Business Value of the Junos Fusion Solution for MX Series 3D Universal Edge Routers

Junos Fusion uses MX Series routers and standards-based IEEE 802.1BR to increase automation, simplify management, and streamline operations.

Challenge

Service providers required to configure and maintain tens of thousands of access ports across hundreds or even thousands of geographically dispersed devices and interfaces need an elegant, simple, and efficient mechanism for aggregating and abstracting access ports.

Solution

Junos Fusion enables a single Aggregation device such as an MX Series router to manage thousands of Ethernet access ports on Satellite devices, allowing network operators to configure and manage these ports just like ports on the MX Series router itself, eliminating complexity and cost.

Benefits

Junos Fusion for MX Series routers streamlines operations in local POPs, leading to faster and simpler turn-up of all Ethernet Satellite devices. Simplifying the configuration and management process promotes faster service delivery with higher quality control, helping network operators easily maintain Aggregation devices in conformance with known configurations and service definitions.

Service providers build out extensive networks with numerous access points and large access nodes in order to reach the largest potential customer base. At the same time, they must successfully acquire new customers in order to receive an acceptable return on their investments and fuel continued revenue growth and innovation. Ongoing capital and operational investments are required to maintain and expand the network and service catalog; accomplishing this in the most financially efficient way is critical to the ongoing business success of the service provider.

The Challenge

The high cost of maintaining, monitoring, and managing their numerous access points is an ongoing challenge for service providers. Expensive truck rolls are required to deliver equipment, and high-value technicians are needed to install, configure, and manage the elements. This is not just a Day 1 problem—it is a Day "N" problem—as administration, configuration, provisioning, and software updates are required in the local points of presence (POPs) on an ongoing basis, with additional administration and configuration required to add new customers and services. While capital expense reductions can be achieved when existing facilities are used to support new customers, or when existing capacity can be used instead of procuring new assets, these savings represent very short-term gains versus long-term operational expenses (OpEx).

Consider a Tier 1 service provider with 40 local POPs and access nodes offering 40x1GbE-UNI connections, for a total of 1,600 customer access ports in the network. The service provider must be fully aware of the status of each port and avoid black-holing traffic in the event of a network failure. Such visibility requires Operation, Administration, and Maintenance (OAM) processes running on each access node that aggregates customer ports. In this example, the service provider might turn on Layer 3 and several other protocols to initiate OAM on the boxes. Even if only one application or service is running on each port, 1,600 separate OAM sessions must be configured across all 40 sites by experienced technicians, requiring multiple truck rolls for service changes and software updates.

In the real world, however, each customer would likely be running multiple applications and services, turning each OAM configuration into a customized effort requiring perhaps 10 to 20 lines of code per configuration. Not only is there a quality issue to be considered, the amount of time required to configure and test the access nodes is huge; configuring 16,000 to 32,000 lines of code consumes hundreds, if not thousands, of hours.

The Juniper Networks Junos Fusion Solution

The Juniper Networks® Junos® Fusion solution employs MX Series 5G Universal Routing Platforms as Aggregation devices, with Juniper Networks QFX5100 and EX4300 Ethernet switches serving as Satellite devices to provide access ports. These Ethernet switches are physically connected via pluggable optical transceivers and optical cable to the MX Series Aggregation device. Using Junos Fusion, each and every QFX5100 and EX4300 Satellite device is automatically discovered by the MX Series Aggregation device using the Link Layer Discovery Protocol (LLDP), which establishes IP connectivity. This sequence of events provides the same plug-and-play simplicity seen with native MX Series router interfaces.

Junos Fusion Solution Components

Aggregation Device	Satellite Devices
• MX2020/MX2010 routers • MX960/MX480/MX240/ MX104/MX80 routers	• QFX5100 switch • EX4300 switch

Satellite devices join the new in-band control plane powered by the fully standardized IEEE 802.1BR specification. Ethernet ports in the satellite network appear as native ports in the MX Series router's CLI, with an incremental slot ID representing a specific Satellite device and an incremental port ID representing a specific port per Satellite device. Subsequently, the Aggregation device pushes a software image called Satellite Network Operating System (SNOS) to the Satellite device, and this software supplants the Juniper Networks Junos operating system on the Satellite devices.

From an OAM perspective, the service provider can now treat all ports on Satellite devices as if they were native, physical ports on the MX Series router serving as the Aggregation device. SNOS updates are pushed on demand by the Aggregation device to the Satellite devices; conversely, Satellite devices push all necessary chassis-related alarms and sensors, inventory, environmental measurements, and interface statistics to the Aggregation device. In fact, any item covered by an SNMP MIB on the Aggregation device can be extended to the Satellite device.

All data flows entering a Satellite device flow up to the Aggregation device for routing and service treatment, reducing the need to implement these functions natively on the Satellite device. Expansive, fully managed satellite networks can be created based on the massive scalability enabled by the MX Series router aggregating these extended ports.

Junos Fusion Features and Benefits

Junos Fusion streamlines local operations, reducing or even eliminating operational costs. Satellite devices can be easily configured, managed, and maintained by the central Aggregation device. Furthermore, some hardware-focused tasks such as per-device hardware updates and changes to cabling infrastructure can be eliminated, making expensive truck rolls unnecessary.

Junos Fusion also reduces "upstream" costs and complexities. Operations support systems (OSS) that are integrated with the MX Series can extend support to all downstream Satellite devices through the Aggregation device rather than through direct connections to each Satellite device. Since the OSS resides in a hardened environment, updates have very long development and

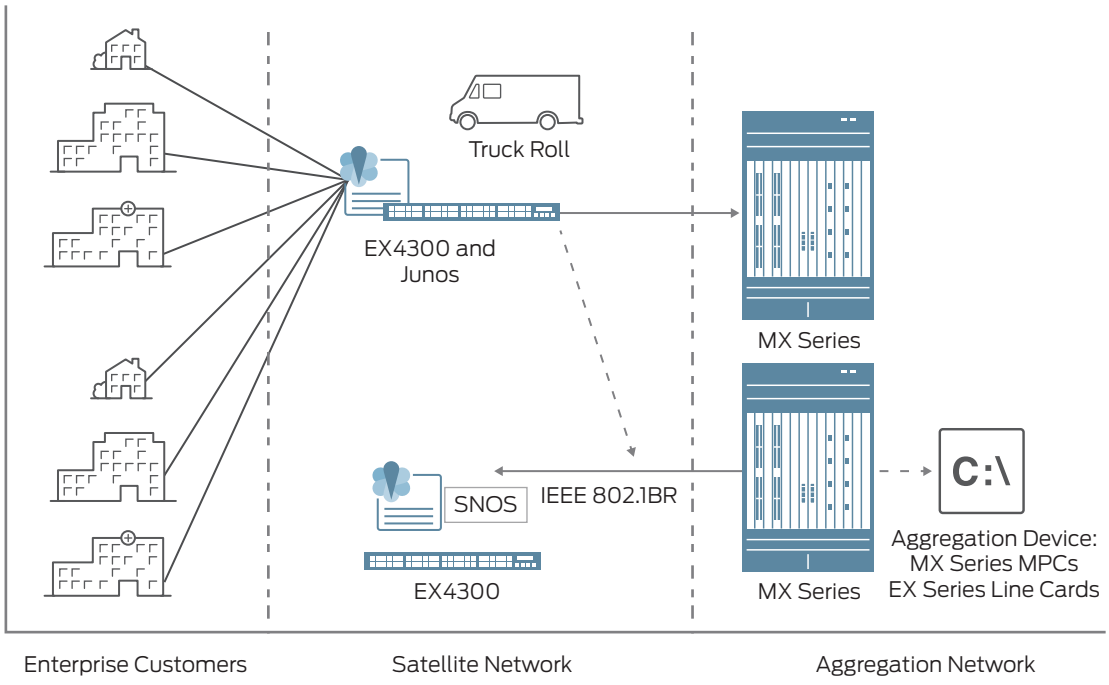

Figure 1. The MX Series Aggregation device automatically discovers and programs Satellite devices with the Satellite Network Operating System (SNOS). Satellite devices appear as extended ports in the router's CLI, along with its native physical line cards.

test cycles with very few entry points; Junos Fusion eliminates the time spent waiting for an entry point in the update cycle, further decreasing time-to-service—and time-to-revenue.

Junos Fusion also brings many application-level benefits. All features available on an MX Series router, including RSVP, MPLS, and OSPF, among others, are extended to the Satellite devices—in effect making the Satellite devices themselves extensions of the router. For example, while L3VPN is an extremely rare feature on L2 switching devices, it is a valuable service offering. With Junos Fusion, L3VPN support is extended to Satellite devices; there is no need to invest in native support by deploying higher functioning and higher priced devices.

Another example is RSVP, a bandwidth reservation protocol used in traffic engineering to secure bandwidth for a specific service. While most L2 switches support just a fraction of the full RSVP protocol suite, MX Series routers support a complete implementation of RSVP features. Extending the full range of RSVP to Satellite devices extends traffic engineering closer to the customer—where services are actually required—with stringent bandwidth guarantees.

The Tier 1 service provider can realize additional benefits from a Junos Fusion deployment. With Junos Fusion, OAM does not have to be configured locally on each Satellite device; it can be centralized at the Aggregation device, which ties all Satellite device ports together. If a customer port fails, OAM on the Aggregation device is aware of the failure and stops forwarding packets to the failed port, which avoids black-holing the traffic. This means that the need to configure 16,000 to 32,000 lines of code, along with the associated testing and implementation overhead, is eliminated.

Additionally, with Junos Fusion, cabling on the Satellite device becomes static and all customer ports are fungible within the MX Series router as the Aggregation device infrastructure; ports can be updated on demand without any changes to the cabling infrastructure. Without Junos Fusion, customer premises equipment (CPE) would have to be reconfigured between customer assignments depending on the specific feature or service required. For instance, if CPE Box A did not support a specific L2 protocol, then that customer's port would have to be migrated to CPE Box B that did support the required feature.

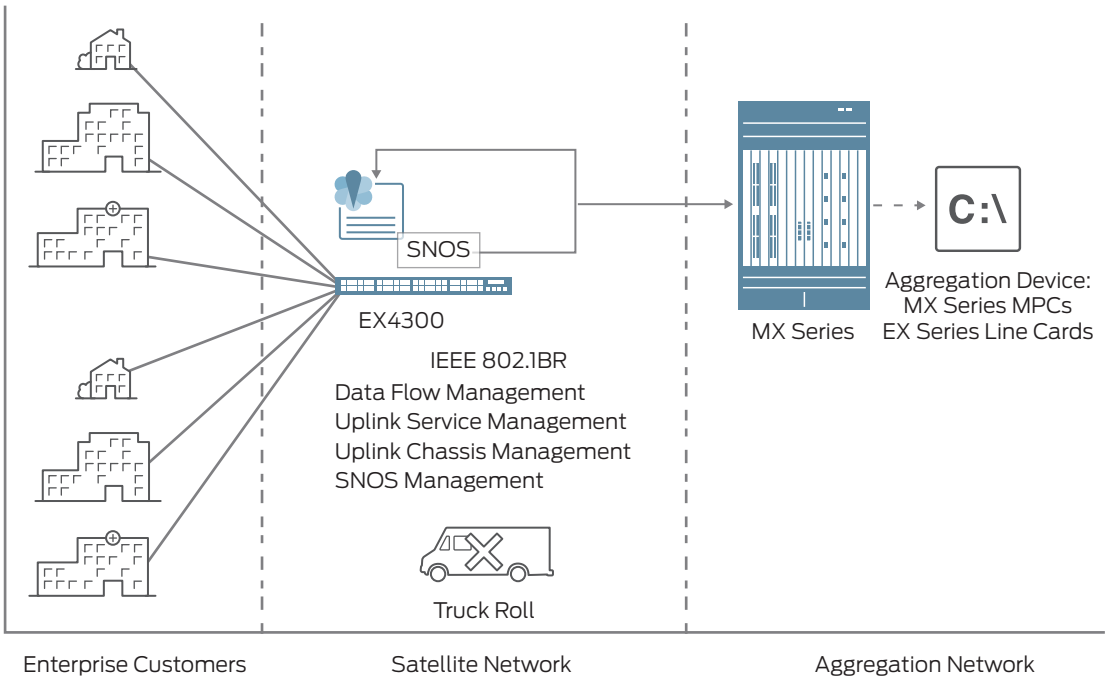

Figure 2. Satellite devices are managed by the MX Series Aggregation device via the IEEE 802.1BR control plane. Satellite device statistics and system logs are all managed by the Aggregation device, greatly streamlining operations.

Table 1. Junos Fusion Features and Benefits

Feature	Benefit
Ports on Satellite devices appear on the Aggregation device's CLI, enabling them to be treated exactly the same as native ports.	• Simplifies operations • Implements quality control in configuration, test, and maintenance • Speeds up the rate of service rollout
The Aggregation device provides advanced features (e.g., IPv6, RSVP, and MPLS); Satellite devices use the 802.1BR control plane for connectivity to the Aggregation device.	• Reduces Satellite device price point due to simpler feature set • Simplifies network and service configuration
Solution is powered by an open standard control plane (IEEE 802.1BR).	• Protects investment in preexisting non-Juniper elements that are IEEE 802.1BR compliant • Avoids Satellite device vendor lock-in
Operations are greatly simplified compared to alternative L2/L3 overlay technologies.	• Reduces price point for CPE devices by eliminating the need for advanced L2 and L3 overlays
Additional Satellite devices are treated as incremental slot spaces on the Aggregation device.	• Increases network scale while reducing complexity • Eliminates Satellite device hardware and feature bottlenecks • Reduces OpEx with plug-and-play user experience
Satellite devices are managed through the aggregation device; Junos OS and SNOS qualification can be performed centrally and pushed to the network supporting a 1:n model, rather than qualifying cycles per access node.	• Decreases OpEx by lowering satellite device and access port overhead for service and maintenance from Day 1 to Day "N"
Time to enable applications and services on each Satellite device and access port is accelerated.	• Accelerates time-to-revenue, which sustains and increases market competitiveness
Automation maintains high-quality configurations and avoids potential for human error.	• Increases service uptime and service-level agreement (SLA) adherence
Satellite device management is enabled via a centralized Aggregation device: • The *Aggregation* device controls the satellite device to initiate the Junos OS to SNOS conversion process. • The *Aggregation* device enables remote login, troubleshooting maintenance, and upgrade processes. • The *Aggregation* device extends SNMP queries that are built into the operations methodology to all satellite devices. • Junos Fusion offloads Satellite device chassis and port statistics to the Aggregation device for analysis; in the event of a failure condition or system log signaling errors, the Aggregation device will show alarm and interface address.	• Reduces operational costs by increasing automation and reducing truck rolls • Improves uptime by ensuring management consistency as network grows, and by improving visibility of the satellite device network • Reduces burdens on technical staff • Speeds mean time to repair (MTTR) by enabling technicians to rapidly mitigate, isolate, and troubleshoot the issue from a central location

Summary

Junos Fusion employs a standards-based control plane to combine MX Series 5G Universal Routing Platforms with value-priced QFX5100 and EX4300 Ethernet switches. This reduces OpEx through lower element installation costs, less management complexity, lower configuration and maintenance costs, elimination of expensive truck rolls for servicing, and simplified management. Services providers using Junos Fusion also realize top-line benefits through service delivery acceleration, leading to faster time to revenue.

Next Steps

For more information on Junos Fusion and the MX Series 5G Universal Routing Platforms, please contact your Juniper Networks sales representative.

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