Automotive Cybersecurity Validation Strategy

2020-12-10 | Nico Vinzenz | ZF Friedrichshafen AG

Why do we need an Automotive Validation Strategy?

Obligatory “Jeep in the ditch”-Picture

- **Jeep Cherokee Hack**
  - 2015 by Miller and Valasek

But the List goes on..

Tesla (2015): Remote vehicle unlock and start

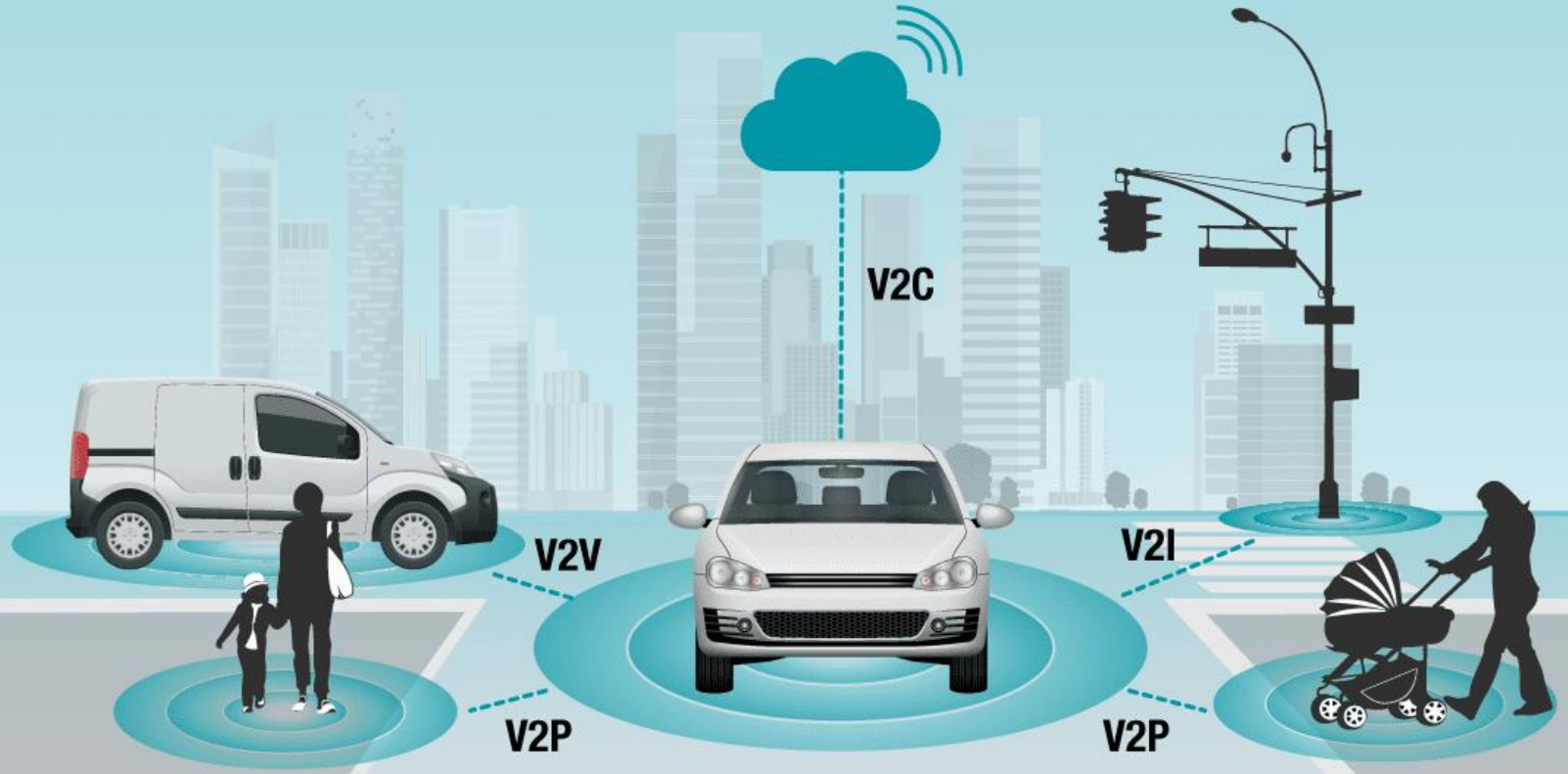
Nissan (2016): Remote instrument panel control

Hyundai (2017): Remote vehicle unlock and start

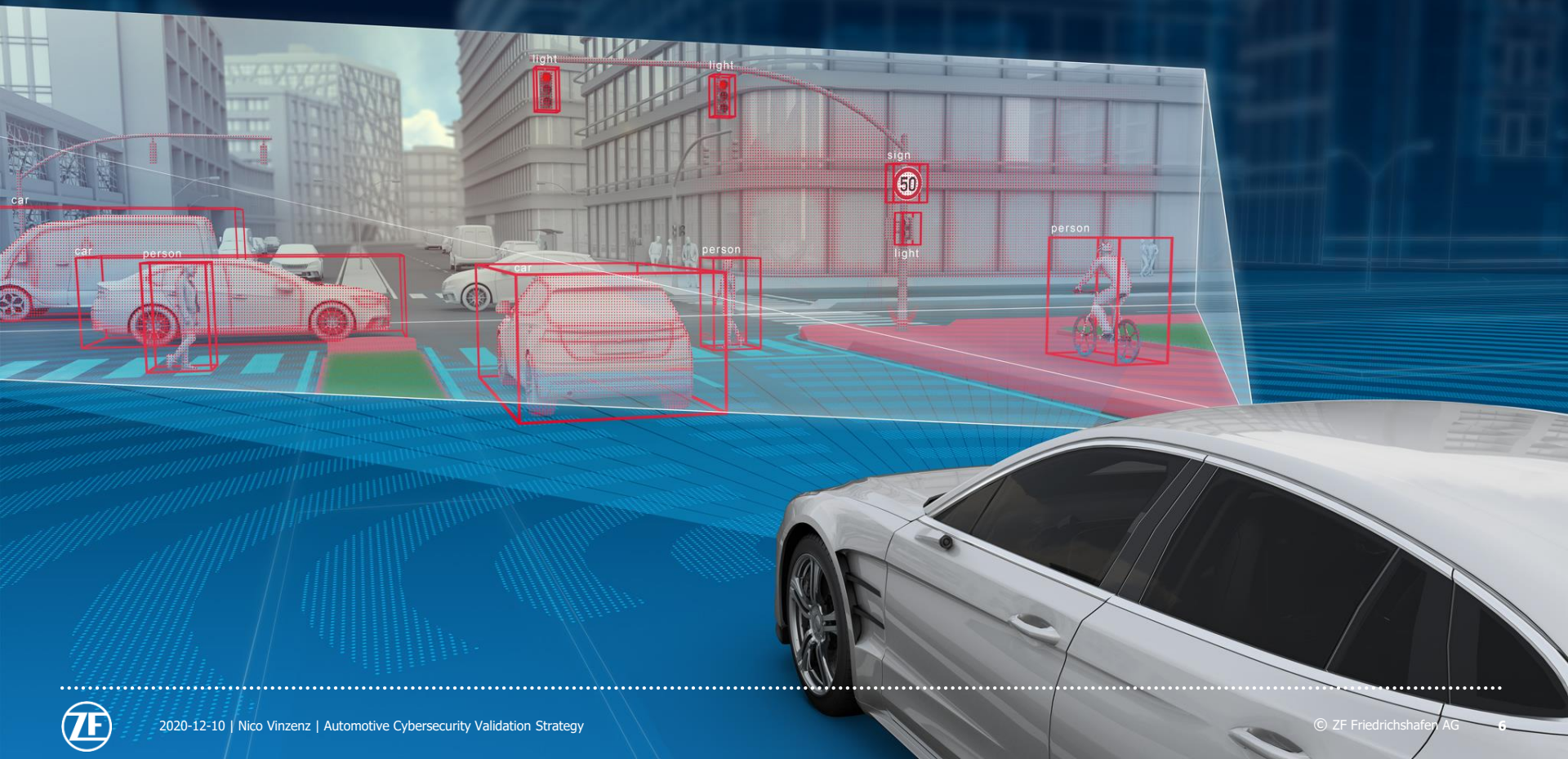
Mercedes-Benz (2019): Remote vehicle unlock and start

Mercedes-Benz

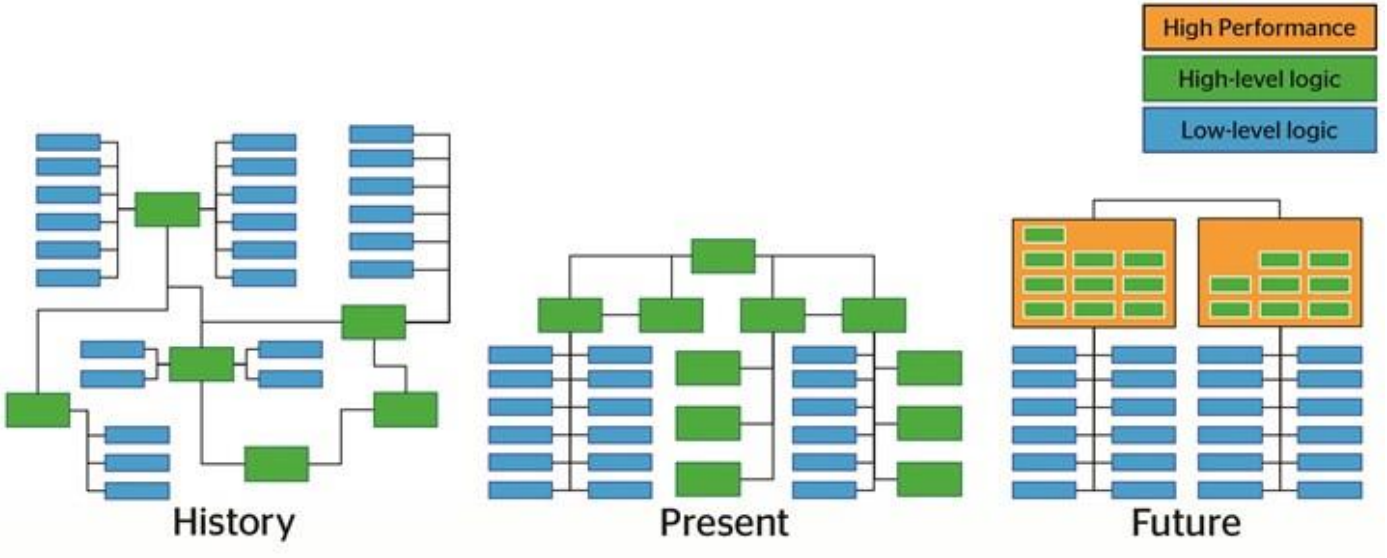
Emerging Challenge – V2X Connectivity



Emerging Challenge – AD Functionality



Emerging Challenge – E/E Architecture

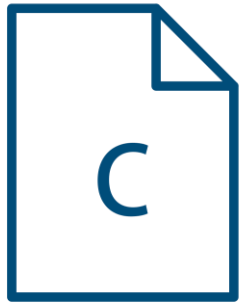


Further Cybersecurity Challenges

Competitive Profit Margins

Hardware Restrictions

Lifetime of 15+ Years



Insecure Programming Languages

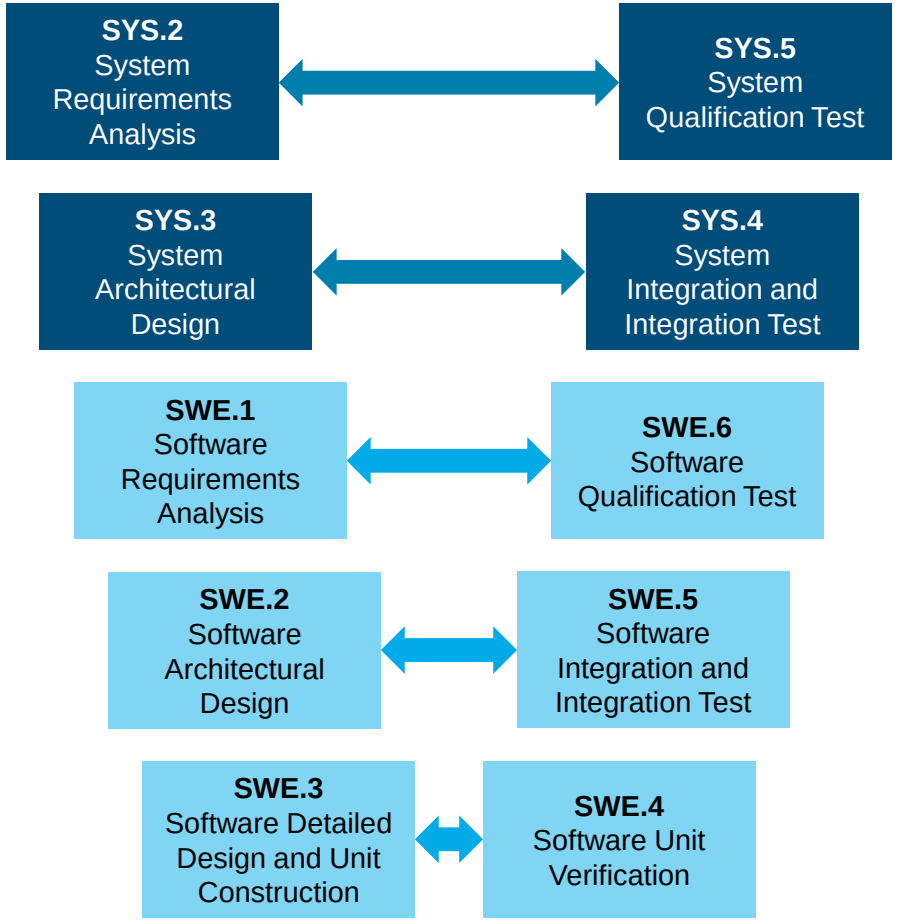
Agenda

01 Automotive Development Process
02 Security Validation Strategies
03 Practical Application
04 Reducing Risks in the Future

01

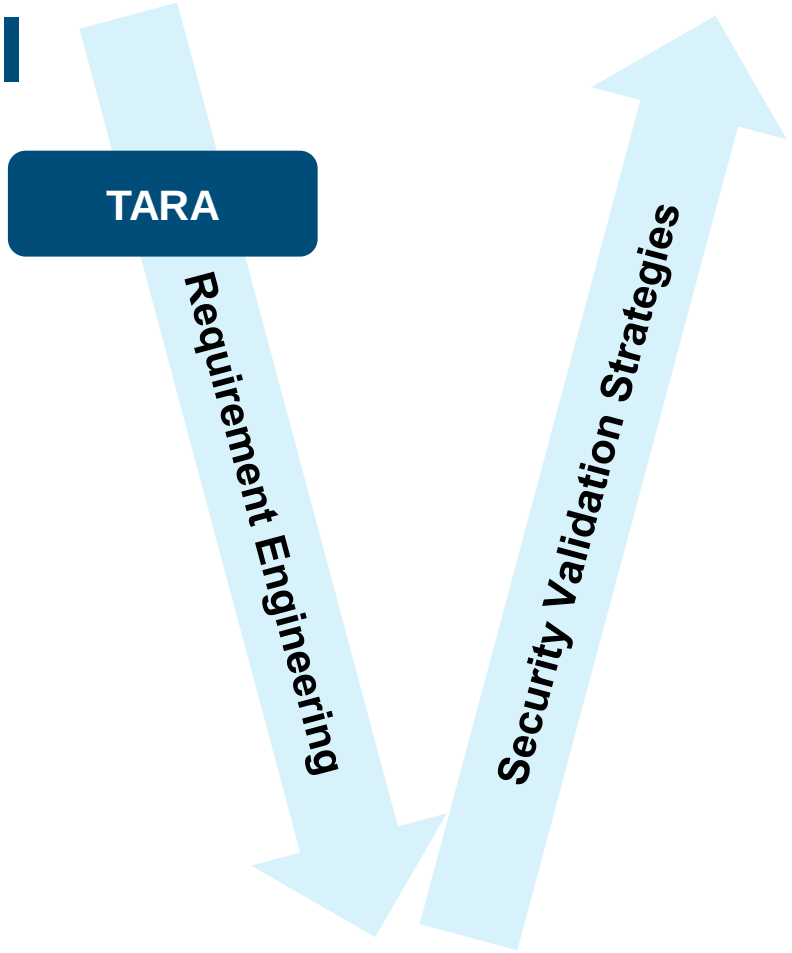
Automotive Development Process

Standard V-Model



Cybersecurity V-Model

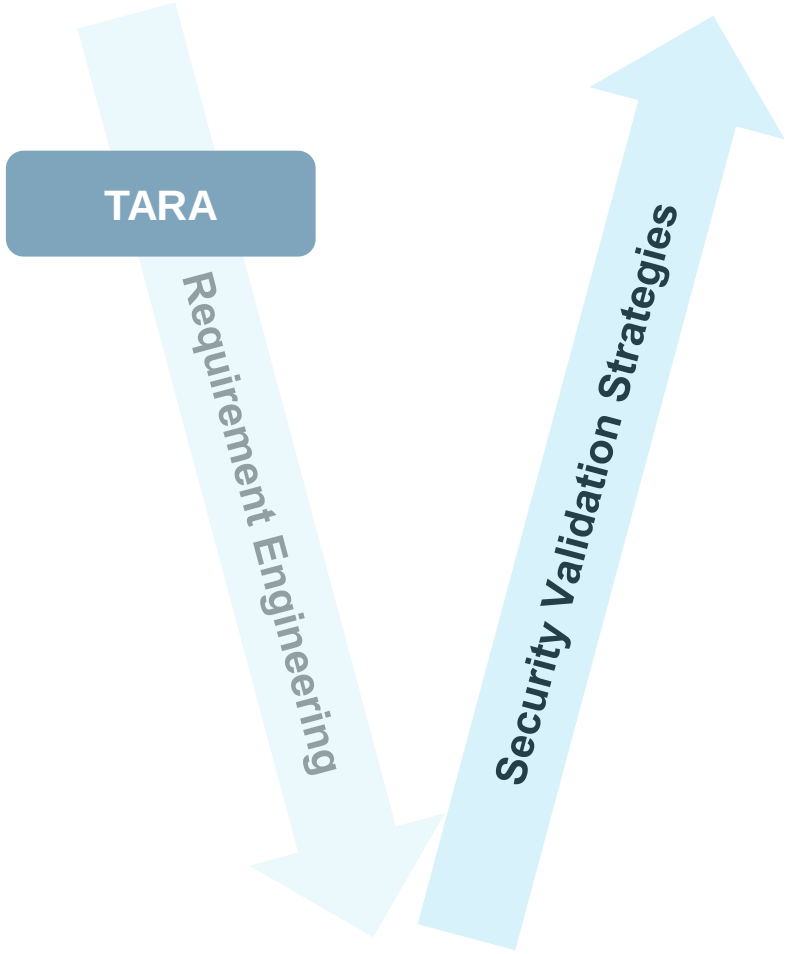
- **Threat Analysis and Risk Assessment (TARA)**
  - Input: System Assets
  - Output: Security Goals
- **Security Validation Strategies**
  - Validate Security Goals



02

Security Validation Strategies

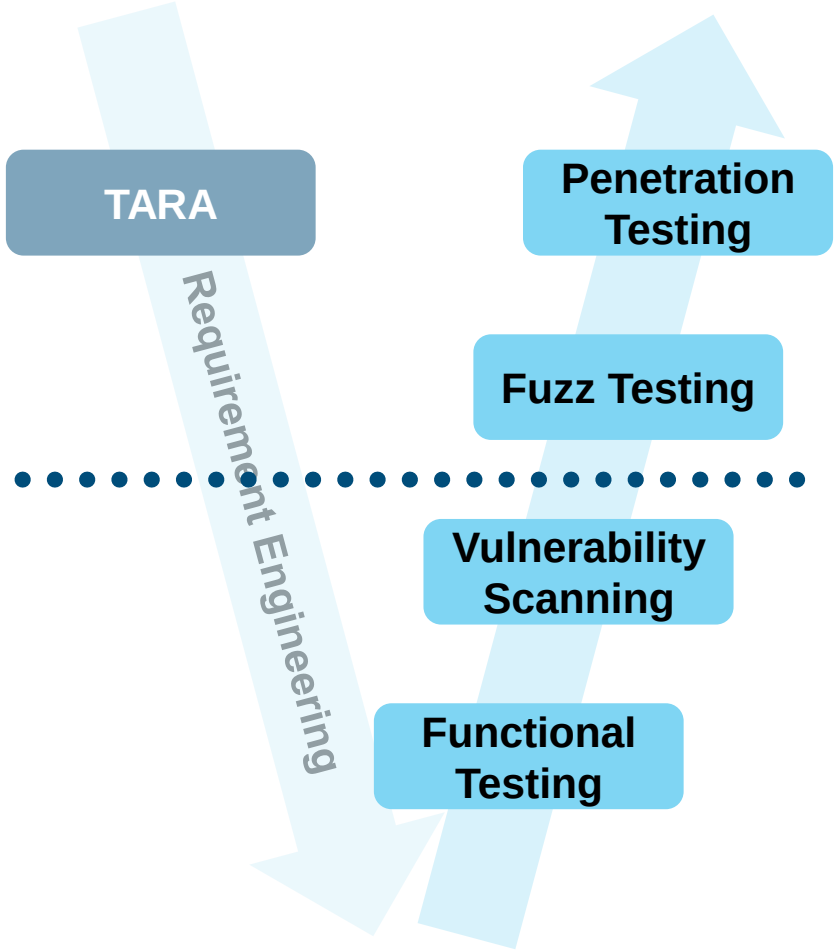
Overview



Overview

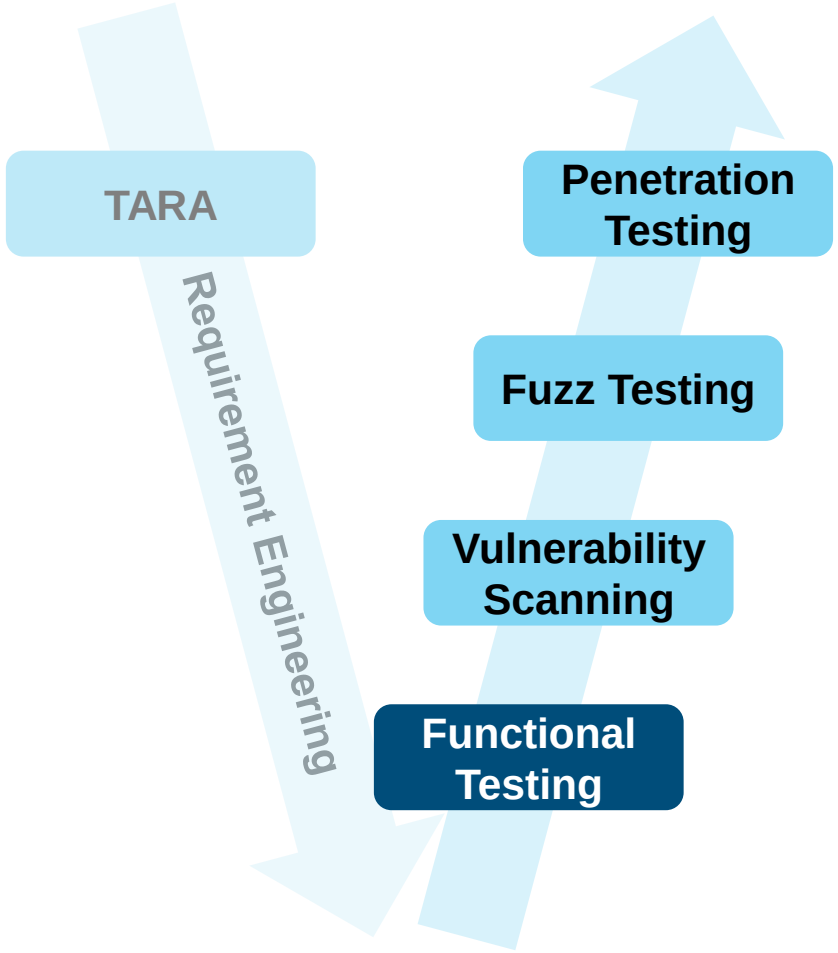
Testing against the “unknown”

Testing against the “known”

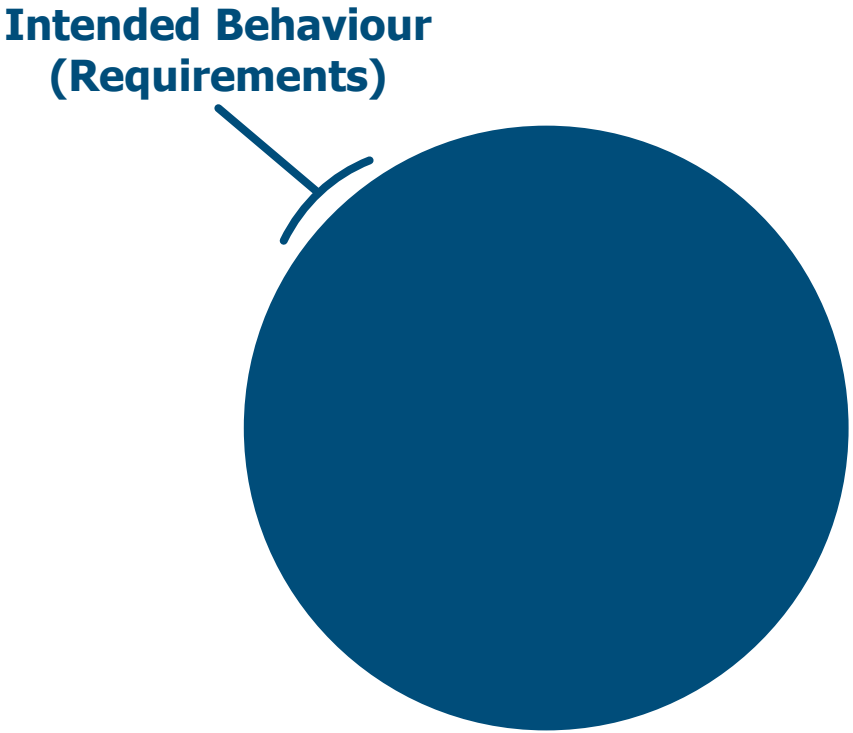


Functional Testing

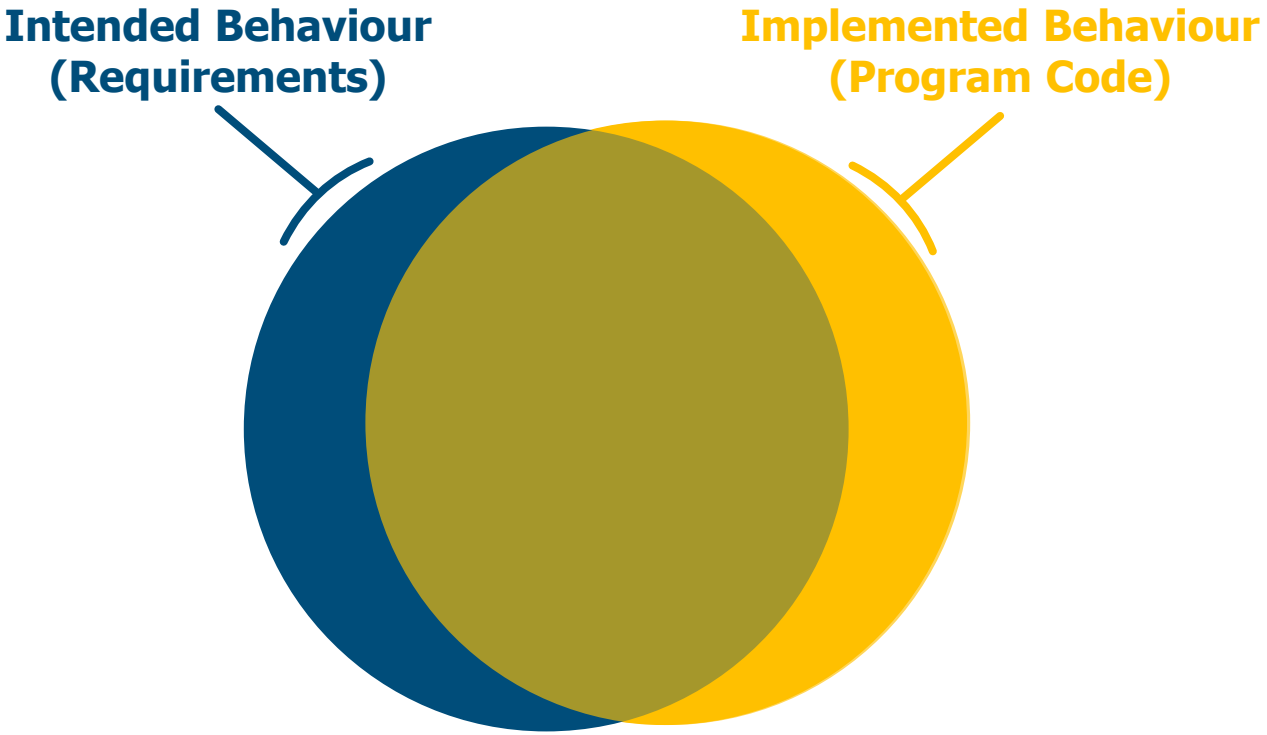
- **Requirement-based Approach**
  - Translate functional requirements into test cases
  - Easy to find intended but not implemented behavior
  - Hard to find implemented but not intended behavior



Functional Testing



Functional Testing



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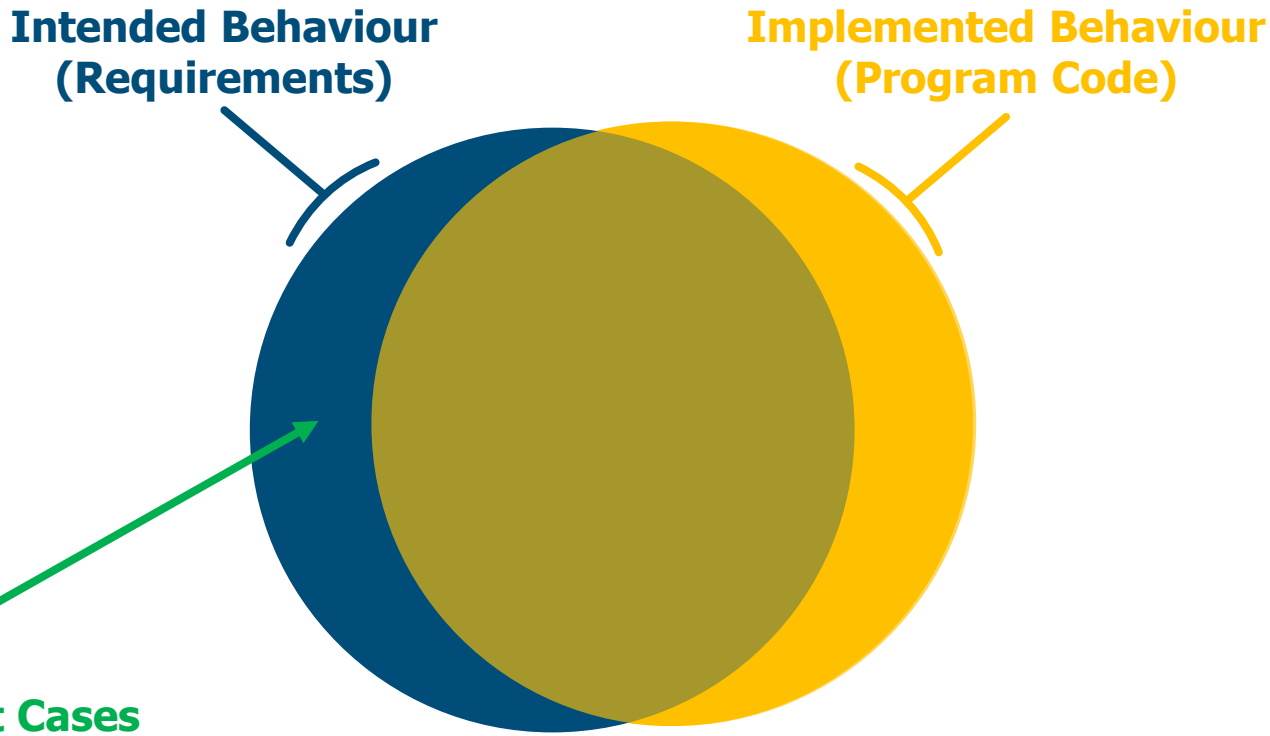
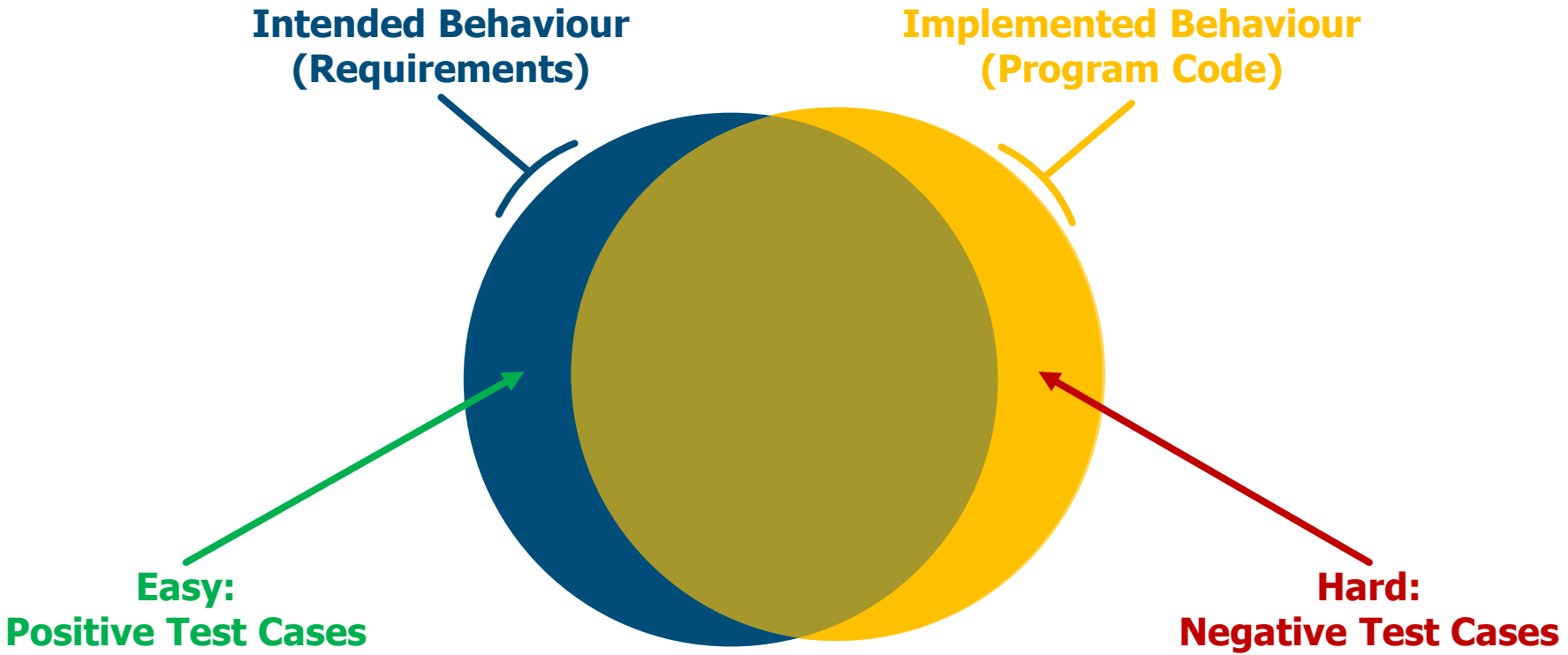
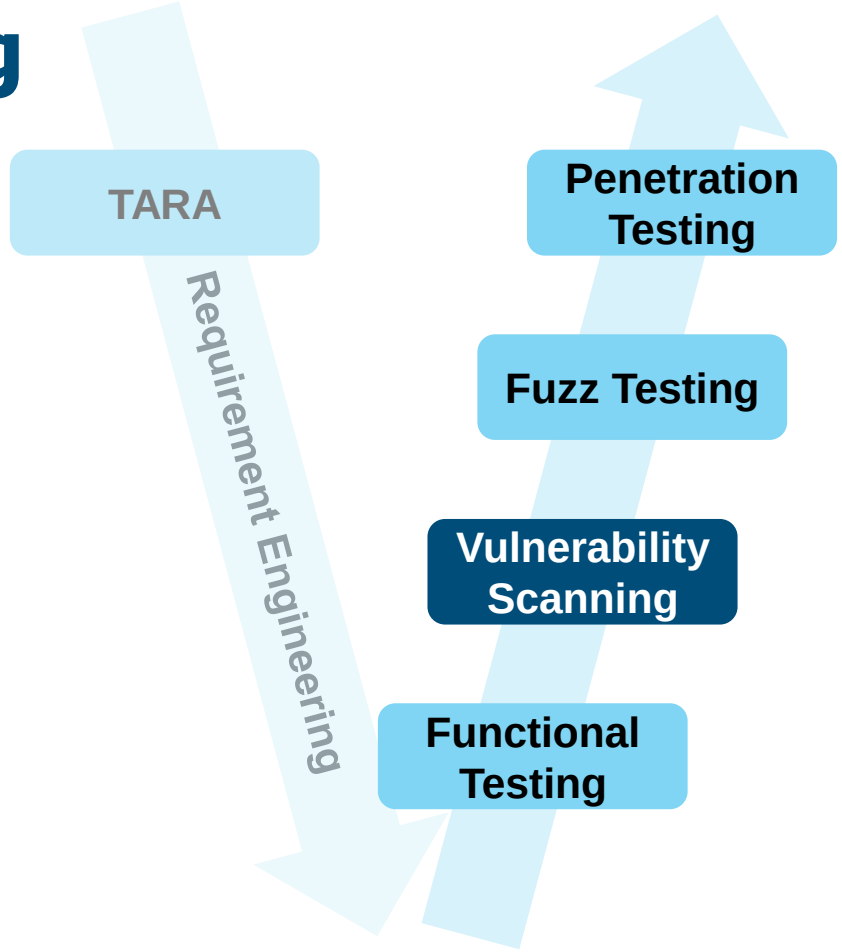


Functional Testing



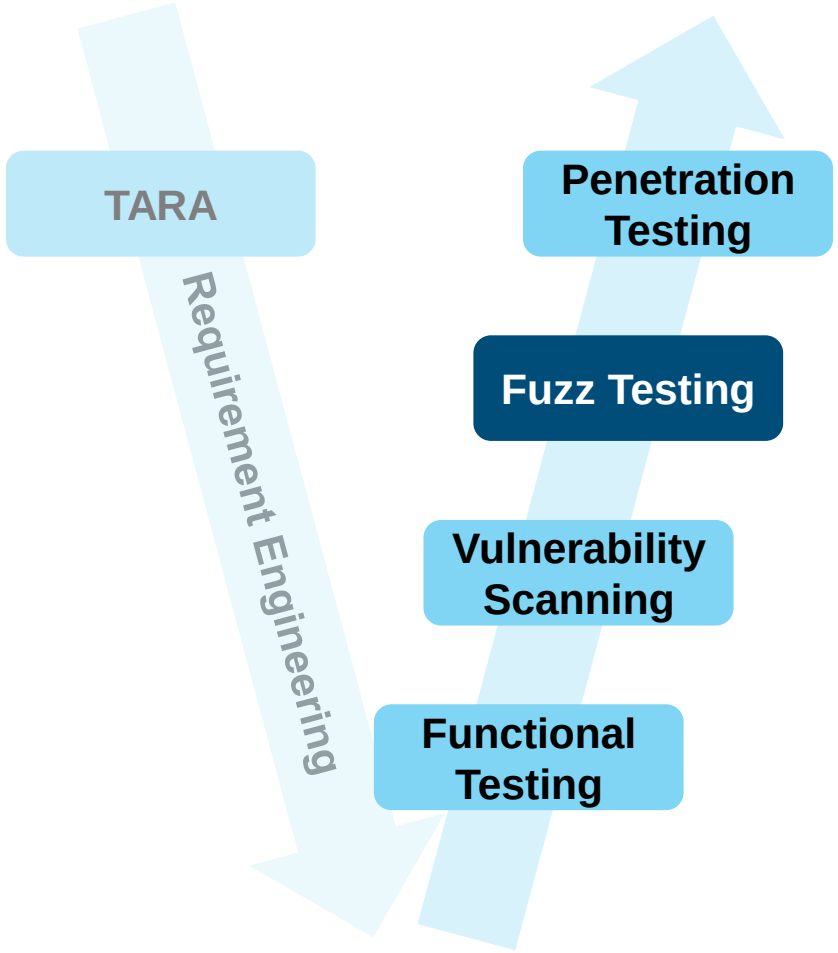
Vulnerability Scanning

- **Knowledge-DB Approach**
  - Static/dynamic code analysis finds weaknesses
  - CVE-matching on Bill of Materials (BoM) finds vulnerabilities
  - Port scanner finds configuration mistakes
  - Oblivious to zero-day and product-unique exploits

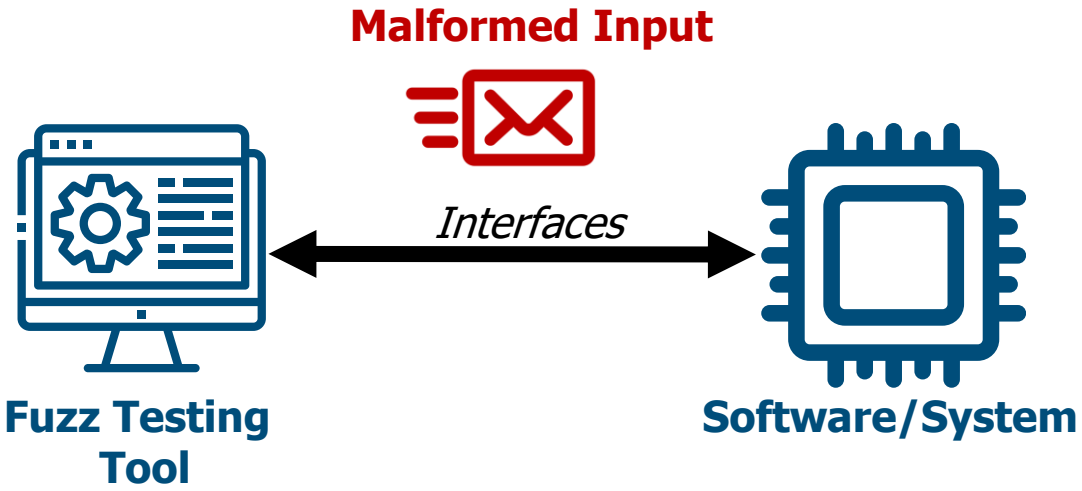


Fuzz Testing

- **Testing into the Void**
  - Interface supplied with semi-valid data
  - System monitored for suspicious behavior
  - Can find unknown vulnerabilities
  - Challenging to configure correctly and generate "evidence"



Fuzz Testing



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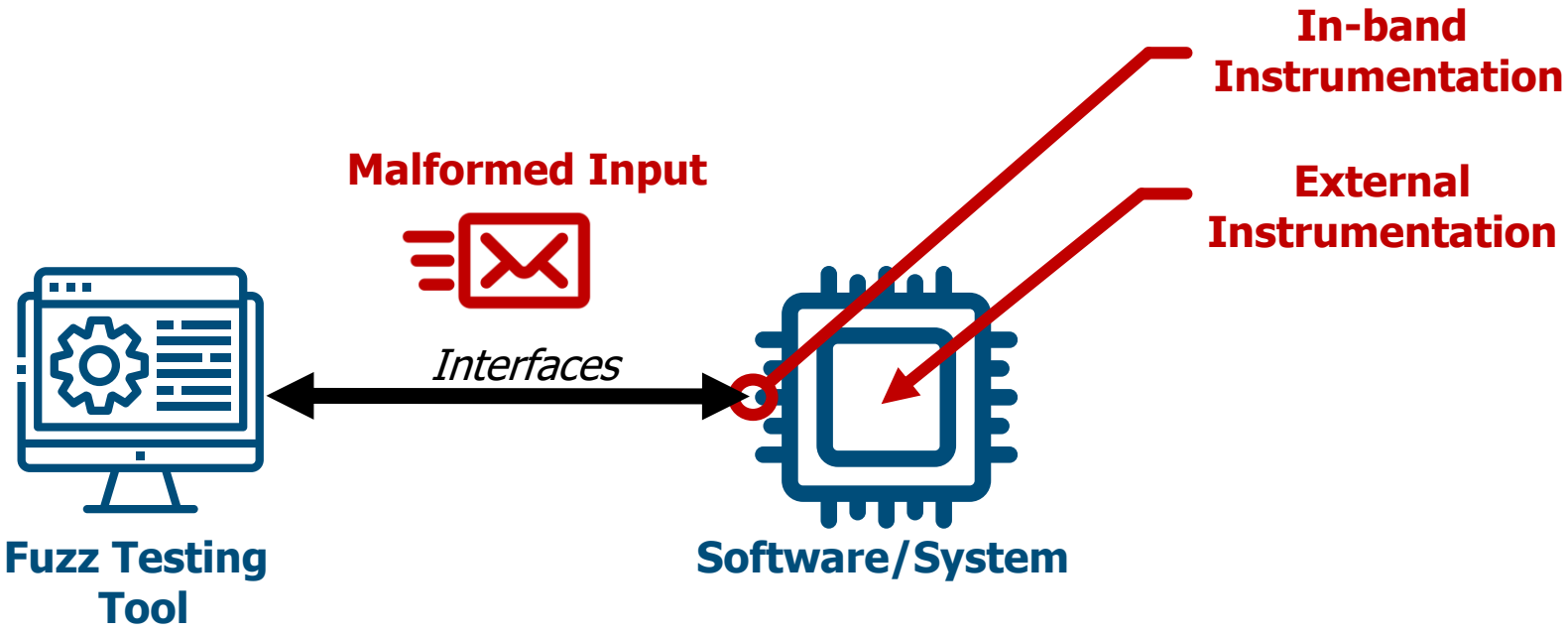
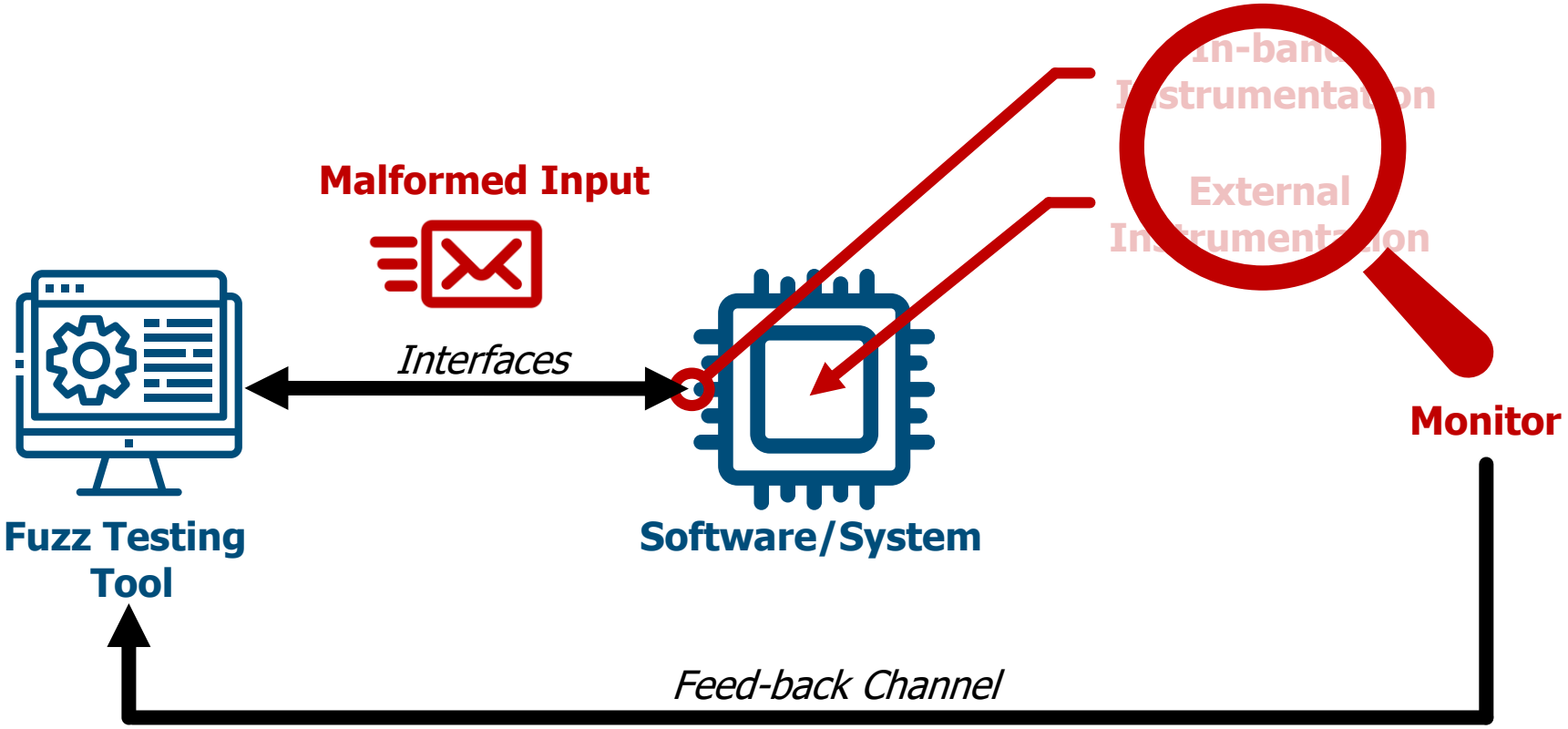
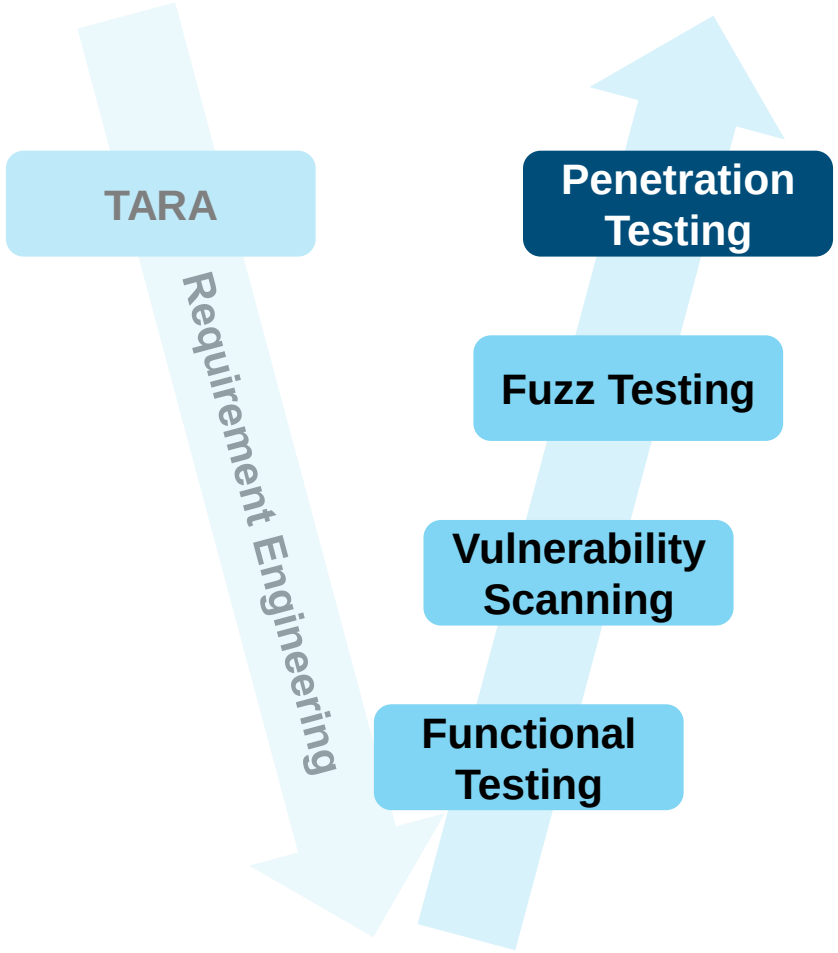


Fuzz Testing



Penetration Testing

- **Authorized Cyberattack**
  - Security expert tries all available techniques within scope
  - Can find unknown vulnerabilities
  - High demand on effort and expertise makes it expensive



Penetration Testing

Large Budget

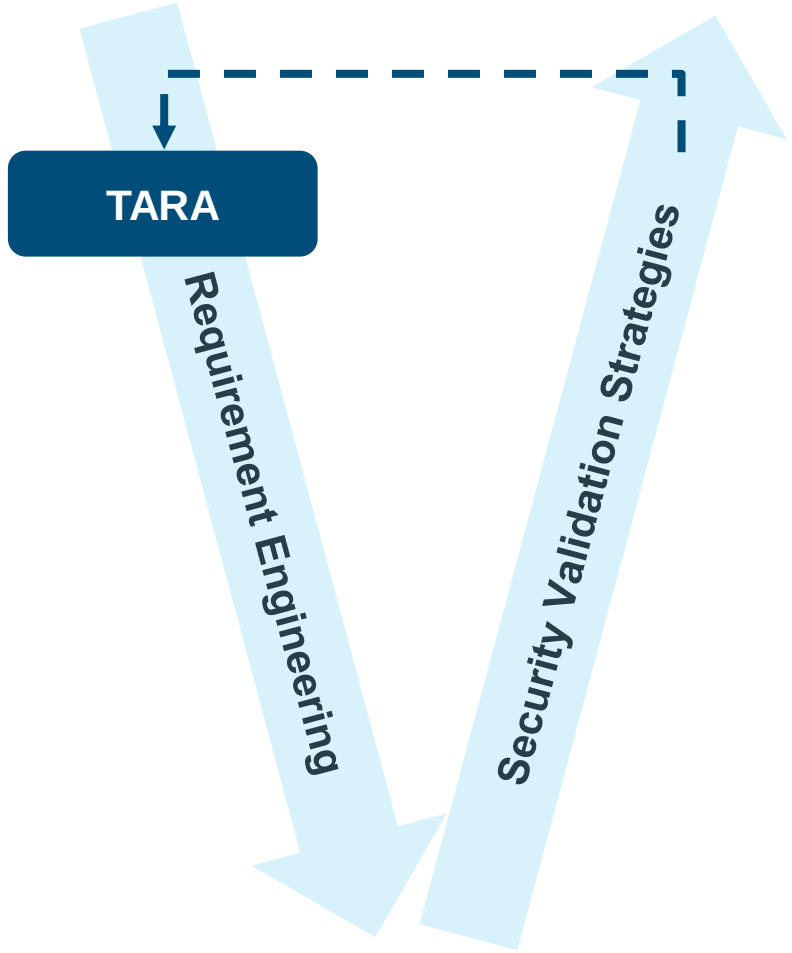
- Multiple experts
- High-tech lab for SCA
- Months of work

Small Budget

- "Script kiddies"
- Generic vulnerability scanner/fuzzer
- Days of work

Iterative Process

- **Iterative Process**
  1. Findings flow back into the TARA
  2. Adaption of security goals and requirements
  3. Adaption of security validation strategies

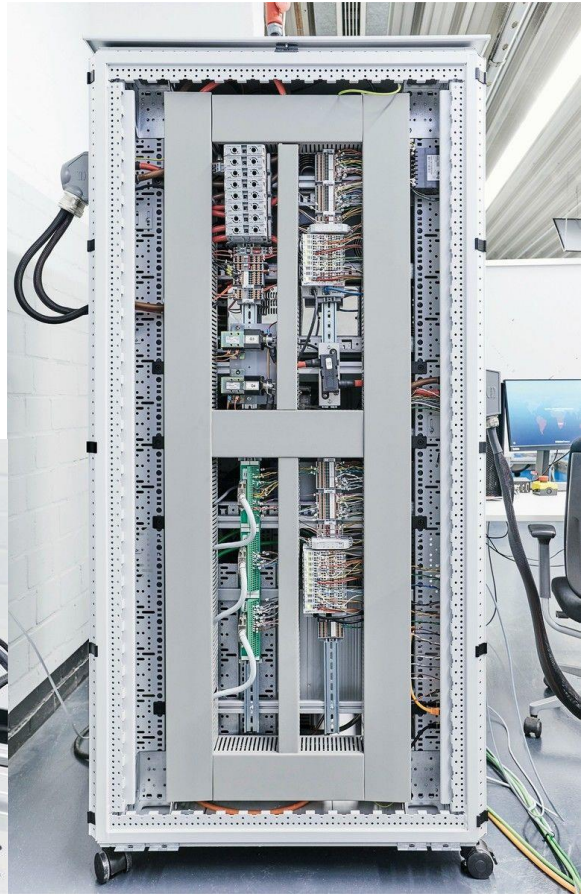


03

Practical Application

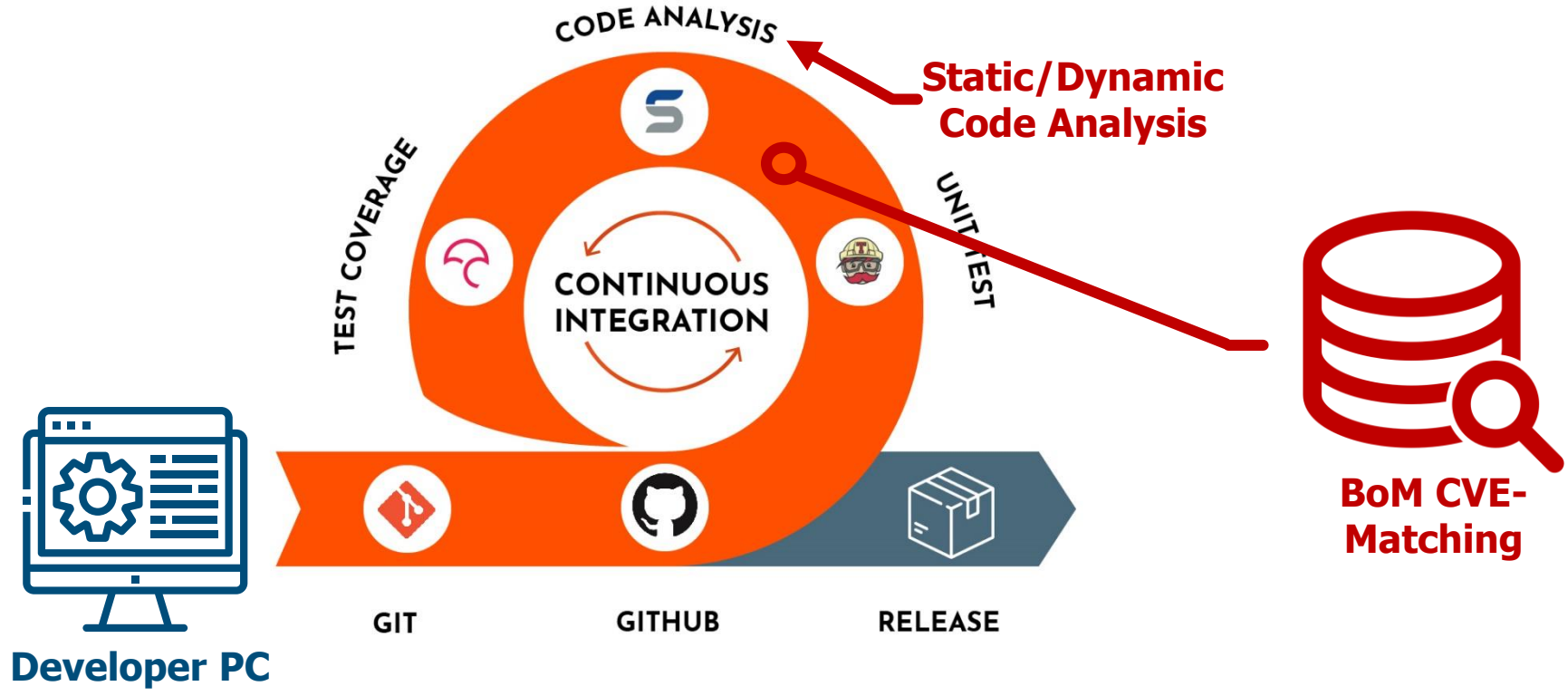
Functional Testing

- **Execute test cases on …**
  - SiL (Software in the Loop)
  - HiL (Hardware in the Loop)



Hardware in the Loop (HiL)

Vulnerability Scanning

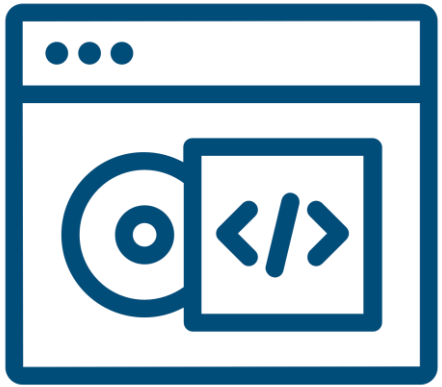


Vulnerability Scanning

Incident Response Process

- Interface to supplier and “Responsible Disclosure” researcher
- PSIRT (Product Security Incident Response Team) ensures appropriate reaction

Fuzz Testing



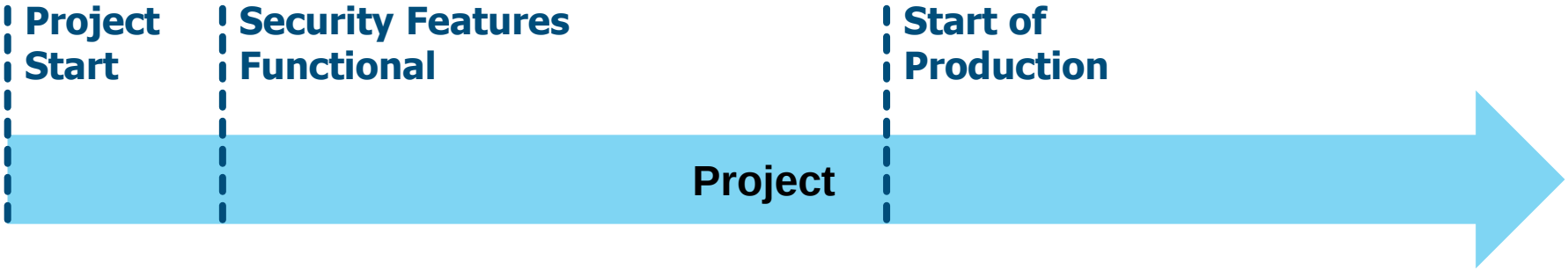
Software Unit Fuzzing

- X.509 certificates
- Custom written parser
- Data input
- Config files

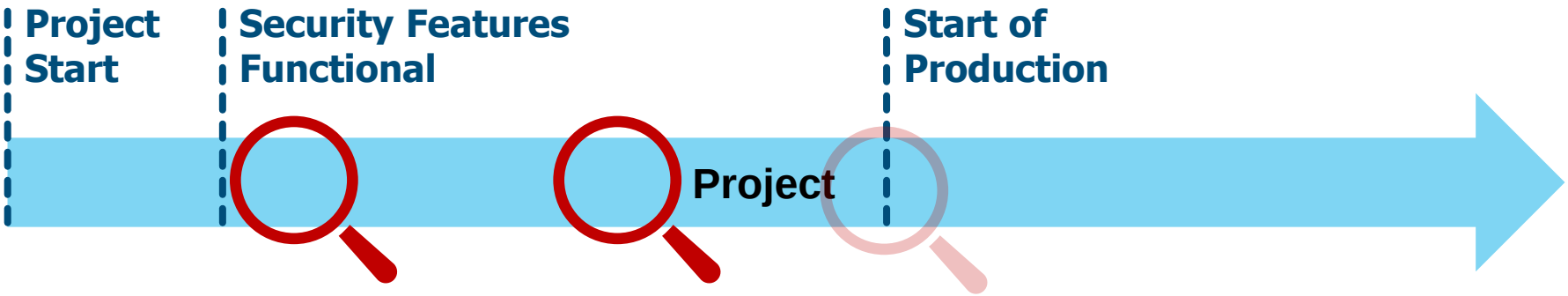
System Interface Fuzzing

- CAN (FD)
  - UDS
- Ethernet Stack
  - IP, TCP, TLS/DTLS

Penetration Testing



Penetration Testing



04

Reducing Risks in the Future

Reducing Risks in the Future

- Upcoming regulation
  - UNECE WP.29 and ISO/SAE 21434
- CEP (Cybersecurity Engineering Process)
- Holistic Cybersecurity Concept
- LTS (Long Time Support)

Thank you!

Questions?

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