

# Migrating to a 40 Gbps Data Center

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Juniper QSFP+ LX4 technology removes cabling cost barriers for migrating from 10 Gbps to 40 Gbps in data center networks

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## Executive Summary

Data center applications are becoming more distributed, with the majority of data center communications happening between compute nodes. As a result, data center architectures are migrating from traditional tree topologies to spine-and-leaf designs, due in large part to their optimal performance for server-to-server communications.

In-rack connectivity in the data center is also evolving. Advanced enterprise applications are generating more bandwidth than ever, occasionally bursting to 10 Gbps, essentially requiring uplink speeds to increase from 1GbE to 10GbE for rack-to-rack connectivity. Multiple 10GbE links are a common way to achieve higher intra-rack bandwidth; however, as individual streams routinely reach 10 Gbps speeds, it is necessary to have native 40GbE links to provide better performance. High-performance, high-density 10 Gbps and 40 Gbps network devices such as Juniper Networks® EX Series Ethernet Switches and Juniper Networks QFX Series switches, equipped with LX4 optics, seamlessly enable this transition.

Short-reach (SR) and extended short reach (eSR4) transceivers for 40 Gbps connectivity in a quad small form-factor pluggable transceiver (QSFP) mode use independent transmit and receive sections, each with four parallel fiber strands. For a duplex 40 Gbps connection, eight fiber strands are required, while QSFP SR4 uses Multipath Optical (MPO) 12-fiber connectors (MPO-12F). This IEEE standard technology must reach up to 400 m using OM4 and provide future support for 100 Gbps speeds using the same cabling infrastructure. However, this technology requires more fiber strands than can be found in today's 10 Gbps infrastructures, which means that data centers will require a cabling upgrade.

Juniper offers an innovative alternative: a 40 Gbps QSFP plus (QSFP+) LX4 technology that allows for zero-cost fiber migration by reusing the current 10 Gbps multimode fiber-optic (MMF) cabling plant for 40 Gbps connectivity. This document discusses the 40 Gbps solutions for intra-data center connectivity using MMF. It also introduces Juniper's 40 Gbps QSFP+ LX4 transceiver and demonstrates the cost saving it provides customers when migrating to 40 Gbps.

## Introduction—40 Gbps QSFP+ LX4

Juniper offers a new 40 Gbps Ethernet optical technology called LX4 and provides a QSFP+ 40GbE optical module that uses the same infrastructure as 10GbE. The LX4 technology represents a new way to deploy 40GbE that meets all of the performance criteria of today's data centers by providing 40GbE on two MMF strands and duplex LC connectors, just like existing 10GbE infrastructures. With 40 Gbps LX4, migrating from 10GbE to 40GbE is straightforward: users simply replace existing 10GbE optical modules with 40GbE LX4 optical modules. There is no need for expensive 40GbE migration cassettes and no need to deploy an additional fiber infrastructure.

The Juniper QSFP+ LX4 transceiver addresses the challenges of fiber infrastructure by providing the ability to transmit full-duplex 40 Gbps traffic over one duplex MMF cable with LC connectors. In other words, the Juniper QSFP+ LX4 transceiver (model number JNP-QSFP-40G-LX4), a short-reach optical transceiver that delivers 40 Gbps over duplex OM3 or OM4 MMF, allows 40 Gbps connectivity to connect directly to the 10 Gbps fiber and fiber trunk.

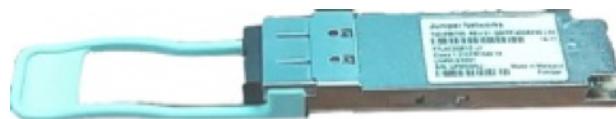


Figure 1. Juniper QSFP+ LX4 transceiver (model number JNP-QSFP-40G-LX4)

The Juniper QSFP+ LX4 transceiver has four 10 Gbps channels, each of which can transmit and receive simultaneously on four wavelengths over an MMF strand. The result is an aggregated duplex 40 Gbps link over a duplex of two MMF strands. Using duplex LC connectors, QSFP+ LX4 connections can reach 100 meters on OM3 MMF or 150 meters on OM4 MMF.

Figure 2 shows the technology concept of the Juniper QSFP+ LX4 transceiver. Products that support 40GbE interfaces such as QFX3000 QFabric Systems and QFX5100 switches support the QSFP+ LX4 transceiver. For a complete list of supported products, please refer to the Juniper 40 Gigabit Optical Transceiver product page at <http://www.juniper.net>.

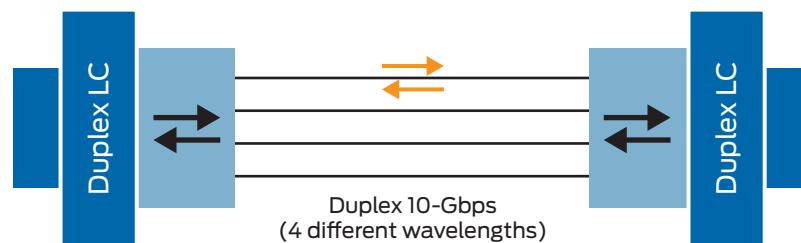


Figure 2. Concept of QSFP+ LX4 transceiver

## Savings with Juniper QSFP+ LX4 When Migrating from 10 Gbps to 40 Gbps

Juniper QSFP+ LX4 technology removes the cost barriers for migrating from and expanding the existing 10 Gbps cabling footprint to a 40 Gbps infrastructure to enable a higher data rate in the network. Connections using unstructured cabling are connected directly with fiber cables; this direct-attachment design is typically used to connect devices over short distances in a data center network, such as switches installed in the same or adjacent racks. Direct connection between two 40 Gbps devices can be provided by MMF cables with either QSFP SR4 or QSFP+ LX4 transceivers at two ends.

The QSFP SR4 transceiver uses MPO-12F connectors, whereas Juniper's QSFP+ LX4 uses LC connectors. Existing 10 Gbps connections are commonly MMF cables with LC connectors. Juniper QSFP+ LX4 allows the same cables to be used for direct 10 Gbps connections to direct 40 Gbps connections, resulting in zero-cost cabling migration.

Figure 3 shows an example of in-place 10 Gbps to 40 Gbps migration using LX4 pluggable modules, including the reuse of existing structured cabling.

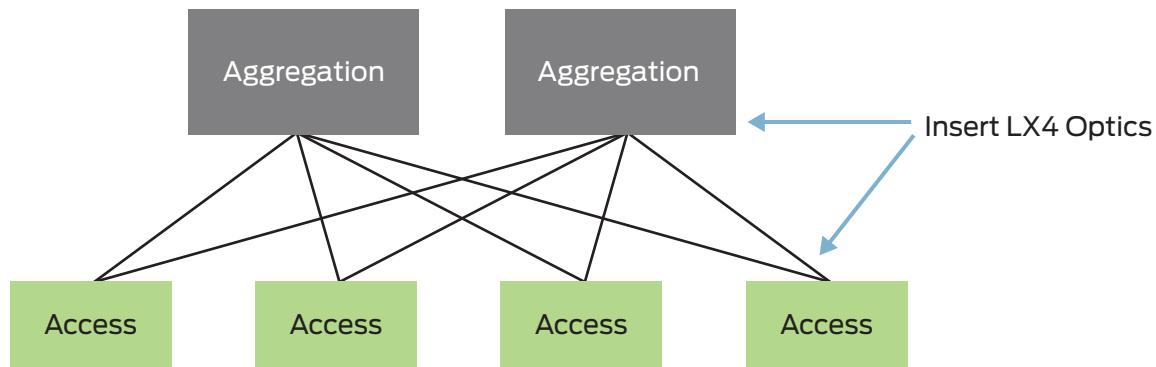


Figure 3. Using Juniper LX4 optics for 10 to 40 Gbps migration over existing MMF

For data centers with a structured 10 Gbps cabling system migrating to 40 Gbps, Juniper's QSFP+ LX4 technology allows the existing cabling system and fiber trunks to be repurposed for the connectivity layer.

Figure 4 depicts a 40 Gbps Virtual Chassis Fabric (VCF) topology using LX4 technology for direct attach of QFX Series switch elements.

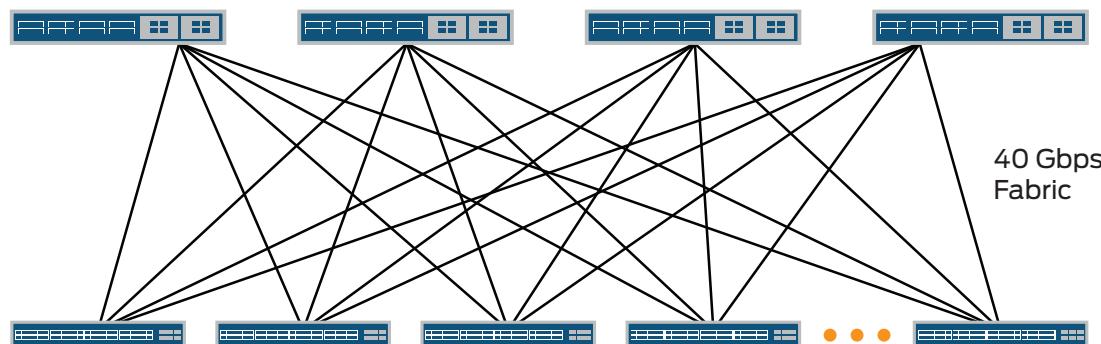


Figure 4. Two-tier network example: QFX5100 spine with QFX5100 leaf

No additional spending on cabling will be required if Juniper QSFP+ LX4 transceivers are used for all 40 Gbps links. As a result, users realize 100 percent investment protection of their existing infrastructure and incur no additional cabling costs—a significant advantage when compared to the cost of reconstructing the cabling system using QSFP SR4 transceivers, which can include the cost of new patch cables, new patch panels, and expansion of the current fiber trunk. If the cabling for this network is an expansion to the existing cabling system, the 40 Gbps connections can be built using MMF cables and QSFP SR4 transceivers or QSFP+ LX4 transceivers. Juniper's QSFP+ LX4 offers greater CapEx savings for 40 Gbps migration.

Attribute	Juniper LX4	Juniper SR4	Juniper eSR4
Rate	40 Gbps	40 Gbps	40 Gbps
Connector Type	LC	MPO	MPO
Fiber Count	2	12	12
Fiber Type	MMF	MMF	MMF
Reach	150 m /w OM4	150 m /w OM4	400 m /w OM4
Watts	3.5	1.5	1.5
Wavelength (nm)	1,310	850	850

Figure 5. Juniper short-reach 40 Gbps optic choices

## Conclusion

Juniper QSFP+ LX4 technology removes 40 Gbps cabling cost barriers for migrating from 10 to 40 Gbps in data center networks. Juniper's QSFP+ LX4 transceivers provide 40 Gbps connectivity with immense cost savings and simplicity for next-generation data center 40GbE deployments. The Juniper QSFP+ LX4 transceiver allows organizations to migrate their existing 10 Gbps infrastructure to 40 Gbps at zero cost of fiber, and to expand the infrastructure with low capital investment. Together with Juniper Networks QFX Series and EX Series switches, which introduce attractive pricing for networking devices as well as expandable fabric architectures, Juniper QSFP+ LX4 technology provides a cost-effective solution for migrating to next-generation 40 Gbps data center deployments.

## For More Information

For more information on Juniper's 40 Gbps LX4 transceiver, please visit [www.juniper.net](http://www.juniper.net).

## 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](http://www.juniper.net).

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