IEEE 802.3 Call for interest (CFI)

Extended reaches single Twisted Pair

Supporters

- Ludwig Winkel, Siemens AG (Industrial Automation)
- 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 Hoglund, 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. Current Industrial Communications:
   - Up to 1200m on a single copper pair
   - Deterministic, low jitter, low latency communications
   - Operating in an impulsive EMI environment
   - Rates of 32 kb/s
   - Low power (50 mW) PHYs
   - Compatible with intrinsically safe line powering
2. Future Industrial needs:
   - all of the above, plus:
     - Symmetric rates of 10 Mb/s or greater
     - Compatibility with Ethernet networks
3. Motivation

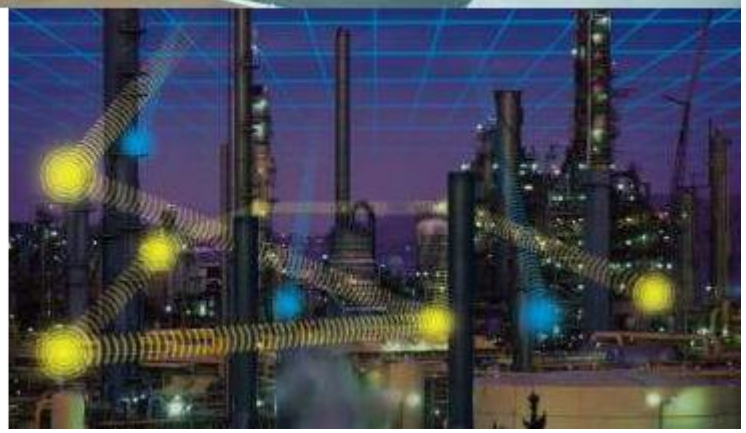
   To provide a higher bandwidth Ethernet single pair option for current industrial communication networks.
2. CFI to initiate a Study group to define parameter for extended reach of 10M, 100M and 1G one pair PHYs to serve industrial Ethernet needs.
3. This work could leverage expertise from 802.3bp, 802.3bw, and 802.3bu.

CFI Announcement Text

- Title: “**Extended reaches single Twisted Pair”**

- This is a call for interest to initiate a Study Group to explore Ethernet solutions for industrial applications over up to 1200m of single twisted pair with data rates of 10 Mbit/s or greater.
- The targeted solutions would support the transition from existing industrial communication networks to an Ethernet network simplifying operations and lowering costs.
- These solutions would be compatible with the needs of real-time control networks and line power.
- It is envisioned that the solution developed will also support Internet of Things (IoT) initiatives.

Examples of application areas



Lead positons

- 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

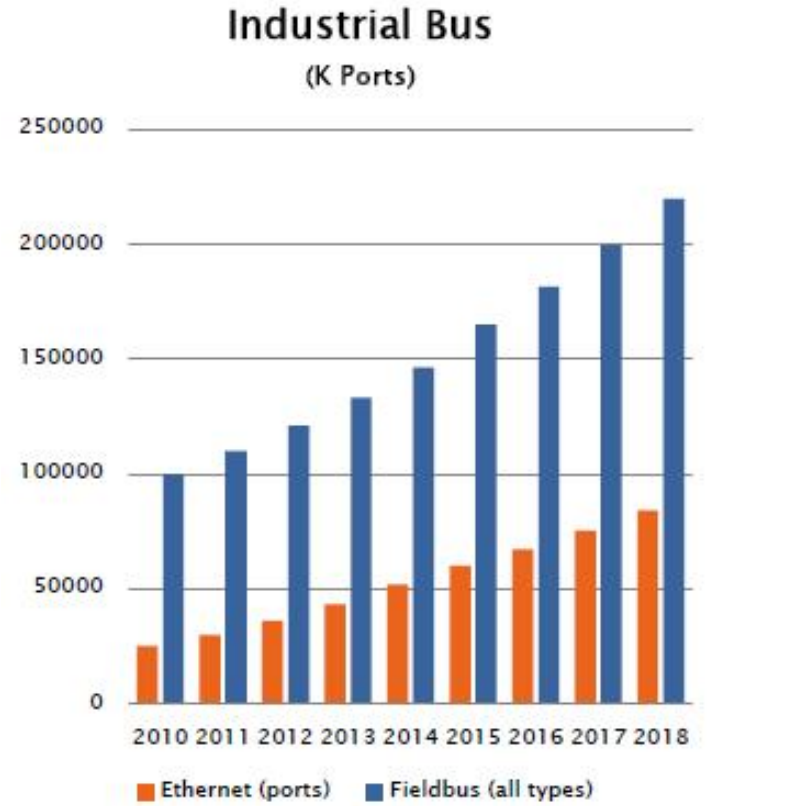
Overview – Ethernet's Growing Deployment

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

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

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Parameter	Limit
Impedance	100Ω with f = 3 .. 100 MHz
Optional capacity	≤30 pF/m
Loop resistance	≤110Ω/km
Wire diameter	>0,64 mm
Wire CSA	>0,34 mm²
L/R proportional for intrinsic safety applications	≤30µH/Ω

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 1000m 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.