Memory Security of Automotive Systems

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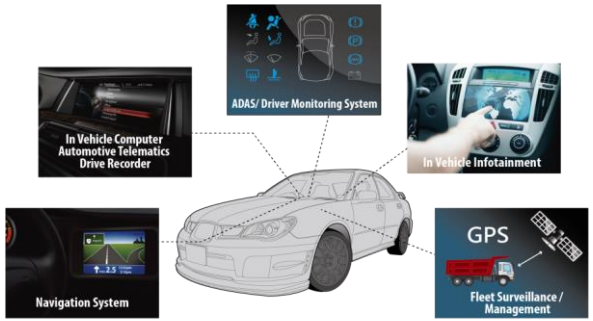
Agenda

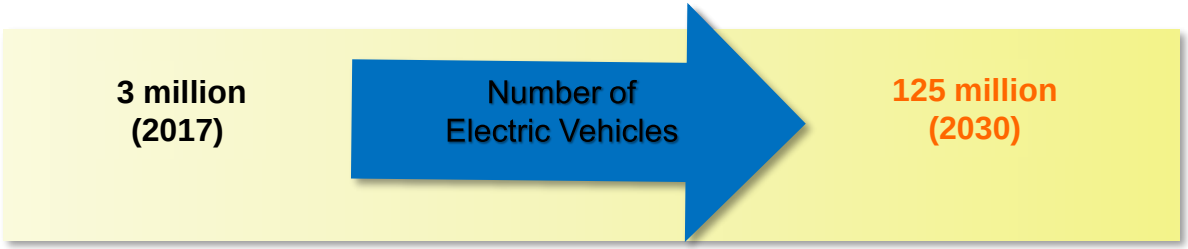
- Trend of Autonomous Car
- Types of NAND Storage Device by Applications
- Focus Migration Safety Security
- Security of Autonomous Car: Memory's Role



Automotive Market – 2030 Projection

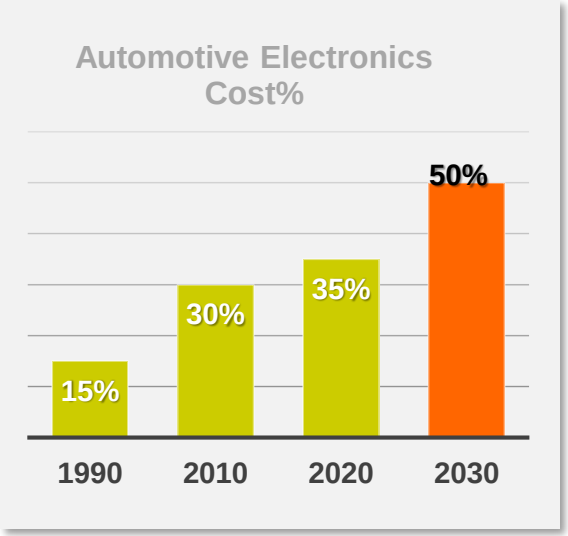
In 2030,

- **100%** car will be connected,
- **55%** of all new cars will be electric cars
- **15%** fully autonomous car (18.75 million)



Data source: Statista, pwc

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

Driver Assistance Level
Safety & Connectivity

High

Low

Time

Navigation

In-Vehicle Infotainment (IVI)

Drive Recorder

EDR/ Tachograph

Fleet Surveillance

ADAS/DMS

Autonomous Car

Mixed

Raw NAND	SD/microSD	eMMC	UFS	PCIe SSD, PCIe BGA PCIe SD (SD Express)
	8GB ~ 64GB	8GB~128GB	16GB ~ 256GB	128GB ~

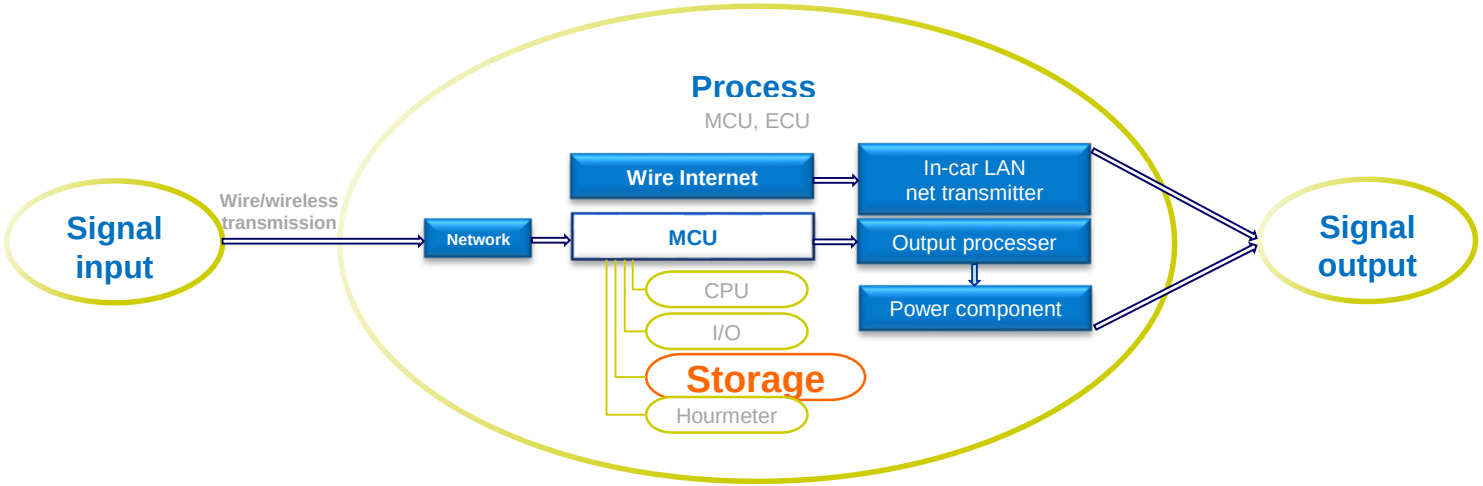
ADAS (Advanced Driver Assistance System)

Input → **Processing** → **Output**

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

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

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



Source:
http://electronicdesign.com/iot/internet-things-here-stay
http://newjust.masterlink.com.tw/HotProduct/HTML/Basic.xdjhtm?A=PA107-1.html
http://www.rsipvision.com/adas-future-opportunities/

Who comes first?

Autonomous car or hacker?

Why the Autonomous Cars

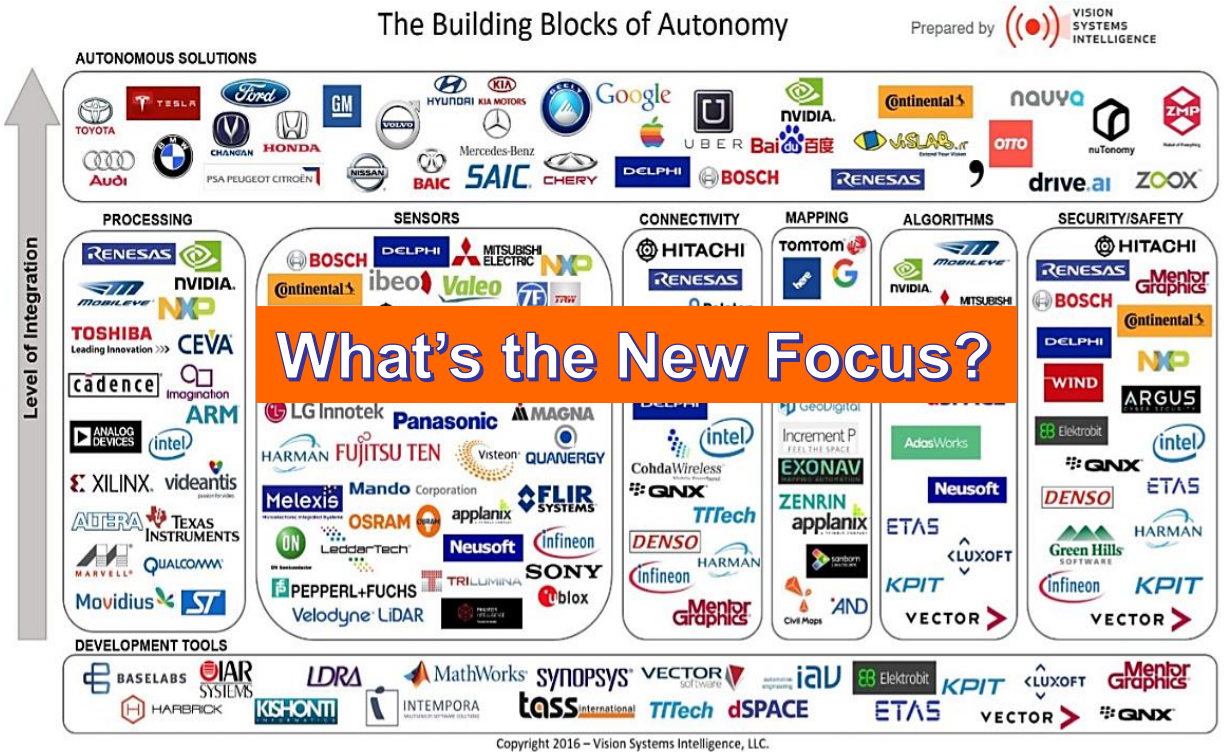
When vehicles can connect to everything, hackers also been connected

- **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



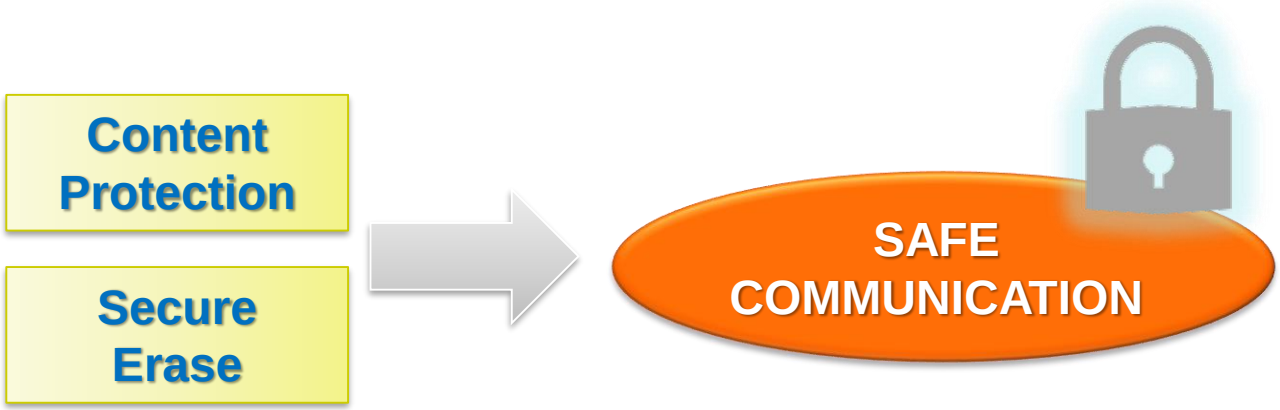
Security Focus of Autonomous Car

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

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

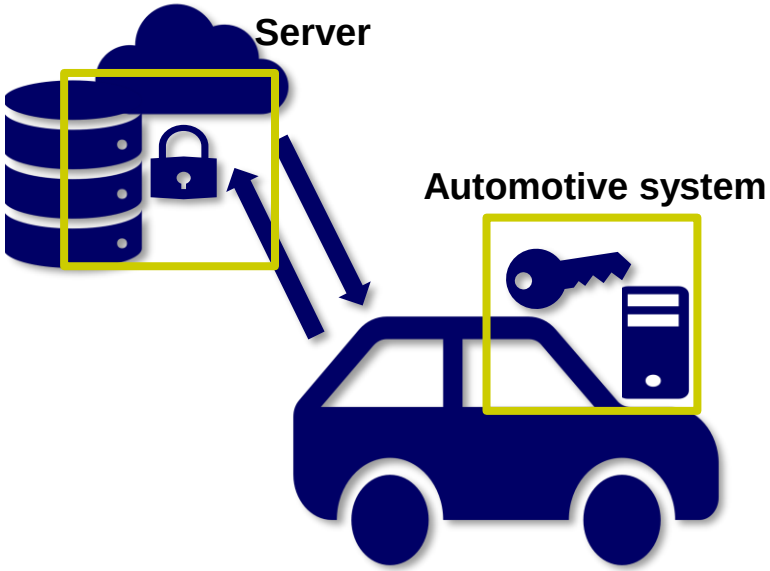
Error Prevention and Failure Protection

- 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)

Way to Security Solution

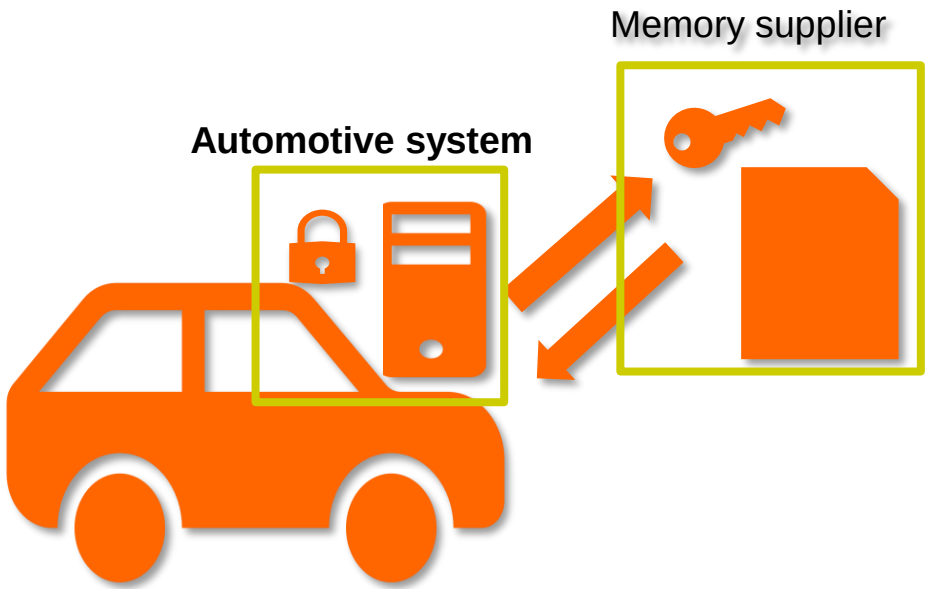
A. For future planning:

As everything is connected



B. Possible current planning:

Security at local side



Plan A, Everything Is Connected

- Need Ecosystem Support
- Global organization for automotive security regulations?

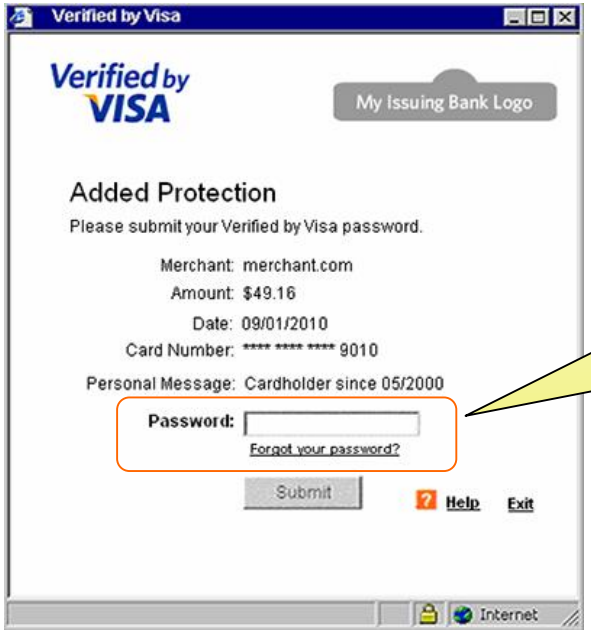
  (e.g. VISA/Master card in credit card payment system)
- Refer to FIPS Federal Information Processing Standard

e.g. FIPS 140-2 Appendix Approved Key Establishment Techniques

Software Based Authentication

Learn from Transaction and Payment Security:

3-D Secure Solution

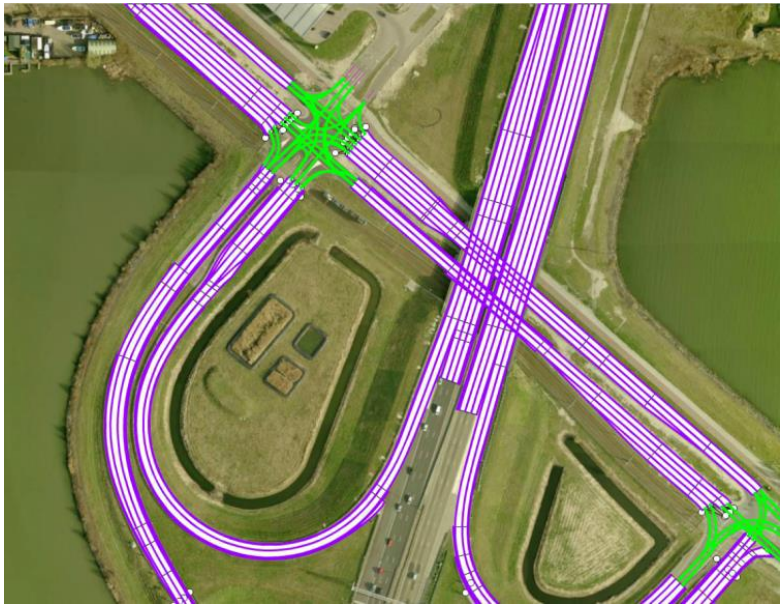


Password as Security Key

Plan B, Security in Local Site

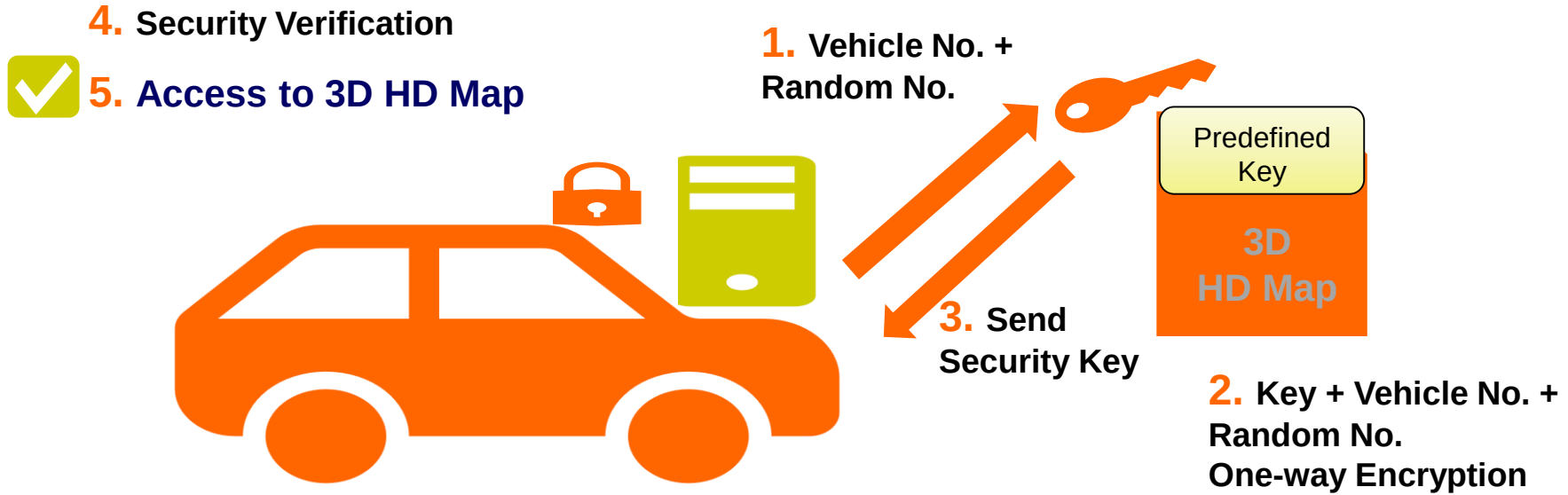
3D Map optimize autonomous car

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



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)

Flash Memory Summit