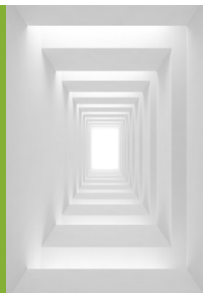
Juniper® Validated Design

JVD Solution Overview: Low Latency QoS Design for 5G Solution



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Executive Summary

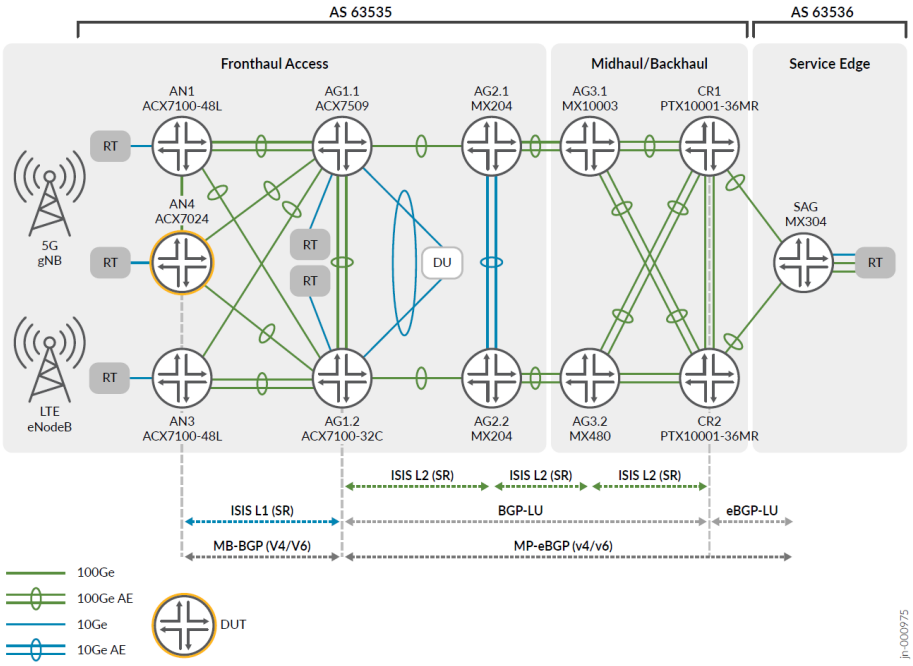
Juniper Validated Design (JVD) is a cross-functional collaboration between Juniper Solution Architects and Test teams to develop coherent multidimensional solutions for domain-specific use cases. The JVD team comprises technical leaders in the industry with a wealth of experience supporting complex use cases.

Using JVD, you can significantly reduce the risk of costly mistakes while saving time and money in the deployment of network solutions. JVD provides benefits such as a more stable network with fewer bugs and a shorter time to resolution if any bugs are discovered. The validation process ensures that the network is optimized for maximum performance, leading to a better user experience for enterprise/SP operation and network service consumers. Furthermore, the design concepts deployed are formulated around best practices, leveraging relevant technologies to deliver the scope of the solution. KPIs are identified as part of an extensive test plan that focuses on functionality, performance integrity, and service delivery. With JVDs, you can shorten the time to market when implementing new network solutions, reducing the lead time to generate revenue from new services.

Solution Overview

5G radio access network (RAN) introduces new requirements for the mobile backhaul (MBH) network infrastructure such as the number of nodes in the network, performance, and features richness. These additional requirements lead to growing network complexity. Juniper provides an end-to-end solution for the 5G xHaul network infrastructure, designed to support 4G MBH and 5G network infrastructure over the same physical network. This approach allows operators to smoothly transition from 4G to 5G network infrastructure without disrupting their existing services. The necessary changes can be gradually introduced to accommodate the evolving requirements of 5G networks. The 5G solution architecture requires strict QoS performance to deliver differentiated services and preserve low latency for critical traffic types.

Figure 1: 5G Solution Architecture



5G O-RAN is an open and disaggregated RAN architecture that aims to enable interoperability, flexibility, and innovation among vendors and operators. The Fronthaul is the most demanding segment of the xHaul architecture, requiring high-performance and functionality to ensure delivery and preservation of ultra-low latency workloads introduced in the 5G network. One of the key features of 5G O-RAN is the support for multiple CoS that can provide differentiated QoS and network slicing for various use cases and applications.

Key objectives of the featured JVD include:

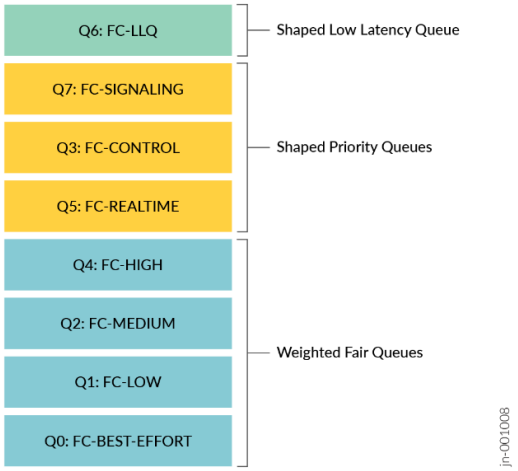
- Comprehensive end-to-end multiservice CoS model
- QoS focused validation
- Differentiated services with multiple priority levels
- Low Latency Queuing with Latency Preservation
- Multiple classification methodologies with Behavior Aggregate, Fixed, and Multi-Field classification to distinguish critical flows
- O-RAN Multiple Priority Queue model
- Traffic Queueing, Scheduling and Rewriting
- Port and Queue Shaping
- Validation of Latency Budgets
- eCPRI Emulation and O-RAN conformance
- Host traffic mapping

The flow-based 5G QoS model provides more granular control and flexibility compared to the bearer-based 4G LTE QCI model. Instead of assigning a single QoS value to the entire bearer, 5G allows different flows within the same bearer to have their own individual QoS requirements. This enables more fine-grained QoS management, allowing different applications and services to receive tailored treatment based on their specific needs. It also enables the network to dynamically adjust QoS parameters for individual flows, optimizing resource allocation and providing a better user experience

5G incorporates new delay-critical guaranteed bit rate (GBR) flow categories. In the 5G Fronthaul segment, eCPRI based flows define the user and control traffic streams between O-RU and O-DU. These traffic characteristics require high bandwidth and extremely low delay. All devices in the access topology must assign the highest priority to this traffic type. This means that service providers may need to rethink their existing CoS designs where the highest priority queues are reserved for voice or video traffic.

To facilitate the JVD test objectives, a complete CoS network model is created to support end-to-end 5G xHaul traffic types. This network model is adjustable to meet your requirements. The JVD CoS model aligns with O-RAN multiple priority queue structure and establishes three main components - Low Latency Queues, Shaped Priority Queues, and Weighted Fair Queues.

Figure 2: CoS Model Components



JVD validation examines CoS operations and performance requirements to ensure integrity of critical 5G Fronthaul traffic flows between the RU to DU emulated devices, as facilitated by the CSR (ACX7024), ACX7100-32C (HSR), and ACX7509 (HSR). Additional validation includes MX304 as the Services Edge with PTX10001-36MR as Core for supporting end-to-end MBH traffic flows.

The main objective is to examine the predictable behavior in terms of how critical and non-critical traffic flows are handled across services in the 5G xHaul network. CoS functionalities are validated across EVPN, L3VPN, BGP-VPLS, and L2Circuit VPN services, aligning with 5QI traffic classifications. QoS implementation should exhibit deterministic functionality. The transport architecture proves capable of supporting the adaptation of existing and emerging mobile applications, preserving delay in budget integrity while guaranteeing traffic priorities.

Through rigorous testing, KPIs are observed and shared to ensure the provided solution is compliant with stringent fronthaul SLA's. The featured Juniper Networks fronthaul platforms, including ACX7024, ACX7100-48L, ACX7100-32C, and ACX7509 are excellent choices for access and aggregation purposes. These platforms deliver enhanced performance, low latency, and high bandwidth with the necessary scale and advanced feature set.

Corporate and Sales Headquarters
Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, CA 94089 USA
Phone: 888.JUNIPER (888.586.4737)
or +1.408.745.2000
Fax: +1.408.745.2100
www.juniper.net

APAC and EMEA Headquarters
Juniper Networks International B.V.
Boeing Avenue 240
1119 PZ Schiphol-Rijk
Amsterdam, The Netherlands
Phone: +31.207.125.700
Fax: +31.207.125.701

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