Juniper® Validated Design

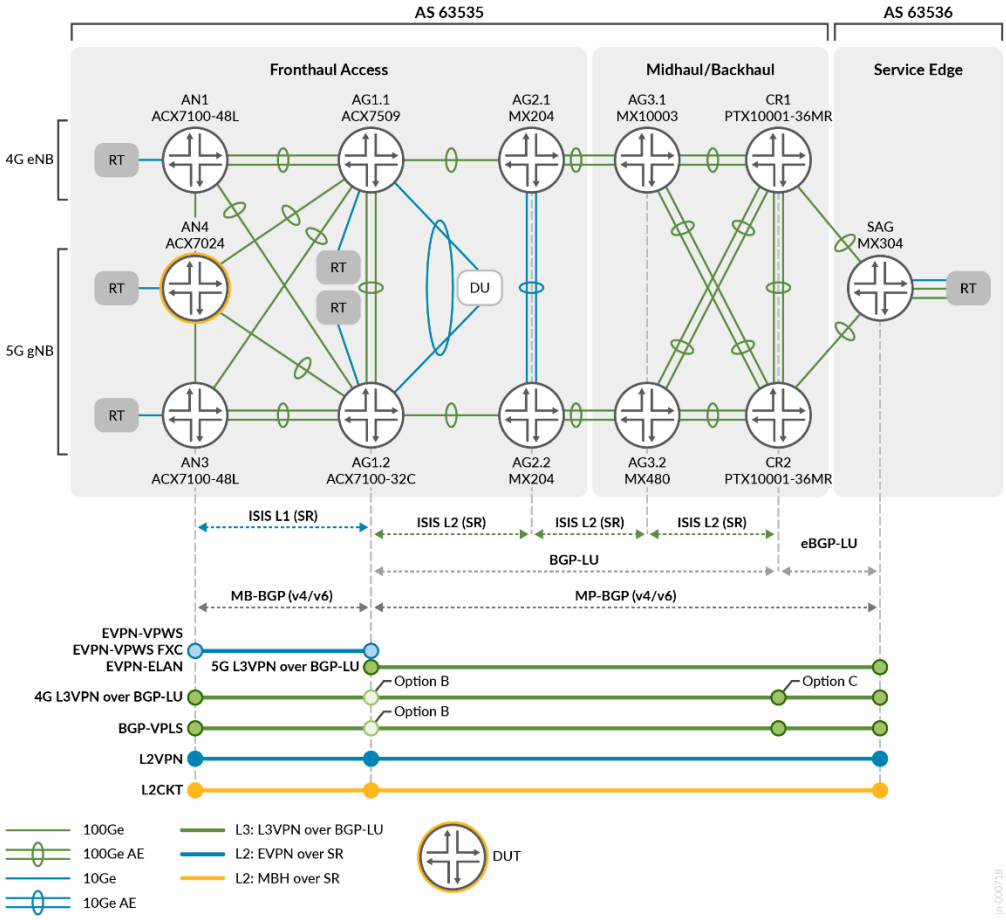
JVD Test Report Brief: 5G Fronthaul Network Using Seamless MPLS Segment Routing

Introduction

This test report brief outlines the summary of the validation that we have conducted for the 5G xHaul network reference design with focus on Cell Site Router (CSR), supporting Fronthaul, Midhaul, and Backhaul services, including EVPN, L2VPN, L2 circuit, VPLS, and L3VPN over Seamless MPLS Segment Routing with focus on ACX7024 Junos OS Evolved platform as the featured CSR DUT. Fronthaul services and Class of Service (CoS) operations related testing is performed on the DUT.

The access segment is expanded with ACX7100-48L (AN1 and AN3), leading to Pre-Aggregation supported by Hub Site Routers (HSRs) ACX7509 (AG1.1) and ACX7100-32C (AG1.2). Aggregation segment is supported by MX204 (AG2.1 and AG2.2) and MX10003 (AG3.1)/MX480 (AG3.2). Core routers include PTX10001-36MR (CR1 and CR2). The MX304 is introduced to the JVD as Services Aggregation Gateway (SAG) supporting dense services termination from both CSR and HSR segments.

Test Topology



Platforms Tested

Role	Platform	OS
Access node 4 (AN4 (DUT))	ACX7024	Junos OS Evolved 22.3R2-S2
Access node 3 (AN3)	ACX7100-48L	Junos OS Evolved 22.3R2-S2
Access node 1 (AN1)	ACX7100-48L	Junos OS Evolved 22.3R2-S2
Aggregation node 1.1 (AG1.1)	ACX7509	Junos OS Evolved 22.3R2-S2
Aggregation node 1.2 (AG1.2 (DUT))	ACX7100-32C	Junos OS Evolved 22.3R2-S2
Aggregation node 2.1 (AG2.1)	MX204	Junos OS 22.3R2-S2
Aggregation node 2.2 (AG2.2)	MX204	Junos OS 22.3R2-S2
Aggregation node 3.1 (AG3.1)	MX10003	Junos OS 22.3R2-S2
Aggregation node 3.2 (AG3.2)	MX480	Junos OS 22.3R2-S2
Core router 1 (CR1)	PTX10001-36MR	Junos OS Evolved 22.3R2-S2
Core router 2 (CR2)	PTX10001-36MR	Junos OS Evolved 22.3R2-S2
R16 Service aggregation node (SAG)	MX304	Junos OS 22.3R2-S2

Version Qualification History

This JVD has been qualified in Junos OS Release 22.3R2-S2 and Junos OS Evolved Release 22.3R2-S2.

Scale and Service Details

Table 1: Access Nodes Validated Scale Parameters

AN/CSR ACX7024 Scale	
Parameter	**JVD-ACX7024 (AN4)**
AE groups	2
AE member links	~2
RIBv4	~200000
FIBv4	~100000
OSPF sessions	50 VRF
EBGP sessions	50 VRF
EVPN-VPVVS A/A MH	100

AN/CSR ACX7024 Scale	
Parameter	**JVD-ACX7024 (AN4)**
EVPN-VPWS SH	200
EVPN-VPWS FXC SH VLAN-aware	50
EVPN-VPWS FXC MH VLAN-aware	50
EVPN-ELAN	50
L2 circuit sessions	100
L2 VPN sessions	50
L3 VPN instances	100
VPLS instances	100
MAC scale – VPLS	5000
CFM UP MEP Is interval	300

Performance Data

Table 2: Aggregated Number of Flows Validated Simultaneously in the Topology

Stream Block	Aggregate Number of Flows	Aggregate FPS	Packet Sizes Tested
IPv4 (Global)	4	4000	512
EVPN-VPWS MH	14	107400	512/1000
EVPN-VPWS SH	4	4000	512
L2CKT	52	30400	512/1000
VPLS	42	23600	512/1000
L2VPN	40	24600	512/1000
L3VPN	52	52000	512

High Level Features Tested

Summary of the key features and functions under test:

- VPN services, including L3VPN, EVPN-VPWS, EVPN-FXC, EVPN-ELAN, BGP-VPLS, L2 circuit, and L2VPN over SR-MPLS transport architecture, which includes combinations of single-homing and multihoming.

- TI-LFA redundancy mechanisms over Segment Routing with Seamless MPLS/BGP-LU.
- Network resiliency, traffic restoration, and measured convergence time for ACX7024 (AN4) with adjacent link failures for all traffic types.
- Solution resilience of Layer 2/Layer 3 flows Access Node (AN) to Pre-Aggregation AG1 (O-RU to O-DU).
- Input and output VLAN operations for the normalization of all VPN services.
- CoS foundational mechanisms:
  - Classification of traffic based on DSCP, 802.1p and EXP with Packet Loss Priority (PLP) high and low.
  - Preservation of QoS codepoints end-to-end for inner and outer tags.
  - Support of ingress classification using Fixed and Behavior Aggregate styles.
  - Creation of at least six Forwarding Classes and six Queues (all featured platforms support eight queues).
  - Two-priority queue scheduling (strict-high and low) with percentage TR and buffers.
  - Strict-high queue preempts low priority queues.
  - Strict-high queue shaping prevents starving low priority queues.
  - Port shaper inherits scheduler characterization.
  - Rewrite operations based on queue assignment supports 802.1p, DSCP, and EXP.
  - Rewrite for single-tagged and dual-tagged (outer only) frames.
- Latency budgets for non-congested scenarios where <100% line rate is offered while strict-high queue is in-profile.
  - O-RU-to-O-DU latency equates to averaging ≤10µ per device (≤6µs single DUT).
  - RU-to-SAG latency ≤10ms (expected ≤150µ).
- Congestion scenarios.
  - Preservation of highest priority (eCPRI) fronthaul traffic.
  - Traffic priorities are maintained across shared links.
  - Traffic priorities are maintained within and between VPN services that share common links.

Event Testing

- Validation of traffic scheduling during network congestion/non-congestion for various traffic classes.
- Validation of latency for various traffic types during network congestion/non-congestion.
- Node Reboot to evaluate the impact in the network.
- Restart critical Junos OS processes (Routing Protocol Process, Chassis Process)
- Traffic recovery was validated post all failure scenarios.
- Field scenarios such as service interface down/up triggers to evaluate the impact of these events in the network.
- Validation of CoS in traffic classification, preservation of codepoints across network, and CoS rewrite.

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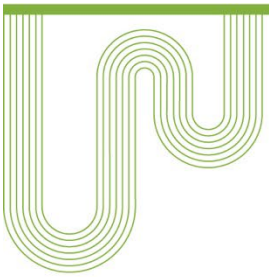

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