

1 pair or 2 pairs for RTPGE: Impact on System Other than the PHY Part 2: Relative Costs

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Motivation

- This slideset compares the impact the decision to use 1 pair or 2 pairs for RTPGE has on the system other than the PHY
- The 5 principle comparison criteria are:

- The logic performance
- The EMC performance
- The power consumption

Mainly PHY concepts related and therefore not considered in this presentation

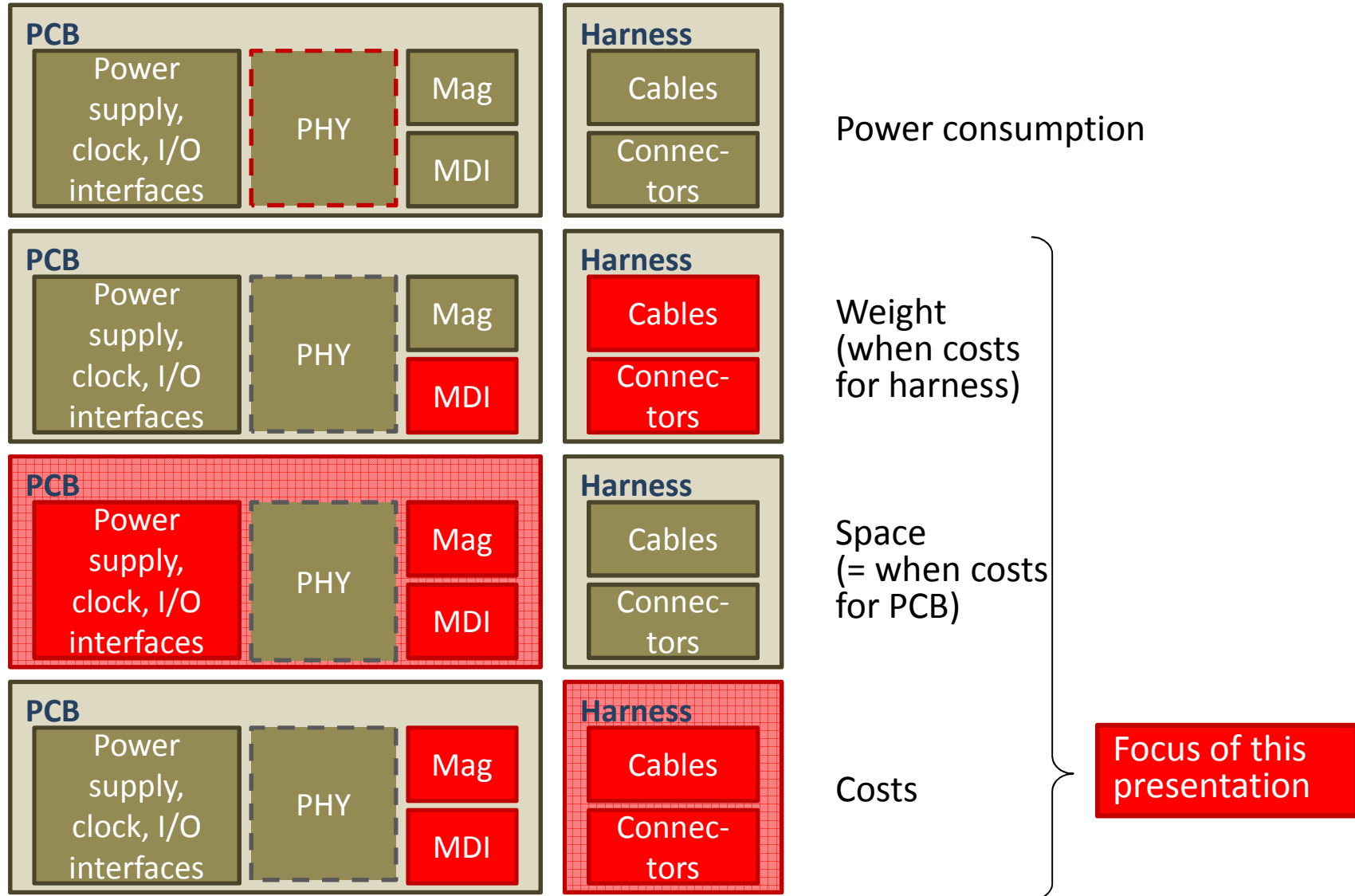
- The weight and space use
- The (relative) costs

Part 1: Shown in Phoenix, 1/13

Part 2: Focus of this presentation

Relevant aspects for system comparison other than PHY

Elements Considered for











Harness evaluation

- The calculation is based on Topology 2
- For all values at least three different sources were used
- The costs caused by weight have been included directly into the calculation for the cables and connectors costs
- For UTP cables multipin connectors have been used. To use standalone connectors, did make a difference, but not one big enough to justify extra columns
- The reference values (“1.0”) do NOT have the same weight (i.e. 1.0 for connectors relates to a completely different monetary value than 1.0 for manufacturing)

Harness Evaluation (1)

Comparison 1: All values related to UTP, 0,18mm², no jacket









												
	0,18 mm ²	0,35 mm ²	0,35 mm ²	0,18 mm ²	0,35 mm ²	0,18 mm ²	0,18 mm ²	0,35 mm ²	0,18 mm ²	0,14 mm ²	0,14 mm ²	0,14 mm ²
Connectors	1,00	1,01	1,01	1,00	1,66	1,65	1,65	1,66	4,20	4,31	4,98	4,98
Cables	1,00	1,02	1,37	1,69	2,34	2,71	2,00	2,04	1,93	2,55	3,34	5,10
Manufacturing	1,00	1,00	0,91	0,91	1,18	1,18	1,81	1,81	0,84	1,37	1,43	1,68

Peculiarities:

- Cables with 0,35mm² can cost less than cables with 0,18mm²
- Manufacturing cables with jacket can cause less costs that manufacturing cables without jackets
- Manufacturing coax cables can be done quite efficiently

Harness Evaluation (2)

Comparison 1: All values related to UTP, 0,18mm², no jacket













													
	0,18 mm ²	0,35 mm ²	0,35 mm ²	0,18 mm ²	0,35 mm ²	0,18 mm ²	0,35 mm ²	0,18 mm ²	0,35 mm ²	0,18 mm ²	0,14 mm ²	0,14 mm ²	0,14 mm ²
Connectors	1,00	1,01	1,01	1,00	1,66	1,65	1,65	1,66	4,20	4,31	4,98	4,98	
Cables	1,00	1,02	1,37	1,69	2,34	2,71	2,00	2,04	1,93	2,55	3,34	5,10	
Manufacturing	1,00	1,00	0,91	0,91	1,18	1,18	1,81	1,81	0,84	1,37	1,43	1,68	

Results:

- *UTP one pair has the best relative costs
- *UTP two pairs with jacket is better than without (owing to manufacturing)
- *UTP two pairs is (only somewhat) better than coax (1 pair)
- *Coax (1 pair) is better than shielded

Harness Evaluation (3)

Comparison 2: Direct comparison 1 pair/2 pairs with same cable type

												
	0,18 mm ²		0,35 mm ²		0,18 mm ²		0,35 mm ²		0,18 mm ²	0,14 mm ²		
Connectors	1,00	1,65	1,00	1,65	1,00	1,65	1,00	1,65	1,00	1,00	1,15	1,15
Cables	1,00	2,00	1,00	2,00	1,00	1,71	1,00	1,61	1,00	1,00	1,31	2,00
Manufacturing	1,00	1,81	1,00	1,81	1,00	1,29	1,00	1,29	1,00	1,00	1,04	1,23

Results:

- Going from 1 to 2 pairs would exactly double the costs for coax (coax makes sense only as a single pair variant). For all other the increase is overall less.
- The smallest increase is for shielded cables.
- For UTP jacketed cables the increase medium.
- For UTP cables without jackets the increase is largest.

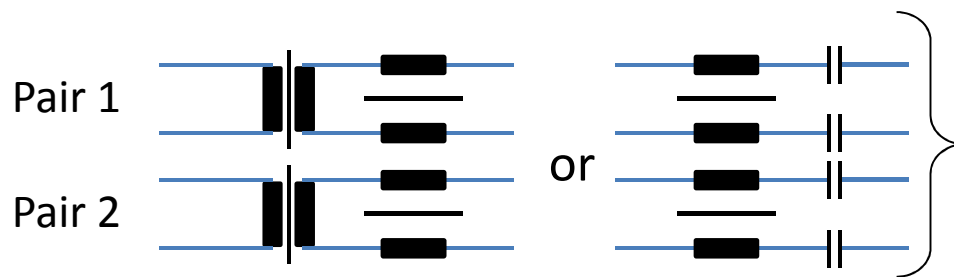
PCB Evaluation

- The space needed depends very much on the actual implementation. The comparison done is therefore on a general level.
- The comparison is based on UTP.

PCB Evaluation (1)

Magnetics & ESD

1. Common Mode Suppression



For 2 pairs, in principle, all elements are needed twice. There is a potential for reduction if the transformer for 2 pairs is realized in one housing (provided this can be automated to meet automotive quality)

2. Low pass filter

Effort depends on the implementation. If realized via external, analogue components at least 50% more effort is expected. If integrated in the chip / digital, additional effort for second pair can be reduced.

3. ESD protection (diode)

Is needed one per pair, but the significance of ESD protection changes with the use case.

PCB Evaluation (2)

Space

Elements for PCB space:

	1 pair	2 pairs
Transceiver	1,0	~1,0
Magnetics/Termination	1,0	~2,0
Power supply	1,0	1,0
Passive components	1,0	~2,0

Actual PCB space needed depends on:

- Termination concept
- Location of use i.e.
 - Temperature range
 - Need for ESD protection
 - Semiconductor process
- LPF concept

The increase of space needed is expected to be between 25% and 100% when using 2 pairs instead of 1 pair

(In a camera or a unit with many ports 25% can make all the difference, in an anyway large unit with only one port 100% might not matter so much.)

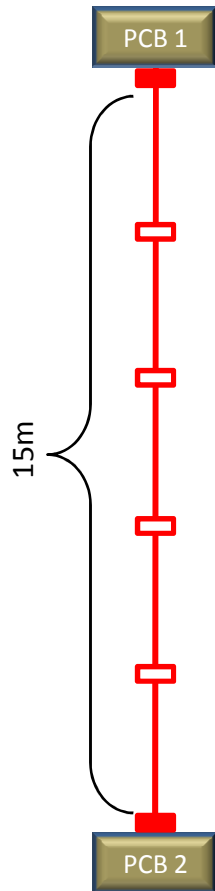
Summary

- From the harness side, one pair UTP is favorable over two pair UTP, which is (just) favorable over coax, which is favorable over shielded.
- Actual market prices and manufacturing process need to be taken into account for a detailed review.
- On the PCB side costs are expected to increase between 25 and 100% when going from 1 pair to 2 pairs (UTP)
- For the overall costs both elements (harness and PCB) are equally important

Back Up Material

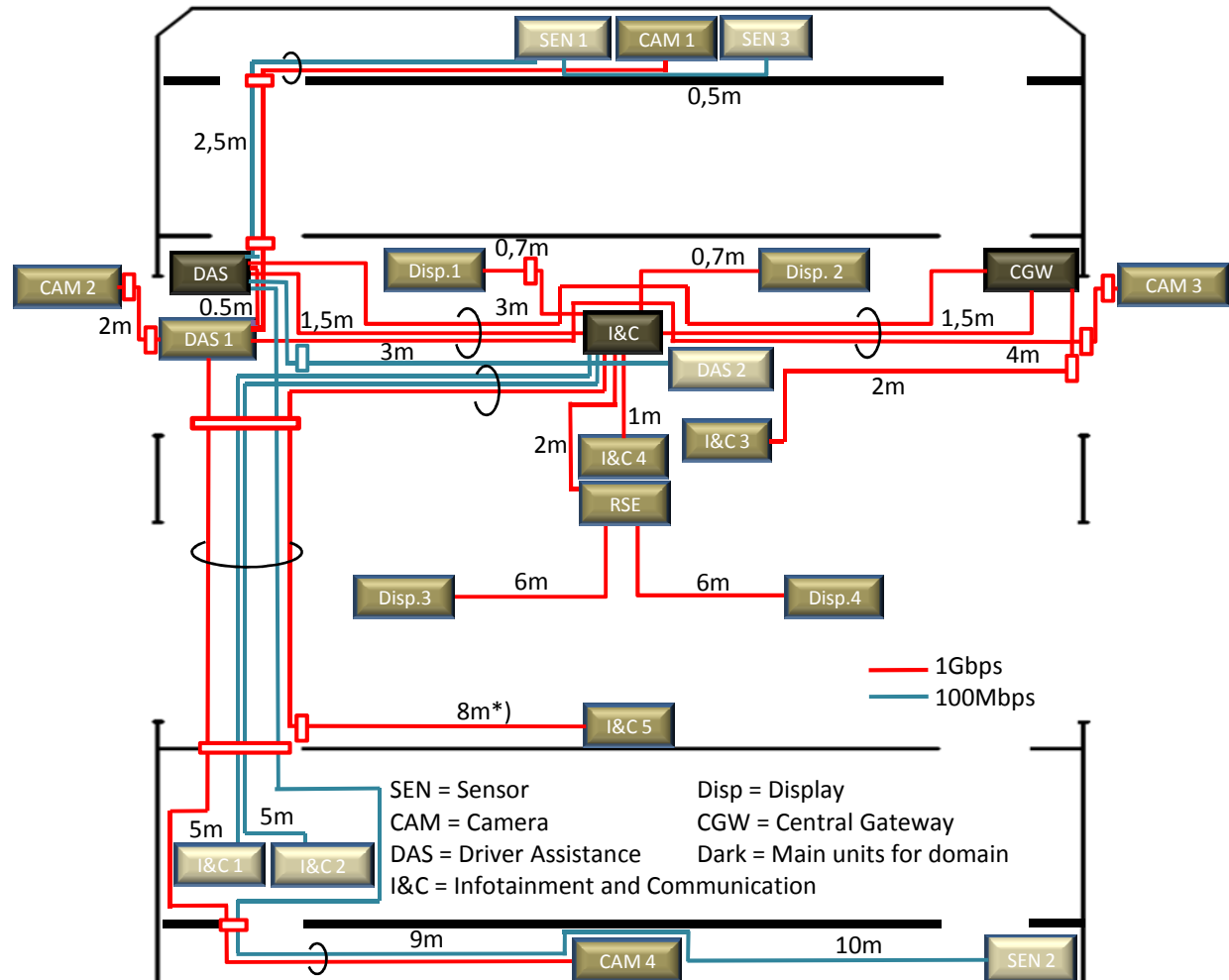
Topologies

Topology 1



Equidistant inline connectors (worst case)

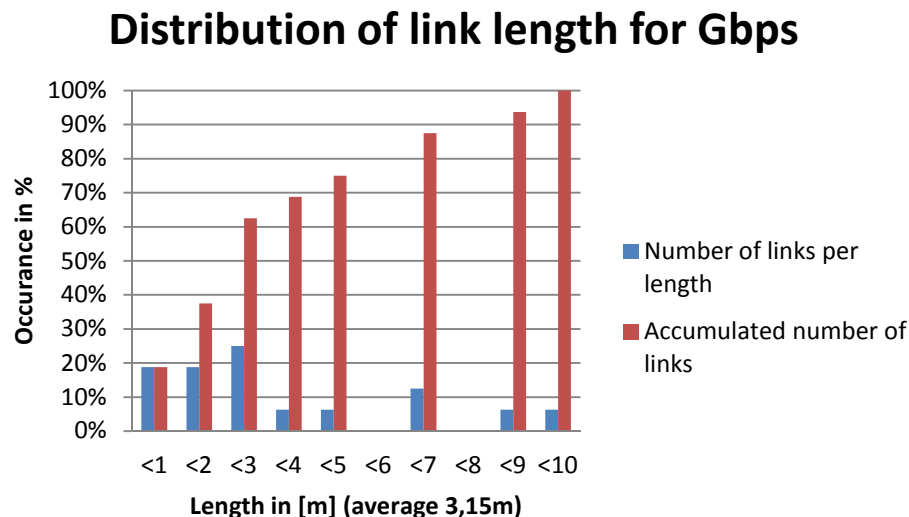
Topology 2



*) Average cable length for 1Gbps (not considering inline connectors) is 3,15m, 3,5m for Ethernet in general

Additional Info on Topology 2

- Topology 2 is an example topology that does not represent any real car, but a combination of values from several
- For the channel (interference) model, other topologies need to be considered additionally. This topology has a maximum of 3 RTPGE cables next to each other
- The 100Mbps links have been added to indicate the playing field. The better the RTPGE solution the more links will be Gbps, the more expensive Gbps the fewer links will upgrade.



Base Data on Topology 2

Topology 2*)	
Overall length of cabling [m]	50m
Number of links	16**)
Number of MDIs	32**)
Number of inline connectors	13
Number of cable segments	29
Number of PHYs	11
Number of Switches	5

*) only 1Gbps

***) one redundant link

Elements for Connector Values

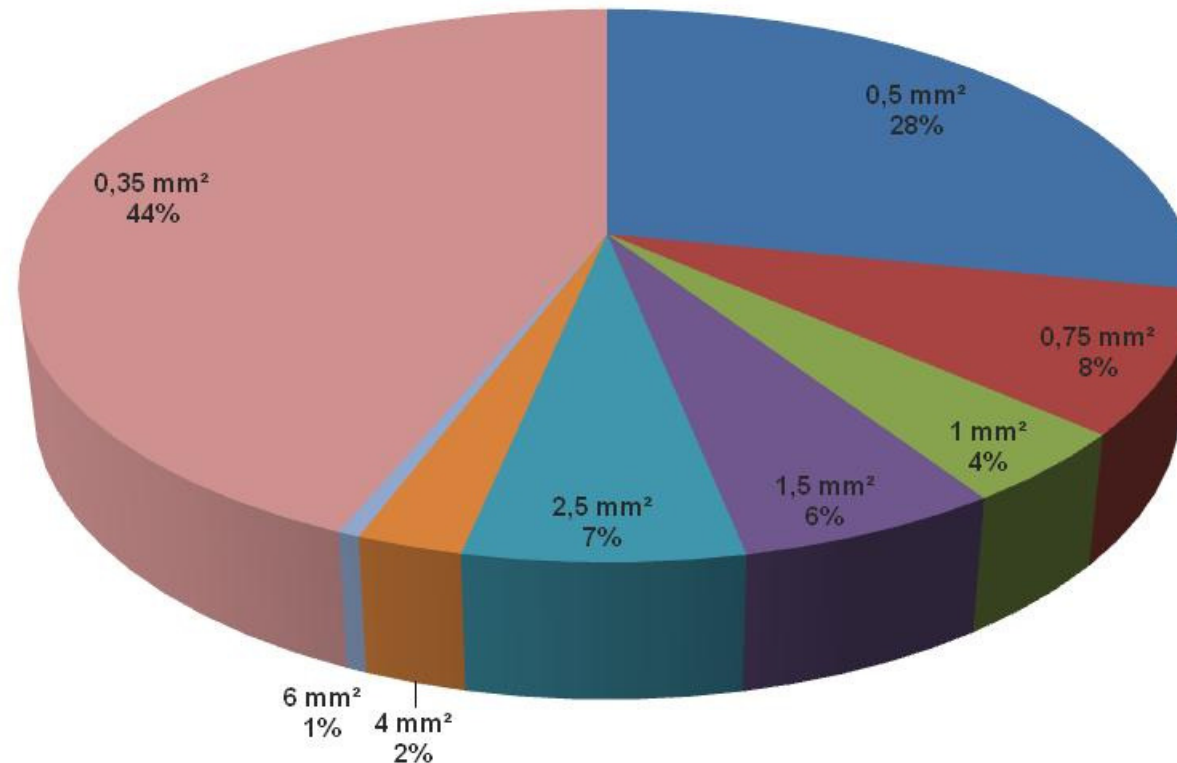


Number of pins needed in case of multipin connectors	Number of pins needed in case of multipin connectors	
	1 pair	2 pairs
PCB (32 MDIs)	55	88
Inline (13 connectors)	120	188

See http://www.ieee802.org/3/bp/public/jan13/matheus_3bp_01_0113.pdf
Page 9 for derivation

Market share for cable gauge

Example of Share of PVC cables following LV112 in a car



Cables with 0,35mm² are the most used cables at the moment. This influences the costs (in boundaries) more than the diameter.

Source: „AK Variantenvielfalt im Bordnetz und deren Auswirkung auf die gesamte Lieferkette / Teilbereich Reduktion der Farbvarianten im Bordnetz“; resp. Andreas Böhm, Bayern Innovativ GmbH, 5.7.2012

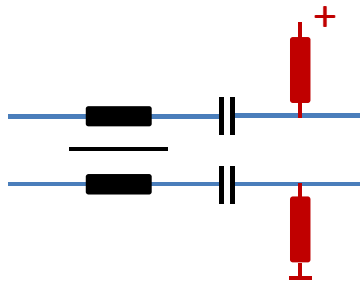
Elements for Harness Manufacturing

Exemplary process units considered:

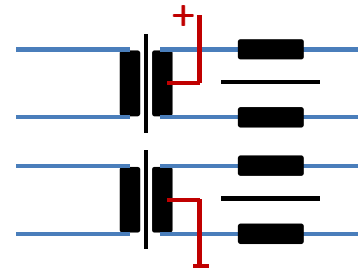
- Preparation for cutting
- Cutting
- Handling
- Stripping wire jacket
- Crimping contacts
- Connector assembly
- Combine to wiring
- Fixing the wiring
- Coiling and handling
- Test of harness 100%

Power over Data Line

1 pair



2 pairs



For automotive, realizing power over data line is not more straight forward for 2 pairs than for one pair. For two pairs, again, the manufacturing process of the transformer needs to allow for automotive quality and in general the cost ratio between 2 coils and one complex transformer might well favor to the coils.