The Futurum Group

More Wide Area Networks: A New Vista for Sustainability Success

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Overview

Corporate sustainability is a top priority for enterprises globally. Networking RFPs and tenders increasingly include sustainability requirements for vendor-level environmental programs to engineer out harmful materials, extend the life cycle of systems, reduce operational costs in the face of rising energy prices, and help drive internal sustainability initiatives. This is reinforced by the fast-growing number of organizations that give top priority to their carbon emission reduction goals. As of November 2023, more than 500 and over 2,000 more organizations committed to setting net-zero targets within the next 24 months.

Vendors with mature programs have already defined their environmental sustainability strategies—such as decarbonization, sustainable technologies, and circularity—to accelerate the fulfillment of their own documented emissions reduction goals. They have strategically invested in renewable energy and power purchase agreements and demonstrated their commitment to delivering sustainable products to the market by investing in advanced low-power, high-performance ASICs and systems. The most progressive vendors have aggressively developed artificial intelligence (AI) and AIOps to demonstrate the virtuous cycle that machine learning has for desirable outcomes like power optimization, leading to customer and shareholder satisfaction. For many customers, these vendors represent the opportunity for increased value and decreased time-to-value; they act as manufacturers of advanced products and as trusted advisors on the road to a more sustainable future.

We believe Juniper Networks is best suited to meet the distinct challenges of fulfilling WAN technical, manageability, and sustainability demands. They have shown an organization-wide dedication to reducing environmental footprint through energy-saving silicon and hardware innovation, AI-Native Networking and management capabilities, and versatile programs that minimize e-waste. This portfolio-wide dedication reinforces Juniper's strategic commitment to net-zero emissions by 2040.

Can My Network Impact Sustainability?

Networking, including the devices that make up the WANs, data centers, and peering points that connect businesses to private networks, cloud, and service provider services, would seem an unlikely place to start a conversation about enterprise sustainability. After all, networking of this sort has long been the anonymous domain of uber-technical specialists responsible for connectivity in the same way a utility generates and delivers power—it's essential, it works most of the time, and it's a massive blow to productivity when it doesn't work as it should.

Even less is understood about how the new generation of networking products can positively impact sustainability initiatives, even as sustainability continues its journey to relevance fueled by customer demand, regulatory oversight, and corporate economics. As IT workloads are repatriated from the cloud, power costs continue to soar, and reliable peering to service/cloud providers become even more mission-critical, there should be a stronger focus on WAN technology use cases as a strategic enabler of business value. Standard or out-of-cycle refreshes of WAN technology can no longer simply be entrusted to an IT decision-maker loyal to a single brand. The financial and sustainability impact of a WAN technology refresh must, at a minimum, be subject to a total cost of ownership (TCO) study that includes the solution's ability to:

- Act as a hedge against rising costs of power
- Extend life cycles from the current five to seven years to 12 to 15 years to help keep e-waste out of landfills
- Anticipate new applications and use cases by employing custom, programmable silicon for features that may not have even entered the standards bodies yet
- Harness the benefits of AIOps with products built to extract rich data and proven algorithms, producing valuable insight
- Possess the software and port density flexibility to satisfy novel requirements in AI/ML-centric data center applications

WAN-specific Sustainability Technologies

The WAN is a potentially important pivot point where significant organization-wide energy and cost savings can be realized. Today, the WAN's most basic constituent part, the routers, fall into two broad categories: legacy devices designed 10 to 20 years ago, and a new generation of routers designed for energy efficiency from inception, combining energy-efficient ASICs, hardware, and AI-enabled power-saving features. These modern routers feature advances in dynamic component-level power management and, when networked together with protocols optimized to stream telemetry to AI/ML algorithms, provide advanced traffic management optimization today and the built-in promise of an intelligent power management of circuit paths.

Our findings indicate that Juniper Networks has integrated sustainability into its design and engineering processes. This enables Juniper's WAN-related product portfolio to prioritize energy efficiency and longer life cycles, strengthening the fulfillment of sustainability goals. Juniper Networks' efforts to advance WAN sustainability are focused in three key areas:

- Commitment to energy-efficient ASICs
- Excellence in hardware and software design
- AI-Native, intent-based networking automation for Day 0, 1, and 2

Energy-efficient ASICs: A Lynchpin for Sustainability Innovation

Juniper has been designing its own ASICs since 1996. The company's silicon strategy has long been a differentiator, and we see Juniper continuing to execute this strategy, as well as the industry breakthroughs in scale and throughput they represent now and into the future. Key to this strategy is leveraging the appropriate type of silicon (including pipeline and run-to-completion architectures) that is optimal for each router role in the WAN. While others attempt to optimize their development efforts by using just one or two families of silicon across their WAN portfolio, (which results in inefficient solutions for certain roles), Juniper stands alone in persisting with three silicon families that deliver products without compromise across all WAN roles. The latest versions of their custom silicon include the seventh generation of Trio ASIC for the MX line of high-service scale routers and the fifth generation of Express ASIC for the PTX line of 100G, 400G, and 800G optimized routers for enterprise, service providers, and cloud networks. Both ASICs deliver enhanced traffic insights, hardware-based sampling, and the horsepower bandwidth-intensive routing applications require; with up to 16M IPv4/IPv6 routes and 8M counters in a sustainable chiplet-based architecture.

The Express 5 ASIC is Juniper's highest radix deep-buffer ASIC to date, and it enables the construction of a wide range of 100G/400G/800G systems, starting from 14.4T fixed-form factor routers to high-capacity petabit routing and switching platforms, with more than twice the power efficiency gains compared with the previous generation. The products based on Express 5 are optimized for the new high-speed 400G and 800G transceivers with 112G electrical interfaces. These transceivers offer a more than 40% power consumption reduction compared with the first generation of 56G optics. Express 5's innovative design lends itself to single-chip, Ethernet-only systems and multi-chip, fabric-based systems with impressive densities and power optimization features, such as the ability to deactivate internal componentry when idle.

The Trio ASIC-based MX Series of routing platforms delivers breakthrough capabilities across system capacity, density, security, and performance metrics with built-in longevity integral to advancing customer digital transformation. Specifically, the 7nm-based Trio 6 platform, on average, exceeds 70% in power and space efficiency compared to its industry-leading Trio predecessors.

The ACX Series Routers, using merchant silicon, directly fulfill the energy efficiency and sustainability demands across metro access, aggregation, and data center implementations underpinned by MEF 3.0 compliance and support of 5G high-precision timing and synchronization capabilities. The ACX Series platform, with its silicon-agnosticism, compact design and energy efficiency, provides up to 64% more space efficiency and up to 77% less power consumption. The latest generation of ACX Series routers are engineered for longevity, providing up to 12 years of lifespan.

Excellence in System and Software Design Innovation

Since the initial design of the M40 router, Juniper Networks has employed the concepts of the "three S's" in development: Silicon, Systems, and Software. The Junos OS operating system provides power management capabilities that are an essential feature across Juniper's WAN portfolio. It allows administrators to configure power priorities for line cards, manage power supply redundancy, and optimize power resources. The solution reduces power consumption through dynamic power management capabilities. This feature allows for better use of the power entry module (PEM) by ensuring that new hardware is only powered on if there is sufficient power available in the PEM to meet the worst-case power requirement for the specific component.

The Juniper Telemetry Interface (JTI) serves as an agile tool for network monitoring and performance management. Specifically, JTI enables real-time performance monitoring by streaming data from network elements to a performance management system. Network administrators can measure link and node utilization trends, allowing them to swiftly address issues such as network congestion. Also, JTI overcomes the limitations of periodic polling with traditional SNMP and CLI models. JTI uses a push model that eliminates the need for polling, delivering data asynchronously, and making it highly scalable.

Experience-First Networking

Juniper Networks distinguishes itself from other networking vendors when it comes to the realm of network management. With the release of its Paragon Automation platform, Juniper creates a differentiated experience that breathes new life into the Intent-based paradigm. The standards-based, cloud-native technologies that make up Paragon's micro-services architecture allow it to move beyond traditional monitoring of devices to a far more fulsome model that intelligently combines device, network, and service key performance indicators (KPI's) through AI-enabled analytics to create an Observability standard that favors only necessary detail and focuses on the actions necessary to maintain network health. Paragon's flexible architecture allows for similar bundling of micro-services for a large and growing set of Use Cases specific to intent-based management. For example, services like workflows, intent plans, device and interface profiles, and active testing are bundled into a Device Onboarding use case. Inventory, software, license, and configuration management are bundled into a Device Management use case. TPM 2.0, compliance, vulnerability, and integrity checks are bundled into Trust and Compliance use cases. And Juniper has already augmented the base services (described above) with advanced feature packs for testing and monitoring using synthetic traffic with test agents to continually test connectivity from layers 1 through 7; and a customizable Service Orchestration use case to translate intent into desired outcomes, such as guaranteed L2 and L3 services that are delivered, tested and placed under management within minutes. Paragon's API-driven architecture provides the flexibility to enable a development pipeline well into the foreseeable future for Use Cases specific to:

Network planning: risk failure analysis and scenario planning

- **Orchestration:** device onboarding, service provisioning, service orchestration, device and service life cycle management
- **Assurance:** ongoing testing and monitoring with synthetic traffic, observability, alarms, logs, and security compliance management
- **Optimization:** autonomous capacity optimization, real-time and near real-time problem detection and mitigation, and policy-based routing

Paragon Automation sets Juniper and its customers on a path of scalable innovation, especially when one considers the powerful flywheel effect created by instrumenting Paragon with its industry-leading Marvis AI capabilities. With more data from more domains, this combination creates more learning and value for the end user. Perhaps the most consequential of new developments is Green (or sustainable) Routing, which is currently in development. Green Routing represents the clear potential for model-based, intent-based service orchestration in the WAN to incorporate power consumption as an intent criterion, which is possible by satisfying the following requirements:

1. **Close integration between hardware and software**. The system is aware of the power consumed by each router in the network and has the ability to influence that. For example, shutting down modules or even entire routers and controlling the paths that network services traverse so that the system can control the power consumption of the network.

2. **Intelligence about how much network capacity is needed to support a given level of throughput and how that throughput changes over time.** By meeting this condition, the system can minimize power consumption without impacting user experience.

First proposed at Mobile World Congress 2024 by Juniper, Green Routing is a key component of power management in the WAN, with early results pointing to significant positive impacts to return on investment and TCO. Green Routing is anticipated to be included in Juniper's Paragon Automation offering in the near to medium term.

Underpinning the Juniper WAN portfolio is its fundamental commitment to its three pillars of sustainability: decarbonization, sustainable technology, and circularity:

- For decarbonization, Juniper is committed to achieving net-zero emissions by 2040, including reducing supply chain emissions by 10% by 2025 and 25% by 2030. Juniper aims to accelerate a zero-carbon economy through meaningful emissions strategies throughout the entire value chain.

- For sustainable technology, Juniper is incorporating sustainability into the design and engineering of its products, emphasizing energy efficiency and longer life cycle network architecture.

- To promote circularity, Juniper is working toward reducing and recycling waste while extending product life cycles by building products with end-of-life goals, enabling them to re-enter the supply chain rather than the landfill.

Juniper's circular economy programs stand out from the competition. For example, the Juniper Try and Buy program enables prospects to upgrade their network with a 60-90-day risk-free trial of Juniper's latest technology. The Juniper Certified Pre-Owned Program (JCPO) purchases excess or previously used products that are refurbished and tested for like-new quality and security. And the Juniper Take Back Program targets maximizing the value of end-use products while minimizing environmental impact, recovering value from decommissioned or excess hardware.

Finally, Juniper Beyond Labs is an innovation hub for Experience-First Networking, which improves Juniper's solutions with various sustainability innovations. These include thermal profiling for better energy distribution observation, power steering for optimal traffic routing, and liquid-cooling methods like immersion cooling.

Juniper's Corporate Sustainability Credentials

Juniper's commitment to climate improvement reinforces its sustainability credentials. Now, Juniper has expanded its climate commitments with a short-term target and a long-term net-zero target by 2040, currently under validation by the Science Based Targets initiative (SBTi). Juniper will follow a standards-based and highly quantifiable approach to continuing to reduce its carbon footprint.

As part of Juniper's decarbonization strategy, purchasing renewable energy is an important element in how they drive down emissions from an organizational standpoint. In April 2024, Juniper announced the company's participation in an aggregated deal to purchase solar energy from a 180-megawatt project in Texas. Once online, it is expected to generate renewable electricity equivalent to 70% of Juniper's electricity demand in North America. In 2023, Juniper commissioned a renewable energy site located in Bengaluru, India. The site powers the Bengaluru site with more than 87% renewable energy.

Attaining the Green Future Best Practice Award further validates Juniper's sustainable technology credentials. Juniper was also recently awarded "Innovation/Game Changer" for the Power Steering innovation at the 2024 Telekom Campus Fair event in Bonn, Germany. This innovation has the potential to improve the power efficiency of network infrastructure by up to 70% by monitoring traffic levels and dynamically aligning power needs with demand, optimizing resource utilization, and creating cost savings for network operators.

Conclusion

Juniper offers the best-in-class solutions essential to successfully enlist the WAN to fulfill organization-wide sustainability objectives. Juniper's AI-Native Networking Platform also encompasses green power management and intelligent traffic control. It brings competitive advantages that are must-haves for cloud, operator, and enterprise decision-makers to prioritize in their selection and adoption processes.

Juniper's AI-Native Networking Platform provides comprehensive AIOps capabilities that are key to improving WAN performance throughout the end user, applications, and network domain continuum by minimizing the potential for network outages and application downtime. The new Express 5 silicon raises the bar for energy-efficient networking performance. The new PTX platforms are built on an optimized design using fewer and more efficient silicon chips, as well as Junos OS power management capabilities and energy-efficient chassis designs. Plus, PTX solutions enable Juniper Paragon Automation intelligent automation capabilities to improve system efficiencies and reduce TCO.

Juniper's product sustainability is strengthened by the energy and space efficiency gains that its PTX Series Routers, ACX Series Routers, and MX Series Routers deliver. This includes portfolio-wide capabilities such as the Juniper PTX platform using power management features in Junos OS to support forwarding engine optimization, the Juniper MX series breakthrough energy and space efficiency gains throughout SDN implementations, as well as the ACX Series Routers across data center, aggregation, and metro access environments.

From our view, Juniper Networks' AI-Native Networking Platform combines the silicon and systems essential to enable the sustainable and secure scaling of WAN infrastructure. The platform is underpinned by the company's AIOps solution that provides data-driven insights and accelerated troubleshooting for fulfilling sustainability objectives and lower costs from client to cloud. This provides the foundation to bring organization-wide efficiencies that demonstrate why Juniper embraces its role as a trusted partner in walking the sustainability walk.

Important Information About this Report

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ABOUT JUNIPER NETWORKS

Juniper Networks believes that connectivity is not the same as experiencing a great connection. Juniper's AI-Native Networking Platform is built from the ground up to leverage AI to deliver the best and most secure user experiences from the edge to the data center and cloud. Additional information can be found at Juniper Networks or connect with Juniper on X (Twitter), LinkedIn, and Facebook.

The link for additional information can be found at Juniper Networks.

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