

Arista 200G Transceivers and Cables: Q&A

What are the benefits of moving to 200G technology

Arista's 200G/port systems allow datacenters and high-performance computing environments to meet growing bandwidth needs at lower cost and power per gigabit. Key benefits include:

- Increase in bandwidth density by a factor of 2 when compared to 100G/port systems.
- Easy connectivity to compute nodes and Network Interface Cards (NICs) that use 50Gb/s PAM-4 per lane. NICs are transitioning from using 10G/25G SFP to 50G SFP ports, and from 100G QSFP28 ports to 100G-2 / 200G-4 QSFP56 ports.
- Upgrade leaf-to-spine links from 100G to 200G with no change to existing fiber plant.
- Reduce the number of optical fiber links, connectors and patch panels by a factor of 2 when compared to 100G/port platforms.

What 200G Transceivers and Cables are available from Arista?

Arista's 200G connectivity solutions include optics for single mode fiber (SMF) and multimode fiber (MMF), Active Optical Cables (AOCs) and copper Direct Attach Cables (DACs). All Arista 200G optics use the QSFP form factor.

Product Number	Product Description
QSFP 200G Transceivers for parallel Multi-mode Fiber (MMF)	
QSFP-200G-SR4	Dual rate 200GBASE-SR4 / 100GBASE-SR4 QSFP200 Transceiver, up to 70m/100m over parallel OM3/OM4 multi-mode Fiber. MPO-12 (PC/UPC) optical connector.
QSFP 200G Transceivers for duplex SMF	
QSFP-200G-FR4	Dual rate 200GBASE-FR4 / 100GBASE-CWDM4 QSFP200 optical transceiver, up to 2km over duplex SMF. Duplex LC (PC/UPC) connector.
200G QSFP Active Optical Cables	
A-Q200-Q200-xM	Dual rate 200G/100G QSFP to QSFP Active Optical Cable, 1m to 30m.
200G QSFP Twinax Copper Cables	
C-Q200-Q200-xM	200GBASE-CR4 QSFP to QSFP Twinax Copper Cable, 1m to 3m.
C-Q200-2Q100-xM	200GBASE-CR4 QSFP to 2 x 100GBASE-CR2 QSFP Twinax Copper Cable, 1m to 3m
C-Q200-4S50-xM	200GBASE-CR4 QSFP to 4 x 50GBASE-CR SFP Twinax Copper Cable, 1m to 3m

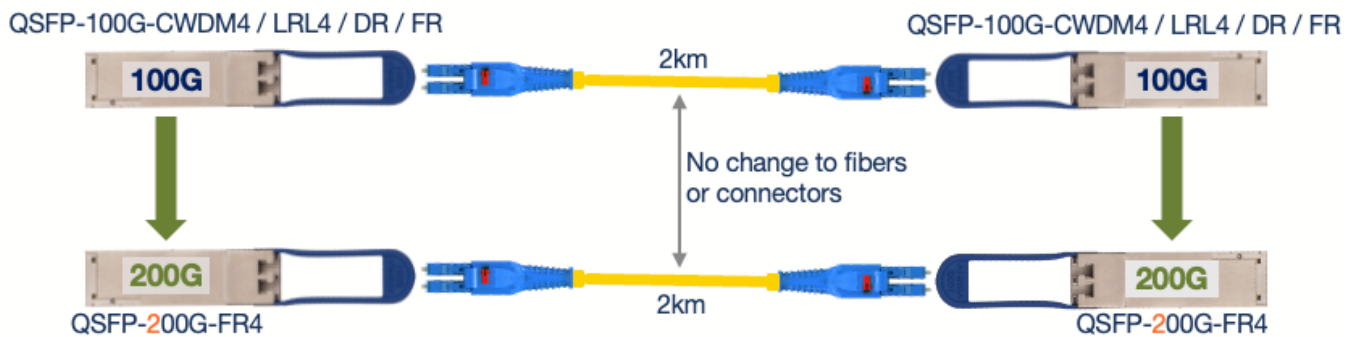
Can 100G links be upgraded to 200G links without changing optical fiber type or connectors?

Yes, if the 100G links use either of the following types of fiber, then the links can be upgraded to 200G without changing any of the underlying fiber connectivity:

- i) Duplex single mode fiber with a max length of 2km, or
- ii) Parallel multimode fiber, with a max length of 70m for OM3, or 100m for OM4 fiber.

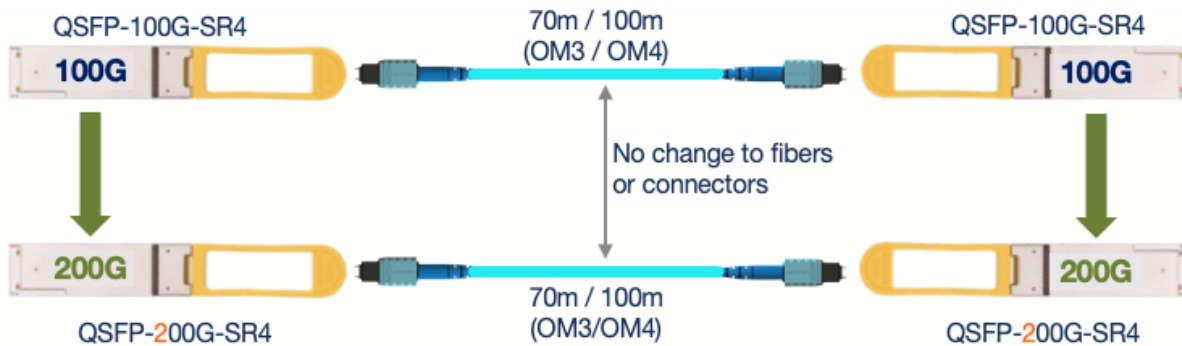
The QSFP-200G-FR4 uses the same fiber type and connectors (duplex LC UPC/PC, SMF) as all Arista 100G duplex SMF optics (such as 100G-CWDM4, 100G-LR4/LRL4, 100G-DR/FR/LR), enabling simple 100G-to-200G upgrade with no change to fiber plant or connectors, provided the fiber lengths are 2km or less. This is illustrated in the diagram below.

Upgrade 100G SMF duplex links to 200G with no change to fiber plant



The QSFP-200G-SR4 uses the same fiber type and connectors (MPO-12 UPC/PC, parallel MMF) as the 100G-SR4/XSR4, enabling simple 100G-to-200G upgrade with no change to fiber plant or connectors, provided the fiber lengths are less than 70m/100 for OM3/OM4 fiber. This is illustrated in the diagram below

Upgrade 100G parallel MMF links to 200G with no change to fiber plant

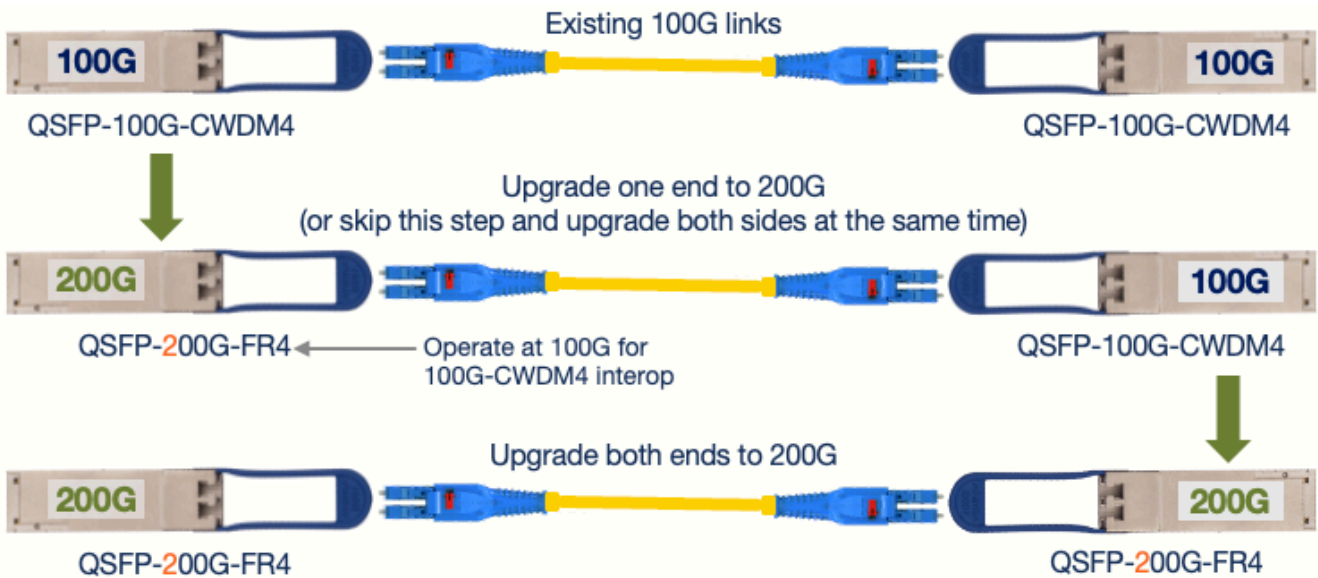


Are there any dual speed 200G/100G optics?

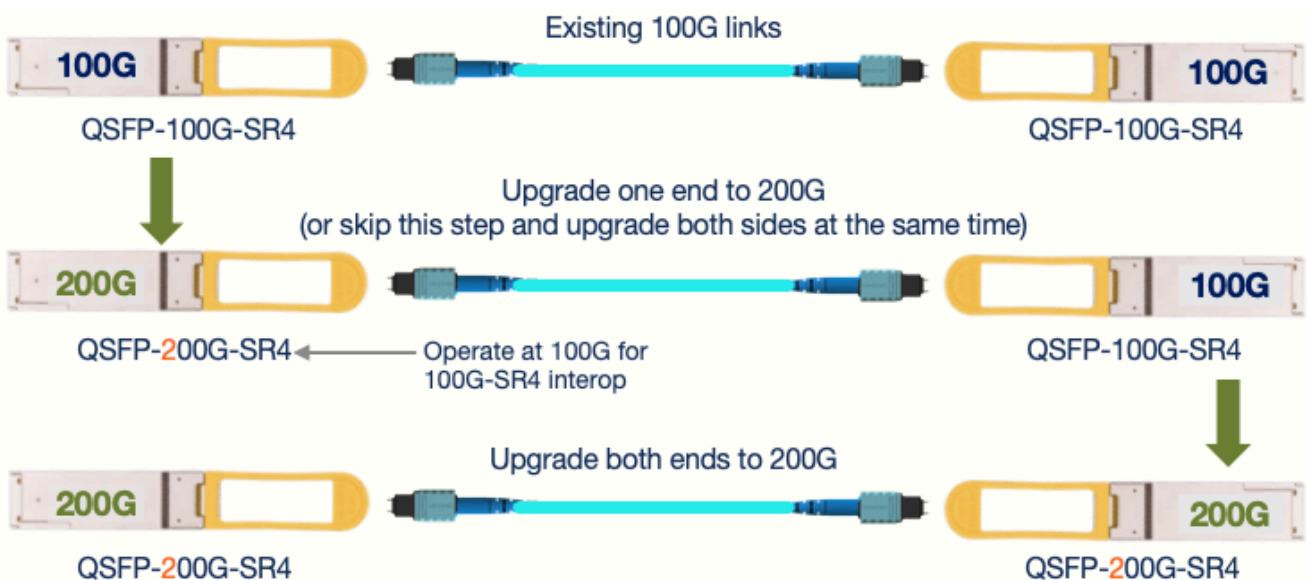
Yes. All Arista's 200G QSFP transceivers and cables are dual-rate and can operate at 100G provided that the QSFP200 switch port that contains the transceiver is configured for 100G.

In addition, when configured for 100G operation, Arista's QSFP-200G-FR4 optically interoperates with a QSFP-100G-CWDM4 transceiver, and Arista's QSFP-200G-SR4 optically interoperates with a QSFP-100G-SR4/XSR4 transceiver. This allows one layer of the network (for example, the spine layer) to be upgraded to use 200G QSFP systems and optics while continuing to interoperate with already deployed 100G optics (at the leaf layer). This is illustrated in the diagrams below

Seamless upgrade from 100G-CWDM4 to 200G-FR4



Seamless upgrade from 100G-SR4 to 200G-SR4



Are there any 200G transceivers that allow the use of standard duplex multi-mode fiber?

No. There is no industry standard for 200G over duplex MMF. For operation over MMF, Arista offers the QSFP-200G-SR4, which uses parallel multimode optical fiber using an MPO-12 optical connector – i.e. the same fiber type and fiber connector as used for 100-SR4. It is possible to use the Arista QSFP-100G-SRBD or QSFP-100G-SWDM4 in any Arista QSFP200 port for operation over duplex fiber at 100G.

Can Arista 100G QSFPs be used in Arista 200G QSFP switch ports?

Yes, Arista 100G QSFP transceivers will be detected and enabled upon insertion into Arista switches. All Arista 200G QSFP ports are capable of being configured for 100G.

Can Arista 200G QSFPs be used in Arista 100G QSFP switch ports?

No – Arista 200G QSFPs should only be used in 200G QSFP ports, or QSFP-DD ports that are configured to operate in 200G mode.

Can 200G QSFP copper cables be used for 100G connectivity?

Yes, Arista 200G QSFP copper cables can be used for 100G, but not vice versa.

Are 200G copper cables supported on all Arista switches with 200G QSFP ports?

Yes.

Which Arista 200G Transceivers and Cables can be used for optical or electrical breakout?

Optical or electrical breakouts allow one QSFP200 port to break out and connect to multiple physically separate lower speed ports.

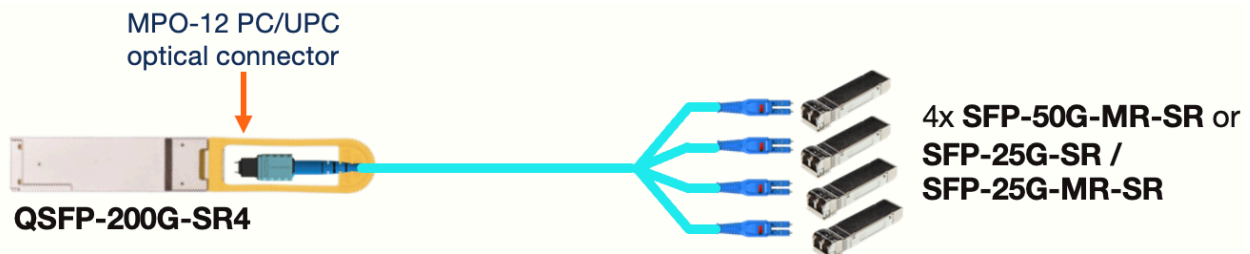
Arista 200G QSFP optics that support breakouts are summarized below.

QSFP200 Optical Breakout Options

QSFP200 SKU	QSFP200 Port Config	Fiber type	Optical Modulation	Breakout Port SKUs
QSFP-200G-SR4	4x 50G	Parallel MMF (4 fiber pairs), 100m Reach	50G PAM-4	4x 50G-SR SFPs
	4x 25G		25G NRZ	4x 25G-SR SFPs (SFP-25G-SR / SFP-25G-MR-SR)
	2x 100G-2		50G PAM-4	2x 100G-SR2 optics (This mode is less common. It can be used to breakout QSFP-200G-SR4 → 2x 100G-SR2 QSFPs or 2x 100G-SR2 SFP-DD/DSFPs)*

* Arista does not provide 100G-SR2 QSFPs, SFP-DDs or DSFPs at this time. This breakout mode may be used with third-party 100G-SR2 optics.

Optical Breakout from 200G-SR4 to 4x 50G-SR/25G-SR SFPs



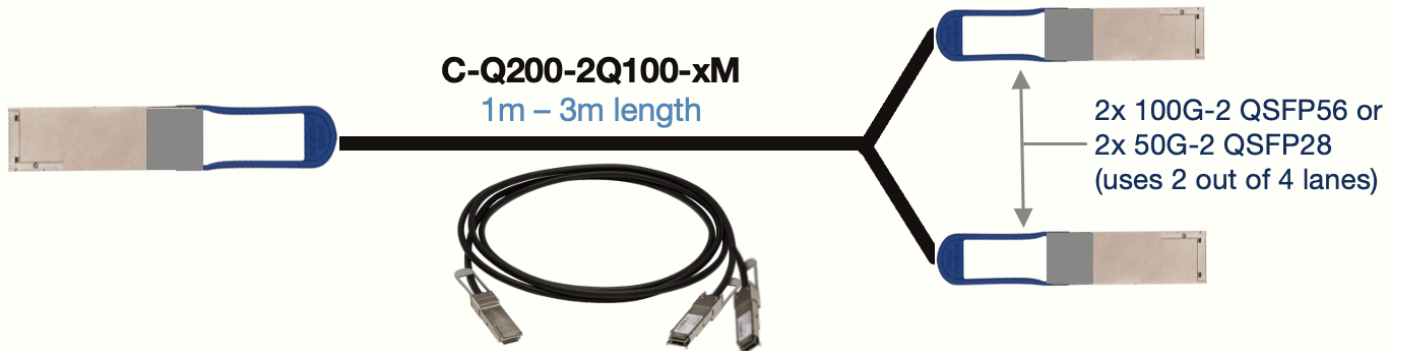
Passive Copper DAC breakout options

Near end port	Near end port config	Electrical Modulation	Remote port
C-Q200-4S50-1M C-Q200-4S50-2M C-Q200-4S50-3M	4x 50G	50G PAM-4	4x 50G SFP ports
	4x 25G	25G NRZ	4x 25G SFP ports
	4x 10G	10G NRZ	4x 10G SFP ports
C-Q200-2Q100-1M C-Q200-2Q100-2M C-Q200-2Q100-3M	2x 100G-2	50G PAM-4	2x 100G-2 QSFP ports (The 100G-2 QSFP port uses only 2 electrical lanes)
	2x 50G-2	25G NRZ	2x 50G-2 QSFP ports (The 50G-2 QSFP port uses only 2 electrical lanes)

Passive Copper DAC Breakout from 200G to 4x 50G / 10G / 25G SFP ports



Passive Copper DAC Breakout from 200G to 2x 100G-2 / 50G-2 QSFP ports



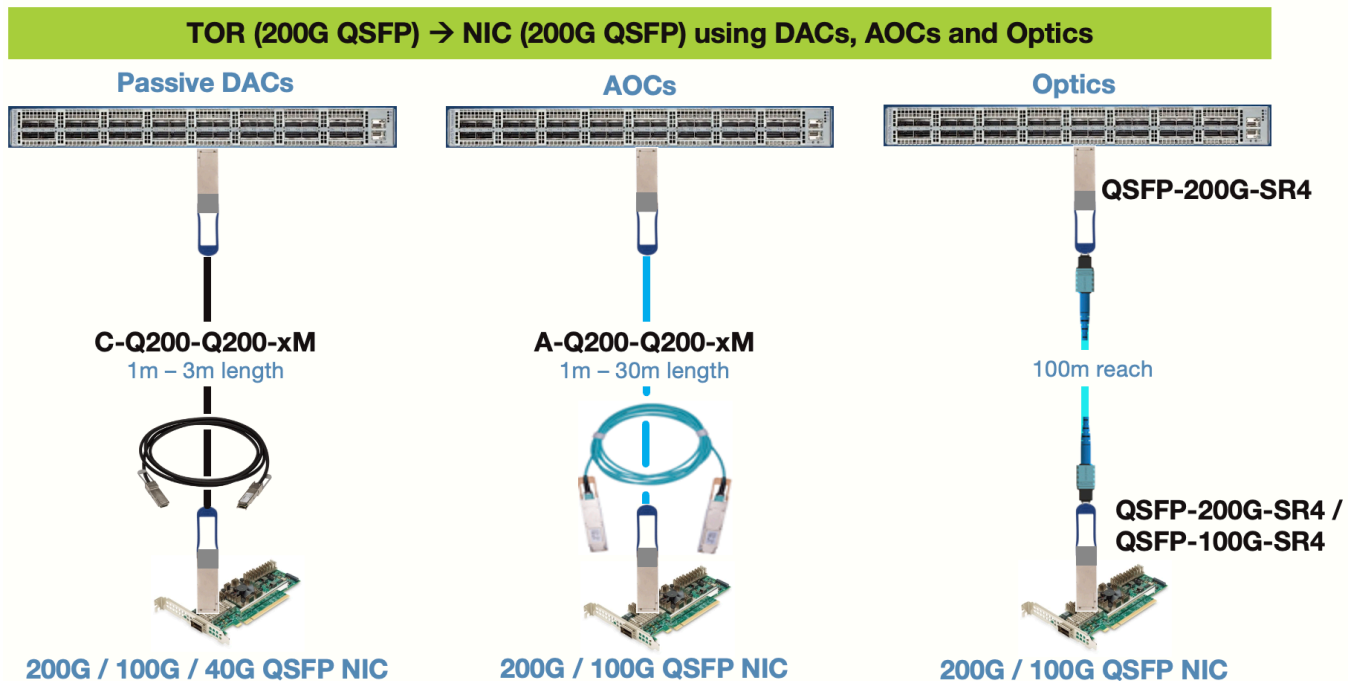
What 200G optics and cables can be used for TOR to NIC connectivity?

To achieve higher data rates, high-speed NICs are transitioning from using 25Gb/s NRZ signaling to 50Gb/s PAM-4 signaling per lane. The table and diagrams below summarize the simplest options to connect from QSFP200 TOR ports to NICs that use 50G PAM-4 serdes technology.

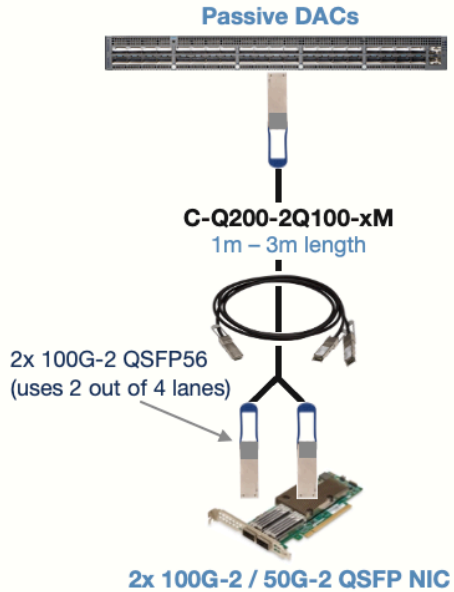
NIC Port Form Factor and Speed			Optics or cable used in the NIC port*	Optics or cable used in the QSFP200 TOR port	Comments
NIC Port type	Speed	No. of lanes and modulation			
QSFP56	200G	4 x 50G PAM-4	C-Q200-Q200-xM		Passive DAC.
			A-Q200-Q200-xM		Active Optical Cable (AOC).
			QSFP-200G-SR4	QSFP-200G-SR4	Optical MMF connectivity between TOR and NIC.
QSFP56	100G-2	2 x 50G PAM-4	C-Q200-2Q100-xM		Passive DAC breakout from one QSFP200 switch port to 2x 100G-2 QSFP NIC ports.
SFP56	50G	1x 50G PAM-4	C-Q200-4S50-xM		Passive DAC breakout to 4x 50G SFP
			50GBASE-SR SFP (SFP-50G-MR-SR)	QSFP-200G-SR4	Optical MMF breakout to 4x 50G-SR SFPs.

* Arista SKU shown. Operation of Arista optics SKUs in third party (non-Arista) equipment (such as NICs) should be tested before deployment. The NIC must be capable of supporting the power required by 200G AOCs and 200G-SR4 transceivers (up to 4.5W). The QSFP-200G-FR4 is not listed since 200G NICs may not be capable of supporting the higher power (up to 6.5W) required by the QSFP-200G-FR4.

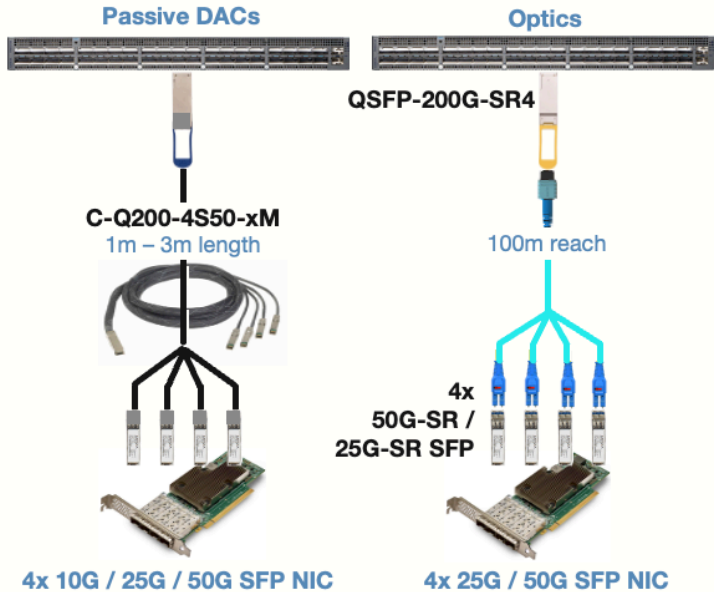
Each of the options listed in the table above are illustrated in the diagrams below.



**200G QSFP56 TOR → 100G-2 QSFP56 NICs
using 200G QSFP to 2x 100G-2 breakout DAC**



**200G QSFP56 TOR → 10G/25G/50G SFP NICs
using breakout DACs and Optics**



Note that QSFP200 ports on Arista switches can be configured at 200G (4x 50G PAM-4), 100G (4x 25G NRZ) and 40G (4x 10G) speeds.

All Arista 200G optics are dual-rate to enable backwards compatibility with NICs and optics that use 25G NRZ signaling (such as 100G QSFP28, or 25G SFP NIC ports).

All Arista 200G copper DACs are tri-rate, to ensure backwards compatibility with NICs that use 25G signaling (such as 100G QFSP28, 50G-2 QFSP28 or 25G SFP NIC ports) or 10G NRZ signaling (such as 40G QFSP+, or 10G SFP NIC ports).

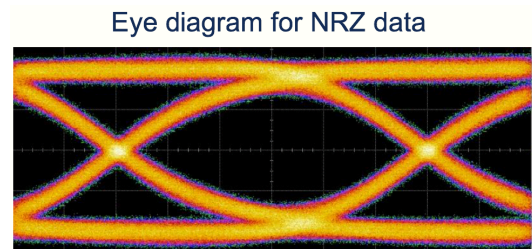
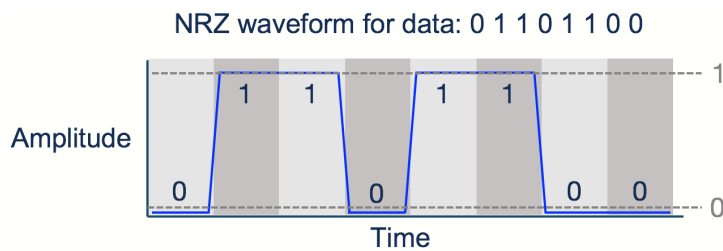
What is the difference between the terms “QSFP56”, “QSFP200” and “200G QSFP”?

They all refer to the same transceiver type. The electrical data path interface of a 200G QSFP consists of 4 lanes, with each lane carrying 50Gbit/s of data when configured for 200GE operation. Each lane of a 200G QSFP is designed to handle up to 56Gbit/s, hence it is sometimes referred to as a QSFP56. Arista refers to the 200G QSFP formfactor as a “200G QSFP” or “QSFP200”.

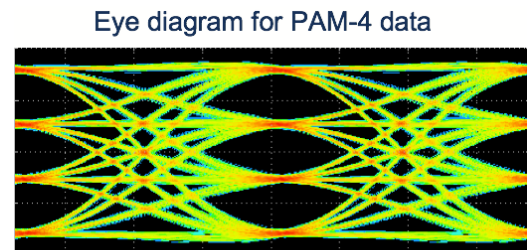
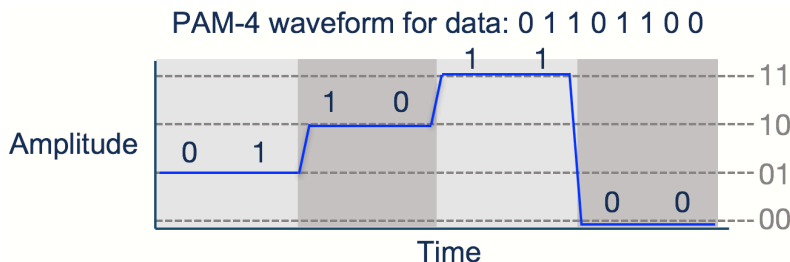
What does it mean when an electrical or optical channel is PAM-4 or NRZ?

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, 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 allowed amplitude levels (or symbols), with one amplitude level representing a digital ‘1’ and the other level representing a digital ‘0’. This is the predominant 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 symbol superimposed on each other.



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 “toggle”) rate. The diagram below shows an example of a PAM-4 waveform, along with an 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”, or “100G PAM-4” it means the signal is carrying data at a rate of 50 Gbit / second, or 100 Gbit / second, respectively, using PAM-4 modulation.

What is the speed and modulation format of the electrical interface of a 200G QSFP module?

All 200G QSFP modules utilize 4x electrical lanes in each direction (4 transmit lanes and 4 receive lanes), operating at a data rate of 50Gb/s PAM-4, enabling an aggregate bandwidth of 200Gb/s. All Arista 200G QSFPs are dual-rate, which means the electrical interface can also be configured to operate at 4x 25Gb/s NRZ, for an aggregate bandwidth of 100Gb/s.

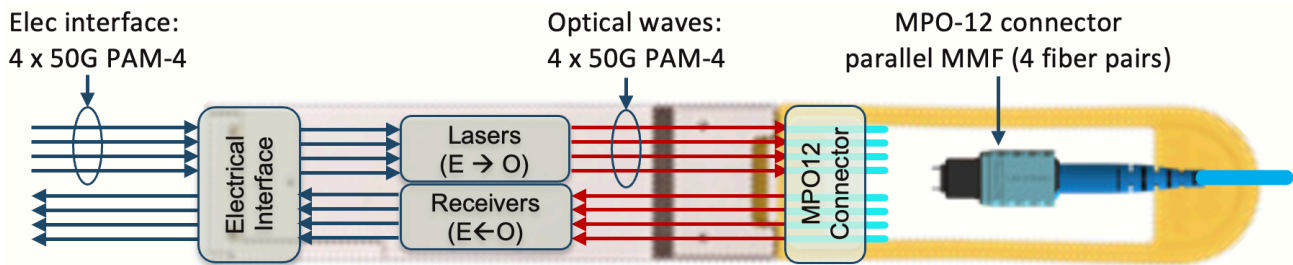
What is the reach, fiber type, connector, and optical modulation for each 200G transceiver type?

The table below summarizes the key parameters for the Arista's 200G transceivers.

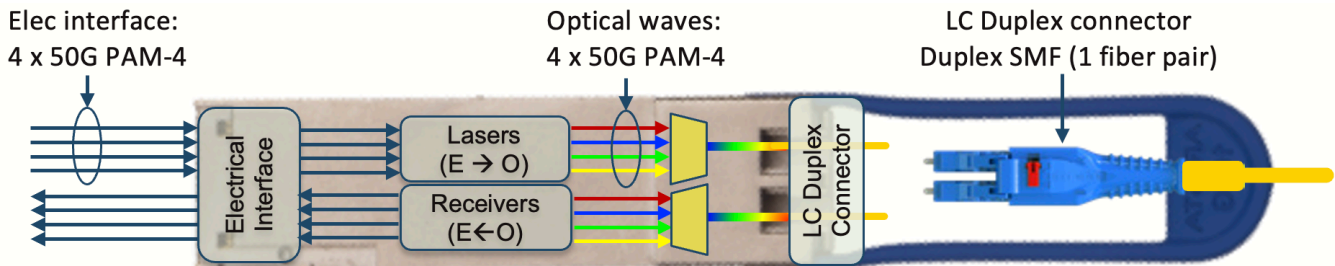
Part Number	Reach	Fiber type	Optical connector	No. of fiber pairs	Optical waves per fiber	Optical modulation
QSFP-200G-FR4	2km	Duplex SMF	Duplex LC (UPC / PC)	1	4	50G PAM-4
QSFP-200G-SR4	100m	Parallel MMF	MPO-12 Un-angled (UPC / PC)	4	1	50G PAM-4

Note that both transceivers listed above use 4x optical channels, with each channel modulated at 50Gb/s PAM-4. The 200G-SR4 uses 4 separate pairs of fiber, with a single optical wavelength per fiber (i.e., four fibers in the Tx direction, and four fibers in the Rx direction). In the case of the QSFP-200G-FR4, four different optical wavelengths are multiplexed onto one fiber (i.e. one fiber in the Tx direction, and one fiber in the Rx direction). The diagrams below illustrate the basic data path architecture of the 200G-SR4 and 200G-FR4 modules.

QSFP-200G-SR4: Data path block diagram



QSFP-200G-FR4: Data path block diagram



What do the terms 200G-4, 100G-2, 100G-4 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 higher data rates, multiple lanes are required.

For example, a 100G QSFP28 port uses 4 lanes, with each lane running at 25Gb/s – i.e., a ‘100G-4’ interface. The number before the letter ‘G’ indicates the bandwidth of the ethernet link, and the number after the ‘-’ indicates the number of data lanes required to achieve this bandwidth. A 200G QSFP56 port uses 4 lanes, with each lane running at 50Gb/s – i.e., a 200G-4 interface.

The table below summarizes the terminology used to describe common ethernet speeds, 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	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. The Arista CAB-Q-2Q-100G-xM or C-Q200-2Q100 passive breakout cables can be used to breakout a QSFP port to 2x 50G-2 QSFP ports.
100G-4	100Gb/s	4	25G NRZ	All 100G QSFP ports. All Arista 200G QSFP ports can also be configured to operate at 100G-4.
100G-2	100Gb/s	2	50G PAM-4	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. Only 2 electrical lanes (out of the 4 electrical lanes) are used. The C-Q200-2Q100 passive breakout cables can be used to breakout a 200G QSFP port to 2x 100G-2 QSFP ports.
200G-4	200Gb/s	4	50G PAM-4	All 200G QSFP ports. 200G-4 QSFP ports can be found on switch/routers and high-speed NICs.

What are the complete set of ethernet speeds that each 200G optical transceiver supports?

Because Arista's 200G QSFP optics are dual-rate, and capable of breakouts, each 200G optic or cable can support several different operating modes. The tables below summarize the supported modes of operation of all Arista's QSFP200 optics and AOCs. The column labels "Lane 1", Lane "2", ... "Lane 4" represent the 4 lane electrical interface at the QSFP200 port. The values in the "Lane" columns refer to the speed configuration of the QSFP200 switch port, while the text in parenthesis indicates the corresponding optical standard.

QSFP-200G-SR4 supported modes				
QSFP200 Logical port configuration (and corresponding optical interface)				Common applications
Lane 1	Lane 2	Lane 3	Lane 4	
200G-4 (200G-SR4)				QSFP-200G-SR4 → QSFP-200G-SR4 over parallel MMF
100G-4 (100G-SR4)				QSFP-200G-SR4 (operated at ½ speed) → 100G-SR4 QSFP over parallel MMF. Useful for interop with 100G-SR4 installed base.
100G-2 (100G-SR2)		100G-2 (100G-SR2)		QSFP-200G-SR4 → QSFP-200G-SR4 over parallel MMF, configured as two 100G-2 logical interfaces. Less common: Optical breakout from QSFP-200G-SR4 → 2x 100-SR2 QSFPs or 2x 100G-SR2 SFP-DD/DSFPs.
50G (50G-SR)	50G (50G-SR)	50G (50G-SR)	50G (50G-SR)	Optical breakout from QSFP-200G-SR4 → 4x 50G-SR SFP. Can be used with NICs using 50G SFP ports.
25G (25G-SR)	25G (25G-SR)	25G (25G-SR)	25G (25G-SR)	Optical breakout from QSFP-200G-SR4 (operated at ½ speed) → 4x 25G-SR SFP. Useful for interop with 25G-SR installed base.

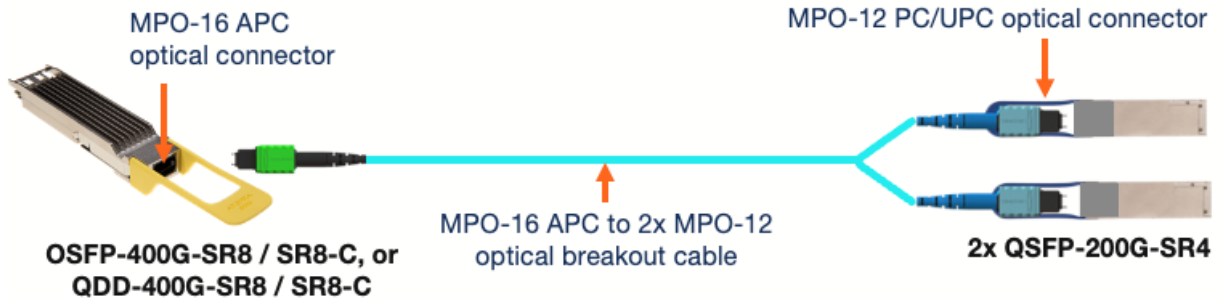
QSFP-200G-FR4 supported modes				
QSFP200 Logical port configuration (and corresponding optical interface)				Common applications
Lane 1	Lane 2	Lane 3	Lane 4	
200G-4 (200G-FR4)				QSFP-200G-FR4 → QSFP-200G-FR4 over duplex SMF
100G-4 (100G-CWDM4)				QSFP-200G-FR4 (operated at ½ speed) → 100G-CWDM4 QSFP over duplex SMF. Interops with 100G-CWDM4 installed base.

A-Q200-Q200-xM supported modes				
QSFP200 Logical port configuration				Common applications
Lane 1	Lane 2	Lane 3	Lane 4	
Same as QSFP-200G-SR4 (each QSFP200 port may be configured as 200G-4, 100G-4, 2x 100G-2, 4x 50G or 4x 25G), except there is no exposed optical interface with an AOC.				Point to Point QSFP200 to QSFP200 links.

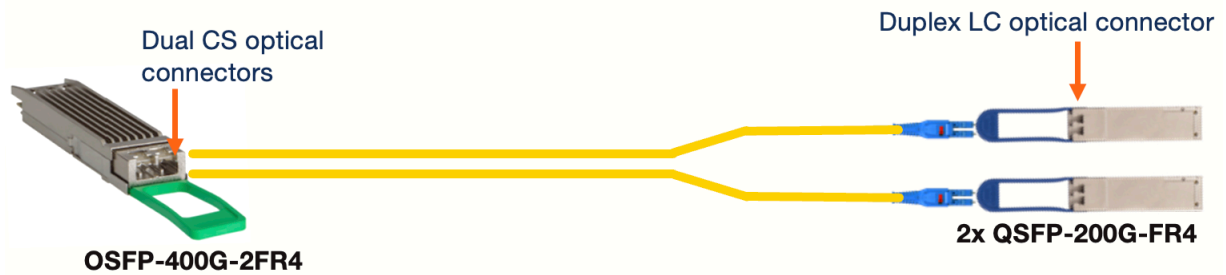
Can a 400G OSFP or QSFP-DD port be broken out into 2x 200G QSFP ports? What type of optics and cables support this breakout?

Yes – the optics and cables that can be used to achieve this is summarized below:

- i) Breakout to 2x 200G over MMF: OSFP(QDD)-400G-SR8 / SR8-C → 2x QSFP-200G-SR4



- ii) Breakout to 2x 200G over SMF: OSFP-400G-2FR4 → 2x QSFP-200G-FR4



- iii) Copper breakout to 2x 200G: CAB-O-2Q-400G-xM or CAB-D-2Q-400G-xM



What are the CLI commands to configure a 200G port for different speeds & logical interfaces?

For 200G-4 operation:

```
switch(config)#interface Ethernet1/1
switch(config-if-Et1/1)#speed 200g-4
```

For 1x 100G-2 operation:

```
switch(config)#interface Ethernet1/1,1/3
switch(config-if-Et1/1,1/3)#speed 100g-2
```

For 1x 100G-4 operation:

```
switch(config)#interface Ethernet1/1
switch(config-if-Et1/1)#speed 100g-4
```

For 4x 50G-1 operation

```
switch(config)#interface Ethernet1/1-4
switch(config-if-Et1/1-4)#speed 50g-1
```

For 4x 25G operation

```
switch(config)#interface Ethernet1/1-4
switch(config-if-Et1/1-4)#speed 25g
```

What is the maximum power consumption of 200G QSFP transceivers?

The table below summarizes the power consumption of Arista 200G QSFP transceivers.

Product Number	Max Power Consumption
A-Q200-Q200-xM	4.5W (for each cable end)
QSFP-200G-SR4	4.5W
QSFP-200G-FR4	6.5W

Are Arista 200G Transceivers interoperable with other 200G transceivers in the industry?

Yes, if the non-Arista 200G transceivers meet the associated industry standard specifications, Arista 200G transceivers provide full optical interoperability.

What industry standards are associated with each of the 200G Transceivers and Cables?

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

Product Number	Associated Industry Standard
QSFP-200G-SR4	IEEE 802.3 200GBASE-SR4 (originally defined in 802.3cd)
QSFP-200G-FR4	IEEE 802.3 200GBASE-FR4 (originally defined in 802.3bs)
A-Q200-Q200-xM	Pre-terminated cables, so there is no exposed optical interface. The electrical interface of Arista's 200G AOC cables are compliant with 50GAUI-4, as defined in IEEE802.3
C-Q200-Q200-xM	IEEE 802.3 200GBASE-CR4

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