10Mbps low cost (automotive suitable) Ethernet PHY

Presentation during IEEE802.3 Plenary Meeting

San Diego, CA, July 2016

Objective of these slides

- To gauge the interest in creating a CFI for

10Mbps low cost Ethernet PHY

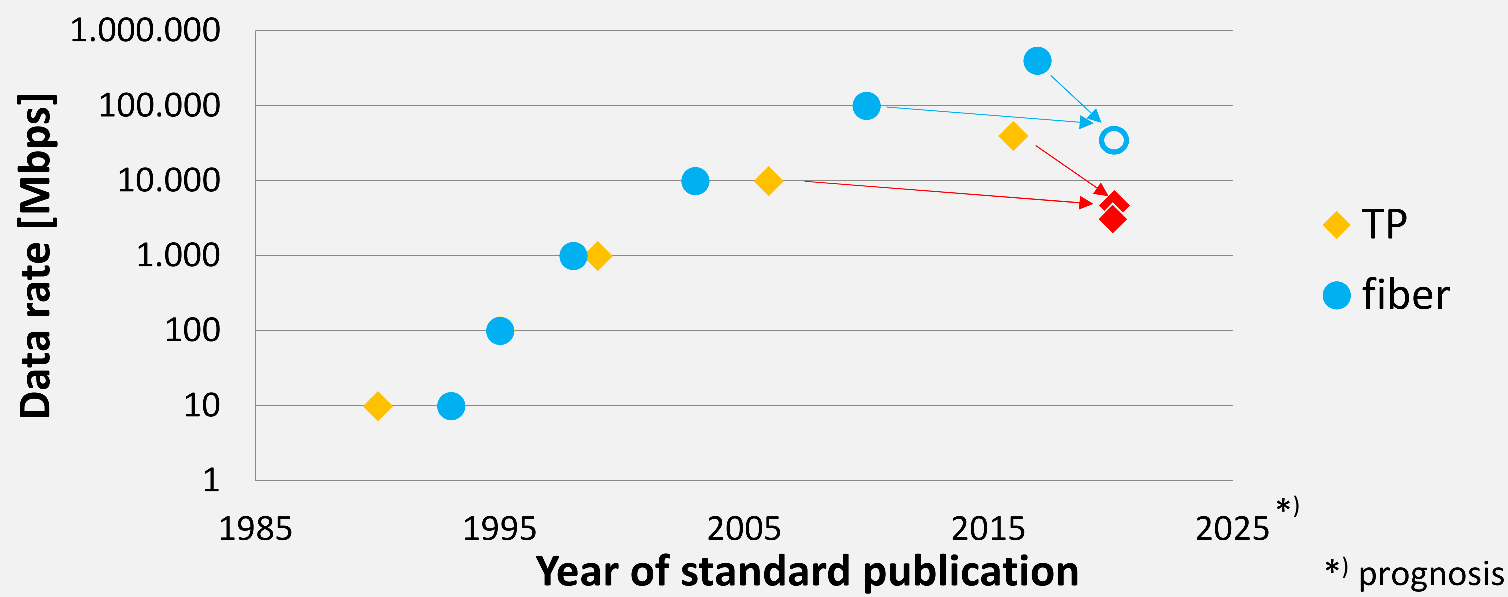
- These slides are NOT the CFI, yet
- These slides do NOT:
  - Fully explore the problem
  - Choose any one solution
  - Debate strengths and weaknesses of solutions
  - Create a PAR or 5 Criteria
  - Create a standard or specification
- Anyone in the room may speak / vote
- Respect … give it, get it

Is it really only ever more?

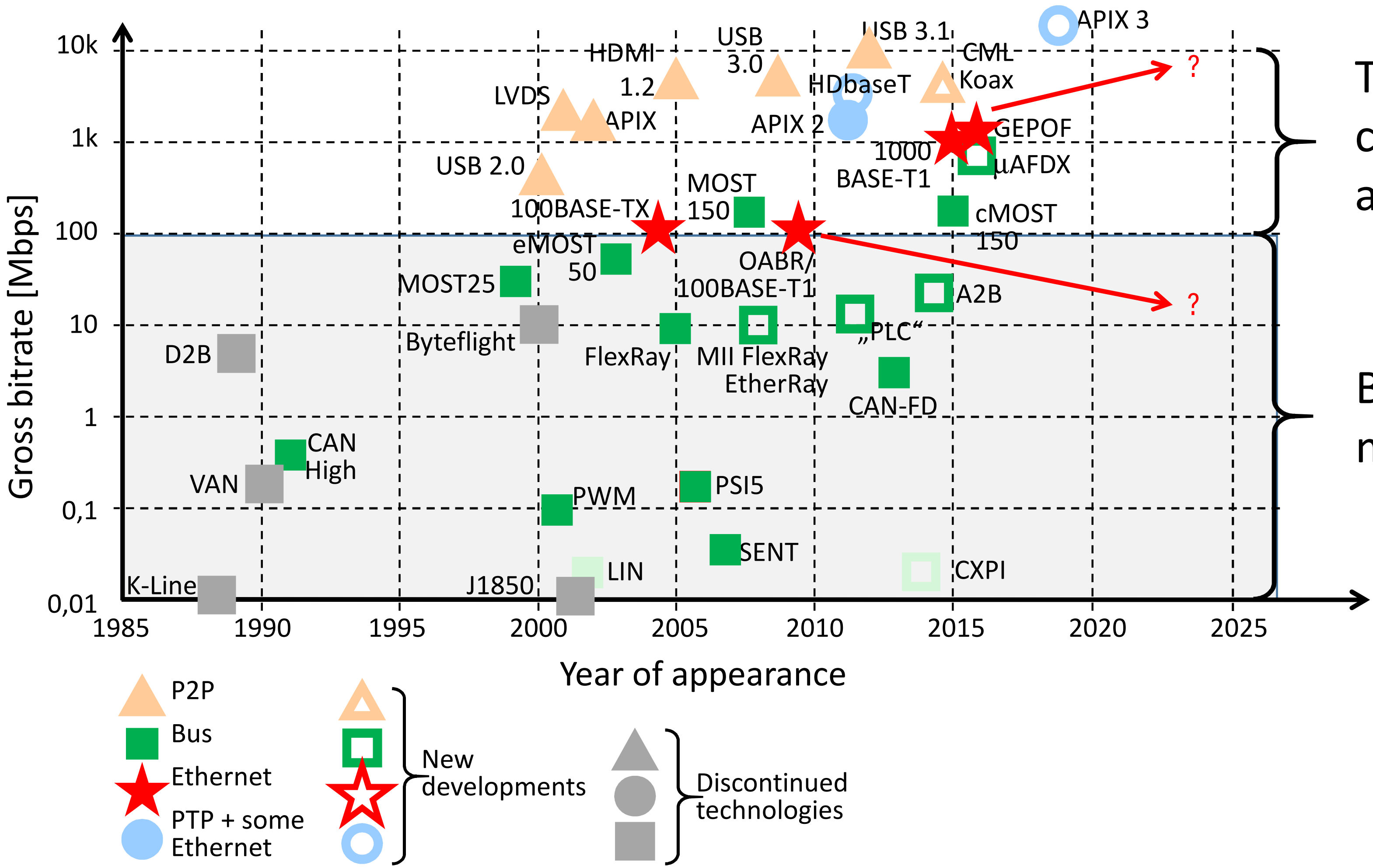
E.g.: In May 2015 the IEEE 802.3 started a Task Force on 2,5/5Gbps long after having completed 10Gbps (2006) and 2 years after having started a 25/40Gbps Task Force; all for copper media and IT use.

The main motivation? Cost optimization, based on actual needs.

Development of copper and fiber Ethernet speed grades at IEEE 802.3



And in automotive?



There is lots of communication above 100Mbps

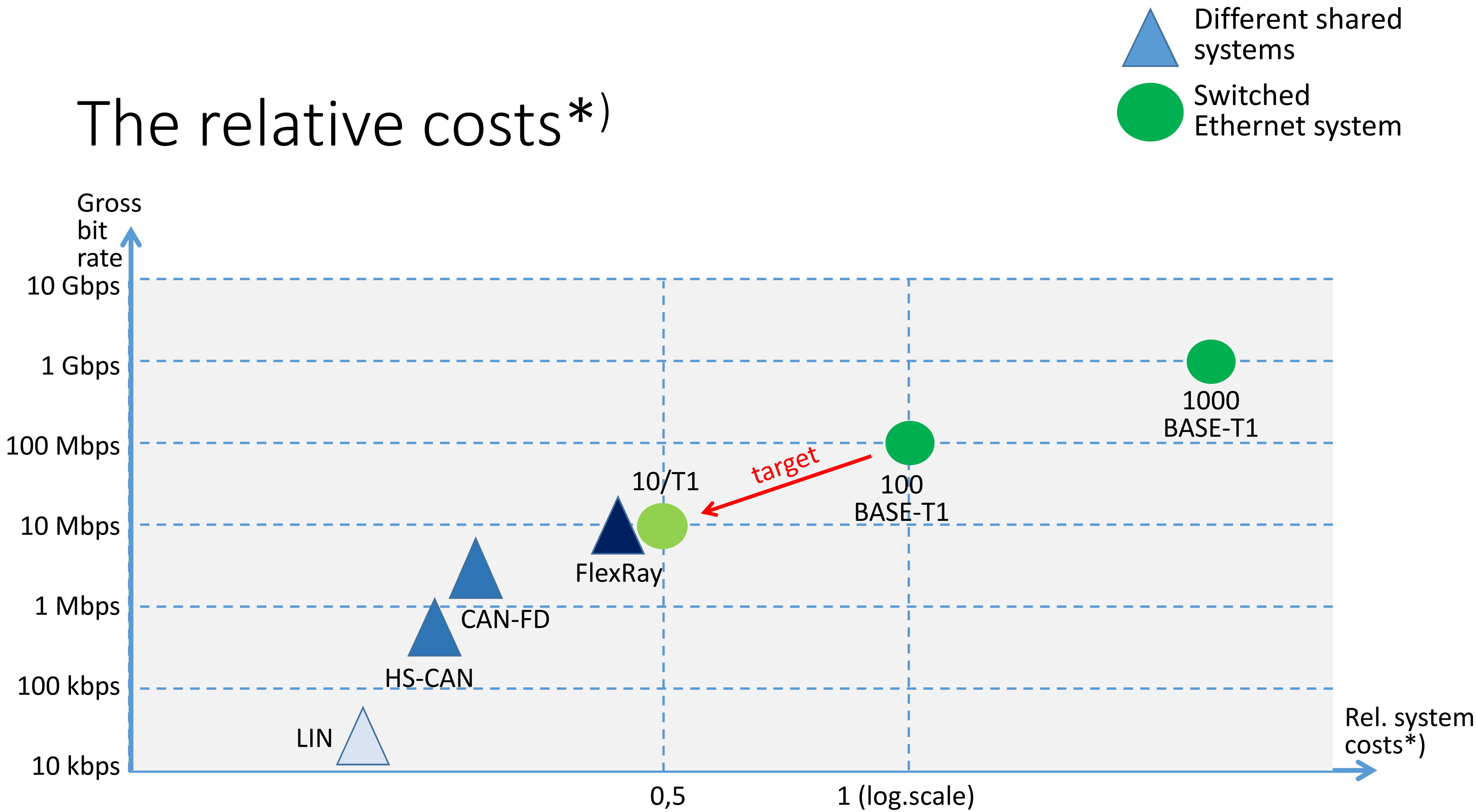
But there is even more below

Motivation and use cases for a 10Mbps low cost Ethernet PHY in automotive.

- The complexity of electrics & electronics (E/E) in cars is continuously increasing. More functions, more ECUs, more sensors, more communication.
- The ubiquitous IP communication network where economically feasible ensures robustness and flexibility.
- A 10Mbps low cost Ethernet PHY can be used
  - For new ECUs or ECU versions, which require more communication data rate than CAN(FD) can provide
  - Instead of legacy in-vehicle networking technologies like FlexRay
  - To reduce the number of in-vehicle networking technologies and gateways
  - For Ethernet ECUs where 100BASE-T1 is not cost and energy efficient because of low data rate
  - For (redundant) sensor networks

Cost target

The relative costs*)



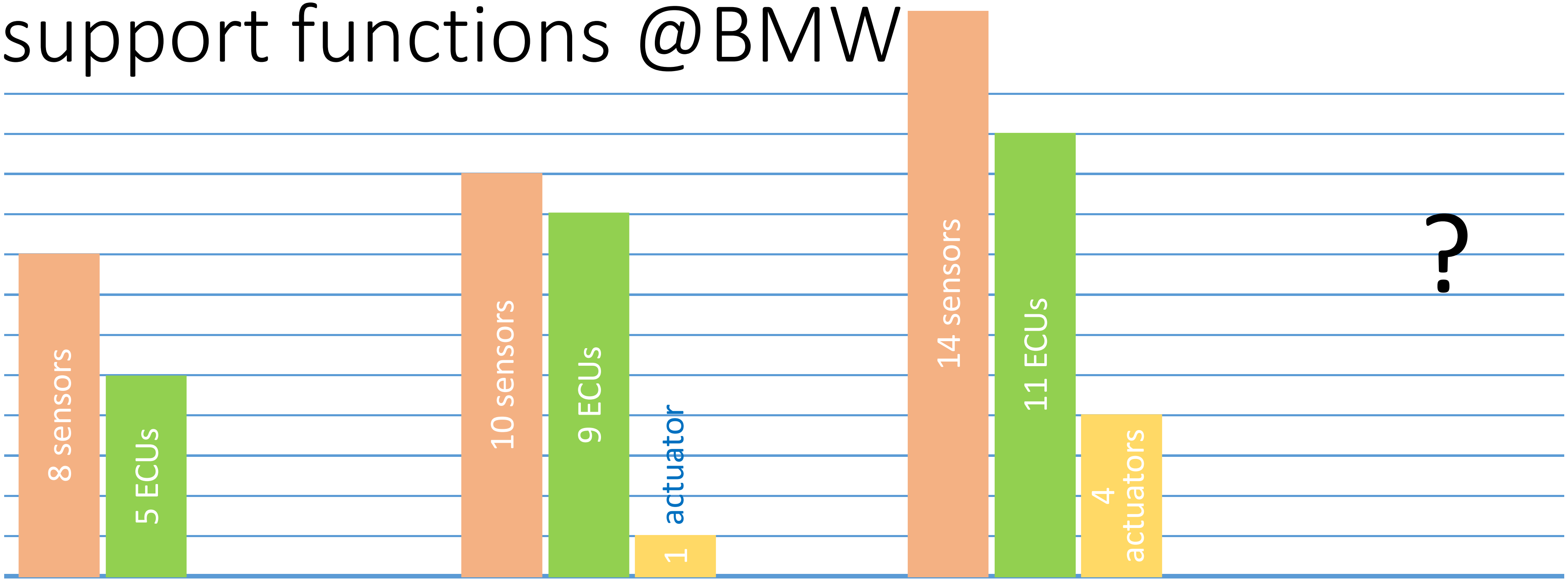
*) The cost values are very dependent on the exact topology that is being compared, this chart gives an indication only.

Cost target achievability

	100BASE-T1	10/T1
Analogue frontend	100%	?
Signal processing	100%	?
Management and housekeeping	100%	?
MII/interface to switch/uC	100%	?
IC Packaging	100%	?
Test cost	100%	?
Switch core	100%	?
CMC	100%	?
Cabling	100%	80%
Connector	100%	100%
Quartz	100%	?
Overall	100%	50%

Increased complexity

Example for complexity increase: Parking support functions @BMW



PDC, Park Distance Control
Gives audible and graphic feedback on space behind and in front of car when parking

PMA, Park Maneuvering Assistant
Automatically steers a car into a previously measured spot alongside. Driver has to accelerate and brake

RPC, Remote Control Parking
Automatically parks a car into narrow parking spot at a distance of 1,5x the length of the car

Valet Parking
Automatically parks a car and returns car when needed

Example for complexity increase: Elements of the E/E architecture.

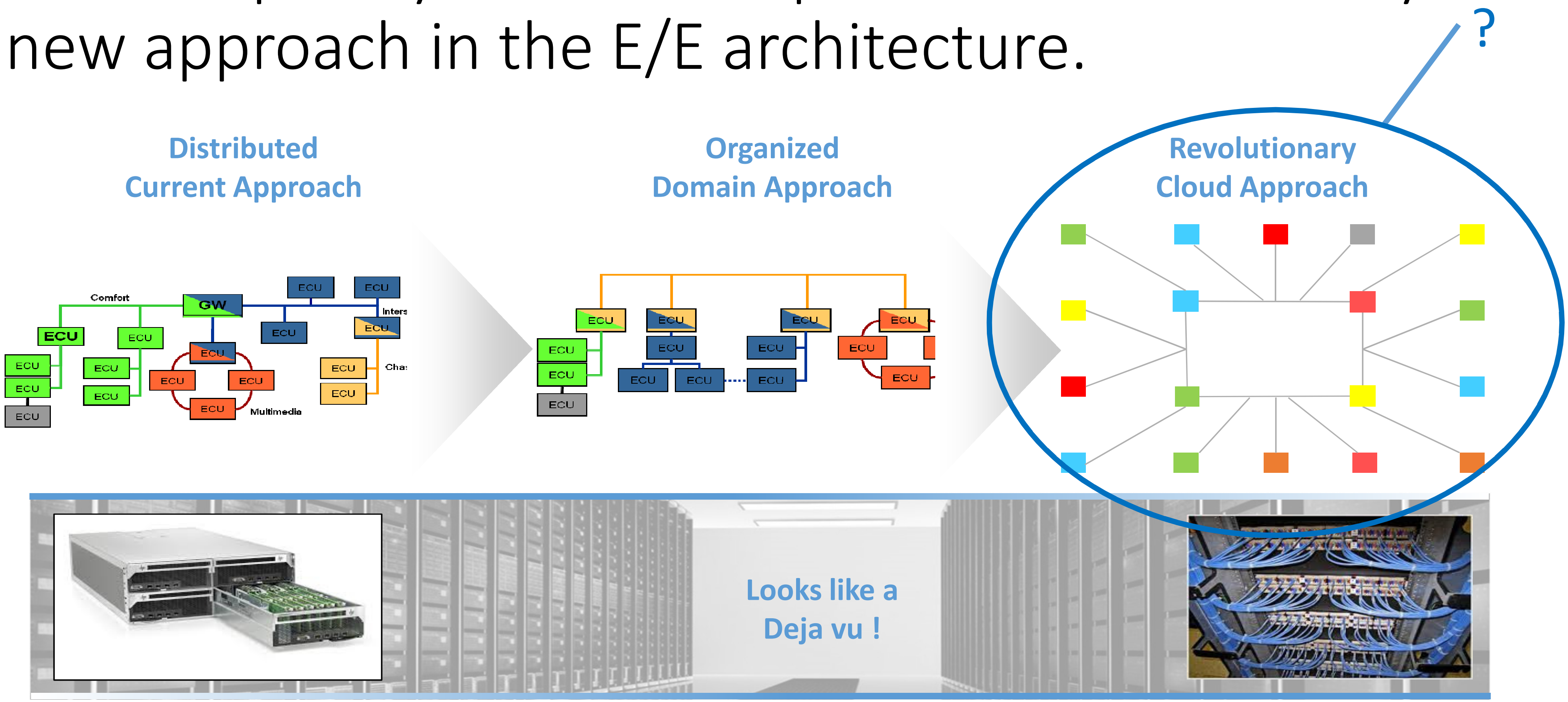
*) Bus or switched

Year	Cable Length (m)	Number ECUs	Signals Onboard NW	Legacy ECUs (%)	Network Types*)	Number Fuses
2015	3.800	200	12.500	40	5	180
	+ 240%	+ 500%	+ 420%	+ 800%	+ 170%	+ 260%
1995	1.600	40	3.000	5	3	70

Example @ BMW

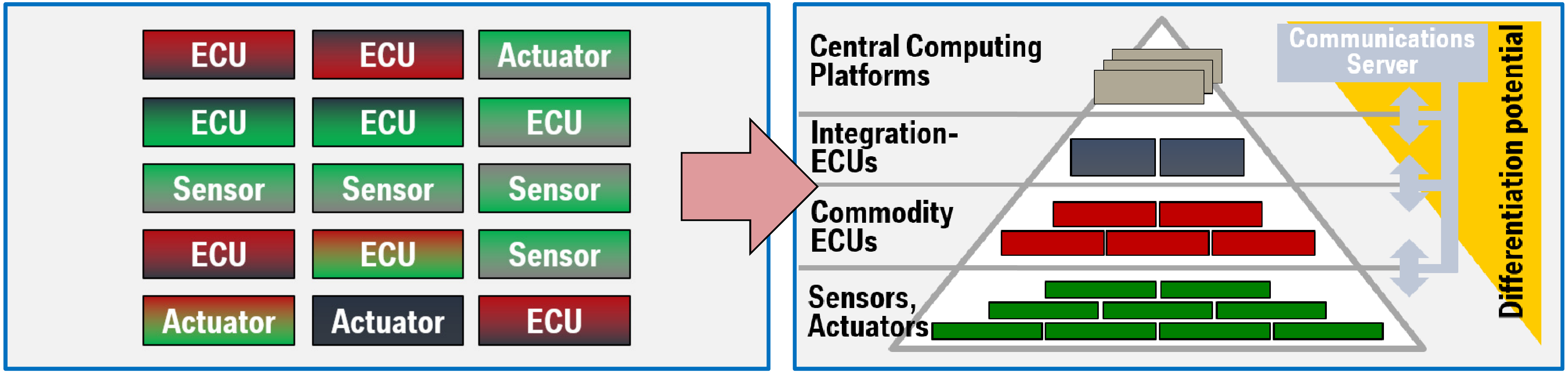
Ubiquitous IP network
& new E/E architecture

The complexity increase requires a fundamentally new approach in the E/E architecture.



Source: Aurora Sere-Schneider © Continental AG @ Automotive Ethernet Congress 2016

This requires new handling of ECUs.



Is:

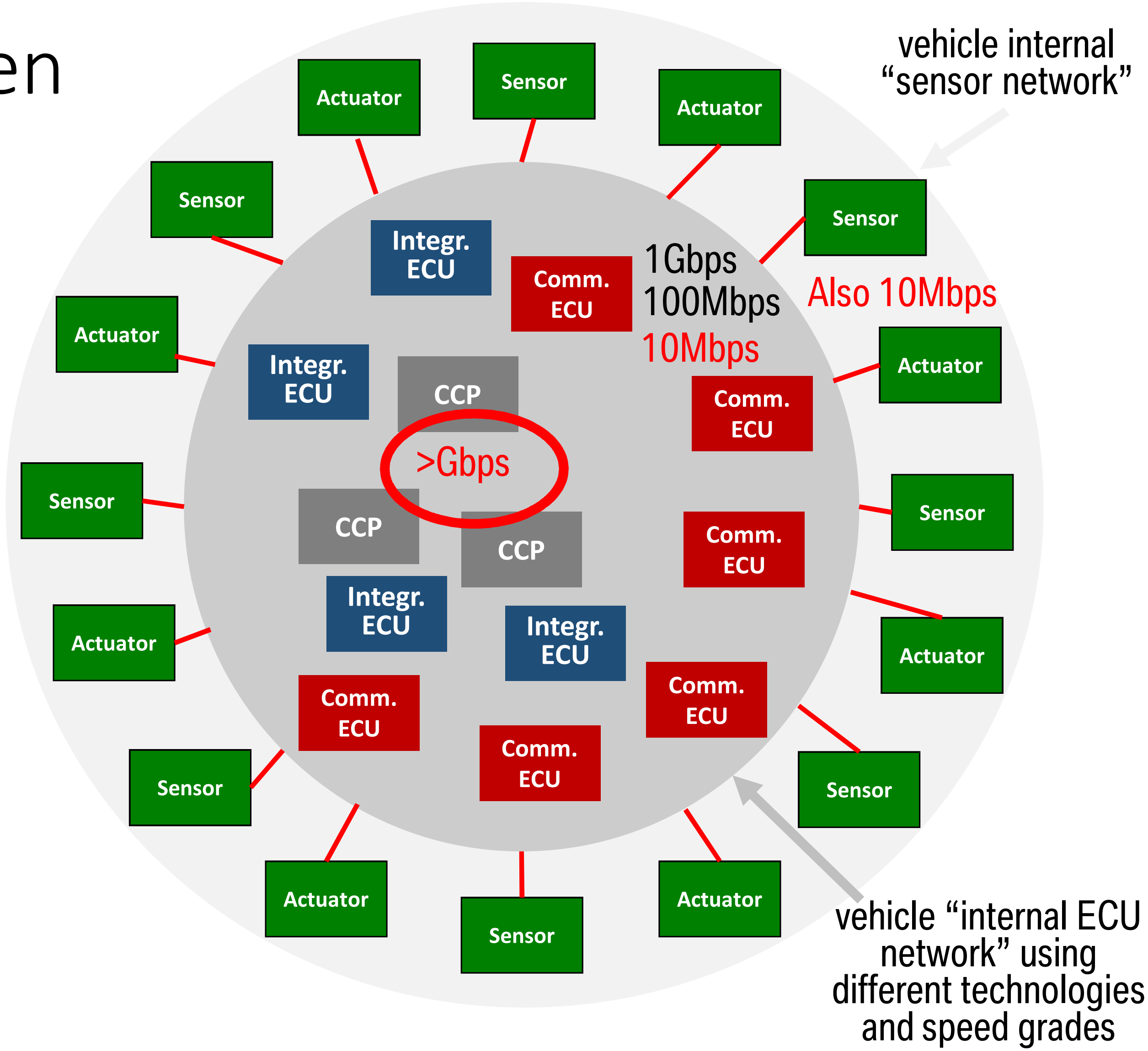
- Partitioning of functions based on the availability of resources.
- Project-specific/heterogeneous development methods depending on department.
- Similar system requirements for all ECUs.
- Focus on local ECU optima.

Target:

- Requirements-based classification of ECU with harmonized development methods and requirements based on ECU-class.
- Optimization on vehicle level.

Independence between physical and logical network

- Accessing each node (sensors/actuators/ECUs) by a unique address (MAC or IP).
- Ultra high data rates between the Central Computing Platforms (CCP).
- Also lower data rates for a more cost an energy efficient integration of sensors and actuators into the network.
- Data rates as needed in the “internal ECU network”



Sensor development

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 ↘

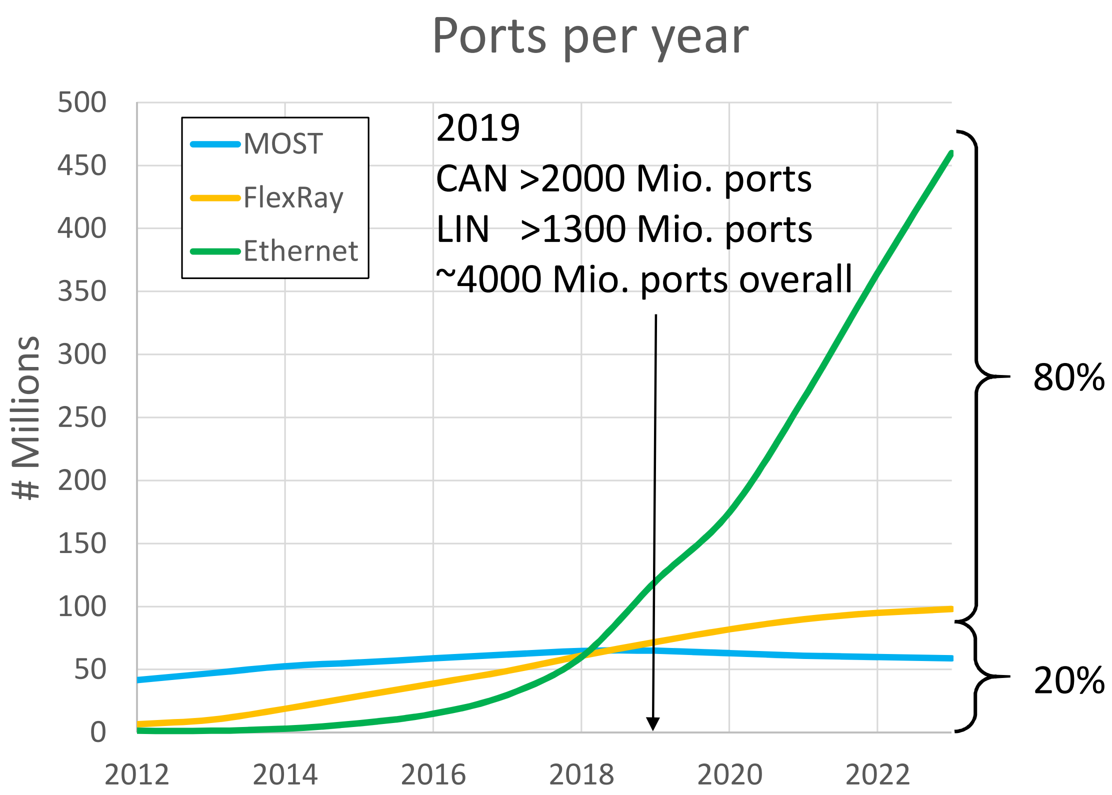
Ultrasound → up to 10Mbps ↗

Microphones → below 10Mbps ↗

10Mb/s candidate ↗ Not a candidate ↘

Market data

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

Summary.

Automotive uses for the 10Mbps PHY are:

- New ECUs or ECU versions requiring faster communication than CAN (FD)
- Replacement of legacy in-vehicle networking (IVN) technologies like FlexRay
- Ethernet ECUs for which 100BASE-T1 is not cost and energy efficient
- Simple and redundant sensor networks

Advantages of the 10Mbps PHY are:

- Allows for fewer IVN-technologies
- Allows for fewer gateways
- Supports the ubiquitous IP network
- Cost savings