10SPE
automotive PHY system considerations
channel+EMC / multidrop aspects

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motivation

- Provide input to the 10SPE task force regarding the channel considerations for the automotive PHY
  - Ideas on channel (relaxation for more flexible pinning, etc.) and EMC-based proposal for “sweet spot” in frequency range.
  - Thoughts on the multidrop concept and system design aspects which needs to be taken into account when designing a multidrop system.

channel considerations

additional input to the slides provided by Kirsten Matheus
(http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_10SPE_01_0217.pdf)

- Using BMW's 100BASE-T1 cabling as starting point for channel considerations is a good approach from our perspective:
  (unjacketed TP cable with non-PVC and multi-pin connectors)

- Two add-ons to be considered when developing the final channel model:

  1. To allow more flexible pinning configurations in multi-pin connectors, there should be a reasonable add-on for the connector RF parameters. Relaxation of untwist length requirements for connector assembly.

  2. Choose appropriate frequency range to ease implementation:
     - To allow PoDL to operate with reasonable, the lower frequency limit should be at least comparable to 100BASE-T1, as well transient disturbers from EV's (electrical vehicles) can be avoided with this approach.
     - The higher frequency limit may be reduced some how (relaxed crosstalk requirements for connectors, reduced EMC burden, relaxation of untwist length).

channel considerations

more flexible pinning configurations in multi-pin connectors

To allow more flexible pinning configurations in multi-pin connectors, there should be a reasonable add-on for the connector RF parameters.

- Allow various multi-pin connectors as well with higher pitch, e.g. 5mm (TBD)
  → increased Impedance mismatch@connector, higher RL@high frequencies
- Allow using “higher” rows in right angled multi pin connectors.
  → increased IL for connector
- Allow more flexible pinning configuration for adjacent channels (no spare pins, etc), pins on different rows of a right angled connector, relaxation of untwist length requirements for connector assembly
  → increased crosstalk and mode conversion@higher frequencies
  (can be overcome by decreased upper frequency limit)

Measurements from connector vendors (or other contributors who are able to measure a connector) to estimate reasonable increase of RF parameters is necessary.

channel considerations

choose appropriate frequency range to ease implementation

Expectation is:
the higher frequency limit may be reduced somehow due to the lower bandwidth needs:

- As said – to get freedom of implementation for connectors, the higher frequency limit should be relaxed compared to 100BASE-T1. This helps to relax RF requirements for connectors

- To allow PoDL and to avoid EMC disturbance of EV's (electrical vehicles) the lower limit should stay at least the same as the 100BASE-T1 (including PoDL) – or it may even shifted a little bit to higher frequencies.

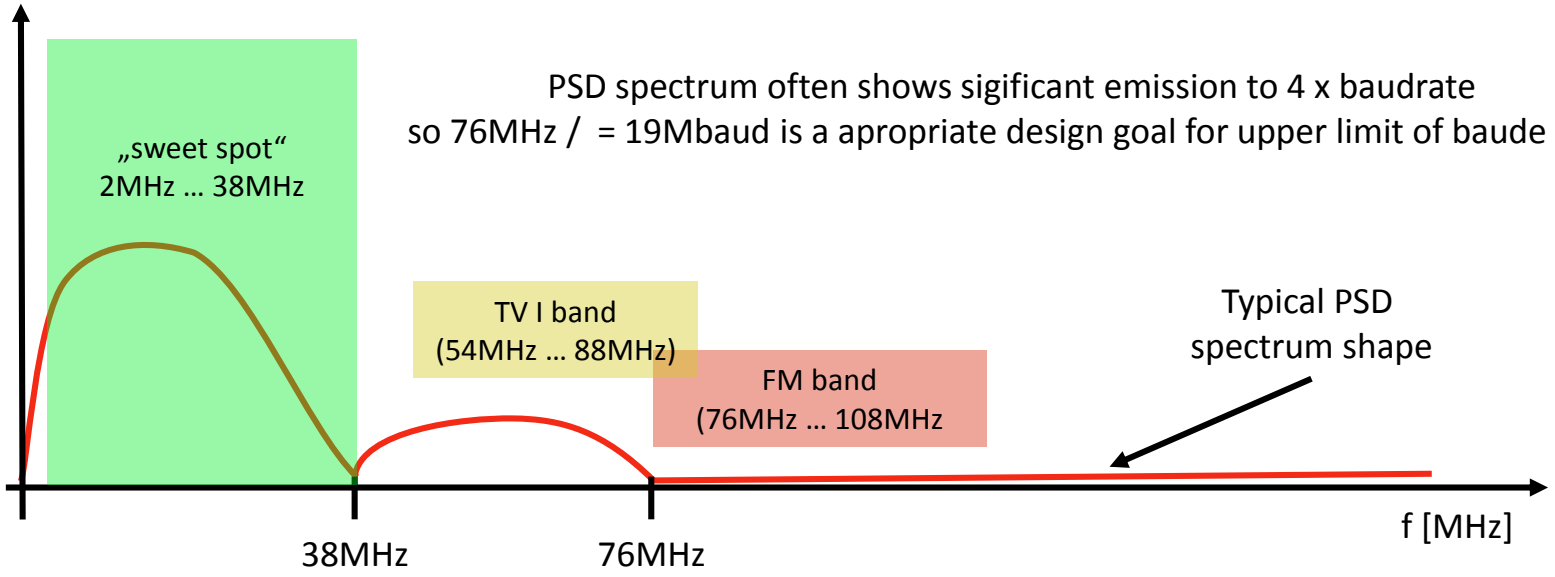
channel considerations

choose appropriate frequency range to ease implementation

- Stringent EMC emission limits apply to the following bands:
  - MW band (0,52MHz – 1,73MHz)
  - [KW49m (short wave) band (5,8MHz…6,3MHz)] today not in use.
  - **<u>Here is the gap for 10SPE</u>**
  - [TVI band (54MHz – 88MHz)],
    TVI no longer in use today, but probably for new applications?
  - **FM band** **(76MHz – 108MHz) most critical**
  - TVII band (99MHz – 108MHz)
  - **DAB** **(174MHz – 241MHz) most critical**

channel considerations – “sweet spot”

choose appropriate frequency range to ease implementation



→ A frequency range between roughly 2MHz…38MHz seems to be a „sweet spot“ for 10SPE in terms of emission and low frequency immunity/PoDL. This range would also allow for acceptable relaxation of limits in the higher frequencies to allow freedom of implementation for channel (connector). Remark: Immunity and basic emission requirements still apply.

Use the “sweet spot” between **2 MHz and 38MHz** for PSD and design 10 SPE PCS/PMA accordingly.

Multidrop system aspects

Multidrop system aspects

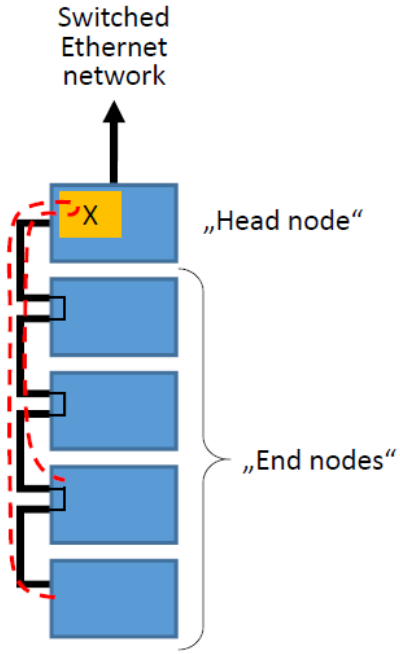
additional input to the slides provided by Kirsten Matheus (http://www.ieee802.org/3/cg/public/adhoc/kaindl_matheus_10SPE_02_0217.pdf)

"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 daisy chain channel on PHY effort*
- *Additional effort in MAC especially in head node MAC (also in comparison to switched scenario)"*

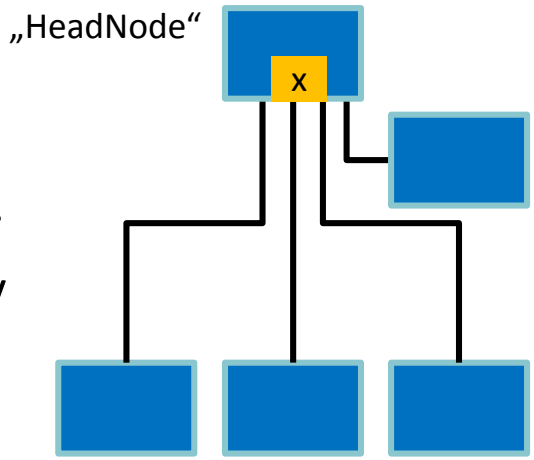
The following slides discuss some system aspects which need to be taken into account when a multidrop system/channel is used.

Multidrop system aspects



Fully flexible topology is not needed, BMW considers passive linear topology (“daisy chain” – which is not exactly correct)

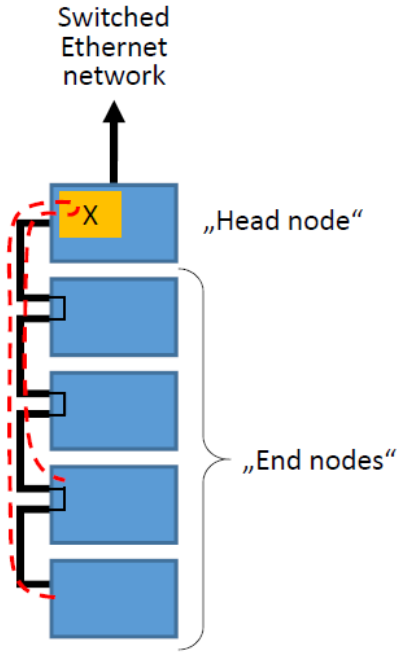
→ Yes, fully flexible topologies might lead to significant different channel, so this should be not considered. However in addition to passive linear topologies also passive star topologies may be considered, as they as well have “friendly” RF behavior. (http://www.ieee802.org/3/10SPE/public/adhoc/buntz_10SPE_03_1005.pdf).



→ So for multidrop channel considerations a passive linear topology* of max. 25m (TBD) **OR** a passive star topology with branches having a maximum length of 8m (TBD) shall be possible.

*) very short stubs (e.g. <100mm are still needed (no daisy-chain with 2 PHYs on each port)

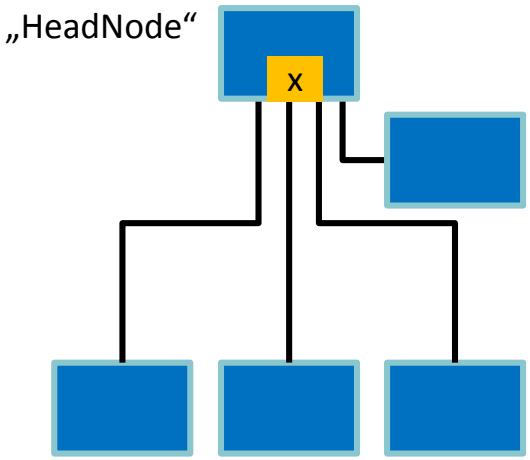
Multidrop system aspects



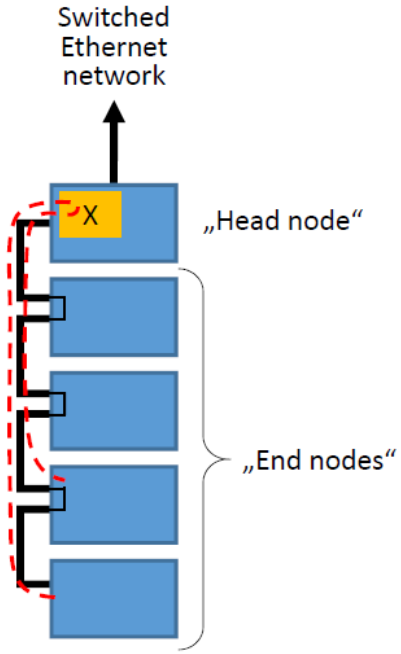
- Termination of multidrop

Termination definition of shared medium always causes difficulties if dedicated termination concept is necessary, which does not inherently go with the multidrop topology itself.

→ Allow for a simple and reliable termination concept of the multidrop topology:
all nodes terminated **OR** no termination at all **OR** only have one termination at the head node, while all other nodes are high impedance.
Remark: This lead to more reflections and a decreased signal quality the PHY has to deal with.



Multidrop system aspects



→ So for multidrop channel considerations a passive linear topology of max. 25m (TBD) **OR** a passive star topology with branches having a maximum length of 8m (TBD) shall be used.

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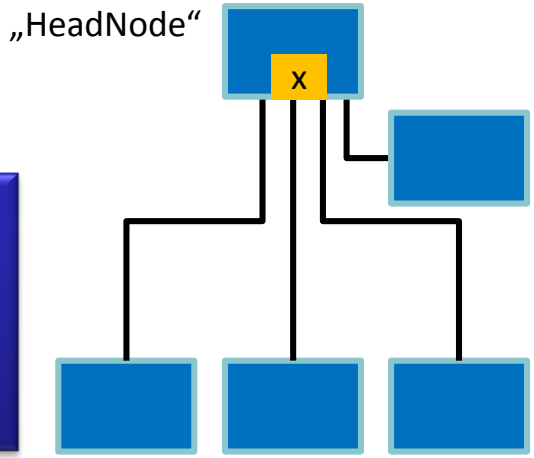

Input of semiconductor vendors is needed:
Are these proposed numbers for a length objective reasonable under the proposed termination concepts?
Other length proposal from semiconductor vendors?