Introduction to Intelligent Vehicles
[13. Certification]

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Certification

Certification

- "The procedure by which an authorized person or agency assesses and verifies characteristics of a system or product in accordance with established requirements, standards, or regulations." [Cofer '13]

Motivations

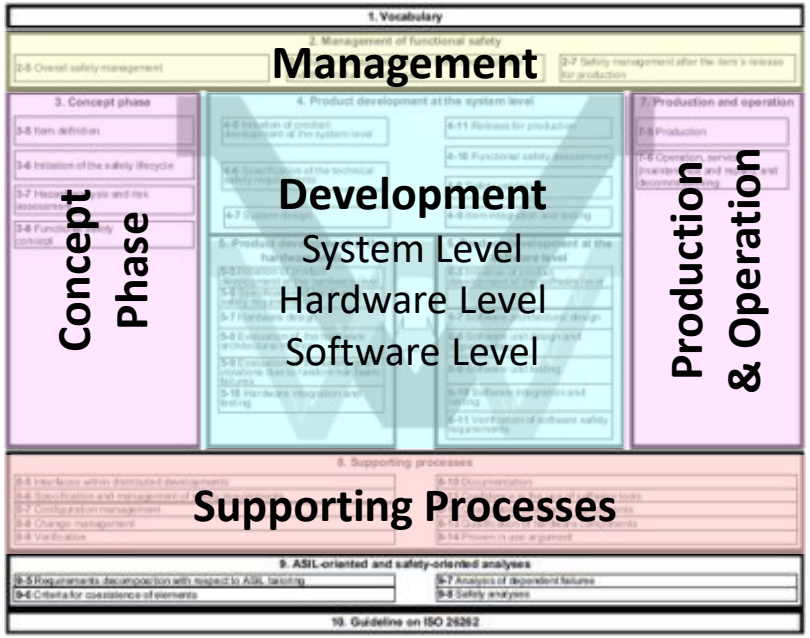
- Provide a proof of quality
- Enhance customers' confidence
- Reduce companies' liability (?)
- Prove the fulfillment of governments' regulations

Current status of automotive certification

- It has been well practiced in the domains of aviation and medical devices, but not so much for automotive systems

ISO 26262

- ISO 26262 is recognized as the state-of-the-art standard for **functional safety** of automotive systems



Automotive Safety Integrity Level (1/2)

- Severity Classifications (S)
  - S0: no injuries
  - S1: light to moderate injuries
  - S2: severe to life-threatening (survival probable) injuries
  - S3: life-threatening (survival uncertain) to fatal injuries
- Exposure Classifications (E)
  - E0: incredibly unlikely
  - E1: very low probability
    - Injury could happen only in rare operating conditions
  - E2: low probability
  - E3: medium probability
  - E4: high probability
    - Injury could happen under most operating conditions

Automotive Safety Integrity Level (2/2)

- Controllability Classifications (C)
  - C0: Controllable in general
  - C1: Simply controllable
  - C2: Normally controllable (most drivers could act to prevent injury)
  - C3: Difficult to control or uncontrollable
- ASIL Level D
  - S3 + E4 + C3
- ASIL Level D → ASIL Level C → ASIL Level B → ASIL Level A
  - In general, for each single reduction in any one classification, there is a single level reduction in the ASIL
- ASIL Level A → QM
  - No safety relevance
  - Only standard Quality Management processes required

Examples

- Hardware level
  - During hardware design, "simulation" is recommended for ASILs C and D
  - Work products: verification plan, specification, and report
- Software level
  - During software unit design and implementation, some software structures are NOT recommended for ASIL D
    - Dynamic objects and variables
    - Multiple uses of variable names
    - Implicit type conversions
    - Unconditional jumps
    - Recursions
  - Work products: software unit design specification, software unit implementation, and software verification report

Limitations and Short Summary

❑ Limitations

- ➢ The standard plans to but not yet consider connectivity and autonomy
- ➢ There is no enforcement from governments or strong push from customers
- ➢ Original Equipment Manufacturers (OEMs) do not have access to suppliers' confidential information
  - Any certification protocol?
- ➢ Process-based certification vs. product-based certification

❑ Summary

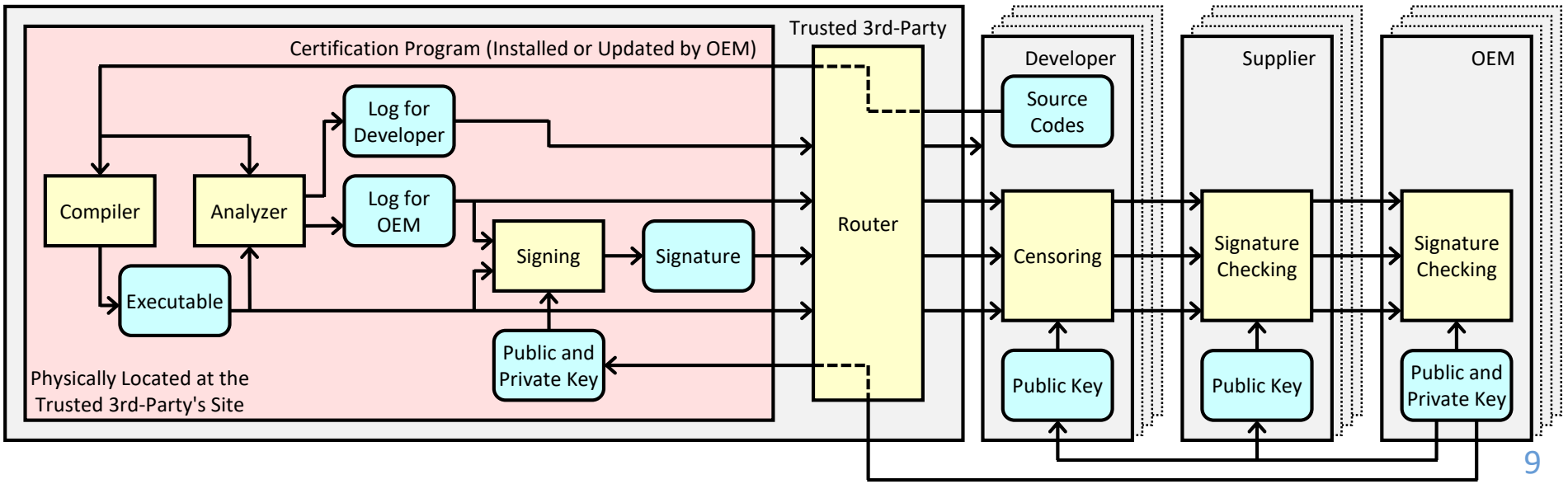
- ➢ ISO 26262 is recognized as the state-of-the-art standard for **functional safety** of automotive systems
- ➢ It can provide some guidelines for the legislation of law and regulation

Certification Protocol: Motivation

- A potential conflict between certification issuers (e.g., OEM) and software suppliers (developers)
  - A certification process represents a systematic way to inspect the source codes
  - Some source codes of software suppliers (developers) are confidential
- Desired properties
  - Authenticity
    - Only authenticated results from compilers and analysis tools (verification, simulation, and/or testing) are considered by the certification issuers
  - Confidentiality
    - Sensitive source codes of the software suppliers and developers are not released to certification issuers

Certification Protocol: Example

- Trusted third-party
  - Run a certification program which consists of a compiler and an analyzer
  - Maintain a router which controls the input and the output
- Certification program
  - All of the compiler, the analyzer, and the private key are updated by the OEM
  - The updating process must be unidirectional to guarantee confidentiality
- Router
  - Only the corresponding developer can be the receiver



Q&A