# Arista 100G SFP-DD and DSFP Connectivity Solutions: Q&A

What are the benefits of using 100G SFP-DD or DSFP systems?

Arista's 100G/port SFP-DD and DSFP systems are quad-rate systems, enabling the use of 10G, 25G and 50G SFP optics and cables, as well as 100G SFP-DD / DSFP cables – enabling one system to support 4 generations of speeds and transceivers. Key benefits & applications include:

- Future-proof Top of Rack (TOR) switch to Network Interface Card (NIC) connectivity: Arista's SFP-DD and DSFP switch ports can be deployed using mature 10G/25G SFP technology today, while being future proof to support 50G SFP and 100G SFP-DD/DSFP modules and cables.
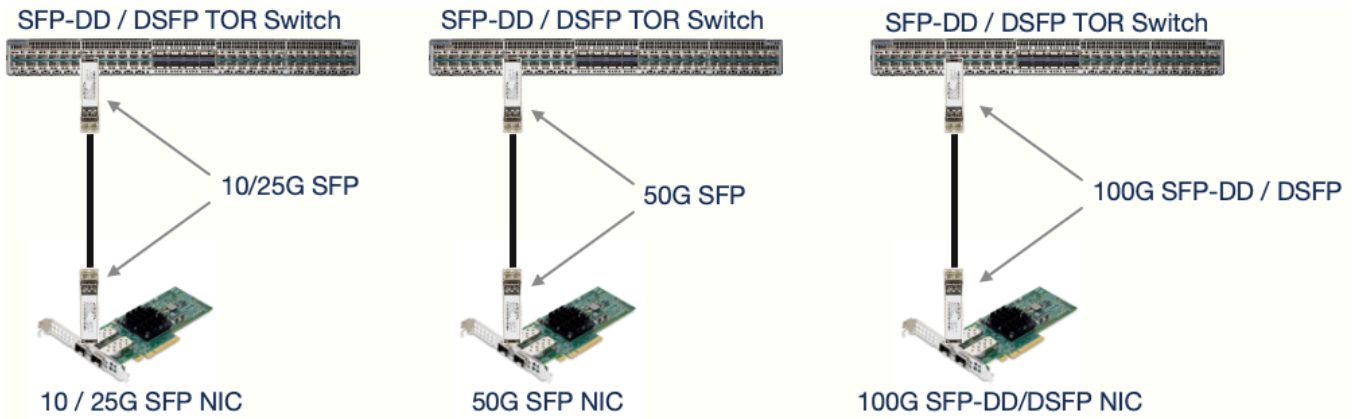

- Easy connectivity 100G-2 QSFP56 based NICs, or breakout to NICs that use 2x 10G/25G/50G SFP ports

- Increase in bandwidth density by a factor of 4 when compared to 25G/port SFP systems.

What are the SFP-DD and DSFP form factors?

The SFP-DD ("Double-Density SFP") and the DSFP ("Dual SFP") are two approaches to achieving the same objective: A compact, SFP-like form factor with 2x 50Gb/s PAM-4 electrical lanes in each direction to enable a total bandwidth of 100G / port. The basic concept is shown below:
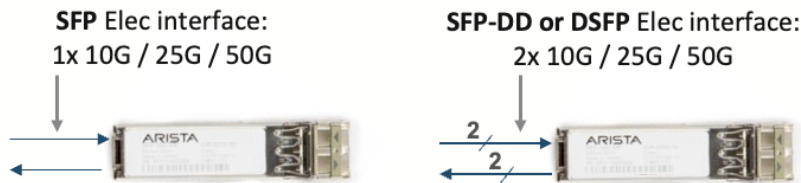
The SFP-DD form-factor is defined by the SFP-DD MSA. The SFP-DD adds a second row of contacts to the SFP electrical connector to enable a 2x 10G/25G/50G electrical interface. The DSFP is defined by the DSFP MSA. The DSFP repurposes some of the low-speed pins of the SFP to enable a 2x 10G/25G/50G electrical interface. The figure below summarizes the approach of the SFP-DD and the DSFP to achieve a dual-lane interface.

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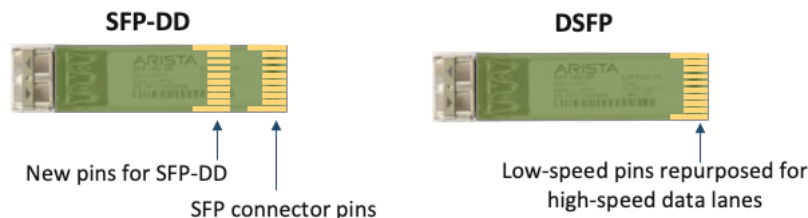
What 100G SFP-DD and DSFP Connectivity options does Arista offer?

Arista offers a variety of SFP-DD / DSFP passive copper DAC cables for cost effective TOR to NIC connectivity. The table below summarizes the SFP-DD and DSFP connectivity options available from Arista.

Product Number	Product Description
SFP-DD Twinax Copper Cables	
C-Z100-Z100-1M C-Z100-Z100-2M C-Z100-Z100-3M	100G / 50GBASE-CR2 SFP-DD TO SFP-DD Twinax Copper Cable, 1 to 3 meters. TOR to NIC connectivity for NICs using native SFP-DD ports.
C-Z100-Q100-1M C-Z100-Q100-2M C-Z100-Q100-3M	100G / 50GBASE-CR2 SFP-DD TO QSFP Twinax Copper Cable, 1 to 3 meters. TOR to NIC connectivity for NICs using 100G-2 QSFP (QSFP56), or 50G-2 (QSFP28) ports. 100G-2 and 50G-2 QSFP ports use 2 electrical lanes, with each lane operating at 50G (for 100G-2) and 25G (for 50G-2).
C-Z100-2S50-1M C-Z100-2S50-2M C-Z100-2S50-3M	100GBASE-CR2 SFP-DD to 2x 50G / 25G / 10GBASE-CR SFP Twinax Copper Cable, 1 to 3 meters. TOR to NIC connectivity for NICs using SFP ports at any data rate from 10G to 50G.
DSFP Twinax Copper Cables	
C-Y100-Y100-1M C-Y100-Y100-2M C-Y100-Y100-3M	100G / 50GBASE-CR2 DSFP TO DSFP Twinax Copper Cable, 1 to 3 meters. TOR to NIC connectivity for NICs using 100G DSFP ports.
C-Y100-Q100-1M C-Y100-Q100-2M C-Y100-Q100-3M	100G / 50GBASE-CR2 DSFP TO QSFP Twinax Copper Cable, 1 to 3 meters. TOR to NIC connectivity for NICs using 100G-2 QSFP (QSFP56), or 50G-2 (QSFP28) ports. 100G-2 and 50G-2 QSFP ports use 2 electrical lanes, with each lane operating at 50G (for 100G-2) and 25G (for 50G-2).
C-Y100-2S50-1M C-Y100-2S50-2M C-Y100-2S50-3M	100GBASE-CR2 DSFP to 2x 50G / 25G / 10GBASE-CR SFP Twinax Copper Cable, 1 to 3 meters. TOR to NIC connectivity for NICs using SFP ports at any data rate from 10G to 50G.

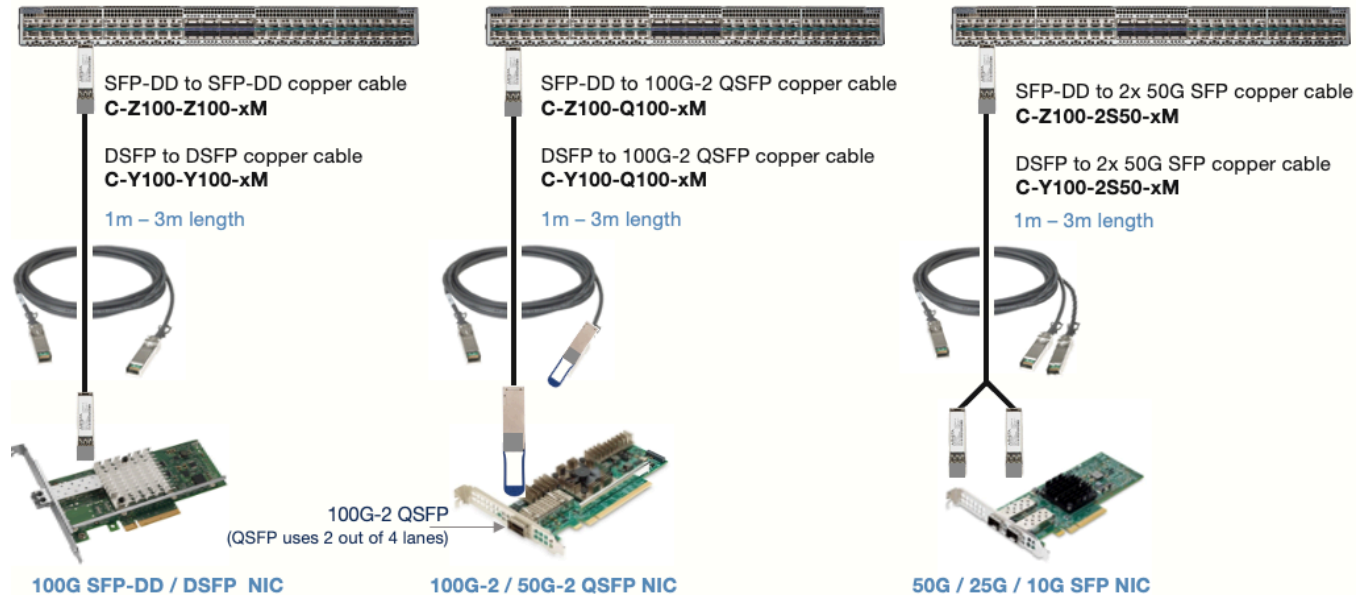## Why does Arista support both the SFP-DD and DSFP form factors?

While both the SFP-DD and DSFP achieve the same objective (supporting up to 100G in an SFP-like form-factor), Arista provides both form-factors to satisfy customer preference. The SFP-DD and DSFP have seen varying levels of deployment in different geographical regions: The DSFP in Asia, and the SFP-DD outside Asia.

What are the main applications for SFP-DD and DSFP copper cables?

To achieve higher data rates, NICs are transitioning from 10G/25G NRZ to 50Gb/s PAM-4 signaling per lane. SFP-DD and DSFP copper cables enable easy connectivity from TOR switches that use SFP-DD / DSFP ports to:

- NICs that use SFP-DD / DSFP ports at 100G-2 (PAM-4) or 50G-2 (NRZ) data rates

- NICs that use QSFP ports at 100G-2(PAM-4) or 50G-2 (NRZ) data rates, and

- NICs that use SFP ports at 10G/25G (NRZ) or 50G (PAM-4) data rates.

The diagrams below summarize the simplest options to connect SFP-DD/DSFP TOR ports to NICs

SFP-DD to SFP-DD copper cable
C-Z100-Z100-xM

DSFP to DSFP copper cable
C-Y100-Y100-xM

1m – 3m length

100G SFP-DD / DSFP NIC

SFP-DD to 100G-2 QSFP copper cable
C-Z100-Q100-xM

DSFP to 100G-2 QSFP copper cable
C-Y100-Q100-xM

1m – 3m length

100G-2 QSFP
(QSFP uses 2 out of 4 lanes)

100G-2 / 50G-2 QSFP NIC

SFP-DD to 2x 50G SFP copper cable
C-Z100-2S50-xM

DSFP to 2x 50G SFP copper cable
C-Y100-2S50-xM

1m – 3m length

50G / 25G / 10G SFP NIC

Can 10G, 25G and 50G SFPs be used in SFP-DD and DSFP ports?

Yes. The SFP-DD and DSFP ports can be considered "quad-rate" ports, and support 10G, 25G and 50G SFP optics and cables, as well as 100G SFP-DD / DSFP copper cables. This allows a single platform to support 4 generations of speeds – a unique feature of SFP-DD and DSFP systems.

Can SFP-DDs or DSFPs be used in 10G, 25G or 50G SFP ports?

No. SFP-DDs should only be inserted into SFP-DD ports, and DSFPs should only be inserted into DSFP ports.

Why doesn't Arista offer SFP-DD and DSFP optical transceivers?

The main application of SFP-DD and DSFP ports in the datacenter is for TOR to NIC connections, where passive copper DACs provide the most cost-effective connectivity. Arista will continue to assess customer demand and may introduce new SFP-DD / DSFP media types (including optics) over time.

What does it mean when an electrical or optical channel is PAM-4 or NRZ?

As switch silicon bandwidth increases, the switch silicon IO, or serializer-deserializer (serdes), needs to be driven at faster speeds. Switch silicon serdes speeds have evolved from 10Gb/s NRZ (used for SFP+ and 40G QSFP ports), to 25Gb/s NRZ (used for SFP25 and QSFP100 ports) to 50G PAM-4 (used for 50G SFP, 100G SFP-DD/DSFP, 200G QSFP and 400G OSFP / QSFP-DD ports). Next generation switch silicon will see the serdes driven at 100Gb/s PAM-4 (enabling 800G OSFP and QSFP-DD ports).

NRZ stands for "Non Return to Zero" modulation, and describes an electrical or optical data channel where there are only two amplitude levels (or symbols), with one amplitude level representing a digital '1' and the other level representing a digital '0'. This is the predominate modulation scheme for transmitting data up to 25Gb/s, and is the simplest way to transmit digital data. The diagram below shows an example of an NRZ waveform, along with an 'eye diagram' for NRZ data. An eye diagram is simply a way of viewing a modulation scheme with each bit value superimposed on each other.

NRZ waveform for data: 0 1 1 0 1 1 0 0

Eye diagram for NRZ data
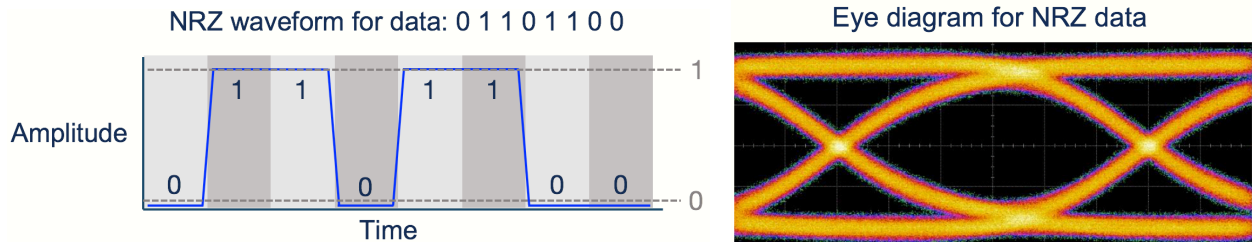
PAM-4 stands for Pulse Amplitude Modulation – 4, where '4' refers to the number of different amplitude levels (or symbols) of the electrical or optical signal carrying the digital data. In this case, each amplitude level (or symbol) represents two bits of digital data. This enables a PAM-4 waveform to transmit twice as many bits as a NRZ waveform at the same symbol (or "baud") rate. The diagram below shows an example of a PAM-4 waveform, along with an eye diagram for PAM-4 data.

PAM-4 waveform for data: 0 1 1 0 1 1 0 0

Eye diagram for PAM-4 data
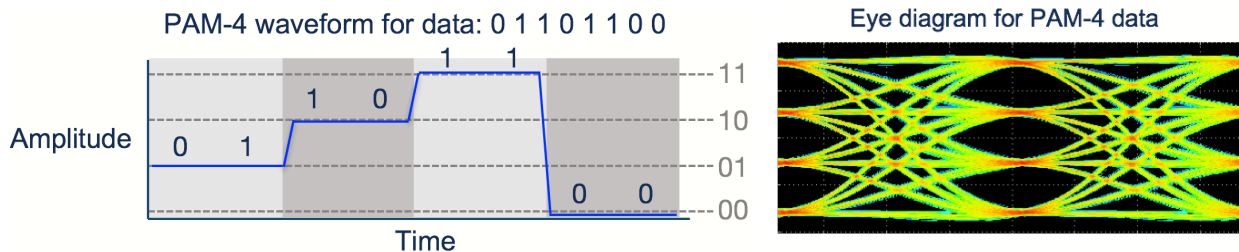
When a signal is referred to as "25Gb/s NRZ" or "25G NRZ", it means the signal is carrying data at 25 Gbit / second with NRZ modulation. When a signal is referred to as "50G PAM-4", it means the signal is carrying data at a rate of 50 Gbit / second using PAM-4 modulation.

What is the speed and modulation format of the electrical interface of a 100G SFP-DD module?

SFP-DD and DSFP modules utilize 2x electrical lanes in each direction (2 transmit lanes and 2 receive lanes), operating at a maximum data rate of 50Gb/s PAM-4, enabling an aggregate bandwidth of 100Gb/s. All Arista SFP-DD and DSFP copper cables can also be configured at lower speeds, enabling 2x 25G & 2x 10G operation.

What do the terms 100G-2 and 50G-2 mean?

These terms describe the bandwidth of an ethernet link, and the number of lanes used to achieve this bandwidth.

Every front panel port of an ethernet switch consists of one or more electrical lanes that transmit and receive ethernet data. For 10G SFP, 25G SFP or 50G SFP ports, a single electrical lane is used (in each direction) and modulated at 10G, 25G or 50G. For SFP-DD and DSFP ports, 2 electrical lanes are used (in each direction) and can be operated at a rate of up to 50Gbs per lane (for a total of 100Gb/s per SFP-DD / DSFP port)

The table below summarizes the terminology used to describe common ethernet speeds used by SFP and SFP-DD/DSFP ports, the number of lanes required to achieve this bandwidth, and some common applications of these interface types:
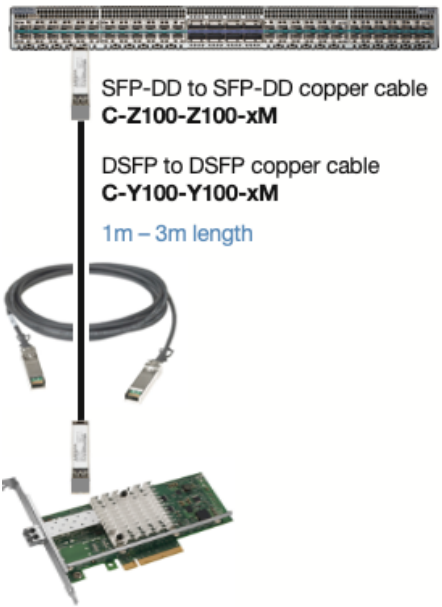
Ethernet link description	Link bandwidth	No. of lanes	Modulation of each lane	Common applications
10G	10Gb/s	1	10G NRZ	All 10G SFP+ ports.
25G	25Gb/s	1	25G NRZ	All 25G SFP ports
50G	50Gb/s	1	50G PAM-4	All 50G SFP ports
50G-2	50Gb/s	2	25G NRZ	All Arista SFP-DD / DSFP ports can be configured as a 50G-2 Ethernet link, and QSFP100 and QSFP200 ports on an Arista switch can often be configured to operate as 2x 50G-2 Ethernet links. 50G-2 QSFP interfaces are sometimes found in 50G NICs. Only 2 lanes (out of the 4 lanes available on a QSFP connector) are used.
100G-2	100Gb/s	2	50G PAM-4	All Arista SFP-DD / DSFP ports can be configured as a 100G-2 Ethernet link, and a QSFP200 port on an Arista switch can often be configured to operate as 2x 100G-2 Ethernet links. 100G-2 QSFP interfaces are sometimes used on 100G NICs that use 50G PAM-4 serdes. Only 2 electrical lanes (out of the 4 electrical lanes) are used.

What are the complete set of ethernet speeds that each SFP-DD / DSFP cable supports?

Each SFP-DD and DSFP port has a 2-lane electrical interface, which can support a maximum data rate of 50Gb/s per lane, enabling a total bandwidth of 100Gbs per SFP-DD and DSFP port. Each lane can be operated at lower speed data rates, and since the SFP-DD and DSFP DACs are passive copper cables, the cable does not impose restrictions on lane speed configuration (except that each lane must be operated at 50Gb/s or lower data rate).

The most common port configurations and applications for each SFP-DD / DSFP copper cable are summarized below. The column labels "Lane 1" & Lane "2" represent the 2-lane electrical interface of the SFP-DD / DSFP port. The values in the "Lane" columns refer to the speed configuration of the SFP-DD / DSFP switch port.

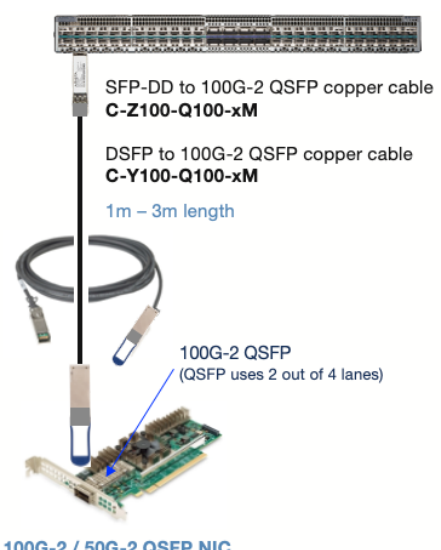| Port configuration & common applications for: SFP-DD to SFP-DD DACs (C-Z100-Z100-xM) and DSFP to DSFP DACs (C-Y100-Y100-xM)			
SFP-DD / DSFP Logical port configuration		Common applications	
Lane 1	Lane 2		
100G-2		100G-2 SFP-DD/DSFP TOR port → 100G-2 SFP-DD/DSFP NIC port	SFP-DD to SFP-DD copper cable **C-Z100-Z100-xM** DSFP to DSFP copper cable **C-Y100-Y100-xM** 1m – 3m length
50G-2		50G-2 SFP-DD/DSFP TOR port → 50G-2 SFP-DD/DSFP NIC port	
50G	50G	SFP-DD/DSFP TOR port configured as 2x 50GE → SFP-DD/DSFP NIC port configured as 2x 50GE	
25G	25G	SFP-DD/DSFP TOR port configured as 2x 25GE → SFP-DD/DSFP NIC port configured as 2x 25GE	
10G	10G	SFP-DD/DSFP TOR port configured as 2x 10GE → SFP-DD/DSFP NIC port configured as 2x 10GE	**100G SFP-DD / DSFP NIC**

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Port configuration & common applications for: SFP-DD to QSFP DACs (C-Z100-Q100-xM) and DSFP to QSFP DACs (C-Y100-Q100-xM)		
SFP-DD / DSFP Logical port configuration	**Common applications**	
Lane 1 / **Lane 2**		
100G-2	100G-2 SFP-DD/DSFP TOR port → 100G-2 QSFP NIC port	
50G-2	50G-2 SFP-DD/DSFP TOR port → 50G-2 QSFP NIC port	
50G / 50G	SFP-DD/DSFP TOR port configured as 2x 50GE → QSFP NIC port configured as 2x 50GE	
25G / 25G	SFP-DD/DSFP TOR port configured as 2x 25GE → QSFP NIC port configured as 2x 25GE	
10G / 10G	SFP-DD/DSFP TOR port configured as 2x 10GE → QSFP NIC port configured as 2x 10GE	

Port configuration & common applications for: SFP-DD to QSFP DACs (C-Z100-2S50-xM) and DSFP to QSFP DACs (C-Y100-2S50-xM)		
SFP-DD / DSFP Logical port configuration	**Common applications**	
Lane 1 / **Lane 2**		
50G / 50G	SFP-DD/DSFP TOR port configured as 2x 50GE → 2x SFP NIC ports configured as 50GE	
25G / 25G	SFP-DD/DSFP TOR port configured as 2x 25GE → 2x SFP NIC ports configured as 25GE	
10G / 10G	SFP-DD/DSFP TOR port configured as 2x 10GE → 2x SFP NIC ports configured as 10GE	

What are the CLI commands to configure a 100G SFP-DD or DSFP port for different speeds & logical interfaces?

For 100G-2 operation:
```
switch(config)#interface Ethernet1/1
switch(config-if-Et1/1)#speed 100g-2
```

For 1x 50G-2 operation:
```
switch(config)#interface Ethernet1/1
switch(config-if-Et1/1)#speed 50g-2
```

For 2x 50G-1 operation
```
switch(config)#interface Ethernet1/1-2
switch(config-if-Et1/1-2)#speed 50g-1
```

For 2x 25G operation
```
switch(config)#interface Ethernet1/1-2
switch(config-if-Et1/1-2)#speed 25g
```

What industry standards are associated with each of the 100G SFP-DD / DSFPs?

The table below summarizes the Arista 200G transceivers and cables and the associated industry standards.

Product Number	Associated Industry Standard
C-Z100-Z100-xM, C-Y100-Y100-xM C-Z100-Q100-xM, C-Y100-Q100-xM	IEEE 802.3 100GBASE-CR2
C-Z100-2S50-xM C-Y100-2S50-xM	IEEE 802.3 50GBASE-CR

What additional resources are available on Transceivers and Cables?

Below is a list of additional resources available on the transceivers and cables page of www.arista.com.

Document	Description
Arista Transceivers and Cables Datasheet	Detailed specifications and ordering information
Transceiver and Cable Guide	Arista EOS support, physical attributes, laser safety and fiber cleaning instructions
400G Transceivers and Cables: Q&A	400G Optics and cables FAQ
200G Transceivers and Cables: Q&A	200G Optics and cables FAQ
100G Transceivers and Cables: Q&A	100G Optics and cables FAQ
Corning 400G Cabling Guide Leviton 100G/400G Cabling Guide Siemon Cabling Guide for 100G and 400G Fiber Optics	Partner documents: Fiber cabling reference guides and loss budget guidelines from Cabling companies like Corning and Leviton