

Validated Design Test Report Brief:

Introduction

This document outlines the qualification testing of the 3-Stage Data Center Reference Design with Data Center Director (Apstra). The design is based on an IPV6 ERB (Type 2 and Type 5) EVPN/VXLAN fabric with spine, server leaf and border leaf devices. The goal is to ensure the design is well-documented and will produce a reliable, predictable deployment for the customer.

This validated design will describe how to provision EVPN/VXLAN 3-stage IPv6 ERB Datacenter design with Data Center Director (Apstra), following the existing 3-Stage Data Center Design but the solution will be implemented using IPv6 instead of IPv4.

The qualification objectives include validation of blueprint deployment, device upgrade, incremental config pushes/provisioning, Telemetry/Analytics checking, failure mode analysis, and verification of host traffic. Hardware models and software release for each device role will be explicitly listed.

Table 1. Platform Updates

Updates	Leaf	Border Leaf	Spine	Access
New Broadcom TD5 chip EVO QFX Platforms	QFX5140-24CD	QFX5140-24CD	QFX5140-24CD	
Trident chip (TD4) platforms	QFX5130-48C/CM	QFX5130-48C/CM	QFX5130-48C/CM	
Trident chip (TD4) platforms (QFX5130-32CD)	QFX5130-32CD		QFX5130-32CD	
Trident chip (TD4) platforms (QFX5700)	QFX5700 / QFX5700E		QFX5700	

Updates	Leaf	Border Leaf	Spine	Access
Tomahawk 4 QFX5230			QFX5230-64CD	
Tomahawk 5 QFX5240/41 (variant 1)			QFX5241-64QD / QFX5241-640D	
Tomahawk 5 QFX5240/41 (variant 2)			QFX5240-640D / QFX5240-64QD	
Tomahawk 5 (additional)			QFX5241-320D	
Introducing Access layer switches				EX4400

Key Feature Updates

- Support for overlapping VLANs using multiple MAC-VRF instances
- Enhanced scaling and performance capabilities

Profile Summary

The design is based on an ERB (Edge Routing and Bridging) EVPN/VXLAN fabric supporting both Type 2 and Type 5 routes.

The topology includes: - Spine, server leaf, and border leaf switches - Access layer switches - Underlay Network (all NON-AE links) - 100G leaf-to-spine - Border Leaf links to external router, and DC interconnections - EBGp underlay IPv6 - BFD with default Apstra timers - Overlay Network - eBGP peering with Loopbacks - ERB EVPN/VXLAN vlan-aware with MAC-VRF instances - Single and dual-homed access with ESI-LAG, non-AE and AE (with LACP) using 10G and 1G links - EP-style trunk access - IPv6 access hosts - IRB with anycast IP and static IRB/IFL MAC inside VRFs for L3 access - ECMP - SNMP - storm-control - T2 & T5 route co-existence - Routing Protocols over L3 interfaces overlay L3 VRF (Border Leafs) - Route Policies for overlay L3 Route import/export/filtering - DHCP Relay - DHCP Forwarding (L2 overlay) IntraSwitch / Interswitch / Across DCI - BPDU Block on Edge - sFlow - Graceful Restart (for EVPN/Applicable Protocols) - Data Center Interconnect over-the-top (DCI_OTT)

Host IPs and VLANs are emulated on test ports to enable end-to-end traffic validation.

An external MX gateway injects a default route into approved VRFs for northbound connectivity. This route is redistributed by the border leaf switches. The border leafs also function as DCI gateways, extending the underlay network via Overlay Transport Tunnel (OTT) to two additional data centers.

An sFlow collector is connected to a leaf switch, with its host route redistributed into the underlay. All fabric devices export sFlow telemetry for both WAN-facing and access interfaces.

Test Strategy

The primary objective of this test plan is to validate that the design is robust, well-documented, and capable of delivering a reliable and predictable deployment experience.

Qualification objectives include: - Blueprint deployment validation - Device upgrade testing - Incremental configuration pushes and provisioning - Telemetry and analytics verification - MAC mobility (MAC move) validation - Failure scenario analysis - End-to-end traffic verification

Hardware platforms and software versions are explicitly defined for each device role.

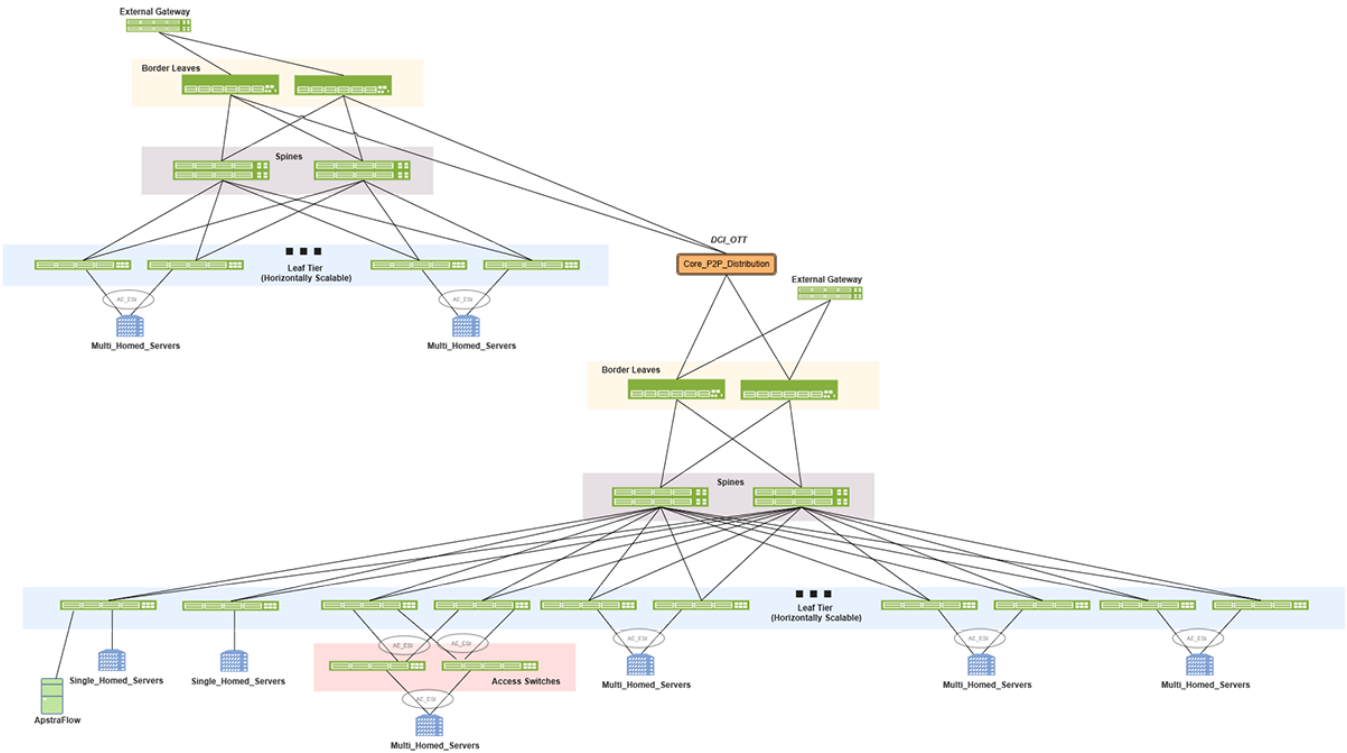
Primary EVPN/VXLAN Commands

Command	What it shows	Why it's valuable
show vlans	VLANs, VNIs, interfaces	Maps VLAN to access, ESI, and VTEP interfaces
show vlans extensive	VLAN details, MAC count, IRB	Adds MAC scale and L3 interface visibility
show evpn instance brief	EVPN instance stats	Quick health view (IRBs, MACs, interfaces)
show evpn instance extensive	Full EVPN details	Deep troubleshooting (ESI, DF election, MAC state)
show evpn database	MAC/IP routes + source	Validates MAC/IP learning and location
show evpn database extensive	Routes + history/log	Debugs mobility and route changes
show evpn globals	Global EVPN + underlay state	Confirms convergence and underlay health
show evpn interface	Interface → VLAN/VNI mapping	Quick view of access + IRB participation
show evpn ip-prefix-database	Type-5 IP prefix routes	Validates L3 EVPN route import/export
show evpn l3-context extensive	Per-VRF L3 EVPN details	Shows VNI, router MAC, and L3 EVPN behavior

Supporting / Scale & Validation Commands

Command	What it shows	Why it's valuable
<code>show ethernet-switching mac-ip-table instance</code>	MAC+IP bindings	Confirms local vs remote learning and forwarding state
<code>show route summary table bgp.evpn.0</code>	EVPN route counts	Quick EVPN scale check
<code>show route table bgp.evpn.0 match "^2:" count</code>	Type-2 routes	Counts MAC/IP (L2) routes
<code>show route table bgp.evpn.0 match "^5:" count</code>	Type-5 routes	Counts IP prefix (L3) routes
<code>show ethernet-switching vxlan-tunnel-end-point remote summary</code>	Remote VTEPs	Verifies overlay peers
<code>show route summary</code>	IPv6 route scale	Overall routing health check
<code>show ipv6 neighbors</code>	ND entries	Validates L3 host reachability
<code>show pfe route summary</code>	FIB usage	Checks hardware forwarding utilization
<code>show ethernet-switching global-information</code>	MAC limits, aging timers	Confirms L2 behavior and scaling

Topology



Platforms, Controllers and Roles

Tag	Role	Model	OS	Linecard	RE	Fabric	VC	Helper/DUT	Additional Info
R0	Spine	QFX5200-128C	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Tomahawk 3
R1	Spine	QFX5200-128C	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Tomahawk 3
R0	Spine	QFX5200-32C	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Tomahawk
R1	Spine	QFX5200-32C	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Tomahawk
R0	Spine			NA	NA	NA	NA	DUT	

Tag	Role	Model	OS	Linecard	RE	Fabric	VC	Helper/DUT	Additional Info
		QFX5230-64CD	JUNOS EVO 25.2X100-D30						Broadcom Tomahawk 4
R1	Spine	QFX5230-64CD	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Tomahawk 4
R0	Spine	QFX5130-48CM	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R1	Spine	QFX5130-48CM	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R0	Spine	QFX5120-48YM	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R1	Spine	QFX5120-48YM	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R0	Spine	QFX5140-24CD	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 5
R1	Spine	QFX5140-24CD	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 5
R2	LEAF	QFX5120-48Y-8C	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R3	LEAF	QFX5120-48Y-8C	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom

Tag	Role	Model	OS	Linecard	RE	Fabric	VC	Helper/DUT	Additional Info
									Trident 3
R4	LEAF	QFX5120-48YM	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R5	LEAF	QFX5120-48YM	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R6	LEAF	QFX5120-32c	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R7	LEAF	QFX5120-32c	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R8	LEAF	QFX5700	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R9	LEAF	QFX5700	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R10	LEAF	QFX5130-48CM	Junos EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R11	LEAF	QFX5130-48CM	Junos EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R12	LEAF	QFX5140-24CD	Junos EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 5
R13	LEAF			NA	NA	NA	NA	DUT	

Tag	Role	Model	OS	Linecard	RE	Fabric	VC	Helper/DUT	Additional Info
		QFX5140-24CD	Junos EVO 25.2X100-D30						Broadcom Trident 5
R14	BORDERLEAF	QFX5130-48CM	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R15	BORDERLEAF	QFX5130-48CM	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R16	BORDERLEAF	QFX5130-32CD	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R17	BORDERLEAF	QFX5130-32CD	JUNOS EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 4
R18	BORDERLEAF	QFX5120-48YM	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R19	BORDERLEAF	QFX5120-48YM	JUNOS 25.2R2-S2	NA	NA	NA	NA	DUT	Broadcom Trident 3
R20	BORDERLEAF	QFX5140-24CD	Junos EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 5
R21	BORDERLEAF	QFX5140-24CD	Junos EVO 25.2X100-D30	NA	NA	NA	NA	DUT	Broadcom Trident 5
R22	ACCESS			NA	NA	NA	NA	DUT	

Tag	Role	Model	OS	Linecard	RE	Fabric	VC	Helper/DUT	Additional Info
		EX4400-48MP	JUNOS 23.4R2-S8						
R23	ACCESS	EX4400-48MP	JUNOS 23.4R2-S8	NA	NA	NA	NA	DUT	
R24	ACCESS	EX4100-48MP	JUNOS 23.4R2-S8	NA	NA	NA	NA	DUT	
R25	ACCESS	EX4100-48MP	JUNOS 23.4R2-S8	NA	NA	NA	NA	DUT	
R26	External_Gateway	MX304	JUNOS 25.2R2-S2	NA	NA	NA	NA	Helper	External Gateway DC1
RT0	Tgen	Spirent	SpirentOS	NA	NA	NA	NA	Helper	Access hosts / DHCP Client/ server

Scale

Item	Value
VTEPs	25
VRFs	25
Switching Zones (MAC-VRF-Instances)	20
VLANs	2000
IRB Interfaces	2000
Global MACs	55000
Global MAC-Ips	55000
Global NDP Hosts	16274

Item	Value
BGP Total Paths	426468
BGP Active Paths	213202

High Level Features

Feature	Description
IPv6 Fabric Addressing	Underlay and overlay link addressing via rack-based blueprint
Firewall Filters	Profiles for loopback interface to protect the device from unwanted control plane traffic
sFlow	Configlets to send sFlow records via Fabric Underlay
Single-homed Access Links	Up to 2,000 VLANs per access interface, distributed between routing and switching zones. IPv4 and IPv6 access hosts per VLAN. DHCPv4 and DHCPv6 client and server emulation on selected VLANs.
Multi-homed Access Links	AE bundles with ESI and LACP shared between ESI leaf pairs. Up to 2,000 VLANs per access AE bundle, distributed between routing and switching zones. IPv4 and IPv6 access hosts per VLAN. DHCPv4 and DHCPv6 client and server emulation on selected VLANs.
Border Leaf Pair	Data Center Director border Leaf function with links to access hosts, DCI Peers, and external generic systems. BGP peering from each VRF to the Generic System to provide connectivity between VRFs, external DHCP server, remote DCI, and external hosts.
EBGP underlay and overlay	Default routing profile for the Data Center Director blueprint.
IP ECMP with fast-reroute	Equal Traffic Distribution at all multipath points (i.e. Leaf-to-Spine1/Spine2), tested in steady state and with link/protocol/device/process flapping.
BFD	Underlay and Overlay BFD with BGP at timers of both 1000 msec and 3000 msec

Feature	Description
	respectively validated in steady state and with link/protocol/device/process flapping.
Multiple MAC-VRF Instance	Data Center Director default routing-instance type for Layer2. Multiple instances per leaf, with 1 VXLAN VNI per VLAN, and vlan-aware service-type
Layer 3 IRB interface	1 L3 IRB address per VLAN/VNI. Same address/MAC used on all leaves per VLAN/VNI. 9000 Byte MTU.
EP-style Access interface	Data Center Director default VLAN configuration style
Type 2 routing	Default Data Center Director L2 route announcement type
Type 5 routing	Default Data Center Director ip-prefix-routes announcement type
DCI	OTT DCI to link 2 Fabrics
DHCP Relay	Per-VRF DHCP forwarding and relay-source override profile
LLDP	Data Center Director default link discovery mechanism
Duplicate MAC detection	Data Center Director default MAC-VRF setting
BGP Graceful Restart	All BGP peers
Asymmetric IRB	Default Data Center Director IRB Method
System Monitoring via AOS (Telemetry)	Probes to Report Anomalies
Selective Tenant Interconnectivity	Real-world scenarios to demonstrate only subset of hosts to be allowed access
Storm Control	Configlets to adjust storm-control policing
RE Protect Filter	Firewall Configlet to accept/discard/police selectively on control plane traffic to the routing engine
MAC Mobility	Support MAC Host moves across DC

Events and Triggers Test

Test	Details
Create agent profiles for managed devices	Data Center Director deployment step as documented in validated design
Create agent profiles for managed devices	Data Center Director deployment step as documented in validated design
Create resource pools for topology	Data Center Director deployment step as documented in validated design
Create pristine configurations and acknowledge managed devices	Data Center Director deployment step as documented in validated design
Create a logical device for spine	Data Center Director Deployment step as documented in validated design
Create a logical device for leaf devices	Data Center Director deployment step as documented in validated design
Create interface maps for spine devices	Data Center Director deployment step as documented in validated design
Create interface maps for leaf devices	Data Center Director deployment step as documented in validated design
Create a rack type for ESI leaf pair + 4 servers	Data Center Director deployment step as documented in validated design
Create a rack type for single leaf	Data Center Director deployment step as documented in validated design
Create a rack type for border leaf	Data Center Director deployment step as documented in validated design
Create blueprint template	Data Center Director deployment step as documented in validated design
Create a blueprint with the template	Data Center Director deployment Step as documented in validated design
Assign all resource pools for the blueprint	Data Center Director deployment Step as documented in validated design
Update cabling map	Data Center Director deployment step as documented in validated design
Commit the blueprint	Data Center Director deployment step as documented in validated design
Configure overlay network routing zones	Data Center Director deployment step as documented in validated design

Test	Details
Assign EVPN resource pools	Data Center Director deployment step as documented in validated design
Create virtual networks	Data Center Director deployment step as documented in validated design
Commit overlay updates	Data Center Director deployment step as documented in validated design
Verify overlay connectivity	Validate forwarding plane establishment with test traffic
Verify sFlow records	FlowData reporting
Data Center Director device state changes	Fabric synchronization with Data Center Director intent
Remove and add tenants	Fabric synchronization with Data Center Director intent
Reboot devices	Fabric resiliency with topology triggers
Server link failure	Fabric resiliency with topology triggers
Multihomed link failure	Fabric resiliency with topology triggers
Leaf to spine link failure	Fabric resiliency with topology triggers
Process restart	Fabric resiliency with topology triggers
MAC move	Tenant resiliency with topology triggers
Deactivate BGP on leaf	Fabric resiliency with topology triggers
Reset DHCP bindings	Tenant resiliency with topology triggers
Longevity tests	Stability over time
Extended negative testing	Stability over time
Scaling targets	Scale
Provision multiple MAC-VRF instances	Data Center Director deployment step as documented in validated design
Intra MAC-VRF traffic validation	

Test	Details
	Validate forwarding plane establishment with test traffic
Inter MAC-VRF isolation	Validate forwarding plane establishment with test traffic
EVPN route separation across MAC-VRFs	Validate control plane in fabric with Data Center Director intent
External Routing per MAC-VRF Instance	Validate control plane in fabric with Data Center Director intent
MAC-VRF lifecycle operations	Tenant resiliency with topology triggers
DCI topology provisioning	Data Center Director deployment step as documented in validated design
Inter-DC L2 connectivity	Validate forwarding plane establishment with test traffic
Inter-DC L3 connectivity	Validate forwarding plane establishment with test traffic
External connectivity via DCI	Validate forwarding plane establishment with test traffic
DCI failure handling	Tenant resiliency with topology triggers

Traffic Profiles

Tenant Traffic Flow Attributes	Description
Packet Size	Mixed packet lengths 128-1500Bytes
Jumbo Frames	Streams which can test maximum MTU
Layer 3	IPv4 and IPv6 Tenant Addressing
Layer 4	Distributed TCP/UDP src/dst ports
INTRA-VLAN	A group of VLANs present on all leaves, and under 1 routing-zone (i.e. RED_ZONE VLAN 400-409, configured on all src/destination leaves for the stream)
INTER-VLAN	VLANs under 1 routing-zone, but some destination hosts are not part of a locally configured VLAN (i.e. RED SRC VLANs 410-419 -> RED DST VLANs

Tenant Traffic Flow Attributes	Description
	420-429). These streams are crucial for testing Type2 Symmetric IRB.
Bridged Overlay	VLANs part of a bridged-overlay, so no L3 possible. (i.e. green VLANs src/dst 2500-2509, no IRB gateway on leaves)
Bridged Overlay - Restricted	Bridged-overlay source VLANs attempting to access hosts in another routing-zone. Traffic will be dropped
Inter-VRF	Traffic between L3 routing-zones (i.e. source hosts in RED_ZONE -> destination hosts in BLUE_ZONE)
External	Bidirectional traffic from hosts to external routes known via the MX external gateway
DCI	INTER-VLAN, INTER-VLAN, Bridged-OVERLAY, INTER-VRF Traffic between PODs
DHCP	Streams for DHCP client/servers in same Fabric, streams for DHCP local clients and remote external DHCP servers
Attack Streams	Streams to test DOS traffic to Leaf and Spine routing-engines to different protocol ports (i.e. BGP / BFD, etc...). These streams are crucial for testing the loopback protection Filter
MAC Spoofing	Streams with spoofed MAC addresses
Overlapping VLANs	Streams from a switching zone on VLANs which occur in another switching (MAC-VRF) zone

Known Limitations

When setting MAC-VRF instance on QFX5120 and QFX5110 leaf devices, the following CLI command is required - set forwarding-options evpn-vxlan shared-tunnels.

Once Data Center Director applies this command, the device will require a reboot and Data Center Director will report this as an anomaly until the device is manually rebooted.

Data Center Director configlets may be required in order to adjust the memory allocation of forwarding table resources to optimize the memory available for different address types based on the needs of your network.

For more information on these features, refer to:

[Junos Multicast Layer 2 Forwarding](#)

By default, Data Center Director applies the host profile to all Junos Evo QFX devices except the QFX5140. A dedicated configlet has been added for the QFX5140 to ensure the host profile is applied consistently across all Evo QFX platforms.

Known Data Center Director telemetry limitations captured below.

- Interface counters data in Data Center Director and device is not matching at least to its closest values.
- Under Analytics telemetry Services → Resource and Disk Utilization, selecting a device results in the error: Network Device not found.
- IRB interfaces are not populated under telemetry-analytics-interfaces section

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