Standardized Automotive Ethernet Cables and Connectors

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Disclaimer

Steve's Industry Involvement

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Introduction

- **What we'll talk about today**
  - **A bit of history on Ethernet connectors and cables**
  - **A bit of history on the collaboration between IEEE 802.3 and the cabling and connector standardization groups**
  - **The benefits of this collaboration**
  - **Suggestions on how and why the automotive industry might collaborate with a cabling SDO**
  - **Suggestions on how and why the automotive industry might do something else**

- **What we won't talk about today**
  - **Put forth any particular cable and connector solution**
  - **Provide a detailed suggestion on how to do this**
  - **Suggest the adoption of the RJ45 for automotive**

An (extremely) short history of Ethernet cables and connectors

1973 - 1990

- **RG8 coax and the “vampire tap” was part of the Alto research project at Xerox PARC and was standardized for commercial use in 802.3-1983 10BASE5**

- **RG58 coax and the BNC T-tap was a cost-reduced and easier to install version of Ethernet, devised by Ron Crane of 3Com and was standardized in 802.3a-1985 10BASE2**

- **Twisted pair star wiring and the RJ45* connector was introduced in AT&T StarLAN in 1986 and standardized in 802.3i-1990 10BASE-T**

- **All standardized in IEEE 802.3**

*IEC 60603-7 8P8C
ISO 8877

TIA TR-42 and ISO/IEC SC25 WG3

- **Telecommunications cabling groups wanted to create standards for telephone system and local area network wiring plants in the late 1980s**
  - **The TIA (Telecommunications Industry Association) in the USA, and ISO/IEC SC25 WG3 internationally standardized the structured wiring plant, aka the generic cabling system, starting in the early 1990s**
  - **Cabling experts attend IEEE 802.3 meetings**
  - **IEEE 802.3 PHY experts attend cabling meetings**
  - **The link segment is developed in IEEE 802.3; the cable and connector standards to support it in the cabling groups**
  - **Lesson learned: Cabling experts are not (usually) PHY experts, and PHY experts are not (usually) cabling experts---you need both working in their own area, with some back-and-forth**

Standardized and Interoperable

- The result is a standardized and interoperable system of IEEE 802.3 devices and ISO/IEC structured wiring plant that works together
- ISO and TIA defines:
  - Physical definition of connectors
  - Cable characteristics: AC, DC and mechanical based on needs of IEEE 802.3
  - Performance classes as speeds increased
- Cable and connectors can come from hundreds of vendors
- Equipment can come from hundreds of vendors
- Lesson learned: as in-car networks move to 1, 2.5, 5, 10 Gb/s and beyond, it becomes imperative to have standardized solutions

Standardized and Interoperable

- Things to consider for connectors:
  - The mating surfaces are standardized, i.e. jacks will always intermate with plugs
  - There can be various standards for the non-mating parts, e.g. PCB mount vs. wall-plate mount vs. ???
  - Latching vs. non-latching – make sure that latching can be used with non-latching and vice versa
- The electrical characteristics will be the same across all versions---that's the payoff!
- Design characteristics will be the same from all vendors
- Lesson learned: It's possible to define connectors that are application-specific while still complying with standards

Standardized and Interoperable

- **Things to consider for cabling:**
  - **The transmission line AC characteristics are standardized; DC characteristics maybe**
  - **Mechanical construction (type of conductor, insulation, jacketing, dimensions, temperature) are standardized**
  - **There's lots of room for variations in material, wire gauge, DC current, temperature, etc. while still being compliant**
  - **There are, for example, hundreds of variations of category cabling**
- **The electrical characteristics will be the same across all versions---that's the payoff!**
- **Design characteristics will be the same from all vendors**
- **Lesson learned: It's possible to define cables that are application-specific while still complying with standards**

Standardized and Interoperable, but where?

- **TIA and ISO/IEC SC25 WG3 have worked well for IEEE 802.3 for over 25 years and will work together for the foreseeable future, but they don't do what needs to be done for automotive**
- **There probably isn't anything in the automotive industry that works quite like TIA and ISO/IEC does in the mainstream networking world**
- **What are some alternatives for the automotive industry?**

Standardized and Interoperable, but where?

- **The automotive industry has lots of places to do this work: SAE, USCAR, Open Alliance, ISO/IEC to name a few---this list is by no means exhaustive!**
- **Or standardize it in IEEE 802.3**
- **Connectors represent the biggest sticking point in any project---cabling is usually easier**
- **If you don't want to standardize a connector in an "automotive" group, go to IEC/TC 48, SC 48B Electrical Connectors* ---they standardize ANY type of electrical connector**

***** **International Electrotechnical Commission- Technical Committee 48-Subcommittee 48B Electrical connectors**

Summary

- **Standardized cabling and connectors have been a major part of Ethernet's success since the 1990s, by working in cooperation with global cabling standards organizations**
- **Standardized and interoperable connector and cabling systems have lowered production and installed costs, increased reliability, and reduced testing and compliance issues**
- **There is no technical reason why the automotive industry can't repeat this success**
- **It doesn't matter what the path is---what matters is getting it done!**

Q & A

Thank you!