Multifiber MDIs
Regarding Comment #I-33 on D3.0

Earl Parsons, CommScope

IEEE 802.3db Ad Hoc Meeting
April 14, 2022

No IEC standard with grade 1m will be published in time for IEEE 802.3db

- The last sentence in 167.10.3.3 refers to grade Bm/1m
- Grade 1m is currently undefined in these publications
- Grade 1m defined in drafts as
  - ≥ 45 dB mated
  - ≥ 35 dB unmated
- IEC 63267-1 (APC MM interface specification) is scheduled to publish in January 2023, after September 2022, when we expect 802.3db to publish
- Informative APC option could be considered by the Task Force

167.10.3.3 MDI requirements for 200GBASE-VR2, 400GBASE-VR4, 200GBASE-SR2, and 400GBASE-SR4

The MDI shall optically mate with the compatible plug on the optical fiber cabling. For 200GBASE-VR2, 400GBASE-VR4, 200GBASE-SR2, and 200GBASE-SR4 the MDI adapter or receptacle shall meet the dimensional specifications for interface 7-1-3: *MPO adapter interface - Opposed keyway configuration*, or interface 7-1-9: *MPO active device receptacle, angled interface*, as defined in IEC 61754-7-1. The plug terminating the optical fiber cabling shall meet the dimensional specifications of interface 7-1-1: *MPO female plug connector, down-angled interface for 2 to 12 fibres*, as defined in IEC 61754-7-1. Figure 167–9 shows an MPO female plug connector with angled interface, and an MDI. The MDI connection shall meet the interface performance specifications of IEC 61753-1 and IEC 61753-022-2 (for category C environment) for performance grade Bm/1m.

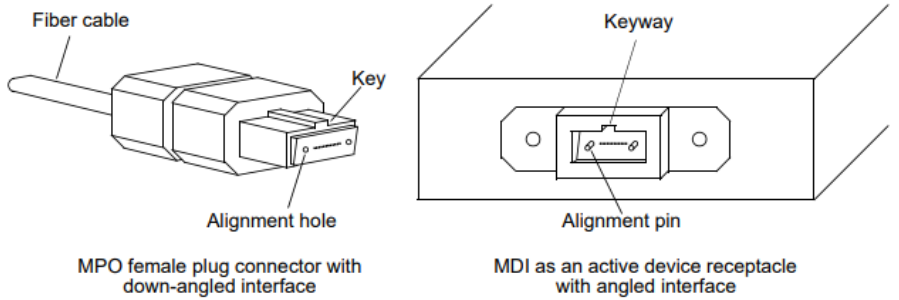


Figure 167–9—MPO female plug with down-angled interface and MDI active device receptacle with angled interface

Use D1.2 Option B for PC

- Change 167.10.3.3 with editorial license to:
- The MDI shall optically mate with the compatible plug on the optical fiber cabling. For 200GBASE-VR2, 400GBASE-VR4, 200GBASE-SR2, and 200GBASE-SR4 the MDI adapter or receptacle shall meet the dimensional specifications for interface 7-1-3: MPO adapter interface - Opposed keyway configuration, or interface 7-1-~~9~~10: MPO active device receptacle, ~~angled~~ flat interface, as defined in IEC 61754-7-1. The plug terminating the optical fiber cabling shall meet the dimensional specifications of interface 7-1-~~1~~4: MPO female plug connector, ~~down-angled~~ flat interface for 2 to 12 fibres, as defined in IEC 61754-7-1. Figure 167–9 shows an MPO female plug connector with ~~angled~~ flat interface, and an MDI. The MDI connection shall meet the interface performance specifications of IEC 61753-1 and IEC 61753-022-2 (for category C environment) for performance grade Bm/~~1~~2m.
- Replace Figure 167-9 and caption in D3.0 with Figure 167-11 and caption from D1.2

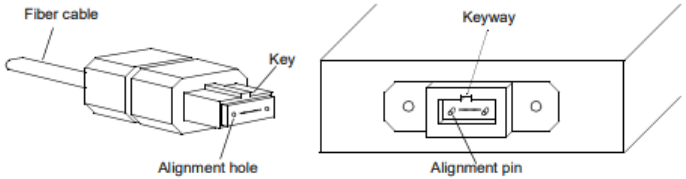
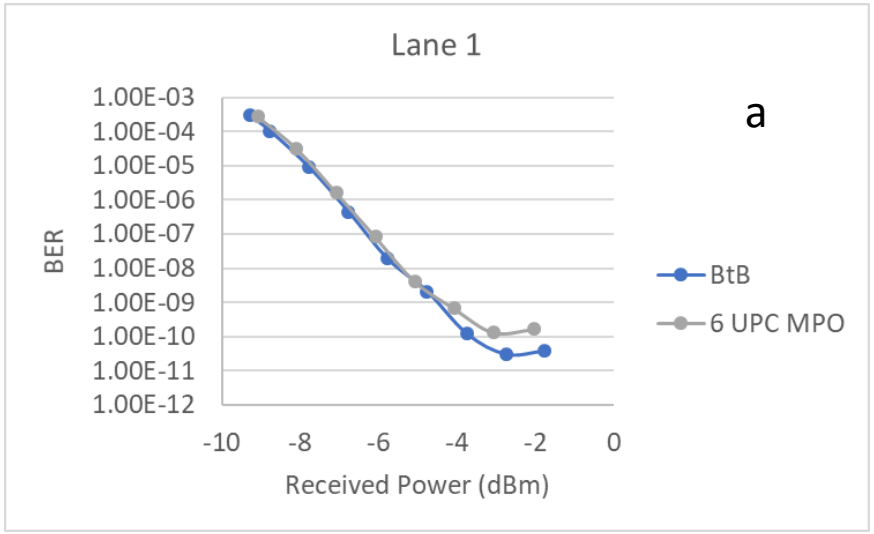


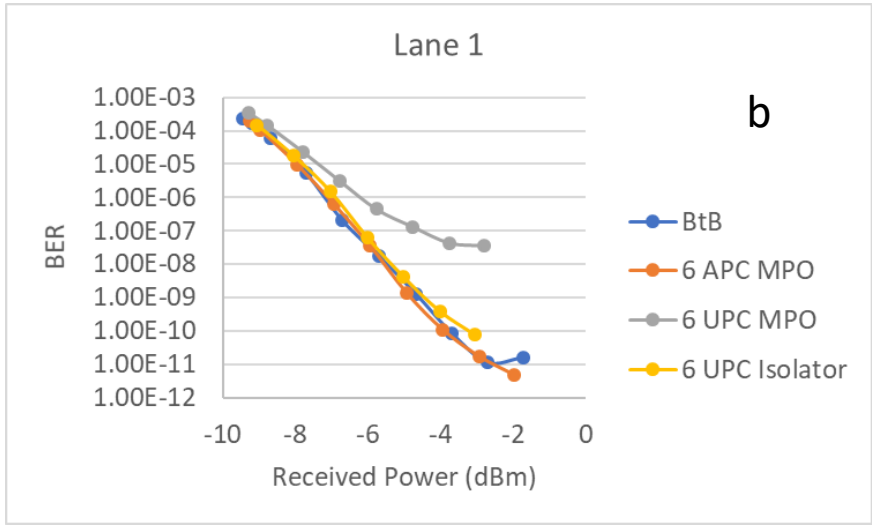
Figure 167–11—MPO female plug with flat interface and MDI active device receptacle with flat interface

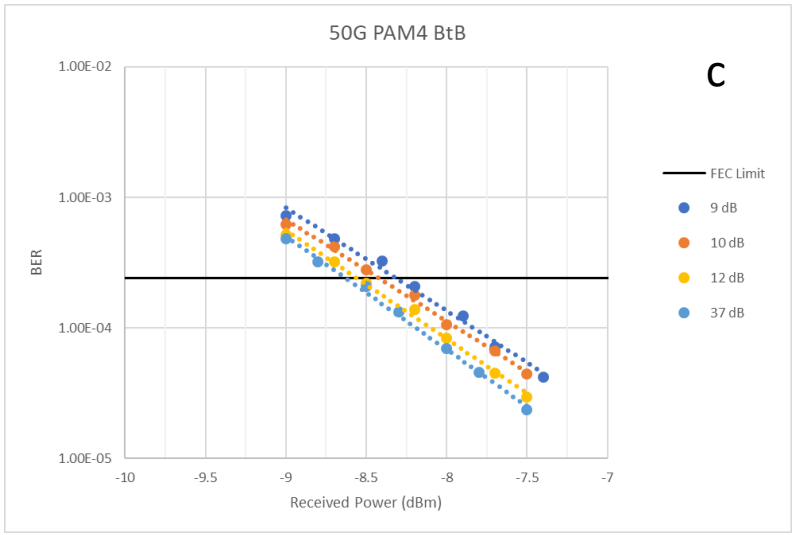
PAM4 signaling will still work over PC multimode connectors

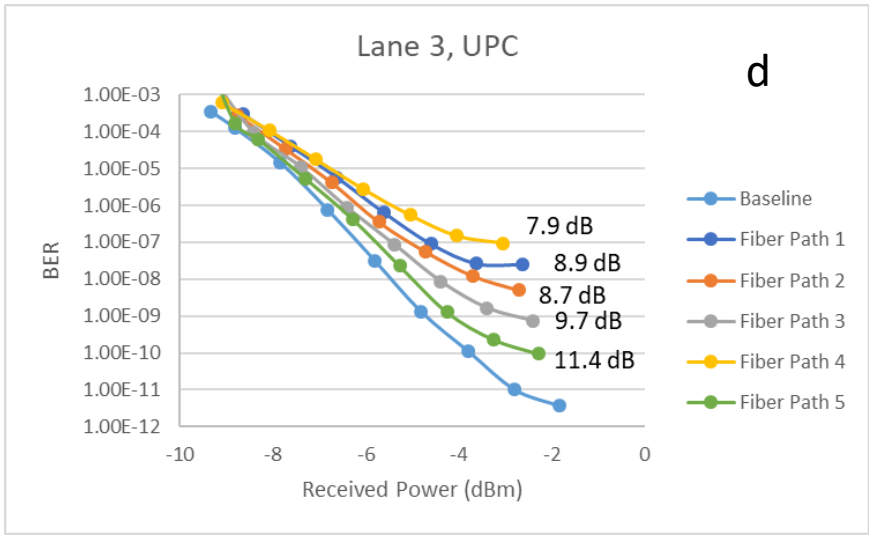
- Links using PC or APC MPO connectors have the same BER performance provided there are no air gaps between the fibers (parsons_3db_adhoc_01_062520)
- PC connectors with air gaps can introduce a BER penalty to PAM4 signals (parsons_3db_adhoc_01_062520)
  - Contamination and/or poor polishing can introduce air gaps
  - Problem is light reflected to Tx, not MPI
  - BER penalty even if MDI is angled
- APC MPO connectors offer insurance against poor performance
  - High RL even when air gaps are present
  - Increase reliability of fiber links
- Relative cost of PC and APC MPO connectors is the same
- Insertion loss of PC and APC MPO connectors is the same

Experimental results using commercially available 400G-SR8 transceiver









- APC connectors introduce no BER penalty (b)
- Well behaved PC connectors introduce no penalty (a)
- Air gap PC connectors introduce penalty (b)
- Penalty scales with link RL (c, d)
- Isolator eliminates penalty from air gap PC (b)

- E. Parsons, IWCS 2019
- E. Parsons IWCS 2020

History of MDIs in 802.3db

- D0.1 only included flat MDI
  - parsons_3db_adhoc_01_040121 recommended adding APC option
  - shen_3db_01a_110520 advocated APC MPO8 connectors for 400G-SR4
- D0.2-D1.2 included both flat and angled options
  - xie_3db_01_051321 recommended APC MPO connectors
- D1.3-3.0 included only angled MDI
  - Comment # 72 on D1.2 and swanson_3db_01_090921 proposed limiting to one option, APC was chosen

A history of MDIs for PAM4 transceivers

- 802.3cd included 200G-SR4
  - SR4 specify flat MPO8 MDI
  - This has been largely ignored by the industry
  - Both angled and flat transceivers manufactured
- 802.3cm included 400G-SR8 and 400G-SR4.2
  - SR8 specified flat MPO16 or flat MPO24
  - This has been completely ignored by the industry
  - I’ve only found angled transceivers with MPO16
  - SR4.2 specified flat MPO8
  - 400G-SR4.2 manufactured with flat MPO8 MDI

Surveyed transceiver manufacturers at OFC

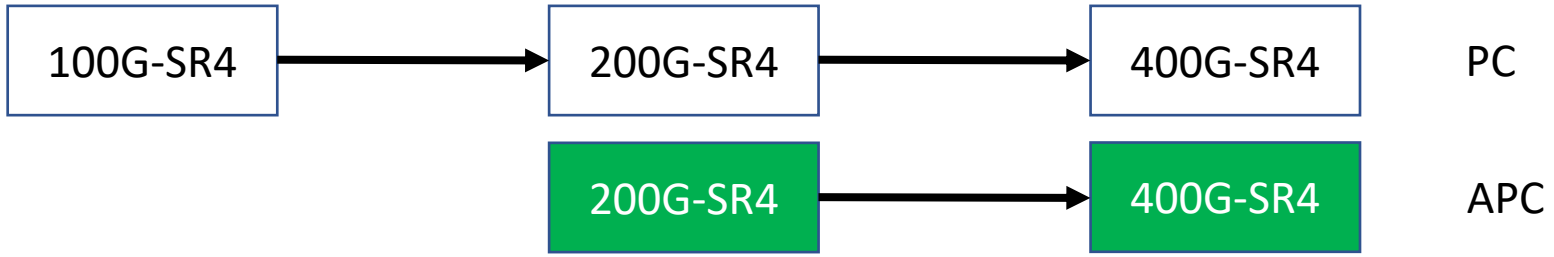
- Asked about MDI at 12 booths that has 200G-SR4 on display

- 1 manufacturer stated that their 200G-SR4 only use PC MPO8
- 7 stated that they only use APC MPO8 for 200G-SR4
- 2 stated that they offer both APC and PC versions of 200G-SR4
- 2 never were able to answer my question

- Most of the salespeople did not know how to answer the question and had to ask their engineers

Two takeaways from my OFC survey

- The market for MM MPO8 transceivers is already split
  - Some end users will want APC for 400G, others will want PC



- We need a visual cue to indicate if Txcvr has angled or flat MDI
  - Cable connectors have green housing and/or boot like with SMF
  - Something simple like pull-tab color
  - Not defined in 802.3db

Future work

- In 802.3db:
  - Change D3.1 of 802.3db to include PC MDI only (similar to slide 3)
  - Consider informative APC option
- Outside of 802.3db:
  - IEC publish grade 1m
  - Industry adopt visual indicator of APC or PC interface on transceivers