SECURE CONNECTIONS FOR A SMARTER AUTOMOTIVE WORLD

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NXP (China) Management
COMBINED POWER ENABLING SECURE CONNECTIONS FOR A SMARTER WORLD

$10B IN ANNUAL REVENUE
4TH LARGEST SEMI COMPANY GLOBALLY

#1 AUTOMOTIVE
#1 SECURE IDENTIFICATION
#1 BROAD-BASED MCUs

#1 RF POWER TRANSISTORS
#1 COMMUNICATION PROCESSORS
#1 SMALL SIGNAL DISCRETES

Making a Difference to
• Customers
• Shareholders
• Society
• Employees
#1 GLOBAL AUTO SEMICONDUCTOR POWERHOUSE

#1 AUTO SEMI SUPPLIER GLOBALLY

2400+ AUTO ENGINEERS

>30 AUTO SITES IN ALL REGIONS

>$3B ANNUAL AUTO REVENUE

~40% OF NXP’S REVENUE IS FROM AUTO

+60 YEARS OF AUTOMOTIVE EXPERIENCE
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 AUTO ANALOG/ RF

#1 AUTO MCU (EX JPN)

#1 AUTO MERCHANT MEMS SENSORS

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

#1 VEHICLE NETWORKING
- Powertrain & chassis
- Microcontrollers
- Pressure/ motion sensors
- Battery management
- Drivers

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TOMORROW: ENABLING THE SECURE CONNECTED CAR

Secure Connected, Self-Driving Cars will save >1.3 million road fatalities globally

NXP Offers Complete Secure ADAS System….

SENSE
Radar Vision Secure V2X

THINK
Process Processing Sensor Fusion Security

ACT
Powertrain Chassis Braking

BIG DATA
Digital Networking Infrastructure Security
AUTOMOTIVE INNOVATION TRENDS

Seamless Consumer Electronics Experience

Enjoying Life. One Hour per Day in the Car.

Advanced Driver Assistance ➔ Self-Driving

Saving Lives. 1.3M Fatalities Every Year.

Energy Efficiency

Reducing CO₂ EU mandates 20% reduction by 2020.
ROAD TRAFFIC ACCIDENTS
THE CAUSES

<table>
<thead>
<tr>
<th>Critical Reasons</th>
<th>Number</th>
<th>%</th>
</tr>
</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>
</tr>
</tbody>
</table>

**Driver-Related Critical Reasons**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number</th>
<th>%</th>
</tr>
</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>
</tr>
<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>

Data source: NMVCCS

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

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

Other Road Users

V2X

Security

Network

ADAS

Broadcast

Radar

V2X

FOCUS OF THIS PRESENTATION
NXP Multi-Standard SDR IC enabling Car-to-X communication, saving lives, reducing CO₂

**Car-to-Car**
- Emergency Vehicle Warning
- Seeing Around Corners
- Do Not Pass Warning

**Car-to-Infrastructure**
- Green Light Optimal Speed Advisory
- Avoidance of traffic jams
- Hazard Warning/Warning Sign
V2X Overview - NXP V2X Solution

NXP World Best Performance V2X Solution

- NXP is the One-Stop Shop for Chipset and Firmware
- Scalable / Flexible Global Solution (SDR)
  - Multi Band Support (EU/US/JPN/WIFI/DSRC)
  - Antenna Diversity support
  - Proven Software Defined Radio IP
  - WIFI 802.11abgn support
- Superior Performance & Range key for mobility
- Proven interoperability (ETSI plug-test passed)
- Secure Link is Key for Day1 Safety Use Cases
- Automotive Quality 802.11p radio solution
- Prepared for One-chip integration (RFCMOS)

NXP Value Proposition

(*Field Test Result)
Shaping tomorrow’s mobility through researching and testing car-to-x and its applications
Partners
Continental, Daimler, Audi, BMW, Opel, VW, Cohda Wireless

China
Government Trail run
ITS cities
Car OEM activities

Japan
Targeted car2carfield trial
Potential Partners
Denso, Cohda Wireless

Field trial and on-road demonstration of DSRC
Rail Trial
100 vehicle rail safety trial
Partners
University South Australia,
La Trobe University
Cohda Wireless

First Deployment:
Bay Area Project
>1,200 Buses and 50 Traffic Lights to provide green phase in 2014

Regional Field trial in Paris region to apply car2x technology
Partners
Renault, PSA, Cohda Wireless

NXP: Leading solution in Car-2-X trials
More than 1 Million Vehicle Days of Testing
September 23, 2014
Secure vehicle networking enters series production:
NXP is the world’s first company to manufacture chipsets for use in series-produced vehicles

Cadillac to Introduce Advanced ‘Intelligent and Connected’ Vehicle Technologies on Select 2017 Models
Super Cruise and V2V technologies slated for production in about two years

Source: www.media.gm.com

ITS WORLD CONGRESS, Sept. 2014

Source: www.media.gm.com

NXP SUPPLIES V2X CHIPSETS INCL. SOFTWARE AND CHIPS FOR DATA SECURITY

Source: www.media.gm.com
NXP IEEE802.11p V2X System

- power supply: TEF5100/SAF5100
  - 3V3 2V5 1V8 1V2
- LNA/PA
- LNA/PA
- LNA
- TEF5100
  - RF ctrl
  - TCXO
- SAF5100
  - ECDSA
  - 802.11p 1609.4
- SXA1700
- i.MX6 Micro Controller
  - security
  - geonetworking
  - Application
  - clk
  - TCXO
  - GPIO
  - USB
  - UART
  - GPIO 1 PPS
  - LNA
- DDR2
- Flash
- GPS
- Ethernet
- CAN
- TJA 104x
- TJA 1100
- TEF5100
- SAF5100
- TJA
802.11p Radio Module
NXP SAF/TEF51xx based)

Functional
• RF Frontend
• IEEE 802.11p PHY
• IEEE 802.11p MAC
• Security Accelerator

Physical
• 30mm x 40mm x 4mm (RF Shield Included)
• Surface Mount module

Temperature
• -40C to +85C (PCB Ambient)

Interfaces
• USB, SPI, UART
• GPIO
• RF (direct to antennas)

5.9GHz Radio
• Two x 5.9GHz Antennas
• 23dBm Tx (Typical)
• -98dBm Rx (Typical)

Power Supply
• 5v, 3v3
SECURING V2X COMMUNICATIONS
MESSAGE AUTHENTICATION VIA DIGITAL SIGNATURES

Digital signature
- For authentication (sender identity, content integrity)
- And non-repudiation (no plausible deniability)

Based on
- Hash function \(\rightarrow\) unique identifier for message
- Public-key crypto: two keys, one is private, other public
- Secret key material involved in signature generation (TX)
- Only public key material involved in signature verification (RX)

ETSI (EU) & IEEE (US) standards mandate
Elliptic Curve Digital Signature Algorithm
- RSA signatures too long (bandwidth limitation)
- Comparable security strength:
  RSA 3072b \(\sim\) ECC 256b \(\sim\) AES 128b

Performance level:
- Broadcast (TX) up to 20 messages/ s
- Receive (RX) N times more messages
  - bandwidth limitation: \(\sim\)1000/s
  - real-life traffic measurements: \(\leq\) 750/s

<table>
<thead>
<tr>
<th>TX</th>
<th>RX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>Signature generation</td>
</tr>
<tr>
<td>Rate</td>
<td>Low: (\leq) 20 / s</td>
</tr>
<tr>
<td>Security level</td>
<td>High: protection of private keys (car identity)</td>
</tr>
</tbody>
</table>
IN-VEHICLE NETWORKS
MORE CONNECTIONS – MORE BANDWIDTH

Network Nodes/Year [Billion]

Year


Network Nodes/Year [Billion]

Year


Ethernet

1000 Mbps
100 Mbps

CAN

+LIN

+FT CAN

+FlexRay

+Partial Networking

+CAN FD

+IsoCAN

+1Gbps Ethernet

+100Mbps Ethernet

30 kg
2 km wire
350 parts

Ethernet

1000 Mbps
100 Mbps

FlexRay™

5 Mbps

1 Mbps

20 kbps

NXP

SECURE CONNECTIONS
FOR A SMATER WORLD
CAR RADAR
77GHZ

- Precise range, approach speed and angle data
- Short-, mid- and long-range functionality
- Excellent multi-target discrimination
- One radar for multiple safety systems
CMOS is the next big step:

• Cocoons of radar sensors for 360° surround view
• Driving radar-based safety from premium into volume market
• Making ultra-sonic parking sensors obsolete
• Next gen: RFCMOS allows integration of frontend with DSP & μC