

# 802.3CG OVERVIEW

## 10 MB/S SINGLE PAIR

## ETHERNET



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# WHERE WE BEGAN

From IEEE 802.3 Call for Interest, Consensus Building Presentation, July 2016

## Vision

- Legacy point-to-point & point-to-multipoint
  - 4-20mA
  - HART modem
  - RS-232
  - RS-485
  - CAN
  - FlexRay
  - Proprietary/custom

Existing

- New applications
  - Enabled through this proposed development

Future

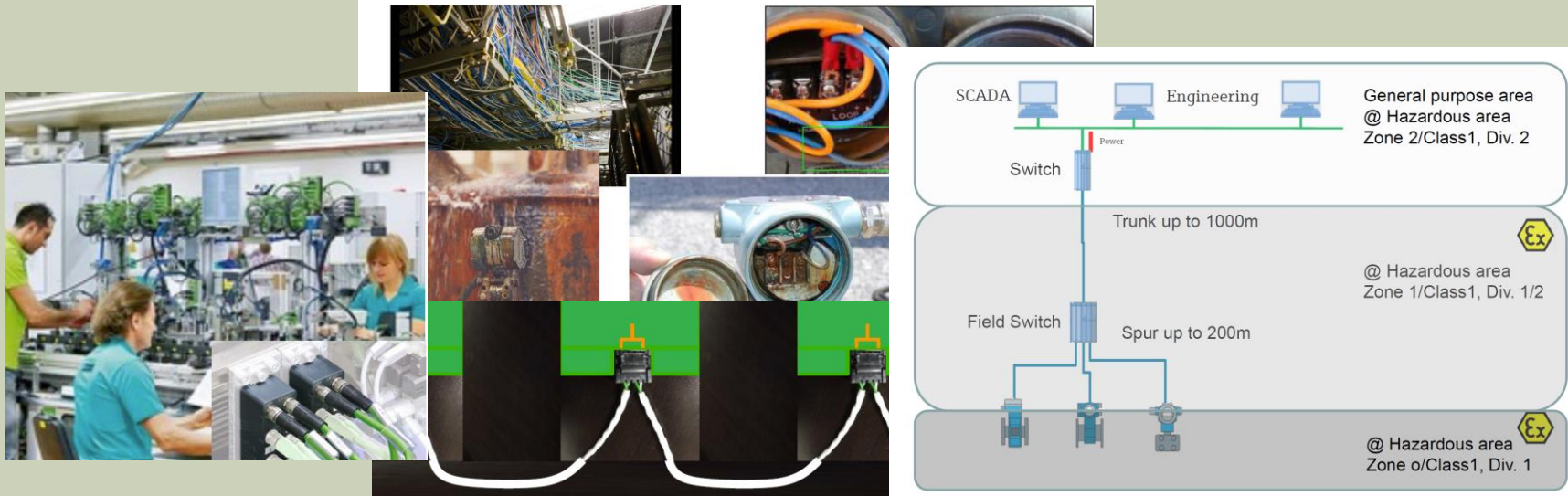
New  
IEEE 802.3  
Standard

10

# IEEE P802.3CG KEY CHARACTERISTICS

- 2 types: Short reach and up to 1 km distance, on a single pair of wiring
  - Can survive fault conditions – even harsh automotive and industrial
  - Energy efficient: Low power as well as quiet and standby modes
- Can be compatible with Intrinsically Safe operation
- Supports optional line powering (PoDL and possible extensions)
- Standard expected in 2019

This is Not an Office Environment



# OBJECTIVES IN BRIEF (RESTATED)

- Major objectives are paraphrased and summarized below:
  - 2 PHYs and link segments:
    - An “up to 15m” PHY and a link segment. The PHY could do multipoint, but a link segment is, by definition, a point-to-point media connection (at  $10^{-10}$  BER)
    - An “up to 1km” PHY and a link segment for point-to-point operation at ( $10^{-9}$  BER)
  - Must support operation in industrial and automotive environments
  - One or more optional powering techniques, associated with the PHYs and suitable for industrial and automotive environments

# APPROVED TIMELINE

## IEEE P802.3cg 10 Mbps Single-Pair Ethernet Proposed Timeline (Adopted 5/17)

### ✓ January 2017 – First Task Force meeting

- July 2017 – Objectives Finalized, Draft 0.1 (skeleton), all baselines presented
- September 2017 – Baselines selected, draft 0.9 for Task Force Review
- **November 2017 – Last features selected - Task Force Review D1.0**
  - Nov:D1.0, Jan:D1.1, possible Feb 2018 extra off-cycle interim, D1.2
- March 2018 – Complete Task Force Review(D1.2/1.3)
- **May 2018 – Draft 2.0, enter working group ballot** (2 recircs: July:D2.1, Sept:D2.2)
- **Nov 2018 – D3.0 – enter Sponsor ballot** (2 recircs Jan'19:D3.1, Mar'19:D3.2)
- **June 2019 Standards Board approval**

- *[NOTE: only 1 meeting cycle slack spread between WG ballot and Sponsor Ballot]*

- Adopted in May 2017
  - Fairly aggressive
- So far, mostly on track
  - Short reach baseline needs more definition
- First BIG milestone is Working Group ballot (May)
  - “Last features” and “D1.0” are a fairly soft milestones, for guidance of the group

# VARIED USE CASES ALREADY IN .3CG

## ■ Short:

- In-cabinet, chassis
- Vehicles
- Multipoint topologies

## ■ Medium:

- Industrial pods (5-40m)
- Building control networks (50-100m)
- Process control “spurs” (200m)

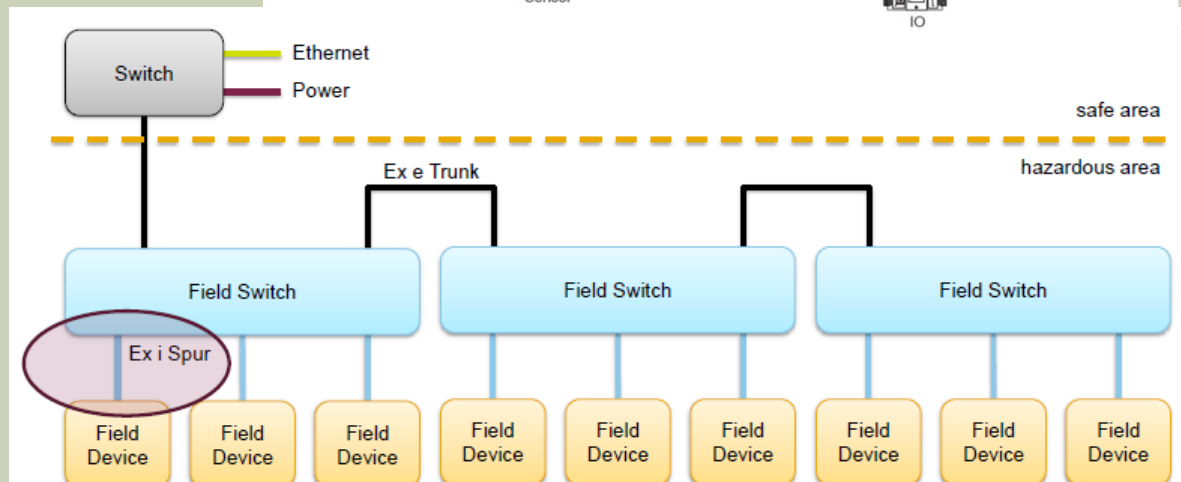
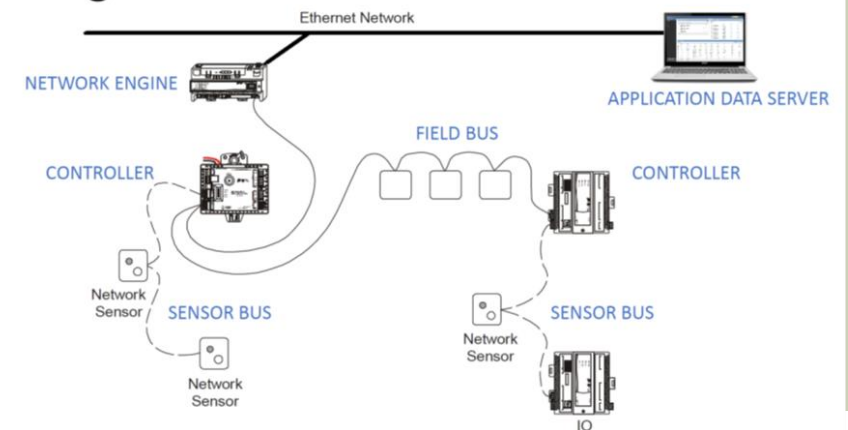
## ■ Long:

- Process control trunks (1km)
- Building automation trunks (500m)
- Elevator shafts

## ■ Gauge likely based on power needs



## Networking for Building Automation and Control





# WITH SUCCESS COMES MORE SUCCESS...

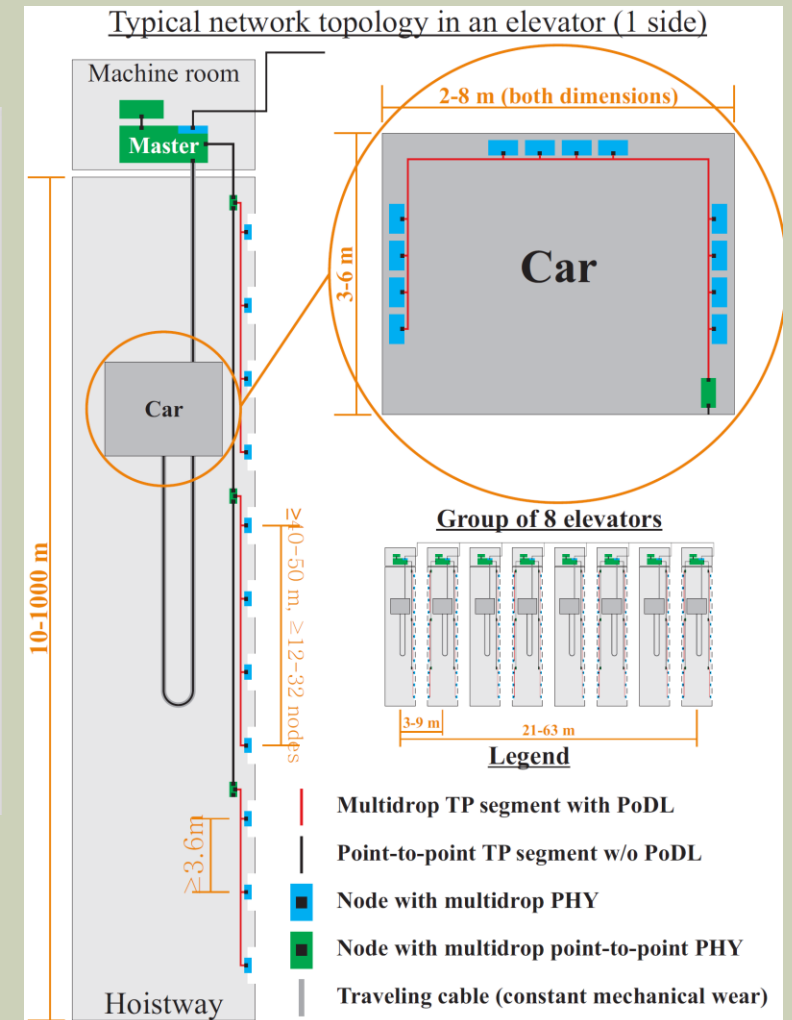
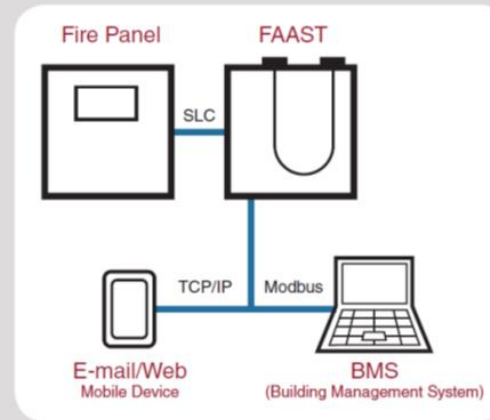
- Every time I turn around, someone has a new use....

- Elevators
- COPS?, Alarms?

- Managed power and data benefits safety

## Direct connection to the SLC

FAAST can connect directly to the signaling line circuit (SLC) of many major Fire Alarm Control Panels, using the same two wires as other detection devices. Contact your panel manufacturer for more information.



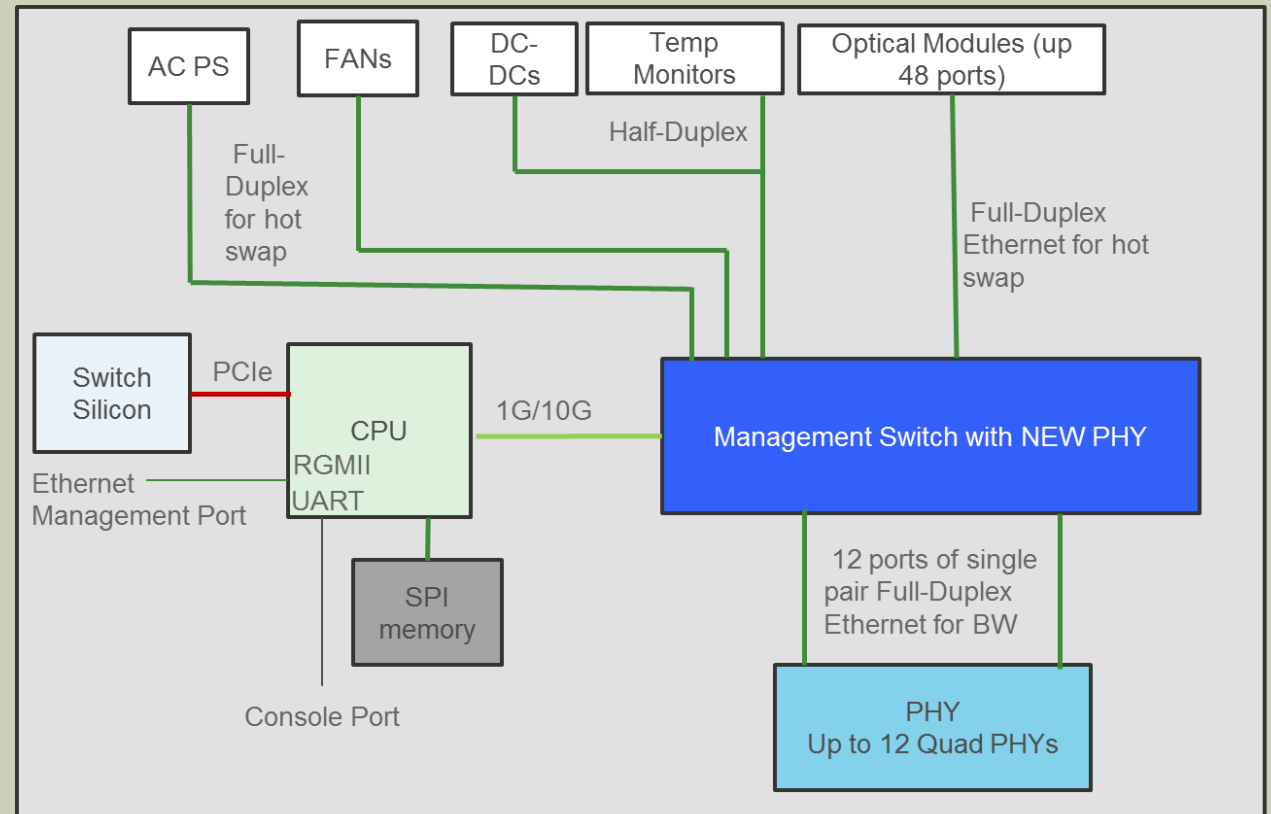
# DISCUSSION OF NEW USE CASES

- Including PCB “pairs”
  - The electrons don’t care about twisting the wires...
- Interest from Network Equipment and Computer OEMs has created the potential for large volume short-reach interconnects
  - Should be useful in industrial applications too
  - Needs are consistent with short-reach PHY
  - Should be manageable without significant delay, and little new work
- BUT: Requires a change in PAR scope, additional PAR “need” text, and updating the “Criteria for Standards Development”
  - Requires a new CFI and Call for Interest
  - Could be a new project, but that would cause more interference with 802.3cg



# EXAMPLE: ETHERNET SWITCHES

- Number of different I/O types reduced by using
- CPU I/O limitation for I2C/MDO removed
- Point-Point Ethernet for BW and or Hot-pluggable interfaces
- Ethernet Driver



# STATUS IN 802.3CG: CL 146, 10BASE-T1L LONG REACH PT-TO-PT PHY

- Draft 0.3 has the basics in place (in 802.3cg private area)
  - Link segment transmission parameters, PCS line coding, PMA modulation & signaling in place as of September meeting (D0.3)
- Details still have a ways to go, for example
  - Several TBDs in PMA electrical parameters
  - Management registers (clause 45)
  - Link segment:
    - Interference parameters – need checking
    - Low frequency cutoff needs checking, feedback from cabling groups
  - Working to validate performance issues in noise

# STATUS IN 802.3CG: SHORT REACH & MULTIDROP

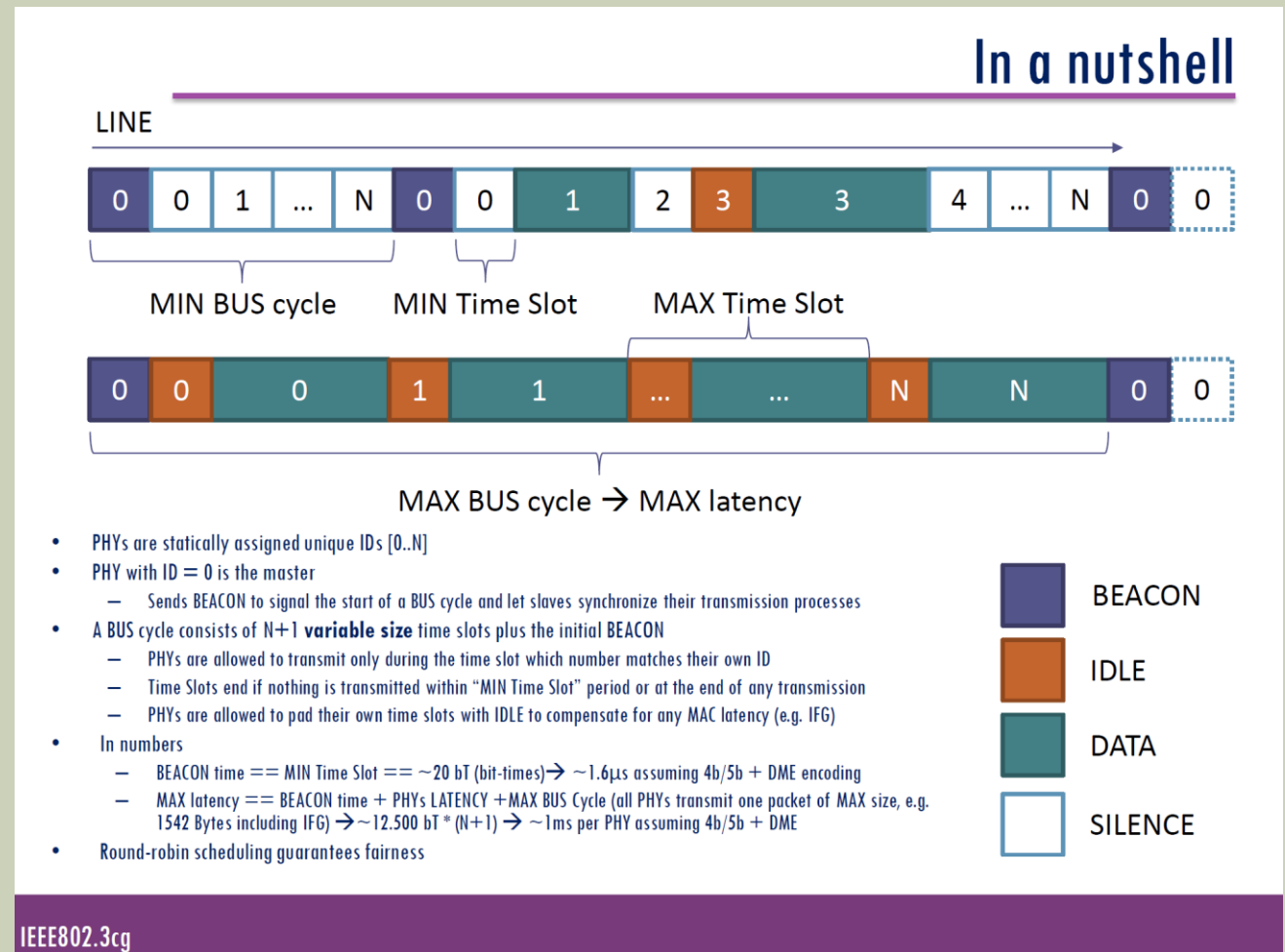
- Short reach link segment in place
- Modulation scheme of DME has been assumed, but not formally adopted
- Short reach focus has been multidrop - now adopted
  - Short reach PHY should be defined in November
- Short reach needs to adopt PCS/PMA & same detailed issues as long reach

- Adopt the equations on slide 18 of [http://www.ieee802.org/3/cg/public/Sept2017/DiBiaso\\_Bergner\\_01c\\_0917.pdf](http://www.ieee802.org/3/cg/public/Sept2017/DiBiaso_Bergner_01c_0917.pdf) as a baseline for the 10SPE short reach link segment.

IL <	$1 + 1.6 (f - 1) / 9 \text{ dB}$	$f = 0.3 \dots 10 \text{ MHz}$
	$2.6 + 2.3 (f - 10) / 23 \text{ dB}$	$f = 10 \dots 33 \text{ MHz}$
	$4.9 + 2.3 (f - 33) / 33 \text{ dB}$	$f = 33 \dots 40 \text{ MHz}$
RL >	14 dB	$f = 0.3 \dots 10 \text{ MHz}$
	$14 - 10 \cdot \text{LOG}_{10}(f / 10) \text{ dB}$	$f = 10 \dots 40 \text{ MHz}$
MC >	30 dB	$f = 0.3 \dots 20 \text{ MHz}$
	$30 - 20 \cdot \text{LOG}_{10}(f / 20) \text{ dB}$	$f = 20 \dots 200 \text{ MHz}$

# OPTIONAL MULTIDROP COLLISION REDUCTION

- Problem was fitting a time-sensitive multidrop into Ethernet's CSMA/CD MAC
- TSN implementation requires undesired pre-engineering
- Proposal for a sublayer modifying carrier detect:
  - Define an optional collision reduction method based on [Beruto\\_3cg\\_01a\\_0917.pdf](#) to provide PHY-level multi-drop performance improvement.
- Proposal only allows a node to start transmission on a prescribed time slot
  - Useful on short link segments where collision delay is very small



# STATUS: POWERING

- Powering is the red-haired stepchild
  - Most powering experts are in 802.3bt right now
- Adopted additional classes of power
  - Can be added to PoDL (802.3bu, Cl 114)
  - Could be provisioned otherwise
- Adopted “optional powering annex”
  - Right now, just cabling resistances and description of topologies
- Will need structure
- Likely not relevant for Intrinsically safe systems, which will need to specify power out of scope of IEEE Std 802.3

Class	Vpse, min V	Ipi, max (A)	Rloop (60C) ohm	Ppd (1000m) W
new 1	20	.102	59	1.4
new 2	20	.155	39	2.2
new 3	50	.255	59	8.9
new 4	50	.388	39	13.6

# AUTONEGOTIATION: WORK TO DO

- Existing BASE-T autonegotiation (cl 28) is incompatible
- Existing BASE-T1 autonegotiation (Cl 98) is delay and loss limited to shorter reach
- Both engineered and multi-speed uses are envisioned
  - So, Autoneg is envisioned
- Modifications are needed to get to long reach

## Potential Issues for 10M SPE

- ▶ Half Duplex Timers designed for up to ~200 meters
- ▶ 16 2/3 MHz symbol rate - 33 1/3 MHz clock
  - May be out of band for 10M SPE
- ▶ Insertion loss of 1000 meters
  - will degrade DME detector performance

IEEE 802.3cg 10 Mbps Single Pair Ethernet Task Force - Jar

## Use cases

- Industrial PHY
  - 10M, future migration to 100M+
  - Long reach
- Automotive PHY
  - Automotive use
    - TBD
  - Industrial use
    - 10M, future migration to 100M and 1G
    - Short reach

Forward or backward compatibility or both?