

Options for addressing 20km 800Gb/s SMF objective

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Overview

20km objective adopted in Jan meeting with little consideration of applications

Historically IEEE 802.3 does not include 20km PMD's

- However, 802.3 has recently added new reaches - 50m, 500m, 6km - where applications exist
- 20km does appear in bidi specs

There are multiple options to address these applications

- Current view is that a solution that allows interoperability with 800GBASE-ER1 is preferred

This contribution provides information on the 20km optical applications, link-budgets, and potential solutions

Interoperability

How important is interoperability between different PMDs?

Currently IEEE has the following objectives in which the adopted baselines are not interoperable

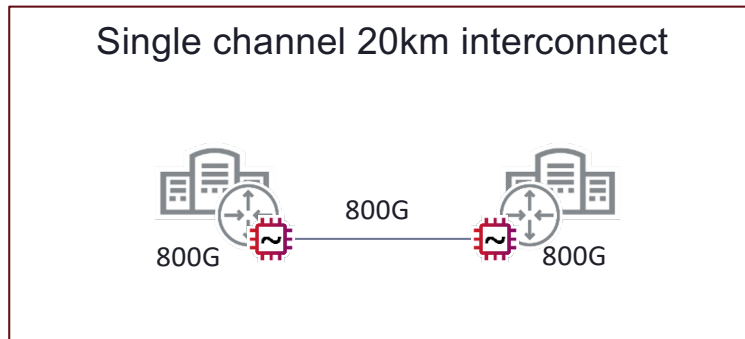
- 800GBASE-DR4 \neq 800GBASE-DR4-2
- 800GBASE-FR4-500 \neq 800GBASE-FR4 \neq 800GBASE-LR4

Interoperability between PMD's with differing reaches is a nice-to-have, but is not typically a requirement

We adopt baselines providing optimal technical solutions to objectives with distinct identity

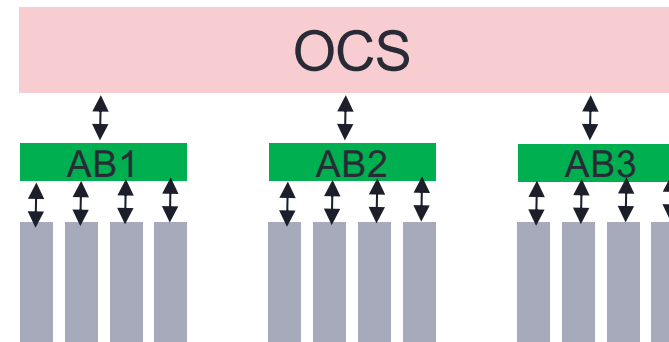
Potential 20km / higher loss Applications

Client-side interconnect



End users are typically more concerned with loss budget than reach, see: [cole_3cu_01b_0919](#)

Data Center switching



Optical Circuit switch designed to replace electrical switch
- One OCS shown for simplicity, multiple OCS required to scale

See: Ryohei Urata et al, "Apollo: Large-Scale Deployment of Optical Circuit Switching for Datacenter Networking", OFC 2023

OIF 800LR application has been addressing the OCS application

- Currently targeting 8dB loss budget

Additional switching layers or link loss may result in requirements for higher loss budget

- Historically dealt with using ER modules

Optical Specifications

Coherent specifications for LR, ER-20, and ER can be met in either C or O band

O band provides minimal Chromatic Dispersion

- O band: $|CD| \leq 1.2$ ps/nm/km
- C band: $|CD| \leq 20$ ps/nm/km

C band provides minimal optical attenuation

- O band loss ~ 0.43 dB/km
- C band loss ~ 0.25 dB/km
 - 0.225 to 0.278 mentioned in stassar_3dj_optx_01a_230427
 - Concatenated loss specs are discussed in ferreti_3cs_01_1119

Potential Optical Budgets

	Adopted Baseline	O-Band ER1-20	Proposed ER1-20	Adopted Baseline	
	800GBASE-LR1	O Band 800GBASE-ER1-20	C Band 800GBASE-ER1-20	800GBASE-ER1	
Operating Distance	10	20	20	40	km
Channel Insertion Loss	4.3	8.6	5	10	dB
Connector Loss	2	2	2	2	dB
Chromatic Dispersion Max	10.1	20.2	40	80	ps/nm
Chromatic Dispersion Min	-12.3	-25	0	0	ps/nm
Polarization Mode Dispersion	5	7	7	8	ps
Allocation for penalties	0.5	0.8	0.8	1	dB
Link Budget	6.8	11.4	7.8	13	dB

C Band 20km spec differs from 800GBASE-LR1 by ~0.2-0.7 dB in channel insertion loss

Potential solutions

The 802.3dj Task Force voted to adopt a 20km SMF objective

Potential solutions:

- A solution based on OFEC, with Ethernet payload GMP mapped into Flex-O (ie a transport solution) to interop with 40km
- A solution based on synchronous BCH Inner FEC (Ethernet coherent) to interop with 10km
- Others?

How do these compare?

- Power
 - OFEC adds 2W to module. SOA solution with lower coding gain BCH FEC results in similar module power.
- Latency
 - If the application includes OCS, then the ~2us additional OFEC latency matters. If the application is 20km links, latency is less important
- Loss budget
 - OFEC improves loss budget by ~1.5-1.9 dB compared to BCH
 - A SOA module implementation can improve loss budget by ~10dB

Summary

The 802.3dj task force voted to add a 20km objective in the Jan meeting

The application identified was for 20km, with interop between 20 & 40km being key requirement

A C band 20km optical budget has almost identical loss as an O band 10km spec

Multiple technical solutions exist for this application, this contribution is intended to open discussion on whether the task force wants to consider different solutions

Thanks!