

**In support of Broad Market Potential (BMP)
& Distinct Identity (DI) for both 4-pair &
8-pair MMF objectives at 400G**

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BMP exists for both 4-pair & 8-pair solutions for 400 Gb/s Ethernet over MMF; DI is maintained

- A 4-pair objective is needed to support end-users who have 4-pair infrastructure and 8 years of experience designing DCs around the quad paradigm
 - Reusing large installed base of 4-pair infrastructure to migrate from 100G-SR4 to 400G-SR4.2
 - Lower relative cost for long 400G SW-SW links; better cable density
 - Implementations could be developed for 100G breakout
- An 8-pair objective is needed by end-users who wish to re-architect for the flexibility enabled by new octal paradigm
 - Supplier base for SR8 PMDs expanded beyond that of SR4.2
 - 400G SW-SW links plus maximum breakout and fiber shuffle flexibility to 50G-SR, 100G-SR2, & 200G-SR4
- Experts from large global cloud companies have endorsed each of these in Geneva SG meeting as best-suited to their architectures. Both have high value.
 - http://ieee802.org/3/NGMMF/public/lingle_ngmmf_03_jan18.pdf
 - http://ieee802.org/3/NGMMF/public/shen_NGMMF_01_jan18.pdf
- These are not two solutions to one problem.

The same speed ratios that gave utility to 4-pair media in the past now give utility to 8-pair media

- We originally moved in factors of 10x from 100Mb to 1Gb to 10Gb
- We began producing “speed” in SFP+ & “4x speed” in QSFP starting with 40G, creating a new *quad* paradigm & form factor
 - QSFP ports became standard on switches for 40 & 100GbE
 - Approximately 50% of the 40GBASE-SR4 was used for SW-SW links and 50% was used as high density 10G in breakout applications, leveraging the four pairs.
 - A 4-pair medium gave access to the SerDes (often the switch) rate for XLAUI-4, CAUI-4, 200GAUI-4
- SerDes & server speeds now growing by factors of 2x as 10G → 25G → 50G → 100G, leading to a wide range of 2x Ethernet speeds
- Due to market need to move to 400G faster, we doubled up on 50Gb SerDes technology and moved to 400GAUI-8, creating a new *octal* paradigm & form factors.
 - OSFP or QSFP-DD ports will be featured on 200/400G switches
 - An 8-pair medium gives access to the SerDes rate for 400GAUI-8 and future 800GAUI-8
 - A 400G-SR8 module is a 400G SW-SW connection or a high density 200G-SR4, 100G-SR2, and 50G-SR, useful for breakout to both 50 & 100G servers and 200G multi-server NICs and fiber shuffle. This is useful since octal ports will be standard on switches. Efficient use of ports is a valid criteria when judging 400G objectives
- The 4-pair cabling paradigm remains valid, because many end-users deployed / designed with it for past 8 years and wish to continue

It is valid to consider breakout & shuffle applications when assessing BMP

- The interest in SR8 is a natural, if unintended, consequence of decisions we made three years ago to enable 400G switching with the 400GAUI-8 interface using 50G SerDes, moving to octal form factors & ports
- We create PMDs because they are good solutions for the MAC rate under consideration, not primarily for breakout to lower speeds. However, breakout & shuffle applications became a fact of life after 802.3ba, improving BMP.
- The 2x server speed cadence and the move to octal ports definitely impact the way some end-users plan to use octal modules to breakout to lower speeds, benefitting from an 8-pair medium.
- The implications for breakout were discussed extensively when considering BMP in the original 400G Ethernet SG in 2013. An objective for supporting breakout was discussed but not adopted.
 - http://www.ieee802.org/3/400GSG/public/13_05/maki_400_01a_0513.pdf
 - http://www.ieee802.org/3/400GSG/public/13_11/dambrosia_400_01a_1113.pdf

Why is a standard needed to define SR8? Does an MSA leveraging 400GAUI-8 and 50GBASE-SR suffice?

- Specs for single-lane are not always the same as for parallel lanes (see 10G-SR vs. 40G-SR4)
- The MDI and lane assignments for 16f MPO should be specified
 - The ground work has been laid in <http://www.qsfp-dd.com/wp-content/uploads/2017/09/QSFP-DD-Hardware-rev3p0.pdf>. See Fig. 33 and Table 10.
- Some technical implementation questions have been raised that are appropriate for Task Force resolution

There is precedent in 802.3 for having multiple parallel solutions for the same speed:

- 2-pair, 4-pair, and 10-pair solutions for 100 Gb/s: SR2, SR4, and SR10, respectively

Examples exist of modules for different pair counts for the same speed, both successful in the market

- 1-pair and 4-pair solutions for 40 Gb/s: LR4 and PSM4, respectively
- 1-pair, 1-pair, and 4-pair solutions for 100 Gb/s: LR4, CWDM4 and PSM4, respectively

Conclusions

- The Broadest Market Potential is created by standardizing both 4-pair & 8-pair solutions for 400 Gb/s Ethernet over MMF
- The interest in 8-pair cabling is a natural outcome of industry & Ethernet choices instantiated in the 802.3bs project, while 4-pair cabling has an 8 year history in Ethernet and a large installed base.
 - End-users from the Cloud have expressed strong interest in both
 - Enterprise interest lies primarily with 4-pair cabling due to lower cable cost for longer SW-SW lengths
- Distinct Identity is maintained. These are not two solutions for the same problem. Precedent exists.
- The CSD responses for the NGMMF Study Group are supported by adopting objectives for 400G over both 4-pair and 8-pair MMF