Wave2Wave.io

CMIS TRANSCEIVER PROGRAMMING & BREAKOUT CONFIGURATION

REFERENCE GUIDE

100G | 200G | 400G | 800G | 1.6T

OSFP · QSFP-DD · QSFP112 · QSFP56 · QSFP28

Ethernet & InfiniBand · SMF / MMF / DAC / AOC / AEC

Wave2Wave.io

Version 1.0 | February 2026

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1 Introduction

1.1 Purpose and Scope

Comprehensive technical reference for breakout configurations, CMIS application settings, and deployment scenarios for all CMIS-based transceivers and cables.

This guide provides deployment configurations for all CMIS-based high-speed optical transceivers and cables. It covers:

- **Transceivers:** OSFP (800G, 1.6T emerging), QSFP-DD (400G/800G), QSFP112 (400G), QSFP56 (200G), QSFP28 (100G)
- **Cables:** AOC (Active Optical), DAC (Direct Attach/Passive Copper), AEC (Active Electrical Copper), ACC (Active Copper)
- **Protocols:** Ethernet and InfiniBand

1.2 How to Read This Guide

Each product section includes: 1. **Physical characteristics** — Form factor, connector type, typical lengths 2. **Use cases** — Deployment scenarios where this configuration is appropriate 3. **CMIS settings tables** — Separate tables for Ethernet and InfiniBand protocols 4. **Breakout options** — Available logical configurations with corresponding hex codes

1.3 Terminology

Term	Definition
CMIS	Common Management Interface Specification — OIF-CMIS-05.2 (April 2022)
Host Code	Electrical interface code for switch-side SerDes
Media Code	Optical/copper interface code for fiber/cable side
Lane Count	`Host:Media lane mapping (e.g., 0x88 = 8 host lanes : 8 media lanes)`
Lane Assignment	How lanes are grouped for breakout configurations
APSEL	Application Select — which application descriptor to activate
Breakout	Splitting a high-speed port into multiple lower-speed ports
SFF-8024	SFF-8024 Rev 4.13 (July 2025) — Transceiver identifier and interface code tables
OIF-CMIS	OIF-CMIS-05.2 (April 2022) — Common Management Interface Specification

1.4 DR vs FR Module Types

Source: SFF-8024 Rev 4.13 (July 2025), Tables 4-6 and 4-7

Understanding the optical type is essential for matching modules to deployment requirements.

Type	Full Name	Reach	Fiber Count	Wavelength	Media Code Examples
DR	Direct Detect	500m	Parallel (8 or 16 fibers)	1310nm	`DR8=0x56, DR4=0x1C`
DR-2	Direct Detect Extended	2,000m	Parallel (8 or 16 fibers)	1310nm	`DR8-2=0x57, DR4-2=0x55`
FR	Far Reach (WDM)	2,000m	2 fibers (wavelength mux)	CWDM	`FR4=0x1D, 0x7A`
LR	Long Reach (WDM)	10,000m	2 fibers (wavelength mux)	CWDM	`LR4=0x7B, 0x19`
SR	Short Reach (MMF)	100m	Parallel multimode	850nm	`SR8=0x12, SR4=0x11`

When to use each:

Module Type	Best For	NOT For
DR	Intra-building connections, same data hall, most data center deployments	Cross-campus, building-to-building
DR-2	Extended intra-campus (up to 2km), campus backbone	Short-reach where standard DR suffices
FR	Building-to-building, metro connections, where fiber count is limited	Short-reach where parallel fiber is cheaper
LR	Campus-to-campus, metro links up to 10km, long-haul data center interconnect	Intra-building where DR/FR suffice
SR	Short-reach MMF installations, existing OM3/OM4 infrastructure	New installations (SMF preferred for future-proofing)

1.5 Ethernet vs InfiniBand Host Codes

Source: SFF-8024 Rev 4.13 (July 2025), Table 4-5

The host electrical interface code tells the switch ASIC which protocol stack to use. **Using the wrong host code will cause the module to fail initialization.**

Protocol	800G Host Code	400G Host Code	200G Host Code	100G Host Code
Ethernet	`0x52 (800GAUI-8-L)`	`0x50 (400GAUI-4-L)`	`0x4E (200GAUI-2-L)`	`0x4C (100GAUI-1-L)`
InfiniBand NDR	`0x32 (IB NDR)`	`0x32 (IB NDR)`	—	—
InfiniBand HDR	—	—	`0x31 (IB HDR)`	—
InfiniBand EDR	—	—	—	`0x30 (IB EDR)`

CRITICAL NOTES:

1. **InfiniBand NDR uses the SAME host code (0x32) for both 800G and 400G.** The lane count byte (0x88 vs 0x44) determines whether it runs as 8-lane (800G) or 4-lane (400G).
2. **Media codes are SHARED between Ethernet and InfiniBand.** The optics don't care about the protocol — a DR8 module uses media code 0x56 regardless of whether it's configured for Ethernet or InfiniBand.
3. **Module compatibility is determined by host code.** An InfiniBand module (host code 0x32) will NOT work in an Ethernet switch. Always confirm the customer's network protocol before ordering.

Common Deployments:

Platform	Protocol	Host Code	Example Use Case
Arista, Cisco, Juniper	Ethernet	`0x52, 0x50, etc.`	Data center spine, leaf
NVIDIA GB300	InfiniBand NDR	`0x32`	AI/ML GPU compute
NVIDIA DGX H100	InfiniBand HDR	`0x31`	HPC compute

1.6 Power Classes by Form Factor

Source: OIF-CMIS-05.2 (April 2022), Section 6.2

> **Quick Context:** Every module draws power from the switch port cage. Higher-speed and longer-reach modules draw more power. The switch must supply enough power for the module's advertised class, or the module will not initialize.

Form Factor	Max Power Class	Typical Range	Power Register
OSFP	Class 8 (up to 24W)	14-20W	`Page 0x00, Byte 0xC8`
QSFP-DD	Class 7 (up to 14W)	8-14W	`Page 0x00, Byte 0xC8`
QSFP112	Class 6 (up to 12W)	8-12W	`Page 0x00, Byte 0xC8`
QSFP56	Class 4 (up to 7W)	3.5-7W	SFF-8636
QSFP28	Class 5 (up to 5W)	2-5W	SFF-8636

Breakout Mode Power Impact: - Straight mode (1x800G): Module runs at base power - Split mode (2x400G): Similar or slightly higher — more DSP processing - Full breakout (8x100G): May draw peak power — all 8 independent datapaths active

Cable Power:

Cable Type	Power Draw	Notes
DAC (passive)	0W from cable	No active electronics
AOC	1-3W per end	Laser drivers + receivers
AEC/ACC	0.5-2W per end	Re-timers/re-drivers

CRITICAL: Confirm the switch port cage supports the module's power class. An OSFP rated at 20W in a cage that supplies only 12W will fail to initialize or throttle performance.

1.7 Firmware and Breakout Availability (IMPORTANT)

> **Quick Context:** Just because a form factor CAN support 8-way breakout doesn't mean every module from every vendor DOES. The Application Descriptors in the module's EEPROM (Page 0x00, bytes 0x56-0x75) list exactly what that specific module supports. Always read the module before assuming a breakout is available.

What determines breakout support:

Factor	Impact
Module firmware version	Newer firmware may add breakout modes
Vendor implementation	Some vendors only program APP 1 and APP 2
Optical design	FR4 (WDM) modules generally cannot breakout — 4 wavelengths are inseparable
DSP capability	4x200G and 8x100G require per-lane DSP — not all DSPs support this

How to verify what a specific module supports:

1. Read Application Descriptors (Page 0x00, bytes 0x56-0x75)
2. Count how many APPs have non-zero values
3. Each non-zero APP is a supported configuration
4. APP slots with all-zero bytes = not supported

Common patterns:

Module Type	Typical APPs Supported	Breakout Limitation
OSFP 800G DR8	APP 1-4 (800G, 2x400G, 4x200G, 8x100G)	Full breakout available
OSFP 800G 2xDR4	APP 1 typical (2x400G native); APP 2-3 possible	Vendor-dependent — each 400G engine MAY support 2x200G or 4x100G if DSP allows (read APPs to confirm)
OSFP 800G 2xFR4	APP 1 only (2x400G native)	No breakout — WDM engines
OSFP 800G FR4	APP 1 only (800G)	No breakout — WDM cannot be split
OSFP 800G LR4	APP 1 only (800G)	No breakout — WDM, 200G/lane host

Module Type	Typical APPs Supported	Breakout Limitation
OSFP 800G DR8-2	APP 1-4 (same as DR8)	Full breakout, extended reach
OSFP 800G SR8	APP 1-2 typical (800G, 2x400G); APP 3-4 possible	Vendor-dependent — 8 independent MMF lanes CAN support 4x200G and 8x100G if DSP allows
QSFP-DD 400G DR4	APP 1-3 (400G, 2x200G, 4x100G)	Full breakout
QSFP-DD 400G FR4	APP 1 only (400G)	No breakout — WDM
QSFP-DD 400G LR4-6	APP 1 only (400G)	No breakout — WDM
QSFP112 400G	APP 1 only (400G)	No breakout — 4 lanes only

2 Deployment Configuration Questionnaire

Quick Context: Before ordering or programming any module, gather these answers. Each question maps to a specific register value or physical constraint. Missing any answer risks ordering the wrong product or misconfiguring the module.

2.1 Switch and Port Questions

These determine physical compatibility and power budget.

#	Question	Why It Matters	Maps To
1	What is the switch make, model, and OS version?	Determines CMIS revision support	`Byte 0x01`
2	What port cage form factor? (OSFP, QSFP-DD, QSFP28)	Module must physically fit	`Byte 0x00`
3	What is the port cage power budget (watts)?	Module power class must not exceed cage supply	`Byte 0xC8`
4	What CMIS revision does the switch support? (3.x, 4.x, 5.0, 5.1, 5.2)	Module revision must match or be compatible	`Byte 0x01`
5	Does the switch NOS support the desired breakout mode?	NOS may not support all CMIS breakout options	APSEL config

2.2 Protocol and Speed Questions

These determine host electrical interface code.

#	Question	Why It Matters	Maps To
6	Ethernet or InfiniBand?	`Determines host code family (0x4x-0x5x vs 0x3x)`	APP Byte 0
7	If InfiniBand, what generation? (EDR, HDR, NDR)	Determines specific host code	APP Byte 0
8	What is the target line rate per port? (100G, 200G, 400G, 800G)	Determines APP selection	APP + Lane Count
9	Is breakout required? If yes, how many ports at what speed?	Determines lane assignment	APP Byte 3

2.3 Fiber and Reach Questions

These determine media interface code and connector.

#	Question	Why It Matters	Maps To
10	What is the distance between endpoints?	Selects DR (≤500m), FR (≤2km), SR (≤100m)	APP Byte 1
11	Single-mode (SMF) or multimode (MMF) fiber plant?	Determines media code table (4-7 vs 4-6)	APP Byte 1
12	What connector is on the patch panel? (MPO-16, MPO-12, LC)	Must match module connector	Physical
13	Is fiber count a constraint?	FR4 uses 2 fibers; DR8 uses 16	Physical

2.4 Cable-Specific Questions (AOC/DAC/AEC)

#	Question	Why It Matters	Maps To
14	What cable length is needed?	Determines cable type (DAC ≤2m, AEC ≤7m, AOC ≤100m)	Physical
15	Is latency critical?	DAC < AEC < AOC (copper wins for latency)	Cable type
16	What form factor on each end? (OSFP↔OSFP, OSFP↔QSFP-DD, etc.)	Determines physical cable and breakout	Physical

2.5 Mixed-Speed / Interop Questions

#	Question	Why It Matters	Maps To
17	Are both ends the same speed?	If not, one end must be in breakout mode	APSEL on each end
18	Are both ends the same form factor?	Different cages may need breakout cable	Physical cable
19	Are both ends the same protocol? (Ethernet↔Ethernet only)	Ethernet and InfiniBand cannot interoperate	Host code
20	If one end is breakout, what are the per-port speeds?	Each breakout port needs its own APSEL	APSEL per lane

2.6 Using the Answers

Once all questions are answered, look up the configuration:

1. **Questions 1-5** → Confirm switch can accept the module (physical fit + CMIS version + power)
2. **Questions 6-9** → Find the correct row in Section 3 (Transceivers) tables (host code, lane count, lane assign)
3. **Questions 10-13** → Find the correct media code column (DR, FR, or SR)
4. **Questions 14-16** → If cable, find the correct row in Sections 4-7 (AOC, DAC, AEC, ACC)
5. **Questions 17-20** → If mixed-speed, configure each end independently using its own row from Sections 3-7

2.7 EEPROM Identity and Compliance Questions

These determine the module identity registers and compliance settings that the supplier must program.

#	Question	Why It Matters	Maps To
21	What exact CMIS revision byte value should be programmed? (0x50 = CMIS 5.0, 0x51 = 5.1, 0x52 = 5.2)	Module revision byte must match what the switch accepts. A CMIS 5.2 module (0x52) may be rejected by a switch that only supports CMIS 5.0.	Byte 0x01
22	What vendor name should appear in the module EEPROM? (16-char ASCII max)	Switch logs and inventory systems display this value. Must match customer expectations or vendor qualification list.	Bytes 0x80-0x8F
23	What vendor part number should be programmed? (16-char ASCII max)	Used for RMA tracking and inventory. Some switches validate this against a qualified parts list.	Bytes 0xA0-0xAF

#	Question	Why It Matters	Maps To
24	Does the target switch enforce a Qualified Vendor List (QVL)? If yes, what vendor OUI or name is required?	Modules from unqualified vendors may trigger "unsupported transceiver" warnings or be disabled entirely.	Bytes 0x80-0x8F, OUI
25	What operating temperature range is required? (Commercial: 0-70°C, Industrial: -40-85°C, Extended: -5-85°C)	Affects module selection and EEPROM temperature calibration. Industrial modules cost more but are required for outdoor or harsh environments.	Module selection
26	Is the far-end module already deployed? If yes, provide the far-end APP descriptor values or a CLI dump.	The new module must match the existing far-end configuration exactly. Mismatched host codes, media codes, or lane counts will prevent link-up.	All APP bytes

2.8 Answer Validation Cross-Checks

Before sending specifications to a supplier, verify that no impossible combinations exist:

If Answer To...	Combined With...	Result	Resolution
Q2 = QSFP112	Q9 = Any breakout	**IMPOSSIBLE**	QSFP112 has 4 lanes only. No breakout available. Change form factor to QSFP-DD or OSFP.
Q6 = InfiniBand	Q2 = QSFP112	**NOT SUPPORTED**	QSFP112 is Ethernet-only. Use QSFP-DD or OSFP for InfiniBand NDR.
Q10 = >2km	Q11 = MMF	**IMPOSSIBLE**	MMF maximum reach is ~100m at 100G+ speeds. Use SMF for distances >100m.
Q10 = >500m	Media type = DR	**IMPOSSIBLE**	DR modules max out at 500m. Use DR-2 (2km), FR (2km), or LR (10km).
Q14 = >5m	Cable type = DAC	**IMPOSSIBLE**	DAC max reach is ~2-3m at 800G, ~5m at 100G. Use AEC (up to 7m) or AOC (up to 100m).
Q9 = 8x100G breakout	Media type = FR4	**IMPOSSIBLE**	FR4 uses WDM (4 multiplexed wavelengths). Cannot be split into 8 independent channels. Use DR8 for 8-way breakout.

2.9 Supplier Programming Specification Template

After completing the questionnaire, fill in this template and provide it to the transceiver or cable supplier. This eliminates ambiguity by specifying exact register byte values. All unused Application Descriptor slots (APP 5-8) should be zeroed (0x00 in all 4 bytes). After programming, the supplier should read back all Application Descriptors and return the dump for W2W verification before shipping.

```
W2W MODULE PROGRAMMING SPECIFICATION
Date:              _________________
Customer:          _________________
W2W Order #:       _________________
Quantity:          _________________

MODULE IDENTITY
Byte 0x00 (Module Identifier):     ____ (0x19=OSFP, 0x18=QSFP-DD, 0x1E=QSFP11
2)
Byte 0x01 (CMIS Revision):         ____ (0x50=5.0, 0x51=5.1, 0x52=5.2)
Vendor Name (0x80-0x8F):           _________________ (16-char ASCII)
Vendor Part Number (0xA0-0xAF):    _________________ (16-char ASCII)
Temperature Range:                  Commercial / Industrial / Extended

APPLICATION DESCRIPTOR 1 (Primary Mode)
Byte 0x56 (Host Interface Code):   ____ (e.g., 0x52 = 800GAUI-8-L)
```

```
Byte 0x57 (Media Interface Code):  ____ (e.g., 0x56 = 800GBASE-DR8)
Byte 0x58 (Lane Count):            ____ (e.g., 0x88 = 8 host : 8 media)
Byte 0x59 (Lane Assignment):       ____ (e.g., 0x01 = straight)

APPLICATION DESCRIPTOR 2 (Split/Breakout Mode 1)
Byte 0x5A (Host Interface Code):   ____ or 0x00 (unused)
Byte 0x5B (Media Interface Code):  ____ or 0x00
Byte 0x5C (Lane Count):            ____ or 0x00
Byte 0x5D (Lane Assignment):       ____ or 0x00

APPLICATION DESCRIPTOR 3 (Breakout Mode 2, if applicable)
Byte 0x5E (Host Interface Code):   ____ or 0x00 (unused)
Byte 0x5F (Media Interface Code):  ____ or 0x00
Byte 0x60 (Lane Count):            ____ or 0x00
Byte 0x61 (Lane Assignment):       ____ or 0x00

APPLICATION DESCRIPTOR 4 (Breakout Mode 3, if applicable)
Byte 0x62 (Host Interface Code):   ____ or 0x00 (unused)
Byte 0x63 (Media Interface Code):  ____ or 0x00
Byte 0x64 (Lane Count):            ____ or 0x00
Byte 0x65 (Lane Assignment):       ____ or 0x00

PROTOCOL:  [ ] Ethernet  [ ] InfiniBand NDR  [ ] InfiniBand HDR

TARGET SWITCH
Switch Make/Model:    _______________
NOS Version:          _______________
QVL Required:         Yes / No

CABLE SPECIFICATIONS (if applicable)
Cable Type:           DAC / AEC / AOC / N/A
Length:               _____ meters
Form Factor A-end:    _______________
Form Factor B-end:    _______________
Jacket Rating:        Plenum / Riser / LSZH / PVC

NOTES: ____________________________________________________________

Prepared by: _______________ Date: ___________
Reviewed by: _______________ Date: ___________
```

3 Transceiver Modules

Quick Context: Transceivers are pluggable modules that convert electrical signals from the switch into optical signals for fiber transmission. Each transceiver plugs into a cage on the switch faceplate. A single 800G transceiver can operate as one fast connection or be split into multiple slower connections (breakout) to serve more devices.

3.1 OSFP (800G, 1.6T Emerging)

Physical Characteristics: - Form Factor: OSFP (Octal SFP) - Module Identifier: 0x19 - Connector: MPO-16 (parallel DR8), 2xMPO-12 (parallel 2xDR4/2xFR4), or LC Duplex (WDM) - Power: Up to 20W

Use Cases: - Data center spine-to-spine interconnects - AI/ML GPU cluster fabric (NVIDIA GB300, DGX) - High-bandwidth storage interconnects - 800G breakout to multiple 400G/200G/100G ports

3.1.1 OSFP 800G DR8 — Ethernet

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	0x52	0x56 (DR8)	0x88	0x01	Spine-to-spine
2x400G (split)	400Gx2	0x50	0x1C (DR4)	0x44	0x11	Spine-to-leaf
4x200G (breakout)	200Gx4	0x4E	0x17 (DR4)	0x22	0x55	ToR to server
8x100G (breakout)	100Gx8	0x4C	0x14 (DR)	0x11	0xFF	Legacy connectivity

3.1.2 OSFP 800G DR8 — InfiniBand NDR

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	**0x32**	0x56 (DR8)	0x88	0x01	GB300 compute port
2x400G (split)	400Gx2	**0x32**	0x1C (DR4)	0x44	0x11	Dual-port compute

3.1.3 OSFP 800G FR4 — Ethernet (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	0x52	**0x7A (FR4)**	0x48	0x01	Building-to-building

Note: FR4 uses 4 wavelengths on 2 fibers (200G/wavelength). Limited breakout options due to WDM nature. VERIFICATION NEEDED: The host code and lane count values shown above (0x52 / 0x48) should be verified against a real 800G FR4 module. Appendix A shows FR4 with host code 0x82 (800GAUI-4) instead. Read the Application Descriptors from a physical module to confirm which host code and lane count the module actually advertises.

3.1.4 OSFP 800G FR4 — InfiniBand NDR (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	**0x32**	**0x7A (FR4)**	0x48	0x01	Long-reach compute

3.1.5 OSFP 800G SR8 — Ethernet (Multimode)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	0x52	**0x12 (SR8)**	0x88	0x01	Short-reach MMF
2x400G (split)	400Gx2	0x50	0x11 (SR4)	0x44	0x11	MMF spine-to-leaf
4x200G (if supported)	200Gx4	0x4E	0x0E (SR4)	0x22	0x55	Vendor-dependent — verify APPs
8x100G (if supported)	100Gx8	0x4C	0x0D (SR1)	0x11	0xFF	Vendor-dependent — verify APPs

Note: SR8 has 8 independent MMF lanes, so 4x200G and 8x100G are optically feasible. However, most SR8 modules only advertise APP 1 (800G) and APP 2 (2x400G). Always read the Application Descriptors to confirm.

3.1.6 OSFP 800G SR8 — InfiniBand NDR (Multimode)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	**0x32**	**0x12 (SR8)**	0x88	0x01	Short-reach IB compute

3.1.7 OSFP 800G 2xDR4 — Ethernet (Split Module)

Physical Characteristics: - Two independent 400G DR4 optical engines in a single OSFP shell - Connector: **2xMPO-12** (one MPO-12 per 400G engine) — NOT MPO-16 - Reach: 500m per engine, SMF - Fiber Count: 8 fibers per engine (16 total, same as DR8 but in two groups)

IMPORTANT: An 800G 2xDR4 module is physically different from a DR8 module doing 2x400G breakout — the 2xDR4 has two separate optical engines while the DR8 has one 8-lane engine that gets logically split. However, the **CMIS settings are identical** because split configurations use standard 400G media codes with lane assignment 0x11.

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
2x400G (native)	400Gx2	0x50	0x1C (DR4)	0x44	0x11	Spine-to-leaf, dual-port NIC
4x200G (if supported)	200Gx4	0x4E	0x17 (DR4)	0x22	0x55	Vendor-dependent — verify APPs
8x100G (if supported)	100Gx8	0x4C	0x14 (DR)	0x11	0xFF	Vendor-dependent — verify APPs

Further breakout beyond 2x400G: Each 400G DR4 engine has 4 independent parallel fibers at 100G/lane — the same optical architecture as a QSFP-DD 400G DR4 module, which commonly supports 2x200G and 4x100G breakout. Whether a 2xDR4 module exposes these modes depends on the vendor's DSP and firmware. **Always read the Application Descriptors (Page 0x00, bytes 0x56-0x75) to confirm what the specific module supports.** Most cost-optimized 2xDR4 modules only advertise 2x400G; premium modules with more capable DSPs may advertise additional breakout modes.

When to choose 2xDR4 over DR8:

Consideration	DR8	2xDR4
Max native speed	800G	400G per port (800G aggregate)
Breakout flexibility	1x800G, 2x400G, 4x200G, 8x100G (always)	2x400G guaranteed; 4x200G and 8x100G vendor-dependent
Connector	MPO-16	2xMPO-12
Existing 400G fiber plant	Requires MPO-16 harness	Uses existing MPO-12 infrastructure

Consideration	DR8	2xDR4
Cost	Higher (full 800G engine)	Lower (two 400G engines)

3.1.8 OSFP 800G 2xDR4 — InfiniBand NDR (Split Module)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
2x400G (native)	400Gx2	**0x32**	0x1C (DR4)	0x44	0x11	GB300/DGX dual-port compute

3.1.9 OSFP 800G 2xFR4 — Ethernet (Split Module, Long Reach)

Physical Characteristics: - Two independent 400G FR4 WDM engines in a single OSFP shell - Connector: 2xLC Duplex (one LC pair per 400G WDM engine) - Reach: 2,000m per engine, SMF - Fiber Count: 2 fibers per engine (4 total)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
2x400G (native)	400Gx2	0x50	0x1D (FR4)	0x44	0x11	Building-to-building dual link

Note: No breakout beyond the native 2x400G — each FR4 engine uses 4 wavelengths that cannot be further split.

3.1.10 OSFP 800G DR8-2 — Ethernet (Extended Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	0x52	0x57 (DR8-2)	0x88	0x01	Campus backbone, up to 2km

Note: DR8-2 extends parallel fiber reach from 500m to 2,000m. Same lane count and connector (MPO-16) as standard DR8. IEEE 802.3, Clause 124.

3.1.11 OSFP 800G LR4 — Ethernet (Long Reach, 200G/lane)

Physical Characteristics: - 4-lane WDM at 200G/lane (106.25 GBd PAM4) - Connector: LC Duplex - Reach: 10,000m (10km), SMF - Host Code: 0x82 (800GAUI-4) — newer 200G/lane host interface.

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	0x82	0x7B (LR4)	0x48	0x01	Metro DCI, campus-to-campus

Note: Requires switch support for host code 0x82 (200G/lane SerDes). Not all current switches support this — confirm compatibility before ordering. IEEE 802.3, Clause 183.

3.1.12 OSFP 800G FR4-500 — Ethernet (Short WDM)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x800G (straight)	800G	0x82	0x79 (FR4-500)	0x48	0x01	WDM where fiber count is limited, ≤500m

Note: Same WDM approach as FR4 but at 500m reach. Uses 200G/lane host interface (0x82). IEEE 802.3, Clause 183.

3.1.13 OSFP 1.6T — Next Generation (Emerging)

Status: Specifications emerging. Host codes defined in SFF-8024 Rev 4.13 but module availability is limited. Include for forward planning only.

Physical Characteristics: - Form Factor: OSFP (same cage as 800G) - Module Identifier: 0x19 - Lane Rate: 200G/lane (106.25 GBd PAM4) — double current 800G lane rate - Power: TBD (expected Class 8+)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Status
1x1.6T (straight)	1.6T	0x83 (1.6TAUI-8-S/L)	TBD	0x88	0x01	Emerging
2x800G (split)	800Gx2	0x82 (800GAUI-4-S/L)	TBD	0x44	0x11	Emerging

Note: Media interface codes for 1.6T are not yet finalized in SFF-8024. Do not use for production orders until codes are ratified. Host codes 0x82 and 0x83 are from SFF-8024 Rev 4.13, Annex 176E.

3.2 QSFP-DD (400G/800G)

Physical Characteristics: - Form Factor: QSFP-DD (Quad SFP Double Density) - Module Identifier: 0x18 - Connector: MPO-12 (parallel) or LC Duplex (WDM) - Power: Up to 14W

Use Cases: - Leaf switch uplinks - Server NIC connectivity - Storage array front-end - 400G breakout to 200G/100G ports

3.2.1 QSFP-DD 400G DR4 — Ethernet

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	0x50	0x1C (DR4)	0x44	0x01	Leaf switch uplink
2x200G (split)	200Gx2	0x4E	0x17 (DR4)	0x22	0x11	Dual-homed server
4x100G (breakout)	100Gx4	0x4C	0x14 (DR)	0x11	0x55	Server farm

3.2.2 QSFP-DD 400G DR4 — InfiniBand NDR

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	**0x32**	0x1C (DR4)	0x44	0x01	GB300 storage port

3.2.3 QSFP-DD 400G FR4 — Ethernet (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	0x50	**0x1D (FR4)**	0x44	0x01	Metro reach

Note: FR4 uses 4 wavelengths on 2 fibers. No breakout options.

3.2.4 QSFP-DD 400G FR4 — InfiniBand NDR (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	**0x32**	**0x1D (FR4)**	0x44	0x01	Long-reach IB storage

3.2.5 QSFP-DD 400G SR4 — Ethernet (Multimode)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	0x50	**0x11 (SR4)**	0x44	0x01	Short-reach MMF
2x200G (split)	200Gx2	0x4E	0x10 (SR2)	0x22	0x11	MMF dual-port

3.2.6 QSFP-DD 400G LR4-6 — Ethernet (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	0x50	**0x1E (LR4-6)**	0x44	0x01	Campus backbone, up to 6km

Note: 400GBASE-LR4-6 provides 6km reach over SMF using 4 CWDM wavelengths on 2 fibers (LC Duplex). No breakout options. IEEE 802.3cu.

3.2.7 QSFP-DD 400G DR4-2 — Ethernet (Extended Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	0x50	**0x55 (DR4-2)**	0x44	0x01	Extended reach, up to 2km

Note: 400GBASE-DR4-2 extends parallel fiber reach from 500m to 2,000m. Same connector (MPO-12) and lane count as standard DR4. IEEE 802.3, Clause 124.

3.3 QSFP112 (400G)

Physical Characteristics: - Form Factor: QSFP112 - Module Identifier: 0x1E - Connector: MPO-12 or LC Duplex - Power: Up to 12W

Use Cases: - 400G single-port connectivity in QSFP form factor - Upgrade path from QSFP56

Constraint: QSFP112 has only 4 lanes at 112G/lane. **No split or breakout options available.**

3.3.1 QSFP112 400G DR4 — Ethernet

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x400G (straight)	400G	0x50	0x1C (DR4)	0x44	0x01	400G point-to-point

Note: QSFP112 is Ethernet-only. No InfiniBand NDR support in this form factor.

3.4 QSFP56 (200G)

Physical Characteristics: - Form Factor: QSFP56 - Module Identifier: 0x11 (SFF-8636 based — same identifier as QSFP28; distinguish by host interface codes: 0x4E = 200G QSFP56, 0x4C = 100G QSFP28) - Connector: MPO-12 or LC Duplex - Power: Up to 7W

Use Cases: - 200G server connectivity - InfiniBand HDR networks - Upgrade from 100G QSFP28

3.4.1 QSFP56 200G DR4 — Ethernet

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x200G (straight)	200G	0x4E	0x17 (DR4)	0x22	0x01	Server uplink
2x100G (split)	100Gx2	0x4C	0x14 (DR)	0x11	0x11	Dual-port server

3.4.2 QSFP56 200G FR4 — Ethernet (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x200G (straight)	200G	0x4E	**0x18 (FR4)**	0x22	0x01	Building-to-building, 2km

Note: 200GBASE-FR4 uses 4 CWDM wavelengths on 2 fibers (LC Duplex). No breakout options. IEEE 802.3, Clause 122.

3.4.3 QSFP56 200G LR4 — Ethernet (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x200G (straight)	200G	0x4E	**0x19 (LR4)**	0x22	0x01	Campus backbone, 10km

Note: 200GBASE-LR4 provides 10km reach over SMF using 4 CWDM wavelengths on 2 fibers (LC Duplex). IEEE 802.3, Clause 122.

3.4.4 QSFP56 200G SR4 — Ethernet (Multimode)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x200G (straight)	200G	0x4E	0x10 (SR4)	0x22	0x01	Short-reach MMF

3.4.5 QSFP56 200G — InfiniBand HDR

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x200G (straight)	200G	**0x31**	0x17 (DR4)	0x22	0x01	DGX H100 compute

3.5 QSFP28 (100G)

Physical Characteristics: - Form Factor: QSFP28 - Module Identifier: 0x11 (SFF-8636 based, not CMIS — same identifier as QSFP56; distinguish by host interface codes: 0x4C = 100G QSFP28, 0x4E = 200G QSFP56) - Connector: MPO-12 or LC Duplex - Power: Up to 5W

Note: QSFP28 typically uses SFF-8636 management, not CMIS. Included for completeness.

Use Cases: - Legacy 100G connectivity - Server ToR connections - Breakout to 4x25G

3.5.1 QSFP28 100G DR — Ethernet

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	0x4C	0x14 (DR)	0x11	0x01	100G point-to-point
4x25G (breakout)	25Gx4	0x02	0x03 (SR4)	0x11	0x55	Server fan-out

Note: Host code 0x02 (25GAUI) uses NRZ signaling at 25.78125 GBd, not PAM4. This is a legacy interface for 25G SFP28 breakout. Both ends must support NRZ 25G signaling.

3.5.2 QSFP28 100G SR4 — Ethernet (Multimode)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	0x4C	0x03 (SR4)	0x11	0x01	Short-reach MMF

3.5.3 SFP28 100G FR1 — Ethernet (Far Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	0x4C	**0x15 (FR1)**	0x11	0x01	Building-to-building, 2km

Note: 100G-FR MSA. Single-lane WDM, LC Duplex connector.

3.5.4 QSFP28 100G LR1 — Ethernet (Long Reach)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	0x4C	**0x16 (LR1)**	0x11	0x01	Campus backbone, 10km

Note: 100G-LR MSA. Single-lane WDM, LC Duplex connector.

3.5.5 QSFP28 100G CWDM4 — Ethernet (WDM)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	0x4C	**0x10 (CWDM4)**	0x11	0x01	Metro reach, 2km, LC Duplex

Note: 100G CWDM4 MSA. 4 wavelengths on 2 fibers. Uses SMF media code table (Table 4-7).

3.5.6 QSFP28 100G PSM4 — Ethernet (Parallel SMF)

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	0x4C	**0x0F (PSM4)**	0x11	0x01	500m, existing 8-fiber infrastructure

Note: 100G PSM4 MSA. 4 parallel lanes on 8 fibers (MPO-12 connector). Choose PSM4 when 8-fiber ribbon infrastructure already exists and distance is ≤500m.

3.5.7 QSFP28 100G — InfiniBand EDR

Configuration	Speed	Host Code	Media Code	Lane Count	Lane Assign	Use Case
1x100G (straight)	100G	**0x30**	0x03 (SR4)	0x11	0x01	Legacy HPC

4 Active Optical Cables (AOC)

> **Quick Context:** AOC cables look like copper cables but contain fiber optics with built-in laser transmitters and receivers at each end. The user plugs them in like any cable — no fiber splicing required. AOCs reach farther than copper (up to 100m) and cost less than separate transceivers plus fiber.

AOC cables have active optical components (laser drivers, receivers) integrated into the cable ends. They provide longer reach than copper (up to 100m) while appearing as a simple cable to the host.

Key Characteristics: - Media Type Code: 0x02 (Active Optical) - Reach: Typically 1m to 100m depending on speed - Power: Draws power from host port - No fiber splicing required

4.1 800G AOC

Physical Options:

AOC Type	Form Factor	Lengths	Breakout Options
800G AOC Straight	OSFP-to-OSFP	1m, 2m, 3m, 5m, 10m, 30m	1x800G, 2x400G
800G Breakout AOC	OSFP-to-2xQSFP-DD	1m, 2m, 3m, 5m	Physical 2-way split
800G Breakout AOC	OSFP-to-8xSFP112	1m, 2m, 3m	Physical 8-way breakout

4.1.1 800G AOC — Ethernet

Configuration	Host Code	Media Code	Lane Count	Lane Assign	Use Case
800G straight	0x52	0x02 (AOC)	0x88	0x01	Standard Ethernet
2x400G split	0x50	0x02 (AOC)	0x44	0x11	Dual-port breakout

4.1.2 800G AOC — InfiniBand NDR

Configuration	Host Code	Media Code	Lane Count	Lane Assign	Use Case
800G straight	**0x32**	0x02 (AOC)	0x88	0x01	GB300 compute interconnect
2x400G split	**0x32**	0x02 (AOC)	0x44	0x11	Dual-port compute

4.2 400G AOC

Physical Options:

AOC Type	Form Factor	Lengths	Breakout Options
400G AOC Straight	QSFP-DD-to-QSFP-DD	1m, 2m, 3m, 5m, 10m, 30m	1x400G, 2x200G, 4x100G
400G Breakout AOC	QSFP-DD-to-2xQSFP56	1m, 2m, 3m, 5m	Physical 2-way split
400G Breakout AOC	QSFP-DD-to-4xSFP28	1m, 2m, 3m	Physical 4-way breakout

4.2.1 400G AOC — Ethernet

Configuration	Physical	Host Code	Media Code	Lane Count	Lane Assign
1x400G	QSFP-DD to QSFP-DD	0x50	0x02	0x44	0x01
2x200G	QSFP-DD to 2xQSFP56	0x4E	0x02	0x22	0x11
4x100G	QSFP-DD to 4xSFP28	0x4C	0x02	0x11	0x55

4.2.2 400G AOC — InfiniBand NDR

Configuration	Physical	Host Code	Media Code	Lane Count	Lane Assign
1x400G	QSFP-DD to QSFP-DD	**0x32**	0x02	0x44	0x01

4.3 200G AOC

Configuration	Physical	Host Code	Media Code	Lane Count	Lane Assign
1x200G	QSFP56 to QSFP56	0x4E	0x02	0x22	0x01
2x100G	QSFP56 to 2xSFP28	0x4C	0x02	0x11	0x11

4.3.1 InfiniBand HDR 200G AOC:

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x200G	**0x31**	0x02	0x22	0x01

4.4 100G AOC

Configuration	Physical	Host Code	Media Code	Lane Count	Lane Assign
1x100G	QSFP28 to QSFP28	0x4C	0x02	0x11	0x01
4x25G	QSFP28 to 4xSFP28	0x02	0x02	0x11	0x55

5 Direct Attach Cables (DAC)

Quick Context: DAC cables are simple copper twinax — no electronics, no optics. They cost the least and add the least latency, but only work for very short distances (a few meters). Use DACs when connecting equipment in the same rack or adjacent racks.

DAC cables are passive copper twinax cables. They provide the lowest cost and lowest latency but are limited to short reaches (typically ≤5m at 800G).

Key Characteristics: - Media Type Code: 0x04 (Passive Copper) - Reach: ≤2m (800G), ≤3m (400G), ≤5m (100G) - No power draw (passive) - Lowest latency option

5.1 800G DAC

Physical Options:

DAC Type	Form Factor	Max Length	Use Case
800G DAC Straight	OSFP-to-OSFP	2m	Top-of-rack, same cabinet
800G Breakout DAC	OSFP-to-2xQSFP-DD	2m	Spine-to-leaf in same row

5.1.1 800G DAC — Ethernet

Configuration	Host Code	Media Code	Lane Count	Lane Assign
800G straight	0x52	0x04 (Passive Cu)	0x88	0x01
2x400G split	0x50	0x04 (Passive Cu)	0x44	0x11

5.1.2 800G DAC — InfiniBand NDR

Configuration	Host Code	Media Code	Lane Count	Lane Assign
800G straight	**0x32**	0x04 (Passive Cu)	0x88	0x01
2x400G split	**0x32**	0x04 (Passive Cu)	0x44	0x11

5.2 400G DAC

Physical Options:

DAC Type	Form Factor	Max Length	Use Case
400G DAC Straight	QSFP-DD-to-QSFP-DD	3m	Switch-to-switch

DAC Type	Form Factor	Max Length	Use Case
400G Breakout DAC	QSFP-DD-to-4xSFP28	3m	4-way server fan-out

5.2.1 400G DAC — Ethernet

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x400G	0x50	0x04	0x44	0x01
4x100G	0x4C	0x04	0x11	0x55

5.2.2 400G DAC — InfiniBand NDR

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x400G	**0x32**	0x04	0x44	0x01

5.3 200G DAC

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x200G	0x4E	0x04	0x22	0x01
2x100G	0x4C	0x04	0x11	0x11

5.4 100G DAC

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x100G	0x4C	0x04	0x11	0x01
4x25G	0x02	0x04	0x11	0x55

6 Active Electrical Cables (AEC)

Quick Context: AEC cables are copper cables with built-in signal boosters (re-timers). They reach farther than passive DAC cables (up to 7m vs 2m) while keeping copper's low latency advantage. Use AECs when you need to span a row of racks but don't need the reach of fiber.

AEC cables have active signal conditioning (re-timers/re-drivers) to extend copper reach beyond passive DAC limits.

Key Characteristics: - Media Type Code: 0x03 (Active Copper) - Reach: Up to 7m (extends beyond DAC) - Power: Draws power from host port - Lower latency than AOC

6.1 800G AEC

Physical Options:

AEC Type	Form Factor	Max Length	Use Case
800G AEC Straight	OSFP-to-OSFP	5m	Cross-cabinet, within row
800G Breakout AEC	OSFP-to-2xQSFP-DD	5m	Dual-port NIC connectivity

6.1.1 800G AEC — Ethernet

Configuration	Host Code	Media Code	Lane Count	Lane Assign
800G straight	0x52	0x03 (Active Cu)	0x88	0x01
2x400G split	0x50	0x03 (Active Cu)	0x44	0x11

6.1.2 800G AEC — InfiniBand NDR

Configuration	Host Code	Media Code	Lane Count	Lane Assign
800G straight	**0x32**	0x03 (Active Cu)	0x88	0x01
2x400G split	**0x32**	0x03 (Active Cu)	0x44	0x11

6.2 400G AEC

6.2.1 400G AEC — Ethernet

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x400G	0x50	0x03	0x44	0x01

6.2.2 400G AEC — InfiniBand NDR

Configuration	Host Code	Media Code	Lane Count	Lane Assign
1x400G	**0x32**	0x03	0x44	0x01

7 Active Copper Cables (ACC)

Quick Context: ACC is industry shorthand that often means the same thing as AEC. When vendors list “ACC” or “AEC” they usually refer to the same product — a copper cable with built-in electronics. The table below clarifies the subtle naming differences you may encounter.

ACC is often used interchangeably with AEC. The distinction:

Term	Description
AEC (Active Electrical Cable)	Emphasizes re-timing/signal conditioning
ACC (Active Copper Cable)	General term for any active copper cable
AAC (Active Analog Cable)	Sometimes used for cables without full re-timing

For CMIS purposes, all active copper cables report Media Type Code 0x03. Use the same CMIS settings as AEC.

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8 Physical Breakout Reference

Quick Context: A breakout splits one high-speed port into multiple lower-speed connections. This section shows which combinations work physically — what plugs into what, what cables connect them, and what connectors you need. Use these tables when planning cabling between switches, NICs, and storage devices.

8.1 Transceiver-to-Transceiver Compatibility

Source	Target	Cable Type	Notes
800G OSFP	800G OSFP	Direct/AOC/AEC/DAC	Straight 800G
800G OSFP	400G QSFP-DD x2	Breakout AOC/AEC	2-way physical split
800G OSFP	200G QSFP56 x4	Breakout AOC	4-way physical breakout
800G OSFP	100G QSFP28 x8	Breakout AOC	8-way physical breakout
400G QSFP-DD	400G QSFP-DD	Direct/AOC/DAC/AEC	Straight 400G
400G QSFP-DD	200G QSFP56 x2	Breakout AOC/DAC	2-way breakout
400G QSFP-DD	100G QSFP28 x4	Breakout AOC/DAC	4-way breakout
200G QSFP56	200G QSFP56	Direct/AOC/DAC	Straight 200G
200G QSFP56	100G QSFP28 x2	Breakout AOC/DAC	2-way breakout
100G QSFP28	100G QSFP28	Direct/AOC/DAC	Straight 100G
100G QSFP28	25G SFP28 x4	Breakout AOC/DAC	4-way breakout

8.2 Connector Types

Speed / PMD	Parallel Connector	WDM Connector	Fiber Count
800G DR8	MPO-16	—	16 (8 Tx + 8 Rx)
800G DR8-2	MPO-16	—	16 (extended to 2km)
800G 2xDR4	**2xMPO-12**	—	8+8 (one MPO-12 per 400G engine)
800G FR4 / LR4	—	LC Duplex	2 (4 WDM wavelengths)
800G 2xFR4	—	2xLC Duplex	2+2 (one LC pair per engine)
800G FR4-500	—	LC Duplex	2
400G DR4	MPO-12	—	8 (4 Tx + 4 Rx)
400G DR4-2	MPO-12	—	8 (extended to 2km)
400G FR4 / LR4-6	—	LC Duplex	2
200G DR4	MPO-12	—	8
200G FR4 / LR4	—	LC Duplex	2
100G DR	LC Duplex	—	2
100G FR1 / LR1	—	LC Duplex	2
100G PSM4	MPO-12	—	8
100G SR4	MPO-12	—	8
100G CWDM4	—	LC Duplex	2

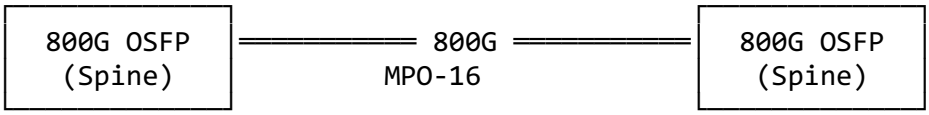
8.3 Physical Breakout Cables

Cable Type	Description
MPO-16 to MPO-16	Straight 800G connection
MPO-16 to 2xMPO-8	2-way split (OSFP to 2xQSFP-DD)
MPO-16 to 4xMPO-4	4-way breakout
MPO-16 to 8xLC-Duplex	8-way breakout (OSFP to 8x100G)
MPO-12 to MPO-12	Straight 400G connection
MPO-12 to 4xLC-Duplex	4-way breakout (QSFP-DD to 4x100G)

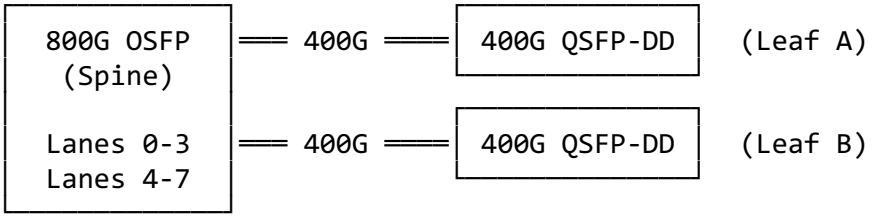
8.4 Visual Breakout Diagrams

8.4.1 800G OSFP Breakout Patterns

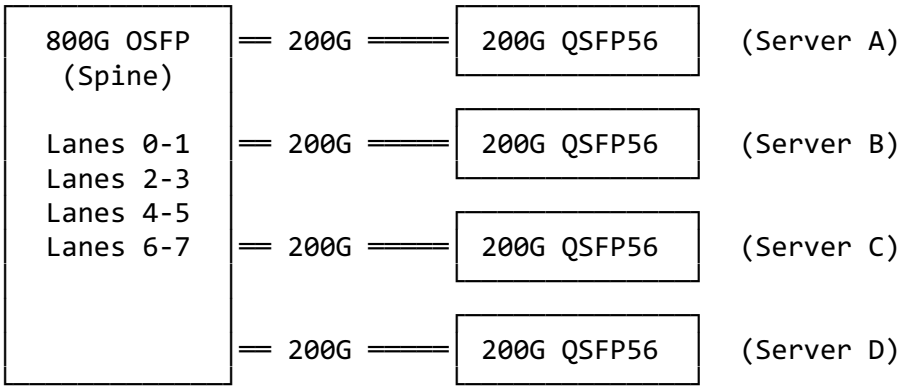
Straight (1x800G):



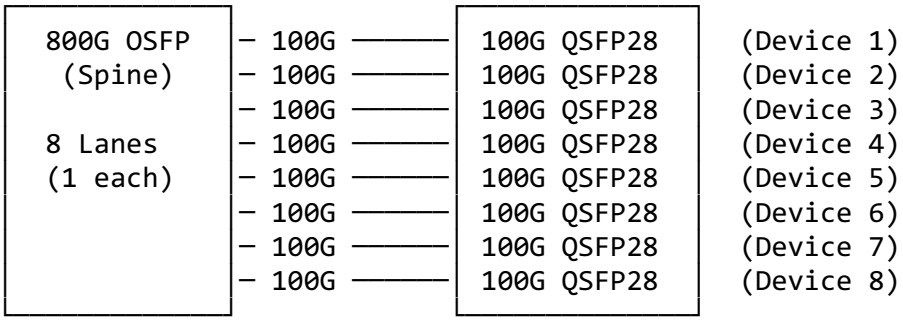
2-Way Split (2x400G):



4-Way Breakout (4x200G):

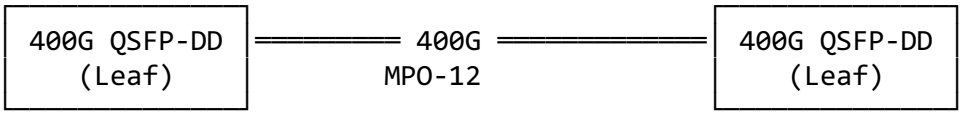


8-Way Breakout (8x100G):

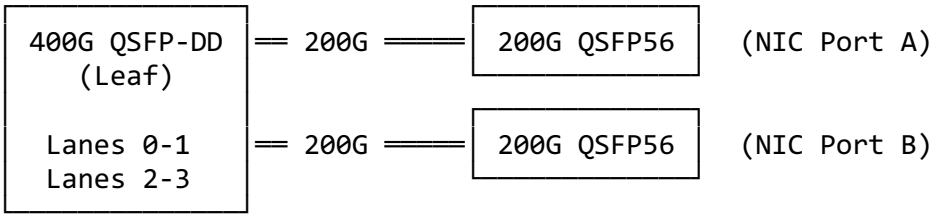


8.4.2 400G QSFP-DD Breakout Patterns

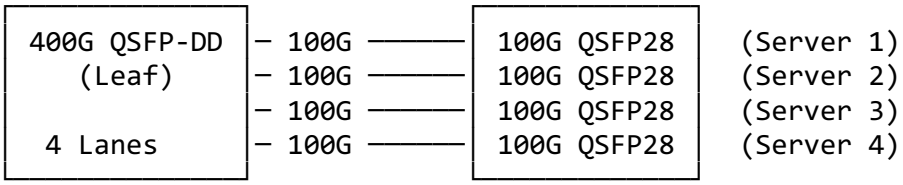
Straight (1x400G):



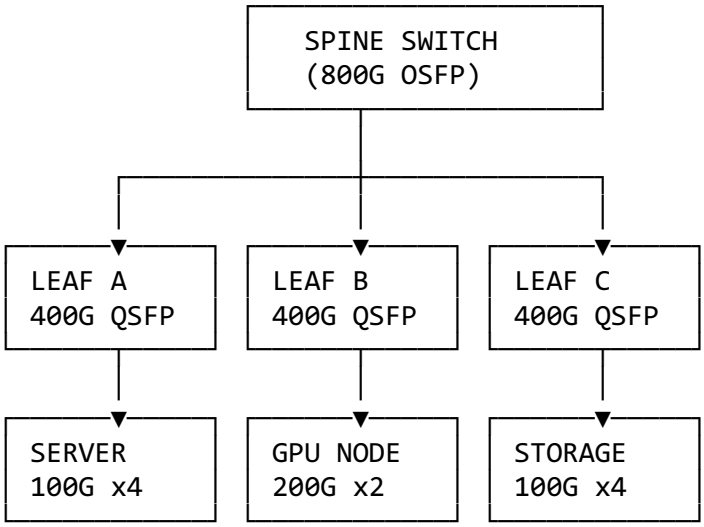
2-Way Split (2x200G):



4-Way Breakout (4x100G):



8.4.3 Typical Deployment Topology



9 CMIS Application Settings Quick Reference

Quick Context: Every CMIS-based module contains registers that tell the switch what configurations the module supports. This section lists the hex codes stored in those registers. When ordering modules or debugging configuration issues, match these codes to what the switch expects.

9.1 Ethernet Host Electrical Interface Codes (SFF-8024 Rev 4.13, Table 4-5)

Speed	Host Code	Name	Modulation	SFF-8024 Table
800G	0x52	800GAUI-8-L	PAM4 53.125G	4-5
400G	0x50	400GAUI-4-L	PAM4 53.125G	4-5
200G	0x4E	200GAUI-2-L	PAM4 53.125G	4-5
100G	0x4C	100GAUI-1-L	PAM4 53.125G	4-5

9.2 InfiniBand Host Electrical Interface Codes (SFF-8024 Rev 4.13, Table 4-5)

Speed	Host Code	Name	Modulation	Notes
800G	**0x32**	IB NDR	PAM4 53.125G	Same code for 8-lane and 4-lane
400G	**0x32**	IB NDR	PAM4 53.125G	Lane count determines speed
200G	0x31	IB HDR	PAM4 26.5625G	QSFP56/QSFP-DD
100G	0x30	IB EDR	NRZ 25.78G	QSFP28 (SFF-8636)

CRITICAL: InfiniBand NDR uses 0x32 for BOTH 800G and 400G. The lane count byte (0x88 vs 0x44) determines the speed.

9.3 Media Interface Codes — DR vs FR vs SR (SFF-8024 Rev 4.13, Tables 4-6 / 4-7)

Media Type	800G	400G	200G	100G	Reach	Fiber Type
DR (Direct)	0x56 (DR8)	0x1C (DR4)	0x17 (DR4)	0x14 (DR)	500m	SMF Parallel
DR-2 (Extended)	0x57 (DR8-2)	0x55 (DR4-2)	—	—	2,000m	SMF Parallel
FR (Far)	0x7A (FR4)	0x1D (FR4)	0x18 (FR4)	0x15 (FR1)	2,000m	SMF WDM
LR (Long)	0x7B (LR4)	0x1E (LR4-6)	0x19 (LR4)	0x16 (LR1)	6-10km	SMF WDM
SR (Short/MMF)	0x12 (SR8)	0x11 (SR4)	0x0E (SR4)	0x0D (SR1)	100m	MMF
PSM4 (Parallel SMF)	—	—	—	0x0F (PSM4)	500m	SMF Parallel
CWDM4 (WDM)	—	—	—	0x10 (CWDM4)	2,000m	SMF WDM

Note: 400G LR4-6 reach is 6km. 800G LR4 and 200G LR4 reach is 10km. 100G LR1 reach is 10km. SR media codes are from SFF-8024 Table 4-6 (MMF); all others from Table 4-7 (SMF).

9.4 Cable Media Type Codes (OIF-CMIS-05.2)

Media Code	Description	Cable Type
0x01	MMF (Multimode Fiber)	Transceivers with MMF
0x02	SMF (Single-mode Fiber) / AOC	Transceivers with SMF, AOC cables
0x03	Active Copper	AEC/ACC cables
0x04	Passive Copper	DAC cables

9.5 Lane Assignment Codes (OIF-CMIS-05.2)

Breakout Mode	Code	Binary	Description
Straight (no breakout)	0x01	00000001	All lanes in single group
2-way split	0x11	00010001	Lanes 0-3 + Lanes 4-7
4-way breakout	0x55	01010101	4 groups of 2 lanes
8-way breakout	0xFF	11111111	Each lane independent

9.6 Lane Count Encoding (OIF-CMIS-05.2)

Config	Host:Media	Hex	Description
8:8	8 host, 8 media	0x88	800G straight
4:8	4 host, 8 media	0x48	800G FR4 (4 wavelengths)
4:4	4 host, 4 media	0x44	400G straight
2:2	2 host, 2 media	0x22	200G straight
1:1	1 host, 1 media	0x11	100G straight

9.7 CMIS Register Address Map (OIF-CMIS-05.2)

Quick Context: These are the exact EEPROM byte addresses where configuration values live. When reading a module with CLI tools or programming it with a supplier, these addresses tell you exactly where to look or write.

9.7.1 Page 0x00 — Module Identity and Application Descriptors

Address	Name	What It Contains
0x00	Module Identifier	Form factor (0x19=OSFP, 0x18=QSFP-DD, 0x1E=QSFP112)
0x01	CMIS Revision	Spec version (0x50=CMIS 5.0, 0x51=5.1, 0x52=5.2)
0x02	Module State	Current operational state
0x03	Module Flags	Status flags

9.7.2 Application Descriptor Layout

Each Application Descriptor occupies 4 consecutive bytes:

Byte Offset	Name	Content
Base + 0	Host Electrical Interface ID	Host code (e.g., 0x52, 0x32)
Base + 1	Media Interface ID	Media code (e.g., 0x56, 0x1C)
Base + 2	Host/Media Lane Count	Upper nibble = host lanes, lower nibble = media lanes
Base + 3	Host Lane Assignment	Lane grouping (e.g., 0x01, 0x11)

9.7.3 Application Descriptor Addresses

APP #	Base	Byte 0 (Host)	Byte 1 (Media)	Byte 2 (Lanes)	Byte 3 (Assign)	Typical Use
1	0x56	0x56	0x57	0x58	0x59	800G / primary
2	0x5A	0x5A	0x5B	0x5C	0x5D	400G / 2-way split
3	0x5E	0x5E	0x5F	0x60	0x61	200G / 4-way
4	0x62	0x62	0x63	0x64	0x65	100G / 8-way
5-8	0x66-0x75	—	—	—	—	Reserved

9.7.4 Module Identification Registers

Address Range	Content
0x80-0x8F	Vendor Name (16-byte ASCII)
0xA0-0xAF	Vendor Part Number (16-byte ASCII)
0xB0-0xBF	Vendor Serial Number (16-byte ASCII)

Address Range	Content
0xC0-0xC7	Date Code (8-byte)
0xC8	Max Power (power class)

10 APSEL Activation Procedure (CMIS 5.x)

Source: OIF-CMIS-05.2 (April 2022), Section 6.3

> **Quick Context:** After a module is physically installed, the switch must tell it which configuration to use. This is done by writing to APSEL (Application Select) registers. This section walks through the activation sequence — what to write, where, and what the module should report back when it's working.

10.1 Overview

The module's Application Descriptors (Page 0x00, bytes 0x56-0x75) are **READ-ONLY** — they advertise what the module supports. To **ACTIVATE** a specific application, the switch writes to APSEL registers on Page 0x01.

10.2 APSEL Register Layout (Page 0x01)

Address	Lane	APSEL Byte Encoding
0x80	Lane 1	Upper nibble = APP #, Lower nibble = Datapath ID
0x81	Lane 2	Same encoding
0x82	Lane 3	Same encoding
0x83	Lane 4	Same encoding
0x84	Lane 5	Same encoding
0x85	Lane 6	Same encoding
0x86	Lane 7	Same encoding
0x87	Lane 8	Same encoding

Encoding: 0xAD where A = Application number (1-8), D = Datapath ID (1-8)

APSEL Value	Meaning
0x11	APP 1 (800G), Datapath 1
0x21	APP 2 (400G), Datapath 1
0x31	APP 3 (200G), Datapath 1
0x41	APP 4 (100G), Datapath 1

10.3 Activation Examples

Straight 800G (APP 1):

Write 0x11 to all 8 lanes (Page 0x01, addresses 0x80-0x87). All lanes belong to APP 1, Datapath 1.

```
Page 0x01:  0x80=0x11  0x81=0x11  0x82=0x11  0x83=0x11
            0x84=0x11  0x85=0x11  0x86=0x11  0x87=0x11
```

2x400G Split (APP 2):

Write 0x21 to all 8 lanes. Lanes 0-3 form Port 1, Lanes 4-7 form Port 2. The lane assignment byte in the APP descriptor (0x11 = 2-way split) tells the module how to group them.

```
Page 0x01:  0x80=0x21  0x81=0x21  0x82=0x21  0x83=0x21
            0x84=0x21  0x85=0x21  0x86=0x21  0x87=0x21
```

4x200G Breakout (APP 3):

Each pair of lanes gets a different Datapath ID:

```
Page 0x01:  0x80=0x31  0x81=0x31   (Lanes 1-2: APP 3, Datapath 1)
            0x82=0x32  0x83=0x32   (Lanes 3-4: APP 3, Datapath 2)
            0x84=0x33  0x85=0x33   (Lanes 5-6: APP 3, Datapath 3)
            0x86=0x34  0x87=0x34   (Lanes 7-8: APP 3, Datapath 4)
```

8x100G Breakout (APP 4):

Each lane is its own independent datapath:

```
Page 0x01:  0x80=0x41  (Lane 1: APP 4, Datapath 1)
            0x81=0x42  (Lane 2: APP 4, Datapath 2)
            0x82=0x43  (Lane 3: APP 4, Datapath 3)
            0x83=0x44  (Lane 4: APP 4, Datapath 4)
            0x84=0x45  (Lane 5: APP 4, Datapath 5)
            0x85=0x46  (Lane 6: APP 4, Datapath 6)
            0x86=0x47  (Lane 7: APP 4, Datapath 7)
            0x87=0x48  (Lane 8: APP 4, Datapath 8)
```

10.4 DataPath State Verification

After writing APSEL, read the DataPath state registers (Page 0x01, bytes 0x88-0x89) to confirm activation.

Expected States (in order):

State	Meaning	Action
DATAPATH_STATE_INIT	Module initializing	Wait
DATAPATH_STATE_TX_TURN_ON	Transmitter powering up	Wait
DATAPATH_STATE_INITIALIZED	Ready for traffic	OK
DATAPATH_STATE_ACTIVATED	Fully operational	**Done**

Error States — STOP and investigate:

State	Meaning	Action
CONFIG_REJECTED_INVALID	Bad configuration values	Check APP descriptor values match what module advertises
CONFIG_REJECTED_UNSUPPORTED	Module doesn't support this config	Verify module firmware supports this breakout (see Section 1.7)
CONFIG_REJECTED_UNKNOWN	Rejected for unknown reason	Contact module vendor
DATAPATH_STATE_DEACTIVATED	Lane not active	Check APSEL write succeeded, re-initialize

11 Appendix: 10 Common Configuration Examples

Each example shows the exact CMIS register values and byte addresses for a real-world deployment scenario.

11.1 Example 1: OSFP 800G DR8 — Ethernet Spine-to-Spine

Deployment: Two spine switches, 800G point-to-point, 500m SMF

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x52	800GAUI-8-L (SFF-8024 Rev 4.13)
APP 1 Media Interface	0x57	0x56	800GBASE-DR8
APP 1 Lane Count	0x58	0x88	8 host : 8 media
APP 1 Lane Assignment	0x59	0x01	Straight
APSEL (Page 0x01)	0x80-0x87	0x11 all lanes	APP 1, Datapath 1

11.2 Example 2: OSFP 800G DR8 — InfiniBand NDR (NVIDIA GB300)

Deployment: GPU compute cluster, 800G IB NDR, OSFP-to-OSFP

Register	Address	Value	Description
APP 1 Host Interface	0x56	**0x32**	IB NDR (NOT 0x52!)
APP 1 Media Interface	0x57	0x56	800GBASE-DR8 (same as Ethernet)
APP 1 Lane Count	0x58	0x88	8 host : 8 media
APP 1 Lane Assignment	0x59	0x01	Straight

11.3 Example 3: OSFP 800G DR8 — 2x400G Breakout (Ethernet)

Deployment: Spine-to-leaf, one OSFP port serving two 400G leaf uplinks

Register	Address	Value	Description
APP 2 Host Interface	0x5A	0x50	400GAUI-4-L
APP 2 Media Interface	0x5B	0x1C	400GBASE-DR4
APP 2 Lane Count	0x5C	0x44	4 host : 4 media
APP 2 Lane Assignment	0x5D	0x11	2-way split
APSEL (Page 0x01)	0x80-0x87	0x21 all lanes	APP 2, Datapath 1

11.4 Example 4: QSFP-DD 400G DR4 — Ethernet Leaf Uplink

Deployment: Leaf switch 400G uplink, straight connection

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x50	400GAUI-4-L
APP 1 Media Interface	0x57	0x1C	400GBASE-DR4
APP 1 Lane Count	0x58	0x44	4 host : 4 media
APP 1 Lane Assignment	0x59	0x01	Straight

11.4.1 Example 5: QSFP-DD 400G DR4 — 4x100G Breakout (Ethernet)

Deployment: Leaf to 4 servers, each getting 100G

Register	Address	Value	Description
APP 3 Host Interface	0x5E	0x4C	100GAUI-1-L
APP 3 Media Interface	0x5F	0x14	100GBASE-DR
APP 3 Lane Count	0x60	0x11	1 host : 1 media
APP 3 Lane Assignment	0x61	0x55	4-way split

Register	Address	Value	Description
APSEL (Page 0x01)	0x80-0x83	0x31, 0x32, 0x33, 0x34	APP 3, Datapaths 1-4

11.4.2 Example 6: 400G AOC — Ethernet (Straight)

Deployment: Switch-to-switch within same row, 5m AOC cable

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x50	400GAUI-4-L
APP 1 Media Interface	0x57	0x02	Active Optical (AOC media type)
APP 1 Lane Count	0x58	0x44	4 host : 4 media
APP 1 Lane Assignment	0x59	0x01	Straight

11.4.3 Example 7: 800G AOC Breakout — OSFP to 2xQSFP-DD (Ethernet)

Deployment: Spine OSFP port to two leaf QSFP-DD ports, physical breakout cable

Register	Address	Value	Description
APP 2 Host Interface	0x5A	0x50	400GAUI-4-L
APP 2 Media Interface	0x5B	0x02	Active Optical
APP 2 Lane Count	0x5C	0x44	4 host : 4 media
APP 2 Lane Assignment	0x5D	0x11	2-way split

11.4.4 Example 8: 800G DAC — Ethernet (Same Rack)

Deployment: Top-of-rack, 1.5m passive copper, lowest latency

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x52	800GAUI-8-L
APP 1 Media Interface	0x57	0x04	Passive Copper (DAC)
APP 1 Lane Count	0x58	0x88	8 host : 8 media
APP 1 Lane Assignment	0x59	0x01	Straight

11.4.5 Example 9: 800G DAC Breakout — OSFP to 2xQSFP-DD (Ethernet)

Deployment: Spine to adjacent leaf racks, 2m passive copper breakout

Register	Address	Value	Description
APP 2 Host Interface	0x5A	0x50	400GAUI-4-L
APP 2 Media Interface	0x5B	0x04	Passive Copper
APP 2 Lane Count	0x5C	0x44	4 host : 4 media
APP 2 Lane Assignment	0x5D	0x11	2-way split

11.4.6 Example 10: OSFP 800G FR4 — Ethernet (Building-to-Building)

Deployment: Cross-building link, 2km reach, WDM over 2 fibers

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x52	800GAUI-8-L

Register	Address	Value	Description
APP 1 Media Interface	0x57	0x7A	800GBASE-FR4 (WDM)
APP 1 Lane Count	0x58	0x48	4 host : 8 media (WDM mux)
APP 1 Lane Assignment	0x59	0x01	Straight — WDM cannot breakout

Document version: 1.0

Created: 2026-02-12

Updated: 2026-02-12

W2W Engineering

Specification references: SFF-8024 Rev 4.13 (July 2025), OIF-CMIS-05.2 (April 2022), IEEE 802.3df, IEEE 802.3bs, IEEE 802.3cu

12 APPENDIX A: Ethernet Application Table

Authoritative Source: SFF-8024 Rev 4.13 (July 10, 2025) — Host codes from Table 4-5, MMF media codes from Table 4-6, SMF media codes from Table 4-7.

Scope: CMIS-based modules only (OSFP, QSFP-DD, QSFP112). All host electrical interfaces use PAM4 signaling at 53.125 GBd or 106.25 GBd.

> **IMPORTANT:** MMF and SMF media interface codes are defined in SEPARATE tables with SEPARATE code spaces. The same hex value means different things depending on the media type. Always confirm the media type before looking up a media interface code.

12.1 Host Electrical Interface Codes (SFF-8024 Table 4-5)

These codes identify the electrical signaling between the switch/NIC and the transceiver module.

Hex	Name	Speed	Lanes	Signaling Rate	Modulation	Notes
0x4C	**100GAUI-1-L**	**100G**	**1**	**53.125 GBd**	**PAM4**	**W2W tool confirmed**
0x4B	100GAUI-1-S	100G	1	53.125 GBd	PAM4	Short-reach variant
0x4E	**200GAUI-2-L**	**200G**	**2**	**53.125 GBd**	**PAM4**	**W2W tool confirmed**
0x4D	200GAUI-2-S	200G	2	53.125 GBd	PAM4	Short-reach variant
0x50	**400GAUI-4-L**	**400G**	**4**	**53.125 GBd**	**PAM4**	**W2W tool confirmed**
0x4F	400GAUI-4-S	400G	4	53.125 GBd	PAM4	Short-reach variant
0x52	**800GAUI-8-L**	**800G**	**8**	**53.125 GBd**	**PAM4**	**W2W tool confirmed**
0x51	800GAUI-8-S	800G	8	53.125 GBd	PAM4	Short-reach variant
0x82	800GAUI-4	800G	4	106.25 GBd	PAM4	Newer 200G/lane (Annex 176E)
0x81	400GAUI-2	400G	2	106.25 GBd	PAM4	Newer 200G/lane (Annex 176E)
0x80	200GAUI-1	200G	1	106.25 GBd	PAM4	Newer 200G/lane (Annex 176E)
0x83	1.6TAUI-8	1.6T	8	106.25 GBd	PAM4	Future (Annex 176E)
0x55	1.6TAUI-16-S	1.6T	16	53.125 GBd	PAM4	Future
0x56	1.6TAUI-16-L	1.6T	16	53.125 GBd	PAM4	Future

Bold rows are confirmed in the Wave2Wave transceiver tool and verified against SFF-8024.

> **-S vs -L:** The -S (Short) and -L (Long) variants define the maximum electrical reach between the switch ASIC and the module cage. -L is more common in data center deployments. Both produce identical optical output. When specifying to suppliers, use -L unless the customer's switch documentation specifies otherwise.

12.2 SMF (Single-Mode Fiber) Ethernet Applications

Media interface codes from **SFF-8024 Table 4-7**.

12.2.1 800G — 8-lane (53.125 GBd PAM4)

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR8	**500 m**	**16**	**0x52 (800GAUI-8-L)**	**0x56 (800GBASE-DR8)**	**Clause 124**	**W2W confirmed**
DR8-2	2,000 m	16	0x52 (800GAUI-8-L)	0x57 (800GBASE-DR8-2)	Clause 124	Extended reach DR8

12.2.2 800G — 4-lane (106.25 GBd PAM4, 200G/lane)

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR4	500 m	8	0x82 (800GAUI-4)	0x77 (800GBASE-DR4)	Clause 180	200G/lane, newer
DR4-2	2,000 m	8	0x82 (800GAUI-4)	0x78 (800GBASE-DR4-2)	Clause 181	Extended reach
FR4-500	500 m	2 (WDM)	0x82 (800GAUI-4)	0x79 (800GBASE-FR4-500)	Clause 183	
FR4	2,000 m	2 (WDM)	0x82 (800GAUI-4)	0x7A (800GBASE-FR4)	Clause 183	
LR4	10,000 m	2 (WDM)	0x82 (800GAUI-4)	0x7B (800GBASE-LR4)	Clause 183	

12.2.3 800G Split — 2x400G

In split mode, each half of the module operates as an independent 400G port. The Application Descriptor uses the **400G media interface code** — there is no separate "2xDR4" or "2xFR4" media code. The split is defined by the lane assignment byte.

Config	Reach	Fibers	Host Code (per port)	Media Code (per port)	Lane Assignment
2xDR4	**500 m**	**8 (x2)**	**0x50 (400GAUI-4-L)**	**0x1C (400GBASE-DR4)**	**0x11 (2-way split)**
2xFR4	2,000 m	2 (x2, WDM)	0x50 (400GAUI-4-L)	0x1D (400GBASE-FR4)	0x11 (2-way split)

CORRECTION FROM v1.0: Previous version listed media codes 0x57 and 0x59 for "800G-2xDR4" and "800G-2xFR4" respectively. Per SFF-8024 Rev 4.13, 0x57 = 800GBASE-DR8-2 (extended reach DR8) and 0x59 = ZR300-OFEC-8QAM (OpenZR+). Split configurations use the standard 400G media codes with lane assignment 0x11.

12.2.4 400G — 4-lane (53.125 GBd PAM4)

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR4	**500 m**	**8**	**0x50 (400GAUI-4-L)**	**0x1C (400GBASE-DR4)**	**Clause 124**	**W2W confirmed**
FR4	**2,000 m**	**2 (WDM)**	**0x50 (400GAUI-4-L)**	**0x1D (400GBASE-FR4)**	**Clause 151**	**W2W confirmed**
DR4-2	2,000 m	8	0x50 (400GAUI-4-L)	0x55 (400GBASE-DR4-2)	Clause 124	Extended reach

12.2.5 400G — 2-lane (106.25 GBd PAM4, 200G/lane)

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR2	500 m	4	0x81 (400GAUI-2)	0x75 (400GBASE-DR2)	Clause 180	200G/lane, newer
DR2-2	2,000 m	4	0x81 (400GAUI-2)	0x76 (400GBASE-DR2-2)	Clause 181	Extended reach

12.2.6 200G

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR4	**500 m**	**8**	**0x4E (200GAUI-2-L)**	**0x17 (200GBASE-DR4)**	**Clause 121**	**W2W confirmed**
FR4	2,000 m	2 (WDM)	0x4E (200GAUI-2-L)	0x18 (200GBASE-FR4)	Clause 122	
LR4	10,000 m	2 (WDM)	0x4E (200GAUI-2-L)	0x19 (200GBASE-LR4)	Clause 122	
DR1	500 m	2	0x80 (200GAUI-1)	0x73 (200GBASE-DR1)	Clause 180	200G/lane, newer

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR1-2	2,000 m	2	0x80 (200GAUI-1)	0x74 (200GBASE-DR1-2)	Clause 181	Extended reach

12.2.7 100G

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR	**500 m**	**2**	**0x4C (100GAUI-1-L)**	**0x14 (100GBASE-DR)**	**Clause 140**	**W2W confirmed**
FR1	2,000 m	2	0x4C (100GAUI-1-L)	0x15 (100G-FR MSA)	Clause 140	
LR1	10,000 m	2	0x4C (100GAUI-1-L)	0x16 (100G-LR MSA)	Clause 140	
CWDM4	2,000 m	2 (WDM)	0x4C (100GAUI-1-L)	0x10 (100G CWDM4 MSA)	—	MSA spec
PSM4	500 m	8	0x4C (100GAUI-1-L)	0x0F (100G PSM4 MSA)	—	MSA spec

12.2.8 1600G (Emerging — Not Yet in Production)

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
DR8	500 m	16	0x83 (1.6TAUI-8)	0x7F (1.6TBASE-DR8)	Clause 180	200G/lane
DR8-2	2,000 m	16	0x83 (1.6TAUI-8)	0x80 (1.6TBASE-DR8-2)	Clause 181	Extended reach

12.3 MMF (Multi-Mode Fiber) Ethernet Applications

Media interface codes from **SFF-8024 Table 4-6**. These codes are from a DIFFERENT code space than the SMF table above.

12.3.1 800G — 8-lane

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
SR8	100 m	16	0x52 (800GAUI-8-L)	0x12 (800GBASE-SR8)	Clause 167	
VR8	50 m	16	0x52 (800GAUI-8-L)	0x20 (800GBASE-VR8)	Clause 167	Very short reach
SR4.2	100 m	8 (BiDi)	0x52 (800GAUI-8-L)	0x22 (800G-SR4.2)	—	BiDi over 4 fibers
VR4.2	50 m	8 (BiDi)	0x52 (800GAUI-8-L)	0x21 (800G-VR4.2)	—	BiDi over 4 fibers

12.3.2 400G

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
SR4	100 m	8	0x50 (400GAUI-4-L)	0x11 (400GBASE-SR4)	Clause 167	
VR4	50 m	8	0x50 (400GAUI-4-L)	0x1F (400GBASE-VR4)	Clause 167	Very short reach
SR4.2	100 m	8 (BiDi)	0x50 (400GAUI-4-L)	0x1A (400GBASE-SR4.2)	Clause 150	400GE BiDi
SR8	100 m	16	0x50 (400GAUI-4-L)	0x10 (400GBASE-SR8)	Clause 138	Older 8-lane NRZ

12.3.3 200G

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
SR4	100 m	8	0x4E (200GAUI-2-L)	0x0E (200GBASE-SR4)	Clause 138	
SR2	100 m	4	0x4E (200GAUI-2-L)	0x1B (200GBASE-SR2)	Clause 138	
VR2	50 m	4	0x4E (200GAUI-2-L)	0x1E (200GBASE-VR2)	Clause 167	Very short reach

12.3.4 100G

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
SR1	100 m	2	0x4C (100GAUI-1-L)	0x0D (100GBASE-SR1)	Clause 167	
VR1	50 m	2	0x4C (100GAUI-1-L)	0x1D (100GBASE-VR1)	Clause 167	Very short reach
SR4	100 m	8	0x4C (100GAUI-1-L)	0x09 (100GBASE-SR4)	Clause 95	Older 4-lane NRZ

12.3.5 1600G (Emerging)

PMD	Reach	Fibers	Host Code	Media Code	IEEE Clause	Notes
SR8.2	100 m	16 (BiDi)	0x55/0x56 (1.6TAUI-16)	0x24 (1.6T-SR8.2)	—	BiDi over 8 fibers
VR8.2	50 m	16 (BiDi)	0x55/0x56 (1.6TAUI-16)	0x23 (1.6T-VR8.2)	—	BiDi over 8 fibers

12.4 OSFP 800G DR8 Application Descriptor Reference

This is the canonical Application Descriptor layout for an OSFP 800G DR8 module, verified against real hardware and SFF-8024 Rev 4.13. Suppliers must program these exact values on Page 0x00.

APP	Byte 0: Host Code	Byte 1: Media Code	Byte 2: Lane Count	Byte 3: Lane Assignment	Speed Mode
1	0x52 (800GAUI-8-L)	0x56 (800GBASE-DR8)	0x88 (8:8)	0x01 (straight)	800G
2	0x50 (400GAUI-4-L)	0x1C (400GBASE-DR4)	0x44 (4:4)	0x11 (2-way split)	2x400G
3	0x4E (200GAUI-2-L)	0x17 (200GBASE-DR4)	0x22 (2:2)	0x55 (4-way split)	4x200G
4	0x4C (100GAUI-1-L)	0x14 (100GBASE-DR)	0x11 (1:1)	0xFF (8-way split)	8x100G

Register addresses on Page 0x00:

APP	Host Code	Media Code	Lane Count	Lane Assignment
1	0x56	0x57	0x58	0x59
2	0x5A	0x5B	0x5C	0x5D
3	0x5E	0x5F	0x60	0x61
4	0x62	0x63	0x64	0x65
5-8	0x66-0x72	0x67-0x73	0x68-0x74	0x69-0x75

Lane Count Byte encoding: Upper nibble = host lanes, lower nibble = media lanes. Example: 0x88 = 8 host lanes, 8 media lanes. 0x44 = 4 host, 4 media.

12.5 Common Configuration Combinations

Most frequently ordered configurations for Wave2Wave customers:

Use Case	Form Factor	PMD	Host Code	Media Code	Lane Count	Lane Assign	Media Table
800G Straight	OSFP	DR8	0x52	0x56	0x88	0x01 (1x8)	SMF
800G SR	OSFP	SR8	0x52	0x12	0x88	0x01 (1x8)	MMF
2x400G Split	OSFP	2xDR4	0x50	0x1C	0x44	0x11 (2x4)	SMF
2x400G FR Split	OSFP	2xFR4	0x50	0x1D	0x44	0x11 (2x4)	SMF
4x200G Breakout	OSFP	DR8→4x200G	0x4E	0x17	0x22	0x55 (4x2)	SMF
8x100G Breakout	OSFP	DR8→8x100G	0x4C	0x14	0x11	0xFF (8x1)	SMF
400G Straight	QSFP-DD	DR4	0x50	0x1C	0x44	0x01 (1x4)	SMF
400G Straight	QSFP-DD	FR4	0x50	0x1D	0x44	0x01 (1x4)	SMF
400G Straight	QSFP112	DR4	0x50	0x1C	0x44	0x01 (1x4)	SMF

13 APPENDIX B: InfiniBand Application Table

Authoritative Source: SFF-8024 Rev 4.13 (July 10, 2025) — Host codes from Table 4-5 (InfiniBand section), media codes from Tables 4-6 (MMF) and 4-7 (SMF).

Scope: InfiniBand NDR (400G/800G per port) and future XDR. Applicable to OSFP and QSFP-DD form factors with CMIS management.

13.1 InfiniBand Host Electrical Interface Codes (SFF-8024 Table 4-5)

InfiniBand has its OWN set of host electrical interface codes, separate from Ethernet. These are defined in the InfiniBand Architecture Specification Volume 2.

Hex	Name	Bit Rate Range (Gb/s)	Lane Counts	Signal Rate (GBd)	Modulation
0x2C	IB SDR	2.5 – 30	1, 2, 4, 8, 12	2.5	NRZ
0x2D	IB DDR	5.0 – 60	1, 2, 4, 8, 12	5.0	NRZ
0x2E	IB QDR	10 – 120	1, 2, 4, 8, 12	10.0	NRZ
0x2F	IB FDR	14.06 – 168.75	1, 2, 4, 8, 12	14.0625	NRZ
0x30	IB EDR	25.78 – 309.38	1, 2, 4, 8, 12	25.78125	NRZ
0x31	IB HDR	53.13 – 637.5	1, 2, 4, 8, 12	26.5625	PAM4
0x32	**IB NDR**	**106.25 – 1275**	**1, 2, 4, 8, 12**	**53.125**	**PAM4**
0xA0	IB XDR (placeholder)	—	—	106.25	PAM4
0xA1–0xA7	Reserved for future InfiniBand codes				

CRITICAL NOTE: InfiniBand NDR = 0x32, not 0x52. Code 0x52 is 800GAUI-8-L, an *Ethernet* host electrical interface. While the SerDes signaling (53.125 GBd PAM4) is identical between IB NDR and 800GAUI-8-L, they are assigned DIFFERENT codes in SFF-8024 because they reference different specification documents (InfiniBand Architecture vs IEEE 802.3).

13.2 InfiniBand NDR Configurations

13.2.1 NDR at 800G (8 lanes, straight)

PMD	Media	Reach	Fibers	Host Code	Media Code	Lane Count	Notes
DR8	SMF	500 m	16	0x32 (IB NDR)	0x56 (800GBASE-DR8)	0x88 (8:8)	NVIDIA GB300 compute
SR8	MMF	100 m	16	0x32 (IB NDR)	0x12 (800GBASE-SR8)	0x88 (8:8)	Short-reach compute
FR4	SMF	2,000 m	2 (WDM)	0x32 (IB NDR)	0x7A (800GBASE-FR4)	0x48 (4:8)[1]	Long-reach, 200G/lane

[1] Lane count may vary depending on module implementation. Confirm with supplier.

13.2.2 NDR at 400G (4 lanes)

PMD	Media	Reach	Fibers	Host Code	Media Code	Lane Count	Notes
DR4	SMF	500 m	8	0x32 (IB NDR)	0x1C (400GBASE-DR4)	0x44 (4:4)	GB300 storage port
SR4	MMF	100 m	8	0x32 (IB NDR)	0x11 (400GBASE-SR4)	0x44 (4:4)	Short-reach storage
FR4	SMF	2,000 m	2 (WDM)	0x32 (IB NDR)	0x1D (400GBASE-FR4)	0x44 (4:4)	Long-reach storage

13.2.3 NDR Split — 2x400G

Config	Media	Reach	Host Code	Media Code (per port)	Lane Assign	Notes
2xDR4	SMF	500 m	0x32 (IB NDR)	0x1C (400GBASE-DR4)	0x11 (2-way split)	OSFP dual-port compute
2xSR4	MMF	100 m	0x32 (IB NDR)	0x11 (400GBASE-SR4)	0x11 (2-way split)	Short-reach dual-port

13.2.4 Legacy InfiniBand (200G and below)

Speed	PMD	Media	Reach	Host Code	Notes
200G (HDR)	SR4	MMF	100 m	0x31 (IB HDR)	QSFP-DD or QSFP56
200G (HDR)	DR4	SMF	500 m	0x31 (IB HDR)	
100G (EDR)	SR4	MMF	100 m	0x30 (IB EDR)	QSFP28 (SFF-8636, not CMIS)
100G (EDR)	CWDM4	SMF	2,000 m	0x30 (IB EDR)	

13.3 InfiniBand vs Ethernet: Key Differences for Programming

The HOST ELECTRICAL INTERFACE CODE is the primary difference. Media interface codes are shared (the optics don't care about the protocol), but the host interface code tells the switch ASIC which protocol stack to use.

13.3.1 Host Electrical Interface Code Comparison

Protocol	800G (8-lane)	400G (4-lane)	SFF-8024 Reference
Ethernet	`0x52 (800GAUI-8-L)`	`0x50 (400GAUI-4-L)`	IEEE 802.3 Annex 120G
InfiniBand	`0x32 (IB NDR)`	`0x32 (IB NDR)`[1]	IB Architecture Vol. 2

[1] IB NDR uses the SAME host code (0x32) regardless of lane count. The lane count byte in the Application Descriptor determines whether it runs as 8-lane (800G) or 4-lane (400G).

> **CRITICAL: An InfiniBand module with Ethernet host code (0x52) will NOT work in an InfiniBand fabric. Similarly, an Ethernet module with InfiniBand host code (0x32) will NOT work in Ethernet switches. Always confirm the customer's network protocol before specifying codes to the supplier.**

13.3.2 Media Interface Codes (Same for Both Protocols)

Media codes are protocol-agnostic. Both Ethernet and InfiniBand use the same SFF-8024 media codes:

Media Code	Name	Table	Used By
`0x56`	800GBASE-DR8	4-7 (SMF)	Both Ethernet and IB NDR 800G
`0x12`	800GBASE-SR8	4-6 (MMF)	Both Ethernet and IB NDR 800G
`0x1C`	400GBASE-DR4	4-7 (SMF)	Both Ethernet and IB NDR 400G
`0x1D`	400GBASE-FR4	4-7 (SMF)	Both protocols

13.4 Common InfiniBand Deployments

Platform	Connection	Form Factor	PMD	Speed	Host Code	Media Code
NVIDIA GB300	Compute Port	OSFP	DR8	800G Straight	`0x32 (IB NDR)`	`0x56`
NVIDIA GB300	Compute Port	OSFP	2xDR4	400Gx2 Split	`0x32 (IB NDR)`	`0x1C`
NVIDIA GB300	Storage Port	OSFP	DR4	400G	`0x32 (IB NDR)`	`0x1C`
NVIDIA DGX B200	Compute Port	OSFP	DR8	800G Straight	`0x32 (IB NDR)`	`0x56`
NVIDIA DGX H100	Compute Port	QSFP-DD	DR4	400G (HDR)	`0x31 (IB HDR)`	`0x1C`

13.5 Validation Note

Before first InfiniBand production order, confirm the correct host code by reading the EEPROM from a known-good NVIDIA InfiniBand module (e.g., from a GB300). The customer's switch firmware determines which code is required.

14 APPENDIX C: CMIS Register Reference

Sources of Truth: SFF-8024 Rev 4.13 (July 2025), OIF-CMIS-05.2 (April 2022), and `wave2wave-transceiver-tool/src/lib/cmis.ts`

This appendix contains the authoritative hex values used throughout the SOP and email templates. Host electrical interface codes and media interface codes are from SFF-8024 Rev 4.13. Register layouts are from the OIF CMIS specification. Configuration scenarios are verified against both specs.

14.1 Table 1: Critical Page 0x00 Registers

Address	Name	Description
0x00	Module Identifier	SFF-8024 module type (see Table 5)
0x01	Revision Compliance	CMIS version (see Table 6)
0x02	Module State	Current operational state
0x03	Module Flags	Status flags
0x56-0x59	APP 1 Descriptor	Application 1 (typically 800G) – 4 bytes
0x5A-0x5D	APP 2 Descriptor	Application 2 (typically 400G) – 4 bytes
0x5E-0x61	APP 3 Descriptor	Application 3 (typically 200G) – 4 bytes
0x62-0x65	APP 4 Descriptor	Application 4 (typically 100G) – 4 bytes
0x66-0x69	APP 5 Descriptor	Application 5 (reserved)
0x6A-0x6D	APP 6 Descriptor	Application 6 (reserved)
0x6E-0x71	APP 7 Descriptor	Application 7 (reserved)
0x72-0x75	APP 8 Descriptor	Application 8 (reserved)
0x80-0x8F	Vendor Name	16-byte ASCII string
0xA0-0xAF	Vendor Part Number	16-byte ASCII string
0xB0-0xBF	Vendor Serial Number	16-byte ASCII string
0xC0-0xC7	Date Code	8-byte date code

14.2 Table 2: Application Descriptor Layout

Each Application Descriptor occupies 4 consecutive bytes:

Offset	Name	Purpose
Base + 0	Host Electrical Interface ID	Identifies host-side speed/protocol (see Table 3)
Base + 1	Media Interface ID	Identifies media-side optics type (see Table 4)
Base + 2	Host/Media Lane Count	Upper nibble = host lanes, lower nibble = media lanes
Base + 3	Host Lane Assignment	Defines lane grouping/split mode (see Table 7)

Application Descriptor Addresses:

APP #	Base Address	Address Range	Typical Use
1	0x56	0x56-0x59	800G
2	0x5A	0x5A-0x5D	400G
3	0x5E	0x5E-0x61	200G
4	0x62	0x62-0x65	100G
5	0x66	0x66-0x69	Reserved

APP #	Base Address	Address Range	Typical Use
6	0x6A	0x6A-0x6D	Reserved
7	0x6E	0x6E-0x71	Reserved
8	0x72	0x72-0x75	Reserved

14.3 Table 3: Host Electrical Interface Codes (SFF-8024 Table 4-5)

These values appear in the **first byte** of each Application Descriptor (Base + 0).

14.3.1 Ethernet Host Interface Codes

-L = Long electrical reach (standard for data center modules).

-S = Short electrical reach (for co-packaged or on-board optics). Most data center deployments use -L variants.

14.3.1.1 53.125 GBd (100G/lane, PAM4) — Current Generation

Hex	Name	Speed	Host Lanes	Modulation	Notes
0x4B	100GAUI-1-S	100G	1	PAM4	Short reach
0x4C	100GAUI-1-L	100G	1	PAM4	**Standard**
0x4D	200GAUI-2-S	200G	2	PAM4	Short reach
0x4E	200GAUI-2-L	200G	2	PAM4	**Standard**
0x4F	400GAUI-4-S	400G	4	PAM4	Short reach
0x50	400GAUI-4-L	400G	4	PAM4	**Standard**
0x51	800GAUI-8-S	800G	8	PAM4	Short reach
0x52	800GAUI-8-L	800G	8	PAM4	**Standard**

14.3.1.2 106.25 GBd (200G/lane, PAM4) — Next Generation

Hex	Name	Speed	Host Lanes	Modulation	Notes
0x80	200GAUI-1-S/L	200G	1	PAM4	Annex 176E
0x81	400GAUI-2-S/L	400G	2	PAM4	Annex 176E
0x82	800GAUI-4-S/L	800G	4	PAM4	Annex 176E
0x83	1.6TAUI-8-S/L	1.6T	8	PAM4	Annex 176E

14.3.2 InfiniBand Host Interface Codes

InfiniBand has its OWN set of host electrical interface codes, separate from Ethernet. These are defined in the InfiniBand Architecture Specification Volume 2, NOT IEEE 802.3.

Hex	Name	Signal Rate (GBd)	Modulation	Notes
0x2C	IB SDR	2.5	NRZ	Legacy
0x2D	IB DDR	5.0	NRZ	Legacy
0x2E	IB QDR	10.0	NRZ	Legacy
0x2F	IB FDR	14.0625	NRZ	Legacy
0x30	IB EDR	25.78125	NRZ	100G (QSFP28)
0x31	IB HDR	26.5625	PAM4	200G (QSFP-DD/QSFP56)
0x32	**IB NDR**	**53.125**	**PAM4**	**400G/800G (OSFP)**

Hex	Name	Signal Rate (GBd)	Modulation	Notes
0xA0	IB XDR	106.25	PAM4	Placeholder (future)

CRITICAL: IB NDR uses ONE code (0x32) for BOTH 800G and 400G. The lane count byte in the Application Descriptor determines whether it runs as 8-lane (800G) or 4-lane (400G). There is NO separate "NDR400" code.

WARNING: The value 0x52 serves double duty – it is BOTH the Host Electrical Interface code for 800GAUI-8-L (Ethernet, in APP Descriptor byte 0) AND a valid CMIS Revision Compliance value for CMIS 5.2 (in byte 0x01). The value 0x32 is the InfiniBand NDR host code. An InfiniBand module with code 0x52 will NOT work in an InfiniBand fabric; an Ethernet module with code 0x32 will NOT work in Ethernet switches.

14.4 Table 4: Media Interface Codes (SFF-8024 Tables 4-6 and 4-7)

These values appear in the **second byte** of each Application Descriptor (Base + 1).

IMPORTANT: Media interface codes come from TWO SEPARATE tables in SFF-8024. The same hex value can mean different things depending on fiber type. The Application Descriptor's media code is interpreted based on the module's media type (MMF or SMF). Media codes are protocol-agnostic — the same codes are used by both Ethernet and InfiniBand.

14.4.1 SMF (Single-Mode Fiber) Media Codes — SFF-8024 Table 4-7

Hex	Name	Speed	Reach	Fibers	Notes
0x14	100GBASE-DR	100G	500 m	2	IEEE 802.3ct
0x15	100GBASE-FR1	100G	2 km	2	IEEE 802.3cu
0x16	100GBASE-LR1	100G	10 km	2	IEEE 802.3cu
0x17	200GBASE-DR4	200G	500 m	8	Media: 4x50G NRZ; Host: 2-lane PAM4 (gearbox)
0x1C	400GBASE-DR4	400G	500 m	8	IEEE 802.3bs
0x1D	400GBASE-FR4	400G	2 km	2 (WDM)	IEEE 802.3cu
0x1E	400GBASE-LR4-6	400G	6 km	2 (WDM)	IEEE 802.3cu
0x56	800GBASE-DR8	800G	500 m	16	IEEE 802.3df
0x57	800GBASE-DR8-2	800G	2 km	16	Extended reach DR8
0x77	800GBASE-DR4	800G	500 m	8	200G/lane (future)
0x7A	800GBASE-FR4	800G	2 km	2 (WDM)	200G/lane (future)

14.4.2 MMF (Multi-Mode Fiber) Media Codes — SFF-8024 Table 4-6

Hex	Name	Speed	Reach	Fibers	Notes
0x0D	100GBASE-SR1	100G	100 m	2	IEEE 802.3
0x11	400GBASE-SR4	400G	100 m	8	IEEE 802.3
0x12	800GBASE-SR8	800G	100 m	16	IEEE 802.3df
0x20	800GBASE-VR8	800G	50 m	16	Short reach MMF

CRITICAL — Split configurations do NOT have separate media codes. A "2xDR4" split uses media code 0x1C (400GBASE-DR4) with lane assignment 0x11 (2-way split). A "2xFR4" split uses 0x1D (400GBASE-FR4) with lane assignment 0x11. The module advertises the per-port media type; the lane assignment byte determines how the 8 host lanes are divided.

14.5 Table 5: Module Identifier Codes (Byte 0x00)

Per SFF-8024 standard. These identify the physical form factor of the module.

Hex Code	Module Type	In Scope for this SOP?
0x19	OSFP	Yes
0x18	QSFP-DD	Yes
0x1E	QSFP112	Yes
0x11	QSFP28	Boundary (QSFP56 variants only)
0x0D	QSFP+	No – uses SFF-8636, not CMIS
0x03	SFP/SFP+	No – uses SFF-8472, not CMIS

14.6 Table 6: CMIS Revision Compliance (Byte 0x01)

The CMIS revision compliance byte uses the **upper nibble** for the major version number.

Hex Value	CMIS Version	Notes
0x30	CMIS 3.0	Older, widely supported
0x40	CMIS 4.0	Common in 100G/400G modules
0x50	CMIS 5.0	Current standard for 800G
0x51	CMIS 5.1	Check target switch support
0x52	CMIS 5.2	Check target switch support

Version Detection Logic (from `detectCMISVersion()` in cmis.ts): - Byte 0x01 >= 0x50 → CMIS 5.x - Byte 0x01 >= 0x40 → CMIS 4.x - Otherwise → CMIS 3.x

CRITICAL: The exact revision value programmed into the module must match what the customer's target switch supports. A module programmed as CMIS 5.2 (0x52) will be rejected by a switch that only supports CMIS 5.0 (0x50). Always confirm with the customer's switch manufacturer/model/OS version before specifying the revision to the supplier.

> **COLLISION WARNING:** The hex value 0x52 appears in TWO completely different contexts: (1) CMIS Revision 5.2 at byte address 0x01, and (2) 800GAUI-8-L Ethernet host interface code at APP Descriptor byte 0 (addresses 0x56, 0x5A, 0x5E, 0x62). Always specify which register you are discussing to prevent supplier confusion.

14.7 Table 7: Lane Assignment Codes

These values appear in the **fourth byte** of each Application Descriptor (Base + 3). They define how the 8 host lanes are grouped.

Hex Code	Mode	Lane Grouping	Split Description
0x01	Straight (no split)	All 8 lanes → 1 group	1x8
0x11	2-way split	Lanes 0-3 → Group 1, Lanes 4-7 → Group 2	2x4
0x55	4-way split	Lanes 0-1, 2-3, 4-5, 6-7 → 4 groups	4x2
0xFF	8-way split	Each lane independent	8x1

14.8 Table 8: Connector Type Codes

Hex Code	Connector Type
0x00	Unknown
0x01	SC
0x07	LC
0x0B	MPO (1x12)
0x0C	MPO (1x16)
0x23	No separable connector

14.9 Table 9: Media Type Codes (CMIS 3.x/4.x)

Hex Code	Media Type
0x00	Undefined
0x01	MMF (Multi-Mode Fiber)
0x02	SMF (Single-Mode Fiber)
0x03	Active Copper
0x04	Passive Copper
0x05	Base-T

14.10 Table 10: Configuration Scenarios

Pre-validated configurations. Each scenario includes the exact register values for all 4 Application Descriptor bytes. Ethernet scenarios verified against OSFP_800G_APPLICATION_DESCRIPTORS in cmis.ts and SFF-8024 Rev 4.13. InfiniBand scenarios verified against SFF-8024 Rev 4.13 Table 4-5.

14.10.1 Ethernet — OSFP 800G DR8 (Straight 800G)

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x52	800GAUI-8-L
APP 1 Media Interface	0x57	0x56	800GBASE-DR8 (SMF Table 4-7)
APP 1 Lane Count	0x58	0x88	8 host : 8 media
APP 1 Lane Assignment	0x59	0x01	Straight (no split)
APSEL (Page 0x01, 0x80-0x87)	—	0x11 all 8 lanes	APSEL 1, Datapath 1 (CMIS 5.x only)

14.10.2 Ethernet — OSFP 2xDR4 (Split 2x400G)

Register	Address	Value	Description
APP 2 Host Interface	0x5A	0x50	400GAUI-4-L
APP 2 Media Interface	0x5B	0x1C	400GBASE-DR4 (SMF Table 4-7)
APP 2 Lane Count	0x5C	0x44	4 host : 4 media
APP 2 Lane Assignment	0x5D	0x11	2-way split
APSEL (Page 0x01, 0x80-0x87)	—	0x21 all 8 lanes	APSEL 2, Datapath 1 (CMIS 5.x only)
DataPath (Page 0x11, 0x80-0x87)	—	Lanes 0-3: 0x01, Lanes 4-7: 0x02	Per-port datapath assignment

14.10.3 Ethernet — OSFP DR8 Breakout (4x200G)

Register	Address	Value	Description
APP 3 Host Interface	0x5E	0x4E	200GAUI-2-L
APP 3 Media Interface	0x5F	0x17	200GBASE-DR4 (SMF Table 4-7)
APP 3 Lane Count	0x60	0x22	2 host : 2 media
APP 3 Lane Assignment	0x61	0x55	4-way split
APSEL (Page 0x01, 0x80-0x87)	—	Lanes 0-1: 0x31, 2-3: 0x32, 4-5: 0x33, 6-7: 0x34	CMIS 5.x only

14.10.4 Ethernet — OSFP DR8 Breakout (8x100G)

Register	Address	Value	Description
APP 4 Host Interface	0x62	0x4C	100GAUI-1-L
APP 4 Media Interface	0x63	0x14	100GBASE-DR (SMF Table 4-7)
APP 4 Lane Count	0x64	0x11	1 host : 1 media
APP 4 Lane Assignment	0x65	0xFF	8-way split
APSEL (Page 0x01, 0x80-0x87)	—	Lane 0: 0x41, Lane 1: 0x42, … Lane 7: 0x48	CMIS 5.x only

14.10.5 Ethernet — QSFP-DD DR4 (400G)

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x50	400GAUI-4-L
APP 1 Media Interface	0x57	0x1C	400GBASE-DR4 (SMF Table 4-7)
APP 1 Lane Count	0x58	0x44	4 host : 4 media
APP 1 Lane Assignment	0x59	0x01	Straight (no split)

14.10.6 Ethernet — QSFP112 DR4 (400G)

Register	Address	Value	Description	Notes
APP 1 Host Interface	0x56	0x50	400GAUI-4-L	
APP 1 Media Interface	0x57	0x1C	400GBASE-DR4 (SMF Table 4-7)	
APP 1 Lane Count	0x58	0x44	4 host : 4 media	**CRITICAL: Must be 0x44, NOT 0x88**
APP 1 Lane Assignment	0x59	0x01	Straight (no split)	

QSFP112 CONSTRAINT: QSFP112 modules have only 4 lanes. Lane Count byte MUST be 0x44 (4 host : 4 media). A value of 0x88 (8:8) will cause the module to fail.

14.10.7 InfiniBand NDR — OSFP 800G (Straight)

Per SFF-8024 Table 4-5: IB NDR = 0x32. Media codes are shared with Ethernet (protocol-agnostic).

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x32	IB NDR

Register	Address	Value	Description
APP 1 Media Interface	0x57	0x56	800GBASE-DR8 (SMF Table 4-7)
APP 1 Lane Count	0x58	0x88	8 host : 8 media
APP 1 Lane Assignment	0x59	0x01	Straight (no split)

14.10.8 InfiniBand NDR — OSFP 2x400G (Split)

Same host code 0x32 — lane count and assignment determine the split mode.

Register	Address	Value	Description
APP 2 Host Interface	0x5A	0x32	IB NDR (same code as 800G)
APP 2 Media Interface	0x5B	0x1C	400GBASE-DR4 (SMF Table 4-7)
APP 2 Lane Count	0x5C	0x44	4 host : 4 media
APP 2 Lane Assignment	0x5D	0x11	2-way split

14.10.9 InfiniBand NDR — OSFP 400G (Straight, Storage Port)

Register	Address	Value	Description
APP 1 Host Interface	0x56	0x32	IB NDR
APP 1 Media Interface	0x57	0x1C	400GBASE-DR4 (SMF Table 4-7)
APP 1 Lane Count	0x58	0x44	4 host : 4 media
APP 1 Lane Assignment	0x59	0x01	Straight (no split)

> **VALIDATION NOTE:** The cmis.ts `CONFIGURATION_SCENARIOS` for InfiniBand uses `hostApp: 0x52` and a separate "NDR400" code `0x53`. Per SFF-8024, the correct IB NDR host code is **0x32**, and there is no separate "NDR400" code. The lane count byte (0x88 vs 0x44) and lane assignment byte determine whether IB NDR runs as 800G or 400G. This should be validated against a real NVIDIA InfiniBand module (e.g., from a GB300) to confirm which code the module actually advertises.

14.11 Page 0x01: Application Select Registers

Per-lane APSEL assignment for CMIS 5.x modules.

Address	Lane
0x80	Lane 1
0x81	Lane 2
0x82	Lane 3
0x83	Lane 4
0x84	Lane 5
0x85	Lane 6
0x86	Lane 7
0x87	Lane 8
0x88	Data Path State Lane 1-4
0x89	Data Path State Lane 5-8

APSEL byte encoding: Upper nibble = Application number (1-8), lower nibble = Datapath ID. - Example: 0x11 = APSEL 1, Datapath 1 - Example: 0x21 = APSEL 2, Datapath 1

14.12 Page 0x11: Active Control Set

Per-lane active configuration for CMIS 5.x modules.

Address	Lane
0x80-0x87	Active Control Set Lanes 1-8

14.13 Lane Datapath Status Values

Used in deployment verification (Phase 3) when reading switch CLI output.

14.13.1 Configuration Status

Status	Meaning	OK?
CONFIG_ACCEPTED	Configuration accepted by module	Yes
CONFIG_SUCCESS	Configuration successful	Yes
CONFIG_IN_PROGRESS	Configuration being applied	Yes (transient)
CONFIG_UNDEFINED	Not configured	No
CONFIG_REJECTED_UNKNOWN	Rejected for unknown reason	**No – STOP**
CONFIG_REJECTED_INVALID	Rejected, invalid configuration	**No – STOP**
CONFIG_REJECTED_UNSUPPORTED	Rejected, unsupported	**No – STOP**

14.13.2 Datapath State

State	Meaning	Active?
DATAPATH_STATE_ACTIVATED	Fully operational	Yes
DATAPATH_STATE_INITIALIZED	Initialized and ready	Yes
DATAPATH_STATE_TX_TURN_ON	Transmitter turning on	Yes (transient)
DATAPATH_STATE_INIT	Initializing	No (transient)
DATAPATH_STATE_DEACTIVATED	Not active	No
DATAPATH_STATE_DEINIT	Deinitializing	No
DATAPATH_STATE_TX_TURN_OFF	Transmitter turning off	No

14.14 Validation Rules

14.14.1 Rule 1: QSFP112 Lane Count

QSFP112 modules have 4 lanes only. Lane Count byte **MUST** be 0x44 (4:4). Reject 0x88 (8:8).

14.14.2 Rule 2: OSFP 800G Lane Count

OSFP 800G modules (DR8, SR8) must have Lane Count byte 0x88 (8:8) for straight mode. Split modes (2xDR4) use 0x44 (4:4) with Lane Assignment 0x11.

14.14.3 Rule 3: InfiniBand Host Interface Code

InfiniBand NDR modules **MUST** use host code **0x32** (IB NDR) per SFF-8024. The same code 0x32 is used for both 800G (8-lane) and 400G (4-lane) configurations — the lane count byte differentiates them. Do **NOT** use 0x52 (800GAUI-8-L) or 0x50 (400GAUI-4-L) for InfiniBand — those are Ethernet-only codes.

14.14.4 Rule 4: Ethernet Host Interface Code

Ethernet modules use host codes from the IEEE 802.3 range: 0x4C (100GAUI-1-L), 0x4E (200GAUI-2-L), 0x50 (400GAUI-4-L), 0x52 (800GAUI-8-L). Do **NOT** use 0x32 (IB NDR) or any InfiniBand code for Ethernet modules.

14.14.5 Rule 5: Protocol / Host Code Cross-Check

The host electrical interface code in the Application Descriptor **MUST** match the customer's network protocol: - Ethernet fabric → Ethernet host codes (0x4B-0x52, 0x80-0x83) - InfiniBand fabric → InfiniBand host codes (0x2C-0x32)

A module with the wrong protocol's host code will not link up, even though the SerDes signaling is electrically identical.

14.14.6 Rule 6: CMIS Revision Must Match Target Switch

The CMIS revision byte (address 0x01) must match what the customer's switch supports. This is determined during the customer requirements gathering phase. If using the W2W Transceiver Programming SOP, this corresponds to Phase 0 and EMAIL-01.

14.14.7 Rule 7: Media Code Must Come from Correct Table

SMF modules use media codes from SFF-8024 Table 4-7. MMF modules use media codes from Table 4-6. Do not mix code spaces — the same hex value can have different meanings in the two tables.

15 APPENDIX D: CLI Verification Commands

Purpose: Commands for verifying transceiver CMIS configuration from the switch CLI. Used during deployment verification. If using the W2W Transceiver Programming SOP, this corresponds to Phase 3 and EMAIL-06 (Customer Quick Start).

Data Source: Real switch output captured from Cisco NX-OS during OSFP 800G DR8 deployment testing.

15.1 Cisco NX-OS (Nexus 9000 Series)

15.1.1 Command 1: Read APSEL / Application Descriptors

```
show hardware internal linkctrl xcvr fcot-info front-port <PORT> raw
```

What it shows: Module identifier, CMIS revision, connector type, and all Application Select entries with hex codes.

Key fields to verify:

Field	What to Check	Example Good Value
ID	Module form factor	`OSFP(0x19)`
Version ID	CMIS revision	`Revision(0x52) = CMIS 5.2`
Connector type	Physical connector	`MPO(1x12)(0xc)`
Host Electrical Interface Code (ApSel N)	Host-side protocol/speed	`800GAUI-8-L (0x52)`
Media Interface Advertising Code (ApSel N)	Media-side optics type	`800G DR8 (0x56)`
Host Lane Count : Media Lane count	Lane configuration	`8 : 8`
Host Lane Assignment	Lane grouping	`0x1 (straight)`
Media Lane Assignment	Media lane grouping	`0x1 (straight)`

Example output (OSFP 800G DR8 — PASS):

```
QSFP-DD XCVR
ID                                      OSFP(0x19)
Version ID                              Revision(0x52)
Connector type                          MPO(1x12)(0xc)

APSEL 1:=
Host Electrical Interface Code (ApSel 1): 800GAUI-8-L (0x52)
Media Interface Advertising Code (ApSel 1): 800G DR8 (0x56)
Host Lane Count : Media Lane count      8 : 8
Host Lane Assignment                    0x1
Media Lane Assignment                   0x1
APSEL 2:=
Host Electrical Interface Code (ApSel 2): 400GAUI-4-L (0x50)
Media Interface Advertising Code (ApSel 2): 400GBASE-DR4 (0x1C)
Host Lane Count : Media Lane count      4 : 4
Host Lane Assignment                    0x11
Media Lane Assignment                   0x11
APSEL 3:=
Host Electrical Interface Code (ApSel 3): 200GAUI-2-L (0x4E)
Media Interface Advertising Code (ApSel 3): 200GBASE-DR4 (0x17)
```

```
Host Lane Count : Media Lane count     2 : 2
Host Lane Assignment                   0x55
Media Lane Assignment                  0x55
APSEL 4:=
Host Electrical Interface Code (ApSel 4): 100GAUI-1-L (0x4C)
Media Interface Advertising Code (ApSel 4): 100GBASE-DR (0x14)
Host Lane Count : Media Lane count     1 : 1
Host Lane Assignment                   0xff
Media Lane Assignment                  0xff
```

Note: Cisco NX-OS may display connector code 0x0C as "MPO(1x12)". Per SFF-8024, code 0x0C is MPO 1x16 (16-fiber). The display label is a known NX-OS rendering issue. Verify the physical connector by inspection if the CLI label does not match the expected MPO-16 for DR8 modules.

> **Verification checklist for 800G DR8 Ethernet:** 1. APSEL 1 Host Code = 0x52 (800GAUI-8-L) 2. APSEL 1 Media Code = 0x56 (800G DR8) 3. APSEL 1 Lane Count = 8:8 4. APSEL 1 Host Lane Assignment = 0x1 (straight) 5. APSEL 1 Media Lane Assignment = 0x1 (straight) — **MUST match Host** 6. Version ID matches what was specified in the customer requirements

15.1.2 Command 2: Read Lane State and Datapath Status

```
show hardware internal linkctrl xcvr lane-state-info front-port <PORT>
```

What it shows: Module state, per-lane config acceptance status, per-lane datapath activation state, and APSEL assignments per lane.

Key fields to verify:

Field	PASS Criteria	FAIL — Stop Immediately
Module State	MODULE_READY	MODULE_LOW_POWER, MODULE_FAULT
Lane N Config Status	CONFIG_ACCEPTED (all lanes)	CONFIG_REJECTED_UNKNOWN on ANY lane
Lane N Datapath State	DATAPATH_STATE_ACTIVATED (all lanes)	DATAPATH_STATE_DEACTIVATED on ANY lane
APSELCODE (all lanes)	Same APSEL on all active lanes	APSEL0 on any lane = not configured

Example output — PASS (all 8 lanes active):

```
Module State:= MODULE_READY

Lane Datapath Config Status:=
Lane 0: CONFIG_ACCEPTED
Lane 1: CONFIG_ACCEPTED
Lane 2: CONFIG_ACCEPTED
Lane 3: CONFIG_ACCEPTED
Lane 4: CONFIG_ACCEPTED
Lane 5: CONFIG_ACCEPTED
Lane 6: CONFIG_ACCEPTED
Lane 7: CONFIG_ACCEPTED
Lane Datapath State:=
Lane 0: DATAPATH_STATE_ACTIVATED
Lane 1: DATAPATH_STATE_ACTIVATED
Lane 2: DATAPATH_STATE_ACTIVATED
```

```
Lane 3: DATAPATH_STATE_ACTIVATED
Lane 4: DATAPATH_STATE_ACTIVATED
Lane 5: DATAPATH_STATE_ACTIVATED
Lane 6: DATAPATH_STATE_ACTIVATED
Lane 7: DATAPATH_STATE_ACTIVATED

Stage Control Set0:=
====================
                     L0     L1     L2     L3     L4     L5     L6     L7
APSELCODE:         APSEL1 APSEL1 APSEL1 APSEL1 APSEL1 APSEL1 APSEL1 APSEL1
Datapath Code:       0      0      0      0      0      0      0      0
Explicit Control:    0      0      0      0      0      0      0      0
```

Source: Port-53-Success.txt, Port-17-Success.txt — real Cisco NX-OS output

Example output — FAIL (lanes 4-7 rejected):

```
Module State:= MODULE_READY

Lane Datapath Config Status:=
Lane 0: CONFIG_ACCEPTED
Lane 1: CONFIG_ACCEPTED
Lane 2: CONFIG_ACCEPTED
Lane 3: CONFIG_ACCEPTED
Lane 4: CONFIG_REJECTED_UNKNOWN
Lane 5: CONFIG_REJECTED_UNKNOWN
Lane 6: CONFIG_REJECTED_UNKNOWN
Lane 7: CONFIG_REJECTED_UNKNOWN
Lane Datapath State:=
Lane 0: DATAPATH_STATE_ACTIVATED
Lane 1: DATAPATH_STATE_ACTIVATED
Lane 2: DATAPATH_STATE_ACTIVATED
Lane 3: DATAPATH_STATE_ACTIVATED
Lane 4: DATAPATH_STATE_DEACTIVATED
Lane 5: DATAPATH_STATE_DEACTIVATED
Lane 6: DATAPATH_STATE_DEACTIVATED
Lane 7: DATAPATH_STATE_DEACTIVATED
```

Source: Port-61-Fail.txt, Port-49-Config_Rejected.txt — real Cisco NX-OS output.

15.1.3 Command 3: Basic Transceiver Information

```
show interface Ethernet1/<PORT> transceiver details
```

What it shows: High-level transceiver info including vendor, part number, serial number, type. Useful for quick identification but does NOT show APSEL hex codes.

15.1.4 Command 4: Interface Status

```
show interface Ethernet1/<PORT> status
show interface Ethernet1/<PORT> brief
```

What it shows: Link state (up/down), speed, duplex. First check before deep CMIS diagnostics.

15.1.5 Additional NX-OS Diagnostic Commands

```
# Module-level CMIS raw dump (all pages)
show hardware internal linkctrl xcvr info front-port <PORT>

# Lane fault flags (optical power, electrical issues)
show hardware internal linkctrl xcvr lane-fault-flags front-port <PORT>

# VDM (Vendor Diagnostic Monitoring) data
show hardware internal linkctrl xcvr vdm front-port <PORT>
```

15.2 Arista EOS

15.2.1 Command 1: Transceiver Details

```
show interfaces Ethernet<PORT> transceiver detail
```

What it shows: Transceiver vendor info, type, DOM (Digital Optical Monitoring) values, and transceiver capabilities.

15.2.2 Command 2: Hardware Transceiver Detail

```
show interfaces Ethernet<PORT> hardware detail
```

What it shows: Lower-level hardware information including CMIS state, lane status, and configuration.

15.2.3 Command 3: Transceiver Properties

```
show interfaces Ethernet<PORT> transceiver properties
```

What it shows: CMIS Application Descriptors, connector type, and module capabilities. Closest Arista equivalent to the NX-OS `fcot-info` command.

15.2.4 Command 4: DOM (Digital Optical Monitoring)

```
show interfaces Ethernet<PORT> transceiver dom
```

What it shows: Real-time optical power levels per lane (Tx and Rx), temperature, voltage. Useful for verifying optical link quality after configuration acceptance.

15.3 NVIDIA MLNX-OS / Cumulus

15.3.1 Command 1: Transceiver Information

```
# MLNX-OS (Onyx)
show interfaces ethernet 1/<PORT> transceiver
show interfaces ethernet 1/<PORT> transceiver details

# Cumulus Linux
ethtool -m swp<PORT>
mlxlink -d /dev/mst/mt4129_pciconf0 -p <PORT>
```

15.3.2 Command 2: Cable/Module Diagnostics

```
# MLNX-OS
show interfaces ethernet 1/<PORT> module-info

# mlxlink (NVIDIA firmware tool – works on all NVIDIA platforms)
mlxlink -d /dev/mst/mt4129_pciconf0 -p <PORT> --cable
mlxlink -d /dev/mst/mt4129_pciconf0 -p <PORT> --show_fec
```

15.3.3 Command 3: CMIS Raw Register Read

```
# Read specific CMIS page/byte via mlxlink
mlxlink -d /dev/mst/mt4129_pciconf0 -p <PORT> --cable --read --page <PAGE> --
offset <OFFSET>

# Example: Read CMIS revision byte (Page 0x00, Byte 0x01)
mlxlink -d /dev/mst/mt4129_pciconf0 -p <PORT> --cable --read --page 0 --offse
t 1
```

> **Note:** The `mlxlink` tool is available on all NVIDIA networking platforms (ConnectX NICs, Spectrum switches) and provides the most detailed CMIS diagnostic access. The device path (`/dev/mst/mt4129_pciconf0`) varies by platform — use `mst status` to find the correct path.

15.4 Quick Verification Procedure (All Platforms)

Use this procedure for Phase 3 deployment verification:

15.4.1 Step 1: Confirm Link Up

Platform	Command
Cisco NX-OS	show interface Ethernet1/<PORT> brief
Arista EOS	show interfaces Ethernet<PORT> status
NVIDIA MLNX-OS	show interfaces ethernet 1/<PORT>

Expected: Link status = up, Speed = expected (800G, 400G, etc.)

15.4.2 Step 2: Verify APSEL Configuration

Platform	Command
Cisco NX-OS	show hardware internal linkctrl xcvr fcot-info front-port <PORT> raw
Arista EOS	show interfaces Ethernet<PORT> transceiver properties
NVIDIA	mlxlink -d <DEV> -p <PORT> --cable

Check: Host Interface Code, Media Interface Code, Lane Count, Lane Assignment match the customer requirements specification.

15.4.3 Step 3: Verify All Lanes Accepted

Platform	Command
Cisco NX-OS	show hardware internal linkctrl xcvr lane-state-info front-port <PORT>
Arista EOS	show interfaces Ethernet<PORT> hardware detail

Platform	Command
NVIDIA	mlxlink -d <DEV> -p <PORT>

PASS: All active lanes show CONFIG_ACCEPTED and DATAPATH_STATE_ACTIVATED. **FAIL:** ANY lane shows CONFIG_REJECTED_UNKNOWN — STOP. Do not install remaining modules. Contact W2W Engineering.

15.4.4 Step 4: Verify Optical Power (Optional but Recommended)

Platform	Command
Cisco NX-OS	show interface Ethernet1/<PORT> transceiver details
Arista EOS	show interfaces Ethernet<PORT> transceiver dom
NVIDIA	mlxlink -d <DEV> -p <PORT> --show_fec

Check: All lanes showing valid Tx/Rx power levels (not 0.0000 mW or -inf dBm).

15.5 PASS / FAIL Decision Matrix

Condition	Verdict	Action
All lanes CONFIG_ACCEPTED + ACTIVATED	**PASS**	Proceed with installation
All lanes CONFIG_ACCEPTED + INITIALIZED	**PASS** (warming up)	Wait 30 seconds, re-check
Some lanes CONFIG_ACCEPTED, some REJECTED	**FAIL**	Stop. Contact W2W Engineering with lane-state-info output.
Module state = MODULE_LOW_POWER	**WAIT**	Module is initializing. Wait 60 seconds
Module state = MODULE_FAULT	**FAIL**	Hardware issue. Try different port/module
All lanes DEACTIVATED	**FAIL**	Configuration not applied. Check APSEL
APSEL0 on any lane	**FAIL**	Lane has no active configuration

16 Revision History

Revision	Date	Author	Notes
1.0	2026-02-13	W2W Engineering	Initial release