Juniper® Validated Design

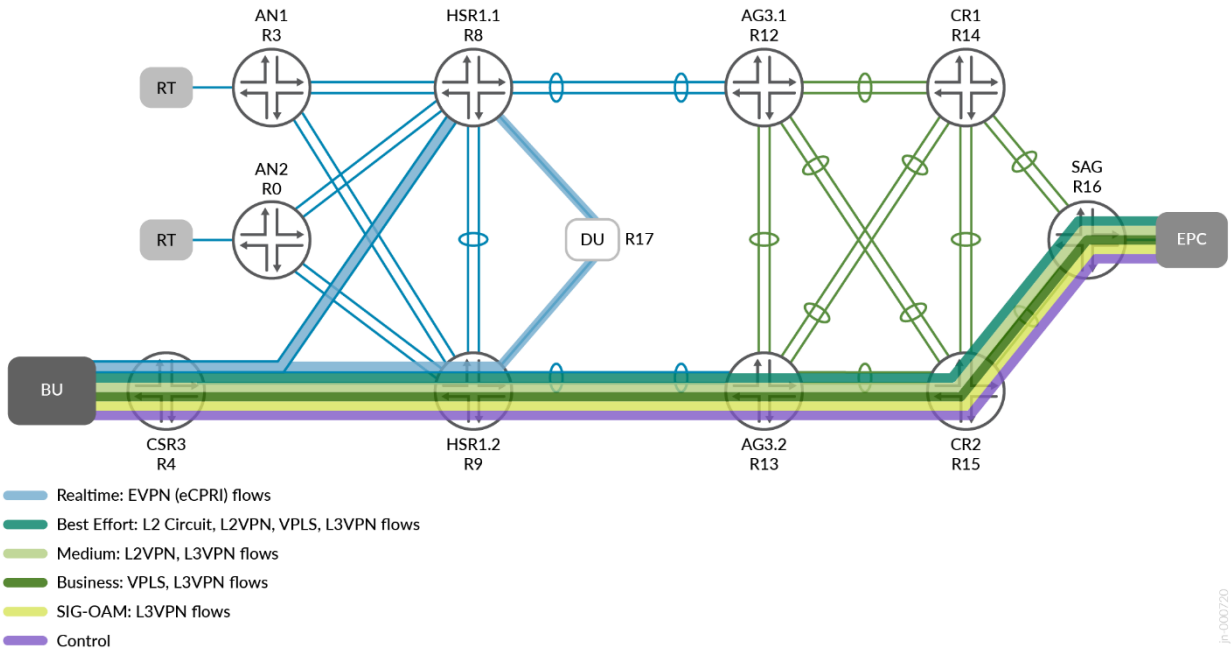
# JVD Test Report Brief: 5G Fronthaul Class of Service

## 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 Fronthaul Class of Service (CoS) functionalities across Juniper ACX7100-48L in the role of Access Node (AN) cell site and ACX7509 as Pre-Aggregation (AG1.1) hub site. Additional helper nodes present as ACX7100-32C for HSR (AG1.2); MX204 as Aggregation (AG2); MX10003 and MX480 as Aggregation (AG3); PTX1000 and MX10003 as Core routers (CR) and MX10003 as a Services Aggregation Gateway router (SAG).

## Test Topology

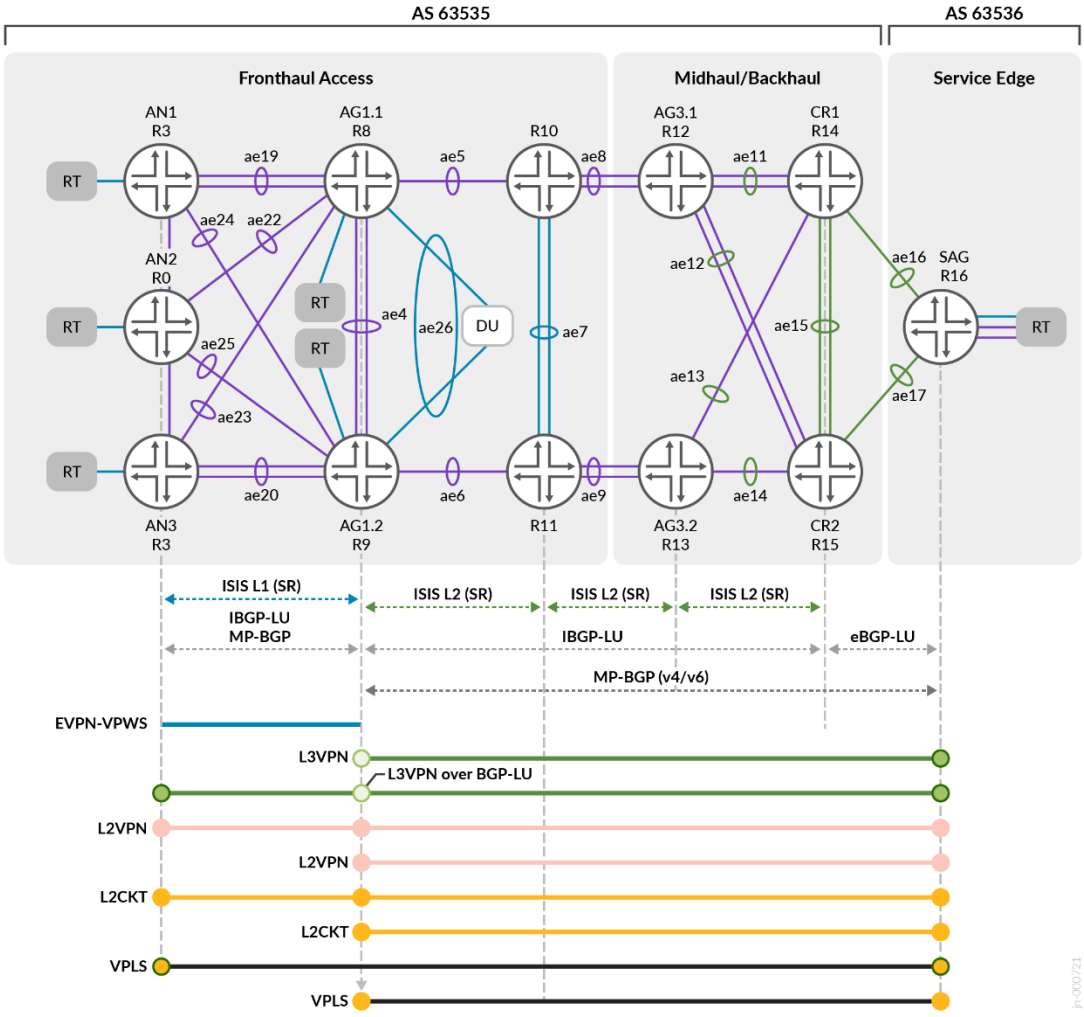
Traffic flows should utilize a mixture of VPN types across a variety of links. From Base Unit (BU) to Distributed Unit (DU), eCPRI flows take dedicated links up through HSR1.1 R8, while eCPRI flows are combined to DU through HSR1.2 R9. From BU to Evolved Packet Core (EPC), VPNs should carry combinations of traffic priorities as fixed and dynamic to support mobile backhaul (MBH) services.




## Service Emulation

1. Layer 2 eCPRI between O-RU to O-DU traffic flows – 5G Fronthaul.
2. Layer 3 IP packet flows between 5G O-DU and CU/EPC – 5G Midhaul and Backhaul.
3. Layer 3 IP packet flows between 4G CSR and EPC (SAG) – 4G L3-MBH.

4. Layer 2 flows between CSR (AN) to EPC (SAG) – 4G L2-Wholesale MBH.
5. Layer 2 Midhaul flows emulating additional attachment segments – 4G Midhaul and Backhaul.




## Platforms Tested

| Role | Platform | OS |
|---|---|---|
| Access node 2 (AN2) | ACX710 | Junos OS 22.3R1-S2 |
| Access node 1 (AN1) | ACX7100-48L | Junos OS Evolved 22.3R1-S2 |
| Access node 3 (AN3 (DUT)) | ACX7100-48L | Junos OS Evolved 22.3R1-S2 |
| Aggregation node 1.1 (AG1.1 (DUT)) | ACX7509 | Junos OS Evolved 22.3R1-S2 |
| Aggregation node 1.2 (AG1.2 (DUT)) | ACX7100-32C | Junos OS Evolved 22.3R1-S2 |
| Aggregation node 2.1 (AG2.1) | MX204 | Junos OS 22.3R1-S2 |
| Aggregation node 2.2 (AG2.2) | MX204 | Junos OS 22.3R1-S2 |

| Role | Platform | OS |
|---|---|---|
| Aggregation node 3.1 (AG3.1) | MX10003 | Junos OS 22.3R1-S2 |
| Aggregation node 3.2 (AG3.2) | MX480 | Junos OS 22.3R1-S2 |
| Core router 1 (CR1) | PTX1000 | Junos OS 22.3R1-S2 |
| Core router 2 (CR2) | MX10003 | Junos OS 22.3R1-S2 |
| Service aggregation node (SAG) | MX10003 | Junos OS 22.3R1-S2 |

## Version Qualification History

This JVD has been qualified in Junos OS Release 22.3R1-S2 and Junos OS Evolved Release 22.3R1-S2.

## Scale and Service Details

The VPN services supported in this JVD might be configured to support the following priority and traffic type allocations:

- EVPN
  - Service Type: eCPRI
  - Classifier Type: fixed
  - Priority: strict high
  - Forwarding Class: REALTIME-SC
  - Traffic Type: delay-critical GBR
- L2 circuit
  - Service Type: wholesale
  - Classifier Type: fixed
  - Priority: low
  - Forwarding Class: BEST-EFFORT
  - Traffic Type: non-GBR user plane
- L2VPN
  - Service Type: 4G/5G services
  - Classifier Type: behavior aggregate
  - Priority: low
  - Forwarding Class: BEST-EFFORT-SC, MEDIUM-SC
  - Traffic Type: medium user plane
- VPLS
  - Service Type: 4G services
  - Classifier Type: behavior aggregate
  - Priority: low
  - Forwarding Class: BEST-EFFORT-SC, BUSINESS-SC

- Traffic Type: non-GBR, GBR user plane business

- L3VPN
  - Service Type: 4G/5G services
  - Classifier Type: behavior aggregate
  - Priority: low
  - Forwarding Class: BEST-EFFORT-SC, MEDIUM-SC, SIG-OAM-SC, BUSINESS-SC
  - Traffic Type: c-plane, m-plane, u-plane, GBR business, non-GBR

Table 1: Access Nodes Validated Scale Parameters

| AN/CSR ACX7100-48L Scale | | |
|---|---|---|
| **Parameter** | **JVD-ACX7100-48L AN3** | **JVD-ACX7100-48L AN1** |
| AE groups | 2 | 2 |
| AE member links | ~2 | ~2 |
| VLANs | 1900 | 1900 |
| ISIS adjacency IPv4 | 13 | 3 |
| IBGP v4 sessions | 2 | 2 |
| EBGP sessions | 200 | 200 |
| IGP v4 routes | ~10000 | ~10000 |
| BGP IPv4 RIB | ~80000 | ~80000 |
| BGP IPv6 RIB | ~50000 | ~50000 |
| EVPN-VPWS MH | 100 | 100 |
| EVPN-VPWS SH | 1000 | 1000 |
| EVPN-ELAN | 0 | 0 |
| L2 circuit sessions | 200 | 200 |
| L2 VPN sessions | 200 | 200 |
| L3 VPN instances | 200 | 200 |
| VPLS sessions | 200 | 200 |
| MAC scale – VPLS | 10000 | 10000 |
| CFM UP MEP | 200 | 200 |
| CFM keepalive interval | 1 Sec | 1 Sec |
| BFD sessions single hop | 3 | 3 |

Table 2: Aggregation Nodes Validated Scale Parameters

| AGI/HSR Scale | | |
|---|---|---|
| **Parameter** | **ACX7100-32C AG1.2** | **ACX7509 AG1.1** |
| AE groups | 5 | 5 |
| AE member links | 2 | 2 |
| VLANs | 5300 | 5300 |
| ISIS adjacency IPv4 | 5 | 5 |
| IBGP v4 sessions | 6 | 6 |
| EBGP sessions | 202 | 202 |
| IGP v4 routes | 10100 | 10100 |
| BGP IPv4 RIB | ~80000 | ~80000 |
| BGP IPv6 RIB | ~50000 | ~50000 |
| EVPN-VPWS MH | 100 | 100 |
| EVPN-VPWS SH | 1000 | 1000 |
| L3VPN Bridge Domain (Midhaul) | 500 | 500 |
| EVPN-ELAN (Midhaul) | 500 | 500 |
| L2 circuit sessions | 1000 | 1000 |
| L2 VPN sessions | 1000 | 1000 |
| L3 VPN instances (OSPF) | 100 | 100 |
| L3 VPN instances (BGP) | 100 | 100 |
| VPLS sessions | 1000 | 1000 |
| MAC scale – VPLS | 103000 | 24000 |
| CFM UP MEP | 1000 | 1000 |
| CFM keepalive interval | 1 Sec | 1 Sec |
| BFD sessions single hop | 5 | 5 |

## Performance Data

Table 3: 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

- 5G xHaul MBH reference architecture
- Segment Routing L-ISIS
- Seamless SR-MPLS across multi-level ISIS domains and Inter-AS with BGP-LU
- Fast Failover Protection TI-LFA, ECMP, BFD failure detection, Ethernet OAM
- Inter-AS Option B/C
- Redundant Route Reflectors
- EVPN-VPWS and Flexible Cross Connect (FXC) Active-Active Multihoming
- EVPN-ELAN with Multihoming and EVPN Anycast IRB
- BGP-VPLS, L2VPN, L2Circuit, L3VPN
- VLAN Translation at CSR and HSR nodes (60 combinations validated)
- Alignment with O-RAN Alliance [ORAN.WG9.XPSAAS-v02.00]
- Quality of Service (QoS) functional mechanisms, which govern how traffic is forwarded, stored, or dropped in conjunction with congestion management and avoidance:
  - Traffic classification (context and packet based)
  - Scheduling and queuing
  - Rewriting
  - Shaping and rate limiting

## Known Limitations

EXP rewrite is not supported on ACX7000 when label push on core interface is more than two labels. This feature is supported from Junos OS Evolved Release 23.2R1.

## 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 and 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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