ACG RESEARCH

An Economic and Environmental Comparison of Juniper Networks' Routers with a Leading Competitor

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EXECUTIVE SUMMARY

This paper presents an in-depth economic and environmental comparison between Juniper's MX and PTX Series Routers and those from a leading competitor, focusing on key metrics such as total cost of ownership (TCO) that is composed of both capital expenditure (CapEx) and operational expenditure (OpEx). The study also compares the carbon footprint and power efficiency of Juniper's routers and those of a leading competitor. The analysis highlights that Juniper routers offer significant advantages over its competition in terms of longevity, cost savings, and environmental impact.

Juniper's routers exhibit a much longer lifespan, avoiding disruptive end-of-life (EoL) events and the need for costly network upgrades, compared to its competitor's. Juniper MX Series, for instance, demonstrates a graceful migration from initial chipset and card technologies to current high-capacity interfaces. This ensures customers can continue using their existing products without major overhauls. In contrast, similar products from competitors often require frequent EoLs and disruptive upgrades.

The study also reveals that Juniper routers deliver substantial operational and environmental benefits. Across various throughput levels, Juniper's routers consistently outperform those of its competitors, offering higher power efficiency, lower OpEx, and reduced carbon footprints. Juniper MX304 achieves a 71% improvement in system power efficiency and a 47% reduction in OpEx compared to a competing router at 800G throughput. Similarly, Juniper PTX10008 router shows a 69% increase in power efficiency and a 66% reduction in OpEx at 86.4T throughput.

The study presents detailed TCO models of four different network use cases:

1. Large global enterprise scenario
2. Regional enterprise scenario
3. Tier 2 CSP scenario
4. Data center interconnect (DCI) scenario

A summary of the savings for each use case is presented in Table 1.

	Savings			
	Global Enterprise	**Regional Enterprise**	**Tier 2 CSP**	**DCI**
Cumulative CapEx	85%	30%	78%	94%
Cumulative OpEx	61%	41%	57%	93%
Cumulative Carbon Footprint	62%	43%	56%	94%

Table 1. Summary of Savings for Each Network Use Case

These findings underscore the superior performance, cost-effectiveness, and sustainability of Juniper's MX and PTX series routers, making them a compelling choice for organizations looking to optimize their network infrastructure.

TCO & Carbon Reduction Benefits of Juniper MX & PTX Series Routers

ACG Research's in-depth study compares Juniper MX and PTX routers to similar routers from a major competitor. The key finding is that Juniper routers have much greater longevity without disruptive EoLs. We also determined that Juniper's TCO, power efficiency, network OpEx, and carbon footprint are all significantly better than those of the leading competitor.

The leading competitor's routers have similar levels of throughput and feature sets. The competitive data in this study uses publicly available pricing information from the internet and power consumption data from competitors' datasheets. The model uses pricing and power data to compute CapEx, power and cooling OpEx, and carbon footprints.

The key points on the longevity of Juniper MX routers series are:

- Offer twice the lifespan and twice the savings of the leading competitor's routers
- Deliver a graceful migration of new chipset and card technologies
- Introduced in 2006, MX240/480/960, which offer 400G interfaces, are still going strong
- No EoLs and disruptive forklift upgrades

The key Juniper CapEx, OpEx, efficiency savings and carbon footprint reductions for the routers that are compared in this study are presented in Table 2 to Table 5. The routers are compared at different throughput levels (from 800G to 80T), highlighting the efficiency and cost benefits of Juniper routers.

	Competitor @800G	Juniper MX304 @1.6T	Savings
System Power Efficiency (Watt/Gbps)	1.18	0.34	71%
Network OpEx ($K/Year)	$3.72	$1.99	47%
Network OpEx Efficiency (OpEx/Gbps)	$4.65	$1.38	70%
Network CapEx Efficiency (CapEx/Gbps)	$25.27	$8.82	65%
Network Carbon Footprint (CO2 Tons/Year)	6.79	3.87	43%

Table 2. Comparison of MX304 with Competitor

	Competitor @40T	Juniper MX10004 @38.4T	Savings
System Power Efficiency (Watt/Gbps)	0.35	0.17	51%
Network OpEx ($K/Year)	$55.25	$25.18	54%
Network OpEx Efficiency (OpEx/Gbps)	$1.38	$0.66	52%
Network CapEx Efficiency (CapEx/Gbps)	$28.07	$7.19	74%
Network Carbon Footprint (CO2 Tons/Year)	101.81	47.22	54%

Table 3. Comparison of MX10004 with Competitor

	Competitor @80T	Juniper PTX10008 6xLC1201 @86.4T	Savings
System Power Efficiency (Watt/Gbps)	0.35	0.11	69%
Network OpEx ($K/year)	$108.90	$36.90	66%
Network OpEx Efficiency (OpEx/Gbps)	$1.36	$0.42	69%
Network CapEx Efficiency (CapEx/Gbps)	$28.06	$3.06	89%
Network Carbon Footprint (CO2 Tons/Year)	201.62	67.32	67%

Table 4. Comparison of PTX10008 with Competitor

	Competitor @32T	PTX10002-36QDD @28.8T	Savings
System Power Efficiency (Watt/Gbps)	0.39	0.03	92%
Network OpEx ($K/Year)	$49.08	$3.19	94%
Network OpEx Efficiency (OpEx/Gbps)	$1.53	$0.11	93%
Network CapEx Efficiency (CapEx/Gbps)	$28.53	$1.87	93%
Network Carbon Footprint (CO2 Tons/Year)	90.64	5.78	94%

Table 5: Comparison of PTX10002 with Competitor

At lower throughput levels, such as 1.6 Tbps, Juniper's MX304 router achieves a 71% increase in system power efficiency, reducing the wattage per Gbps from 1.18 to 0.34. This efficiency translates into significant cost savings, with operational expenditure halved and CapEx efficiency improving by 65%. Additionally, the carbon footprint is reduced by 43%, highlighting the environmental benefits of Juniper MX304.

As throughput increases to 38.4 Tbps, Juniper's MX10004 continues to demonstrate substantial benefits. System power efficiency is enhanced by 51% and the OpEx savings reach 54%. The efficiency in operational and capital expenditures is notable, with a 52% and 74% improvement, respectively. Moreover, the MX10004 significantly lowers the carbon footprint by 54%, reinforcing Juniper's advantage in sustainability.

At the highest throughput levels, such as 86.4 Tbps, Juniper's PTX10008 router maintains its superior performance. It delivers a 69% increase in power efficiency and a 66% reduction in OpEx. The CapEx efficiency improves dramatically by 89% and the carbon footprint is reduced by 67%. These figures underscore Juniper's capability to provide high-performance routers that are not only cost-effective but also environmentally friendly.

One of the key drivers for Juniper's cost and power efficiency at high levels of throughput is that the PTX series routers are designed as cost-effective, power-effective MPLS transport routers in core networks. They lack many features provided by service routers, but these features are not required in core networks. This means that as core routing throughput increases, Juniper routers continue to deliver TCO benefits, power efficiency benefits, and reduced carbon footprints.

Overall, the comparative analysis across different throughput levels demonstrates that Juniper routers consistently outperform their competitor's. They offer substantial savings in power consumption, operational costs, and capital expenditures, along with significant reductions in carbon emissions. These benefits make Juniper routers an attractive choice for organizations seeking efficient, cost-effective, and sustainable networking solutions.

The following sections provide an overview of four different use cases and the TCO and environmental modeling results.

Large Global Enterprise Scenario

The technical architecture of the enterprise WAN edge, backbone, and underlay is presented in Figure 1. In this architecture, the MX304 router is used at the WAN edge and the PTX10001 is used as an MPLS backbone node. For the edge node, we compare Juniper MX304 edge router with a similar router from a leading competitor:

1. Juniper MX304 @1.6T
2. Competitor @800G

For the core nodes, we compare similar core routers from Juniper and a competitor:

3. Juniper PTX10008 6xLC1201 @86.4T
4. Competitor @80T

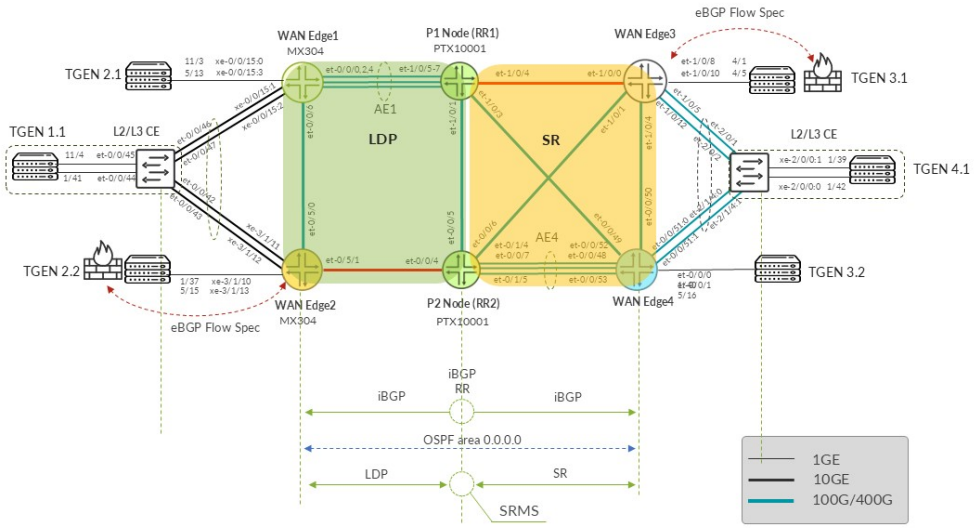

Figure 1. Technical Architecture of Enterprise WAN Edge and Backbone Routing and Underlay

For the large global enterprise scenario, we use the example network presented in Figure 2 with 120 edge nodes and 16 core nodes.

Model	Nb
PTX 10001	16
MX 304	120

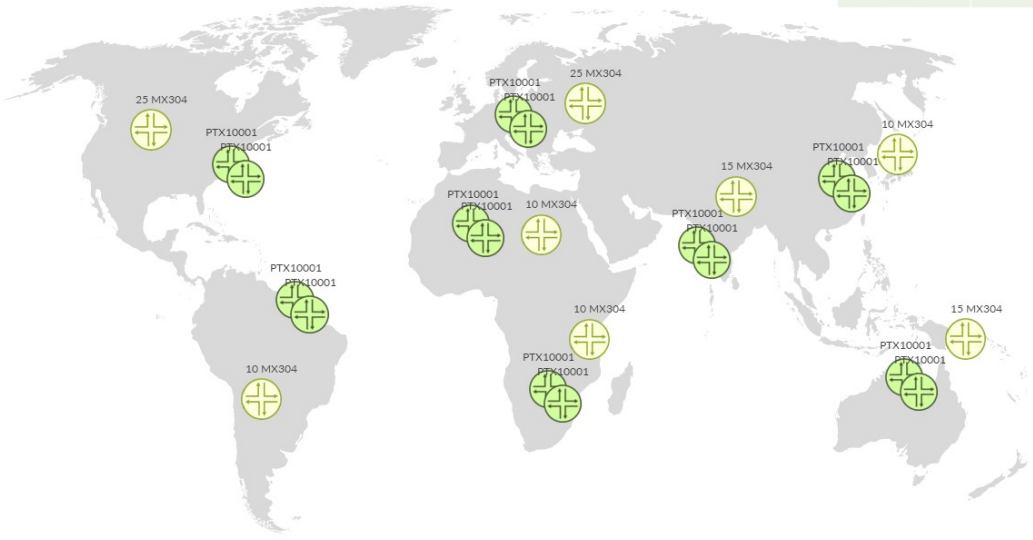

Figure 2. Example of Large Global Enterprise Scenario

The results of our analysis are presented in Table 6, Figure 3, and Figure 4 where we compare the five-year cumulative OpEx, TCO, and carbon footprint between a network with Juniper routers and a competitor's products. The graphs illustrate that the OpEx, TCO, and carbon footprint are reduced by both Juniper edge and core routers in a large global network as compared to similar routers provided by a competitor.

Global Enterprise	Competitor	Juniper	Savings
Cumulative CapEx	$191,737,746	$29,628,336	85%
Cumulatative OpEx	$10,944,521	$4,218,088	61%
Cumulative Carbon Footprint	20,205	7,706	62%

Table 6. Five-Year Cumulative CapEx, OpEx, and Carbon Footprint

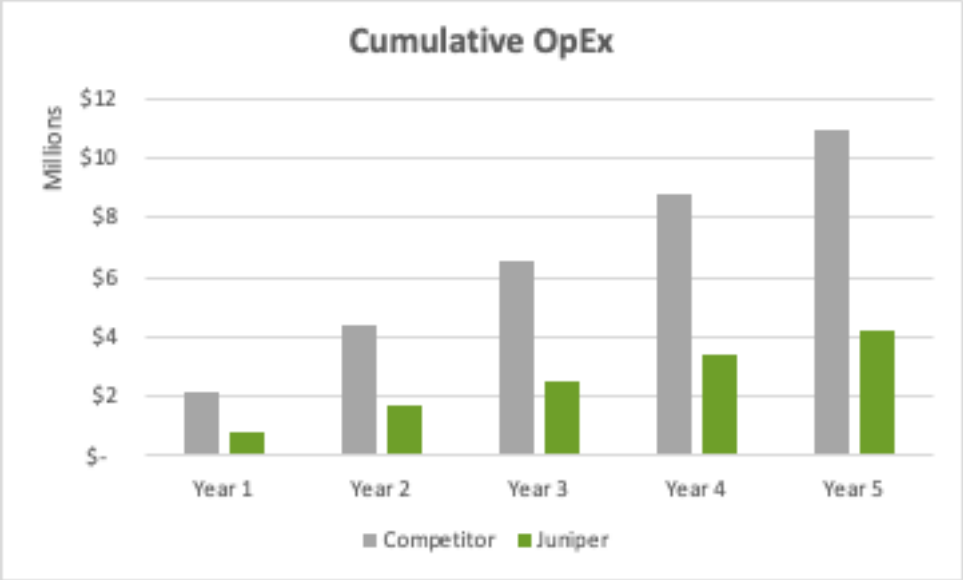

Figure 3. Cumulative OpEx Comparison of Juniper and Competitor for Large Global Enterprise

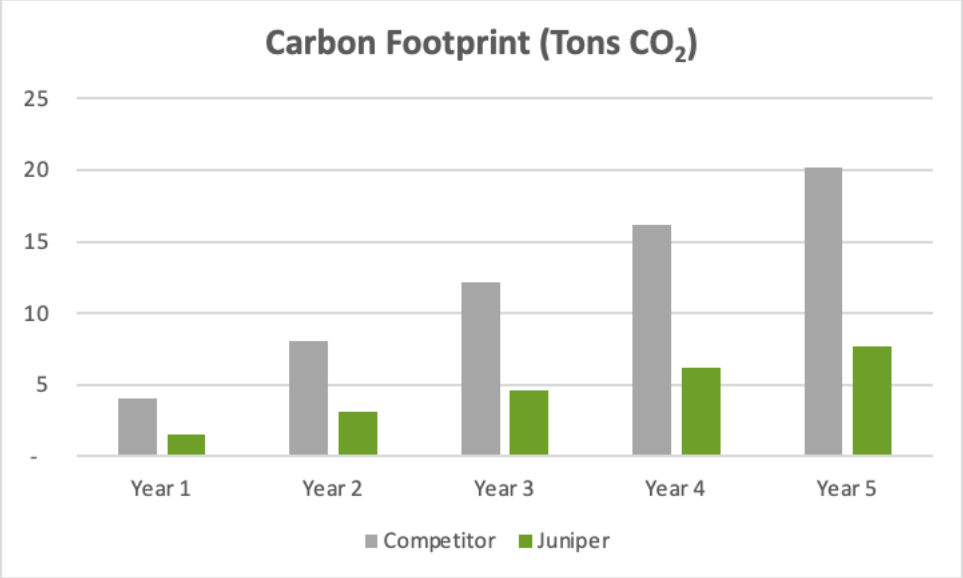

Figure 4. Cumulative Carbon Footprint Comparison of Juniper and Competitor for Large Global Enterprise

Regional Enterprise Scenario

The regional enterprise scenario is presented in Figure 5. In this scenario, we assume there are edge routers in the network. We compare:

1. Juniper MX304 @1.6T
2. Competitor @800G

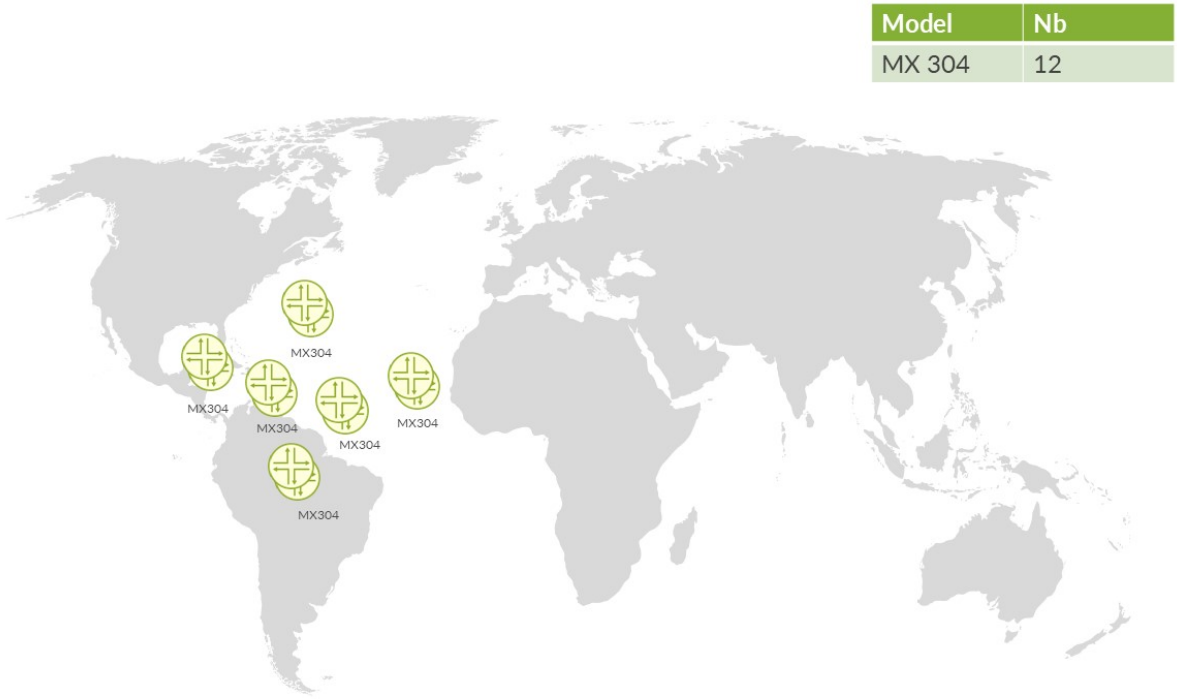

Figure 5. Regional Enterprise Scenario with 12 MX304 Routers

The results of our analysis are presented in Table 7, Figure 6, and Figure 7. For the regional enterprise scenario, we compare the five-year cumulative OpEx, TCO, and carbon footprint between a network with Juniper routers and a competitor's products. The graphs illustrate that OpEx, TCO, and carbon footprint are significantly reduced by Juniper MX304 routers in a regional enterprise network as compared to similar routers provided by a competitor.

Regional Enterprise	Competitor @800G	MX304 @1.6T	Savings
Cumulative CapEx	$1,212,861	$846,336	30%
Cumulatative OpEx	$223,239	$132,261	41%
Cumulative Carbon Footprint	408	232	43%

Table 7. Five-Year Cumulative CapEx, OpEx, and Carbon Footprint

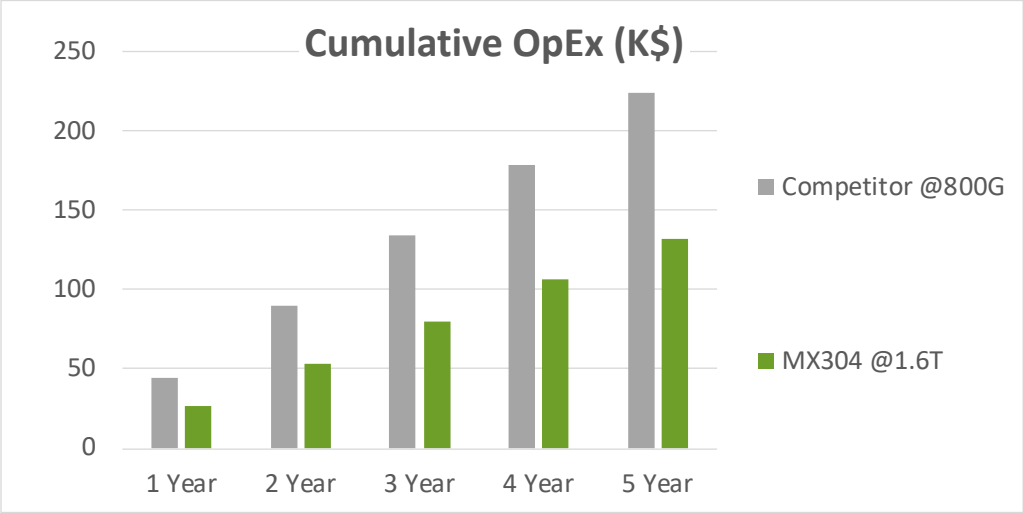

Figure 6. Cumulative OpEx Comparison of MX304 and Competitor for Regional Enterprise Scenario

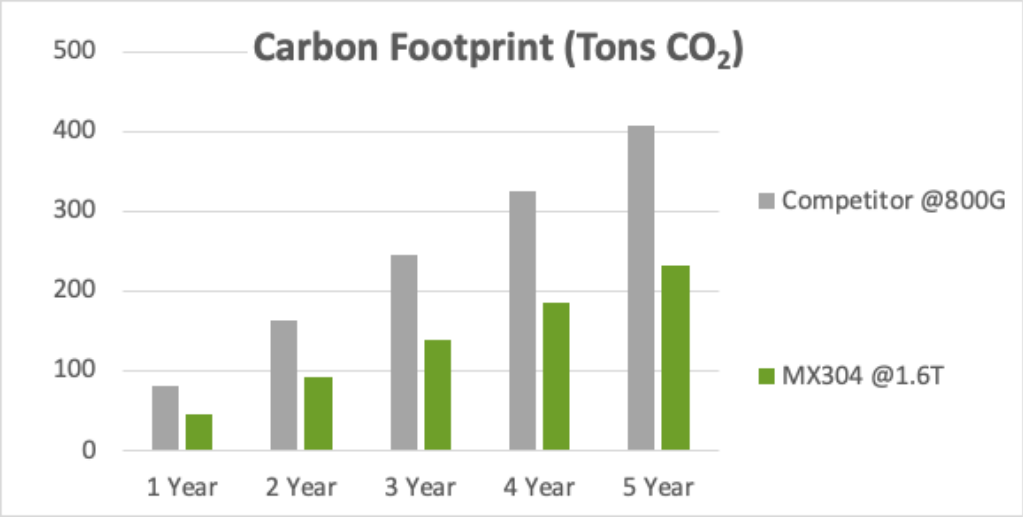

Figure 7. Cumulative Carbon Footprint Comparison of MX304 and Competitor for Regional Enterprise Scenario

Tier 2 Communication Service Provider Network Scenario

In this Tier 2 communication service provider (CSP) network use case, network edge routers provide services to CSP residential and business customers and core routers provide a high-speed MPLS backbone. For the edge node, we compare:

1. Juniper MX10004 @38.4T
2. Competitor @40T

For the core nodes, we compare similar core routers from Juniper and a competitor:

3. Juniper PTX10008 6xLC1201 @86.4T
4. Competitor @80T

The technical architecture of the CSP network is presented in Figure 8, and the Tier 2 CSP scenario is depicted in Figure 9. In this network, we assume there are 120 scalable edge service nodes and 16 MPLS backbone nodes.

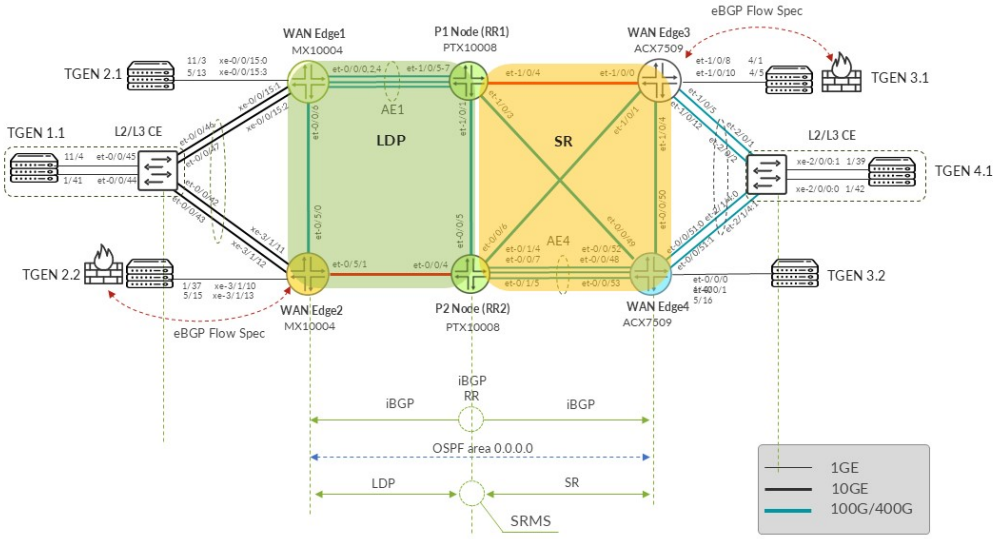

Figure 8. Tier 2 CSP Network Architecture

Model	Nb
PTX 10008	16
MX 10004	120

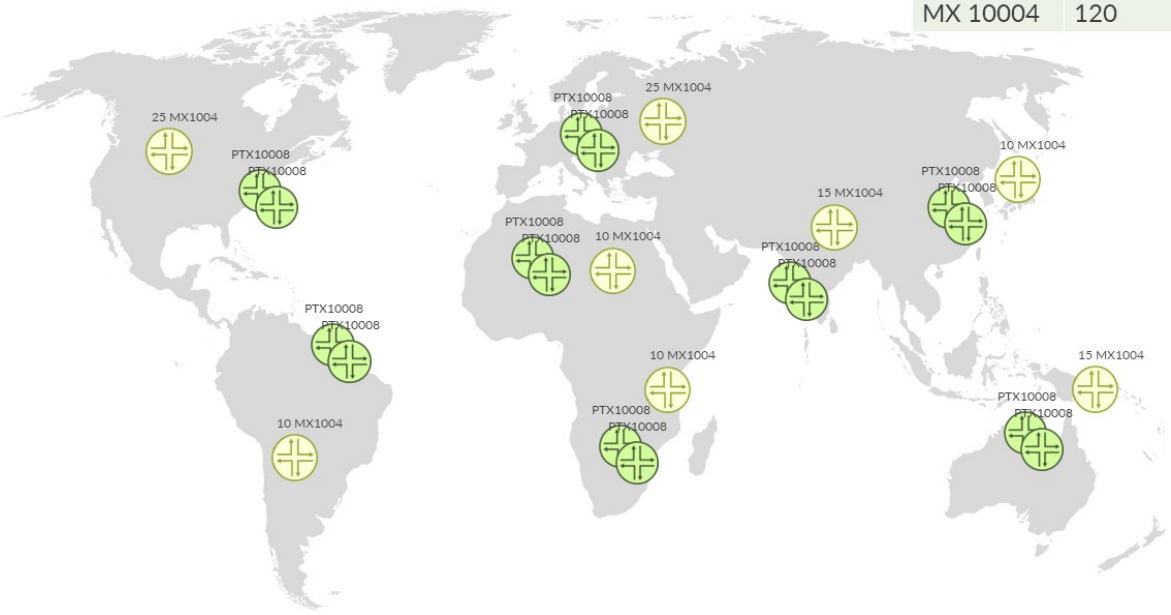

Figure 9. Tier 2 CSP Network Scenario

The results of our analysis are presented in Figure 10 and Figure 11 where we compare the five-year cumulative OpEx, TCO, and carbon footprint between a network with Juniper routers and a competitor's products. The graphs illustrate that the OpEx, TCO, and carbon footprint are reduced by both Juniper edge and core routers in a Tier 2 CSP network as compared to similar routers provided by a competitor.

CSP Network	Competitor	Juniper	Savings
Cumulative CapEx	$853,349,630	$186,930,576	78%
Cumulatative OpEx	$41,862,637	$18,001,598	57%
Cumulative Carbon Footprint	76,616	33,721	56%

Table 8. Tier 2 CSP Compared to Competitor's Routers

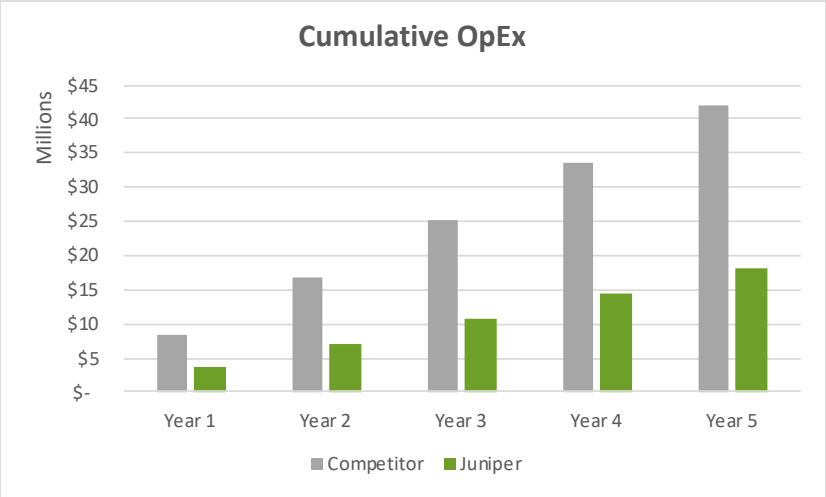

Figure 10. Cumulative OpEx Comparison of Juniper and Competitor for Tier 2 CSP Scenario

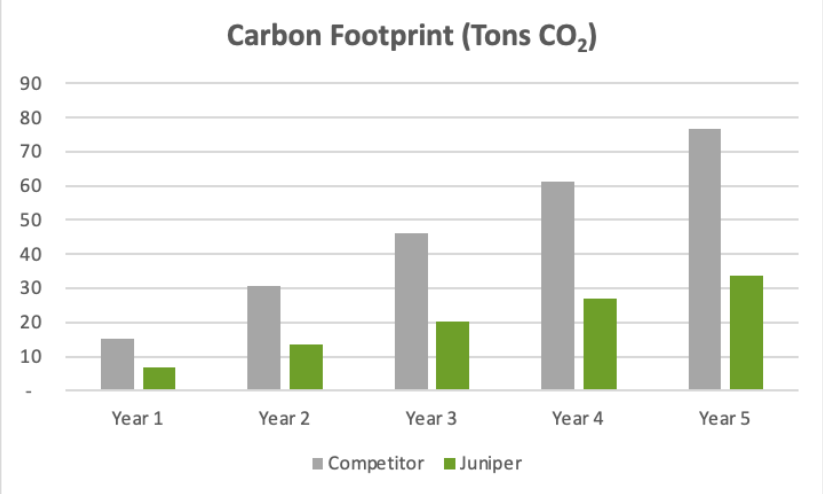

Figure 11. Cumulative Carbon Footprint Comparison of Juniper and Competitor for Tier 2 CSP Scenario

Data Center Interconnect Scenario

Hyperscalers, CSPs, and enterprises need high bandwidth routers to interconnect data centers with each other to provide a conduit for east-west traffic that helps provide for data redundancy, data localization, distributed workloads, and disaster recovery requirements. The data center interconnect (DCI) scenario presented in Figure 12 is an example of a large enterprise or service provider with multiple data centers requiring DCI routers. In this scenario, six global data centers each use a pair of DCI routers, adding up to a total of 12 DCI routers.

For the DCI scenario, we compare similar DCI routers:

1. Juniper PTX10002 @28.8T
2. Competitor @32T

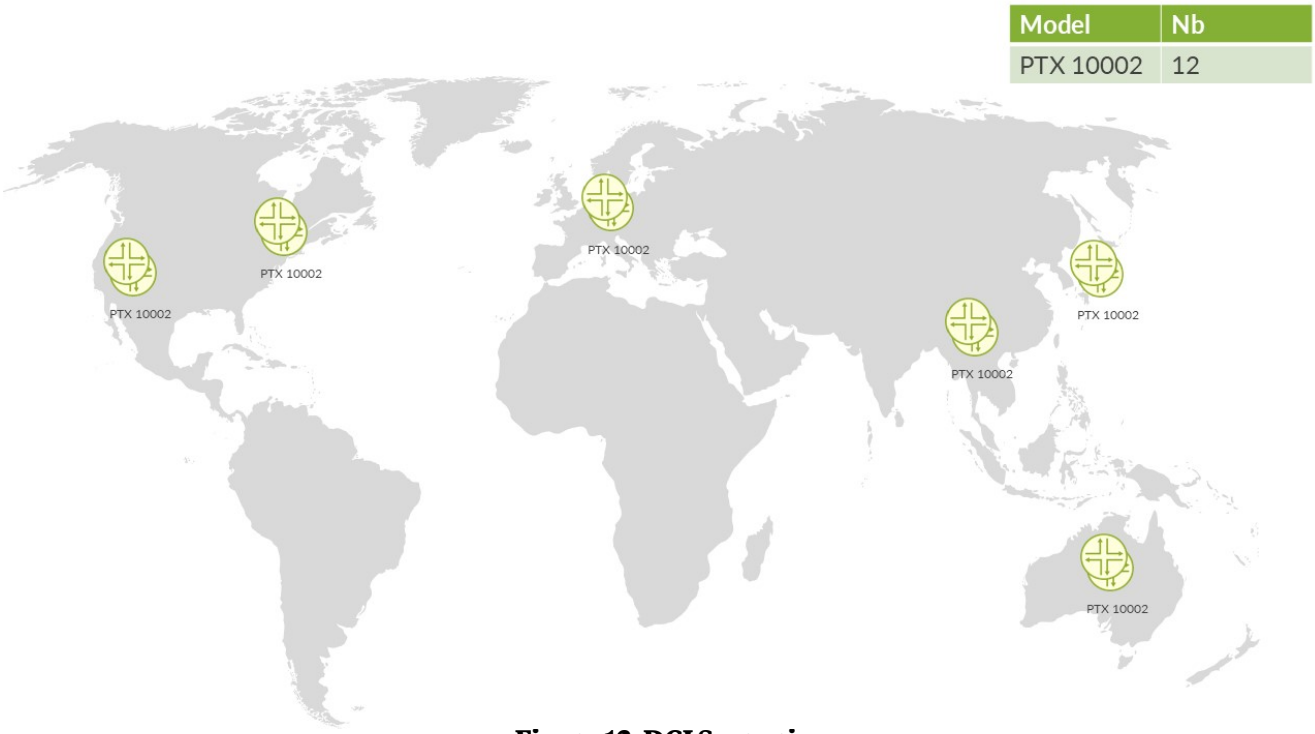

Figure 12. DCI Scenario

The results are presented in Figure 13 and Figure 14. For the DCI scenario, we compare the five-year cumulative OpEx, TCO, and carbon footprint between a network with Juniper routers and a competitor's products. In this scenario, the savings are more significant than the other scenarios considered. The graphs illustrate that the OpEx, TCO, and carbon footprint are reduced by Juniper PTX10002 routers in a DCI network as compared to similar routers provided by a competitor.

DCI	Competitor @32T	PTX10K2-36QDD @28.8T	Savings
Cumulative CapEx	$54,779,125	$3,236,436	94%
Cumulatative OpEx	$2,944,751	$191,721	93%
Cumulative Carbon Footprint	5,438	347	94%

Table 9. Cumulative OpEx Comparison of PTX10002 and Competitor

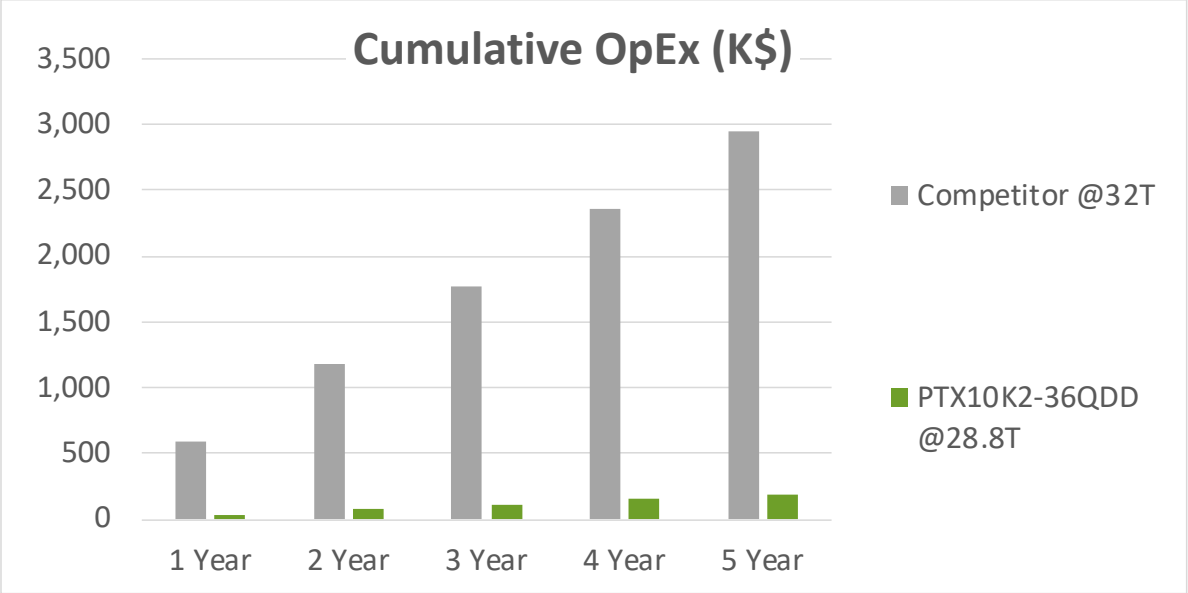

Figure 13. Cumulative OpEx Comparison of PTX10002 and Competitor for DCI Scenario

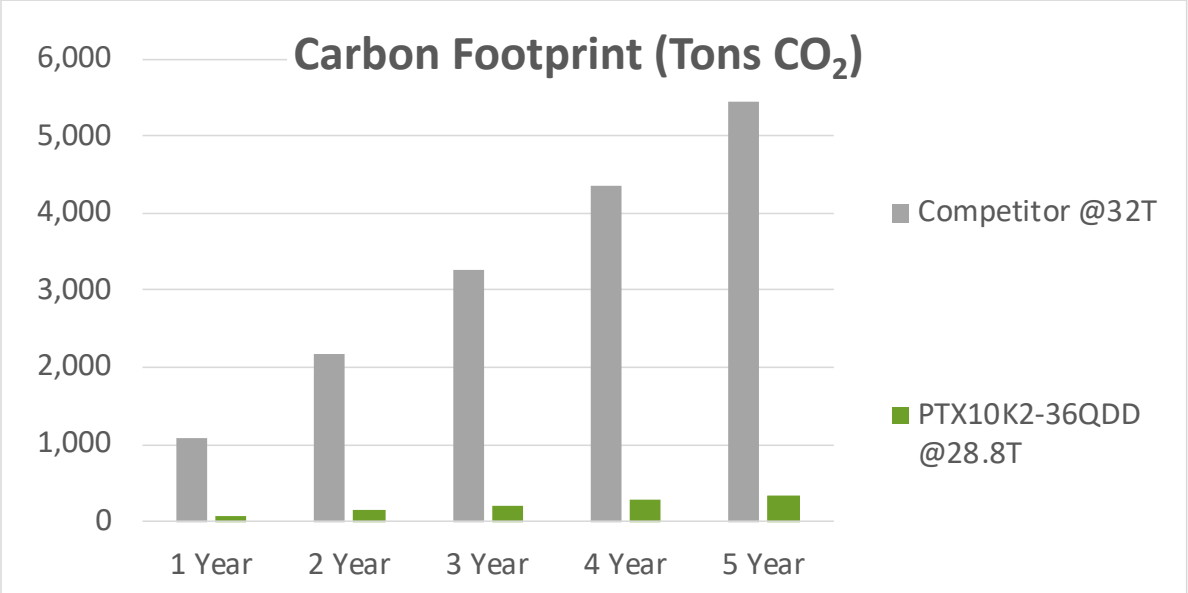

Figure 14. Cumulative Carbon Footprint Comparison of PTX10002 and Competitor for DCI Scenario

Carbon Footprint Reduction

For each of the scenarios, a Juniper network results in a significant carbon footprint reduction. This reduction can be translated to dollars using an average trading cost for carbon credits, which range from $40 to $80 per metric ton[1] of CO2. To calculate the dollar savings associated with carbon credits, we use an average of $60 per metric ton. The carbon credit values for each scenario are presented in Table 10.

	Year 1	Year 2	Year 3	Year 4	Year 5
Global Enterprise	$149,991	$299,982	$449,973	$599,964	$749,955
Regional Enterprise	$2,106	$4,213	$6,319	$8,425	$10,532
Tier 2 CSP	$514,747	$1,029,495	$1,544,242	$2,058,989	$2,573,737
DCI Interconnect	$61,100	$122,200	$183,299	$244,399	$305,499

Table 10. Value of Carbon Credits for Each Scenario Assuming $60 per Metric Ton

[1] https://terrapass.com/blog/creating-carbon-credits-is-it-profitable/#:~:text=How%20Much%20Is%20One%20Carbon%20Credit%20Worth%3F&text=As%20mentioned%20above%2C%20one%20carbon,is%20also%20fueled%20by%20regulations.

Conclusion

The comparative analysis between Juniper's MX and PTX Series Routers and those of a leading competitor demonstrates that Juniper's offerings provide significant advantages in terms of longevity, cost savings, and environmental sustainability. Juniper's routers not only have a longer lifespan but also facilitate smoother technology migrations without disruptive upgrades.

In terms of economic benefits, Juniper routers exhibit superior power efficiency and operational expenditure savings across various throughput levels. The reduced power consumption and lower OpEx directly contribute to significant cost savings for network operators. Furthermore, the improved capital expenditure efficiency indicates that Juniper routers provide better value for the investment compared to their competitor's.

- The case of a large enterprise choosing Juniper equates to 83% CapEx and 61% OpEX savings.
- A regional enterprise choosing Juniper equates to 30% CapEx and 41% OpEX savings.
- A Tier 2 CSP choosing Juniper equates to 78% CapEx and 57% OpEX savings.
- An enterprise with a DCI connection choosing Juniper equates to 94% CapEx and 93% OpEX savings.

Environmentally, Juniper routers have a lower carbon footprint, reinforcing their advantage in sustainability. The reduction in CO2 emissions aligns with the growing emphasis on eco-friendly practices in the technology sector.

The study highlights that Juniper MX and PTX Series Routers are not only technologically advanced but also economically and environmentally beneficial. These attributes make Juniper's routers an excellent choice for enterprises and service providers aiming to enhance their network performance while reducing costs and minimizing environmental impact.

Appendix: How to Augment a WAN Modernization ROI with AIOPs and Automation

Benefits of Juniper AIOPs

Artificial intelligence for IT operations (AIOps) offers several key benefits for enterprise and service provider wide area networks (WANs). By leveraging advanced machine learning algorithms and data analytics, AIOps enhances network performance through real-time monitoring, anomaly detection, and predictive maintenance. This initiative-taking approach allows IT teams to identify and resolve potential issues before they impact network availability or performance, thereby reducing downtime and improving overall reliability. AIOps provides valuable insights into network usage patterns, enabling more informed decision making for capacity planning and future network expansions. By automating routine tasks and providing actionable intelligence, AIOps reduces the burden on IT staff, allowing them to focus on more strategic initiatives. This leads to a more agile and resilient enterprise network infrastructure. More detail on AIOps is provided in the following white paper: *ESG white paper: AI-Native Requirements for Modern Network*[2].

Increased observability reduces complexity, allowing effortless troubleshooting using natural language to proactively detect anomalies. This reduces the mean time to repair/innocence and automates root-cause analysis for more efficient issue identification and resolution.

As a cloud-delivered service, Juniper's new routing assurance product simplifies operations and delivers the most effective way to monitor, analyze, and resolve issues swiftly across multiple branch offices, WAN edge, and peering locations. The extension to Marvis VNA for routing empowers WAN operation with faster documentation search, enabling network operators to query network configurations and ask detailed product questions.

Juniper has measured significant improvements in network operations in networks managed with Mist AI, as depicted in Figure 16. ACG Research conducted a previous economic study, *Financial Benefits of Juniper Networks' Wired and Wireless Access Driven by Mist AI in Managed Network*

[2] https://www.juniper.net/content/dam/www/assets/white-papers/us/en/2024/ai-native-requirements-for-modern-networks.pdf

Services[3] , on Mist AI networks showing a 74% OpEx savings associated with AIOps. This technology is currently supporting some ACX and MX routers, and is roadmap to support Juniper PTX Routers Series. More information can be found at: *https://www.juniper.net/us/en/products/cloud-services/routing-assurance.html.*

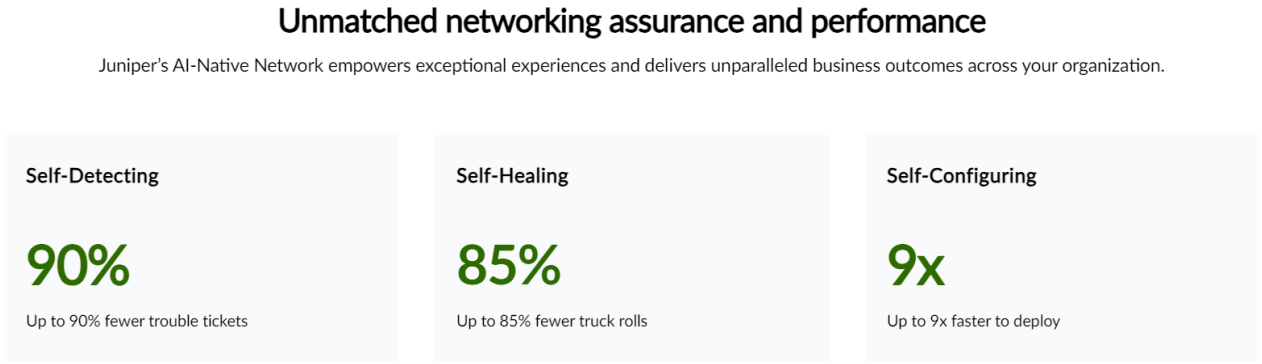

Figure 15. Benefits of Juniper AI-Native Networking Platform

Benefits of Juniper Paragon Automation

In a previous research ACG report, *The Economic Benefits of Automating Capacity Optimization in IP Networks*[4], we demonstrated how network operators can achieve incremental TCO savings of an estimated 27% by deploying network optimization capabilities and use cases such as Juniper Paragon Automation and its autonomous capacity optimization use case. The model we applied in that estimation is equally applicable in each of the scenarios previously described, delivering a further cumulative impact on TCO in networks powered by Juniper's routers.

The evolution of network architectures and the requirements for scalability and flexibility in increasingly complex networks drives the need for next-generation network automation. Most network operators believe automation is necessary to remain competitive and support the increasing scale of operational demands. However, most operators still resort to manual or semi-automated network operations. In a 2023 survey by *Heavy Reading*, 82% of respondents reported they currently rely largely or entirely on manual network operations. Next-generation network automation covers all aspects of the network and service l ife cycle within a common platform

[3] https://www.juniper.net/content/dam/www/assets/analyst-reports/us/en/2022/acg-research-financial-benefits-of-juniper-networks-wired-wireless-and-sd-wan-driven-by-mist-ai-in-managed-network-services.pdf

[4] https://www.juniper.net/content/dam/www/assets/white-papers/us/en/2022/the-economic-benefits-of-automating-capacity-optimization-in-ip-networks.pdf

architecture, with use cases spanning Day 0 through Day 2, such as those depicted in Figure 16.

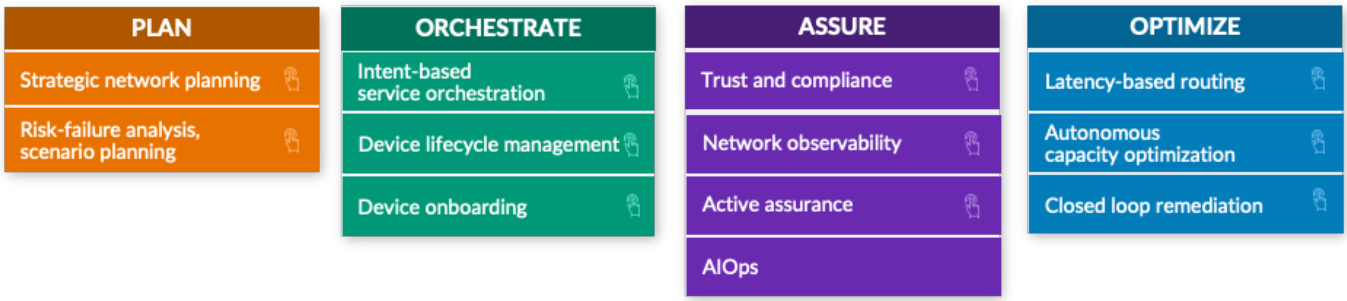

Figure 16. Automation Use Cases Spanning the End-to-End Network and Service Life Cycle, Supported by Juniper Paragon

In our analysis, we see significant potential for further incremental TCO benefits beyond the 27% estimated in our previous study, which was based on just one of the automation use cases previously shown, Autonomous Capacity Optimization:

1. **In the planning phase,** there are clear CapEx benefits to a more precise planning decision-making process, allocating budget for capacity expansion and densification only where the analysis shows a clear need.
2. **In the orchestration phase,** there is a clear TCO advantage to ceding the onboarding, configuration, and validation of new devices and services (as well as changes in-life) to an automated and deterministic method guided by a much simpler intent-based approach to overlay service definition.
3. **In the assurance phase,** the automation of detection, root-cause analysis, mitigation, and even resolution of user-impacting problems has obvious OpEx benefits for complex transport networks. This is particularly true as networks are becoming more distributed and programmable. This is not to mention the benefits of avoiding costly outages, which Juniper's Paragon portfolio supports using active assurance test agents that can detect user-impacting problems regardless of whether there are any live users in the network itself.
4. **In the optimization phase,** we noted previously the estimated 27% TCO saving coming from the Autonomous Capacity Optimization use case (sometimes referred to as running the network hotter). It is easy to see positive impacts to the business case on a more fundamental level as well: the ability to deliver more reliable, resilient network services in high-value scenarios without relying on network engineers to manually manage networks to the extent that many operators do today.

Peter Fetterolf

Peter Fetterolf, Ph. D. is an expert in network technology, architecture and economic analysis. He is responsible for financial modeling and whitepapers as well as software development of the ACG Research Business Analytics Engine. Dr. Fetterolf has a multidisciplinary background in the networking industry with over thirty years of experience as a management consultant, entrepreneur, executive manager, and academic. He is experienced in economic modeling, business case analysis, engineering management, product definition, market validation, network design, and enterprise, and service provider network strategy.