THE AI-DRIVEN CAMPUS ARCHITECTURE

Artificial intelligence will be critical to delivering the campus networks of the next decade

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EXECUTIVE SUMMARY

The network for the next decade centers around delivering better user experiences and simplifying IT operations. Traditional wired and wireless LAN solutions lack the scalability, reliability, performance, and agility needed to address today's challenges and diverse enterprise needs.

The new enterprise network is now powered by artificial intelligence (AI), allowing IT teams to focus on strategic initiatives rather than spending countless hours on tedious, manual operations as the numbers of mobile and IoT devices connected to the campus network soar. This white paper explains how to design an end-to-end AI-driven campus network that spans the WAN, LAN, Wi-Fi, and security, delivering unique capabilities across the network.

Introduction

Enterprise networks are undergoing massive transitions to accommodate the growing needs of cloud-ready networks, as well as a plethora of mobile and IoT devices. Unfortunately, as the number of devices grows, so does complexity. Cloud-based applications enable new business models, provide greater business agility, and support the adoption of key technologies such as unified communications, video, and other latency-sensitive applications. Additionally, the technological advances and widespread adoption in machine learning (ML) and AI can vastly improve operations and experiences for both IT teams and end users.

Network architects are redesigning their networks to accommodate the modern business requirements of cloud-ready applications for data, voice, and video using open standards and software-driven management platforms to reduce operational costs. The ultimate goal is to leverage simpler automation, telemetry, and AI capabilities to build out the network of the next decade.

The Juniper AI-Driven Campus Network

The Juniper Networks portfolio of services, software, and hardware products delivers end-to-end campus network solutions, extending across the WAN, LAN, Wi-Fi, and security domains—all while supporting open standards like Ethernet VPN-Virtual Extensible LAN (EVPN-VXLAN) to drive architectural simplicity, scale, and performance.

Juniper's AI-Driven Campus is composed of the following:

- AI-powered Wi-Fi and Wired Assurance
- Campus fabrics
- Campus-ready Power over Ethernet (PoE) and multigigabit switches
- Enterprise-grade access points with Wi-Fi, Bluetooth LE, and IoT
- Juniper Connected Security and network segmentation
- Junos® operating system, the foundation of high-performance networks
- Junos telemetry
- Modern, microservices cloud AIOps platform

AI-Powered Wi-Fi and Wired Assurance

Mist, a Juniper company, pioneered Wi-Fi and Wired Assurance cloud service offerings that deliver amazing wired and wireless experiences for end users, IoT devices, and clients, while simplifying and automating operations for IT teams.

Wi-Fi assurance, driven by machine learning, replaces manual troubleshooting tasks with automated wireless operations by making Wi-Fi predictable, reliable, and measurable with visibility into user service levels. Anomaly detection automates triggers to capture packets for event correlation, building network intelligence with Radio Resource Management (RRM) at the client level for unprecedented visibility into the user's experience with the wireless network.

Wired Assurance delivers an unparalleled network experience for wired devices, transforming IT operations from reactive troubleshooting to proactive remediation and turning insights into actions. Wired Assurance provides visibility into the wired experience, as well as into the health of platforms like Juniper Networks® EX Series Ethernet Switches, IoT devices, access points, servers, printers, and more. The data is leveraged within the Mist cloud and AI engine to deliver simpler operations, shorter mean time to repair, and better visibility into end-user experiences.

Wi-Fi and Wired Assurance are complemented by Marvis, a Virtual Network Assistant service (with Marvis Actions) that simplifies troubleshooting and integrated helpdesk functions, bringing self-driving actions to the network to automatically remediate issues such as unhappy users at a particular site, missing VLANs, bad switch cables, and more.

Campus Fabrics

The increasing use of IoT devices in the campus dictates that networks be able to scale rapidly without adding complexity. Since many of these devices have limited networking capabilities, they require L2 adjacency across buildings or campuses. This problem was traditionally solved by extending VLANs across buildings and campuses using data plane flood and learn. This approach, however, is inefficient and hard to manage—inefficient due to excess consumption of network bandwidth, and difficult to manage because VLANs need to be extended to new network ports.

EVPN-VXLAN

The AI-Driven Campus architecture decouples the overlay network from the underlay with technologies such as Ethernet VPN (EVPN) and Virtual Extensible LAN (VXLAN), addressing the needs of the modern enterprise network by allowing network administrators to create logical L2 networks across different L3 networks. Juniper supports various EVPN-VXLAN based campus fabric architectures:

- EVPN multihoming (on collapsed core or distribution)
- Campus fabric: Core-distribution
- Campus fabric: IP Clos

An end-to-end EVPN-VXLAN architecture lets you manage your campus and data center as a single IP fabric, with over-the-top (OTT) policy and control provided by Juniper. Any number of switches can be connected in a Clos network or IP fabric, with EVPN-VLAN to extend the fabric and connect multiple enterprise buildings, and VXLAN stretching L2 across the network. An IP Clos network between the distribution and the core layers can exist in two modes: centrally routed bridging overlay or edge routed bridging overlay.

For more information, visit www.juniper.net/assets/us/en/local/pdf/solutionbriefs/3510643-en.pdf.

Aside from EVPN-VXLAN based architectures, Juniper also supports Virtual Chassis, allowing up to 10 interconnected switches to operate as a single, logical device with one IP address. Virtual Chassis technology enables enterprises to separate physical topology from logical groupings of endpoints, ensuring efficient resource utilization.
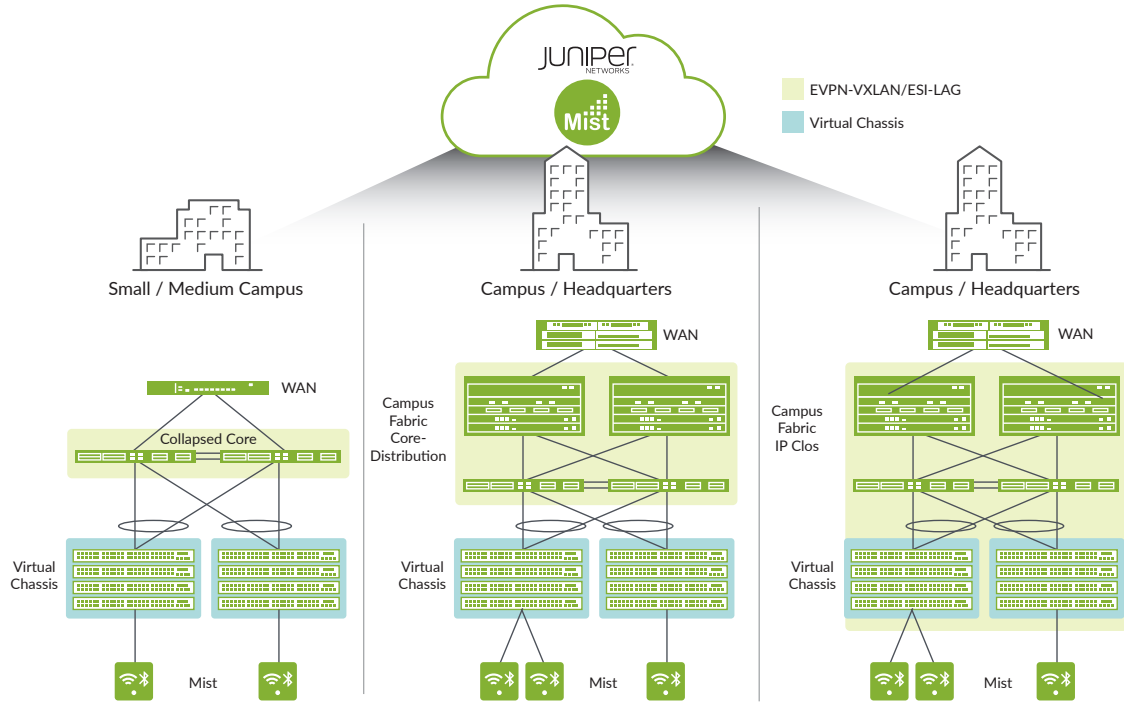
Figure 1: Campus fabrics showing Virtual Chassis and EVPN-VXLAN based architectures.

Campus-Ready PoE and Multigigabit Switches

Juniper offers high-performance multigigabit access switches for advanced branch or campus deployments. The modern campus environment must adapt to Wi-Fi 6 (802.11ax) standards and accommodate access points that require multigigabit speeds and increased power requirements. Juniper's multigigabit (802.3bz) switches are a flexible and secure offering for the ever-connected enterprise, supplying up to 1680 W of PoE with two power supplies for redundancy, supporting business-critical high-density IP telephony, surveillance cameras, and/or wireless access point deployments.
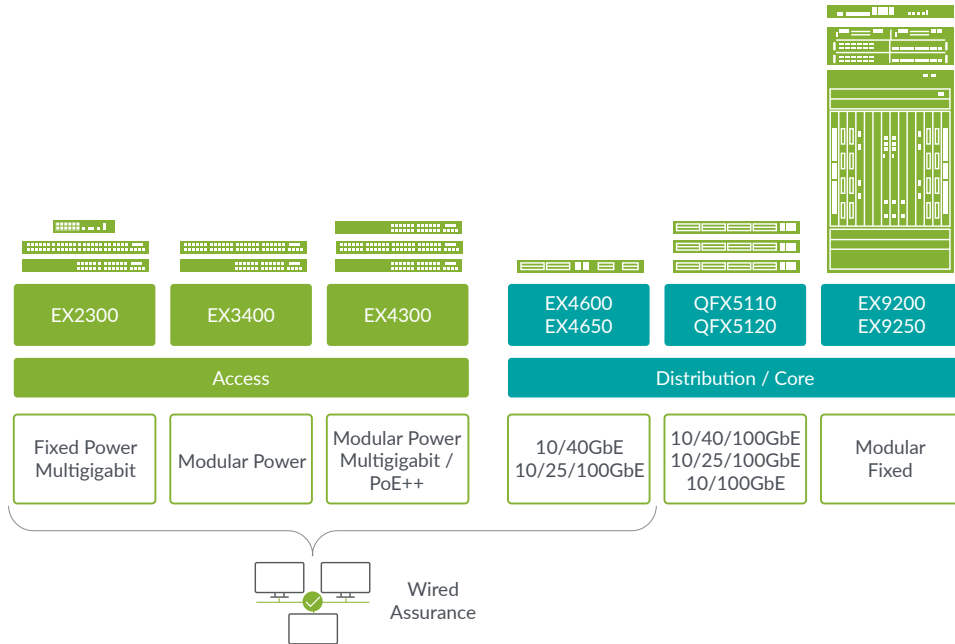

Figure 2: The campus portfolio of EX Series and QFX Series Switches.

Enterprise-Grade Wi-Fi Access Points

Mist leads the convergence of Wi-Fi, Bluetooth Low Energy (BLE), and IoT with enterprise-grade access points. These products leverage machine learning and event correlation to offer data collection, analysis, and policy enforcement capabilities. Mist access points have a patented dynamic vBLE 16-element antenna array for the industry's most accurate and scalable location services. Models are available with 802.11ax (Wi-Fi 6) and 802.11ac Wave 2 radio technologies. Mist access points are purpose-built to collect metadata for more than 150 states that flow into a cloud-based AI engine. And Mist access points incorporate a third radio for always-on security monitoring and troubleshooting.

Feature	AP43	AP61	AP41	AP21	BT11
Deployment	Indoor	Outdoor	Indoor	Indoor	Indoor
Wi-Fi Tri-Radio	802.11ax (Wi-Fi 6) 4x4: 4	802.11ac Wave 2 4x4: 4	802.11ac Wave 2 4x4:	802.11ac Wave 2 2x2: 2	No
Antenna options	Yes	Yes	Yes	No	No
Virtual Bluetooth LE	Internal/external	Internal/external	Internal/external	Internal	Internal
IoT interface	Yes	No	Yes	No	No
IoT sensors	Humidity, temperature, pressure	No	Yes	No	No

Juniper Connected Security

To combat rising cyberthreats, you need to safeguard users, applications, and infrastructure across the network, end to end and top to bottom. Juniper Connected Security unifies network elements into a single sensor or domain to deliver context-aware threat alerts, then dynamically enforces security policy with software-defined containment designed to reduce the overall attack surface.

By leveraging Juniper switches, Juniper Connected Security provides access security, control, and connection to servers and clients. The access and aggregation switches connect clients and endpoints with endpoint protection software.

Segmentation in Campus Networks

Network architects can adopt a combination of techniques such as micro and macrosegmentation to secure data and assets. A universal EVPN-VXLAN architecture can extend across campuses and data centers for consistent end-to-end network segmentation of endpoints and applications. It also helps minimize Layer 2 flooding to reduce security threats and simplify the network.

- Macrosegmentation is a logical separation of the network inside shared network devices and across shared links. It is achieved in an EVPN-VXLAN network by using VLANs at Layer 2 and virtual routing and forwarding (VRF) at Layer 3. VRFs provide isolation by keeping IP traffic between two VRFs isolated from each other.

- Microsegmentation addresses critical network protection issues by reducing risk and adapting to security demands. Juniper helps implement microsegmentation based on access control lists (ACLs) or firewall filters to control intra-virtual network traffic.
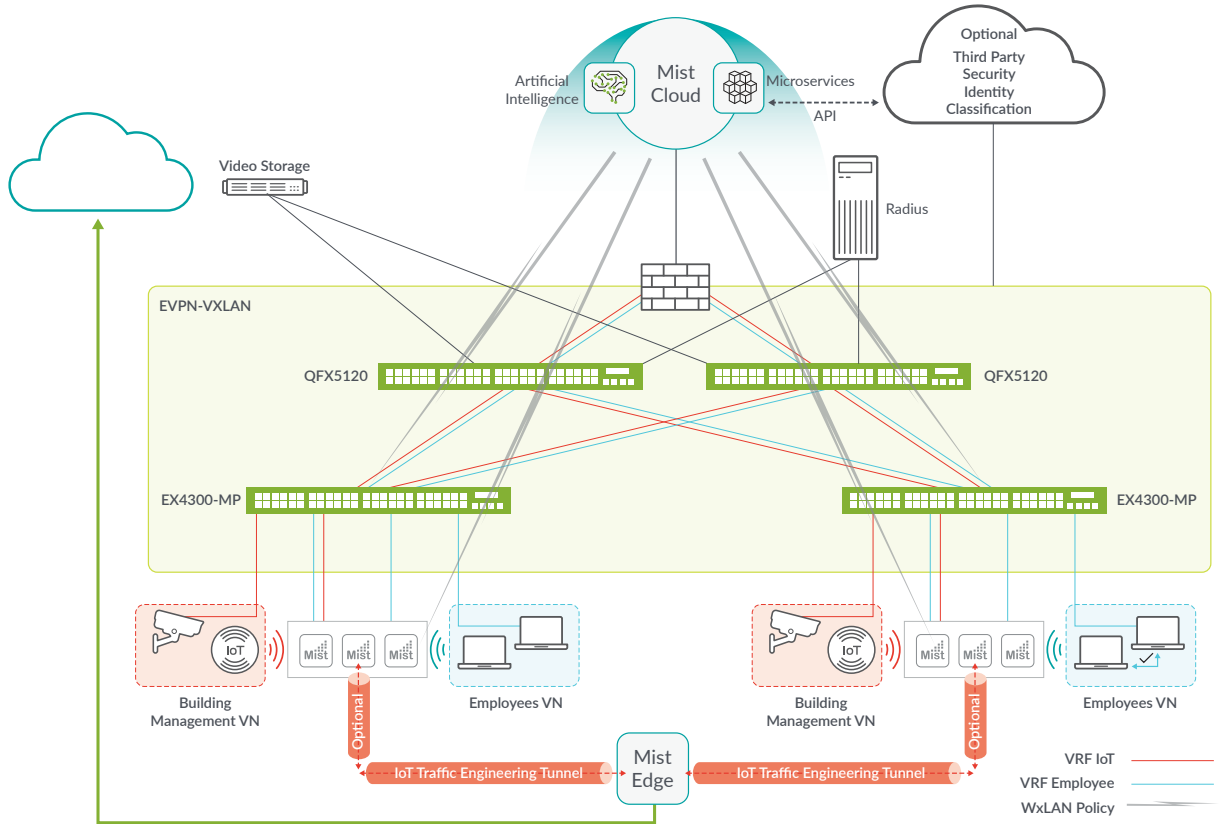
Figure 3: Network segmentation based on employee or device profile.

Junos OS: The Foundation of High-Performance Networks

The Junos operating system provides a common language across Juniper's routing, switching, and security devices. The power of one Junos OS reduces complexity in high-performance networks to increase availability and deploy services faster with lower TCO. The consistent user experience and automated toolsets of Junos OS make planning and training easier, increase the efficiency of day-to day operations, and allow changes to be implemented faster across the network.

What sets Junos OS apart from other network operating systems is the way it is built—one operating system delivered in one software release track and with one modular architecture. Key advantages include:

- One operating system across all types and sizes of platforms reduces the time and effort to plan, deploy, and operate network and security infrastructure.
- One release track meets changing needs in software with stable delivery of new functionality in a steady, time-tested cadence.
- One modular software architecture provides highly available, secure, and scalable software open to automation and partner innovation.

Junos Telemetry

Traditional data models that gather operational health statistics have reached the limits of network scale and efficiency. The Junos telemetry interface (JTI) overcomes these limitations by relying on a push model to deliver data asynchronously, which eliminates polling. As a result, JTI is highly scalable and can monitor thousands of objects in a network.

JTI lets you provision sensors to collect and export data for various system resources, such as physical interfaces and firewall filters. Two data models are supported:

- An open and extensible data model defined by Juniper Networks. Because this model features a distributed architecture, it scales easily.
- An OpenConfig data model that generates data as Google protocol buffer (gpb) structured messages in a universal key/value format. gRPC remote procedure calls are based on TCP, and support SSL encryption, so it is considered secure and reliable.

Modern, Microservices Cloud AIOps Platform

A microservices cloud architecture brings unparalleled agility, scale, and resiliency when adding or removing new features. New enhancements and bug fixes can be delivered almost weekly without network disruption. Services scale up or down elastically as needed, eliminating the cost and complexity of monolithic hardware. The Mist platform is 100% programmable, using open APIs, for full automation and seamless integration with complementary products, including our AI for IT partners across LAN, WAN, security, engagement, and asset location.

Conclusion

Juniper's AI-driven campus is designed to provide customers with a flexible, standards-based, modern architecture for a cloud-ready future. It meets today's stringent requirements without compromising reliability, security, and agility. Common building blocks, prepackaged automation workflows, and custom automation toolkits extend the benefits of predictive analytics from the data center to the campus and beyond.

Additional Resources

- Campus Design Center
- Wired Assurance
- Wi-Fi Assurance
- EX2300 Datasheet
- EX3400 Datasheet
- EX4300 Datasheet
- EX4650 Datasheet
- QFX10000 Datasheet
- QFX5120 Datasheet

About Juniper Networks

Juniper Networks brings simplicity to networking with products, solutions, and services that connect the world. Through engineering innovation, we remove the constraints and complexities of networking in the cloud era to solve the toughest challenges our customers and partners face daily. At Juniper Networks, we believe that the network is a resource for sharing knowledge and human advancement that changes the world. We are committed to imagining groundbreaking ways to deliver automated, scalable, and secure networks to move at the speed of business.

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: +31.0.207.125.700

Fax: +31.0.207.125.701

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