Lessons from Existing Multi-drop Networks

IEEE 802.3

IEEE P802.3cg 10 SPE and Multi-Gig Automotive Ethernet PHY Study Group

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Multi-drop

- There are a lot of networks that use a multi-drop “bus” topology
- Stations connect directly to the shared media bus
- Most topologies are linear
- Some are star, but may be star, loop, or free-form (combination of linear, star and loop)

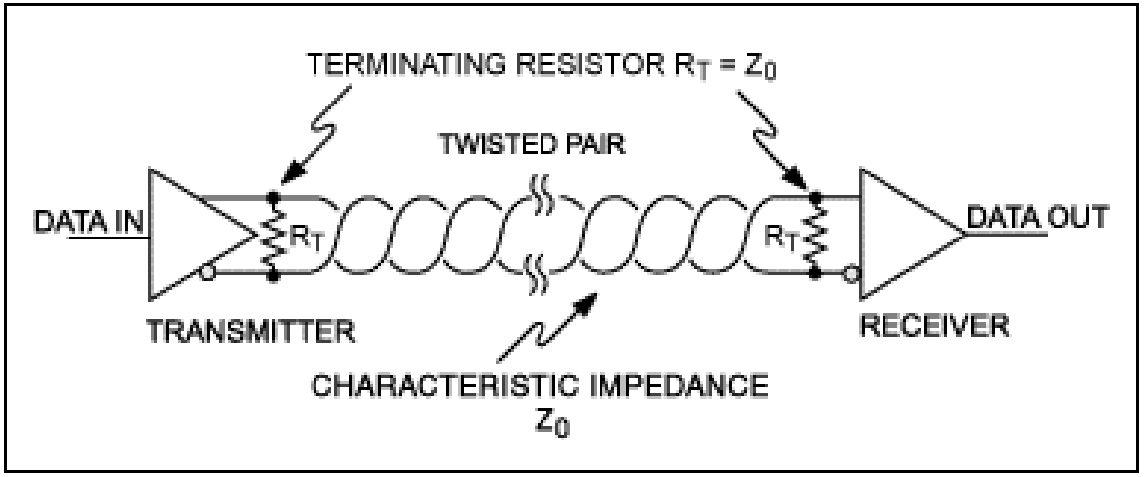
Ethernet

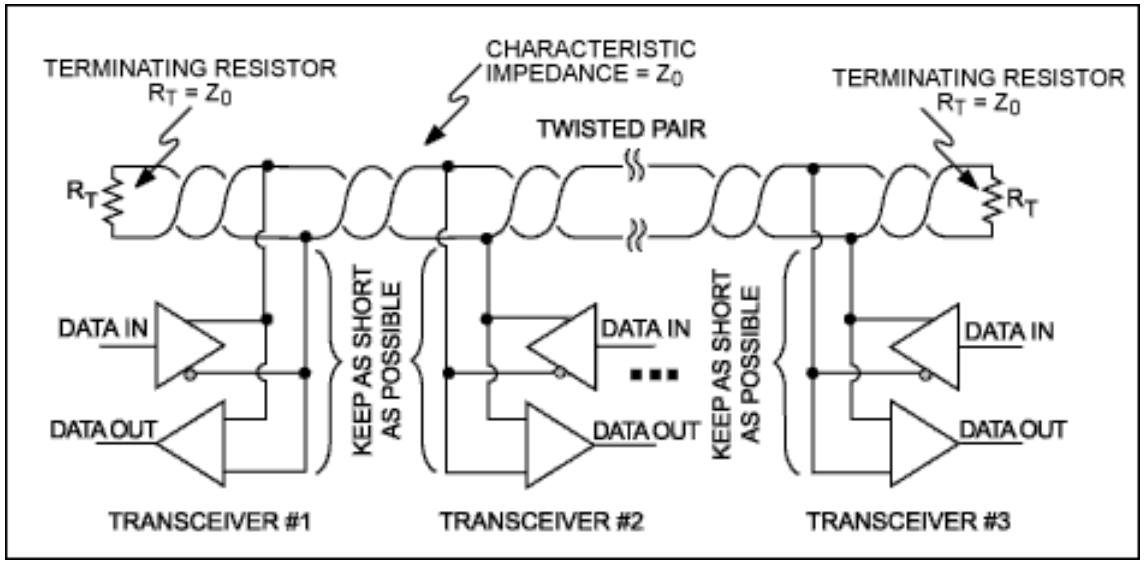
- The original Ethernet, 10BASE5, used a coaxial cable bus with network nodes attached on the cable by “vampire taps”
- Cable was marked with allowed tap points
- The coax could be up to 500 meters
- A 50 Ohm termination was required at each end
- 10BASE5 is still in 802.3-2015
- **10. Medium attachment unit and baseband medium specifications, type 10BASE2**
  - NOTE—This MAU is not recommended for new installations. Since September 2011, maintenance changes are no longer being considered for this clause.

RS-485

- TIA RS-485 defines a differential driver and receiver specification
- Many network topologies may be supported, e.g.
  - Point-to-point
  - Multi-drop
  - A single twisted pair multi-drop bus is popular in industrial controls and building automation
- The bus is terminated at each end in 120 Ohms

RS-485 topology





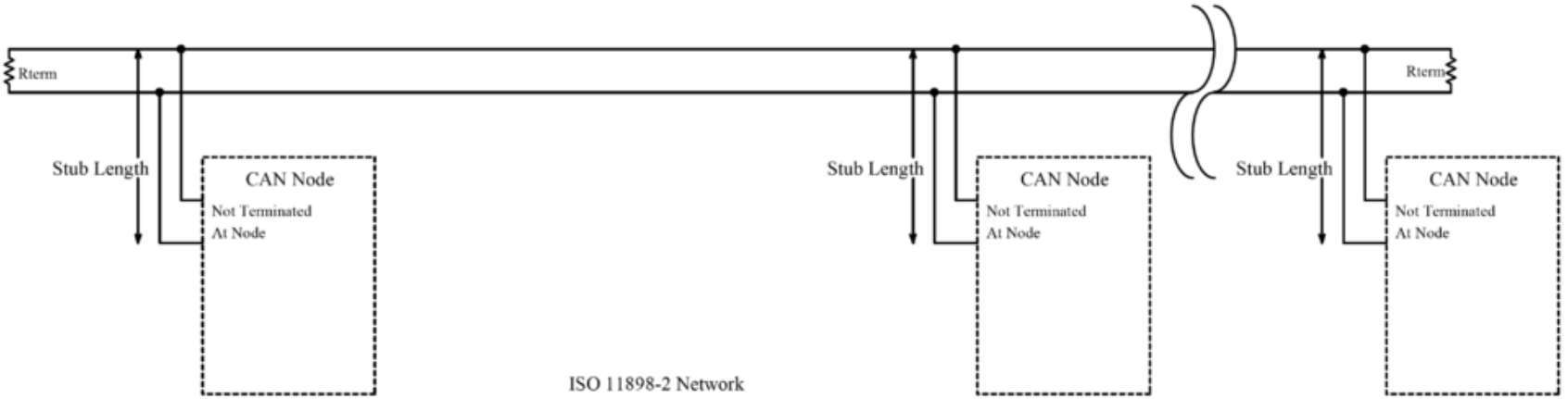
RS-485 rates and reach

- RS-485 is specified (sort of) for a maximum date rate of 10 Mb/s and ~1300 meters
- But not at the same time
- System designers must do their own rate/reach analysis
- Original cable spec is 120 Ohm STP
- CAT5 or better cables are used in many applications

RS-485 example

- ANSI E1.11 2008 (R2013) Entertainment Technology USITT DMX512-A Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories
  - Specifies 250 Kb/s at 500 meters
- Other examples
  - Bitbus up to 375kbps
  - European installation bus (EIB) up to 9600bps
  - PROFIBUS DP up to 12Mbps @ 100 meters
  - There are many, many more!

CAN bus (high speed)



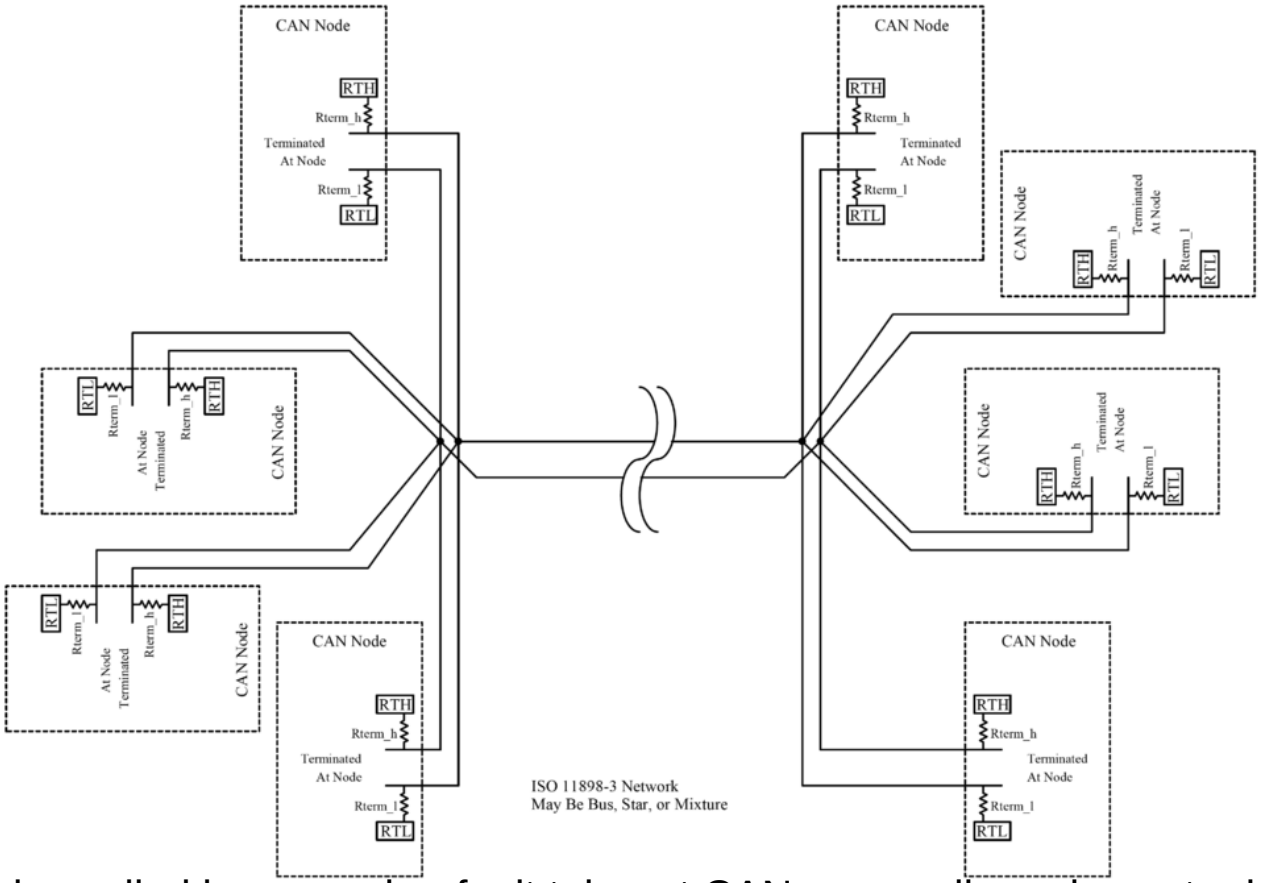
ISO 11898-2 High speed CAN 1 Mb/s

Each end of the bus is terminated in 120 Ohms, and stub length needs to be controlled

“Free-topology”

- Some systems can use a mix of linear, star or ring topologies
- This is sometime called “free-topology”
- Free-topology systems can require extra design effort at the network interfaces to support it

CAN bus (low speed)



ISO 11898-3, also called low speed or fault tolerant CAN, uses a linear bus, star bus or multiple star buses connected by a linear bus and is terminated at each node by a fraction of the overall termination resistance. The overall termination resistance should be about 100 Ω, but not less than 100 Ω. Data rate is 40 KB/s up to 125 KB/s

ISO/IEC 14908

- Linear or free topology (linear bus, star, ring, free = all of the above)
- Date rate:
  - 78 KB/s @ 1400 meter w/ 3 meter stubs
  - 1.25 Mb/s @ 130 meter w/ 0.3 meter stubs
    - Termination network (RC) required
- Manchester encoded, typically transformer-isolated, signal polarity insensitive
- 16 to 64 nodes per network

Conclusion

- Multi-drop systems are used in a wide variety of applications
- Can support linear bus, star, loop, or free (mixed topology)
- Linear bus and terminations are straight forward
- Other topologies add complexity and add wiring constraints
  - Termination can be more complex
- There are lots of models to borrow from
- No need to re-invent the wheel. (be it ring, or star, or daisy chain...)

Thank you!