First considerations for 10Mbps@15m multidrop

13.3.2017

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Introduction

The objectives for 10SPE explicitly do not insist on full duplex communication only for the 15m channel but allowed for investigating half duplex/multidrop/bus topology as well.

For the automotive industry the multidrop scenario offers many use cases of interest. Also for industrial communication use cases have been identified.

The following slides therefore provides first input on

a) the multidrop channel and

b) the medium access scheme.

The multidrop channel

Requirements to decide on

A multidrop channel can take a large variety of forms, depending on various parameters:

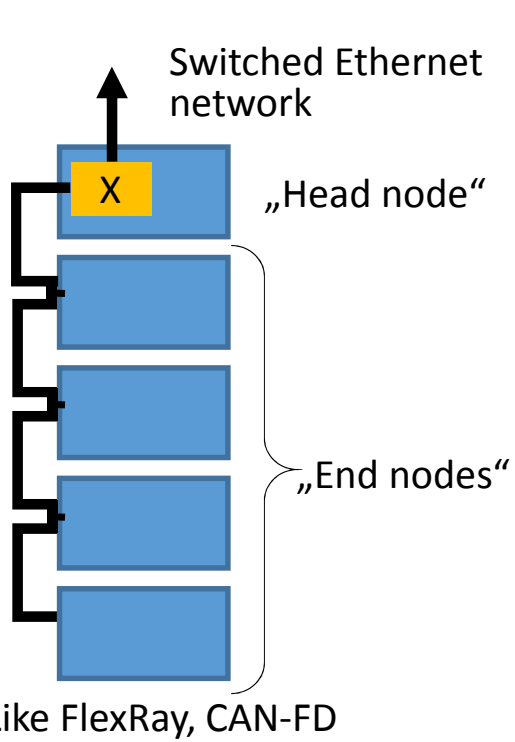
a) Topology
b) Length
c) Number of units to be supported
d) Number of inline connectors to be supported
e) Termination

=> More details on next slides

*) „Either or“, not linear topologies as branches of the star

Topology

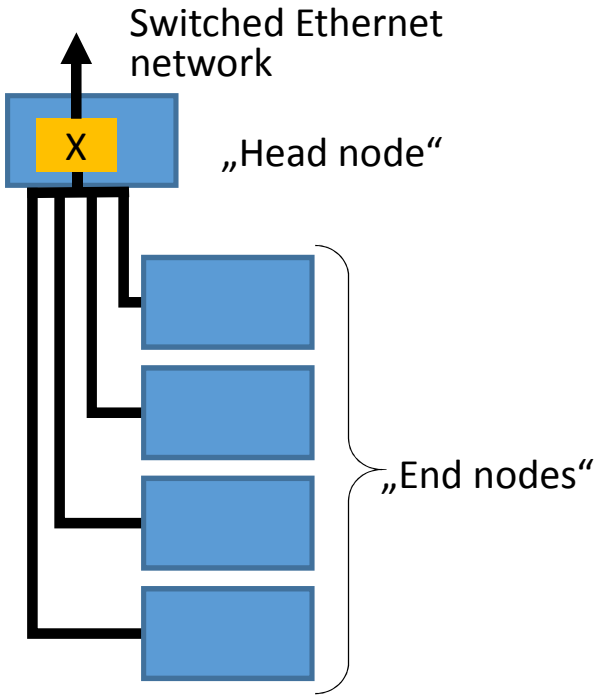
„(passive) linear“



Like FlexRay, CAN-FD

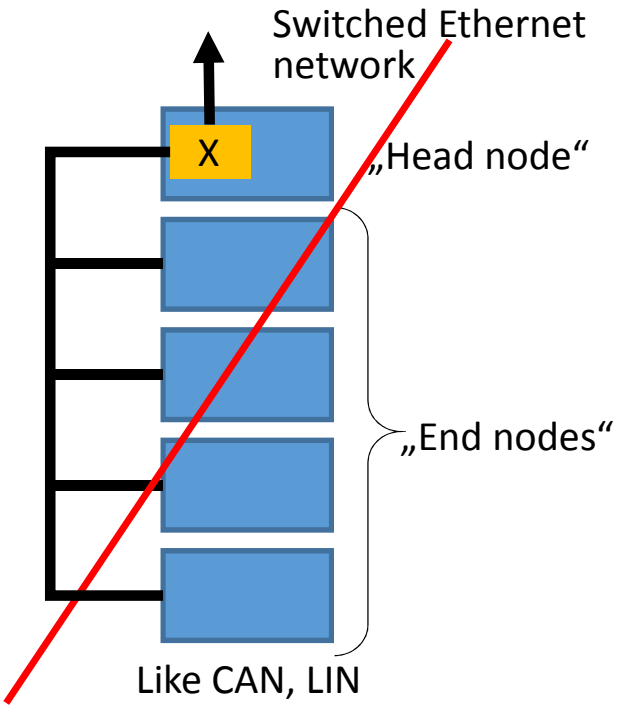
Topology should be supported *)
(short stubs <~10cm prob. on PCB)

„ (passive) star“



Topology should be supported *)

„(passive) stubs“



Like CAN, LIN

Topology with stubs >~10cm not supported
Channel reflections too complex

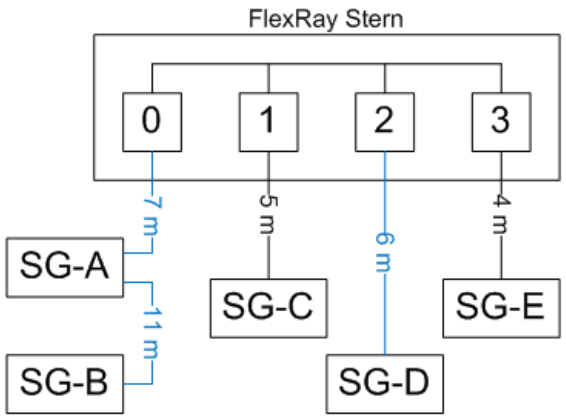
Length

- 10SPE objectives: 15m/4 inline connectors P2P
- Tbd., the overall link length in a linear/star scenario
- FlexRay defines 24m (using an active star, see below!)
- Linear CAN(-FD) overall ~30m (SAE-J2284-3)

Starting point:
- **25m in a linear topology max**
- **8m per star branch max**

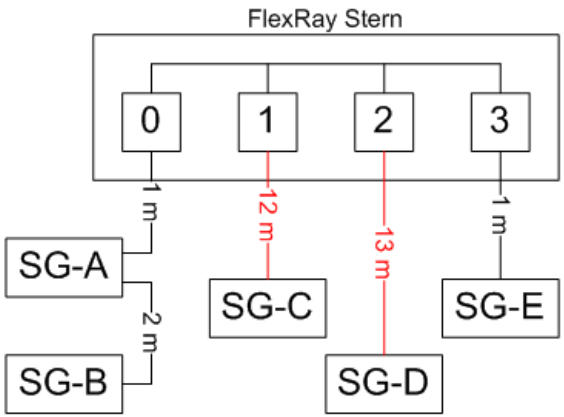
Needs to be confirmed

FlexRay active star coupler



Overall length 24m

FlexRay active star coupler



Overall length 25m

Number of nodes

- @BMW, CAN can have 16 participants
- @BMW, CAN-FD can currently have 7 participants (expected to grow in the future)

⇒**A maximum number of 8 participants on a 10SPE@15m@bus (including the head node) is a reasonable requirement**

⇒Needs to be confirmed

Additionally:

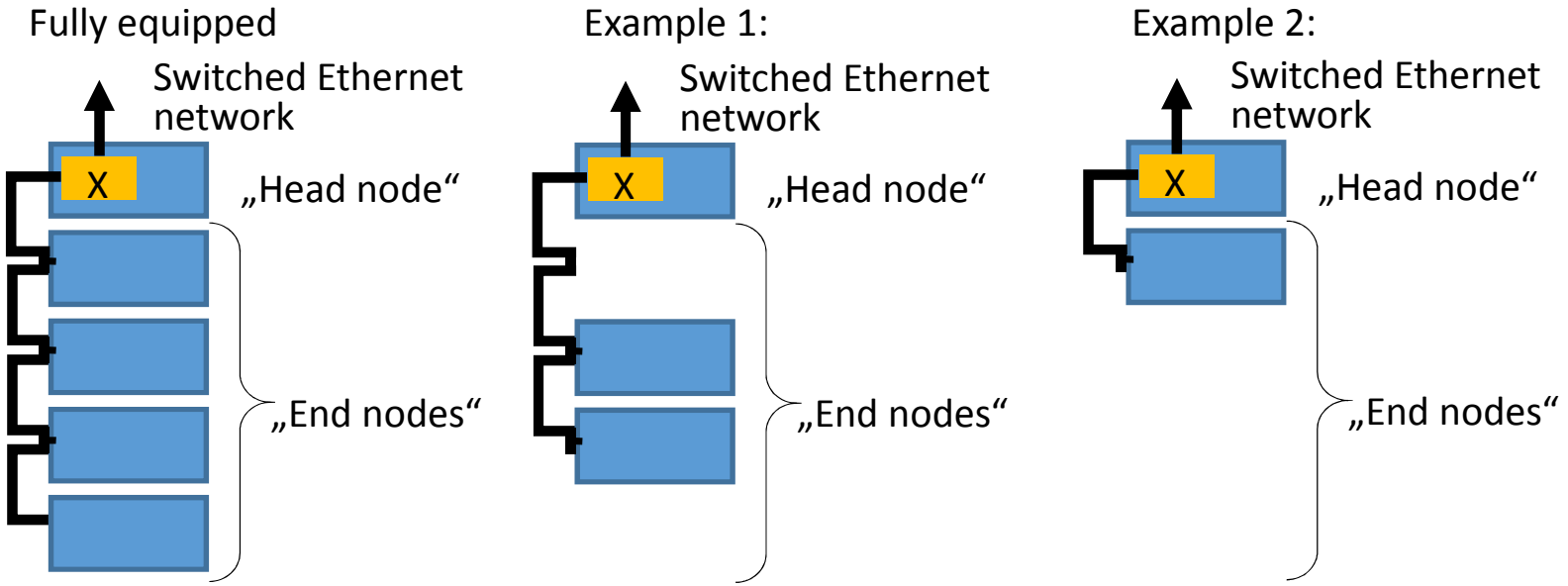
- Single data rate for up and downlink

Number of inline-connectors

- The assumption is that the effect of lining up units is expected to dominate the transmission behavior in comparison to the in-line connectors.
- However, a realistic in-vehicle scenario has to allow for two inline connectors minimum per linear multidrop topology.

Impact of termination (1)

- Every channel requires some termination in order to mitigate the effect of reflections.
- In an automotive multidrop scenario this more challenging as not all nodes are always there. Having node variants depending on the actual configuration is not acceptable.
- Thus a termination concept is desired that goes inherently with the multidrop scenario.

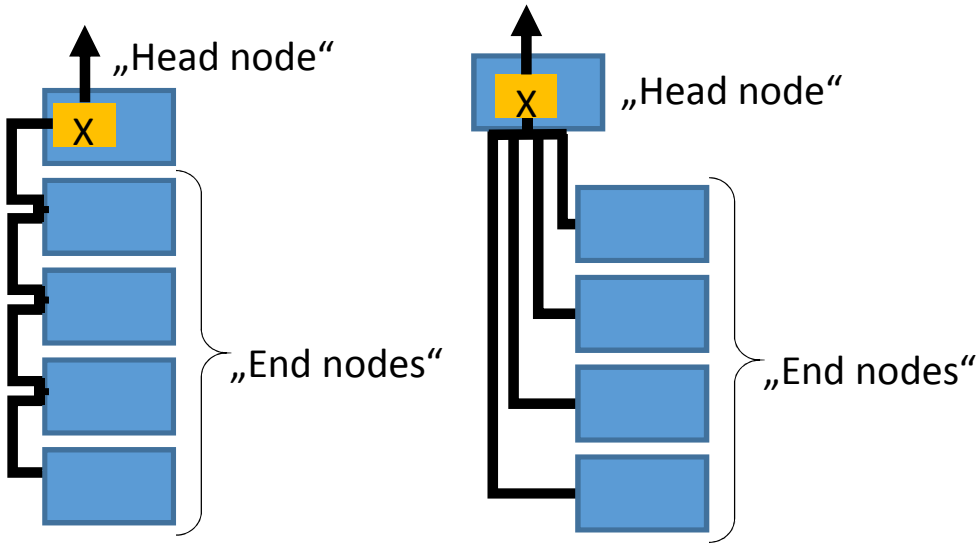


Impact of termination (2)

Examples of **simple and reliable termination concepts** of the multidrop topology:

- No Termination
- Termination in all units
- Only have one termination at the head node, while all other nodes are high impedance.

These might lead to decreased signal quality the PHY has to deal with.



Open question

Input is needed:

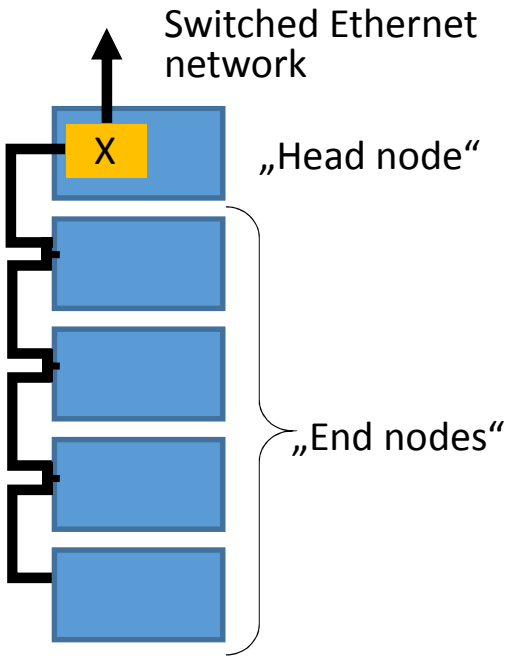
- Are the requirements (topologies, link length, termination concept, number of nodes) on the multidrop channel reasonable?
- Do requirements have to be reduced on order to have a competitive solution?
- (How) Does the addition of a multidrop channel increase the effort in a PHY in comparison to a P2P channel only?

The channel access scheme

Problem description

- If 10SPE@15m supports a bus structure (“multidrop”) the channel access has to be organized differently than in the switched network
- Existing IEEE 802.3 access schemes are:
  - CSMA -> outdated
  - P2MP in EFM -> suitable?
  - P2MP in copper EPON (EPoC) -> suitable?

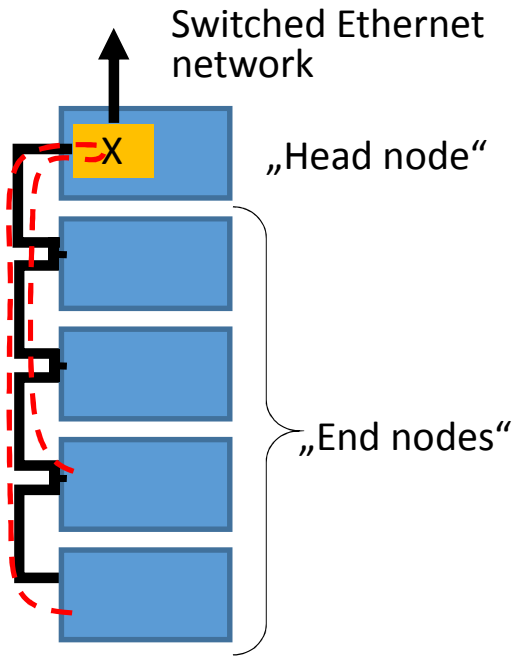
  Same basic principles
- The question thus is whether reuse is possible for 10SPE@15m (the development of a new multiple access scheme means significant effort)



Suitability of EFM/EPoC (1)

Current expectations based on Marek Hajduczenia's presentation in the 10SPE adhoc on Nov 30, 2016:

1. The desired linear/star topologies can be supported. However, the communication always passes via the head node, even if two end nodes want to communicate (see figure to the right). This is possible but uses additional bandwidth on the bus.
2. In principle, the same PHYs can be used in P2P as in multidrop scenarios. The changes needed happen on the data link layer, i.e. either in the bridge of the head node or in the processor the PHY is connected to in the end node.



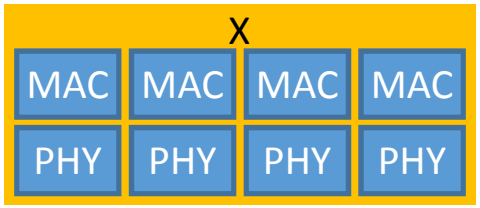
Suitability of EFM/EPoC (2)

Current expectations based on Marek Hajduczenia's presentation in the 10SPE adhoc on Nov 30 2016:

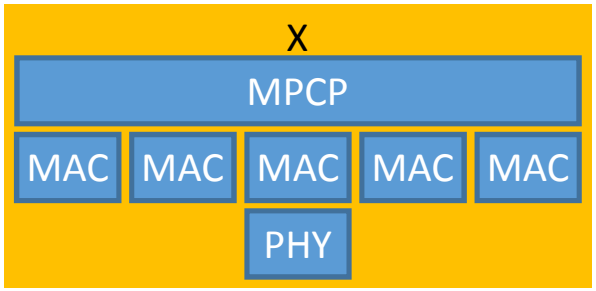
3. In the end node MAC there is some additional effort for the address mapping and bandwidth reservation/allocation.
4. In the head node there is significant additional effort, with more complexity for address mapping, bandwidth reservation, one MAC per end node plus one for the downlink etc. In the original scenarios for EFM/EPoC, this effort was not crucial, in the 10SPE@bus scenario it might be.

   Is the additional effort reasonable?

Simplified head node switch for **switched Ethernet network** with 4 end nodes

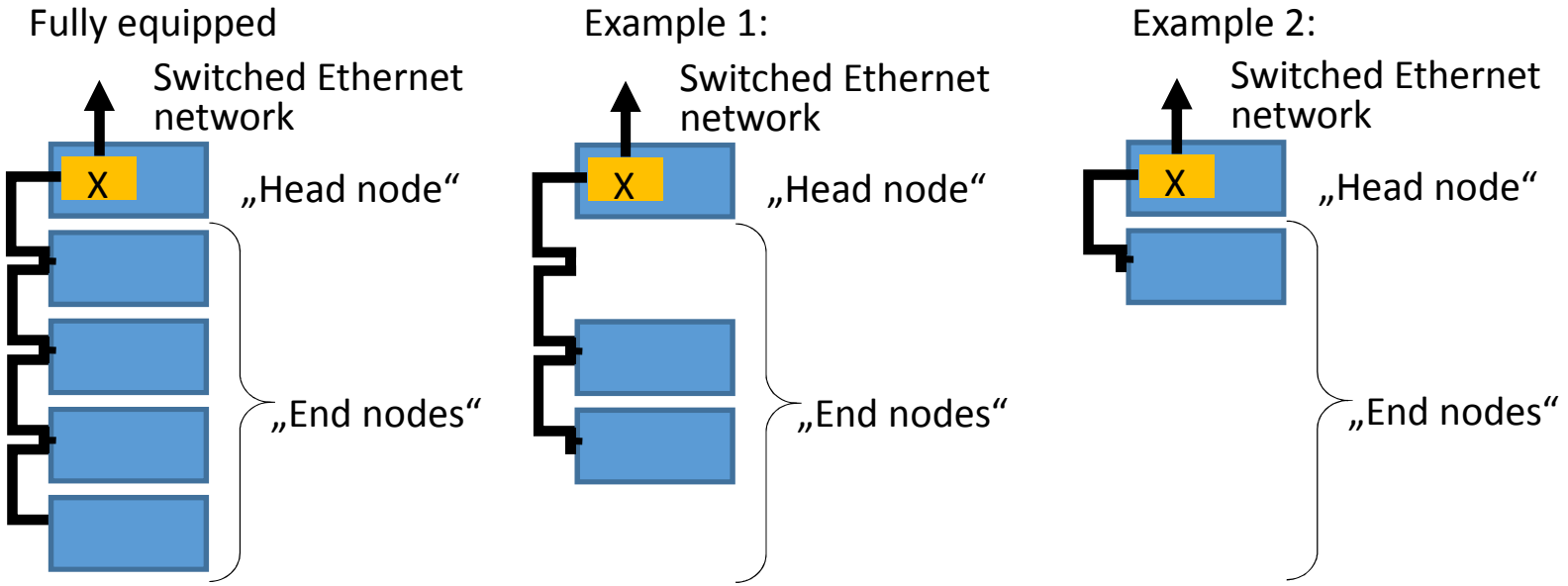


Simplified head node switch for **bus Ethernet network** with 4 end nodes



Configuration

“Automotive Plug&Play” required not only in respect to termination but also to the channel access/bandwidth allocation. It has to be possible that the Head node determines the nodes present and the bandwidth requirements automatically (at band end).



Conclusion

- Desired multidrop channel
  - Linear (stubs <10cm) and star topology
  - 25m over length of linear topology, 8m length of star branch
  - 8 units maximum (including head node)
  - An inherent termination concept
- In principle, a bus topology should be possible with the same PHY (and the same cables, connector might vary depending on chaining concept) as the P2P topology
- Input needed on
  - Expected impact of linear/star channels and termination on PHY effort (in comparison to P2P scenario)
  - Measurements of channel, S-parameters of example multidrop link segment

- In principle the EFM/EPoC multidrop scheme seems usable for the 10SPE@15m scenario. Questions on actual multiple access scheme
- Input needed on
  - Additional effort in MAC especially in head node MAC (also in comparison to switched scenario)
  - Dynamic allocation of bandwidth at band end