxlan 2 vtep 10.0.0.50
line console
exit
```

```
line telnet
exit

line ssh
exit

spanning-tree mode rstp
!
set igmp
ip pim sparse
ip pim rp-address 192.168.10.4 225.0.0.0 240.0.0.0
ip multicast
interface loopback 0
no shutdown
ip address 10.0.0.60 255.255.255.255
exit


interface 0/5
no shutdown
vlan pvid 10
vlan participation exclude 1
vlan participation include 10
routing
ip address 10.1.1.1 255.255.255.0
exit



interface 0/6
no shutdown
vlan participation exclude 1
```

```
vlan participation include 20
vlan tagging 20
routing
ip address 40.1.1.1 255.255.255.0
exit



interface 0/49
no shutdown
routing
ip address 16.1.1.3 255.255.255.254
exit



interface 0/51
no shutdown
routing
ip address 26.1.1.3 255.255.255.254
exit



interface vlan 10
no shutdown
routing
ip address 192.168.30.4 255.255.255.0
ip ospf area 0
ip igmp
ip igmp version 2
ip pim
```

```
exit



interface vlan 20
no shutdown
routing
ip address 192.168.40.4 255.255.255.0
ip ospf area 0
ip igmp
ip igmp version 2
ip pim
exit


router ospf
router-id 10.0.0.60
exit
ipv6 router ospf
exit
router bgp 65501
bgp router-id 10.0.0.60
maximum-paths 24
neighbor 16.1.1.2 remote-as 64601
neighbor 16.1.1.2 allowas-in 3
neighbor 16.1.1.2 fall-over bfd
neighbor 26.1.1.2 remote-as 64601
neighbor 26.1.1.2 allowas-in 3
neighbor 26.1.1.2 fall-over bfd
redistribute connected
address-family vpnv4 unicast
exit
```

```
address-family ipv6
exit
exit
exit
```