Secure innovations for connected mobility

Internet of Things - May 14th – 15th in Milwaukee

Leland Key
NXP Semiconductors

4 key mega trends shaping our society:
Energy Efficiency, Connected Devices, Security and Health

High-Performance Mixed-Signal Solutions
that enable

Secure Connections for a Smarter World

RF, Analog, Power Management, Interface, Security and Digital Processing
... for Automotive, Mobile, Security ....
and Lighting, Industrial, Consumer and Computing.

We enable our customers to differentiate features, cost of ownership and time-to-market.

A global semiconductor company with operations in more than 25 countries, NXP Semiconductors posted revenue of $4.36 billion in 2012.
NXP Driving Growth in Automotive – Connecting the Car

### Core

- #1 Car Entertainment
- #1 Car Access
- #1 In-Vehicle Networking
- #3 Magnetic Sensors
- #1 Automotive Logic
- #1 Small Signal Discretes
- #3 Low Voltage Power Interface Products

### Growth

#### Connect the Car

- SW Defined Digital Radio
- Smart Car Access
- Smart Key
- Car-to-Car/ Infrastructure
- NFC for Automotive
- FlexRay & Ethernet

#### CO₂ Reduction

- Partial Networking
- Class-D Amplifiers
- LED Drivers
Internet of Things Drives Connectivity Standards

Number of Connected Devices (B Units)

- 2020: 25–50
- Early 2000s: ~1
- 2011: 9–12
- 2020: 35–40

Source: WSTS (extrapolated after 2011), Cisco, Machina Research / GSMA

Note: connected devices = “Connections to remote sensing, monitoring and actuating devices, together with associated aggregation devices”
... with massively growing number of connections and dramatic need for security

Time

Adoption

Internet of Things

Connected Cars

Cloud

SmartGrid

Mobile Devices & Accessories

Cards & RFID

“Secured by NXP”
Mega Trends Shaping the Automotive Industry

Energy Efficiency
- Government regulations
- Electrification of drive train
- Replacement of mechanics by smart electronics

Advanced Safety & Traffic Management
... towards Autonomous Driving
- Driver Assistance Systems
- Sensor Fusion
- Smart Actuators

Connected Devices
- Intelligent traffic management
- Safety & Remote Car Mgmt.
- Entertainment & convenience

Security
- Protection against hacking
- Theft prevention
- Detection of counterfeit parts

Safety
- Active accident prevention
- Rapid help in case of emergency
- Reliable wireless communication
Connected cars –
Enablers for automated driving

Cars will be big part of the
“50 Billion connected devices by 2020”

Driver assistant systems will be in
“50% of the new cars by 2020”

Connected Devices
we expect in 2020 & their estimated values

<table>
<thead>
<tr>
<th></th>
<th>Billion $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected Car</td>
<td>600</td>
</tr>
<tr>
<td>Pay-As-You-Drive Car Insurance</td>
<td>245</td>
</tr>
<tr>
<td>New Biz. Models for Car Usage</td>
<td>225</td>
</tr>
<tr>
<td>Traffic Management</td>
<td>100</td>
</tr>
<tr>
<td>Electric Vehicle Charging</td>
<td>75</td>
</tr>
</tbody>
</table>

Source: PC Today, April 2012

55% (B$1,3) of connected devices
market in 2020 is car-related

Penetration of Advanced Driver Assistance
Systems (ADAS) in new cars will grow from
6% today to 50+% in 2020 (CAGR >30%)

2005  Assisted driving (ADAS)
2015  Auto Pilot (@ limited conditions)
2025  Autonomous Driving

Source: Barclays – The Connected Car Report, April 2013
Connected Mobility

... enables communication between cars, people, infrastructure, inside the car
Car Access
Intelligent Car Access Solutions

NXP designed in at most OEMs:
almost one billion car keys out in the field.
Automotive NFC
... connecting Car, Key, Smartphone & Infrastructure

Connecting Key & Infrastructure
- Diagnostic for service
- Payment

Connecting Car & Phone
- Data Exchange & BT/ WiFi pairing
- Car Sharing
- Complementing Car Access
- Wireless power charging (data channel)

Data exchange & BT/ WiFi pairing
Passenger preference settings
- Seat, mirror, light, air condition
- Music, video, internet settings
- Trip planning
- Starting smartphone apps
- Hot spot credentials Vehicle diagnostics

Connecting Key & Phone
- Data Exchange & BT/ WiFi pairing
Car-2-X Communications
Car2X communication – Saving lifes, Reducing CO₂

High-level Motivation:

- **80% less crashes** & associated societal cost
  - > 1.2 Million deaths in road
  - > 50 Million injured in road
  - 2% GDP cost

- **Congestion wastes >1 T$** of world GDP
  - Megacities traffic collapses
  - 3-5% CO₂ reduction

Key Use Cases:

- **Safety**
  - Intersection Collision Warning
  - Emergency Break Warning
  - Hazardous Location Warning

- **Intelligent Traffic Management**
  - Green Light Optimal Speed
  - Avoidance of traffic jams
  - Mobility Enhancements

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1: US Department of Transportation Study
2: World Health Organization, Report 2004
3: World Bank Global Road Safety Facility, 2010
In Vehicle Networks
Automotive – Hungry for More Bandwidth

1 Gbps - IEEE802.3bp (RTPGE)
OPEN Alliance created proposal for Reduced Twisted Pair Gigabit Ethernet (RTPGE).
NXP is member of IEEE802.3bp

100 Mbps - BroadR-Reach de-facto standard
OPEN Alliance founded to proliferate technology

2015  2018  > 2020

- Developments in ADAS drives demand for higher data rate
  - High-resolution cameras require high-speed data transfers
Security
Connected Cars need enhanced security

**Connected Car**
- Avoid car hacking
- Data Security is *precondition* to Car2X communications

**(H) EV**
- Connection to the Grid at charging facilities
- Secure billing & battery swapping

**Manipulation**
- Easy access to car network via OBD…
  - Engine tuning
  - Unpaid (optional) feature activation

**Counterfeiting**
- Counterfeiting creates high economic damage
- Parts are looking good but perform badly
Looking for Trust Anchors …

What are the assumptions underlying the security design?
What can I trust?
… adding Secure Elements (SE) to the In-Vehicle Network

**Diagram Description**

- **Gateway/BCM**
  - LED Ambient
  - door control front right
  - HVAC main
  - door control front left
  - immo
  - start stop
  - lighting switch
  - rain light sensor
  - connectivity units
  - infotainment units

- **Network Connections**
  - Powertrain CAN / FlexRay (HSCAN/FlexRay)
  - Instrument CAN
  - Body CAN (HSCAN/FTCAN)
  - Ethernet
  - LIN (LIN 1.3/2.x)
  - Diagnosis CAN or Ethernet

- **Key Components**
  - Engine control
  - Transmission control
  - Stability control
  - Power steering
  - (adaptive) cruise control
  - Headlight control
  - Anti-lock brake
  - Airbag control
  - AFS
  - Top column module
  - Rear power module
  - Level sensor
  - Flapper 1
  - Flapper 7
  - Start stop
  - Dashboard
  - Gateway/BCM
  - LED Ambient

- **Other Network Elements**
  - AFS
  - Fan
  - Heater
  - Flapper 1
  - Flapper 7
  - Antenna
  - Roof module
  - Car access module
  - Interior lighting
  - Gateway/BCM
  - Gateway/BCM
  - Gateway/BCM
  - Gateway/BCM
  - Gateway/BCM

**NXP**
Body Controller with Secure Element

Secure Element

- Network Bus Data Encryption
- Message Authentication
- System Key Management
- Setup Secure Channels
- Secure Boot
- Data Verification

Secure Element as source of TRUST
A reliable Trust Provisioning scheme

Manufacturing

Not impacted by key management

Tier x

Dealer

OEMs

Secure communication

Service Provider

Trust Service Manager

Data/App

Initial Security Module key

Secure communication
Winning with NXP Automotive