Automotive Requirements for 10SPE

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This presentation is an update of the following presentation created for RTPGE

http://grouper.ieee.org/groups/802/3/RTPGE/public/july12/zinner_02_0712.pdf

Agenda

- Motivation
- BER of 10e-10
- Requirements overview
- Packet sizes
- References

Motivation

The fundamental idea of a 10Mbps automotive suitable Ethernet PHY is that it seamlessly integrates into the Ethernet network.

For this, there needs to be a basic version of a 10Mbps automotive Ethernet PHY for which as little changes as possible. I.e. in principle the same requirements need to be fulfilled as for the 100Mbps and 1Gbps automotive PHYs.

The slides therefore show adapted automotive requirements for 10Mbps Ethernet. Additionally some information on typical automotive transceiver packages is provided.

BER 10e-10

- The car industry has end-to-end requirements on application level
  - This effects start up times
  - This effects quality requirements over the link
- The transmission technology is supposed to NOT impair the end-to-end performance

➔ Automotive applications rely on a transmission quality of BER 10e-10, a BER of 10e-9 means that certain applications cannot use the channel

➔Therefore the objective should contain a BER of 10e-10 for the defined worst case channel after equalization and decoding

(Fitting simulation results might achieved with 10e-9 when worst case channel/measurement set up is adapted accordingly)

Automotive 10SPE requirements

*) Changes to original slides shown reddish

	Mandatory	Additional/optional
Physical Medium	Unshielded, unjacketed TP cabling	If possible, CAN cable (i.e. PVC insulation)
Max. link length	15 m for passenger vehicles	40 m for commercial vehicles
No. of in-between connectors	4	
Remaining Bit Error Rate	< 10e-10	Need to be achieved by part
Electro-Magnetic Compatibility	Like for 100BASE-T1/1000BASE-T1	See e.g. ISO11452-1,2,3,4, CISPR25, ISO7637-3, IEC6100-4-2, ISO10605
DC decoupling	Necessary	Especially in combination with PoDL
Connectors	State of the art unshielded multi-pin connectors (same as CAN, FlexRay)	If possible, relaxation of pinning constraints compared with 100BASE-T1
PoDL		Optional
Data interface to Layer 2 (MAC)	Standard interfaces (low pin count), RMII, SPI, ….	

Automotive 10SPE requirements (continued)

*) Changes to original slides shown reddish

	Mandatory	Additional/optional
EEE		Optional, minor power saving
Autoneg.		Optional, preconfig. network
Crystal accuracy	Has cost saving potential (no clock input for CAN and FlexRay)	Normally, crystal must meet automotive temperature range as well as start-up requirements; Depending on cost and added value +/- 50 ppm might be OK, +/- 100 ppm might be OK, or more
PHY-wake-up		Optional, see future ISO 21111, part 2
Link acquisition time (PHY to PHY link start up time)	<100 ms	optional

Product related requirements for automotive 10SPE

*) Changes to original slides shown reddish

	Mandatory	Additional/optional
Diagnosis for active link	Signal Quality Indicator (MSE)	
Diagnosis for link-up	Polarity detection and correction Link-training time	optional
Enhanced diagnosis	Cable and link break/ short circuit/ wrong voltage Distance to OPEN/SHORT	optional
Control interface to Microcontroller	standard automotive µc interfaces (RMII, MDIO, SPI…)	
Costs (see next page)	50% of 100BASE-T1 system costs	

Cost saving potential in smaller pin count

Overview of some examples for automotive bus systems packages and pin counts

Type	Reference	Description	used e.g. for
SOIC8	https://en.wikipedia.org/wiki/Small_Outline_Integrated_Circuit	8 pin package with leads (4mm x 5mm)	NxP TJA1050 (http://www.nxp.com/documents/data_sheet/TJA1050.pdf) Microchip MCP2551-E/SN (http://ww1.microchip.com/downloads/en/DeviceDoc/21667f.pdf) OnSemi NCV7352 (http://www.onsemi.com/pub_link/Collateral/NCV7351-D.PDF) and others…
TSON8 (HVSON8)		8 pin package without leads (3mm x 3mm)	Infineon TLE7250 (http://www.infineon.com/dgdl/Infineon-TLE7250-Data-Sheet-DS-v01_00-EN.pdf?fileId=5546d4624fb7fef2014fe03888f95f4f) NxP TJA1044 (http://cache.nxp.com/documents/data_sheet/TJA1044.pdf?pspll=1)
TSON14 (HVSON14)		14pin package without leads (4,5mm x 3mm)	NxP TJA1043 (http://cache.nxp.com/documents/data_sheet/TJA1043.pdf?pspll=1)
TSSOP14	https://en.wikipedia.org/wiki/Small_Outline_Integrated_Circuit#TSSOP	14pin package without leads (5mm x 5,5mm)	NxP TJA1082 (http://cache.nxp.com/documents/data_sheet/TJA1082.pdf?pspll=1)

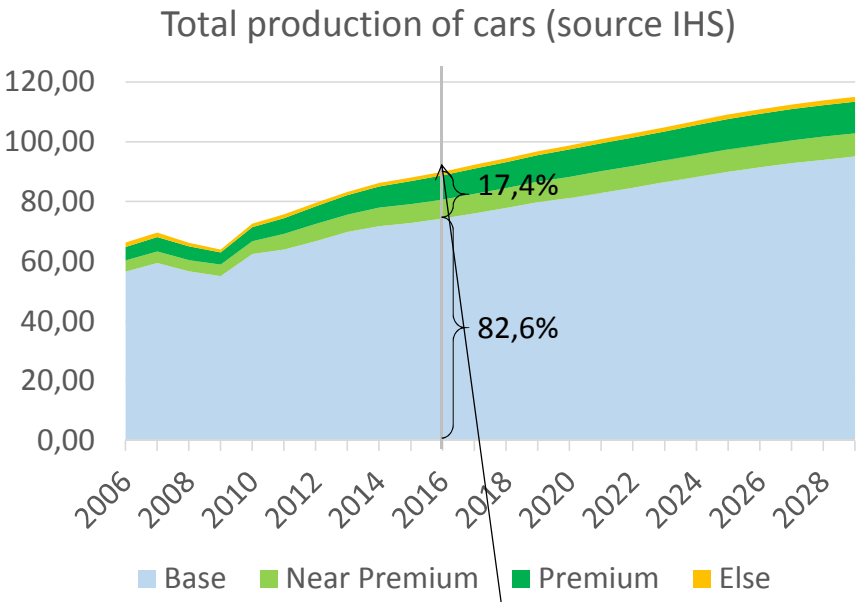
Packaging conclusion for 10SPE

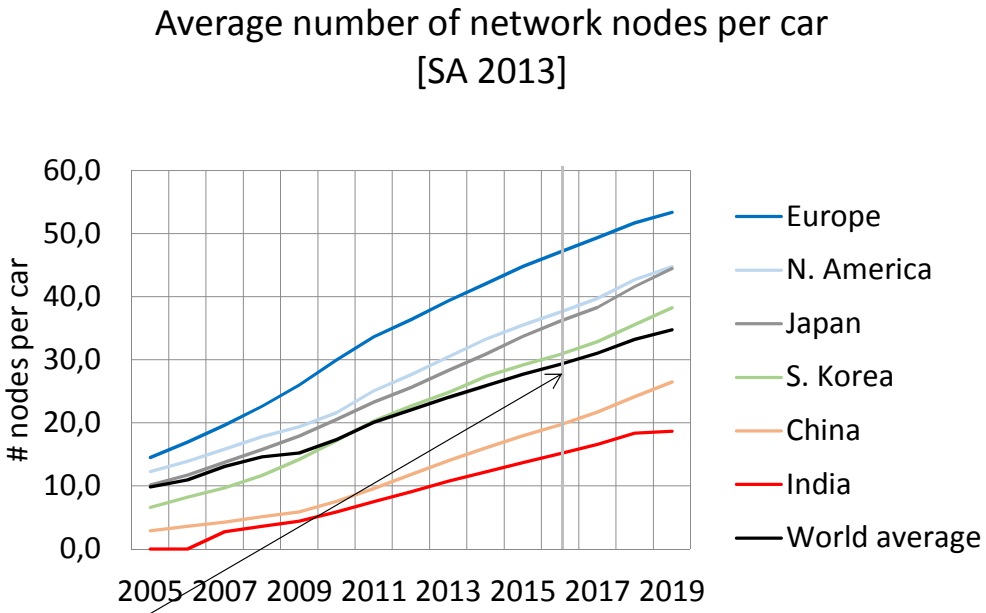
- 10SPE PHYs needs to fit into economically attractive packages
  - therefore using e.g. standard MII interface is counterproductive
  - There are MAC/PHY interface solutions available with smaller pincount (see presentation cordero_thaler_01_0915.pdf or http://ww1.microchip.com/downloads/en/DeviceDoc/ksz8851snl_ds.pdf)
  - Freedom of choice to the PHY vendors, no objective necessary

Market potential

- For units part of the Ethernet network but needing <10Mbps data rate only
- For replacement of FlexRay
- For new sensors

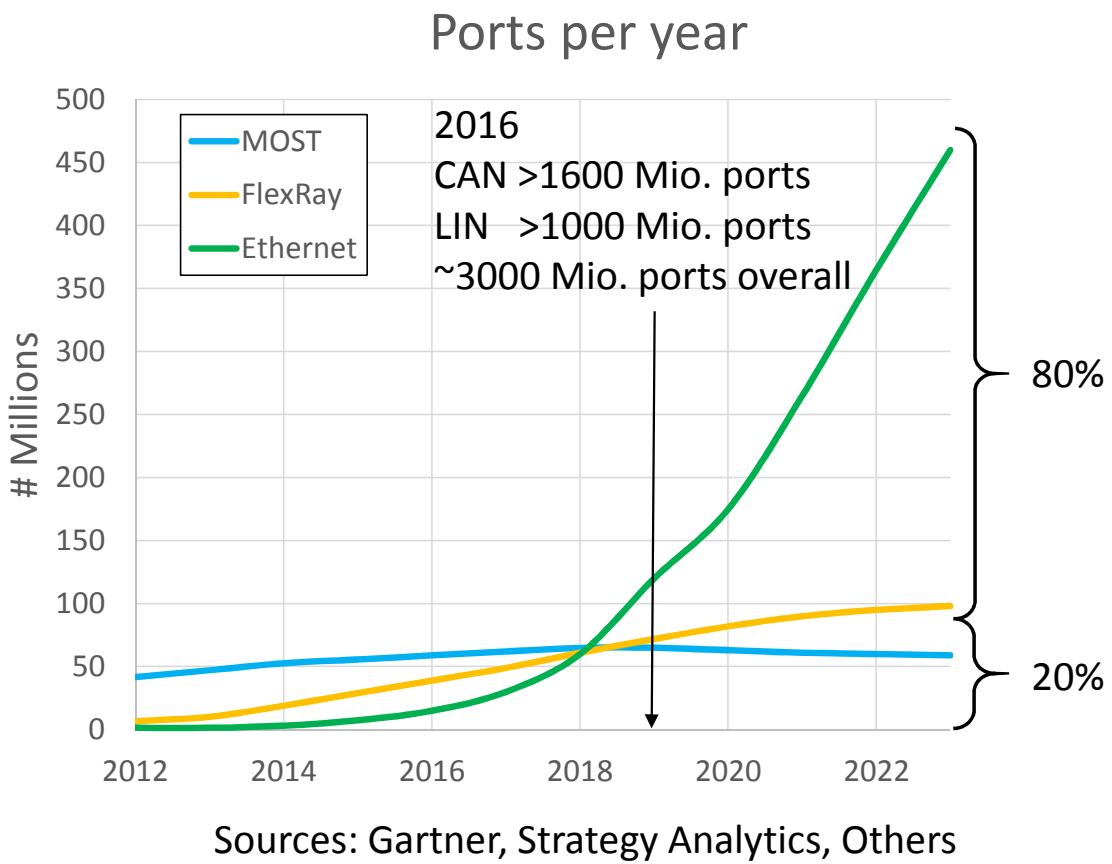
Automotive market potential for in-vehicle networking





2016: 90.021.956 cars x 29,3 nodes/car = 2 637 643 311 networked nodes

Automotive Ethernet market potential



Sources: Gartner, Strategy Analytics, Others

The current analyses consider 100Mbps and 1Gbps only.

Gartner expects that in a ration of 80% 100Mbps to 20% 1Gbps PHYs.

The 10Mbps market will leverage from

- FlexRay
- New Sensor applications
- Where 100BASE-T1 is too much
- New ECU developments

It can expected to be minimum as large as 1Gbps automotive market

Sensor Classes

Video/Cameras → >>1Gbps ↘

Radar →

Radar Type ↘	FarRangeRadar ↘	ShortRangeRadar ↘	HighResolutionRadar ↘	UltraShortRangeRadar ↗
Reach	250m	70m	3-10m	1dim.
Data rate	~130Mbps	>1Gbps	2,5Gbps	<10Mbps

all radars compressed <10Mbps feasible ↗

Lidar → implementation dependent, generally >> 10Mbps ↘

Ultrasound → up to 10Mbps ↗

Microphones → below 10Mbps ↗

10Mb/s candidate ↗ Not a candidate ↘

References

Please review also the following 1000BASE-T1 documents:

- http://grouper.ieee.org/groups/802/3/RTPGE/public/may12/buntz_01_0512.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/may12/hogenmuller_01_0512.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/july12/buntz_03_0712.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/july12/hoganmuller_01a_0712.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/july12/hoganmuller_02a_0712.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/july12/zinner_02_0712.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/sept12/jones_01_0912.pdf
- http://grouper.ieee.org/groups/802/3/RTPGE/public/nov12/buntz_01_1112_rtpge.pdf
- http://www.ieee802.org/3/RTPGE/public/adhoc/buntz_01_1112_rtpge.pdf

References

Please review also the following 100BASE-T1 and PoDL documents:

- http://www.ieee802.org/3/bw/public/buntz_tazebay_3bw_01_0914.pdf
- http://www.ieee802.org/3/bw/public/Wienchowski_3bw_02_0914.pdf

- http://www.ieee802.org/3/bu/public/jan14/buntz_3bu_01_0114.pdf

Also following further information could be helpfull:

- http://www.fordemc.com/