Arista 7500 Series Interface Flexibility

Today's large-scale virtualized datacenters and cloud networks require a mix of 10Gb, 25Gb, 40Gb, 50Gb 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 7500 Series 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 7500 Series of modular switches.

Arista 7500 Series

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

The 7500 Series offers a range of platform density choices for the datacenter and each system 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 7512R is an 18 RU system with a 115Tbps fabric that supports up to 12 line cards and provides 1,728 – 10Gb or 25Gb ports, 432 – 40Gb or 100Gb Ethernet ports in a single system - unparalleled density and performance in the industry.

The 7508R is a 13 RU system with a 75Tbps fabric that supports up to 8 line cards and provides 1,152 – 10Gb or 25Gb ports, 288 – 40Gb or 100Gb Ethernet ports in a single system.

The Arista 7504R provides room for 4 line cards in a compact 7RU chassis that delivers 38Tbps of bandwidth allowing up to 576 - 10Gb ports, 144 – 40Gb ports or 100Gb Ethernet ports.

A choice of high-density wire-speed 10GbE, 40GbE and 100GbE line cards is fully supported with the ability to mix and match any combination of modules from the 7500E and 7500R Series. The 40GbE and 100GbE modules enable flexible break out modes such that high density 10GbE and 25GbE ports are provided or can be used as a single 40G or 100G port.

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

Arista 7500E Series Line Cards

36 Port 40GbE QSFP + Line Card, DCS-7500E-36Q-LC

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

The Arista 7500E 36 port QSFP+ line card has 36 QSFP+ ports that allow for a high degree of flexibility in a mixed 10G/40G network. 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, XSR4, SRBD, UNIV, LRL4, LR4, PLR4, PLRL4, ER4, CR4, AOC-40G
    - Each 40G port can function as 4 x 10G-SR (400m or 150m OM4 MMF), 4x10G-LR (10km or 1km) or 4 x 10G-CR (5m)
- Simple software command to switch from 1x40G to 4x10G or vice-versa

This line card 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 100GbE QSFP100 + Line Card, DCS-7500-12CQ-LC

Figure 4: DCS-7500E-6C2-LC

The Arista 7500E Series 6 x 100G CFP2 line card provides high performance 100G using industry standard CFP2 optics that are hot pluggable. The CFP2 form factor is designed to allow for long haul optics with a size that is approximately 50% smaller than the CFP optic. As a result CFP2 based line cards allow for up to 6 ports per line card, which increases overall system density. The CFP2 form factor allows 100GbE optics to be installed and with the use of 10x10 and 2x40 mode a choice of 10/40/100GbE.

- Non-blocking 10/40/100GbE line card

- L2 / L3 switching up to 900Mpps

- VoQ architecture

- Ultra-deep buffering of 1000MB+ per 100G port

- Low latency from 4usec port to port

- 6 CFP2 optic ports utilize integrated optics for triple speed capability

- Industry standard 10/40/100G in flexible combinations with long haul options

- Each 100G port can function as

    º 10 x 10G-SR [300m OM3 (400m OM4) MMF]

    º 2 x 40G-SR4

    º 1 x 100G-SR10, LR4 or ER4

- Simple command to switch between 1x100G, 2x40G, or 10x10G

The 7500E-6C2 line card is best used when long distance, up to 40km, 100GbE connections are required with the ability to migrate from 10G to 100G, with easy cabling using "SR" connections.

12 Port 100GbE MTP/MPO, DCS-7500-12CM-LC

The Arista 7500E Series 12 x 100G MTP/MPO line card provides high density 100G using Arista Multi-speed Ports (MXP) with

Figure 5: DCS-7500E-12CM-LC

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 line card.

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

- Non-blocking 10/40/100GbE line card

- L2 / L3 switching up to 1.8Bpps

- 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

    º 12 x 10G-SR [300m OM3 (400m OM4) MMF]

    º 3 x 40G-SR4 / XSR4 to [300m OM3 (400m OM4) MMF]

    º or 1 x 100G-SR10 [300m OM3 (400m OM4) MMF]

- Simple command to switch between 1x100G, 3x40G, or 12x10G

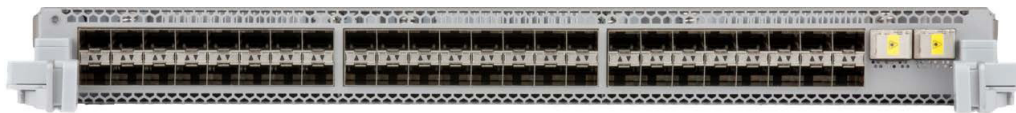## 48 Port SFP + And 2 MTP/MPO Line Card, DCS-7500E-72S-LC

Figure 6: DCS-7500E-72S-LC

The Arista 7500E 48 SFP+ and 2 port 100GbE MXP line card 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 Line card

- 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

    º 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 line card 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.

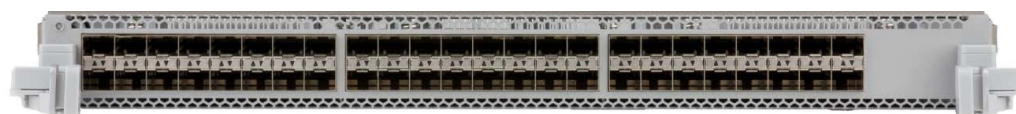## 48 Port 10GbE SFP +, DCS-7500E-48S-LC

Figure 7: DCS-7500E-48S-LC

The Arista 7500E Series 48 port 1/10GbE SFP+ line card has 48 SFP+ ports. Having 48 ports of SFP+ ports allows this line card 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 Line card with consistent features for 7500E Series

- Non-blocking 1/10GbE line card

- L2 / L3 switching up to 720Mpps

- 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 (AOCs, SR, SRL, CR, LR, LRL, ER, ZR, Tunable 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 line cards in the 7500E Series. Feature consistency ensures no loss of compatibility together with low cost of migration from 1G to 10G.

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

Arista 7500R Series Line Cards
36 Port 100GbE QSFP100 Line Card, DCS-7500R-36QC-LC

Figure 8: DCS-7500R-36CQ-LC

The Arista 7500R Series 36 ports QSFP100 line card allows for a high degree of flexibility in a mixed 10G/40G/100G environment. All 36 ports can operate as either a single 100Gb or 40Gb Ethernet port.

A wide range of additional interface speed flexibility is possible, with all ports able to support 4 x 10G Ethernet, 4 x 25G Ethernet or 2 x 50G Ethernet. This flexibility allows for a choice of 5 speeds on all ports and allow for simple migration from 10G to 100G and a wide range of combinations:

- Industry leading 36 ports of 100G

- Up to 36 ports of 40G

- Up to 144 ports of 10G or 25G

- Up to 72 ports of 50G

- Any to any - Non-blocking performance

- Ultra-deep buffering of 600MB+ per 100G port

- 4.32Bpps of Layer2 & Layer3 line rate forwarding

- 3.6 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

- QSFP100 ports leverage a broad range of optics

    º 36 x 100G-SR4, LR4, LRL4, CWDM4, PSM4, AOC or CR4

    º 36 x 40G-SR4, XSR4, LR4, LRL4, PLR4, PLRL4, ER4, UNIV, SRBD, AOC or CR4

    º All ports can function as 4 x 10G-SR, SRL, LR, LRL or CR

- Simple software command to switch between 1x100G, 1x40G, 2x50G, 4x10G or 4x25G

This line card is best used when a datacenter requires high-density 100G and 40G connectivity with the flexibility to migrate from 10G or ensure future support for 25G and 50G connections.

36 Port 40GbE QSFP+ Line Card, DCS-7500R-36Q-LC

Figure 9: DCS-7500R-36Q-LC

The Arista 7500R 36 port QSFP+ line card allows for a wide range of flexibility in a mixed 10G/40G environment. All QSFP+ ports can operate as either a single 40Gb Ethernet port. Additional interface flexibility is possible, with ARISTA WHITE PAPER ARISTA 7500 SERIES INTERFACE FLEXIBILITY 7 up to 24 ports able to support 4x10G mode and 6 ports of 1x100G mode. These interface speed choices allow for simple migration from 10G to 100G and a wide range of possible combinations:

- 36 ports of 40G at wire speed

- Up to 96 ports of 10G

- 6 QSFP100 ports allow up to 6 ports of 100G, 24 ports of 25G or 12 ports of 50G

- Any to any - Non-blocking performance

- Ultra-deep buffering of 200MB+ per 40G port

- 1.4Bpps of Layer2 & Layer3 line rate forwarding

- 1.8 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

- QSFP+ ports leverage broad range of optics

   ○ 36 x 40G-SR4, XSR4, LR4, LRL4, PLR4, PLRL4, ER4, UNIV, SRBD, AOC or CR4

   ○ 24 40G ports can function as 4 x 10G-SR, SRL, LR, LRL or CR

   ○ 6 100G ports can function as 1 x 100G-SR4, LR4, LRL4, CWDM4, PSM4, AOC or CR4

- Simple software command to switch between 1x40G, 1x100G, 2x50G, 4x25G or 4x10G

This line card is best used when a datacenter requires high-density 10G and/or 40G connectivity with 100G connections to other spine systems with a broad range of flexibility.

48 Port 1/10GbE SFP+ And 2 Port 100GbE QSFP100 Line Card, DCS-7500R-48S2CQ-LC

Figure 10: DCS-7500R-48S2CQ-LC

The Arista 7500E 48 SFP+ and 2 port 100GbE QSFP line card provides a flexible combination of 48 ports of SFP+ and 2 QSFP100 ports for up to 56 10Gb Ethernet ports. The two 100G QSFP100 ports allow for 1x 100G, 1x40G, or 4x10G capability.

- Any to any non-blocking performance

- Ultra-deep buffering of 100MB+ per 10G port

- 720Mpps of Layer2 or Layer3 line rate performance

- 680Gbps 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 QSFP100 for 10/40/100GbE combinations

- Simple software command to switch a port between supported speed combinations

This line card 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.

Flexible SFP+ / QSFP+ / CFP2 / QSFP100 / MXP Optical Interface Options
The 7500 Series line cards offer five different physical interface choices – SFP+, QSFP+, CFP2, QSFP100 and MXP to provide the widest variety of port density, link 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+	CFP2	QSFP100	MXP
100Mb	Yes	-			-
1Gb	Yes	-	-	-	-
10Gb	Yes	Yes (4)	Yes (10)	Yes (4)	Yes (12)
25Gb	-	-	-	Yes (4)	-
40Gb	-	Yes	Yes (2)	Yes (1)	Yes (3)
50Gb	-	-	-	Yes (2)	-
100Gb	-	-	Yes	Yes	Yes

In addition to providing a combination of speeds each physical interface supports a variety of distance and media types. Table 2 shows the range of distances available based on the different connection types.

Table 2: Interface Distances						
Interface	Media	SFP+	QSFP+	CFP2	QSFP100	MXP
Twinax (CR)	Copper	5m	5m	-	5m	-
Short Range Lite (OM3/OM4)	Multi-mode fiber	100m / 150m	-	-	-	100m / 150m
Short Range (OM3/OM4)	Multi-mode fiber	300m / 400m	100m / 150m	300m / 400m	100m / 150m	300m / 400m
Extended Short Range (OM3/OM4)	Multi-mode fiber	-	300m / 400m	300m / 400m	-	300m / 400m
Long Range Lite	Single-mode fiber	1km	1km	-	2km	-
Long Range - LR / ER	Single-mode fiber	10km / 40km	10km / 40km	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 Compatibility 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) 400m (OM4)			
40G-SR4	100m (OM3) 150m (OM4)	100m (OM3) 150m (OM4)	100m (OM3) 150m (OM4)		
40G-XSR4	100m (OM3) 150m (OM4)	300m (OM3) 400m (OM4)	100m (OM3) 150m (OM4)	300m (OM3) 400m (OM4)	
MXP-SR10/12	100m (OM3) 150m (OM4)	300m (OM3) 400m (OM4)	100m (OM3) 150m (OM4)	300m (OM3) 400m (OM4)	300m (OM3) 400m (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+ or QSFP100 port is broken out into 4X mode each of the individual connections shares the same transceiver. They must use the same speed, and if the transceiver needs to be replaced, then all four ports must be disconnected. In contrast a single SFP+ port supports just one interface such that only that port is affected by the selection of the port speed or any transceiver event. Arista's line card options provide a choice of high-density modules and a range of modules where a single interface is used for each port.

Power budgets and cooling requirements are also an important consideration when planning for a data center deployment. While the 7500 Series 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+ and QSFP100 ports or embedded MXP ports the Arista 7500 Series uses less than 4W per 10G port. As SFP+ enables lower overall system density the average power per port in SFP+ mode is a little higher per port.

Implementing a scalable and well-structured cabling infrastructure is critical when matching to the line cards for the 7500 Series.

100G MTP/MPO Interfaces

The 7500E Series 100G MXP ports use an MTP/MPO interface that offers 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 MTP/MPO 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.
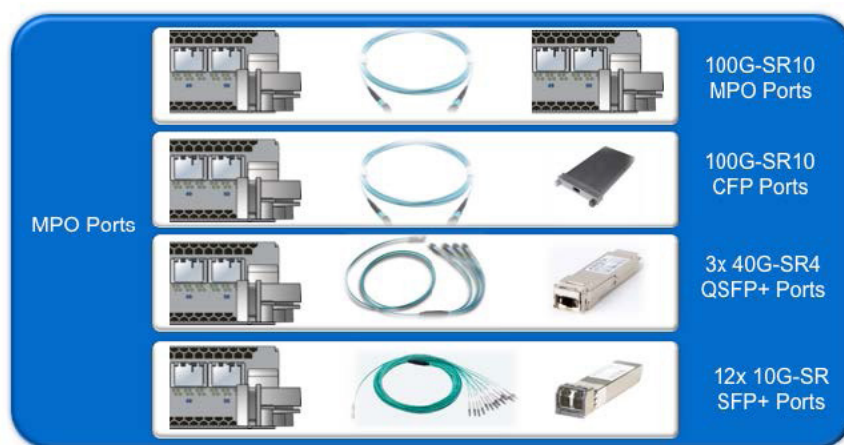

Figure 11: MTP/MPO Connectivity options

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.

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 12: 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 40km.

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, multi-mode or single-mode fiber

- Low power consumption

- Flexibility of optical media options

- Fully standards compliant with matching IEEE compliant optics

- Interchangeable and hot swappable

Figure 13: 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 line card. 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.
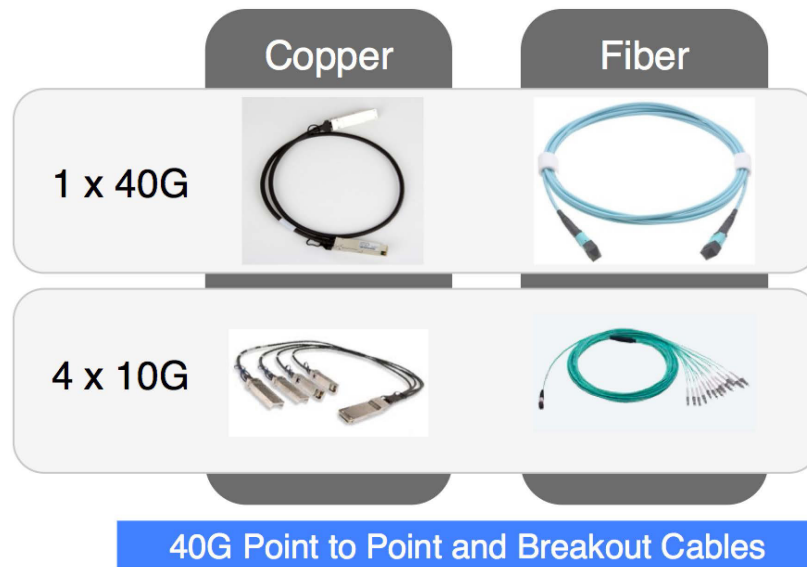
Figure 14: QSFP+ 10G and 40G Cabling Options

QSFP100 Transceivers

The QSFP100 (Quad Small Form-Factor Pluggable at 100G) transceivers offer both 100G and 4x25 options using standard transceiver modules with copper cables or multi-mode fiber and single mode fiber for connections up to 10km.

Major features of QSFP100 optics:

• High Density 100G using a single cable (MTP or LC depending on type)

• Breakout cables allow 4x25G and 2 x 50G options with copper, single-mode or multi-mode fiber

• Low power consumption

• Flexibility of optical media options

• Fully standards compliant with matching IEEE compliant optics

• Interchangeable and hot swappable

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.
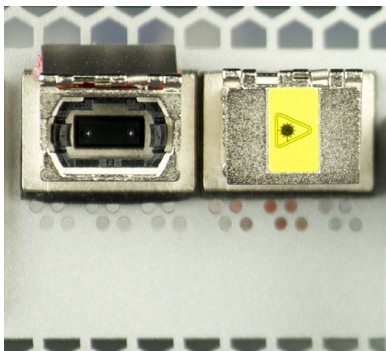
Figure 15: Arista MXP Interface for MTP-24 Cables

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

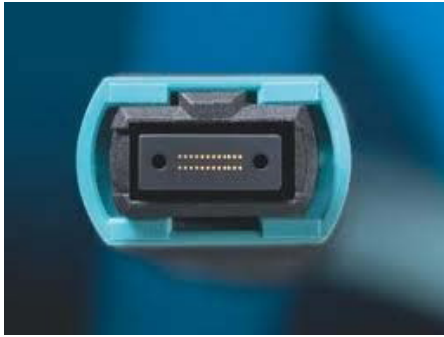- Fully standards compliant for 10GBASE-SR, 40GBASE-SR4 and 100GBASE-SR10

Figure 16: 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 theplug.

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 17: MTP-24 to 3 x MTP-12 Breakout Cable
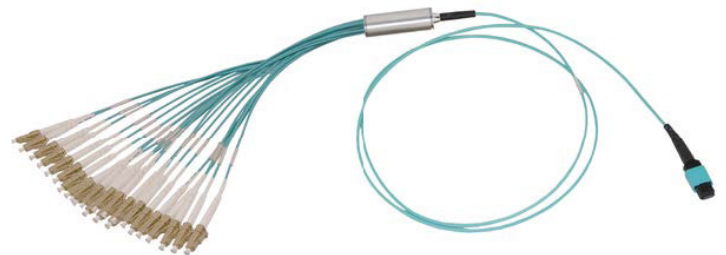
Figure 18: MTP-24 to 12x LC Breakout Cable

Conclusion

Arista's focus on the data center provides customers with choice and flexibility to select the interfaces they need for the 7500 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 line cards 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 7500 Series to grow, scale, and interoperate with almost any datacenter design. The unparalleled density, scalability, performance, and resiliency of the 7500 Series offer scalable options for today's most demanding datacenter networks.

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