



# Automated Testing for Autonomous Cars?

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# Agenda

- Introduction
- Wireless Fault Injection
- Automated Autonomous Test
- Conclusion

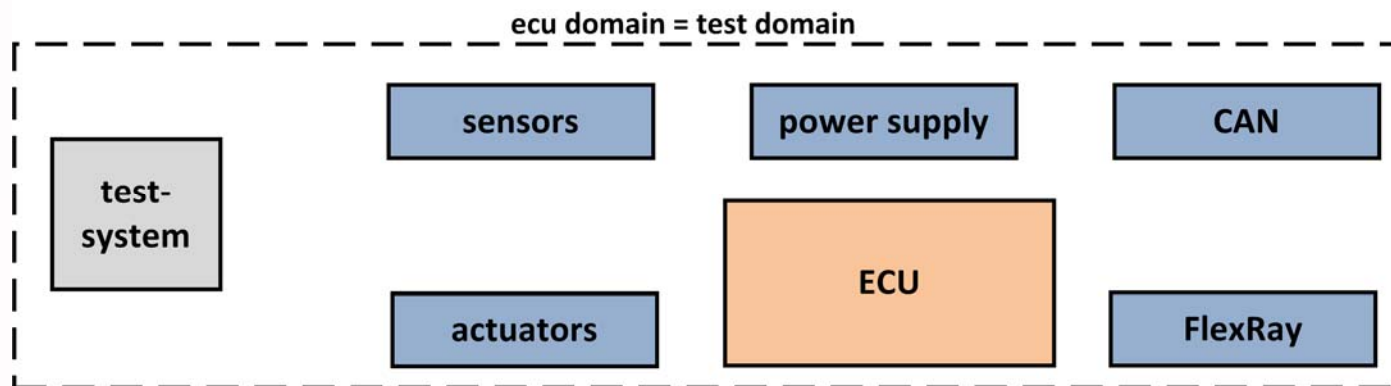


## INTRODUCTION

Distributed events – new challenges

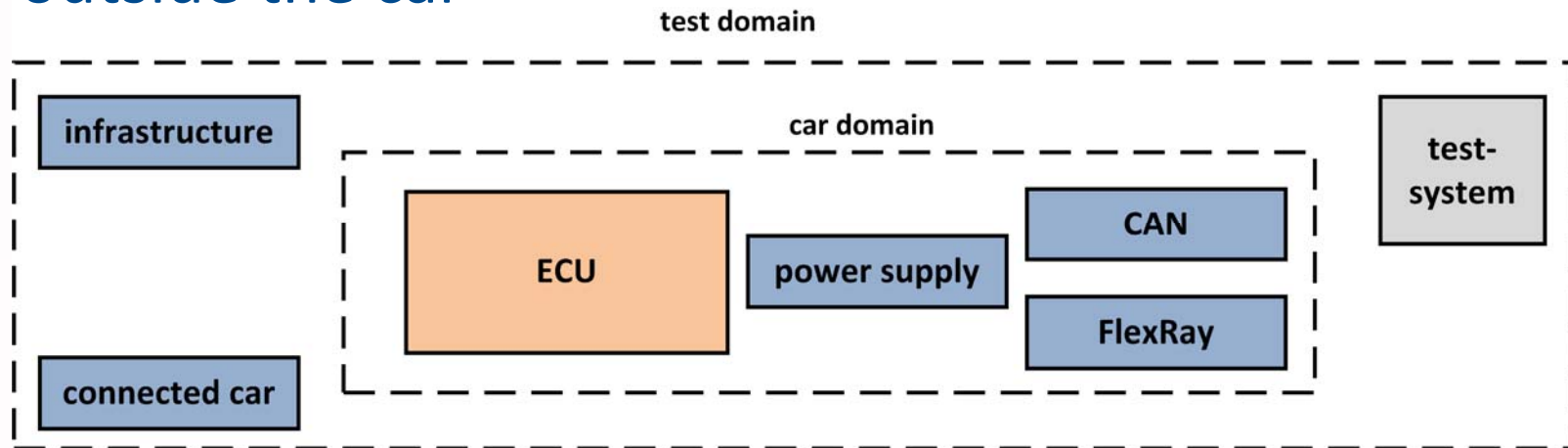
## Classic test setup

- ECUs inside a car are connected to different
  - bus systems
  - sensors
  - actuators
- These are all inside the car



## New test setup

- Car is wirelessly connected to
  - other cars
  - intelligent infrastructure
- Car processes more and more events happening outside the car





## WIRELESS FAULT INJECTION

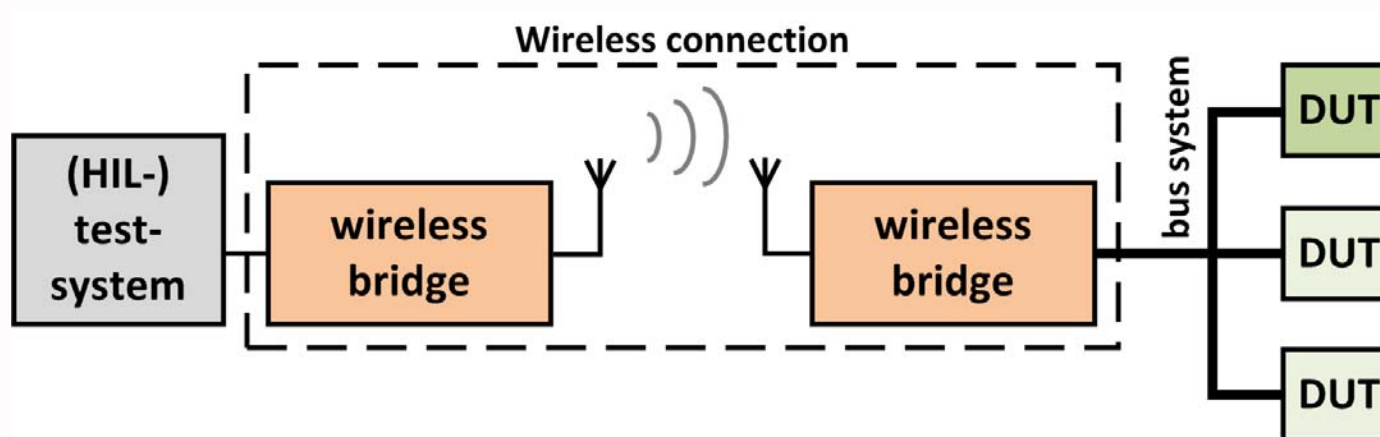
Use of a real-time wireless bridge

## Idea

- Be able to wirelessly connect to a (driving) car for testing purposes
  - e.g. via XCP
- Use existing toolchains
  - e.g. CANape<sup>®</sup>
- Synchronize time of distributed events  
→ common time-base

## Concept

- Development of a wireless bridge
  - Deterministic data transfer
  - 1ms real-time capability
  - GPS timestamp



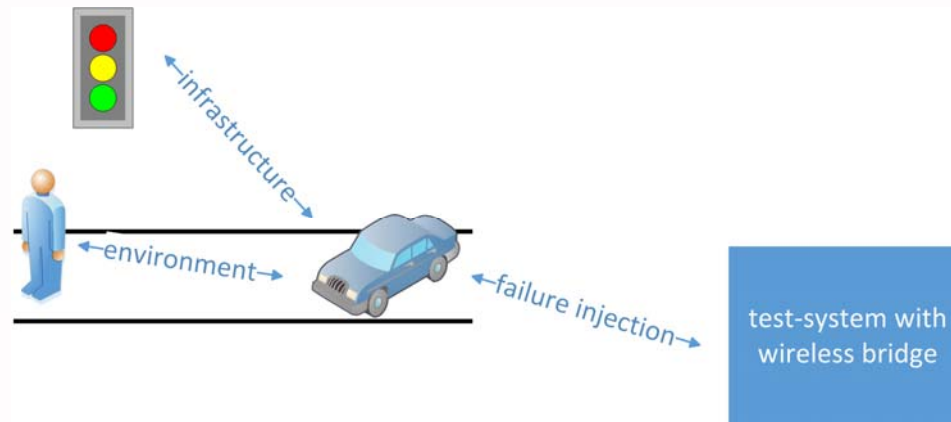


## Implementation

- Simulation driven development
- Automatic code generation
- Real-time Linux, FPGA and SDR based
- Layered structure
  - Adaptable to different toolchains
- Optimized for aspects of testing

## Wireless Fault Injection

- Using a deterministic wireless bridge enables to:
  - remotely access an ECU, even in a driving car
  - inject faults to a specific time
  - remotely observe the fault reaction



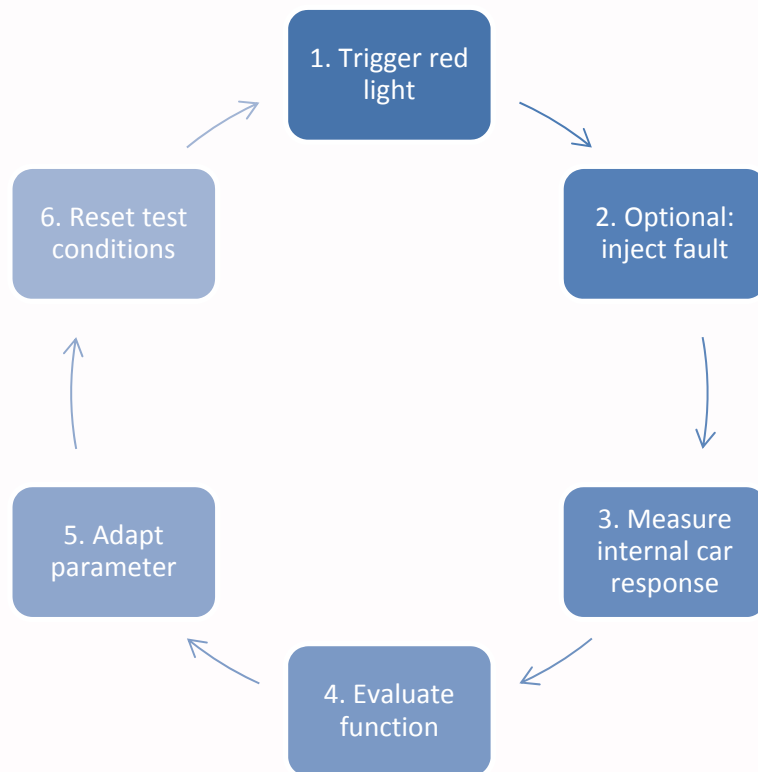


# AUTOMATED AUTONOMOUS TEST

A future test method?

# Wireless HIL-Techniques

- Example of an automated test of an autonomous car



car can “test itself”

1. Wireless connection to traffic light
2. Wireless connection to car
3. Wireless connection to car
4. Local test script
5. Wireless connection to car
6. Wireless connection to car and traffic light

## Added Benefits

- External control of functions in a self-driving car during development
- Automated real-world test of autonomous cars, controlled by a HIL-like system
- Automated generation of test-data for machine learning purposes



## CONCLUSION

key-takeaways

## Summary

- Testing, especially automated testing, of wirelessly connected cars is challenging
- Testing functionality depending on distributed events needs synchronization
- Use of a self developed wireless bridge to
  - create a common time base for testing
  - enable the use of existing test tools and methods for automated tests

**4<sup>th</sup>**  
**UCAAT** *User Conference on  
Advanced Automated Testing*



**Thank you for your attention!**

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