Automotive Digitalization: Resilience and intelligent transfer concepts in the world of connected mobility
Introducing

Nexperia is a dedicated global leader in Discretes, Logic and MOSFETs devices. We became independent at the beginning of 2017...

...and bring decades of proven quality, commitment, and efficiency to automotive applications.
A new force in Discretes, Logic & MOSFETs
With a long history, broad experience and a global customer base.

Key Facts

- A dedicated company for Discretes, Logic and MOSFETs with leadership positions in all product areas
- Over 1.3 billion US$ revenues (2017)
- More than 13% market share
- High volume production of 90 billion units annually
- 11,000 Employees supporting customers globally
- 2 own frontend, 3 own backend manufacturing sites
- Over 60 years of expertise in semiconductors, the former Standard Products division of NXP
- Headquarters in Nijmegen, The Netherlands
The efficiency company for automotive

Innovation
For electrification and safety

Efficient products
+800 types launched within a year

Quality & reliability
Exceeding AEC-Q100/101

Manufacturing
Vertically integrated – maximum efficiency

Continuous innovation
silicon & package technology

90 billion
products every year

Strategic focus on Automotive

AEC-Q101
sub-ppm failure rate
Discrete, Logic and MOSFET devices for...
Continuous innovation in silicon & package technology to support Automotive trends
The „Digitalization of the car“ creates breakthroughs in connected mobility

- Autonomous driving
- Car-Car-communication
- Car-Infrastructure communication
- „The cabin of the future“
  
  gesture control
  microprojectors, etc.
Global semiconductor market

- **Automotive**: low volume market
- **Even lower market for new automotive applications**

*source: TRACE project*
Global semiconductor market investment challenges

- Investment strategy mainly driven by mass market communication & consumer electronics industry
- Automotive volumes are not capable of financing an own operative landscape in the future

source: TRACE project
Automotive electronics market
Summary

2 major challenges can be derived out of the „Digitalization of the car“

- Leveraging from communication/consumer electronics development and scale without loss of quality

- Improving robustness and resilience of electronic systems in order to manage the rising electronic content in the car without loss of quality
Enabling intelligent transfer concepts

**EU-CATRENE project TRACE**
*Technology readiness in automotive for consumer electronics*

Project at a glance:
- **lead:** BOSCH
- > 30 partner covering the whole automotive value chain
- **Start:** ~ Q2/2016

<table>
<thead>
<tr>
<th>Produkt &amp; System</th>
<th>Industry</th>
<th>Start-ups/SME</th>
<th>R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEM automotive</td>
<td>VW, Daimler, BMW, Volvo</td>
<td>IMAR, Open Wide Vedeocom</td>
<td></td>
</tr>
<tr>
<td>System level (Tier1)</td>
<td>Bosch Siemens, Continental Vedeocom</td>
<td>TRONICS IMSYS</td>
<td>CEA</td>
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<tr>
<td>Semiconductor Component level</td>
<td>Bosch, NXP, Nexperia, AMS STM</td>
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<tr>
<td>Kompetenz &amp; Technologie</td>
<td>Design</td>
<td>Silkan RT, KTH</td>
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<tr>
<td>Technology</td>
<td>QRTECH HELIOX</td>
<td>CEA, Uni Siegen, Uni Bordeaux</td>
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<tr>
<td>Test &amp; Validation</td>
<td>AKKA, VW</td>
<td>Berliner Nanotest Goepel CWM, Fries TWT</td>
<td>Swerea, Fraunhofer Uni Bremen</td>
</tr>
<tr>
<td>Simulation</td>
<td></td>
<td>Catena Coventor</td>
<td>Fraunhofer TU Delft FH Johanneum</td>
</tr>
</tbody>
</table>
Enabling intelligent transfer concepts

EU-CATRENE project TRACE
Technology readiness in automotive for consumer electronics

<table>
<thead>
<tr>
<th>Consumer</th>
<th>Automotive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature range</strong></td>
<td><strong>Temperature range</strong></td>
</tr>
<tr>
<td>0°C ... +40°C</td>
<td>-40°C ... +155°C</td>
</tr>
<tr>
<td><strong>Lifetime</strong></td>
<td><strong>Lifetime</strong></td>
</tr>
<tr>
<td>1..3 years</td>
<td>10 ... 15 years</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td><strong>Vibration</strong></td>
</tr>
<tr>
<td>negligible</td>
<td>0 ... 2000 Hz</td>
</tr>
<tr>
<td><strong>Acceleration</strong></td>
<td><strong>Acceleration</strong></td>
</tr>
<tr>
<td>negligible</td>
<td>500 m/s²</td>
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<tr>
<td><strong>ESD safety</strong></td>
<td><strong>ESD safety</strong></td>
</tr>
<tr>
<td>up to 3kV</td>
<td>up to 15 kV</td>
</tr>
<tr>
<td><strong>Acceptable field failures</strong></td>
<td><strong>Acceptable field failures</strong></td>
</tr>
<tr>
<td>&lt; 10%</td>
<td>Goal: zero failure</td>
</tr>
<tr>
<td><strong>Failure documentation</strong></td>
<td><strong>Failure documentation</strong></td>
</tr>
<tr>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Long-term supply</strong></td>
<td><strong>Long-term supply</strong></td>
</tr>
<tr>
<td>no</td>
<td>up to 30 years</td>
</tr>
</tbody>
</table>
Leadless QFN power temperature cycling test with Fraunhofer ENAS under different test conditions:
CT-scan of solder joints before and after stress

Example: QFN board level reliability
Evaluating influence of board level stress/solder fatigue on system lifetime

Collaboration:
VW, Volvo,
Continental, Bosch,
NXP, Nexperia, Sverea,
Fhg ENAS
Enabling resilience in automotive

EU-CATRENE project RESIST
Resilient integrated systems

Project at a glance:
- lead: NXP
- ca. 20 partner covering the whole automotive value chain
- Start: ~ Q2/2014
RESIST
RESilient Integrated SysTems

Project scope:
reliability aware design methods and run-time approaches
for next-generation resilient integrated electronic systems in Automotive and Avionics

• **Enhancing lifetime of integrated circuits & embedded devices** from today’s 10-15 years up to tomorrow’s 25 years for **Automotive** and 35 years for **Avionics**

• Enable an innovative ‘**design for resilience**’ approach that is at least 2x more cost-effective than conventional redundancy practices for the same level of system’s reliability

• At least 20% **increase in the number of integrated components**, or integration density of such components, for integrated electronics systems in cars and airplanes for the same, or better level of system’s reliability

• **Reducing reliability testing costs** by 25%, and reducing the qualification time by 30% for integrated electronic components
Activity overview

- Resist aims at increasing the quality of integrated circuits and systems by developing
  - Reliability aware design approaches
  - Techniques for improving the reliability
  - Health monitoring on IC/ system level
  - Design for resilience which is 2 times more cost effective than normal redundancy strategies
- Focus are automotive and avionics applications
- The focus is mainly on IC design
Examples: Resilience by system-level ESD

ESD concepts: ESD protection for Car Ethernet

Capacitance and ESD robustness can be scaled
Examples: Resilience by system-level ESD

ESD concepts: ESD protection for Car Ethernet

ESD simulation algorithm

• Setting up a simulation tool box for modelling ESD-events on components & systems
• Aiming for finding layout dependent ESD weaknesses of components and systems
• Collaboration with Fraunhofer EAS in Dresden
Summary

2 major challenges can be derived out of the „Digitalization of the car“

- Leveraging from consumer electronics development and scale without loss of automotive quality

- Improving robustness and resilience of electronic systems in order to manage the rising electronic content in the car without loss of quality

- The european industry is joining forces to come to the next level for both challenges

Funded by BMBF and CATRENE
EFFICIENCY WINS.