Memory Security of Automotive Systems

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Agenda

• Trend of Autonomous Car
• Types of NAND Storage Device by Applications
• Focus Migration Safety Security
• Security of Autonomous Car: Memory’s Role
Automotive Market – 2030 Projection

In 2030,
• 100% car will be connected,
• 55% of all new cars will be electric cars
• 15% fully autonomous car (18.75 million)
Profit in Automotive Trend

2030,
HW COMPONENTS OF AUTONOMOUS DRIVING will reach to $40B.

DIGITAL SERVICES & SHARED MOBILITY will get to profit $216B.

Data source: PWC, IEA, McKinsey & Company
Evolution of Automotive Systems

VS.

NAND Storage Form Factor

<table>
<thead>
<tr>
<th>Driver Assistance Level</th>
<th>Safety &amp; Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Autonomous Car</td>
</tr>
<tr>
<td>Low</td>
<td>Fleet Surveillance</td>
</tr>
<tr>
<td></td>
<td>Mixed</td>
</tr>
<tr>
<td>Raw NAND</td>
<td>SD/microSD</td>
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<tr>
<td></td>
<td>eMMC</td>
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<tr>
<td></td>
<td>UFS</td>
</tr>
<tr>
<td></td>
<td>PCIe SSD, PCIe BGA</td>
</tr>
<tr>
<td></td>
<td>PCIe SD (SD Express)</td>
</tr>
<tr>
<td>8GB ~ 64GB</td>
<td>8GB~128GB</td>
</tr>
<tr>
<td>16GB ~ 256GB</td>
<td>128GB ~</td>
</tr>
</tbody>
</table>

Navigation (IVI)

In-Vehicle Infotainment (IVI)

Drive Recorder

EDR/Tachograph

ADAS/DMS

Time
ADAS (Advanced Driver Assistance System)

Input
Perceive external data
e.g. sensor, radar, camera

Processing
Process data and make decision
e.g. MCU, ECU

Output
Take actions based on computed results
e.g. display HMI

Signal input
Perceive external data
Wire/wireless transmission

Process
MCU, ECU

Wire/wireless transmission

Wire Internet

Network

MCU

CPU
I/O

Storage

Hourmeter

In-car LAN net transmitter

Output processor

Power component

Signal output
Take actions based on computed results

Source:
http://www.rsipvision.com/adas-future-opportunities/
Who comes first?

Autonomous car or hacker?
Why the Autonomous Cars

When vehicles can connect to everything, hackers also been connected

• **Gear vehicles vs. Smart cars**
  To make autonomous car happen, it is impossible to rely on single sensor for real time situation so there are many different systems to gather in one vehicle.

However, the difficulty of data fusion from different sensor systems give hackers a way to cyberattack.
Automotive Ecosystem

The Building Blocks of Autonomy

What’s the New Focus?

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Security Focus of Autonomous Car

Functional Safety
Cryptographic

CYBER SECURITY
Security Focus Migration: Supplier of NAND Storage Device
How can memory suppliers contribute in this connected car ecosystem?
# Automotive Quality Standards

<table>
<thead>
<tr>
<th>Regulations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IATF16949</td>
<td>Automotive manufactory method for product design and process development</td>
</tr>
<tr>
<td>AEC-Q100</td>
<td>Automotive Electronics Council: IC Verification Standard</td>
</tr>
<tr>
<td>VDA6.3</td>
<td>VDA (Verband Der Automobilindustrie) Process Audit</td>
</tr>
<tr>
<td></td>
<td>German Association of the Automotive Industry</td>
</tr>
<tr>
<td>ISO-26262</td>
<td>Part 6 Software relative</td>
</tr>
<tr>
<td>A-SPICE*</td>
<td>Flash storage devices, which contain firmware algorithm or software diagnostics</td>
</tr>
</tbody>
</table>

*Automotive Software Process Improvement & Capability Determination
Error Prevention and Failure Protection

- ECC (Error Correction Code): e.g. LDPC
- Soft error detection
- CRC checksum
- Multiple back up (e.g. FW code, file system, important user data)
- Static/Dynamic Data refresh
- Power failure protection
- Data Path Protection
- Health monitoring (software integration)
A. For future planning:
As everything is connected

B. Possible current planning:
Security at local side

Server

Automotive system

Memory supplier
Plan A, Everything Is Connected

- Need Ecosystem Support
- Global organization for automotive security regulations?
  (e.g. VISA/Master card in credit card payment system)
- Refer to FIPS Federal Information Processing Standard
  e.g. FIPS 140-2 Appendix Approved Key Establishment Techniques
Software Based Authentication

Learn from Transaction and Payment Security:
3-D Secure Solution

Password as Security Key
Plan B, Security in Local Site

3D Map optimize autonomous car
High Accuracy map enable autonomous car execution
even when sensor is disconnect

Source: NDS open lane model for autonomous driving
3D High Definition Map Scenario

2. Key + Vehicle No. + Random No. One-way Encryption
3. Send Security Key
4. Security Verification
5. Access to 3D HD Map
Key Points of Security Key

- Encrypted
- Dynamic (e.g. OTP: One-Time Password)
- Non-predictable (RNG: Random Number Generation)
- Unique for each “set” (e.g. IVI + storage device)
- One-way / Irreversible (e.g. SHA: Secure Hash Algorithm)
Take Away

• In 2030, 100% car will be connected and generate more NAND storage demands
• Based on different usage cases, various form factors to serve the needs
• NAND Storage Supplier plays an important role in Automotive Ecosystem
  1) Automotive Quality Systems/Standards
  2) Error prevention and failure protection
  3) Security key as safe communication between automotive systems and NAND devices (e.g. 3D HD map)
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2018 Flash Memory Summit August 7th ~9th