

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 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 and servers) has evolved over time, the network architecture itself has not. Instead, the data center network has become extremely complex, preventing 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 expanded over time. Growing numbers 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 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

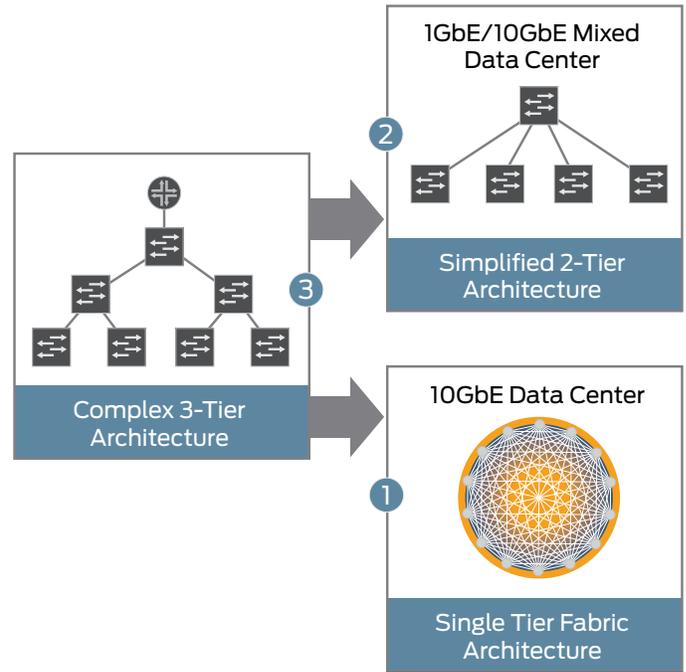
Juniper delivers a strategy for simplifying the data center network. It is called the 3-2-1 Data Center Network Architecture, and it eliminates layers of switching by flattening and collapsing the network, evolving from today’s complex three-tier tree structure to a drastically simplified two- or one-layer architecture. 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.

By creating a data center-wide switch-based fabric, the 3-2-1 Data Center Network Architecture enables any-to-any connectivity between resources, reducing complexity and accelerating performance. To achieve this architecture, Juniper offers a broad portfolio of switching solutions that address a wide variety of customer requirements, including bandwidth (10GbE or 1GbE), performance, resiliency, simplified management, and rich feature sets. These solutions, delivered on systems that run the Juniper Networks® Junos® operating system, fundamentally simplify the overall network by reducing the number of connections, enabling centralized management and, ultimately, making the entire data center easier to maintain.

This not only improves overall application performance, it also has a significant 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 ability is available today with Juniper’s Virtual Chassis technology, which allows multiple interconnected switches to operate as a single, logical device. Available on the Juniper Networks EX3300, EX4200, EX4500 and EX8200 lines of Ethernet switches, Virtual Chassis technology dramatically reduces the number of managed devices, links, and layers in the data center, delivering a highly efficient, high-performance network. Members of a Virtual Chassis configuration can even be distributed over large distances, separated by up to 80 km, further simplifying multi-site management.



Virtual Chassis technology is ideal for organizations with a mix of 1GbE and 10GbE servers in their data centers. For small to mid-tier IT data centers with 1GbE servers, an EX4200-based Virtual Chassis configuration allows customers to consolidate their network, creating a single layer that is managed as a single device. EX4500 switches can be added to an EX4200 Virtual Chassis configuration to provide access for high-performance 10GbE

3 Legacy Data Center Network, 3 Tiers.

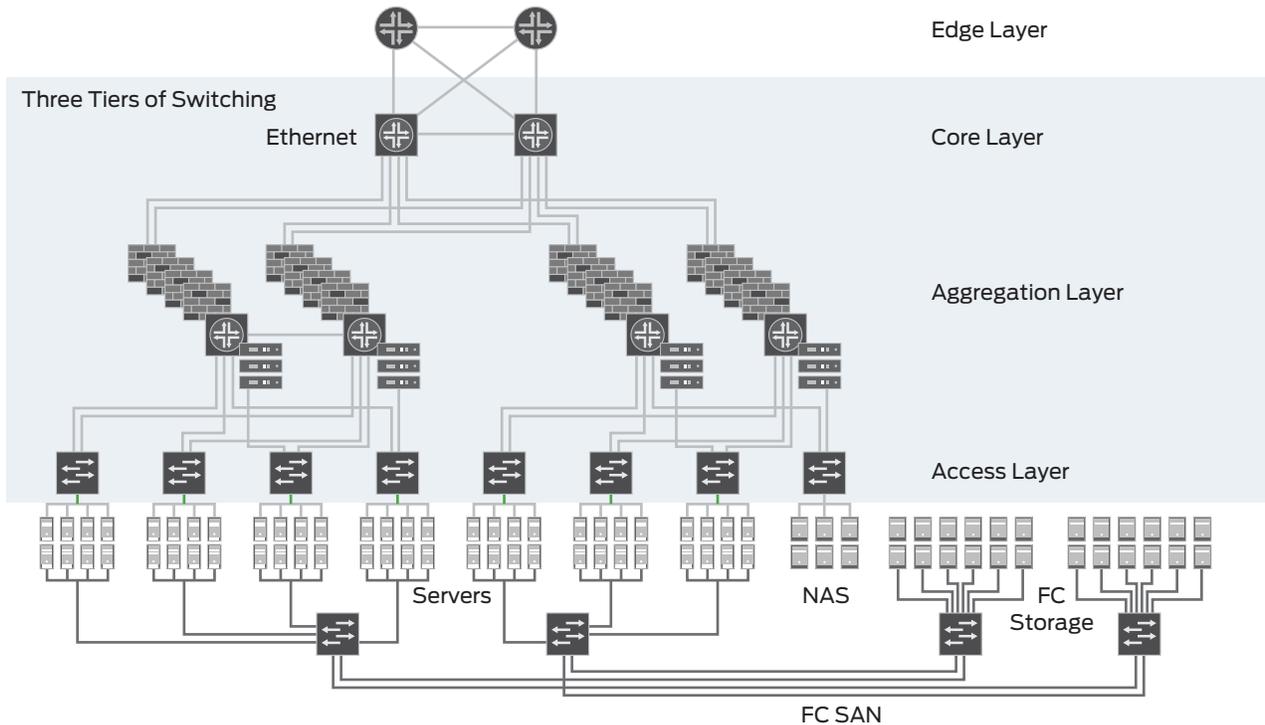


Figure 1. The legacy tree network structure.

2 Virtual Chassis – Simplified for 1GbE and 10GbE

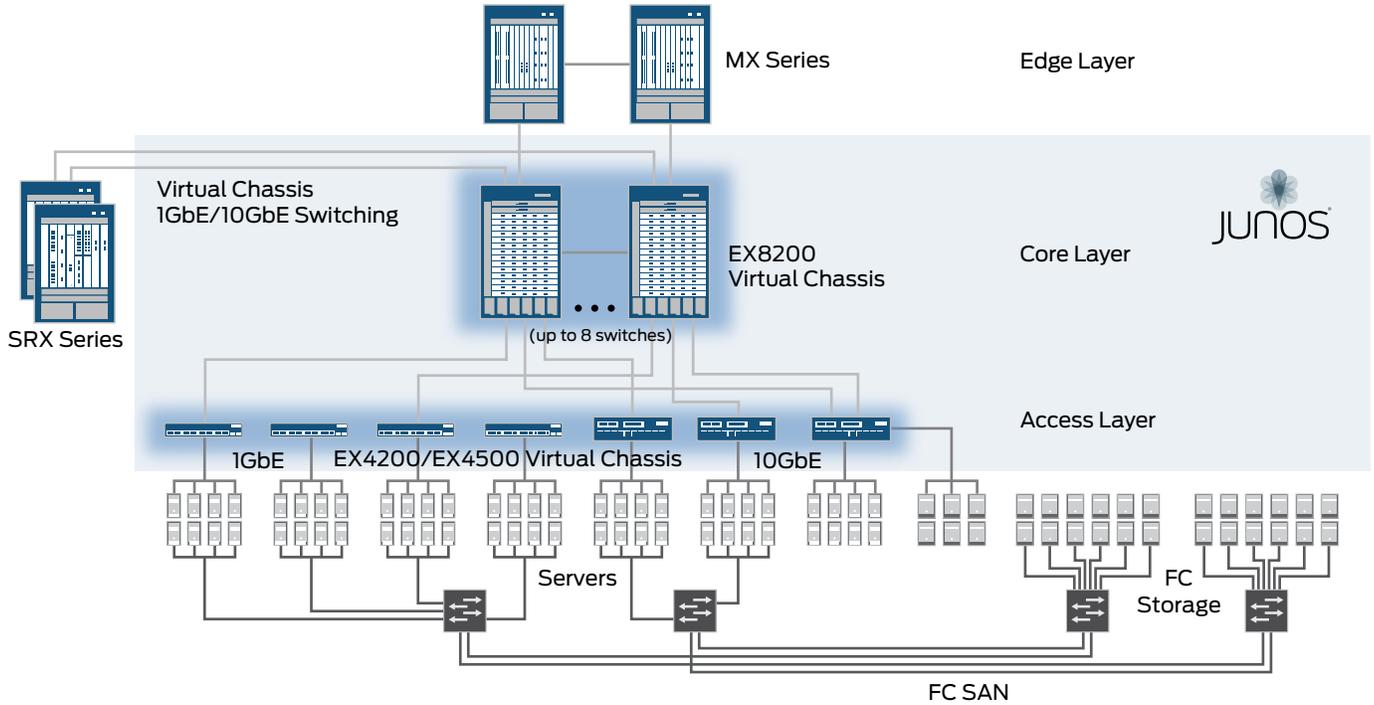


Figure 2: Virtual Chassis technology on EX Series Switches and MX Series 3D Universal Edge Routers, combined with the QFX3500 Switch, eliminate the aggregation tier and Spanning Tree Protocol in the data center.

1 QFabric – Simplified for 10GbE

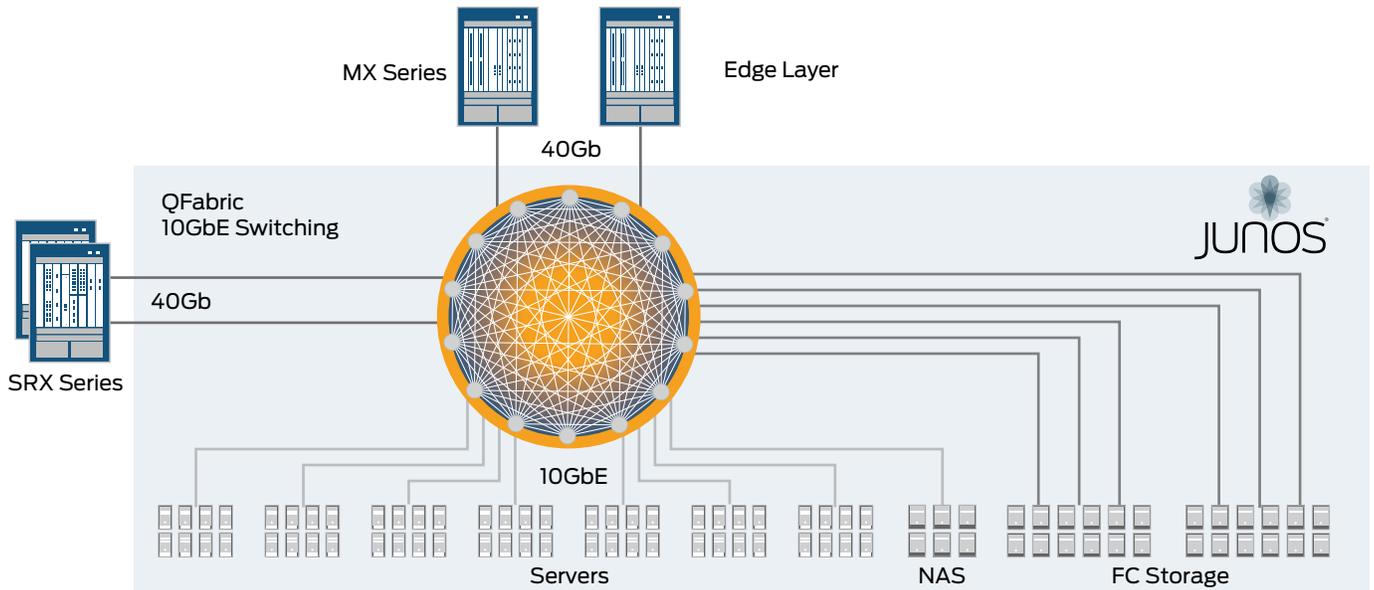


Figure 3: Juniper's QFabric technology reduces the data center network to a single flat any-to-any fabric.

servers as they are deployed in the data center. Up to 10 EX4200 and EX4500 switches can be combined in a single Virtual Chassis, providing businesses with tremendous configuration flexibility.

Meanwhile, in the core, up to eight EX8200 switches can be deployed in a Virtual Chassis configuration, delivering a scalable, resilient, and simplified solution that eliminates the need for Spanning Tree Protocol (STP) in the data center.

The network simplification enabled by Virtual Chassis technology 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 organizations running 10GbE servers in the data center, Juniper Networks QFabric technology delivers a fabric-based solution that enables them to manage the entire data center network as a single, logical switch. Based on the Junos OS, just like the EX Series switches, QFabric technology delivers the simplicity, efficiency and performance that businesses are looking for.

The QFabric architecture implements a flat, any-to-any fabric that improves data center performance and economics. Featuring a distributed intelligence approach that delivers the scalability, resiliency, management simplicity and operational savings that today's businesses demand, QFabric is the foundation of virtualized data centers for the next decade.

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 three-tier data center networks, QFabric implements a single, flexible network layer that enables organizations to achieve cloud-like efficiencies and create a more agile network environment.

Unleashing the Power of the Data Center

Juniper's Virtual Chassis and QFabric technologies are well suited for the “east-to-west” exchanges that make up the majority of today's data center traffic flows. By reducing complexity and lowering capital, management, and operational expenses, these technologies unleash the power of the data center, helping organizations realize the full benefit of their investments in server consolidation, virtualization, service-oriented architecture (SoA) and distributed application architectures.

Unlike other data center network architectures, the Virtual Chassis and QFabric technologies are the only solutions that provide performance at scale with no single point of failure, maximum resiliency, and simplified management.

	QFabric	Virtual Chassis	End of Row	Multi-Tier ToR	Hub and Spoke
Performance	✓	✓	✓		
Resiliency	✓	✓		✓	
Management Simplification	✓	✓	✓		✓
Cable Simplification	✓	✓		✓	✓

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

Implementing QFabric

The QFabric architecture features three separate components that work together as a single switch to deliver any-to-any connectivity, high performance, and management simplicity, making it the ideal foundation for cloud-ready, virtualized data center environments.

The QFabric Node delivers a high-performance top-of-rack switch featuring up to 48 10GbE ports and four 40GbE-capable uplinks to provide low-latency, high-speed access into and out of the fabric. Running the Junos OS and supporting a rich set of standards-based Layer 2, Layer 3 and I/O convergence features, QFabric Nodes can also operate as independent, standards-based, low-latency top-of-rack switches, letting customers easily migrate to a QFabric solution.

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

Collectively, these three components comprise the QFabric System. All devices are managed from a single point and run a single instance of Junos OS, greatly simplifying the provisioning, monitoring and troubleshooting of the QFabric architecture.

Two QFabric System models are available:

- The QFX3000-M, designed for customers with mid-tier, satellite, and container or space-constrained data center environments, features a fixed form-factor QFabric Interconnect and can scale from 48 to 768 10GbE ports in a single fabric.
- The QFX3000-G, designed for large-scale enterprise and service provider environments, uses chassis-based QFabric Interconnects and can scale up to 6,144 10GbE ports in a single fabric.

Designed for flexibility and investment protection, these models are based on identical architectures, giving customers different entry points into QFabric that allow them to easily scale as their 10GbE demands grow.

Summary

By reducing the number of devices and networking tiers, Juniper's Virtual Chassis and QFabric technologies eliminate complexity in the data center, delivering better application performance and a better user experience, all 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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