

JUNIPER NETWORKS 3-2-1 DATA CENTER NETWORK ARCHITECTURE

Simplifying the Data Center Network to Reduce Complexity and Improve Performance

Challenge

Escalating traffic levels, increasing numbers of applications, and ever growing numbers of users have created the need for an exponential data center that can keep pace with growing network demands.

Unfortunately, today's data center network—too complex, too inefficient and too slow—is ill-equipped to handle the load, resulting in overall poor performance.

Solution

The Juniper Networks 3-2-1 Data Center Network Architecture delivers a strategy for simplifying the data center by flattening the existing multilayer tree structure to improve overall performance as well as the user experience.

Benefits

- Reduces latency by eliminating switch layers in the data center
- Improves application performance by reducing the number of interactions required to complete a transaction
- Reduces capital and operational expenses by eliminating equipment in the data center, saving power, cooling and space costs
- Simplifies overall management and maintenance, enabling easy transition to cloud-like efficiencies
- Allows easy integration of new services such as security throughout the data center

The Challenge

Today's data center networks are under tremendous pressure. Not only are they growing geometrically to keep pace with rapidly escalating network demands, support new application architectures and virtualized environments, and improve the overall user experience, they are expected to do so more efficiently and more cost-effectively than ever before.

The problem lies in the fact that, while everything else in the data center (applications, storage, servers) has evolved over time, the network architecture itself has not. Rather than evolve, the data center network has instead become extremely complex. This complexity prevents the network from scaling properly, restricting available resources and limiting the ability to virtualize the data center.

Connections Breed Complexity; Complexity Inhibits Growth

This complexity is due, in large part, to the way data centers have evolved over time. Although they started out simple enough, the growing number of servers and storage devices, combined with the sheer volume of data and information transfer, have led to the creation of multi-tiered tree structures composed of access, aggregation, and core layers required to interconnect the resources

The result is a highly inefficient infrastructure that is not only expensive to manage and maintain, but also results in slow, highly unpredictable application performance. Up to 50 percent of all ports in today's data center—typically the most expensive ports—are used to connect switches to other switches, not servers or storage or users. More switch layers means more devices to manage, with a corresponding geometric increase in the number of device interactions. That's because, while the majority of traffic in today's data center is between servers—in other words, "east-to-west"—it must first move up and down the tree structure—"north-to-south"—to reach its destination. These extra hops introduce complexity and add latency that severely impacts application performance, degrading the user experience.

Businesses can't afford to continue operating in this way. Until the data center network undergoes a fundamental change and transforms the way information is shared, realizing the full potential of a virtualized data center will be nearly impossible.

The 3-2-1 Data Center Network Architecture

Juniper's Solution: Start with Simplification

Juniper delivers a strategy for simplifying the data center network. It is called the 3-2-1 Data Center Network Architecture, and it eliminates layers of switching to flatten and collapse the network from today's three-tier tree structure to two layers to, ultimately, just one. This simplification is achieved by interconnecting multiple physical switches, creating a single, logical device that combines the performance and simplicity of a switch with the connectivity and resiliency of a network.

The 3-2-1 Data Center Network Architecture reduces complexity and accelerates performance by creating a single, data center-wide fabric that provides any-to-any connectivity between resources. This solution, delivered on systems that run the Juniper Networks® Junos® operating system, fundamentally simplifies the overall network by reducing the number of connections, enabling centralized management, and, ultimately, making the entire data center simpler to maintain.

This not only improves overall application performance for businesses, but it also has a significant, positive impact on the bottom line. According to estimates by analyst firm IDC, if all data centers in the world removed the aggregation layer from their three-tier networks, they would collectively save \$1 billion in IT spending—money that could be better spent on productivity enhancing or mission-critical activities.

How It Works—The Simplicity of Fabric

The key to the 3-2-1 architecture is fabric technology—the ability to make multiple devices appear, behave and operate as one. This capability is available today with Virtual Chassis technology on the Juniper Networks EX4200, EX4500 and EX8200 lines of Ethernet switches. Virtual Chassis technology—which allows multiple interconnected switches to operate as a single, logical device—dramatically reduces the number of managed devices, links, and layers in the data center, delivering a highly efficient, high-performance network.

This network simplification is enhanced by the MPLS, virtual router and logical system technologies supported on the Juniper Networks MX Series 3D Universal Edge Routers. Virtualization enables greater deployment flexibility by making applications completely transparent to the underlying network architecture, allowing more efficient use of resources while lowering costs and improving power utilization.

For small IT data centers featuring 1GbE servers, the EX4200 switches with Virtual Chassis technology allow customers to collapse their network into a single switching layer and manage the configuration as a single device. EX4500 switches can be added to an EX4200 Virtual Chassis configuration to provide access for high-performance 10GbE servers. The EX8200 line of switches with Virtual Chassis technology delivers a robust, resilient solution for the data center core that eliminates the need to run Spanning Tree Protocol.

At the edge, Juniper Networks MX5, MX10, MX40 and MX80 3D Universal Edge Routers are midrange devices that seamlessly scale to support speeds ranging from 20 Gbps to 80 Gbps, delivering uncompromised functionality in a compact form factor for both Ethernet and non-Ethernet environments. Consuming just 320 watts—the lowest in its product class—the routers are also a cost-effective solution for small data centers.

For larger organizations, Juniper Networks QFabric™ technology enables the entire data center network to be managed as a single switch based on Junos OS, delivering the simplicity and efficiency organizations are looking for.

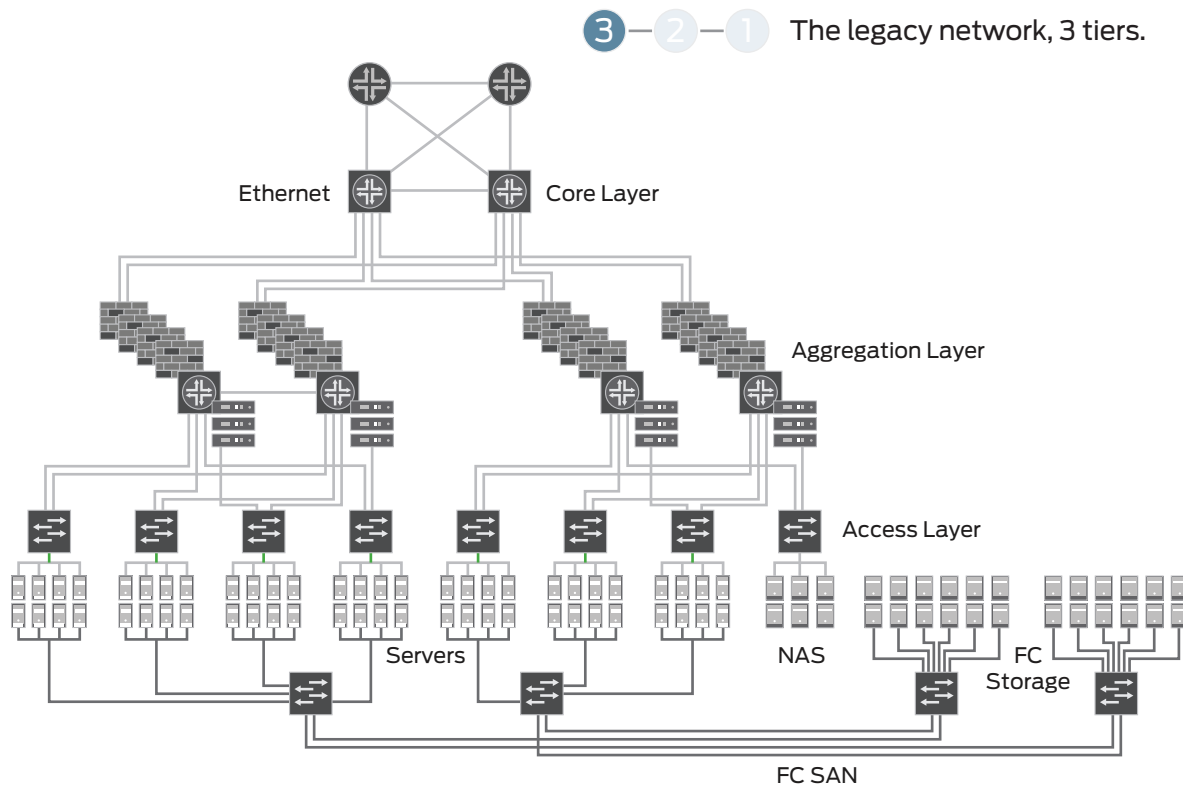


Figure 1. The legacy tree network structure.

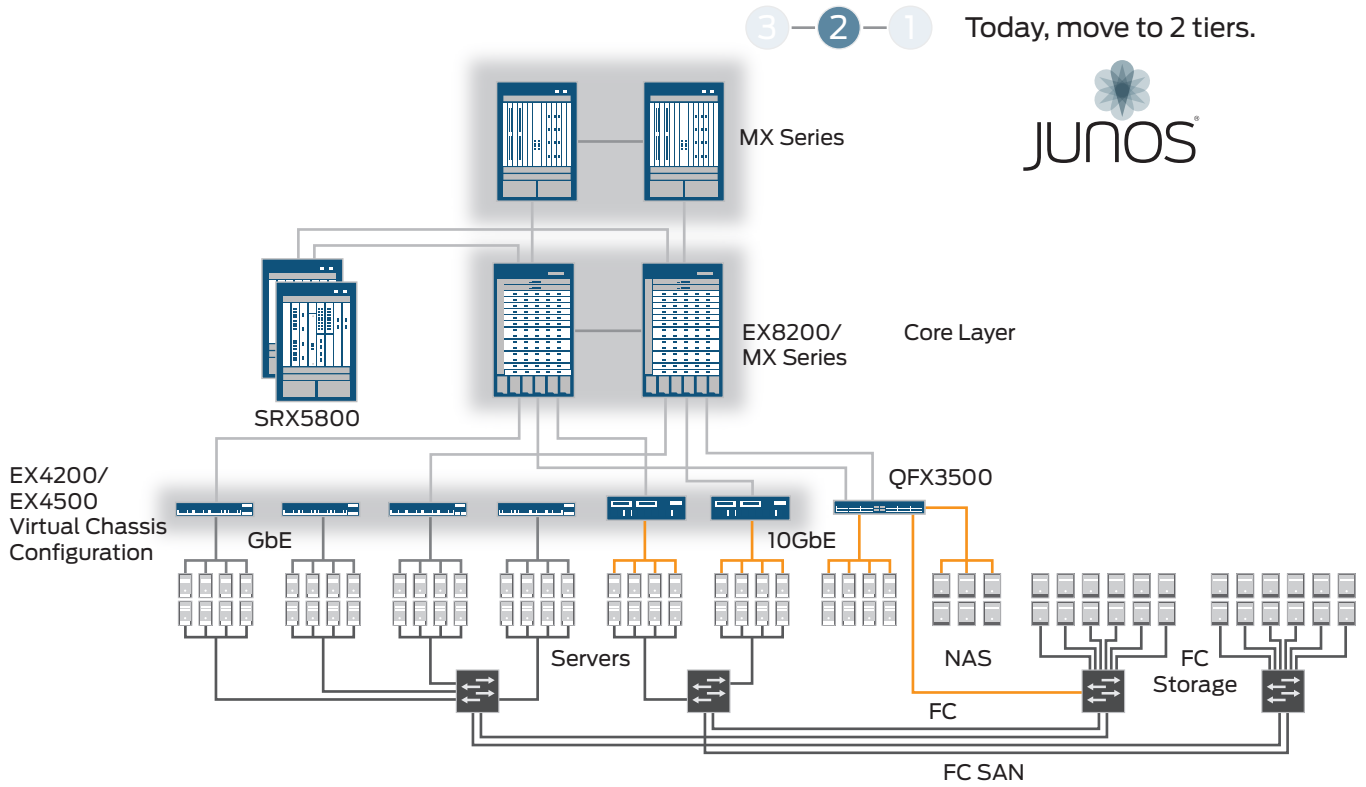


Figure 2: Virtual Chassis fabric technology on the EX4200, EX4500 and EX8200 switches and the MX Series 3D Universal Edge Routers, combined with the QFX3500 Switch, eliminate the aggregation tier and Spanning Tree Protocol in the data center.

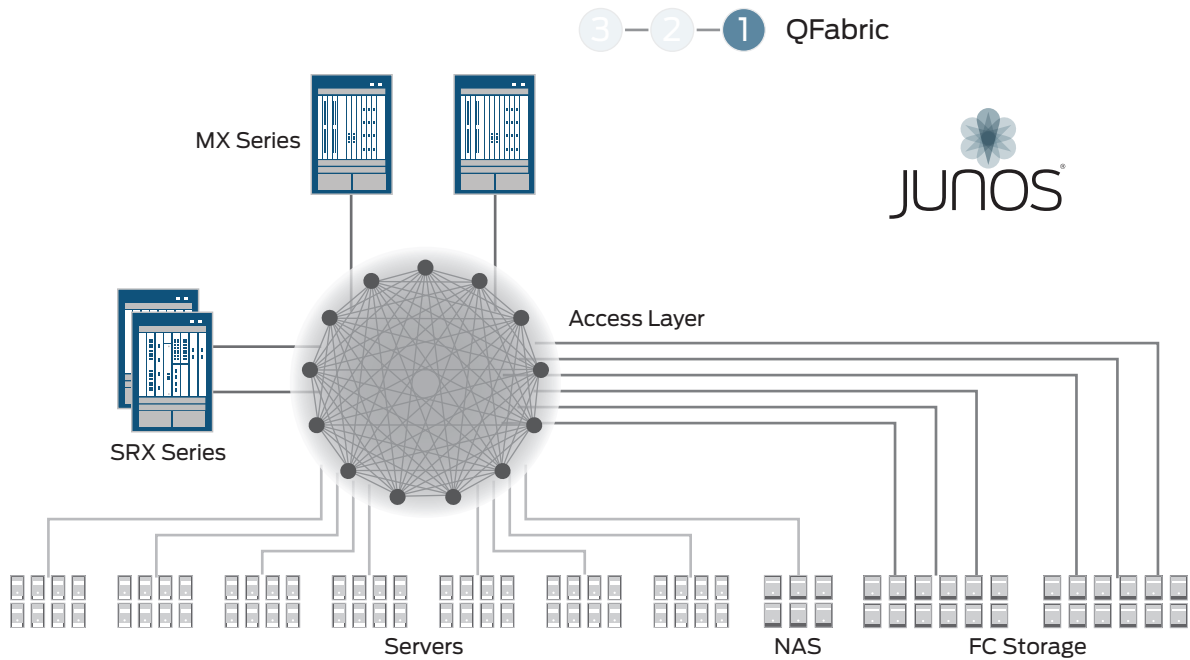


Figure 3: Juniper's vision for the ultimate simplification of the data center with a single tier data center network—QFabric.

Running a single instance of Junos OS, the QFabric architecture brings radical change to the data center that will pay dividends for years to come—a distributed intelligence approach that delivers the scalability, resiliency, management simplicity and operational savings that today's businesses demand.

Complementing the QFabric technology, high-end Juniper Networks MX Series 3D Universal Edge Routers deliver a powerful, highly scalable Layer 2/Layer 3 core solution. Scaling to speeds of up to 2.6 Tbps, the high-end MX Series routers provide large data centers with high-performance routing and superior resiliency.

Unleashing the Power of the Data Center

QFabric represents the "1" in the 3-2-1 architecture, dramatically reducing complexity in the data center by delivering any-to-any connectivity while lowering capital, management, and operational expenses. By unleashing the power of the modern data center, Juniper Networks QFabric architecture helps organizations realize the full benefit of their investments in server consolidation, virtualization, service-oriented architecture (SOA), distributed application architectures, and other technologies.

The high-performance, non-blocking, and lossless QFabric architecture delivers much lower latency than traditional network architectures—crucial for the high-speed communications that define the modern data center. Rather than fragment network and server capacity like traditional data center networks, QFabric implements a single, flexible architecture that enables organizations to achieve cloud-like efficiencies and create a more agile network environment.

The QFabric technology also offers unprecedented scalability with minimal additional overhead, supporting I/O converged traffic and making it easy for enterprises to run a mix of Fibre Channel, Ethernet, and Fibre Channel over Ethernet over a single network.

Implementing QFabric

The QFabric architecture consists of three separate but interdependent devices—Juniper Networks QFX3500 QFabric Node, QFX3008 QFabric Interconnect, and QFX3100 QFabric Director—that work together to create a single high-performance, low latency fabric, unleashing the full power of the data center. By taking the basic attributes found in any switch fabric and breaking them out into these individual components, QFabric introduces a highly scalable solution that revolutionizes the data center network.

The QFX3500 Node delivers a high-performance top-of-rack switch featuring 48 10GbE ports and four 40GbE-capable uplinks to provide low-latency, high-speed access into and out of the QFabric federated architecture. Running the Junos operating system and supporting a rich set of standards-based Layer 2, Layer 3 and I/O convergence features, the QFX3500 can also function as an independent switch.

The QFX3008 Interconnect acts like the backplane of a modular switch, connecting all Node edge devices in a full mesh topology. The QFX3100 Director represents the Routing Engines typically installed in a modular switch, providing control and management services for the fabric. Deployed in clusters for redundancy, Directors provide a single interface for managing the scalable data plane provided by the Node and Interconnect devices.

Collectively, these three components comprise the QFX3000 QFabric Switch, which can interconnect up to 128 Node edge devices in a single fabric capable of supporting 6,000 10GbE ports. All devices are all managed from a single point, greatly simplifying the provisioning, monitoring and troubleshooting of the QFabric architecture.

Summary

By reducing the number of devices and networking tiers, Juniper's Virtual Chassis and QFabric technologies eliminate complexity in the data center to deliver better application performance and a better experience for the end user at a dramatically lower cost—a network with no trade-offs.

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at www.juniper.net.

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