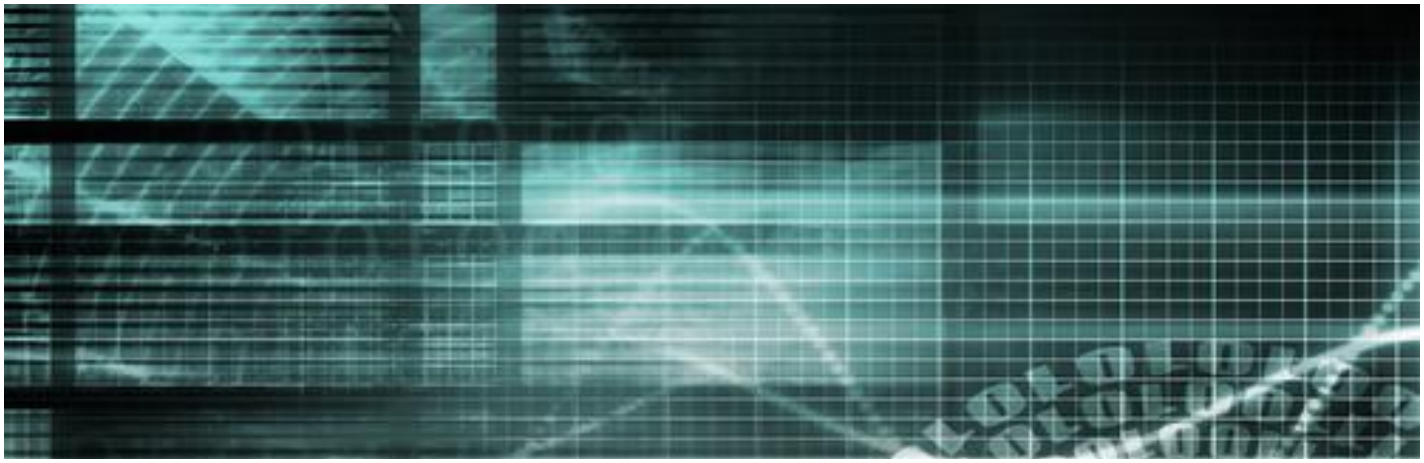
Optimizing the Network Edge with Juniper Networks MX Series 3D Universal Edge Router



Executive Summary

Service providers are increasingly looking to optimize their network design and reduce operational complexity in order to minimize total cost of ownership (TCO), contain operational risk, and reduce environmental impact. Traditionally, service providers use a variety of appliances to deliver and monitor services and ensure security; however, this approach becomes more inefficient, complex, expensive, and risky as network scale and service offerings increase.

Juniper Networks' trumps these shortcomings by integrating services on one platform, the MX Series 3D Universal Edge Router, and one operating system, Junos®. Consolidating routing and services on the MX Series 3D and Junos supports the service provider's business goals by significantly lowering the cost to implement and operate the network and by reducing implementation risks and environmental impact.

In this paper ACG Research compares network upgrades for two hypothetical operators. Operator 1 implements a traditional appliance-based edge network, and Operator 2 implements a converged edge network utilizing the Juniper Networks MX960 hosting both routing and services. Among other findings, the research establishes that the converged MX960 solution demonstrates up to 49 percent lower TCO and 64 percent lower environmental emissions than the traditional appliance-based service delivery method.

KEY FINDINGS

Compared with single service edge elements, consolidating routing and services on the Juniper Networks' MX Series 3D offers:

Financial benefits

- 49% lower TCO
- 57% lower opex
- 38% lower capex

Operations benefits

- 94% less OS patch/upgrade costs
- 80% lower OAM costs
- 15X lower operational risk
- 64% power and cooling cost reduction
- 80% floor space reduction

Time to market benefits

- 69% faster system deployment

Introduction

The study develops an edge network scenario for two theoretical network operators that are aggregating residential broadband, business broadband, and mobile backhaul network traffic. The "new" edge network must support redundant scale through 1Tbps capacity in order to accommodate both subscriber and traffic growth with network and security features that protect network resources and increase network visibility and fault isolation capabilities.

Meeting these objectives requires a variety of services in the network edge. Specifically:

- Carrier Grade NAT (CGN) to preserve the current IPv4 address pool
- Flow monitoring for network troubleshooting and analysis tasks
- Firewall services to protect critical control plane resources
- Video monitoring to ensure quality video service delivery
- Traffic balancing for better network resource utilization
- Network visibility and fault isolation capabilities

The study analyzes cost, time to revenue, risks, and environmental impact for two different approaches to edge network and service implementations:

- Operator 1 implements a traditional edge network with discrete routing, switching and service elements; each service is implemented using a discrete appliance that is connected to the network via a router or switch.
- Operator 2 implements a converged edge network with all services implemented on the Juniper MX960 via licensed software applications that run on the programmable Junos Trio chipset and on multiservices cards.

In the analysis, all capital expenses (capex) are incurred on project initiation; operations expenses (opex) are incurred and calculated for five years.

Operator 1, Appliance-Based Service Delivery

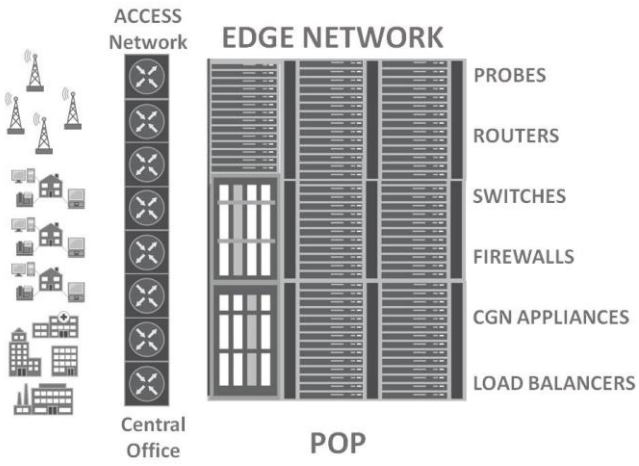


Figure 1 – Operator 1, Appliance-Based Network Configuration

This traditional, single service per element design employs 35 network elements and five network operating systems to provide routing, switching, flow and video monitoring, CGN, firewall, and load balancing in a redundant design that consumes 131 rack units (about three standard telecom racks).

Operator 2, Routing and Service Convergence Using Juniper Networks MX960

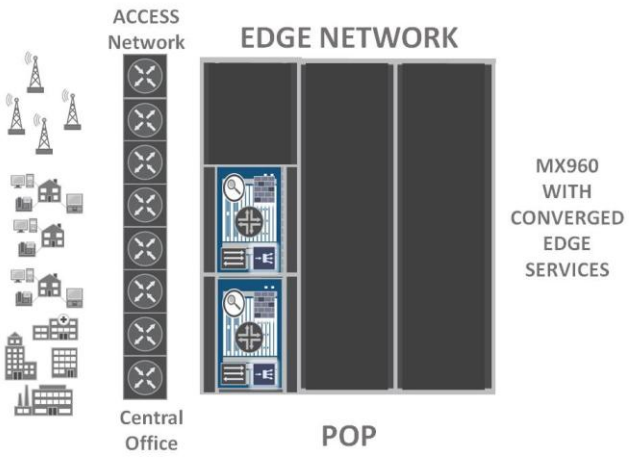


Figure 2 – Operator 2, Fully Converged Network Configuration

Operator 2 uses the MX960 to fully converge routing with licensed CGN, firewall, flow monitoring, video monitoring, and load balancing applications that run on programmable Junos Trio chipsets. This redundant design uses just two MX960 chassis and one network operating system, Junos®, and occupies 26 rack units (about two-thirds of a standard telecom rack).

Total Cost of Ownership Comparison

The initial costs to implement each service complex and ongoing operations expenses for five years are compared in this section. Figure 3 shows the TCO comparison for the cumulative five-year TCO.

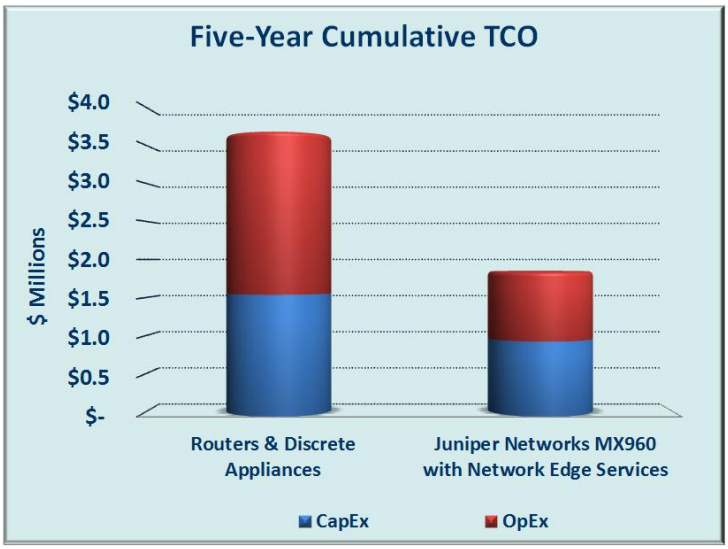


Figure 3 – Five-Year Cumulative TCO Comparison

Using the MX960, Operator 2 achieves 49 percent lower TCO, 57 percent less opex, and 38 percent less capex than Operator 1. The lower capex and opex afforded by the MX960 are directly attributable to its converged approached.

The following table summarizes the number of elements and operating systems used by the solutions.

Operator	Service Approach	Chassis	Operating Systems
Operator 1	Routers and Discrete Appliances	35	5
Operator 2	Juniper Networks MX960 with Network Edge Services	2	1

Table 1 – Number of Chassis and Network Operating Systems

The primary source of the capex advantage of the MX960 is the use of a single chassis for all services. Operator 1's appliance-based service model uses 18 times more chassis than Operator 2's MX960 implementation. Because each chassis has common equipment such as power supplies, fans, and controllers, the multiple chassis used by Operator 1 replicates these costs many times. In Operator 2's implementation, the MX960 shares common components across routing, switching, and services.

Operations Expense Comparison

Figure 4 shows the opex for all expense categories except vendors' service fees.

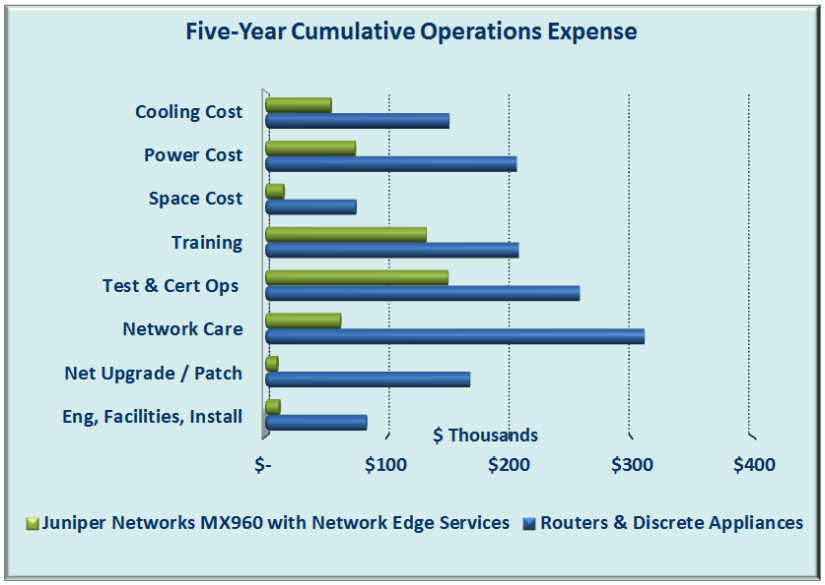


Figure 4 – Five-Year Operations Expense Comparison less Vendors' Service Fees

The converged edge model has substantially lower opex in each expense category because using fewer elements and a single operating system reduces labor expenses, environmental costs, and sparing and service fees while reducing qualification configuration, upgrade, and troubleshooting tasks.

Environmental Impact Comparison

Figure 5 shows the environmental impact of powering and cooling the service delivery equipment.

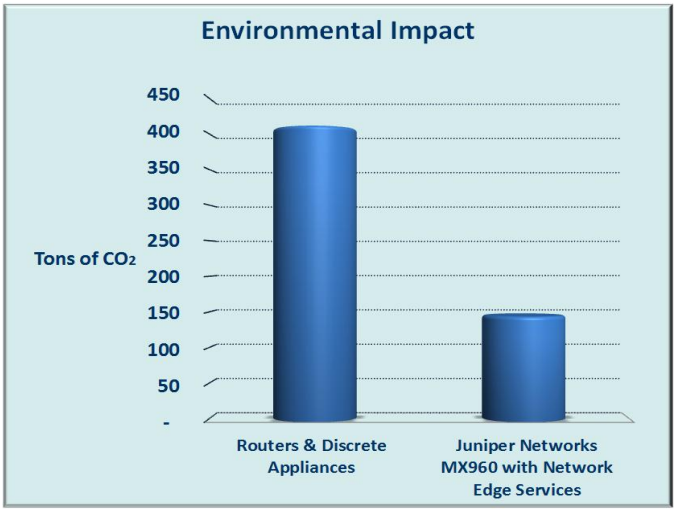


Figure 5 – Five-Year Environmental Impact Comparison (Carbon Emissions)

The electricity needed to power and cool the network produces greenhouse gases. Operator 2's implementation reduces these emissions by 64 percent compared to Operator 1. These emissions are equivalent to driving 1.1 million miles for Operator 1 versus 0.4 million miles for Operator 2.

Time to Revenue Comparison

The converged network edge model improves time to market by utilizing a single network element (the MX960) and operating system (Junos), enabling a consistent set of operations, administration and management processes (OAM); software update schedule and procedures; and technical support.

Implementation times were analyzed using a work breakdown structure per solution; the implementation time for the MX960 solution is 69 percent faster to implement than the appliance solutions (Figure 6).

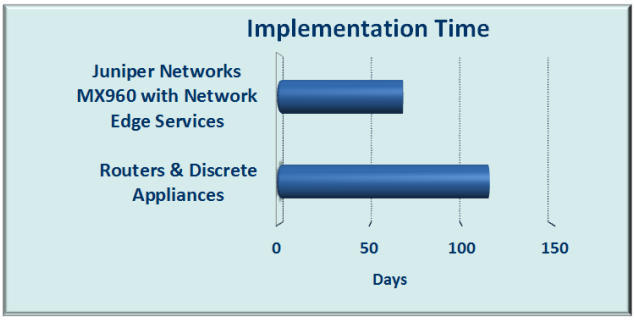


Figure 6 – Implementation Time

Comparison of Implementation and Operational Risks

All projects are subject to risks: vendors and products can fail qualification testing; installation can fail due to bad design or execution; and project management can fail when coordination breaks down. The

probability of these risks occurring increases with complexity, for example, the risk of an install failure grows as the number of elements increases. Given a one percent chance of an implementation failure event occurring per element, Figure 7 shows that Operator 2 faces a two percent chance of implementation failure versus a 30 percent chance (15 times more[1]) for Operator 1.

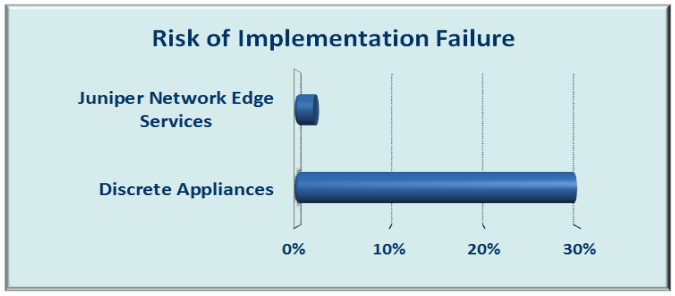


Figure 7 – Risk of Implementation Failure

Conclusion

Two network edge solutions, one composed of multiple service-specific elements and one fully converged solution composed of the MX960 hosting routing and services were compared by modeling implementation and operation of the solutions for two operators.

The research indicates that Juniper Network's edge solution reduces cost and environmental impact by providing full convergence of routing and services. It delivers consistent operations and management across applications, improves environmental efficiency, and lowers deployment and operations costs as summarized in Table 2.

Metric (Costs Are Five-Year Totals)	Savings
OS Patch and Upgrade Cost	94%
OAM Cost	80%
Emissions	64%
Time to Market for First Office Application	69%
Risk of Failure	93%
Space	80%
Power	64%
TCO	49%
Capex	38%
Opex	57%

Table 2 – Summary of Percentage Savings Produced by Juniper Solution

[1] The probability that no risk event will occur during implementation is $1 - Pr^N$ where Pr is the probability of an event not occurring for one chassis and N is the number of chassis.