

Support for Optional Bus Topology in 10SPE

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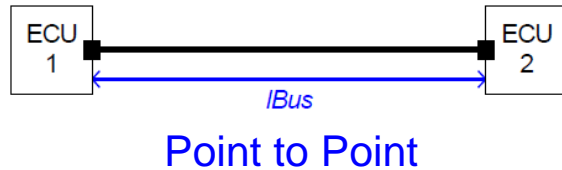
Foreword

- Study group is formed under IEEE 802.3 to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for 10Mb/s Single Twisted Pair Ethernet (10SPE). The application for 10SPE includes automotive and low cost solution is one of the main objectives.
- Automotive data networks available today provide for bus topology support. These include Lin, CAN, FlexRay and Most. In particular, FlexRay 10Mbps with bus topology support may be closer to 10SPE objectives and is reviewed in this presentation.
- With P2P Ethernet PHY and switch, daisy chained wiring provides for an alternative bus topology. Such solution however is more costly.
- Beside lower cost , inherent fault tolerance, low deterministic latency and partial networking capabilities of TDMA bus architecture are additional benefits. 10SPE support for optional bus topology is therefore beneficial and feasible.

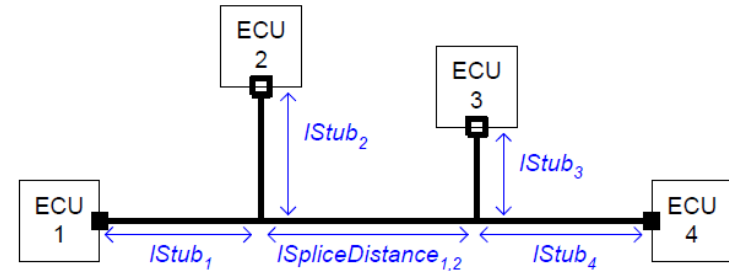
Automotive Data Networks with Bus Support

- There are multiple automotive data networks with bus topology shared medium support.
 - **LIN** with data rates below 20Kbps
 - **CAN** with data rates below 1Mbps using a random access technique
 - **FlexRay** with data rates below 10Mbps using TDMA
 - **MOST** with data rates below 150Mbps using TDMA
- IEEE 100BASE-T1 with full duplex data rate of 100Mbps supports P2P PHY connections. Multi port applications are supported using Ethernet switches.

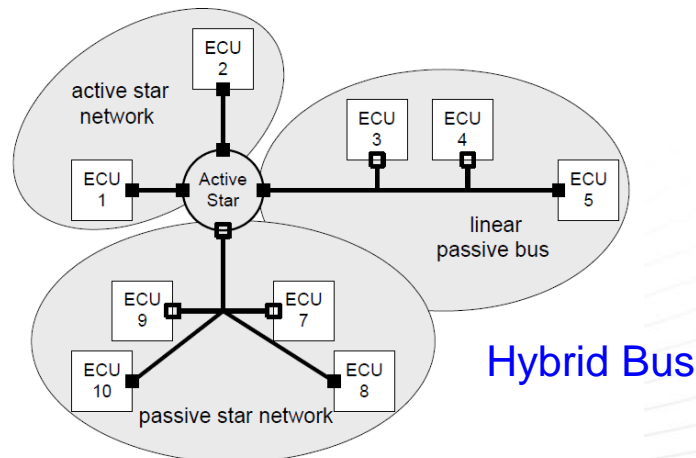
FlexRay Network Topology Options



Point to Point



Linear Passive Bus

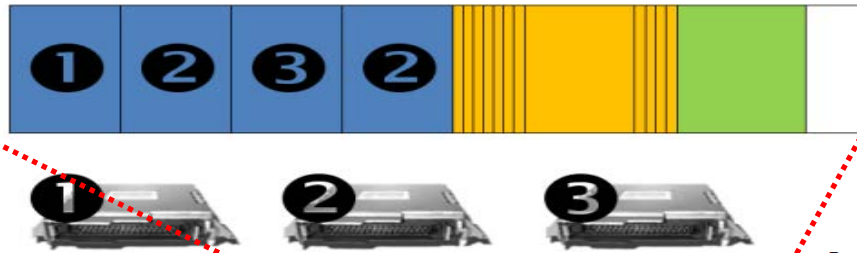


Hybrid Bus

- FlexRay allows for various P2P and bus topologies including dual channel bus option (not shown here)

Source: FlexRay Communications System Electrical Physical Layer Specification, Version 3.0.1

FlexRay Communication Cycle



Static Segment

Reserved slots for deterministic data that arrives at a fixed period.

Dynamic Segment

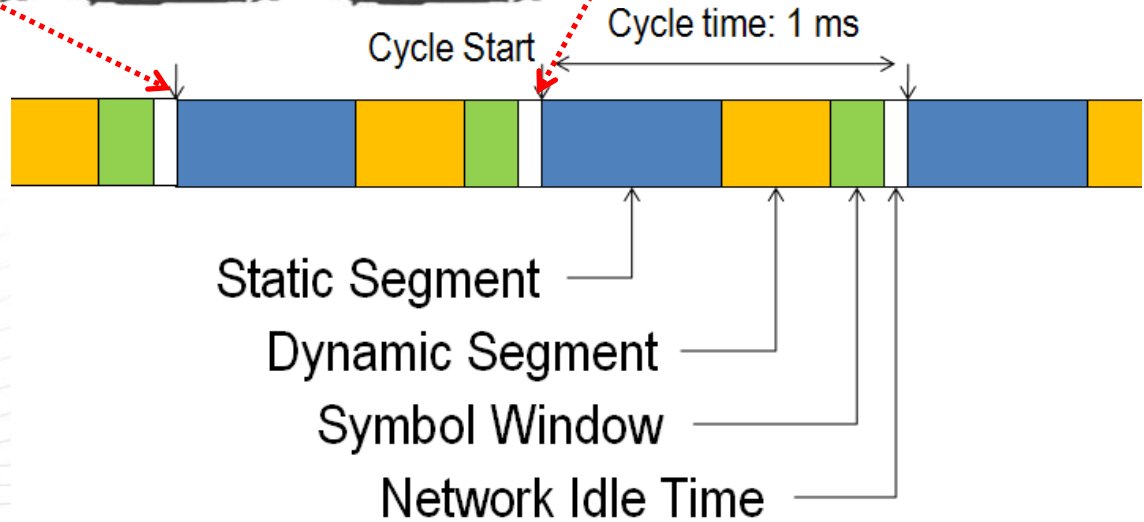
The dynamic segment behaves in a fashion similar to CAN and is used for a wider variety of event-based data that does not require determinism.

Symbol Window

Typically used for network maintenance and signaling for starting the network.

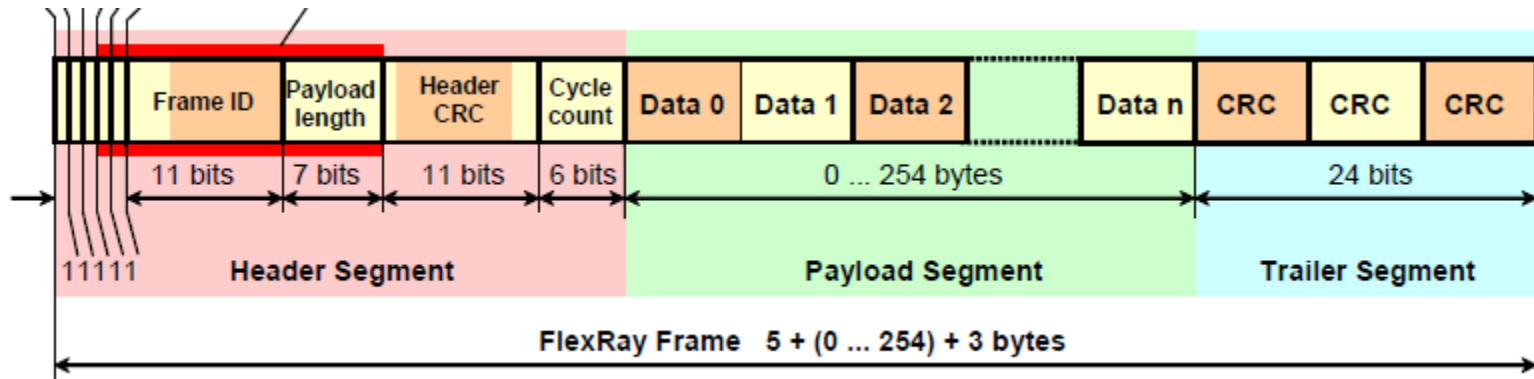
Network Idle Time

A known "quiet" time used to maintain synchronization between node clocks.



Source: <http://www.ni.com/white-paper/3352/en/>

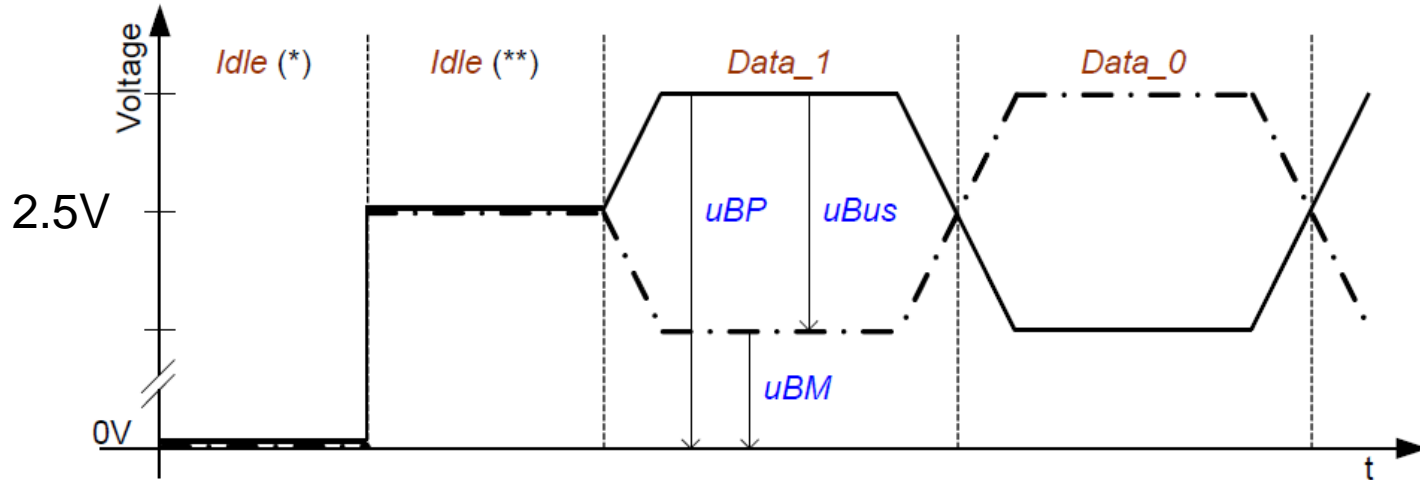
FlexRay Frame Format



- Frame ID (11 bits) defines the slot in which the frame should be transmitted

Source: FlexRay Communications System Protocol Specification, Version 3.0.1

FlexRay Electrical Signaling



(*) in case all nodes (and active stars) are in a low power mode

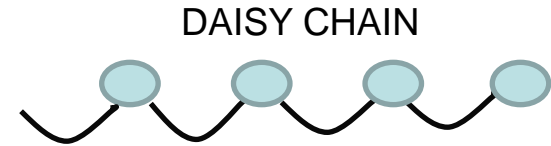
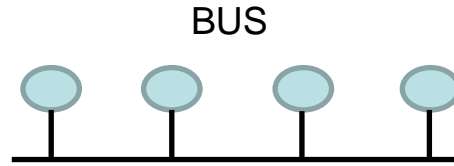
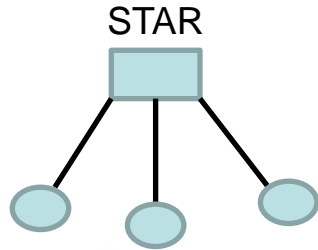
(**) in case no node (and no active star) is in a low power mode

Source: FlexRay Communications System Electrical Physical Layer Specification, Version 3.0.1

FlexRay Features' Summary

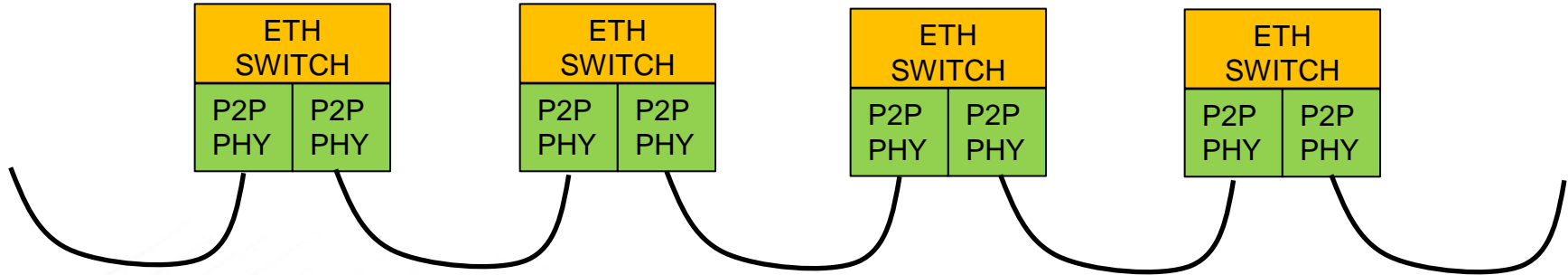
- Provides for up to 10Mbps on a single channel (up to 20Mbps gross data rate using two channels)
- Wiring flexibility allowing various network topologies for cost effective and reliable solutions.
- Deterministic latency using static segment of communication cycle (synchronous real time)
- Network fault tolerance, dual channel bus option
- Partial networking and wake up

P2P Ethernet Network Topology Options



- P2P Ethernet PHY often used in STAR topologies
- Linear bus topology is not supported but daisy chain topologies may be used with similar wiring requirements

Daisy Chain Network Topology Using P2P PHY



- Daisy chaining provides for an alternative bus topology.
- Each node requires 2 PHYs and one Ethernet switch, more costly than alternative TDMA bus
- Ethernet switch has additional latency and synchronization requires support for 1588 or AVB. TDMA bus provides for deterministic latency.
- With daisy chaining, fault (or power down) of a network node results in network failure unless redundant routing is provided. TDMA bus nodes may be powered down with no network failure.

10SPE Networking Options

- 10SPE supporting P2P Ethernet PHY and along with Ethernet switches and AVB has potential to provide for various network topologies including star, daisy chain and hybrid topologies.
- There are many applications for which bus networks provide for more cost effective solutions than switched P2P networks. Many low cost automotive solutions available today provide for bus support as recognition of the fact. E.g. FlexRay provides for deterministic TDMA bus at 10Mbps.
- TDMA type of bus topology at 10Mbps for automotive is feasible. Supporting such option in 10SPE provides for more cost effective and fault tolerant networks.

Conclusion

- In order for Ethernet to address requirements of a larger sector of automotive data networks, it is suggested that the support for optional bus topology is considered for 10SPE objectives.



Thank You!