ARISTA WHITE PAPER

Arista 7500E Series Interface Flexibility

Introduction:

Today's large-scale virtualized datacenters and cloud networks require a mix of 10Gb, 40Gb and 100Gb Ethernet interface speeds able to utilize the widest range of flexible connectivity options. These same networks require a variety of cost-effective cabling options for both short reach and long reach to address connectivity and to allow for simple migrations as network speeds and density requirements evolve. As datacenters scale and bandwidth demands increase, the networking infrastructure must be capable of scaling with it. Arista's 7500E platform offers a wide range of standards based interconnect options that allow the maximum flexibility with scalability in the datacenter while maintaining investment protection. This document highlights the wide range of connectivity options available with the Arista 7500E Series of modular switches.

ARISTA 7500E SERIES

The Arista 7500E Series delivers line rate non-blocking switching that enables faster and simpler network designs.

The 7500E Series offers two choices for the datacenter a 4-slot 7504 and the 8-slot 7508. The 7500E Series supports a range of interface speeds from 100Mbps up to 100Gbps Ethernet in a single system, ensuring broad choices without limiting system performance when scaling from 10G to 100G.

The 7508E is an 11RU chassis with a 30Tbps fabric that supports up to 8 linecards and provides 1,152 – 10Gb ports, 288 – 40Gb ports, or 96 – 100Gb Ethernet ports in a single system - unparalleled density and performance in the industry.

The Arista 7504E provides room for 4 linecards in a compact 7RU chassis that delivers 15Tbps of bandwidth allowing up to 576 - 10Gb ports, 144 – 40Gb ports, and a massive 48 – 100Gb Ethernet ports.

A choice of high-density wire-speed 10GbE, 40GbE and 100GbE linecards is fully supported with the ability to mix and match any combination of modules. The 40GbE and 100GbE modules enable up to 144x10G ports per linecard. Each 40G interface can be used as either a single 40G or 100G port or quad 10G Ethernet ports. The 100G interfaces can be a single port of 100Gb, three ports of 40Gb or 12 ports of 10Gb Ethernet.

Figure 1: 7504E and 7508E with up to 1,152 10G ports

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ARISTA 7500E SERIES LINECARDS

36 PORT QSFP+ LINECARD, DCS-7500E-36Q-LC

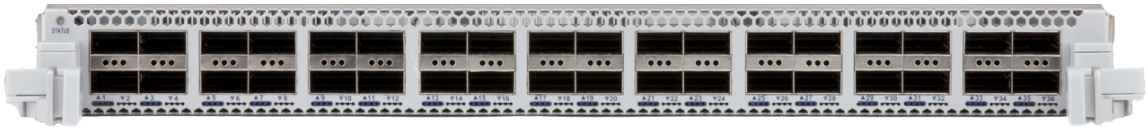

Figure 2: DCS-7500E-36Q-LC

The Arista 7500E 36 port QSFP+ linecard has 36 ports of 40GbE QSFP+ that allows for a high degree of flexibility in a mixed 10G/40G. All QSFP+ ports can operate as either a single 40Gb Ethernet port or quad 10Gb Ethernet ports with up to 36 ports of 40G or 144 ports of high-density 10G allowing for simple migration and a wide range of combinations:

- Industry leading 36 ports of 40G / 144 ports of 10G
- Any to any - Non-blocking performance
- Ultra-deep buffering of 500MB+ per 40G port
- 1.8Bpps of Layer2 & Layer3 line rate forwarding
- 3.84 Tbps of fabric capacity for zero performance degradation with loss of fabric
- VoQ architecture to ensure traffic delivery with no head of line blocking
- Low latency 4usec port to port across modules
- Low power of just 13W per 40G port
- QSFP+ ports leverage broad range of optics
    - 40G-SR4, LR4, CR4, XSR4, PLRL4 AOC-40G (10G-SR, SRL, LR, CR)
    - Each 40G port can function as 4 x 10G-SR (150m OM4 MMF), 4x10G-LR (1km) or 4 x 10G-CR (5m)
- Simple software command to switch from 1x40G to 4x10G or vice-versa

This linecard is best used when a datacenter requires high-density 10G and/or 40G connectivity a 7500E chassis that allows for the most flexible combination of both 10G and 40G.

12 PORT MTP/MPO, DCS-7500-12CM-LC

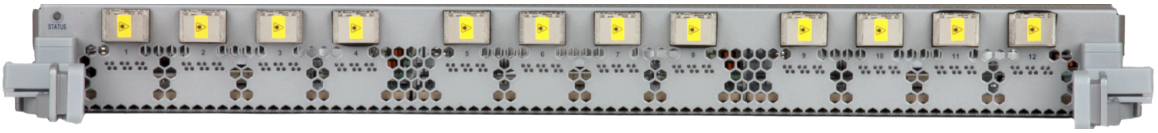

Figure 3: DCS-7500E-12CM-LC

The Arista 7500E Series 12 x 100G MTP/MPO linecard provides high density 100G using Arista Multi-speed Ports (MXP) with embedded optics. The MXP ports use 100GBASE-SR10 (Short Range) transceivers and are fully compatible with any standards compliant 100GBASE-SR10 ports. Each MXP port can be enabled in single 100Gb, triple 40Gb or twelve 10Gb Ethernet mode for up to 12 – 100Gb, 36 – 40Gb and 144 – 10Gb Ethernet ports per linecard.

Since each of MXP ports come with integrated optics, no external transceivers are required for this linecard.

- Non-blocking 10/40/100GbE linecard
- L2 / L3 switching up to 1.8Bn PPS
- N+1 fabric capacity for zero performance degradation fabric failure
- VoQ architecture
- Ultra-deep buffering of 1000MB+ per 100G port
- Low latency from 4usec port to port
- 12 MTP/MPO ports utilize integrated optics for triple speed capability
- Industry standard 10/40/100G in flexible combinations
- Each 100G port can function as
    - 12 x 10G-SR [300m OM3 (450m OM4) MMF]
    - 3 x 40G-SR4 / XSR4 to [300m OM3 (450m OM4) MMF]
    - or 1 x 100G-SR10 [300m OM3 (450m OM4) MMF]
- Simple command to switch between 1x100G, 3x40G, or 12x10G

The 7500E-12CM linecard is best used when very high density of 10G/40G and 100G Ethernet interfaces is required with the ability to migrate from 10G to 100G, with easy cabling using “SR” connections.

48 PORT SFP+ AND 2 MTP/MPO LINECARD, DCS-7500E-72S-LC

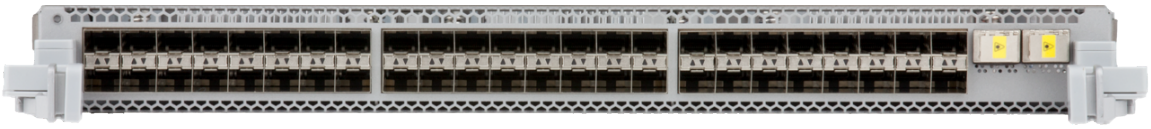

Figure 4: DCS-7500E-72S-LC

The Arista 7500E 48 SFP+ and 2 port 100GbE MXP linecard provides a flexible combination of 48 ports of SFP+ and 2 MPO ports for up to 72 10Gb Ethernet ports. The two 100G MTP/MPO ports provide 100G capability using Arista Multi-speed Ports (MXP) with integrated optics. MXP ports use 100GBASE-SR10 (Short Range) transceivers and are fully compatible with any standards compliant 100GBASE-SR10 ports. Each MXP port can be easily configured as a single 100Gb, triple 40Gb or twelve 10Gb Ethernet. This allows this module to support up to 72 – 10Gb Ethernet ports, or 48 – 10Gb Ethernet ports with a choice of 6 – 40Gb or 2 – 100Gb Ethernet ports allowing for a flexible combination of density and uplink flexibility.

- SFP+ and MTP/MPO ports for high density 72 x 10GbE Linecard
- Any to any non-blocking performance
- Ultra-deep buffering of 100MB+ per 10G port
- 900Mpps of Layer2 or Layer3 line rate performance
- 1.92 Tbps of fabric capacity for zero performance degradation with loss of fabric
- VoQ architecture to ensure traffic delivery with no head of line blocking
- Low latency 4usec port to port across modules
- Low power of just 3.8W per 10G port
- 48 SFP+/SFP ports for broadest range of 1/10GbE optics
- 2 Ports of MPO with embedded SR10 optics for 10/40/100GbE combinations
    - 12 x 10G-SR / 3 x 40G-SR4 / 1 x 100G-SR10

- Simple software command to switch a port between 1x100GbE, 3x40GbE, or 12x10GbE

This linecard is best used when the network requires a wide variety of 10G optics including single mode and support for longer distances where discrete 10G-SFP+ optics provide the broadest combinations, or when introducing into existing networks where 10G SFP+ is the primary connection type.

48 PORT 10GBE SFP+, DCS-7500E-48S-LC

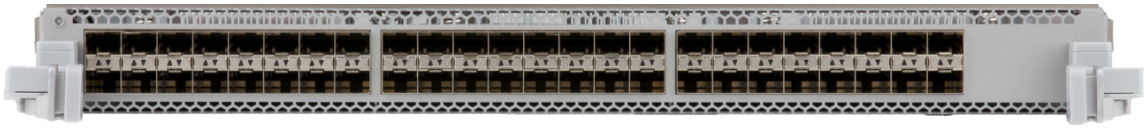

Figure 5: DCS-7500E-48S-LC

The Arista 7500E Series 48 port 1/10GbE SFP+ linecard has 48 SFP+ ports. Having 48 ports of SFP+ ports allows this linecard the flexibility to utilize any existing Arista SFP+ optic or direct attach cables, and to support both 1Gb and 10Gb speeds.

- SFP+ ports for 48 x 10G Linecard with consistent features for 7500E Series
- Non-blocking 1/10GbE linecard
- L2 / L3 switching up to 720M PPS
- N+1 fabric capacity for zero performance degradation fabric failure
- VoQ architecture
- Ultra-deep buffering of 100MB+ per 10G port
- Low latency from 4usec port to port
- 48 SFP+/SFP ports leverage broad range of 1/10GbE
  (SR, SRL, CR, LR, LRL, ER, DWDM and 1G (T, SX, LX) optics
- 1.92 Tbps of fabric capacity for zero performance degradation with loss of fabric

The 48x SFP+ module supports a consistent set of features for L2/L3 forwarding when used with the other linecards in the 7500E Series. Feature consistency ensures no loss of compatibility together with low cost of migration from 1G to 10G.

This linecard is best used when 1/10G connectivity is required in a dense modular system.

FLEXIBLE SFP+ / QSFP+ / MXP OPTIONS

The 7500E Series linecards offer three different physical interfaces – SFP+, QSFP+ and MXP to provide a wide variety of density, distance and interface speed combinations.

Choosing the correct module and optic option depends on the design requirements in the datacenter. As each interface supports multiple speeds it increases the flexibility when migrating or requiring a range of connection options. Table 1 shows the three different interface types and the available Ethernet speeds available.

Table 1: Interface Speed and Physical Interface Compatibility Matrix

Interface Speeds	SFP+	QSFP+	MXP
100Mb	Yes	-	-
1Gb	Yes	-	-
10Gb	Yes	Yes (4)	Yes (12)
40Gb	-	Yes	Yes (3)
100Gb	-	-	Yes

In addition to providing a combination of speeds each physical interface supports a variety of distances and media types from copper, to multi-mode and single-mode fiber. Table 2 shows the range of distances available based on the different connection types.

Table 2: Interface Distances

Interface	Media	SFP+	QSFP+	MXP
Twinax (CR)	Copper	5m	5m	-
Short Range Lite (OM3/OM4)	Multi-mode fiber	100m/150m	-	100m/150m
Short Range (OM3/OM4)	Multi-mode fiber	300m/450m	100m/150m	300m/450m
Extended Short Range (OM3/OM4)	Multi-mode fiber	-	300m/450m	300m/450m
Long Range Lite	Single-mode fiber	1km	1km	-
Long Range - LR / ER	Single-mode fiber	10km/40km	10km / -	-
Long Range - ZR / DWDM		80km/80km	-	-

A number of 10G, 40G and 100G specifications allow for interoperability between the various types. The tables below show both interoperability and the maximum supported distances when running between combinations.

Table 3: Optics Interoperability and Compatability Matrices

Multi-mode Fiber

Interface	10G-SRL	10G-SR	40G-SR4	40G-XSR4	MXP-SR10/12
10G-SRL	100m (OM3) 150m (OM4)				
10G-SR	100m (OM3) 150m (OM4)	300m (OM3) 450m (OM4)			
40G-SR4	100m (OM3) 150m (OM4)	100m (OM3) 150m (OM4)	100m (OM3) 150m (OM4)		
40G-XSR4	100m (OM3) 150m (OM4)	300m (OM3) 450m (OM4)	100m (OM3) 150m (OM4)	300m (OM3) 450m (OM4)	
MXP-SR10/12	100m (OM3) 150m (OM4)	300m (OM3) 450m (OM4)	100m (OM3) 150m (OM4)	300m (OM3) 450m (OM4)	300m (OM3) 450m (OM4)

Single-mode Fiber

Interface	10G-LRL	10G-LR	40G-PLRL4	40G-LR4
10G-LRL	1km SMF			
10G-LR	1km SMF	10km SMF		
40G-PLRL4	1km SMF	1km SMF	1km SMF	
40G-LR4	-	-	-	10km SMF

* Distances are based on the lowest range of the paired transceivers based on optical specifications in transceiver data sheet

A number of other considerations should also be balanced when choosing the right optics for the network solution.

Fate sharing is one such consideration. When a QSFP+ port is broken out into 4x10G mode each of the 10Gb Ethernet connections shares the same transceiver. They must use the same speed and if that needs to be replaced, then all four ports must be disconnected. In contrast a single SFP+ port supports just one port so that only that port is affected by the selection of the port speed or any transceiver event. Arista's linecard options provide a choice of high density QSFP+ for up to 144 x 10Gb, and SFP+ based modules where lower density provides for one interface for each port.

Power budgets and cooling requirements are also an important consideration when planning for a data center deployment. While the 7500E has one of the highest power efficiencies in the industry, understanding per port power consumption and balancing overall power requirements with interface demands is important. When using QSFP+ ports or the embedded MXP ports the Arista 7500E uses less than 3.8W per 10G port. As SFP+ enables lower overall system density the SFP+ ports have slightly higher power per port.

Implementing a scalable and well-structured cabling infrastructure is critical when matching to the linecards for the 7500E. The SFP+ port offers the largest variety of options, while the QSFP+ and MTP/MPO interfaces offer the densest options.

100G MTP/MPO INTERFACES

The 100G MTP/MPO interfaces offer a wide range of speed (10/40/100G) and breakout options as shown in Figure 6. Each combination of speed and connections requires the correct cabling to match the MPO/MTP port to the interface mode.

A connection between two MPO ports at 100GbE is made using MTP-24 cables. The 7500E 100G MXP ports use standard 100GBASE-SR10 for 100GbE connectivity ensuring that in 100GbE mode the MPO interfaces connect with 100GBASE-SR10 ports in other equipment using either CFP or CXP based transceivers with MTP-24 connectors.

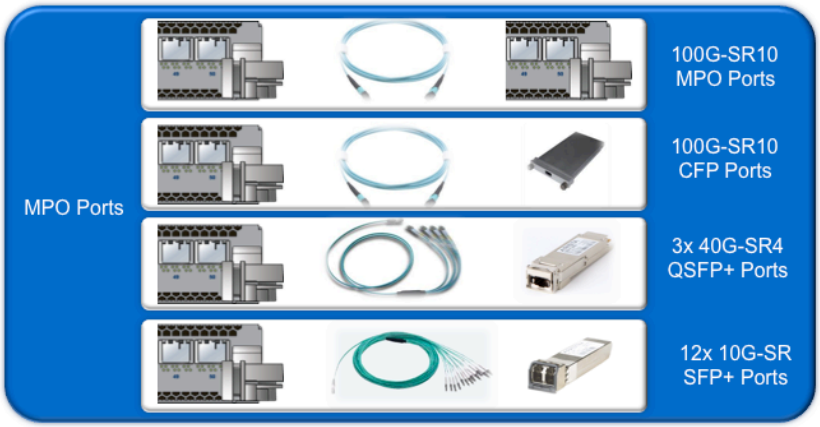

Figure 6: MTP/MPO Connectivity options

Operating the MXP ports in 40G mode allows 3 40GbE ports per MPO interface, and connects to standard QSFP+ SR4 ports using an MTP-12 connector on the QSFP+. The 10G mode allows 12 ports of 10G, which connect to 10GBASE-SR up to 300m using LC connectors.

The ability to reconfigure the MXP port as 100G, 40G or 10G allows a range of connection options and a migration path from 10G to 100G without changing or replacing transceivers, just the cables.

10G SFP+ TRANSCEIVERS

The SFP+ (Small Form-Factor Pluggable) transceivers offer the widest range of options for a choice of 100M/1G/10G cabling and connections.

Major features of SFP+ optics:

- Deployment flexibility of 10G, 1G or 100M speeds
- Smallest and lowest power 10G optic module form factor
- Hot swappable to maximize uptime and simplify serviceability

- Optical interoperability with XFP, X2 and XENPAK pluggable form factors
- Flexibility of media and interface choice on a port-by-port basis
- DWDM options provides high capacity bandwidth for long-haul networks
- Robust design for enhanced reliability

Figure 7: SFP+ module offers many 100M/1G/10G options

40G QSFP+ TRANSCEIVERS

The QSFP+ (Quad Small Form-Factor Pluggable) transceivers offer both 4x10G and 40G options using standard transceiver modules with copper cables or multi-mode fiber and single mode fiber for connections up to 10km.

Major features of QSFP+ optics:

- High Density 40G using a single cable (MTP or LC depending on type)
- Breakout cables allow 4x10G options with copper or multi-mode fiber
- Low power consumption
- Flexibility of optical media options
- Fully standards compliant with matching IEEE compliant optics
- Interchangeable and hot swappable

Figure 8: QSFP+ Module with MTP connector

All Arista 40G QSFP+ ports offer the ability to run as either 1x40G or 4x10G allowing for mixed modes on a single linecard. In the 1x40G mode a QSFP+ port is connected using either copper DAC (direct attached cable) or MTP-12 to MTP-12 multi-mode fiber. A QSFP+ port in 4x10G mode uses a fiber break-out cable to split the MTP-12 into four ports, or a DAC cable with 1xQSFP+ to 4xSFP+ ends. Figure 9 shows these combinations.

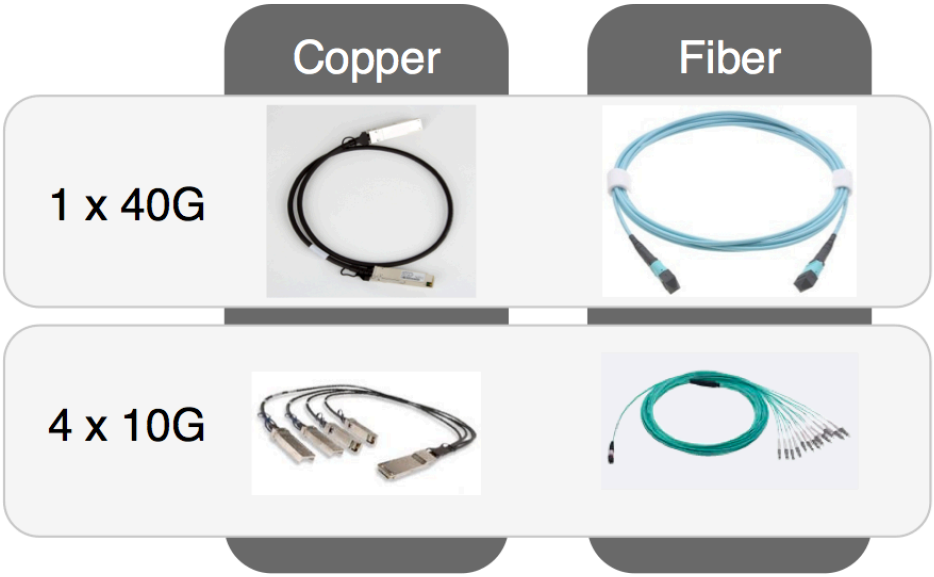

Figure 9: QSFP+ 10G and 40G Cabling Options

MPO INTERFACE CABLING

Arista 100G MXP ports provide a choice of three interface speeds - 10G, 40G, and 100G and a range of density options using embedded optics and a standard MPO/MTP interface. The integrated optic is fully standards compliant and supports a variety of short-range optics distances. Figure 10 shows the MXP ports that connect to an MTP-24 cable. Note the two alignment pins and the “key-up” style of MPO connector.

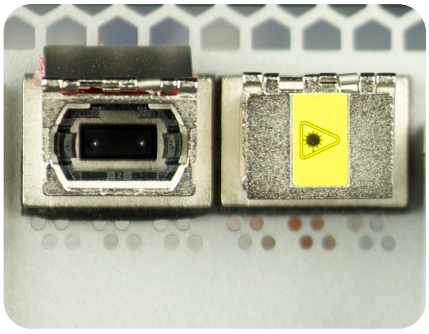

Figure 10: Arista MXP Interface for MTP-24 Cables

Major Features of MXP embedded optics:

- Very high density 10/40/100G front panel connectivity
- Lowest power consumption (3.5W per 10G port)
- No external transceiver modules required
- Fully standards compliant for 10GBASE-SR, 40GBASE-SR4 and 100GBASE-SR10

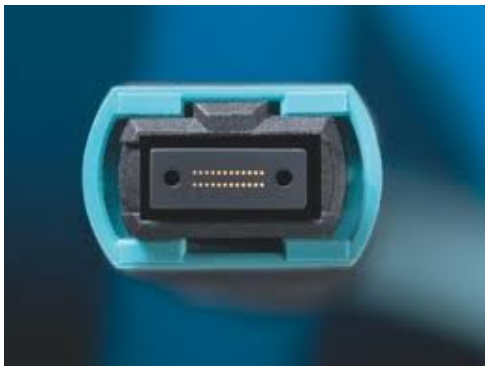

Figure 10: MTP-24 Cable

The Arista 7500E uses MTP-24 (24 lanes) to connect 1x100G, 3x40G, or 12x10G from a single connector. The MTP-24 connector offers the flexibility of a high density and works with other industry standard 10G, 40G, and 100G ports. Figure 10 shows an MTP-24 cable. Note the locator pin sockets and the position of “key-up” on the plug.

Using cables as shown below the Arista MXP ports can be used to breakout into three 40G Ethernet ports or twelve 10G Ethernet cables.

Figure 11: MTP-24 to 3 x MTP-12 Breakout Cable

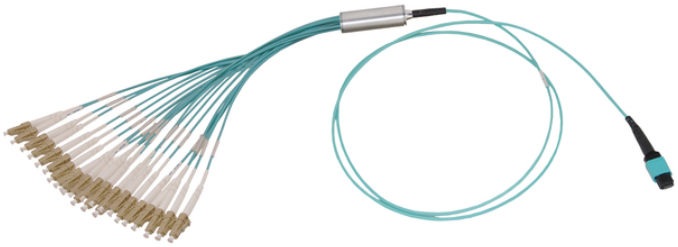

Figure 12: MTP-24 to 12x LC Breakout Cable

ARISTA AGILEPORTS

The Arista 7500E Series linecards deliver features designed to allow datacenter networks to scale and grow with minimal disruption. In addition to offering the ability to breakout 40G and 100G ports the 7500E Series has the capability to combine groups of 10G ports in sets of 4 and run as 40Gb Ethernet ports – AgilePorts.

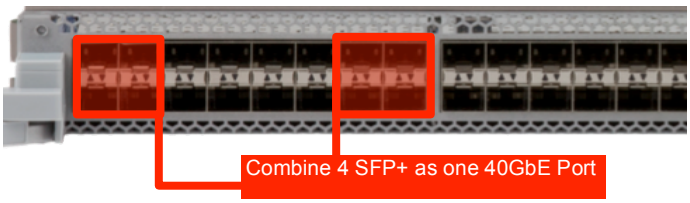

Figure 13: Agile Ports

This feature is important in the datacenter for two major reasons:

1. Flexibility to deploy a 10G linecard now with future proof migration to 40G as requirements evolve.

2. Extend 40G across distance using 10G-SFP+ single mode optics, without being limited by the options in the existing 40G standard.

With AgilePorts Arista customers can reuse the linecards they buy for their datacenter of today for the next generation of attached devices. This investment protection provides a significant advantage compared to replacing linecards, transceivers and even entire switches as the datacenter bandwidth need increases.

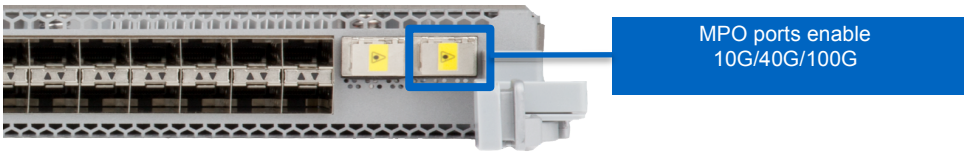

Figure 13: MXP ports for 10/40/100Gb Ethernet

CONCLUSION

Arista's focus on the data center provides customers with choice and flexibility to select the interfaces they need for the 7500E Series based on the rich complex environments without being limited by lower density, fewer optics combinations on single speed ports. With three options for interface types across four linecards each supporting multiple speeds customers can mix and match based on their requirements for scalability, bandwidth demand, and cabling infrastructure. Determining the 10G, 40G, and 100G requirements can be a difficult challenge. A wide range of options allows the 7500E to grow, scale, and interoperate with almost any datacenter design. The unparalleled density, scalability, performance, and resiliency of the 7504E and 7508E offer scalable options for today's most demanding datacenter networks.

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ABOUT ARISTA NETWORKS

Arista Networks was founded to deliver software-defined cloud networking solutions for large data center and computing environments. The award-winning Arista 10 Gigabit Ethernet switches redefine scalability, robustness, and price-performance. More than one million cloud networking ports are deployed worldwide. The core of the Arista platform is the Extensible Operating System (EOS®), the world's most advanced network operating system. Arista Networks products are available worldwide through distribution partners, systems integrators, and resellers.

Additional information and resources can be found at www.aristanetworks.com.