First considerations for the 10Mbps@15m channel

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Content

- Channel considerations for 10Mbps@15m P2P link
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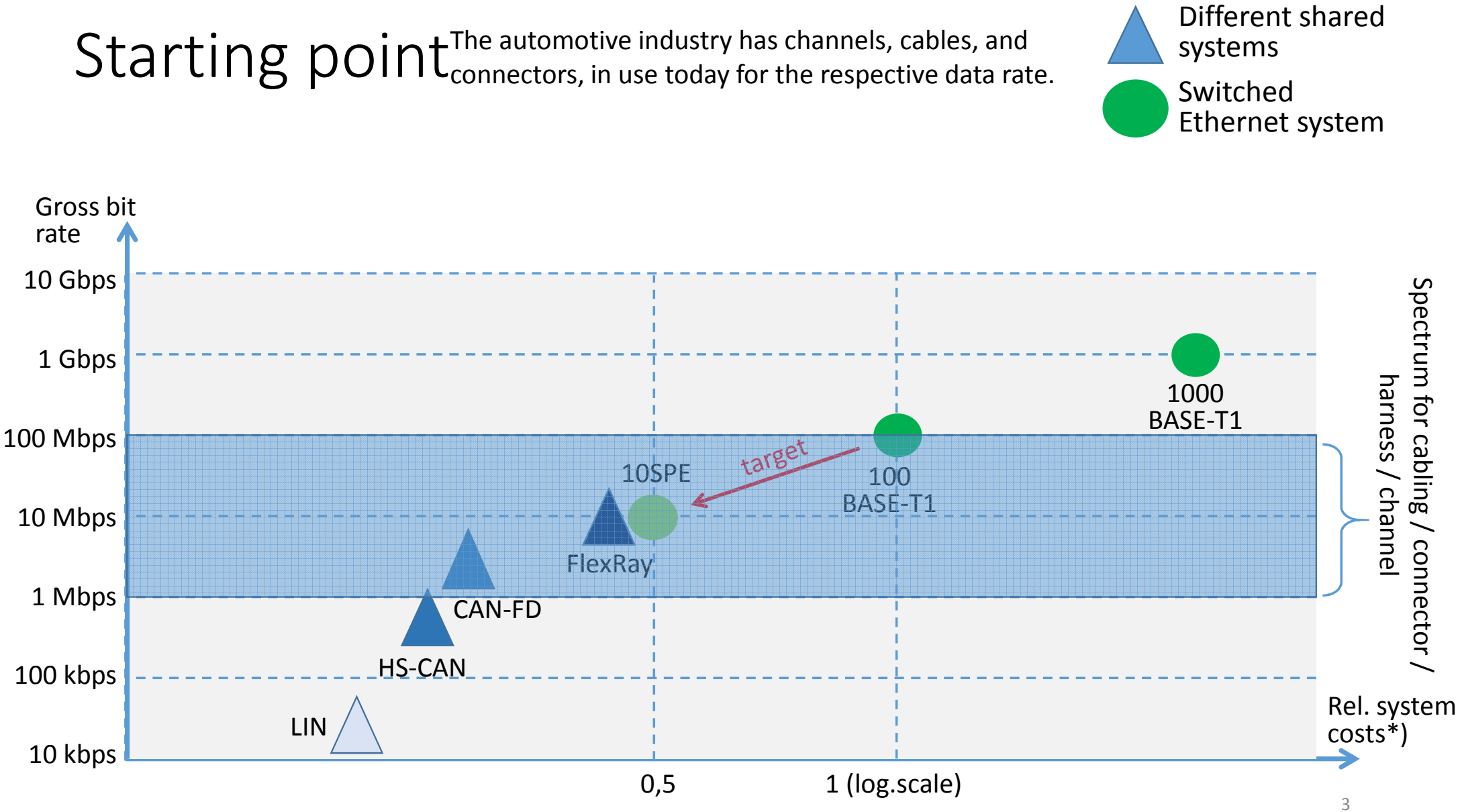
Starting point

The automotive industry has channels, cables, and connectors, in use today for the respective data rate.



*) The cost values are very dependent on the exact topology that is being compared, this chart gives an indication only.

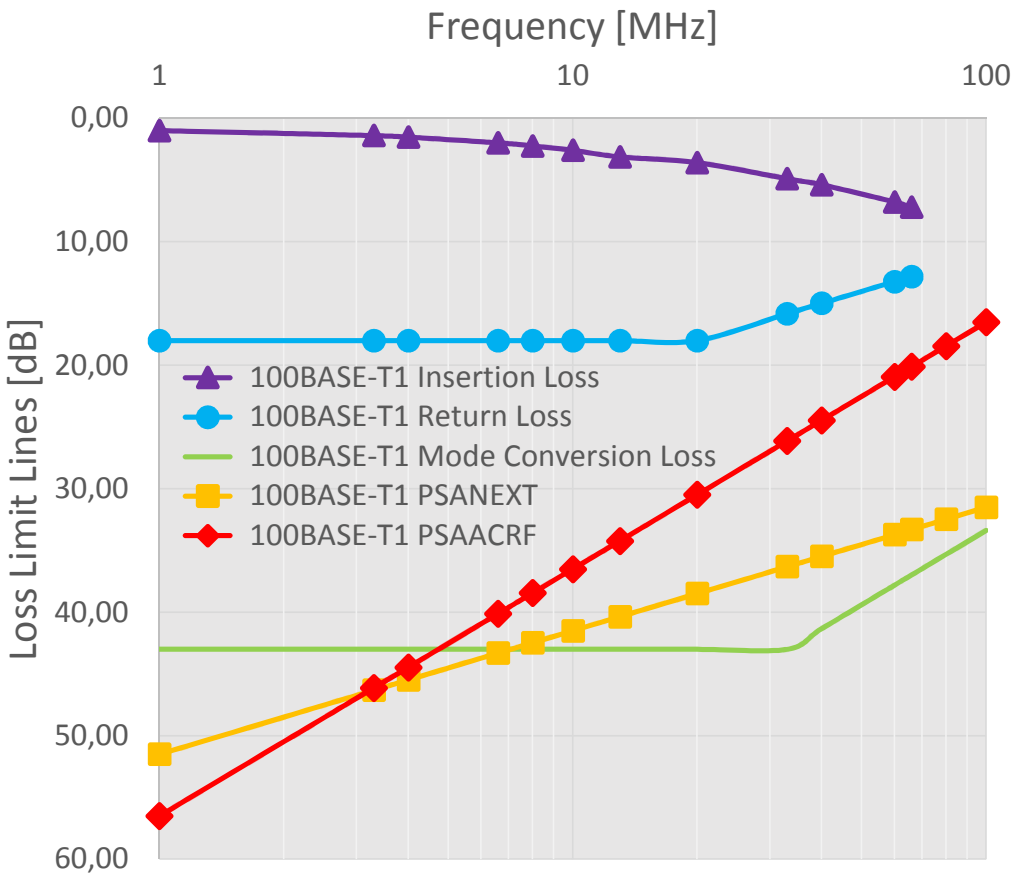
Cables & connectors used

- The starting point for 100BASE-T1 cabling was FlexRay cabling. 100BASE-T1 is UTP used with a smaller twist rate and PP*) instead of PVC.
  - ➢ PP is better temperature resistant and more resistant to XTALK
  - ➢ Smaller twist rate proved better in the mode conversion
- In consequence the 100BASE-T1 cabling is also considered for CAN-FD @2Mbps@BMW.
- For qualification and handling it also has advantages to use the same cabling for different technologies.

➢ It is therefore reasonable to start with the same cabling basis for 10SPE@15m as for 100BASE-T1

*) PP = Polypropylene

Channel parameters in respect to 100BASE-T1



- XTALK in respect to CAN, CAN-FD, FlexRay. Model for frequencies <1MHz?
- Possibility to optimize twist ratio?

$$IL = \begin{cases} 1+1.6x(f-1)/9dB & \text{for } 1 \text{ to } <10MHz \\ 2.6+2.3x(f-10)/23dB & \text{for } 10 \text{ to } <33MHz \\ 4.9+2.3x(f-33)/33dB & \text{for } 33 \text{ to } 66MHz \end{cases}$$

$$RL = \begin{cases} 18dB & \text{for } 1MHz \text{ to } 20MHz \\ 18-10x\log10(f/20)dB & \text{for } 20MHz \text{ to } 66MHz \end{cases}$$

$$MCL = \begin{cases} 43dB & \text{for } 1 \text{ to } 33MHz \\ 43-20x\log10(f/33)dB & \text{for } 33 \text{ to } 200MHz \end{cases}$$

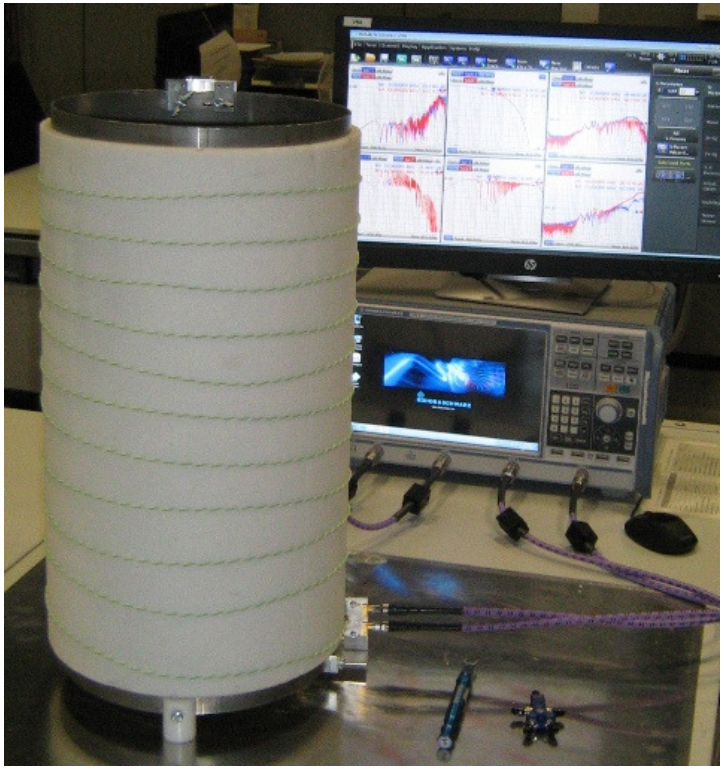
$PSANEXT = 31.5-10x\log10(f/100)dB$ for 1 to 100MHz

$PSAACRF = 16.5-20x\log10(f/100)dB$ for 1 to 100MHz

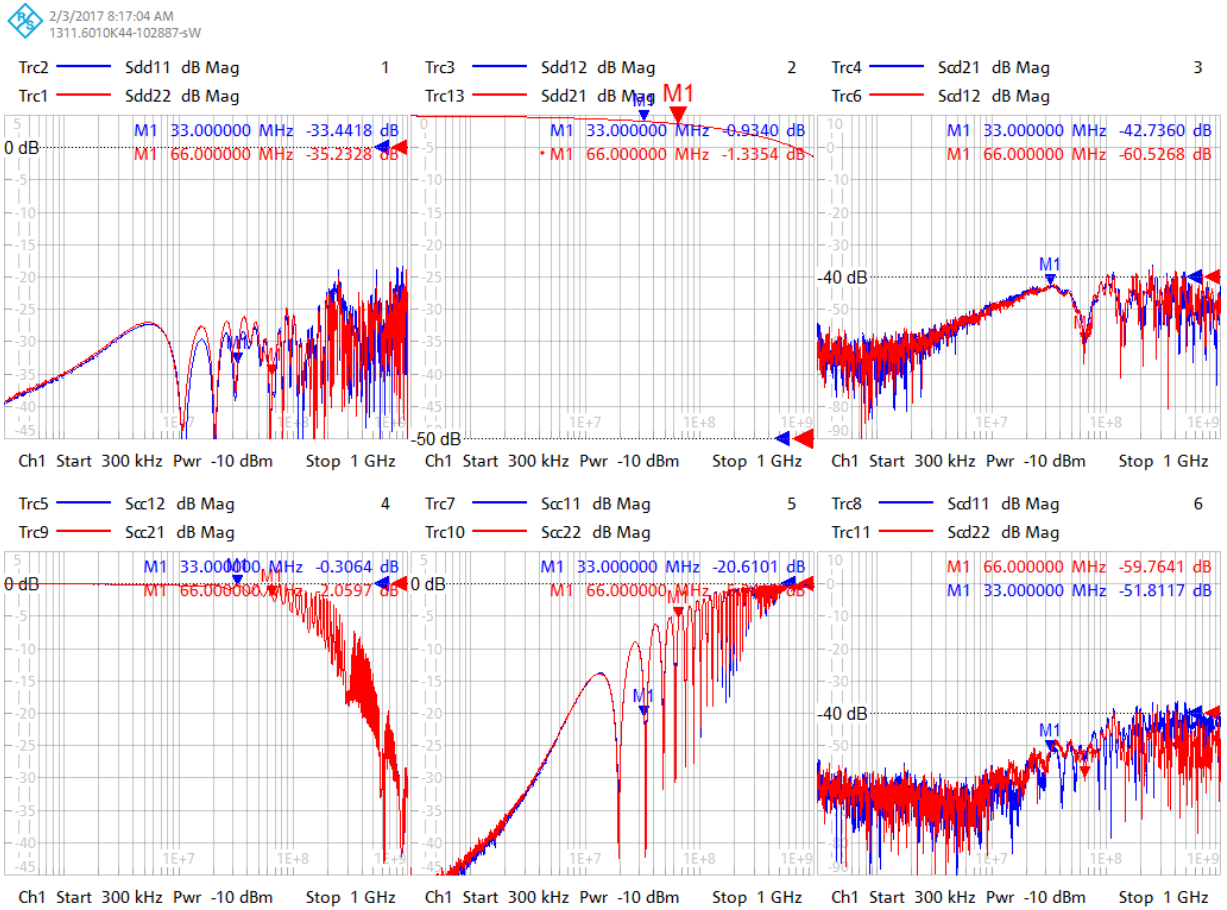
Measurement set-up

VNA S-parameter measurements

- DUT 100BASE-T1 UTP cable 0,35mm² PP, 10m
- Starting at 300kHz
- Drum measurement according to OPEN Alliance channel component specification, Cdim 200 Ohm



Measurement results

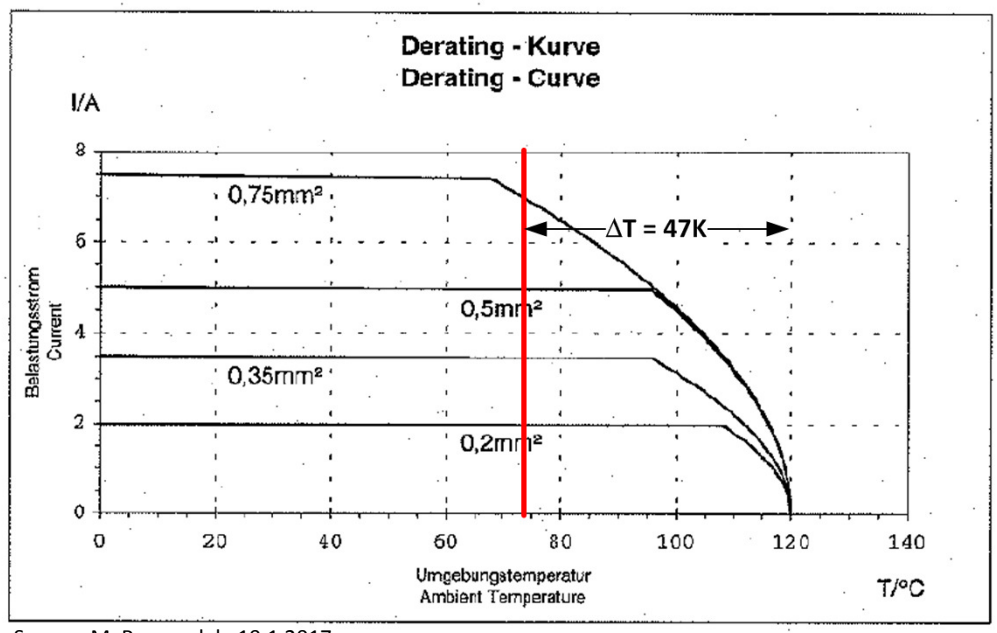


No unexpected non-linear behavior for S-parameters below 1MHz

Interference model for frequencies <1MHz tbd. if necessary.

10Mbps Power over Dataline

40W (@Ubatt=12V) possible with
0,35mm² cables and MQS/nMQS @3,5A



Source: M. Respondek; 19.1.2017;

However, if the communication of 10SPE 15m is shifted to lower frequencies <1MHz the size and cost of the parts increases

Conclusion

- The cabling choices for CAN-FD/100BASE-T1@BMW are a good starting point for the channel definition for 10SPE 15m
- As both are the same, the channel model for 100BASE-T1 provides a basis for the 10SPE 15m channel
- First measurements of S-parameters show no unexpected, non-linear behavior for frequencies between 300kHz and 1MHz
- However, should really frequencies <1MHz be used for the communication, this impacts PoDL and requires an additional investigation on the interference models
- Input requested:
  - Feedback from PHY and cable manufacturers on feasibility and suitable frequency range
  - Investigation on impact of twist rate
  - Final definition of the channel model