

# (Re)structured Cabling Systems



**Harshang Pandaya**

**General Manager – Test & Measurements**

**AEM Singapore Pte Ltd**

**Diploma in Electronics Engineering - India**

**Masters in Science in Electronic Eng'ng -  
India**

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# (Re)structured Cabling Systems

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# Overview

## Copper cabling landscape is changing rapidly

- Security cameras, Wireless access points have far outgrown PCs as connected devices
  - New topologies such as plug terminated links and direct attach gaining popularity
  - PoE proliferating
  - 2.5G and 5G Ethernet in addition to 1G and 10G help optimize connection speed
- New Ethernet connected industrial and automotive networks are adapting ideas from enterprise cabling systems and adding more innovations

## Single pair Ethernet could be a game changing trend

- Offers optimum combination of size, cost, and performance!
- Considerable activities in standardization committees including IEEE and TIA around single pair cabling



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# More Topologies

## Traditional topologies

- Permanent link
  - Permanently installed cabling link terminated into sockets at both ends
- Channel
  - Both ends are plug terminated patch-cords

## New topologies

- Plug terminated link
  - A link from a socket at one end to a plug-termination at the other end
  - Typical application: security camera
- Direct attach
  - A cord with plugs at both ends
  - Typical application: server to switch connection

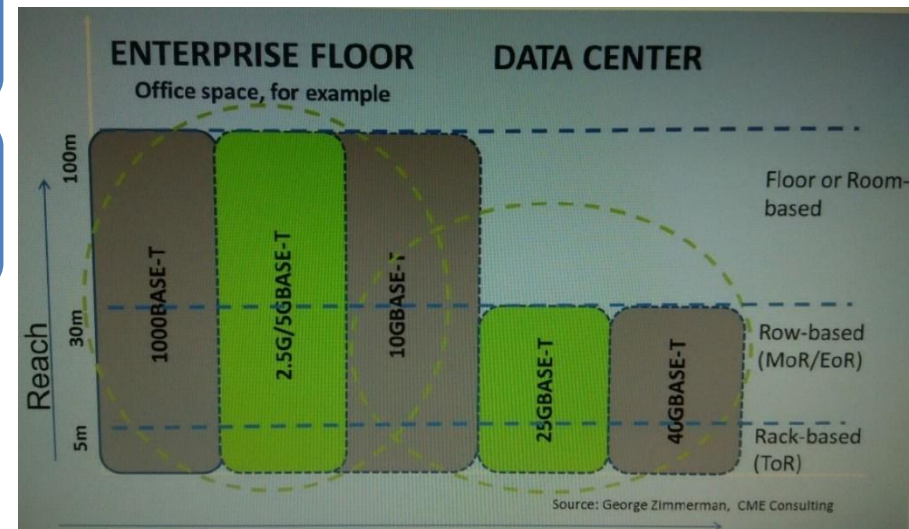


# Enterprise and Data Center

Data centers continue to look at 25G and 40G copper Ethernet as an alternative to fiber based links

On the enterprise side, availability of 2.5G and 5G in addition to 1G and 10G opens new possibility and cost efficiency

Power-over-Ethernet up to 90W enables powering of a large number of devices with Ethernet cables, resulting in high controllability and cost efficiency



# PoE proliferation

## PoE use is rapidly growing

- It is increasingly attractive to use Data cable also to apply power to the connected devices
  - Eliminate power connection to the devices and thereby reduce cost
  - Enable sophisticated remotely controlled powering schemes
- 15W, 30W, and 60W PoE Standards currently available
- 90W PoE standard under development (IEEE 802.3bt)

# Ethernet is Spreading

## Automotive Ethernet is fast gaining popularity

- 1G and 100M Automotive Ethernet standards developed over single twisted pair
- 15m and 40m systems to support different types of vehicles

## Ethernet based industrial networks

- Higher demand of speed of industrial connectivity (Industrial IoT)
- Copper Industrial Ethernet provides speed at large distances (100Mbps to 1km)

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# Single pair

## Single pair Ethernet systems are coming in a big way

- Cost saving, space saving, and environment friendliness are compelling reasons to adopt single pair
- Technical feasibility known (25G and 40G on four pairs give confidence about 1G and beyond with one pair)

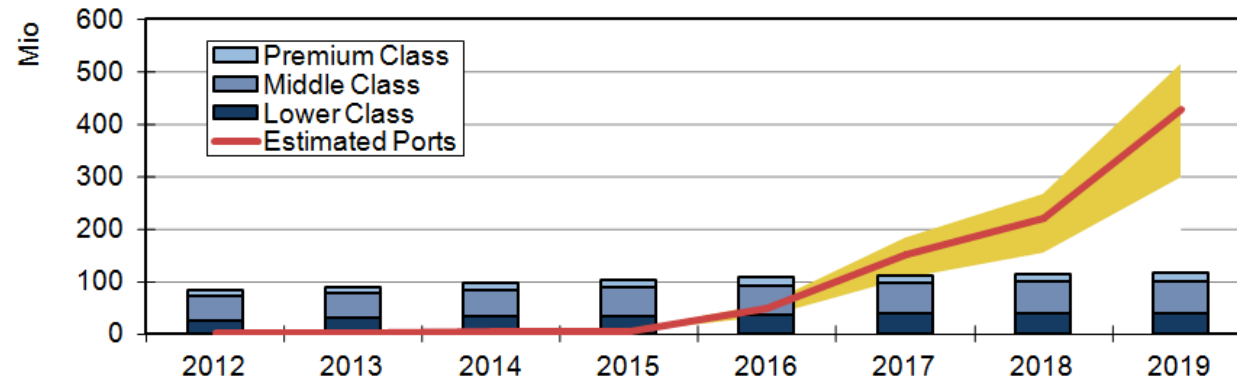
## Adoption

- Initially conceived for Automotive Ethernet (proprietary implementations followed by RTPGE project)
- High potential seen for industrial Ethernet
- And also for commercial premise Ethernet!
- Standards activity is very hot for single pair systems





# Ethernet in Automotive



\* From Robert Bosch data presented in IEEE presentation

Single pair Ethernet systems are quickly replacing traditional data communication bus systems in automotive

- Increasing data rates with autonomous and connected cars is driving the transition
- Cost, size, and weight are key factors

Automotive Ethernet to exceed 400M ports by 2020

- This is more than the total switch ports in all data centres of the world combined!



# Standardization for single pair Automotive Ethernet

## OPEN Alliance (One Pair Ethernet Alliance)

- Joint effort from large automotive companies, PHY manufacturers, and Network equipment manufacturers
- Promotes Ethernet proliferation in automotive

## IEEE 802.3

- 802.3bw: Single pair Ethernet for 100Mb data rate (100BASE-T1)
- 802.3bp: Single pair Ethernet for 1000Mb data rate (1000BASE-T1)
- Two length options under consideration:
  - UTP/STP cable for up to 15m (car)
  - STP cable for up to 40m (truck)



# Standardization for single pair Industrial Ethernet

## IEEE 802.cg (expected by 2019)

- 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.
- 1000 meter reach at 10Mb and 100Mb rates

# Standardization for single pair Enterprise Ethernet

TIA has started serious efforts to define single pair Ethernet for enterprises

- ANSI/TIA-568.5-D
- Single pair balanced twisted-pair telecommunications cabling and components

A logical move for connective sensors, IoT devices, smart building networks

# Field Testing Considerations

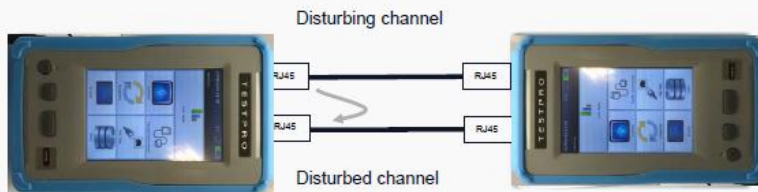
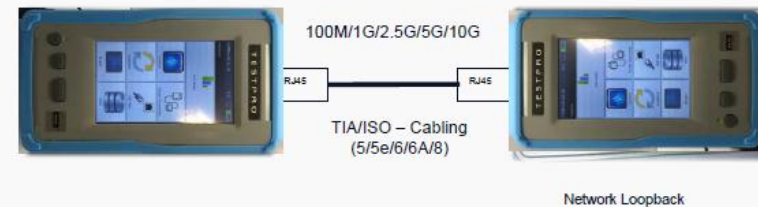
With increasing variety of cabling construction, topologies, and applications, the task of ensuring high quality cabling infrastructure is complex

Test systems to meet the new needs must be flexible, versatile, adaptive to new requirements, and yet cost effective!

# Example Field Test Scenarios

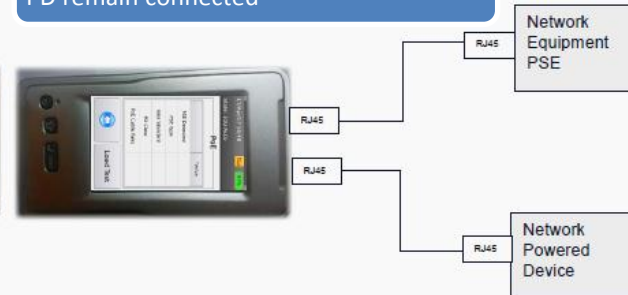
Cabling link validation for required Ethernet Speed  
(post-installation, pre-deployment)

Certification test against cabling standards  
(installation)



PoE performance measurement

Preferably also in-line while the PSE and PD remain connected



In-coming inspection and troubleshooting of PD

Alien cross-talk measurement

Not time-consuming certification but a quick and reliable check

# Summary

Copper Ethernet is witnessing a transformation

New topologies are allowing Ethernet reach to connected devices such as cameras and access points

Move to higher speeds for data centers is complimented by need for flexibility in commercial buildings

Automotive Ethernet is growing faster than any of us might have imagined

Industrial connectivity is benefiting from single pair Ethernet

Proliferation of single pair from automotive to industrial to commercial building networks

A highly diverse network needs a careful test strategy and powerful yet cost efficient tools!



Thank you!

[Harshang.pandya@aem.com.sg](mailto:Harshang.pandya@aem.com.sg)

