**Automotive Ethernet,
Holistic Approach for a Next-generation
In-vehicle Networking Standard**

AMAA 2012

Steffen Müller
NXP Semiconductors

Content
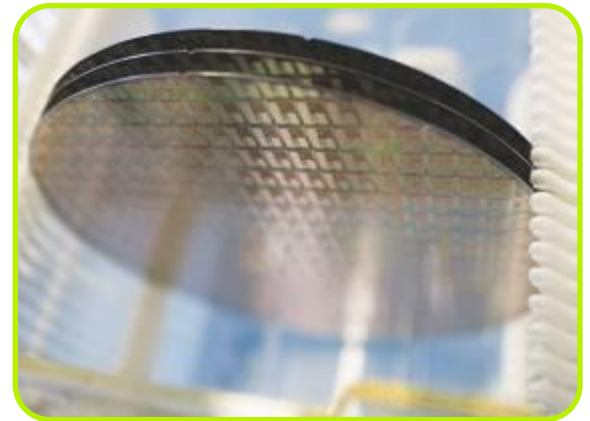
Introducing NXP Semiconductors

NXP Semiconductors provides High Performance Mixed Signal and Standard Product solutions that leverage its leading RF, Analog, Power Management, Interface, Security and Digital Processing expertise

- **Headquarters**: Eindhoven, The Netherlands

- **Employee base:**

    - approximately 25,000 employees

    - in more than 25 countries

    - R&D in Europe, US, and Asia

    - Manufacturing in Asia and Europe: 85 % out of own production

- **Net sales**: $4.2 B in 2011, over 60% in Asia Pacific

- **Customers**: Leading OEMs worldwide

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NXP – Automotive Product Portfolio

Established leadership positions

Driving growth

2011 and beyond

In-vehicle networking
- CAN / LIN
- FlexRay
- System Basis chips

#1

Car access & Immobilizers

#1

Car entertainment
- Radio/Audio DSP
- Tuner
- Audio Amplifiers

#1

Magnetic Sensors
- Speed (ABS, engine)
- Angular (steering, throttle)

#3

Small Signal Discretes
- Diodes & Transistors
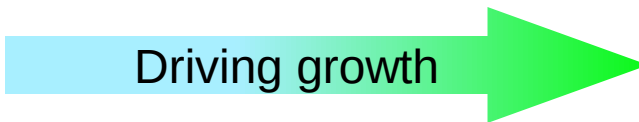
#1

Automotive Logic

#1

Standard MOSFET

Interface Products
▸ LCD Drivers, LED Controllers, UARTs & Bridges, I/O Expanders, GPIOs, RTCs, PCI express PHY, Cap Touch

Connected Mobility

Car entertainment
- Multi Standard Digital Radio
- Digital 1-Chip Radio

Car access
- Passive Keyless Entry / Go
- Connected Key: 2-way, NFC

NEW!

Telematics and Car ITS
- e-Call & Eco routing
- Car-2-x communications

NEW!

CO_2 reduction

Sensors for Brushless DC motors

IVN
- Partial Networking
- Ethernet
- Isolated CAN

NEW!

Lighting & Instrumentation
- LED Driver IC
- LED Backlighting

NEW!

Battery Management
- Realtime Clocks for Hybrid Drive

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Automotive Transceivers reach 3 Billion

CAN *lin* FlexRay
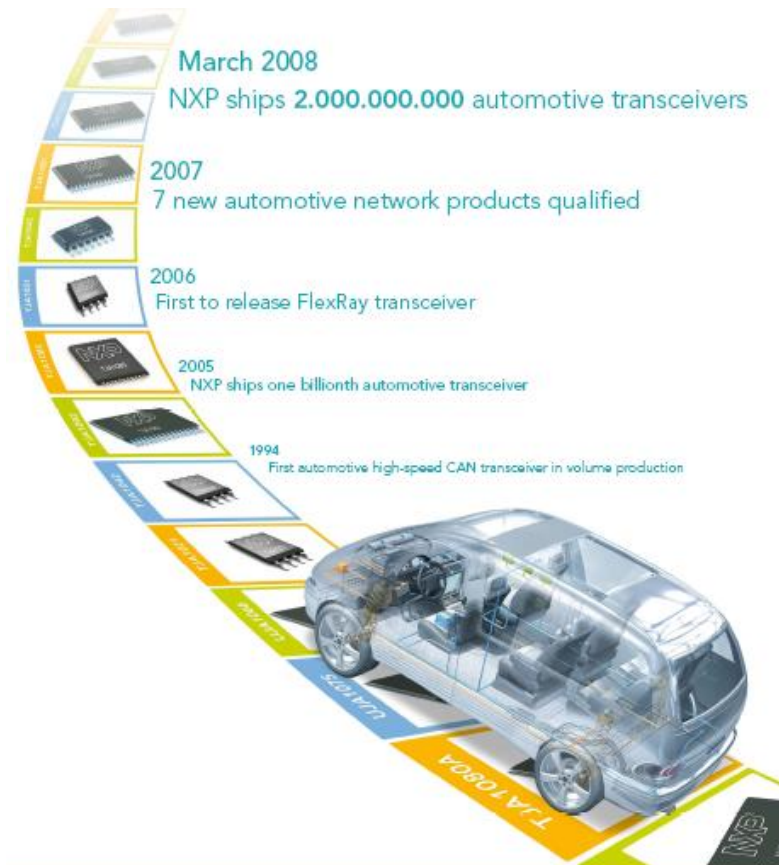
11 years to the 1st billion…

11 quarters to the 2nd billion…

11 quarters to the 3rd billion….

… to the 4th billion in 2012

March 2008
NXP ships **2.000.000.000** automotive transceivers

2007
7 new automotive network products qualified

2006
First to release FlexRay transceiver

2005
NXP ships one billionth automotive transceiver

1994
First automotive high-speed CAN transceiver in volume production
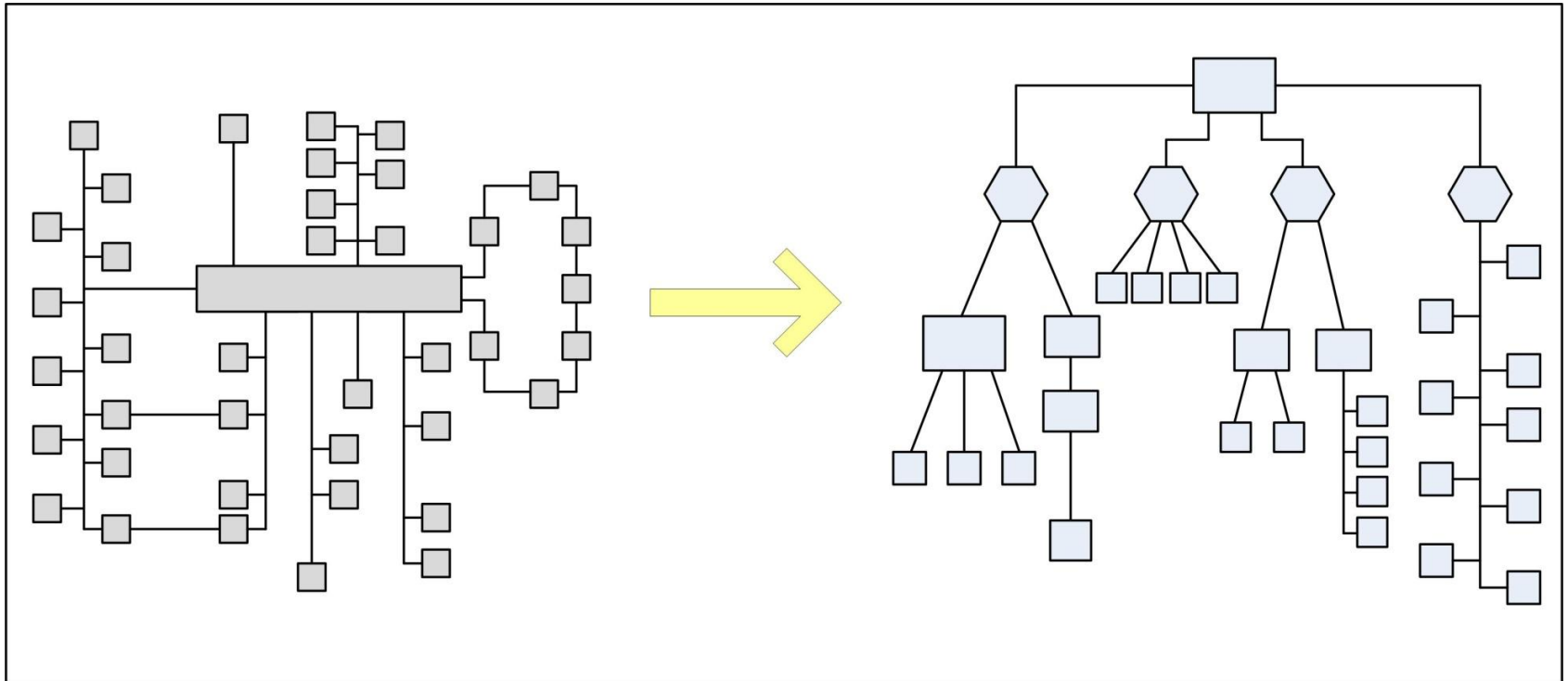
Milestone in September 2010 → 3 billion transceivers shipped
Every newly produced car has 8 NXP transceivers on board

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Why Automotive Ethernet?

▸ Communication and bandwidth requirements increase more and more with more complex car applications, e.g. enhanced safety, entertainment

▸ Car networks like LIN, CAN, FlexRay are not specified to cover increasing demands for bandwidth and scalability

▸ Network solutions for higher bandwidth are available but expensive

▸ End users expect in the car same level of data availability as at home

▸ Future networking technology shall re-use as much as possible from non-automotive while taking automotive-specific requirements into account

<u>Today, car network architectures are of a heterogeneous and historically grown nature</u>

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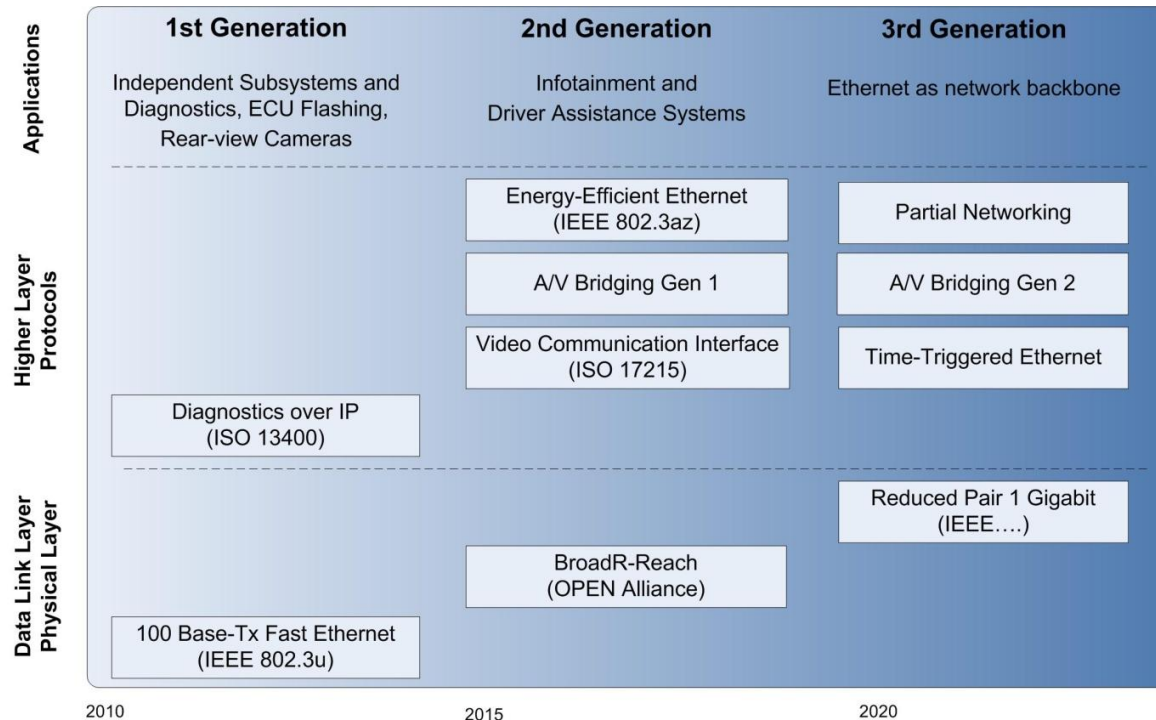
Domain Architecture, Today and in Future (1)

Domain Architecture, Today and in Future (2)
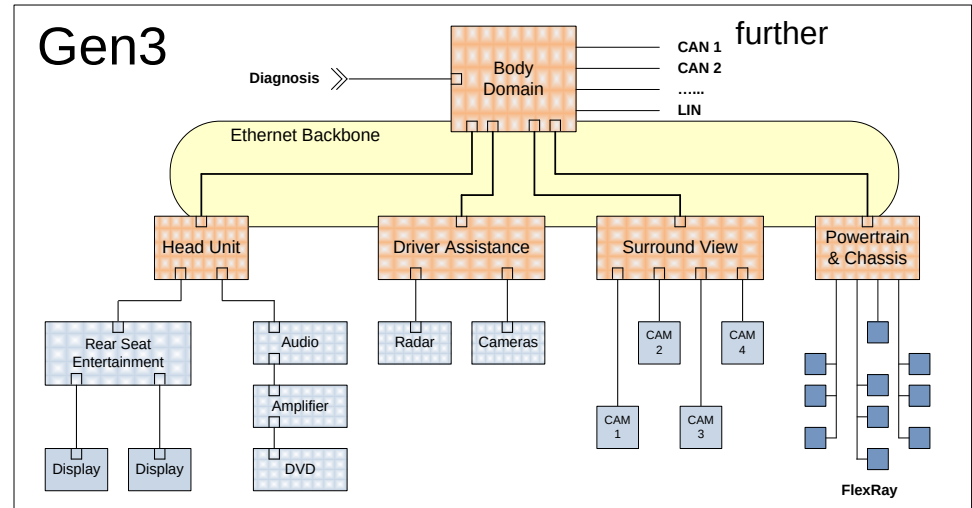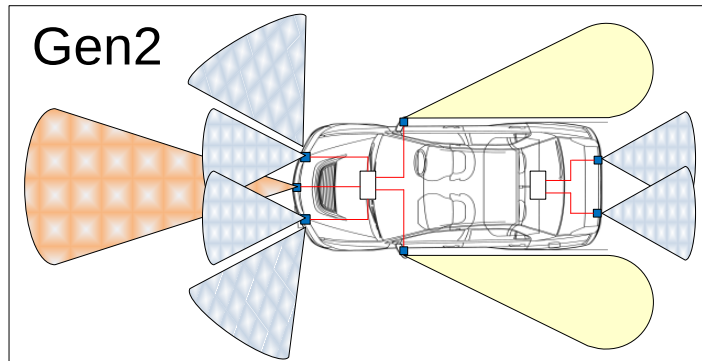
▸ Ethernet is good for backbone bus systems to connect application domains and sub-networks that require higher bandwidth

▸ Switched Ethernet networks rely on point-to-point comm. and bandwidth is more efficiently used than in broadcast systems (CAN, FlexRay)

▸ Ethernet is a paradigm shift in design of next-generation car networks to

- Connect different application domain networks
- Transport different kinds of data (control data, streaming, etc.)
- Fulfil stringent robustness demands (Temp, EMC) across network protocols

Evolution towards Automotive Ethernet (1)

	1st Generation	2nd Generation	3rd Generation
Applications	Independent Subsystems and Diagnostics, ECU Flashing, Rear-view Cameras	Infotainment and Driver Assistance Systems	Ethernet as network backbone
Higher Layer Protocols	Diagnostics over IP (ISO 13400)	Energy-Efficient Ethernet (IEEE 802.3az); A/V Bridging Gen 1; Video Communication Interface (ISO 17215)	Partial Networking; A/V Bridging Gen 2; Time-Triggered Ethernet
Data Link Layer Physical Layer	100 Base-Tx Fast Ethernet (IEEE 802.3u)	BroadR-Reach (OPEN Alliance)	Reduced Pair 1 Gigabit (IEEE….)

2010   2015   2020

▸ One Pair EtherNet OPEN Alliance; over 50 partners, formed for physical layer

▸ Standardisation for components, tests based on Broadcom's BroadR-Reach tech.

▸ Gather requirements for future networks "Reduced Pair Gigabit"

▸ AUTOSAR addresses Automotive Ethernet in their software layer stack

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Evolution towards Automotive Ethernet (2)
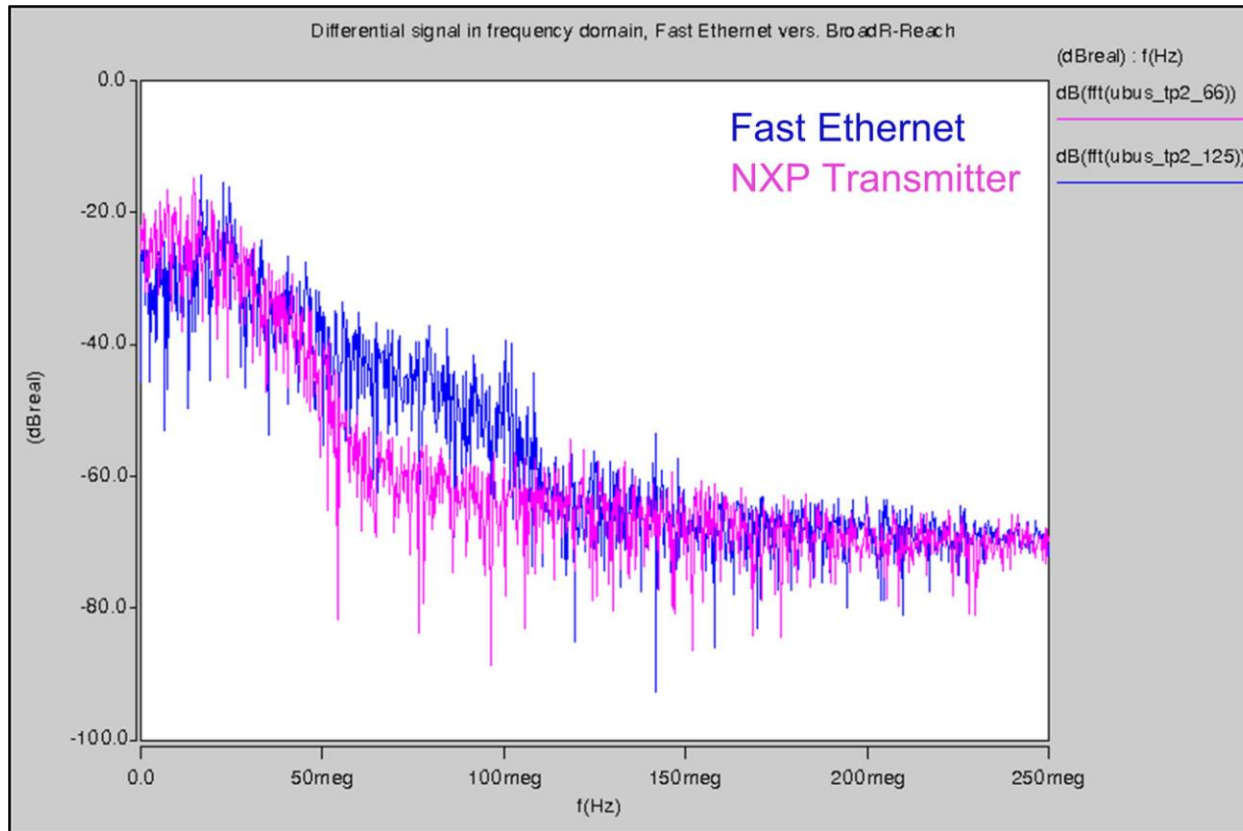
- Driver Assistance Systems include several cameras to allow surround view
- High-resolution cameras require high bandwidth (for uncompressed data) transfers
- Backbone architecture is hierarchically organized with domain controllers
- Different data communication classes coexist on the same network
- IP based routing concept eases addressing and allows scalability

BroadR-Reach Ethernet Solution

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EMC Fast Ethernet vs. BroadR Reach

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Summary

▸ CAN and FlexRay remain for body and safety-critical communication

▸ Increasing bandwidth needed for driver assistance and infotainment

▸ Network topologies will change from decentralised domain-specific architectures to hierarchical architectures that need backbone

▸ Ethernet provides scalability and flexibility for next-generation networks

▸ New automotive optimised components required (Ethernet switches, PHY), promising steps taken with BroadR-Reach technology

▸ Further studies needed to validate the secure coexistence of different data communication classes on the same Ethernet network

▸ OPEN Alliance and AUTOSAR are driving further standardisation on the hardware and software levels

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