

IEEE 802.3 Call for interest (CFI)

Physical Layer Specifications and Management Parameters for a Single Twisted Pair with a reach up to at least 1 000 m

Supporters

- **Ludwig Winkel, Siemens AG** (Industrial Automation (includes process automation, Factory automation), Drives, Building automation, Transportation, Healthcare, Smart Cities, Power generation/Energy distribution)
- **Klaus Wächter, Siemens AG** (Building automation)
- **Chris DiMinico**, (Cable)
- **Mick McCarthy**, Analog
- **Matthias Fritsche, HARTING Electronics** (Industrial Automation)
- **Bernd Horrmeyer, Phoenix-Contact** (Industrial Automation)
- **Frank Schewe, Phoenix-Contact** (Industrial Automation)
- **Stephan Kehrer, Hirschmann** (Industrial Automation)
- **Oliver Kleineberg, Hirschmann** (Industrial Automation)
- **David Brandt, Rockwell Automation** (Industrial Automation)
- **Claude Gauthier, OmniPhy** (PHY vendor)
- **David Hوجلund, Johnson Controls** (Building automation)
- **Laura Schweitz, Turck** (Industrial Automation)
- **Maris Graube, Relcom Inc.** (Industrial Automation)
- **Bob Moskowitz, Consultant** (Building automation)
- **Bob Wagner, Panduit** (Cable)
- **Jordon Woods, Innovasic, Inc.** (Semiconductor Vendor)
- **Mohammad S. Ahmed tyco electronics**, (Cable)
- **Alan Flatman, LAN Technologies** (Cable)
- **Hans Lackner, QoSCom** (Cable)
- **Rubén Pérez de Aranda, KDPOF** (PHY vendor)

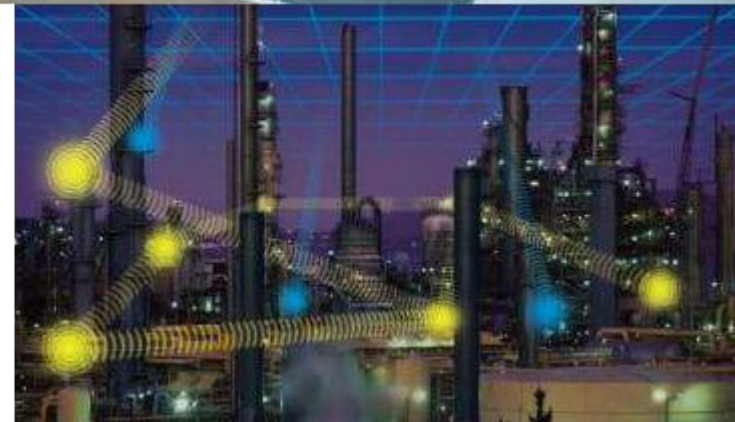
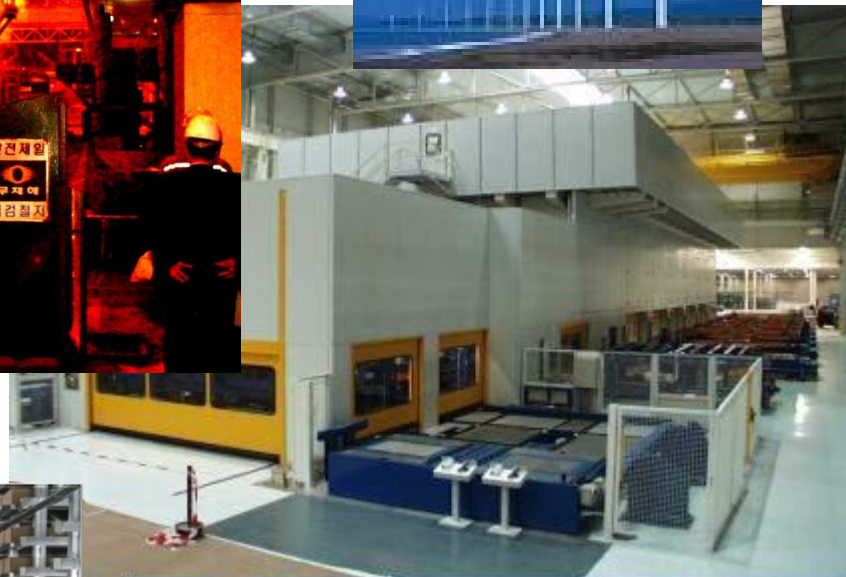
Motivation and Goals

1. Motivation
 - a. A large portion of industrial Ethernet uses 100BASE-TX, a two pair solution, with little/no spare pairs to transition to 4 pair GE.
 - b. A large portion of industrial buses use 1 pair at up to 1000m.
2. CFI to initiate a Study group to define parameter for extended reach of 100M and 1G one pair PHYs (100BASE-T1 and 1000BASE-T1) to serve industrial Ethernet needs, and explore longer reach (up to 1000 meters) over one pair at some lower rate to provide higher bandwidth option for current industrial buses at its comparable reach.
3. This work to begin near the end of 802.3bp and 802.3bw baseline:
 - to NOT interfere with on-going work.
 - leverage the work and focus the study on extending reach on media types that are typical of industrial Ethernet.
 - leverage the expertise of 100BASE-T1 on study of very long reach.
4. Solution shall support PoDL standards, optional AN, and optional EEE.

CFI Announcement Text

- Title: **“Amendment Physical Layer Specifications and Management Parameters for a Single Twisted Pair with a reach of up to 1000m”**
- This is a call for interest to initiate a Study Group to explore the need for extending the reach of 100BASE-T1 and 1000BASE-T1 on twisted pair in support of industrial and other one pair operation outside of in-car automotive use cases. In addition, this proposed work to explore the needs very long reach, e.g. 1000 meters at slower rate than 100 Mb/s to serve as higher bandwidth upgrade to industrial buses and help the transition to Ethernet.
- The transition to Ethernet is also supporting the Internet of Things (IoT) initiatives.

Examples of application areas



Lead positions

- SG Chair ?
- Editor ?
- Recording secretary ?

CFI Objectives

- To gauge the interest in starting a study group to **investigate** parameters that extend the reaches of single pair Ethernet PHYs, and explore reach up to 1000m at a lower data rate, optimized for industrial applications, Building automation but not limited to these.
- This Meeting will **NOT**:
 - Fully explore the problem
 - Choose any one solution
 - Debate strengths and weaknesses of solutions
 - Create a PAR or CSD
 - Create a standard or specification
- Anyone in the room may speak / vote
- **RESPECT... give it, get it.**

Agenda

- Overview
- The needs
 - Reach Extension of Single Pair Ethernet PHYs
 - There is a need for extended reach, up to 1000 m
- Technical Viability
 - 10 Mb/s Single Twisted Pair PHY
- Why now?
- Q&A
- Straw Polls

Overview: Reach Extension of Single Pair Ethernet PHYs

- Single Pair UTP PHYs (1000BASE-T1 and 100BASE-T1) are attractive PHYs for industrial networking.
 - The dominant driving market for the past 802.3 single pair projects was in-car automotive and their associated shorter reach (trade-off EMC and reach).
 - Industrial Networking is the other referenced large market for the same technologies, and requires longer reach.
- Single Twisted Pair Fast Ethernet and Gigabit Ethernet PHYs had been broadly supported by industrial networking representatives in 802.3, and by the affiliated companies.
- Industrial networking
 - Current industrial protocols that adopts Ethernet technology supports at least 100 m.
 - uses less than four twisted pairs in many cases.
 - Leverage single pair PHYs in standards development, explore extended reach of at least 100 m.
 - Current industrial buses support distances up to 1000 meters and at lower data rates over a single twisted pair.
 - Sensors and actuators require higher bandwidth in emerging applications, like machine vision, motion control, process control, etc.
 - Maintenance is easier if shop floor and control floor using the same base technology

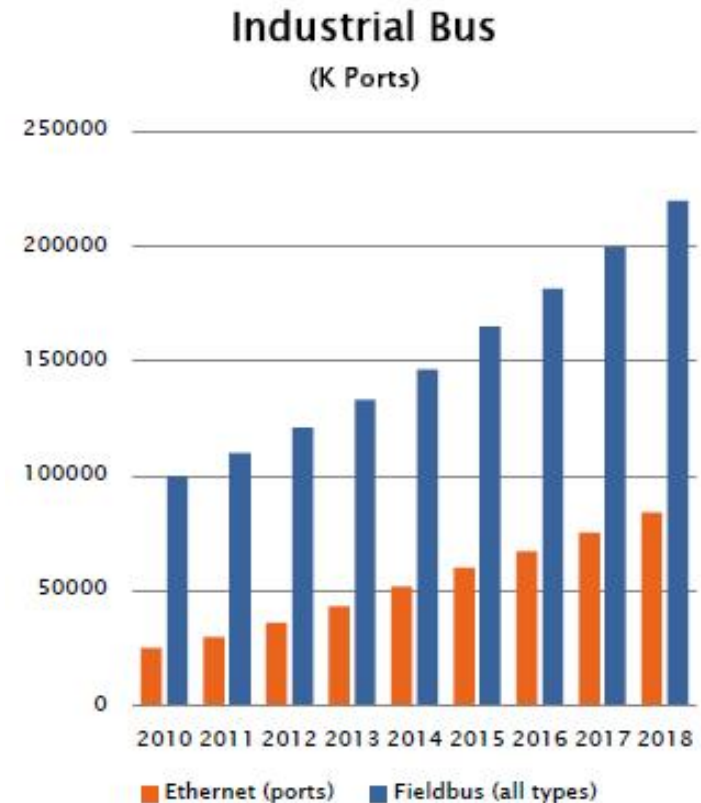
Overview – Ethernet's Growing Deployment

Introduction

- Ethernet use in industrial and commercial market is growing.
- About a dozen purposeful industrial protocols currently serve these networking needs

Forecast

- Strong desire and need for converged networks.
- Expect both conversion from fieldbus and growth of Ethernet over time.



Source: Contributions from Hirschmann, Siemens and Broadcom

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Why the 1000 meter Reach ?

- Installed cables for existing fieldbuses are often good quality single twisted pair cable, both unshielded but mostly shielded (at least outside US).
- Fast Ethernet (and some Gigabit) adoption in the many of the dominant Industrial Ethernet flavors. These (grossly) adhere to IEEE 802.3 standards in its use.
- But the traditional industrial buses support longer reach (BW-distance trade-off) at lower data rates (a few Mb/s down to a few Kb/s).
- 1000 meter reach at lower than 100 Mbps rate (e.g. 10 Mbps), would:
 - Enable new higher bandwidth applications on modern sensors and actuators, e.g. machine vision, faster control loop, central versus distributed processing, etc.
 - Provide higher bandwidth connections to existing installed cable plant, and continue to serve industrial network distances.

TECHNICAL FEASIBILITY

- Reach Extensions of 100BASE-T1
 - Automotive EMC takes more than 10 dB away from the dynamic range
 - Both 1000BASE-T1 and 100BASE-T1 should be able to make use of the margin.
 - 100BASE-T1 (at lower frequency or lower EMC) has the potential to go beyond 100m
 - EMC (radiated and susceptibility) trade off with distance and/or rate.
- It exists already at least one proprietary solution

Longer reach at lower rate

Typical Installed Cable Characteristics

Parameter	Limit
Impedance	135 .. 165 Ω with $f = 3 .. 20$ MHz
Optional capacity	≤ 30 pF/m
Loop resistance	$\leq 110 \Omega/\text{km}$
Wire diameter	$> 0,64$ mm
Wire CSA	$> 0,34$ mm ²
L/R proportional for intrinsic safety applications	$\leq 30 \mu\text{H}/\Omega$

Technical Viability Summary

- 1000BASE-T1 and 100BASE-T1 could reach up to 100 meters through use of new channel definition and reduced EMC requirements (compared to automotive use).
- Extended reach up to 1000 m could leverage existing PHYs by trading lower speed for longer reach.

Why Now?

- 1000BASE-T1 and 100BASE-T1 technical baseline adopted, and technical stability anticipated.
- Time to consider extended reach of at least 100m on these PHYs.
 - To address the needs of industrial Ethernet on its own merits
 - Leverage one pair PHY standardization and also its supplier R&D efficiency (design, development, validation, etc.).
- Industrial control and networking requested standardization nearly complete.
 - Expect IEEE 802.3br IET, and IEEE 802.1 TSN, etc, to help converge diverse industrial standards toward mainstream IEEE 802.3 networks.

Q&A

Panelists:

- Ludwig Winkel
- Xy (Moderator)
- ...

STRAW POLLS

- Should an 802.3 Study Group be formed for
Longer reach?

People in the Room

Y: ____

N: ____

A: ____

Dot 3 Voters Only

Y: ____

N: ____

A: ____

STRAW POLLS

Participation

- I would participate in a “Reach extensions of Single Pair Ethernet PHYs” study group in IEEE 802.3
- Tally: _____
- My company would support participation in a “Reach extensions of Single Pair Ethernet PHYs” study group
- Tally: _____

Future Work

- Ask 802.3 at Thursday's closing meeting to form a "Reach extensions of Single Pair Ethernet PHYs" study group
- If approved:
 - 802 EC informed on Friday of formation of the study group.
 - First study group meeting would be during next IEEE 802.3 interim meeting.