# P802.3dj
# A path forward for 10km SMF

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P802.3dj optics ad hoc 2/22/2023

# P802.3dj current status
## and how to resolve the 10km PMD debate

- Multiple technical proposals arguing different approaches to create a 10km baseline
- At root of debate is that there are two quite distinct market use-cases that would use a 10km PMD
- Recently a proposal was made to the B400G reflector suggesting a path forward by revisiting the project's objectives
  - https://www.ieee802.org/3/B400G/email/msg00671.html
  - Received positive support from multiple individuals on reflector

This ad hoc presentation is intended to:

- Consider this proposal, procedural issues, and how it could be justified.
- allow discussion for feedback
- represent, as P802.3dj TF leadership, our interpretations of the discussions we have heard in task force meetings and on the reflector.

Potentially leads to individuals bringing a proposal into the Task Force in March meetings

# Resolving the 800 GbE 10km debate

P802.3dj current objectives for 800 GbE physical layers

Define a physical layer specification that supports 800 Gb/s operation:

- over 4 pairs of copper twin-axial cables in each direction with a reach of up to at least 1.0 meter ·
- over 4 pairs of SMF with lengths up to at least 500 m
- over 4 pairs of SMF with lengths up to at least 2 km
- over 4 wavelengths over a single SMF in each direction with lengths up to at least 2 km
- over a single SMF in each direction with lengths up to at least 10 km
- over a single SMF in each direction with lengths up to at least 40 km

To address the 10km objective we currently have 3 concepts raised (not all are full baseline proposals in P802.3dj yet):

- IMDD based: rodes_3df_01a_2211.pdf
- Coherent based (oFEC based): williams_3dj_01a_230206.pdf
- Coherent based (OIF 800LR based): maniloff_3dj_01a_230206.pdf

# Understanding the 10 km market application

500 m 2 km 10 km 40km

"Intra-building/campus" use case

Characterized by:

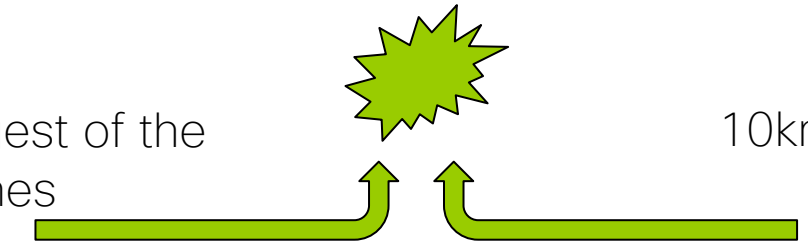
- Strong bias towards low cost (function of component reuse across reaches)
- Breakout support is known deployment use-cases (increases component re-use)
- Higher confidence of a more modern fiber plant
- Intra-building/campus – lower latency desired

"Campus/outside-plant" use case

Characterized by:

- Strong bias towards low cost and low opex (within the context of longer reaches)
- Component re-use supports low-cost goals (including applications outside P802.3dj)
- Higher performance addresses the potentially broader deployment of legacy fiber fiber plant and configurations (connectors/splices). Link budget robustness adds value.
- Campus/Metro/WAN – lower importance on latency due to time of flight

10km PMD is longest of the short reaches



10km PMD is shortest of the long reaches

# Understanding the 10 km market application


"Intra-building/campus" use case

10 km technology solution:

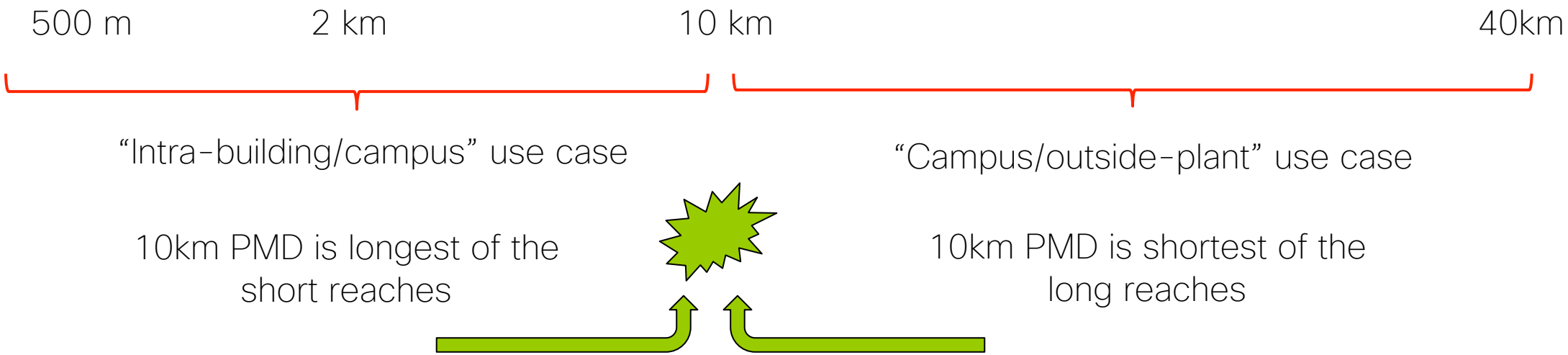
- IM-DD modulation consistent with this use case
- Re-use as many components as possible from higher volume solutions
- Re-assessing the channel definition methodology:
  - less risky because of the use of modern fibers in the intra-campus plant

"Campus/outside-plant" use case

10km technology solution:

- Coherent modulation offers greatest robustness to real world outside plant fiber deployments
- Re-use as many components as possible from higher volume solutions
- Supports existing fiber specs and channel methodologies

# Resolving the P802.3dj challenge @ 800 GbE 10km




The current IMDD and Coherent baseline proposals are both addressing a single P802.3dj objective but really are addressing two different market applications

# Proposal

Replace the following objective:

Define a physical layer specification that supports 800 Gb/s operation:

- over a single SMF in each direction with lengths up to at least 10 km

with the following:

Define a physical layer specification that supports 800 Gb/s operation:

- over 4 wavelengths over a single SMF in each direction with lengths up to at least 10 km
- over 1 wavelength over a single SMF in each direction with lengths up to at least 10 km

# P802.3dj project logistics considerations

- Modifications to Objectives requires Task Force and Working Group approval
  - Usual approval mechanism.  Build consensus, Adopt motion @ TF, Adopt motion @ WG
- Need to review the Task Force's existing CSD and PAR responses to see if any changes needed.
  - After review, the conclusion is that no changes are needed
  - Distinct Identity being the obvious concern raised
  - Technical Feasibility remains a focus for the TF

# What about Distinct Identity?

## IEEE 802 LMSC Operations Manual –

### 14.2.3 Distinct Identity

> Each proposed IEEE 802 LMSC standard shall provide evidence of a distinct identity. Identify standards and standards projects with similar scopes and for each one describe why the proposed project is substantially different.

## Project Scopes or Objectives in a single project have been distinct by:

- Different media
- Different reaches
- Different number of either fibers or differential pairs of the same media
- Different number of optical wavelengths

Reference: dambrosia_3cz_01_301121.pdf

# Broad Market Potential

https://mentor.ieee.org/802-ec/dcn/22/ec-22-0256-00-ACSD-p802-3dj.pdf

ec-22-0199-03-00EC

## Broad Market Potential

**Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:**

**a) Broad sets of applicability.**
**b) Multiple vendors and numerous users.**

- The principle of building equipment that supports IEEE 802.3 networks operating at different Ethernet rates has been amply demonstrated by a broad set of product offerings.
- Per the IEEE 802.3 2020 Bandwidth Assessment Report, by 2025 the bandwidth requirements of various applications will grow between 2.3 to 55.4 times relative to their 2017 levels. For these key application areas: cloud-scale data centers, internet exchanges, co-location services, content-delivery networks, wireless infrastructure, service provider and operator networks, and video distribution infrastructure. :
  - the definition of higher density 800 Gb/s Ethernet will address the cost and power considerations.
  - The definition of 1.6 Tb/s Ethernet will address the growing diverse bandwidth requirements and cost considerations.
- Presentations have been submitted to the study group that illustrate the market adoption of Ethernet ports addressing multiple rates and medias for use with duplex and parallel infrastructures.
- Evolving needs of computing applications will be enabled by parallel solutions targeting noted high–bandwidth applications.
- There has been wide attendance and participation in the study group by subject matter experts familiar with the needs of end users, equipment manufacturers and component suppliers. It is anticipated that there will be sufficient participation to effectively complete the standardization process.

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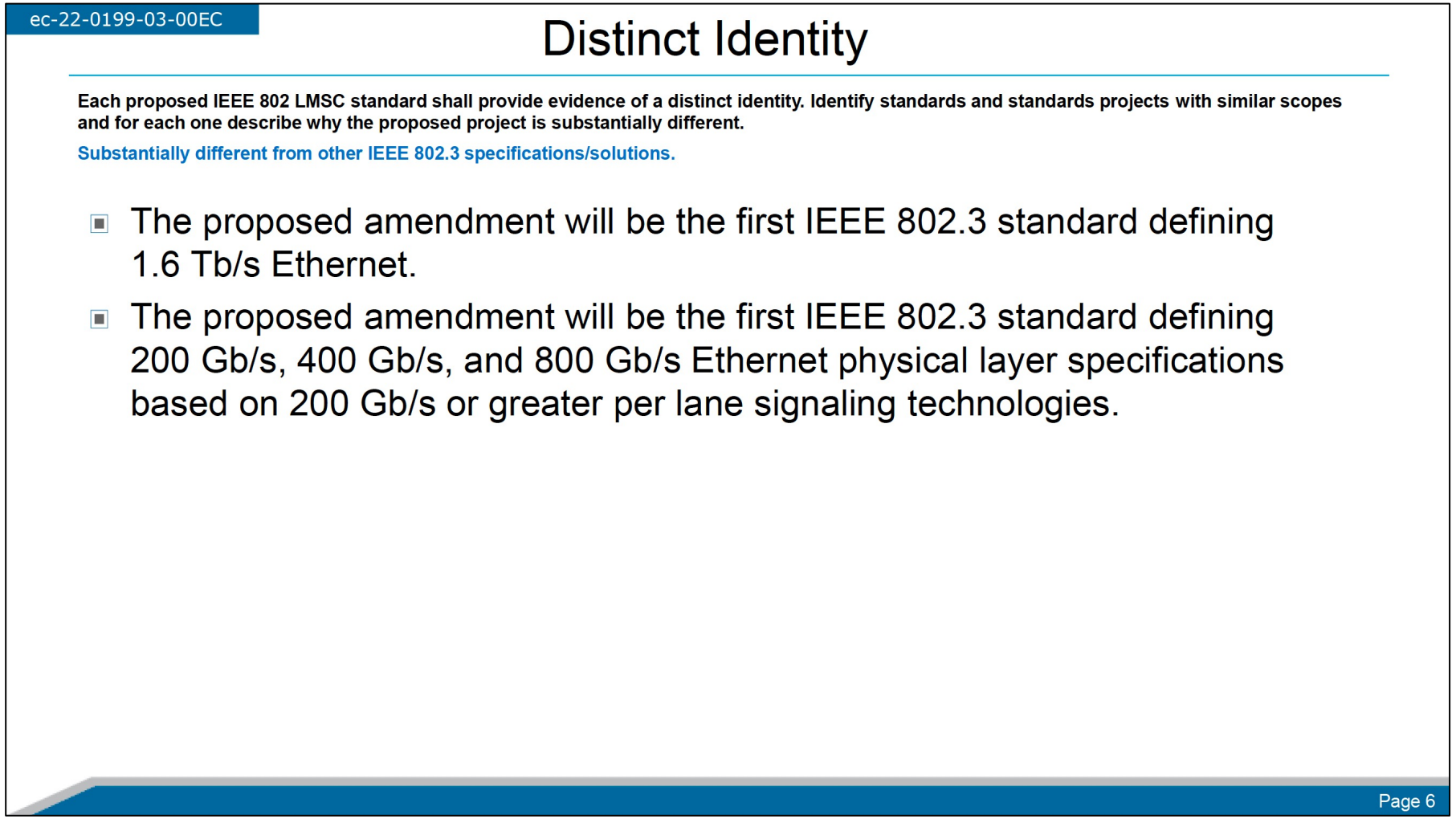
Included here for review.

No changes required for this proposal

# Distinct Identity

https://mentor.ieee.org/802-ec/dcn/22/ec-22-0256-00-ACSD-p802-3dj.pdf




Included here for review.

No changes required for this proposal

# Technical Feasibility

https://mentor.ieee.org/802-ec/dcn/22/ec-22-0256-00-ACSD-p802-3dj.pdf

ec-22-0199-03-00EC

## Technical Feasibility

**Each proposed IEEE 802 LMSC standard shall provide evidence that the project is technically feasible within the time frame of the project. At a minimum, address the following items to demonstrate technical feasibility:**

**a) Demonstrated system feasibility.**
**b) Proven similar technology via testing, modeling, simulation, etc.**
**c) Confidence in reliability.**

- The principle of scaling the IEEE 802.3 MAC to higher speeds has been well established by previous work within IEEE.
- The principle of building equipment that supports IEEE 802.3 networks operating at different Ethernet rates has been amply demonstrated by a broad set of product offerings.
- Systems with an aggregate bandwidth of greater than or equal to 1.6 Tb/s have been demonstrated and deployed in operational networks.
- The proposed project will build on the array of Ethernet component and system design experience, and the broad knowledge base of Ethernet network operation.
  - Contributions have been made that presented data at 800 Gb/s and 1.6 Tb/s over copper and single-mode fiber based on 200 Gb/s or greater per lane signaling technologies. Proposals, which either leverage existing technologies or employ new technologies, have been provided.
  - The experience gained in the development and deployment of technologies since the start of the development of 40 Gigabit Ethernet and 100 Gigabit Ethernet (IEEE 802.3ba) starting in 2008, is applicable to the development of specifications for components at higher speeds. For example, some combination of the following approaches could be used to address 800 Gb/s and 1.6 Tb/s Ethernet, as well as to address reduced lane count solutions for 200 Gb/s and 400 Gb/s Ethernet: pulse-amplitude modulation, parallel transmission techniques, forward error correction, optical coherent signaling, and wavelength-division multiplexing
- Based on prior experience with developing higher speed solutions, the reliability of Ethernet components and systems is understood and can be projected in the target environments with a high degree of confidence.

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Included here for review.

No changes required for this proposal

Recommendation: To be included for a future Task Force presentation ahead of any motion:

- Summary of technical contributions supporting feasibility

# Economic Feasibility

https://mentor.ieee.org/802-ec/dcn/22/ec-22-0256-00-ACSD-p802-3dj.pdf

ec-22-0199-03-00EC

## Economic Feasibility

**Each proposed IEEE 802 LMSC standard shall provide evidence of economic feasibility. Demonstrate, as far as can reasonably be estimated, the economic feasibility of the proposed project for its intended applications. Among the areas that may be addressed in the cost for performance analysis are the following:**

**a) Known cost factors.**
**b) Balanced cost factors.**
**c) Consideration of installation costs.**
**d) Consideration of operational costs (e.g., energy consumption).**
**e) Other areas, as appropriate.**

- Prior experience scaling IEEE 802.3 indicates the cost distribution between servers, switches, routers, and the infrastructure will remain acceptably balanced for 200 Gb/s, 400 Gb/s, 800 Gb/s, and 1.6 Tb/s Ethernet.
- The cost factors for Ethernet components and systems are well known. The proposed project may introduce new cost factors which can be quantified.
- The deployment of 800 Gb/s and 1.6 Tb/s Ethernet standards and derivatives at 200 Gb/s and 400 Gb/s will allow economies of scale to reduce cost for all solutions.
- In consideration of installation costs, the project is expected to use proven and familiar media, including twin-axial copper cables, and single-mode optical fiber cabling.
- Network design, installation and maintenance costs are minimized by preserving network architecture, management, and software.
- In consideration of operational costs associated with power consumption, the project will examine alternatives that trade off physical medium dependent (PMD) sublayer complexity, power, latency, and implementation constraints.

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Included here for review.

No changes required for this proposal

# Summary

- Two distinct market applications exist that could both be addressed by a technical solution to the 10km objective.
- Two types of technical solutions exist that optimally address the needs of these different markets
- There is a path forward: modify P802.3dj objectives to enable both types of technical proposals to optimize for the distinct market applications.

Note: This does not alter the need for baseline proposals to be made and adopted against these new objectives.

Step # 1: Modify objectives → Step # 2: Resume considering baselines

# Potential Motion for March Plenary

Move to:

Replace the following objective:

Define a physical layer specification that supports 800 Gb/s operation:

- over a single SMF in each direction with lengths up to at least 10 km,

with the following objectives:

Define a physical layer specification that supports 800 Gb/s operation:

- over 1 wavelength over a single SMF in each direction with lengths up to at least 10 km,
- over 4 wavelengths over a single SMF in each direction with lengths up to at least 10 km.

# Straw Poll for today's ad hoc

I would support the proposal to make the following changes to P802.3dj objectives:

Replace the following objective:

Define a physical layer specification that supports 800 Gb/s operation:

- over a single SMF in each direction with lengths up to at least 10 km,

with the following objectives:

Define a physical layer specification that supports 800 Gb/s operation:

- over 1 wavelength over a single SMF in each direction with lengths up to at least 10 km,
- over 4 wavelengths over a single SMF in each direction with lengths up to at least 10 km.

Yes: 56

No: 4

Needs More information: 13