LinkX User Guide for 400G and 200G using 50G-PAM4 and 100G using 25G-NRZ Modulation Cables and Transceivers

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NVIDIA LinkX QSFP-based Cables and Transceiver Portfolio

LinkX 400GbE Cables and Transceivers Portfolio

This document profiles 400Gb/s QSFP-DD-based cables and transceivers for Ethernet only from 0.5-meters to 10km

The LinkX® 400GbE QSFP-DD portfolio consists of straight and splitter DACs, an AOC cable and five transceivers with reaches from 1-to 10k-meters. QSFP-DD cables and transceivers support only Ethernet.

NVIDIA 400GbE QSFP-DD product line:

- DAC cables have 1:2 and 1:4 split configuration with maximum reach of 2.5-meters
- AOC have only QSFP-DD-to-QSFP-DD AOC and no splitters.
- 400GbE SR8 multimode transceiver can be split to 2x 200G QSFP56 and to 2x 100G
  - Use 3rd party MPO-16/APC-to-2x MPO-12/UPC fiber cables – not offered by NVIDIA.
  - Note, the 400GbE SR8 uses a 16-fiber MPO-16/APC optical connector
- 400GbE DR4 can be split to 4x 100G DR1 using 3rd party supplied splitter fiber cables.
  - MPO-12/APC-to-4x LC Duplex
  - DR1 is 1x100G-PAM4 optical to 4x25G-NRZ
- 400G FR4 and LR4 are optically multiplexed and cannot be split and used for long, leaf-spin and spine-super spine links.

LinkX 400GbE Ethernet QSFP-DD Cables and Transceiver Portfolio

400GBE ETHERNET QSFP-DD (50G-PAM4)

SN5400
400GbE Spine/Super Spine Ethernet Switch
64 400GbE QSFP-DD cages
Spectrum-4

SN4700
400GbE Spine/ToR Ethernet Switch
32 QSFP-DD cages
Spectrum-3

8x50G-PAM4

Direct Attach Copper (DAC)

Active Optical Cables (AOCs)
400GbE
C-DQ8FNMxxx-H0-M

400GbE SR8
QSFP-DD 100m
T-DQ8FNS-N00-M

400GbE DR4
QSFP-DD 500m
MMS1V00-WM

400GbE FR4
QSFP-DD 2km
MMS1V50-WM

400GbE LR4
QSFP-DD 10km
MMS1V90-WR

400GbE
MCP1660-W0xxExx

400GbE-to-2x200GbE
MCP7H60-W0xxRxx

400GbE-to-4x100GbE
MCP7F60-W0xxRxx

Switch-to-Switch or
ConnectX-6 and/or
BlueField-2 DPUs

MPO-16/APC

MPO-12/APC

Duplex LC/UPC
2-fiber
Optical Connector

SN5400
400GbE Spine/Super Spine Ethernet Switch

SN4700
400GbE Spine/ToR Ethernet Switch

8x50G-PAM4

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LinkX 200GbE and InfiniBand HDR Cables and Transceiver Portfolio

The LinkX 200GbE and InfiniBand HDR QSFP56 portfolio consists of straight and 1:2 splitter DACs and AOC cables, two transceivers with reaches from 1-to 2k-meters. Some of the parts are either InfiniBand or Ethernet specific with different part numbers, or sometimes a single part number supports both InfiniBand and Ethernet.

- 200GbE and HDR portfolios are very similar, except the InfiniBand DACs are maximum reach of 2-meters.
- 200G straight DAC and 200G SR4 multimode transceivers are InfiniBand part number specific and require more stringent BER testing.
- InfiniBand cables and transceivers can be used in NVIDA Spectrum™ Ethernet switches in NVIDIA end-to-end configurations.
  InfiniBand testing is more stringent than Ethernet. However, Ethernet cables and transceivers cannot be used in InfiniBand systems.
- 200GbE and HDR SR4 transceivers can be split into 2x 100G creating 2x50G-PAM4 QSFP56 100GbE or HDR100 ends.
  - Use 3rd party MPO-12/UPC-to-MPO-12/UPC fiber cables –- not offered by NVIDIA.
- 200G FR4 is optically multiplexed and cannot be split and used for long, leaf-spin and spine-super spine links.
- 200G FR4 can be used in ConnectX®-6 adapters under specific air flow conditions in servers; check the *NVIDIA ConnectX-6 User Manual*.
- 200GbE and HDR use 4x50G PAM4 = 200G.
- HDR100 and 100GbE based on 2x50G PAM4 is 100G and not compatible with 100GbE based on 4x25G-NRZ.

LinkX 200GbE Ethernet & HDR InfiniBand QSFP56 Cables and Transceiver Portfolio

200GBE & HDR INFINIBAND QSFP56 (50G-PAM4)

Quantum InfiniBand HDR QM8700
Spectrum Ethernet SN3000 series

32 cages QSFP56
200Gb/s

4x50G-PAM4

200G QSFP56-to-200G QSFP56

MCP1650-H0xxExx IB only
MCP1650-H0xxExx EN only

4x50G-PAM4

MFS1S00-HxxxV

IB+ EN

200G QSFP56-to-2x 100G QSFP56

MCP7H50-H0xxRxx IB + EN

4x50G-PAM4   2x50G-PAM4

MFS1S50-H0xxV IB+ EN

200G QSFP56-to-4x 50G SFP56

MCP7H70-V0xxRxx EN only

4x50G-PAM4

200GbE SR4 HDR
850nm Multi-mode 100-meters
QSFP56

MMA1T00-HS IB-only
MMA1T00-VS EN only

Fibers not supplied by NVIDIA

MPO-12/UPC
8-fiber
Optical Connector

200GbE FR4 HDR
1310nm Single-mode 2km
QSFP56

MMS1W50-HM IB+ EN

Duplex LC/UPC
2-fiber
Optical Connector

ConnectX-6   BlueField-2   Quantum InfiniBand HDR QM8700
Spectrum Ethernet SN3000 series

32 cages QSFP56
200Gb/s

4x50G-PAM4

NVIDIA Spectrum 400G, 200G, 100GbE Ethernet Switch Portfolio

There are many different switch port configurations in the Spectrum Ethernet switch product line using various combination of QSFP-DD, QSFP56, QSFP28 and SFP28. The DACs, AOCs and multimode transceiver are generally used in switch-to server links and multimode for longer links beyond 2.5-meter DAC maximum reach.

The NVIDIA Spectrum, Spectrum-2, Spectrum-3, and Spectrum-4 are successive switch IC generations dating back to 2015 with the Spectrum-4 being the latest offering. The Spectrum-4 is also offered as the SN5600 in twin-port OSFP 800G 64-port configuration based on 100G-PAM4 modulation.
The Spectrum Ethernet switches are protocol specific and do not support InfiniBand.

NVIDIA Spectrum Ethernet Switch Portfolio

SN2000 Series Spectrum QSFP28 & SFP28	SN3000 Series Spectrum-2 QSFP56, QSFP28 & SFP28	SN4000 Series Spectrum-3 QSFP-DD,QSFP56 & SFP28	SN5000 Series Spectrum-4 QSFP-DD, QSFP56

The 400GbE QSFP-DD cables and transceivers line is for the NVIDIA SN5400, SN4700, SN4410 Ethernet switches only and not used for InfiniBand. The QSFP-DD cages are backwards compatible and accept all QSFP-based cables and transceivers, both 50G-PAM4 and 25G-NRZ line rates and 25, 40, 100, 200, and 400G aggregate data rates. Similarly, the 200GbE QSFP56 cages are backwards compatible to QSFP28.

• 400GbE • 200GbE • 100GbE	QSFP-DD QSFP56 QSFP28	8x50G-PAM4 4x50G-PAM4 4x25G-NRZ

NVIDIA Quantum HDR 200G InfiniBand Switch Portfolio

The 200G HDR is offered in 32-ports of 200G HDR in QSFP56 cages.

- QSFP56 cages accept 100G EDR cables and transceivers
- HDR was the first InfiniBand products to offer 1:2 splitter DACs and AOCs

The HDR cables and transceivers product line overlaps the 200GbE Ethernet portfolio with a few InfiniBand-only exceptions for a DAC and SR4 transceiver. InfiniBand has a much lower bit error ratio (BER) requirement to minimize the use of forward error correction which induces significant latency.

NVIDIA Quantum HDR InfiniBand Switch Portfolio
NVIDIA Quantum QM8700 Switch
32 cages QSFP56 200Gb/s

NVIDIA ConnectX Network Adapter Portfolio

The ConnectX line coverts PCIe bus signals to Ethernet or InfiniBand protocols. The ConnectX portfolio consists of three generation of adapter ICs.
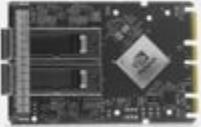
• 400GbE/NDR • 200GbE/HDR • 100GbE/EDR	ConnectX-7 ConnectX-6 ConnectX-5	QSFP112 QSFP56 QSFP28	OSFP SFP56 SFP28

- ConnectX-7 is offered in 4x100G-PAM4 OSFP and QSFP112.
- ConnectX-7 and most ConnectX-6 products support both Ethernet and InfiniBand.
- SFP56 and OCP cards are Ethernet specific.
- As with the switch port cages, the ConnectX-7 QSFP112 is backwards compatible to the slower QSFP56, QSFP28, etc. Similarly, for the QSFP56 based ConnectX-6 and QSFP28.
- ConnectX line is not offered with QSFP-DD cages.

NVIDIA ConnectX-7 Network Adapter Portfolio

CONNECTX-7 PORTFOLIO

Comprehensive portfolio to support entry level & premium boards

4P X SFP56 - HHHL / FHHL	2P X QSFP112 - HHHL	2P X QSFP112 - OCP3.0
25G/50G - W/ & W/O SYNCE/GNSS	200G - PAM4 56 & PAM4 112	200G - PAM4 56 & PAM4 112

1P X OSFP - HHHL	1P X OSFP - OCP3.0
400G - PAM4 112	400G - PAM4 112
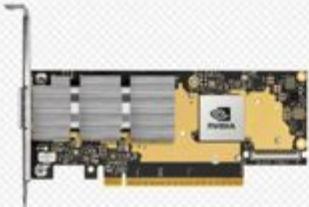
NVIDIA BlueField-3 DPU Portfolio

BlueField DPUs contain an ARM® CPU, memory, accelerators, PCIe switch and ConnectX-6 or ConnectX-7 adapters.

- BlueField-2 DPUs are offered in 200G QSFP56 for InfiniBand and Ethernet
- BlueField-3 DPUs are offered in 200G and 400G QSFP112 for InfiniBand and Ethernet
- Not offered with OSFP or QSFP-DDs
- QSFP112 cages accept 200G QSFP56 and 100G QSFP28

NVIDIA BlueField-3 DPU Portfolio 200G & 400G, InfiniBand and Ethernet QSFP112

Single QSFP112	Dual QSFP112

Where to Find More LinkX Documentation

This user guide is to be used in conjunction with other documents located in folders in docs.nvidia.com/networking/ > Interconnect.
This site is where the following LinkX cables and transceivers documents are provided.

LinkX Overview Documents:	Review of parts, important notes, and configuration details for linking to NVIDIA switches and adapters • LinkX Cables and Transceivers Guide to Key Technologies • LinkX User Guide for 400Gb/s 100G-PAM4 OSFP & QSFP112-based Cables and Transceivers • LinkX User Guide for 400Gb/s and 200Gb/s using 50G-PAM4 and 100Gb/s using 25G-NRZ Modulation Cables and Transceivers (this document)
Configuration Maps:	Picture and part number-based PowerPoint® slides for every configuration with NVIDIA switches, network adapters, and DGX GPU systems for 100G-PAM4, 50G-PAM4, 25G-NRZ cables and transceivers • Configuration Maps
Parts Lists:	Tables summarize by speed, form factor, connector, power, reach, etc. and hyperlinks to individual products specs • 400Gb/s (100G-PAM4) Transceivers and Fiber Parts List • 400Gb/s and 200Gb/s (50G-PAM4) and 100Gb/s (25GNRZ) Cables and Transceivers Parts List using QSFP-DD, QSFP56, QSFP28, SFP28
Product Specifications:	10-to-16-page detailed hardware datasheets with physical, thermal, electrical, and optical specifications for each product • docs.nvidia.com/networking/ > Interconnect > *select speed and type*
Additional Docs:	• NVIDIA Cable Management Guidelines and FAQ

Document Revision History

Version	Date	Changes
1.0	August 2023	Initial release

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