# IoT: Internet of Threats? Protect the Things!

## IoT Security principles and its reflection on Automotive Security

Inside Secure

*George Kuan*

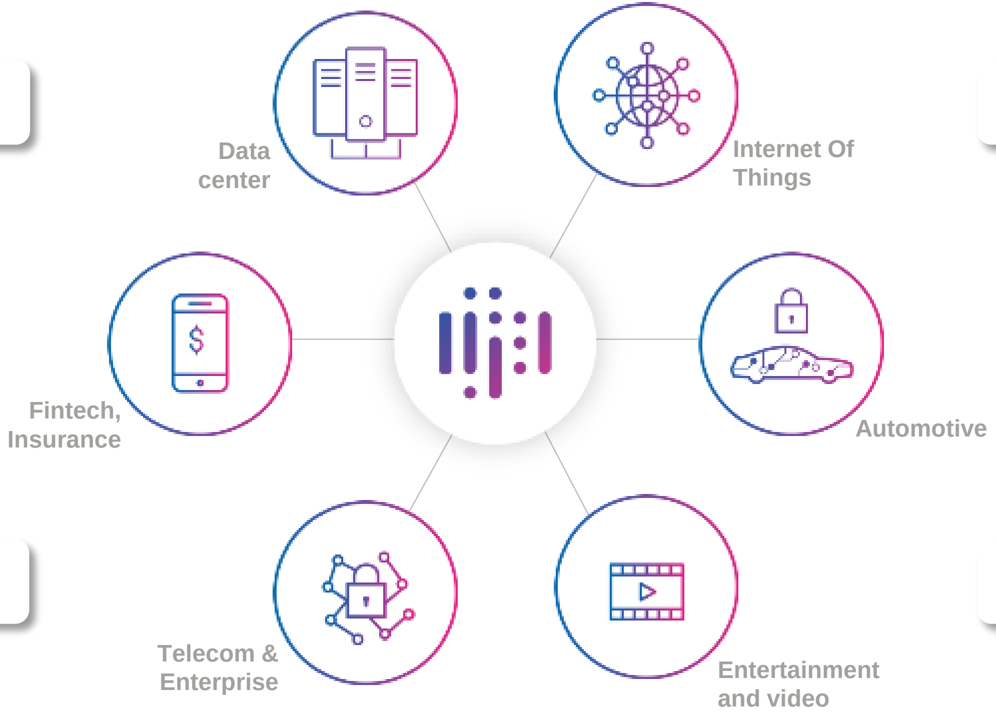
www.insidesecure.com

inside secure

# Inside Secure is uniquely positioned **to help grow business safely** in high potential markets

Securing data & communication

Supplying Strong Authentication



Protecting mobile payment

Safeguarding Applications

Securing semiconductors

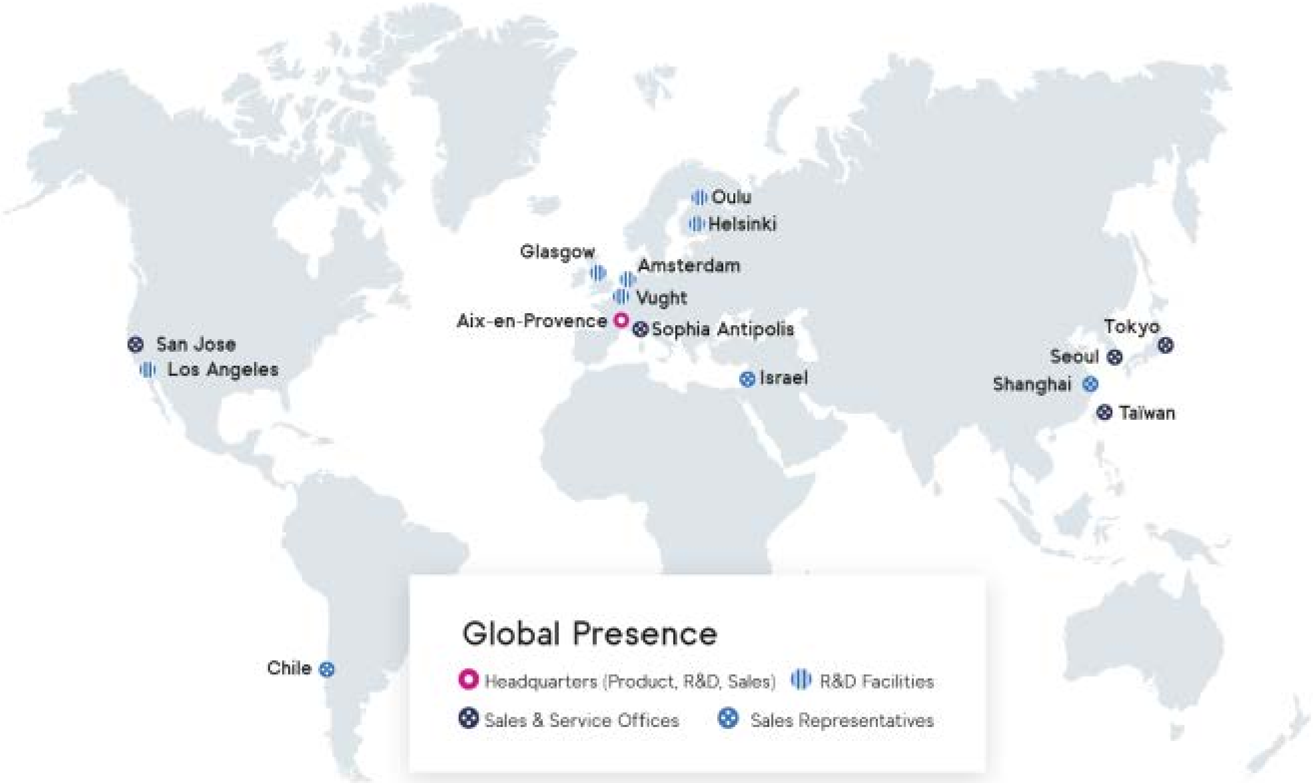
Protecting movies and TV

# Trusted by the world’s top companies

| | |
|---|---|
| Banks and payment system | CHASE<br>Santander<br>VISA<br>mastercard |
| Content distributors | HBO<br>QUICKPLAY<br>sky<br>orange<br>Virgin media<br>amazon |
| Top IT companies | SAMSUNG<br>htc<br>ASUS<br>hp<br>CISCO |
| Major semiconductor companies | BROADCOM.<br>QUALCOMM<br>intel<br>TEXAS INSTRUMENTS<br>Mstar semiconductor |

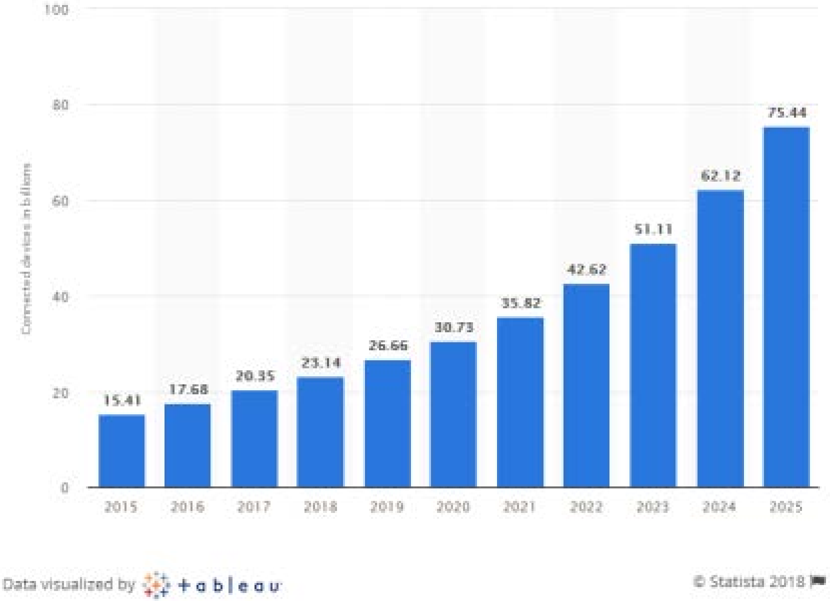
Protecting the solutions of the broadest range of customers: service providers, content distributors, security system integrators, device makers, semiconductor companies

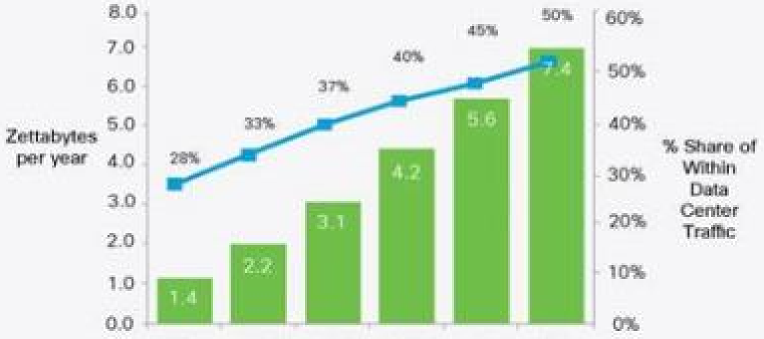
# With a worldwide team of security experts



# Continued growth of connected devices and cloud services

- Internet of Things overtook # mobile phones in 2018
- Data center capacity doubles every 3-4yrs
- Edge devices must find right balance between local computation, power consumption & storage and security capabilities.





Source: Cisco Global Cloud Index, 2016–2021.

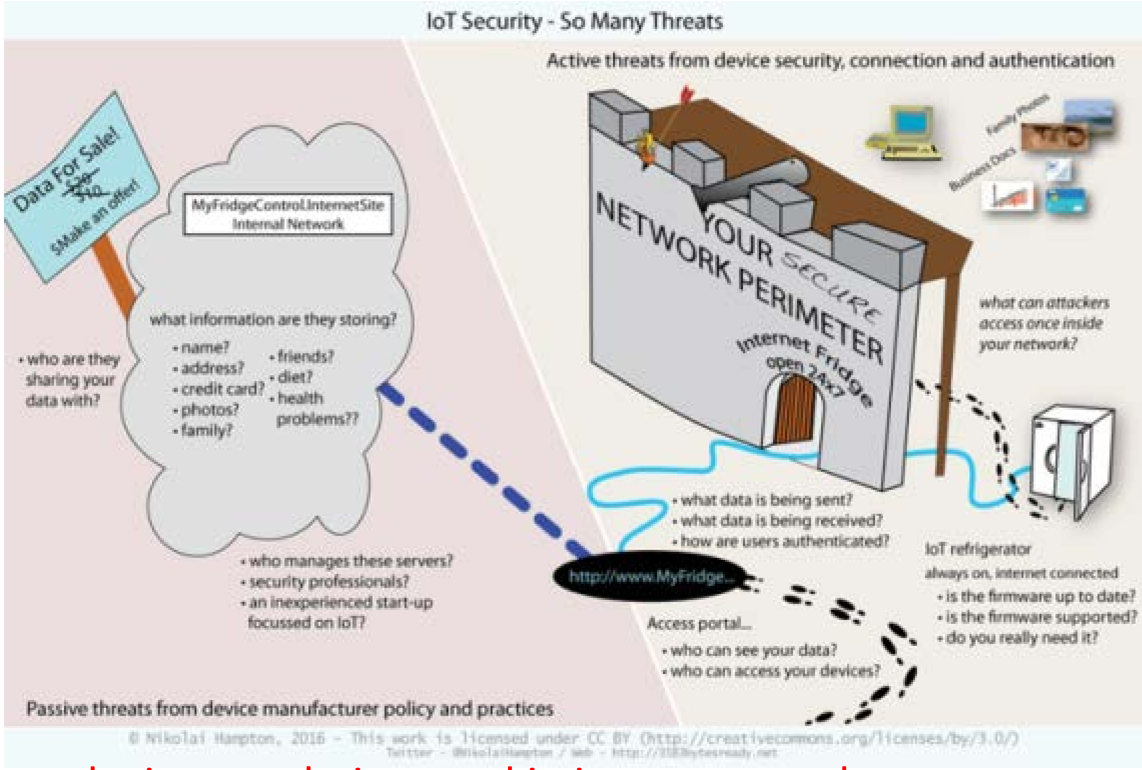
# Why IoT Security?

For device owners:

- IoT devices are typically connected in the trusted network
- IoT devices make connection to the cloud
- IoT devices collect private data

For service providers

- Trust the users of your service
- Understand/Know the source of the stored data


IoT Security - So Many Threats
Active threats from device security, connection and authentication
Data For Sale!
~~$20~~ $10
$Make an offer!
MyFridgeControl.InternetSite
Internal Network
what information are they storing?
• name?
• address?
• credit card?
• photos?
• family?
• friends?
• diet?
• health problems??
• who are they sharing your data with?
YOUR SECURE NETWORK PERIMETER
Internet Fridge open 24x7
Family Photos
Business Docs
what can attackers access once inside your network?
• what data is being sent?
• what data is being received?
• how are users authenticated?
• who manages these servers?
• security professionals?
• an inexperienced start-up focussed on IoT?
http://www.MyFridge...
Access portal...
• who can see your data?
• who can access your devices?
IoT refrigerator
always on, internet connected
• is the firmware up to date?
• is the firmware supported?
• do you really need it?
Passive threats from device manufacturer policy and practices

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Twitter - @NikolaiHampton / Web - http://3583bytesready.net

- For device manufactures: What if your devices are being used in internet attacks (DDOS, privacy violation, ransomware, ... )

# Challenge #1: many different verticals

### Infotainment

- Video / gaming / VR
- Toys
- wearables

### Smart home

- Access control
- Surveillance and physical security
- Energy management
- Maintenance
- Appliance

### Smart City

- Parking meters
- Traffic control
- Waste management
- Public safety
- Lighting

### Retail

- Inventory management
- Smart payments
- Smart displays
- Shoppers tracking

### IIoT

- Robotic control
- Production monitoring
- Process control
- Maintenance

### Health

- Medication management
- Health monitoring
- Remote diagnostic
- Maintenance

### Transportation

- Vehicle diagnostics
- Autonomous driving car
- Fleet management

### Environment

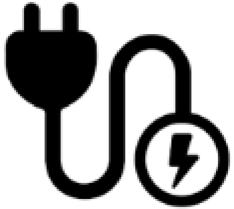
- Air/water quality
- Noise
- Radiation
- flooding

### Agriculture

- Corp yield monitoring
- Soil monitoring
- Irrigation control

# Challenge #2: Different devices, different constraints, different needs

Resource constrained

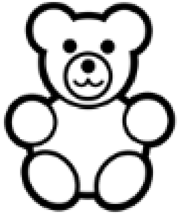


Resource rich

High volume; Low margins

Low volume; high margins

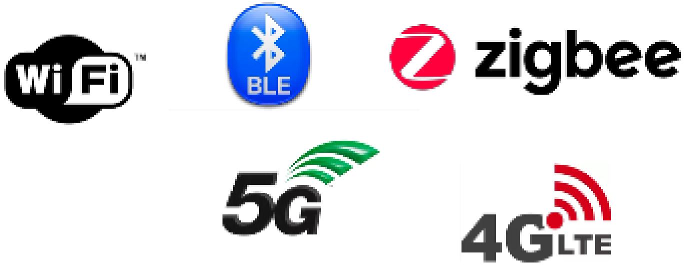
Consumer



Mission critical application

**Challenges:**

**#3: Connectivity interoperability**



**#4: Fragmented device architecture**

**#5: Fragmented cloud architecture**

**#6: Huge supplier/device manufacturer base**

**#7: lack of standardization**

# Still there are generic Security Requirements applicable for IoT, including automotive

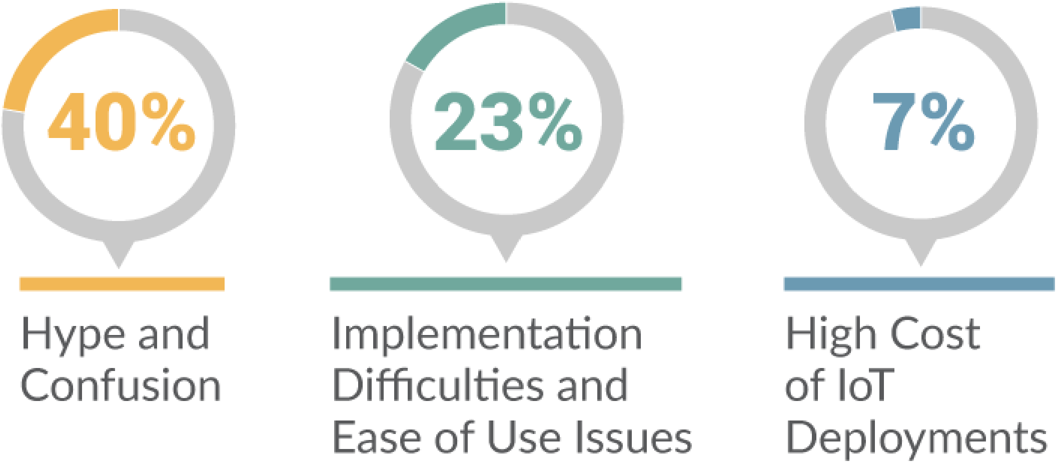
## Automotive and IoT Security Essentials

| | |
|---|---|
| ➢ Keep it Simple | ● Single step integration in the system architecture |
| ➢ Secure Boot | ● Prevent execution of unauthorized software |
| ➢ Identity protection | ● Shield the ID from external software |
| ➢ Device security | ● Protecting device assets, data and services |
| ➢ Authentication | ● Have a trusted identity to protect the service! |
| ➢ Secure connection | ● TLS support, required by cloud services |
| ➢ Data security | ● Encrypt data stored / created / accessed |
| ➢ Secure updates | ● Secure updates and recovery; incl. attestation (measured boot) |

# Why Simple

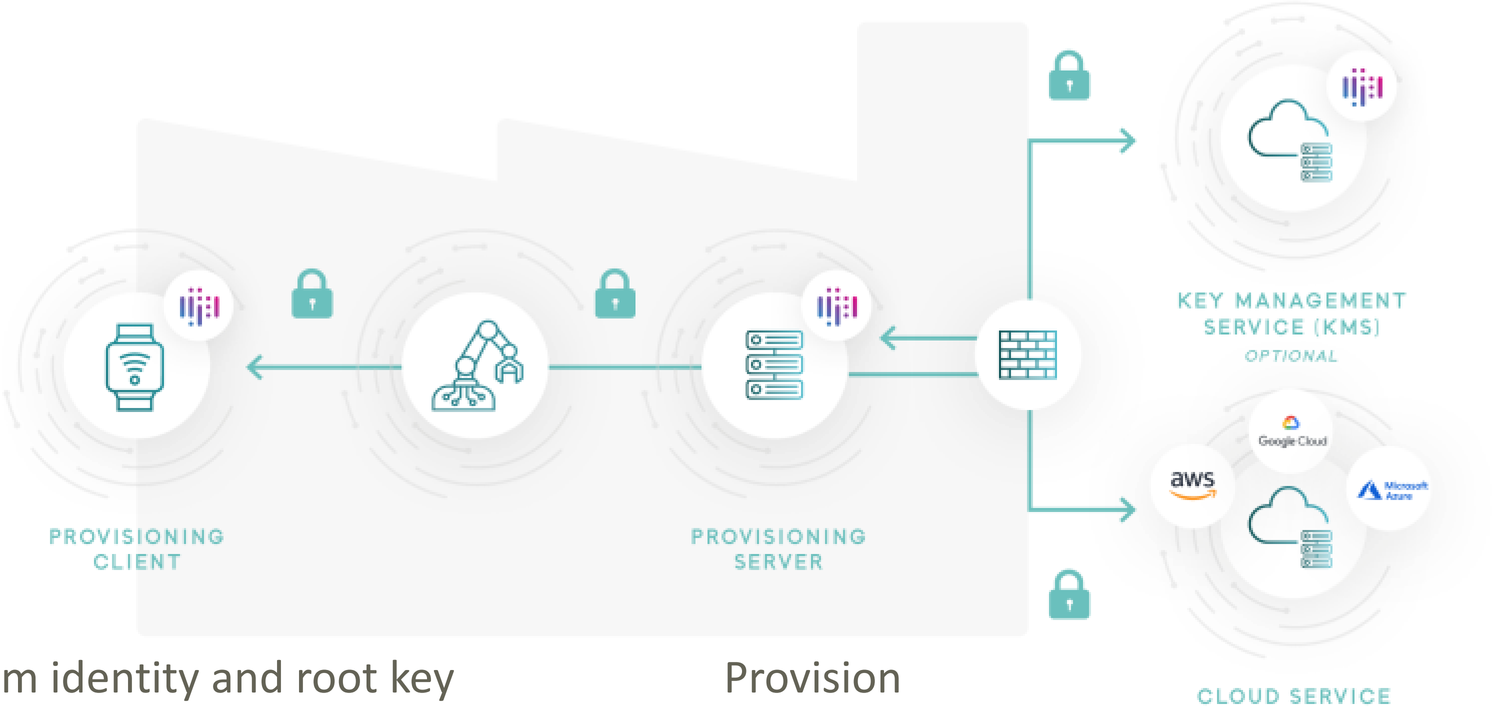
- Security knowledge is limited
  - Mistakes in deployment
  - Prevent enablement
- Implementation is difficult
  - Use complete solutions
  - Use standard integrations

What is the Biggest Frustration you have with the Internet of Things?



*IoT Frustration Survey from IoTsudit TM*

# #1: Provisioning -- create a trusted Identity



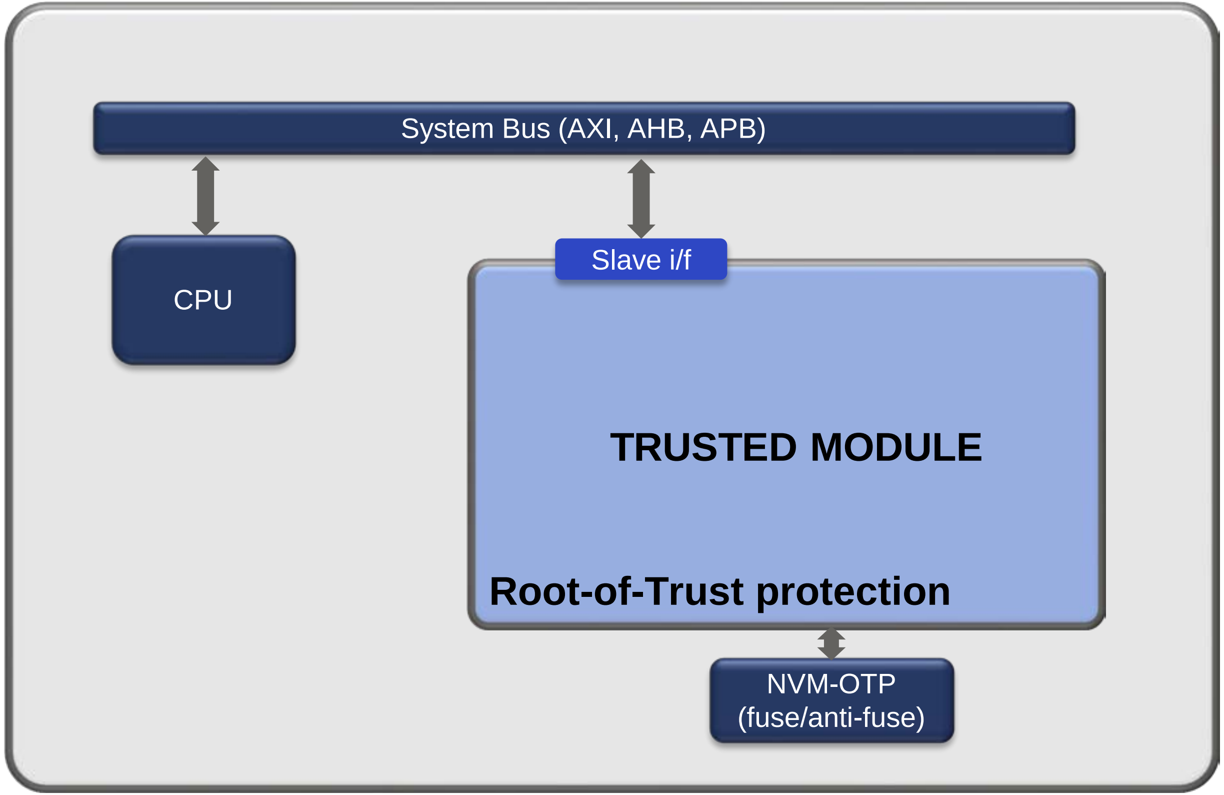
- Program identity and root key at manufacturer
- Program service/user keys during deployment

Provision

- Device identity
- Root Key

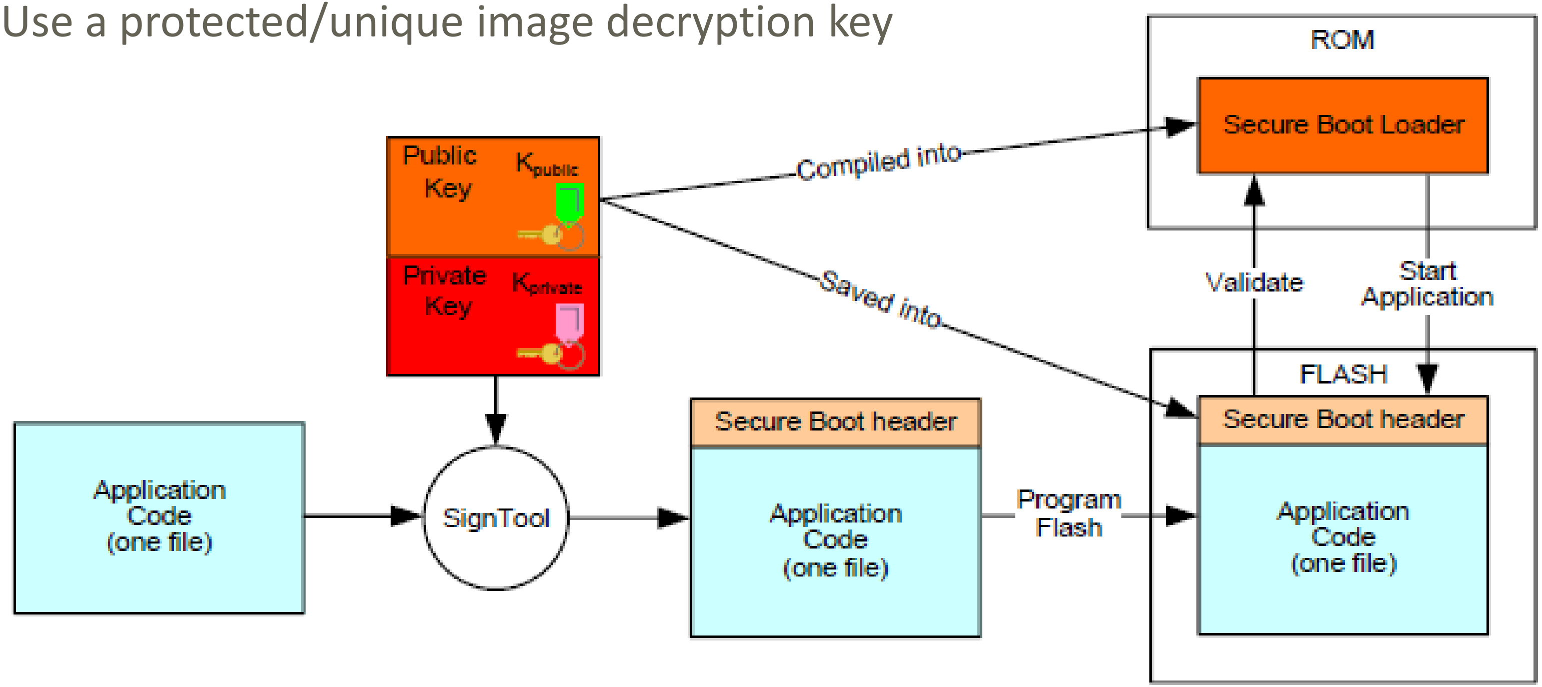
# #2: Protect the identity of devices, such as sensors

- ID cloning gives unauthorized access to:
  - Services
  - Data
- A Root-of-Trust prevents:
  - Usage of fake parts: **Liability**
  - Misuse and Disruption of the service
  - Misuse of proprietary or personal data stored in the cloud



# #3: Secure Boot

- Boot the device from an immutable source like a ROM
- Use a immutable (internally stored) public key to validate the downloaded SW image
  - Typically the hash of this key is stored in OTP or ROM
- Use a protected/unique image decryption key



# Automotive Security (cybersecurity) specs (1)

- EVITA: *Design, verify, and prototype an architecture for automotive on-board networks where security-relevant components are protected against tampering and sensitive data are protected against compromise when transferred inside a vehicle*
  - Full : Target is V2X Communications
    SW Crypto: ECDSA, ECDH, MAC/HMAC
    HW Crypto: ECC, AES, Whirlpool, TRNG
    Programmable CPU
  - Medium : Target is on-board communications
    SW Crypto: ECDSA, ECDH, MAC/HMAC
    HW Crypto: AES, TRNG
    Programmable CPU
  - Light : Target is on-board communications
    SW Crypto: AES, MAC
    HW Crypto: AES, PRNG (external seed)
    No programmable CPU

# Automotive Security (cybersecurity) specs (2)

- Secure Hardware Extension (SHE)

  *- Protect cryptographic keys from software attacks*

  *- Provide an authentic software environment*

  *- Security depend on the strength of the underlying algorithm and the confidentiality of the keys*

  *- Allow for distributed key ownerships*

  *- Keep the flexibility high and the costs low*

  - Hardware AES 128 (with CMAC)
  - AES & MAC crypto functions
  - Secure Boot (and associated OTP)
- Hardware Security Module (HSM)
- PRESERVE
  - Vehicle security architecture
  - Operates with an HSM / VaultIP model
  - Focus on typical security analysis
  - Risk assessment, Threat analysis, Policies etc, etc

# Safety vs. Security

- **Safety** is the ability to manage risk and responses on malfunction
- **Security** is degree of resistance to attacks resulting in intentional failures

Several commonly used and referenced standards

- ISO26262 is a safety standard for automotive
- ISO19790 is a security requirement standard
- FIPS 140-2 is a security standardization
- ISO IEC62443 defines industrial processes that are also related to safety; 62443-4 is fully focused on security

- Fault detection for safety is not the same as fault injection detection

# ISO26262

- Defines development process
- Defines 4 different safety levels ASIL A…D
- Defines a requirement for an FMEDA
  - Failure Modes, Effects, and Diagnostic Analysis
- Dependent on the safety level, fault detection and fault management is required
- Requires certification by a lab

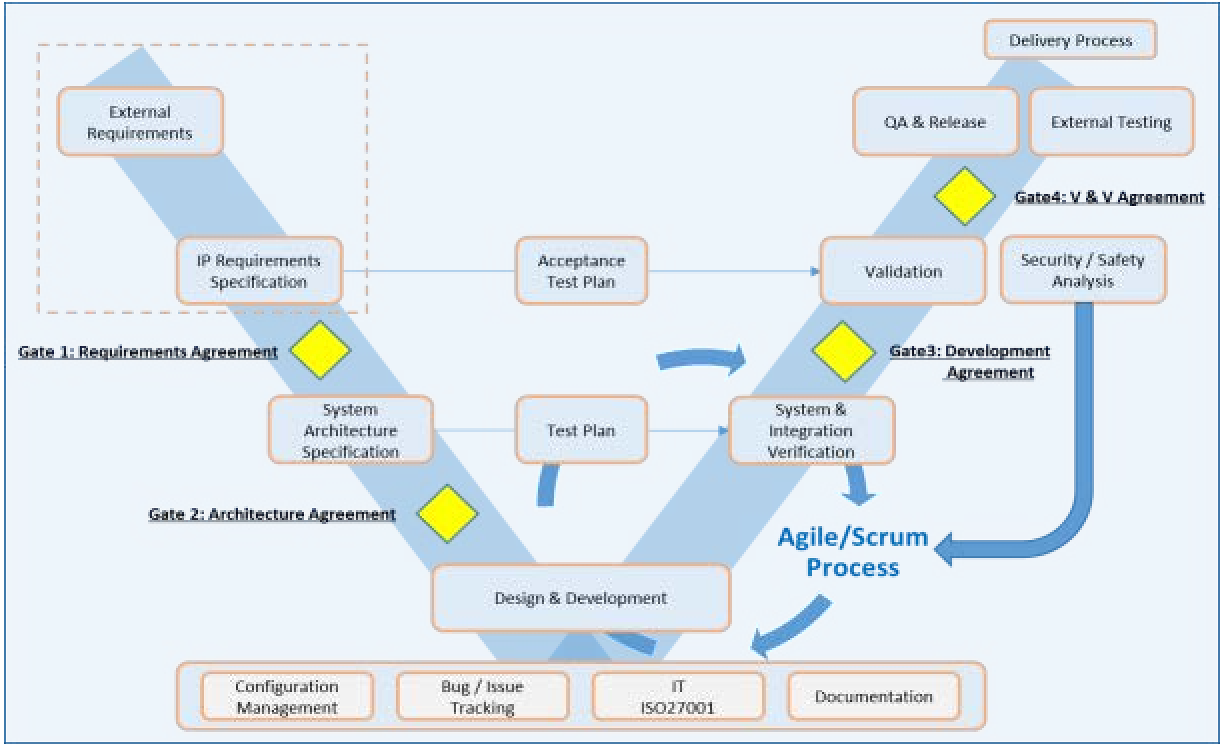
# What brings ISO26262 to Security (IPs)

Process

- Development process
- FMEDA
- Safety Manual

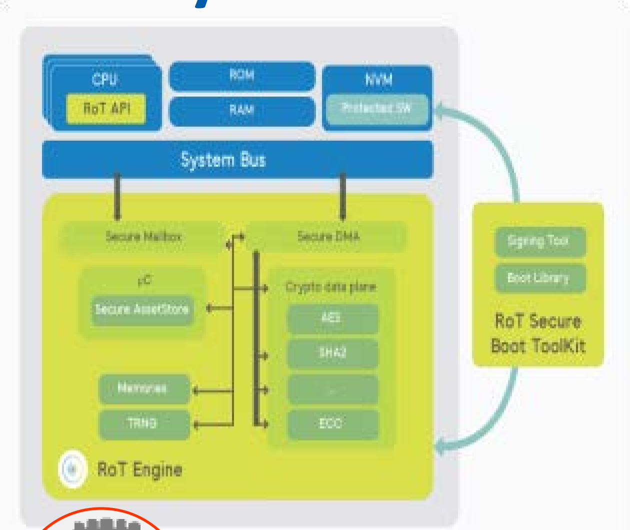
Design

- Redundancy
- Fault detection logic
- Fault management



# Solution for ECU and V2X: Flexible Security Module

- Embedded HSM
  - ➢ IP Cores for Evita Light, Medium, Full
- Secure Boot Image Encryption
  - ➢ Secure boot library
  - ➢ Software cryptography
  - ➢ Multi-stage boot support
- Secure CAN and Ethernet
  - ➢ MACsec IEEE Std 802.1AE™ Standard support



- ➢ V2V Public Key Engine
- ➢ IPsec, TLS/DTLS SW Toolkit
- ➢ IPsec, TLS/DTLS, 3GPP IP

# #4: Chose a flexible hardware based security solution

Device:

- Supporting all cryptographic primitives!
- Protects the keys/assets

Device access:

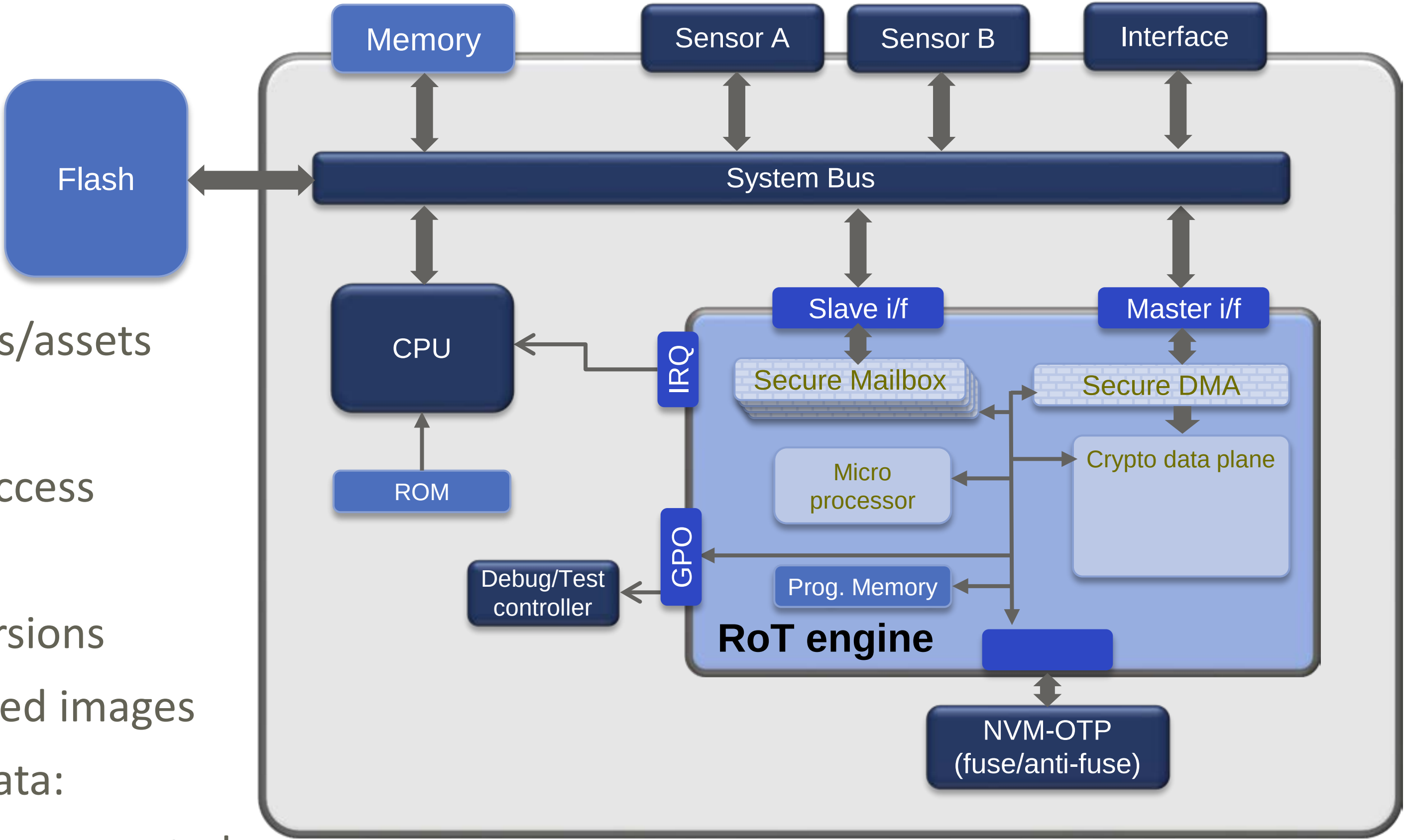
- Protect debug access

Device updates:

- Maintain FW versions
- Only allow verified images

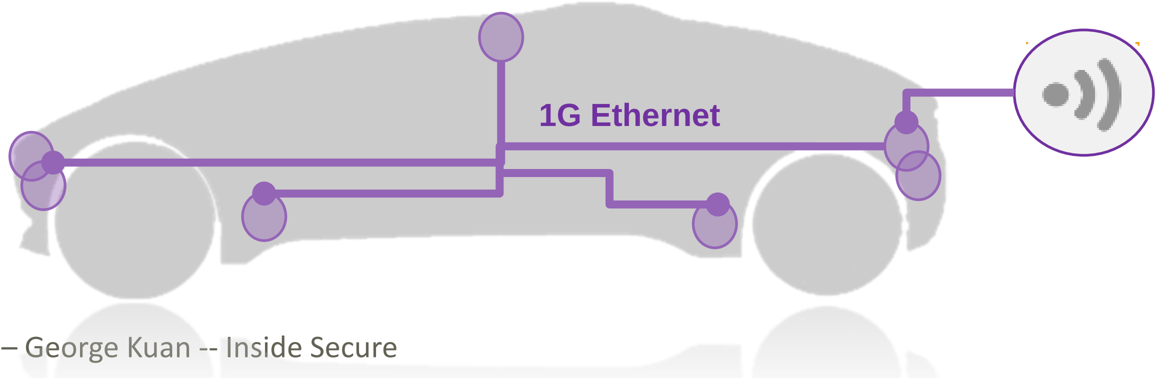
Externally stored data:

- Store critical data encrypted



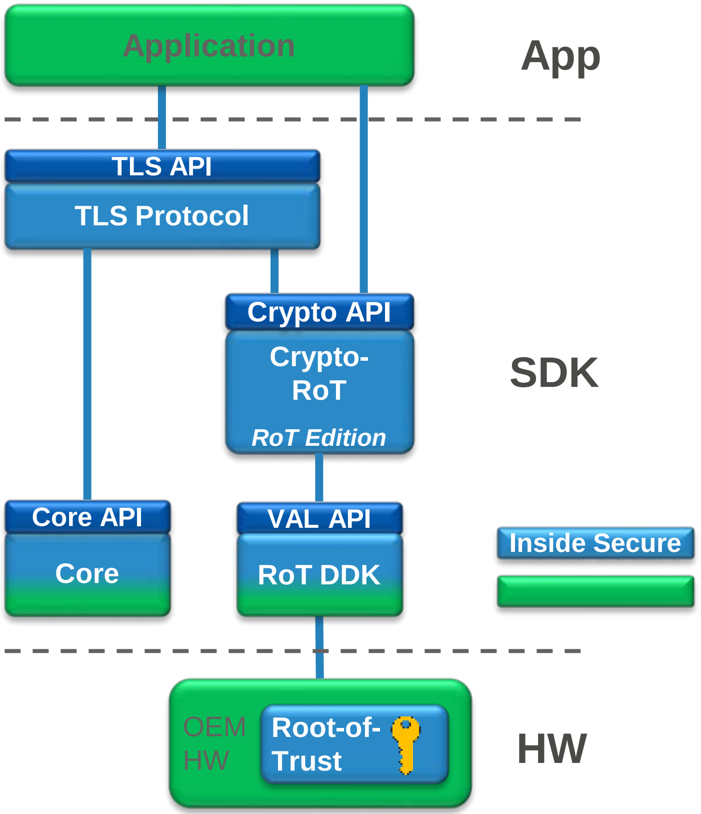
# Don’t forget to protect the network

- Data is generated, and must be available instantaneously
- Ethernet Infrastructure, but also LIDAR-sensor networks in a car require high-speed low latency links
- MACsec is very scalable and matches these requirements
- Inside Secure offers:
  - High-speed TLS / IPsec / MACsec engines ranging from 1Gbps for industrial and automotive networks to 50Gbps for gateways supporting full range of algorithms
  - MACsec / IPsec engines up to 400Gbps/800Gbps engines for data center security



# #5 Secure Connection and Data transfer

- Establish a secure connection with the infrastructure
  - Require a provisioned device.
  - (Almost) All cloud services require TLS
- Root-of-Trust provides **HW protection for the TLS Client/Server private key**
- Root-of-Trust Edition offloads cryptographic operations to Root-of-Trust HW
- Client/server authentication
- Shared secret generation
- Pseudo-random number generation for client_random and server_random

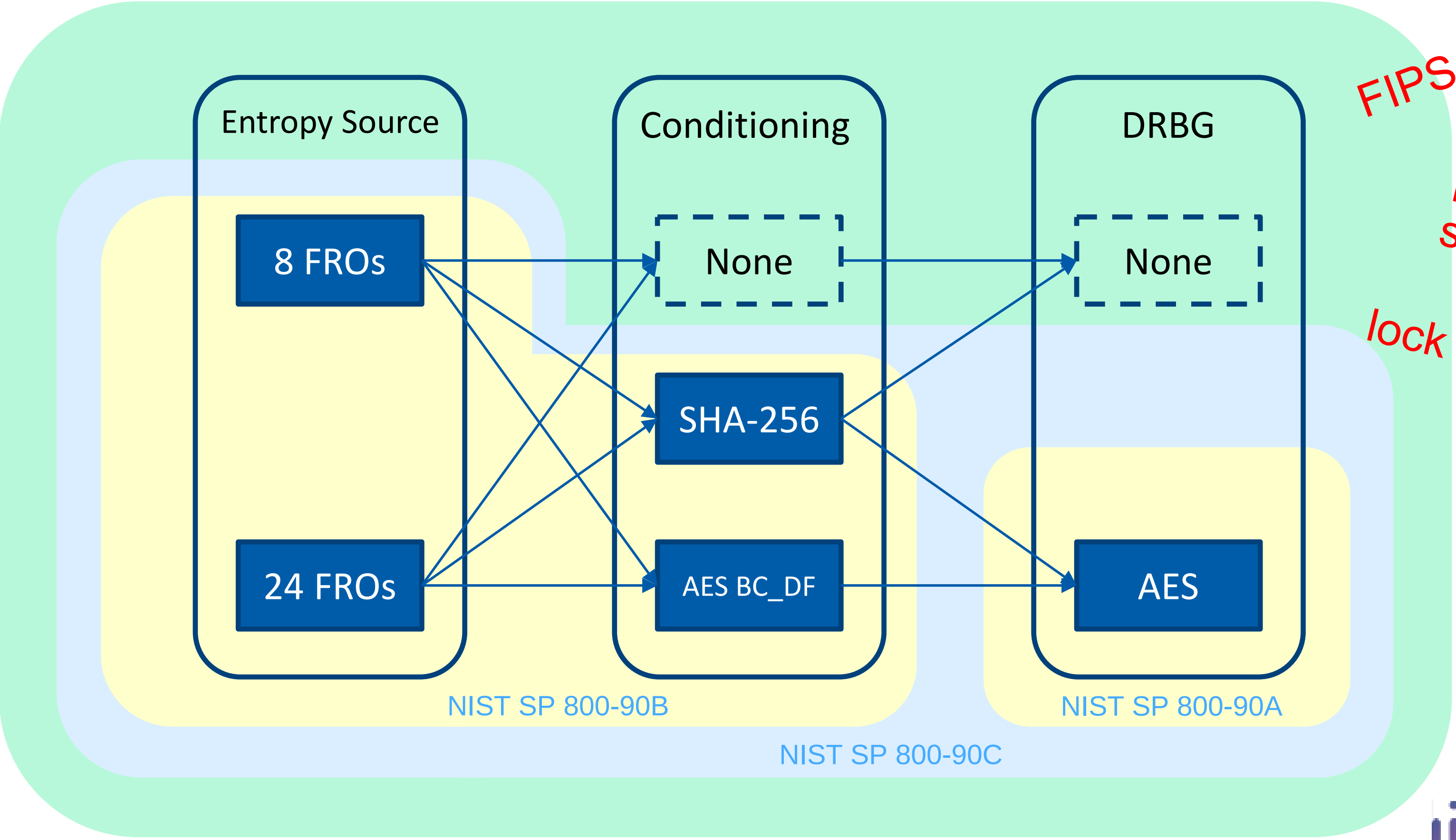


# #6 V2X communication - Public Key Acceleration IP

- ECC on all memories
- FIPS-140-2 compliant operations
  - Hardware zeroization logic for all memories containing sensitive data
  - Optional TRNG with SP800-90A (FIPS-140-2) compliant post processing  using a separate AES-256 core and TRNG buffer RAM wiping
  - Capability to execute run-time the known-answer tests on local AES (if present), through firmware (high-level commands).
  - Capability to execute run-time the known-answer tests on the TRNG post-processor through direct access to the module registers.
- Optionally side channel attack counter measures available
- High Speed PKA engine with High Assurance Mode:
  - An external input can control or block access to the master controller
- High Speed PKA engine with Debug Mode

# #7: Random Source: True Random Number Generator (TRNG)

## Without random data no secure communication!



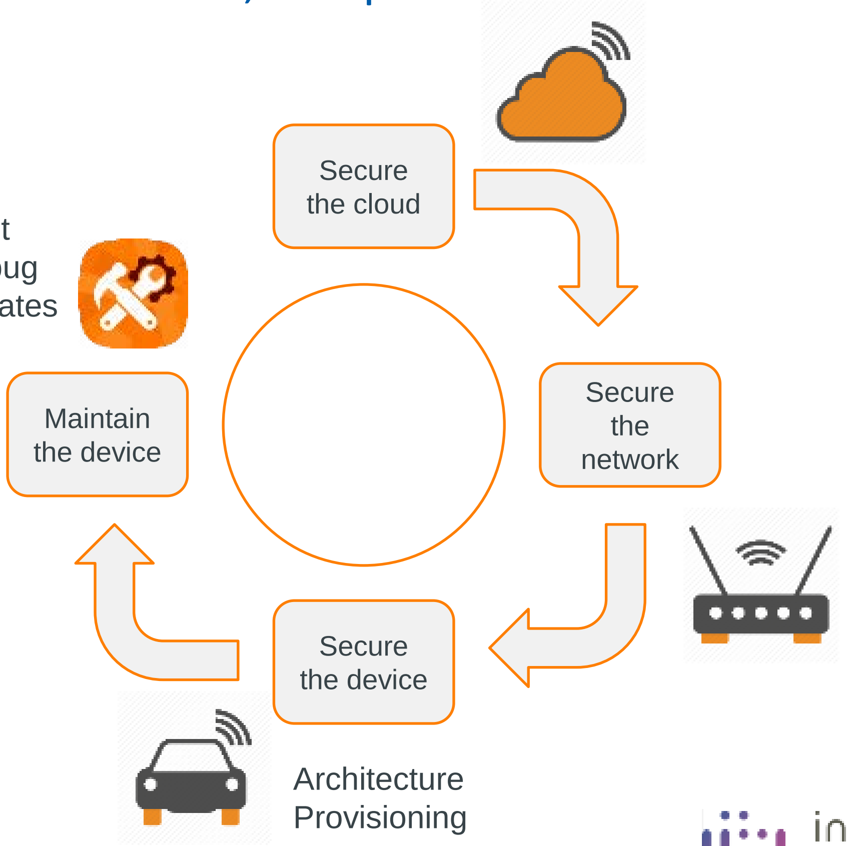
FIPS compliant

patented sampling and lock detection

# Was it simple?

Let us offload the complexity with mature solutions, comprehensive documentations, tests and support

You are protected!


Secure Boot
Secure Debug
Secure updates
Attestation

Secure the cloud

Secure the network

Secure the device

Maintain the device

Architecture
Provisioning

# Inside Secure’s Solutions for Automotive Market

## ECU solutions

- Programmable RoT Embedded HSM
- Secure Boot Image encryption
- MACsec IP Core

## Telematic Solutions

- E-Wallet & Payment
- FIPS 140-2 Crypto Lib
- Programmable RoT Secure Boot
- IPsec, TLS, DTLS, 3GPP VPNs

## Infotainment Solutions

- Programmable RoT Secure Boot
- HDCP SW and HW
- Embedded DRM

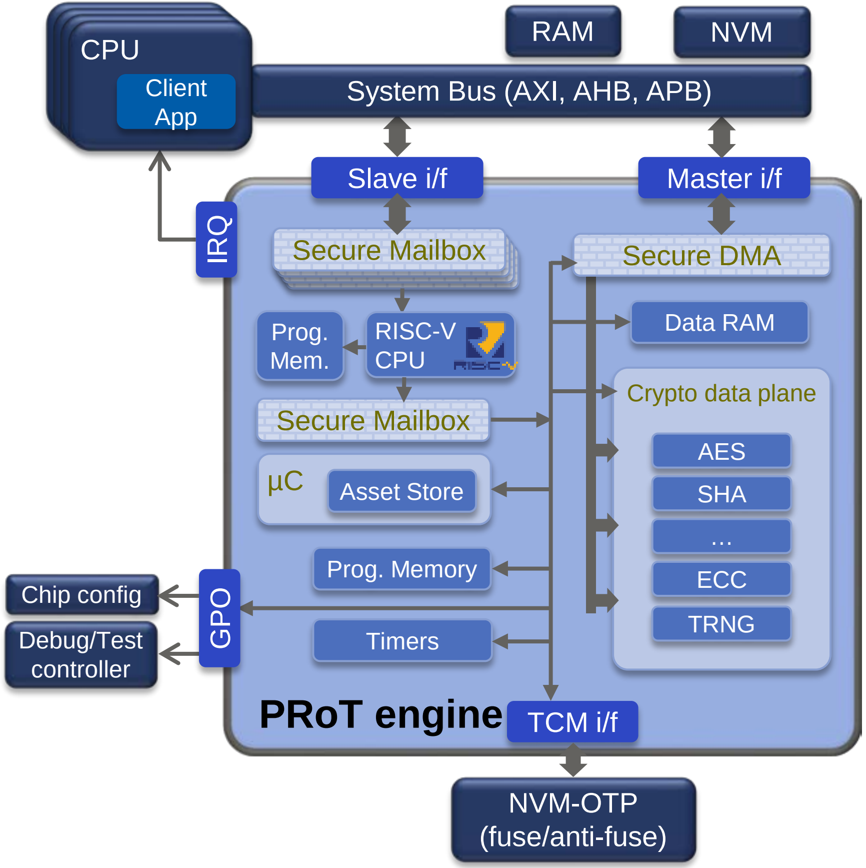
## V2X Solutions

- V2X Public Key Engine
- IPsec, TLS/DTLS SW Toolkit
- Programmable RoT Embedded HSM

Check it out on https://www.insidesecure.com/Markets/Automotive

# HSM: C-Programmable Root-of-Trust

## A Programmable Vault in the SoC



- Embeds Root-of-Trust engine protecting the assets
- Can run high-level applications in secure environment
  - ➢ Includes Customer developed applications
- Provides user-authentication
- Inside Secure has a complete development platform with PRoT
- RISC-V external debug support (currently uses OpenOCD framework)