

The need for optical link models for new fiber applications

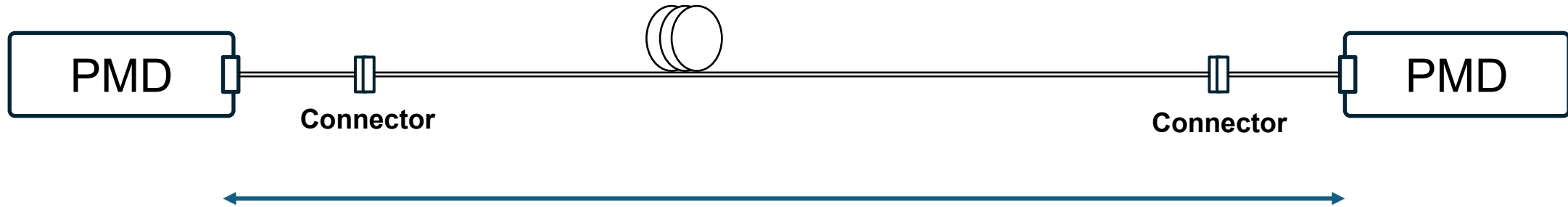
Guangcan Mi

11 July 2026

Introduction

- This presentation is an update to the [mie4ai_01a_260224](#) contribution to IEEE 802.3 E4AI [Fiber for AI workshop](#)
- Currently, there are no industry specifications addressing multi-core or hollow-core fiber
 - Considered to be another “type” of SMF fiber
- There is growing industry interest observed in using both fiber types for high speed optical links to address various challenges
 - Increasing challenge to link budget of WDM IMDD PMDs at speed beyond 200Gb/s/lane
 - Observed challenge in fiber cabling in AI infrastructure detailed in [dambrosia_e4ai_01a_260611](#)
- These new fiber applications could be suggested for future IEEE 802.3 projects defining new Ethernet optical PMDs.
- Development of IEEE 802.3 optical PMD specifications requires establishment of a normative channel model, not optical fiber specifications
- This presentation will provide an overview of the IEEE 802.3 specification methodology for optical PMDs / channels.

It Starts with the Channel

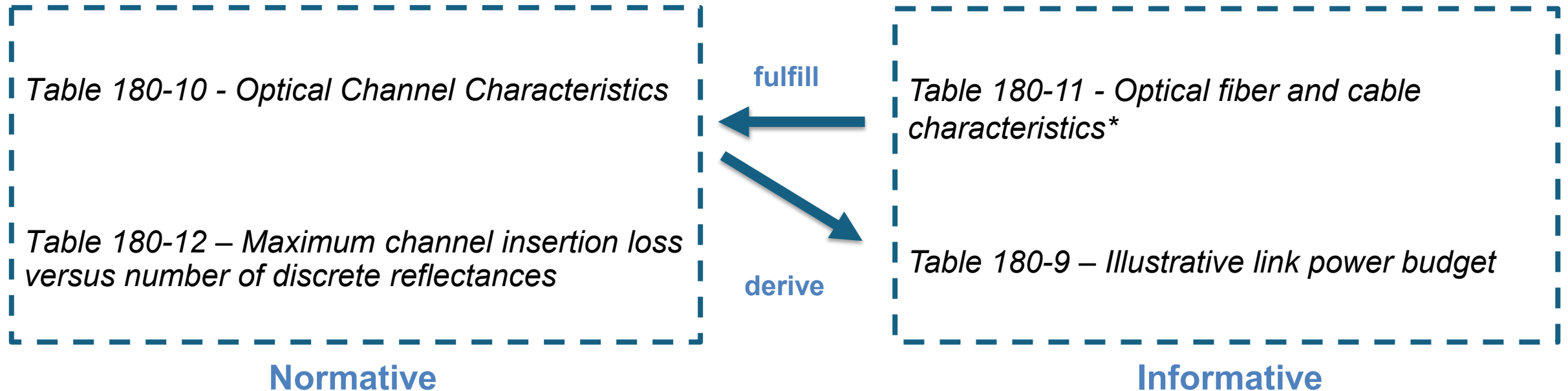


“Fiber optic cabling model”
“Fiber optic cabling” is the channel

Individual aspects of the channel are not normative

- i.e. patch cord, link, fiber, connector or splices and their specifications

Today – IEEE 802.3 Approach: An example from CL180



Note: Other clauses called out ITU standards, e.g. CL 187

TIES users TD link: [\[316-GEN\] LS/i on IEEE P802.3dj draft D3.1](#)

Updating optical channel for new fiber applications

Channel Insertion Loss

- Channel with MMF: potentially higher loss due to connector
- Channel with HCF: likely higher loss due to fiber & connector

Chromatic dispersion

- Updated statistical model of SMF CD adopted in 802.3dj
- HCF features “*engineered-dispersion*”, ZDW & slope

DGD_max

- Updated SMF PMD model adopted in 802.3dj
- MCF maybe more sensitive to stress, leading to new DGD characteristic
- HCF’s core geometry lead to engineered PMD

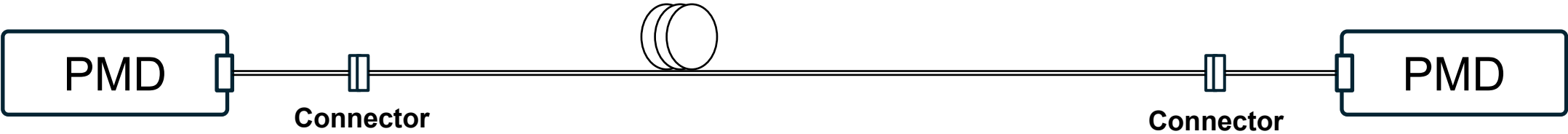
New characteristics

- *Inter-core crosstalk* of MMF may introduce new feature in the optical channel. Penalty modeling also needed.

Other considerations

- The emerging AI infra market brings updates to the use case model of Ethernet optical PMDs, e.g. emerging new connector technology lead to proposal of new channel model in [stone_400GPL_01a_260630](#)

Translating to power budget requires further work



Channel model	Insertion Loss	Chromatic Dispersion	DGD_max	Connector model	New characteristics
↓					
Power Budget =	Insertion Loss	CD Penalty	DGD Penalty	MPI Penalty	New Penalty allocation
SMF		Updated in 802.3dj* *: no new fiber specification was defined, only updated channel model	Updated in 802.3dj*	Updated in 802.3dj*	
MCF				new methods	Xtalk/new methods
HCF		reduced penalty		new methods	

Going Forward

- IEEE 802.3 is based on a normative channel approach.
 - This includes the specification of the interaction between maximum channel insertion loss and number of discrete reflectances.
- Definition of Ethernet optical PMDs can begin once the characteristics of an optical *channel* using multi-core or hollow-core fibers are available:
 - independent of the standards/specifications for the fiber
 - independent of the standards/specifications for the connector
 - Building the power link budget of new fiber application requires further technical work
- New and emerging projects in 802.3 include:
 - 802.3ds (MMF targeting 30m and 50m, using 850nm and 1060nm VCSELs)
 - 400G Per Lane Study Group
 - Next MAC rate, new optical PMDs for 1.6TbE, and higher capacity Ethernet ports, currently being discussed in E4AI