THE ROAD AHEAD FOR SECURELY CONNECTED CARS

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BU Automotive / BL AAA
NXP Semiconductors
EXPANDED SOLUTIONS AFTER MERGER

#1 Communications Processors
#1 RF Power Transistors
#1 Automotive Radar
#1 Automotive Safety
#2 MCUs

Sources: HIS, ABI Research, Strategy Analytics, The Linley Group
(1) MCU market excluding Automotive
(2) Automotive Analog and Sensors in Airbag, Braking, Radar, and TPMS applications
NXP - #1 GLOBAL AUTO SEMI POWERHOUSE

#1 AUTO SEMI SUPPLIER GLOBALLY

>30 AUTO SITES IN ALL REGIONS

2400+ AUTO ENGINEERS

~40% OF NXP’S REVENUE IS FROM AUTO

+60 YEARS OF AUTOMOTIVE EXPERIENCE

https://youtu.be/H5eLhER9jZ4

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NXP ENABLING TRUE APPLICATION SOLUTIONS

TODAY: 90% OF AUTO INNOVATION VIA ELECTRONICS

#1 INFOTAINMENT
- Tuners
- Software-defined digital radio
- Multimedia processors
- Sound system DSPs & amplifiers
- NFC BT pairing
- Wireless power charging
- Power management

#1 VEHICLE NETWORKING
- CAN/LIN/ FlexRay
- Ethernet
- Central gateway controller
- Security

#1 BODY
- Microcontrollers
- Position/ angle sensors
- System basis chips

#1 SAFETY
- Microcontrollers
- Airbag analog
- Airbag analog
- Braking sensors
- Braking
- Tire pressure monitoring

#1 SECURE CAR ACCESS
- Immobilizer/ security
- Remote keyless entry
- Passive keyless entry/ go
- Bi-directional keys
- NFC
- Ultra wide band

#1 STANDARD PRODUCTS
- Logic
- Power
- Discretes

#1 AUTO ANALOG/ RF
- Auto analog/ RF

#1 AUTO MCU (EX JPN)
- Auto MCU (ex JPN)

#1 AUTO MERCHANT MEMS SENSORS
- Auto merchant MEMS sensors

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AUTOMOTIVE INNOVATION TRENDS

SEAMLESS CONNECTED MOBILITY EXPERIENCE

ADVANCED DRIVER ASSISTANCE ➔ SELF-DRIVING

ENERGY EFFICIENCY

Enjoying Life.
One hour per day in the car

Saving Lives.
1.3M Road Fatalities Every Year

Reducing CO2.
EU mandates 20% reduction by 2020

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ROAD TRAFFIC ACCIDENTS

THE CAUSES

Every year!
~1.3 M fatalities
>50 M people seriously injured
>$3 trillion cost of road accidents
>90% caused by human mistakes

Data source: NMVCCS

<table>
<thead>
<tr>
<th>Critical Reasons</th>
<th>Number</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Driver</td>
<td>2,046,000</td>
<td>94%</td>
</tr>
<tr>
<td>Vehicles</td>
<td>44,000</td>
<td>2%</td>
</tr>
<tr>
<td>Environment</td>
<td>52,000</td>
<td>2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>47,000</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>2,189,000</td>
<td>100%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Driver-Related Critical Reasons</th>
<th>Number</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Recognition Error</td>
<td>845,000</td>
<td>41%</td>
</tr>
<tr>
<td>Decision Error</td>
<td>684,000</td>
<td>33%</td>
</tr>
<tr>
<td>Performance Error</td>
<td>210,000</td>
<td>11%</td>
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<tr>
<td>Non-performance Error (e.g. Sleep)</td>
<td>145,000</td>
<td>7%</td>
</tr>
<tr>
<td>Other</td>
<td>162,000</td>
<td>8%</td>
</tr>
<tr>
<td>Total</td>
<td>2,046,000</td>
<td>100%</td>
</tr>
</tbody>
</table>

We need to get the Human Factor out of the equation!
CONNECTING THE CAR

Other Road Users

Camera, LiDAR

Radar

Security

Network

Sensors

Actuators

ADAS

Car Access

Portable devices

Infrastructure

Broadcast

Big Data

Cellular

Security

Network

Sensors

Actuators

ADAS

Car Access

Portable devices

Infrastructure

Broadcast

Big Data

Cellular

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CONNECTING THE CAR

Other Road Users

V2X

Security

Network

Radar

ADAS

Infrastructure

FOCUS OF THIS PRESENTATION

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SMART RECEPTION AND SENSING

ADAS
- Radar
- Camera
- LIDAR
- Wheel speed & Angular

COMMUNICATION
- V2X
- Smart Car Access
- Broadcast Radio

Sense

Think
- DSP
- Security
- Ethernet
- FlexRay
- CAN

Act
- Light
- Matrix/Laser
- Display
- Vehicle Control
  - Brake
  - Steer

Big Data

Maps

Sensor Fusion

Entertainment
APPs

Amps

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IN-VEHICLE NETWORKS
MORE CONNECTIONS – MORE BANDWIDTH

Nodes/Car 0.01 0.05 0.2 0.6 1.3 2.3 3.7 5.3

Year 2014 2016 2018 2020
Network Nodes/Year [Billion] 20

CAN +LIN +FT CAN
+Partial Networking
+FlexRay
+CAN FD
+IsoCAN
+1Gbps Ethernet
+100Mbps Ethernet

30 kg
2 km wire
350 parts

Ethernet
1000 Mbps
100 Mbps
FlexRay™
10 Mbps
CAN FD
5 Mbps
CAN
1 Mbps
lin
20 kbps

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ENABLING THE SECURE CONNECTED CAR OF TOMORROW

Significantly reducing the >1.3M global road fatalities

SENSE
Radar Vision
Secure V2X

THINK
Processing Sensor Fusion Security

ACT
Powertrain Chassis Braking

BIG DATA
Digital Networking Infrastructure Security

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CAR RADAR
RFCMOS: SYSTEM SIZE OF A STAMP

- High performance at low power consumption
- Small footprint
- Ease of application
- Low system cost

- Cocoons of radar sensors for 360° surround view
- Driving radar from premium into volume market
- Making ultra-sonic parking sensors obsolete
- Next gen: integration of frontend with µC
VEHICLE-TO-EVERYTHING (V2X) COMMUNICATIONS BASED ON IEEE802.11P STANDARD

INTELLIGENT TRANSPORT SYSTEMS (ITS)

Avoiding road accidents
Improving traffic flow / CO₂
Enabling autonomous driving

IEEE802.11p is derived from IEEE802.11a/g (today’s WiFi standard in computing)
**VEHICLE-TO-EVERYTHING**

**USE CASE EXAMPLES**

<table>
<thead>
<tr>
<th><strong>Typical V2V</strong></th>
<th><img src="image1.png" alt="Diagram" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous location warning</td>
<td>Emergency Electronic Brake Warning</td>
</tr>
<tr>
<td>Slow vehicle warning</td>
<td>Do Not Pass Warning</td>
</tr>
<tr>
<td>Stationary vehicle warning</td>
<td>Hazardous Location</td>
</tr>
<tr>
<td>Emergency brake light</td>
<td>Emergency Vehicle</td>
</tr>
<tr>
<td>Emergency vehicle warning</td>
<td>Left Turn / Intersection Assist</td>
</tr>
<tr>
<td>Motorcycle approaching indication</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Typical V2I / I2V</strong></th>
<th><img src="image2.png" alt="Diagram" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Vehicle (Floating Car) Data</td>
<td></td>
</tr>
<tr>
<td>Signal traffic light phase and time</td>
<td></td>
</tr>
<tr>
<td>Road works warning</td>
<td></td>
</tr>
<tr>
<td>In-vehicle signage</td>
<td></td>
</tr>
</tbody>
</table>

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SYSTEM SECURITY

- NXP #1 in Auto HW Security
- 4-Layer Security Solution
- Plus Best-in-Class
- Secure Car Access
- Recognized Thought & Innovation Leader

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ISO26262 – FUNCTIONAL SAFETY

What is ISO26262?

System Level vs. ICs

Must have for future Automotive ICs

Certification? (ICs vs. Overall Process)
SUMMARY

Consumers need to be able to trust their cars
- Quality, Safety & Security are basic requirements

Key technologies to make self-driving, securely connected cars a reality
- Compact radar solutions based on mixed-signal RFCMOS
- Secure, high-performance V2X
- High-bandwidth distributed vehicle networks / Ethernet
- Cryptoelectronics

No need to reinvent the wheel … but to ADAPT what we already know from other industries
THANK YOU

SECURE CONNECTIONS FOR A SMATER WORLD

NXP

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