Automotive Megatrends, Challenges and Solutions - an OEM Perspective
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Ulrich Abelein
Key Factors for Success Story of German Car OEMs

Innovations

Quality

Design

Ulrich Abelein, AUDI AG
Semiconductors as Driver for Innovations
Complexity on System Level

Number of ECUs

Time

A8 2002  A5 2007  A8 2010

Number of ECUs  68  65  100

Increase in software  x1  x1.5  x4.5

Ulrich Abelein, AUDI AG
Complexity on Subcomponent Level

- Automotive semiconductor technologies
- Comfort zone
- Increase of maturity
- ITRS technology trend
Will this trend continue?

Let’s look at the upcoming megatrends…
Megatrends 2020+

- Driver Assistance
- Car-2-X
- Electromobility
Megatrends 2020+

- Car-2-X
- Driver Assistance
- Electromobility
During the last decade we connected all vehicle systems.

During this decade, the vehicle will be fully connected to its environment, the internet, other vehicles and the driver.

Ricky Hudi, Head of Electric/Electronic Development, AUDI AG
Car-to-X
Infotainment

Concept

- HMI
- Navigation
- Phone
- Connectivity
- Media

Multimedia Modul (MMX)

Radio & Car Control-Unit (RCC)

Supply Structure

Tier 1

e.solutions

Sofort Venture von Elektronik und Audi

Dauerhaltbarkeit

Google

ECE

NUANCE

gracietto
Development of Computing Power for Infotainment

2012
- MIB1
  - ~ 4,000 DMIPS

2014
- MIB2
  - ~ 8,000 DMIPS

2015
- MIB2
  - ~ 12,000 DMIPS

2016
- MIB2+
  - ~ 20,000 DMIPS

Modularity enables consumer electronics like innovation cycles but with automotive reliability!
Megatrends 2020+

- Car-2-X
- Driver Assistance
- Electromobility
Driver Assistance – Piloted Driving
Megatrends 2020+

- Car-2-X
- Driver Assistance
- Electromobility
Electrification means realization of basic vehicle functions (steering, power train, mobility) by electronics → Instant increase of the whole system complexity

Ulrich Abelein, AUDI AG
Electromobility
What means „Automotive Quality“?

Standard requirements for a car:

- 15 years of lifetime
- 300,000 km minimum mileage
- 8000 hours „ignition on“

Electronics have to withstand extremely rough conditions during the lifetime:

- Operating temperatures from –40 °C up to +175 °C
- High humidity
- Instable voltage conditions
- Harmful chemicals and gases
Some already know....

From a datasheet of a semiconductor manufacturer:

As battery-powered devices go mobile there is a natural interest in plugging into the cigarette lighter in order to conserve or even recharge battery packs during operation. But before you connect, be advised: you are plugging into the supply from hell. The main battery line in an automobile is the source of a number of nasty potential transients, including load dump, reverse battery and double battery.

Load dump is the result of a loose battery cable. When the cable breaks connection, the field collapse in the alternator can cause a positive spike as high as 60V which takes several hundred milliseconds to decay. Reverse battery is just what it says, while double battery is a consequence of tow-truck operators finding that a 24V jump start cranks
Influence of Subcomponent Quality

7,000 semiconductor devices / premium car

1 ppm intrinsic failure rate (assumption)

7 failures / 1000 cars

4000 cars per day

1 failure each hour
System Quality – Robust Design

Semiconductor competence becomes core competence of car manufacturer

- Robust Design starts on device level (Design, testing, screening / use in application / livetime)
- Electrification leads to fundamentally new requirements for certain systems and subcomponents
- Involvement of the whole supply chain necessary
- Minimum competence level necessary for each member of the chain
- Formalized but standardized interaction necessary to break down requirements on each level
Automotive semiconductor requirements
from technology to application

Automotive Requirements: Reliability, Zero Defects, Supply Guarantee, …

- **Technology Development**
  - Silicon & Package Design
  - DfT, DfM, DfR

- **Qualification Characterization**

- **Manufacturing Safe Launch**

- **Product Testing**

- **Application Safe Land**

- **Support, FA, FQE, PCN, EOL, …**

Standards: ISO26262, AEC-Q100/101/200, TS16949, …

Automotive Requirements

- **Reliability**: Long life under extreme temperature ranges, high humidity, unstable voltage conditions and harmful chemicals & gases

- **Zero Defects and robust operation**: Driven by safety applications & warranty costs

- **Logistics**: Reliable & long-term supply, fast response to incidents
Schnellere Innovationszyklen für Elektroniksysteme entlang der Automobilwertschöpfungskette

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Development cycles

Vehicle development cycle: 7 years

Semiconductor development cycle: technology development, de-risking, product

Technology cycle MOSFET

Moors law

MNAND cycle: start of mass production till end of production

AEC-Q100 qualification

qualified semiconductor 2 years before SOP

1 year
Vision

Collaboration model of the future

New collaboration models need new tools and methods
Focus of autoSWIFT

Innovation and Quality

Technology Development Process & Requirements

Application Requirements & Interaction with Technology

Aligned Development Processes
Keep the pace!

Keyfactor: Unity of Quality and Innovation
Summary

► The unity of quality, innovation and design is the key factor for the worldwide success of German car manufacturers

► Semiconductors are the main driver of innovations in the automotive industry

► The upcoming megatrends of our society will pose completely new challenges for the German car OEMs

► The evolution from a automotive qualification to a automotive quality approach is necessary to handle these challenges and combine quality, reliability and innovation in the future

► An integrative approach involving car OEM, tier1 and semiconductor manufacturer from development on is the base for this evolution