Eclipse IoT-Testware

EclipseCon Europe 2018
Ludwigsburg, Germany

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Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

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Agenda

1. Motivation and Challenges in IoT Testing
2. The IoT-T Project
3. IoT Testing Landscape
4. The IoT-Testware
5. IoT-Testware Use Cases
6. Demo

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IoT

Motivation and Challenges in IoT Testing

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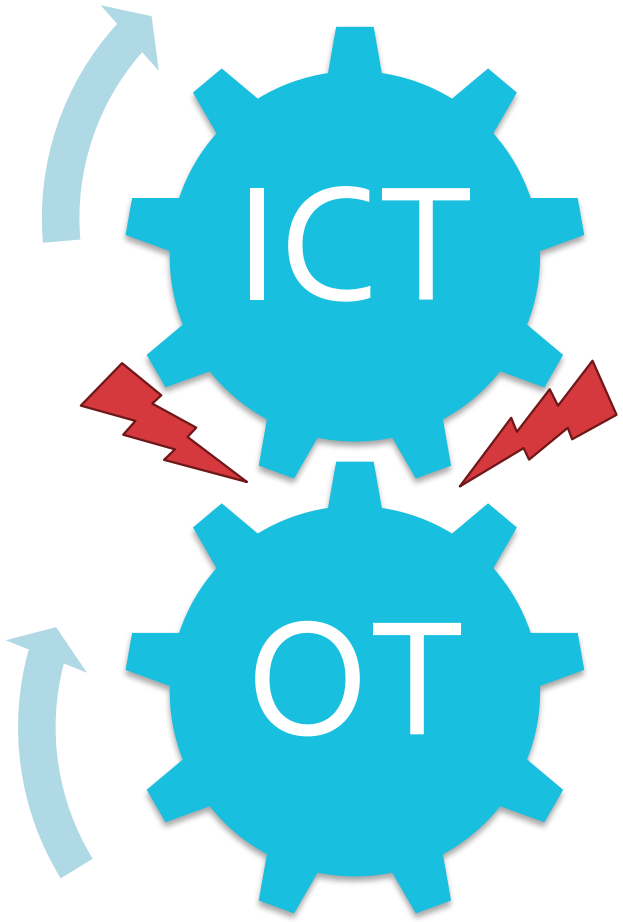
IoT

Convergence of ICT and OT



- Openness
- Security and Privacy
- Availability and Reachability
- Virtualization
- Latency tolerant
- Highly dynamic

- Isolated Networks
- Security and Safety
- Availability and Reliability
- Robustness
- Realtime (µs)
- Mostly static

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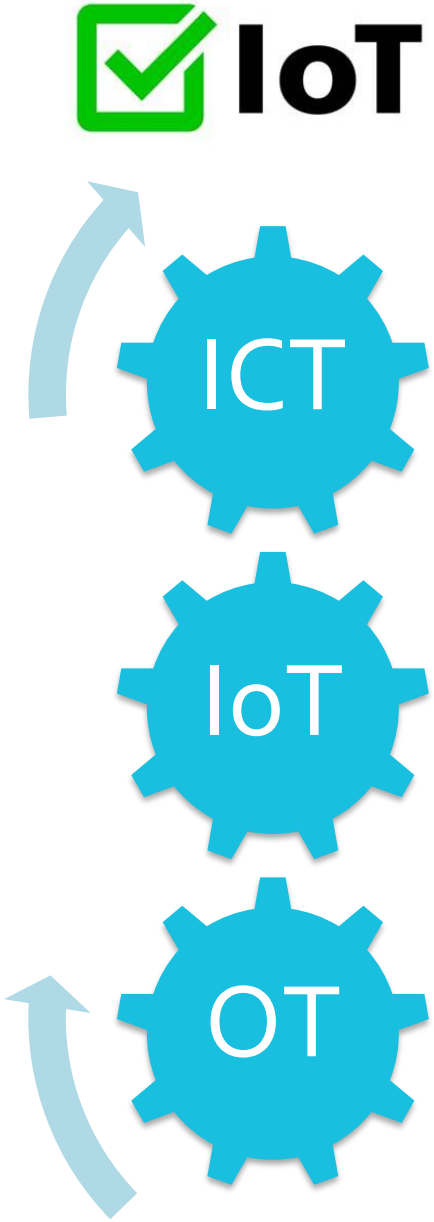
IoT Testing



- Diverse thread and attack vectors
- Diverse protection profiles
- Diverse testing methodologies

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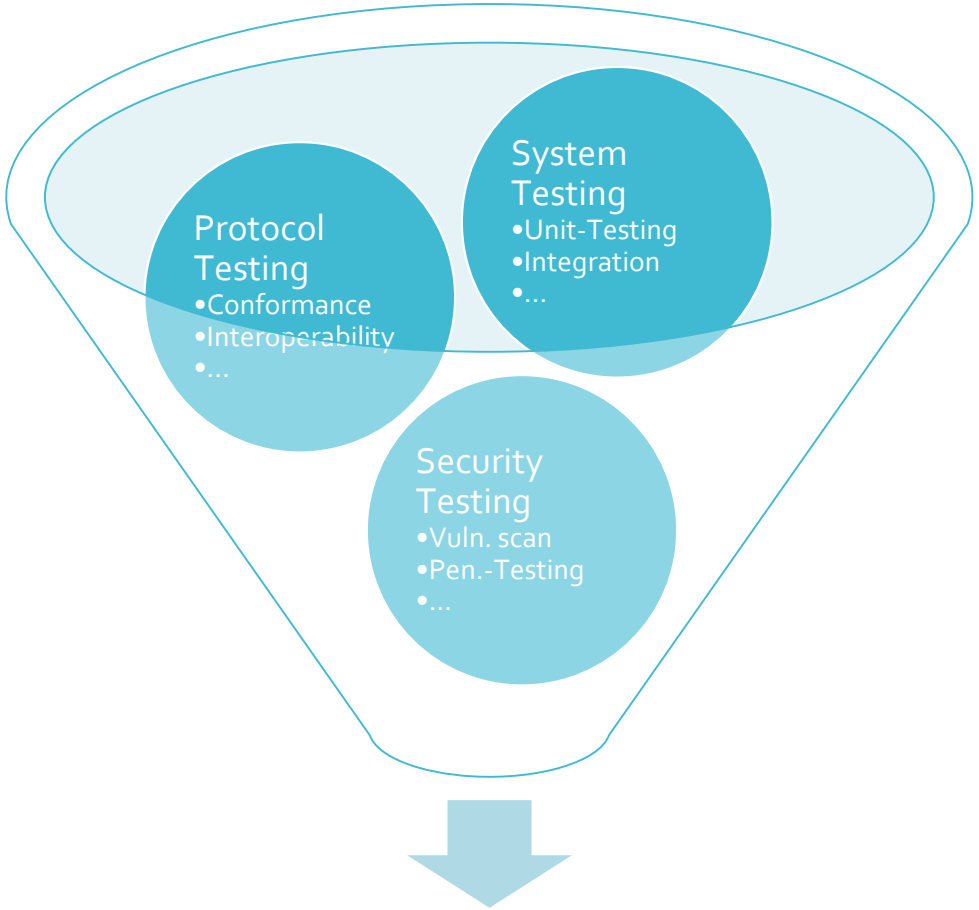
Testing Approaches



IoT Testing

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The IoT-T Project

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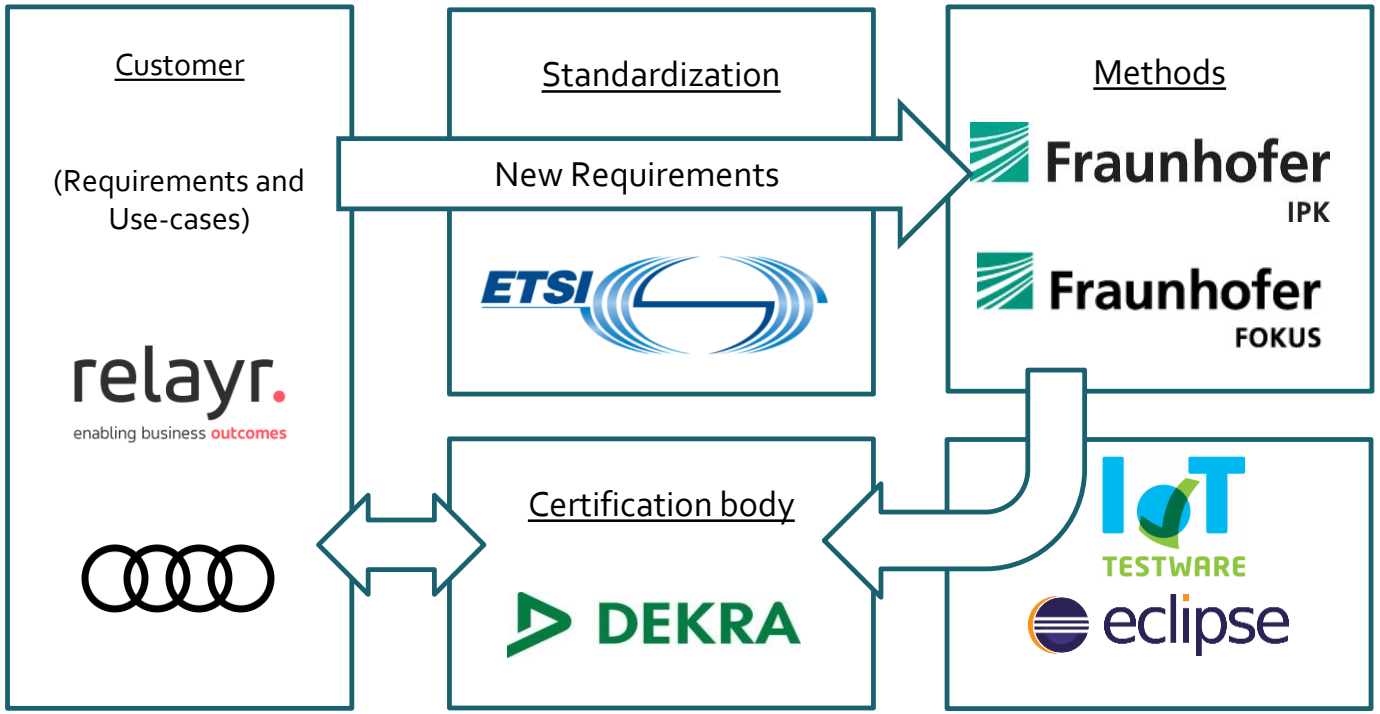
The IoT-T Project



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IoT Testing Landscape

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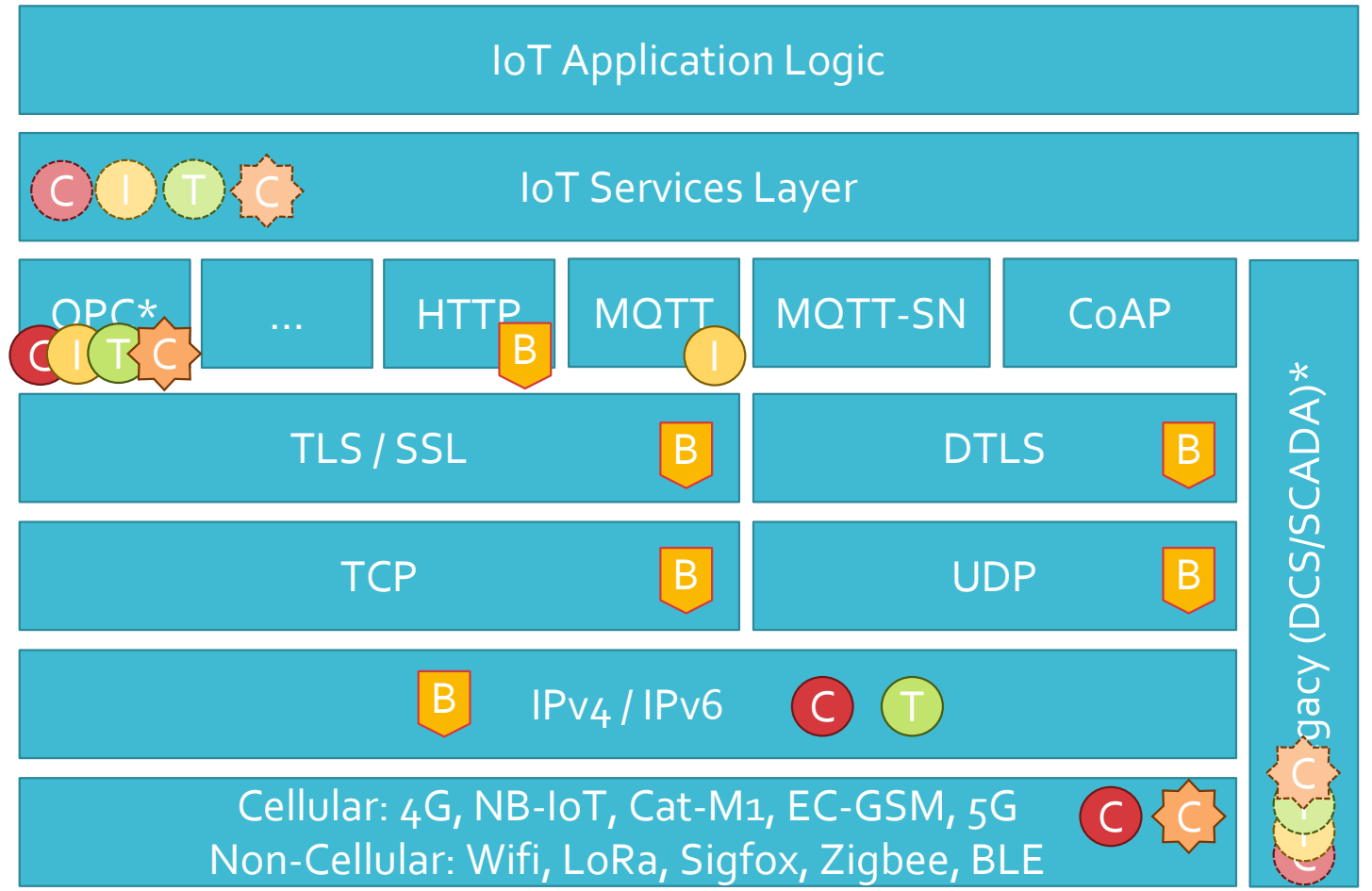
Challenges in testing IoT



B Battle Proofed

C Conformance

I Interop.

T Compliance-Tool

C Certification

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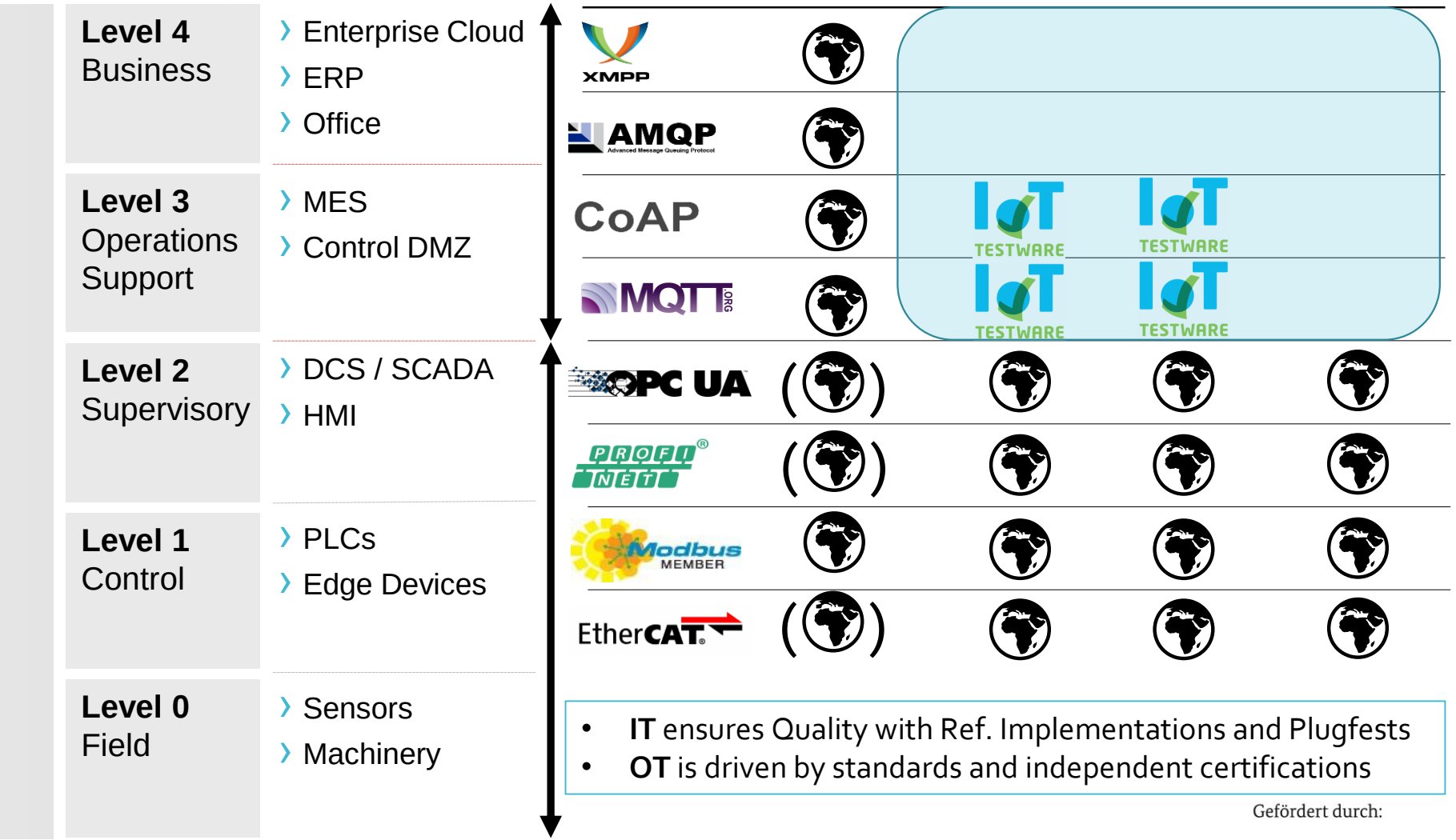
Newcomer vs. Fieldbuses



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IoT

The IoT-Testware

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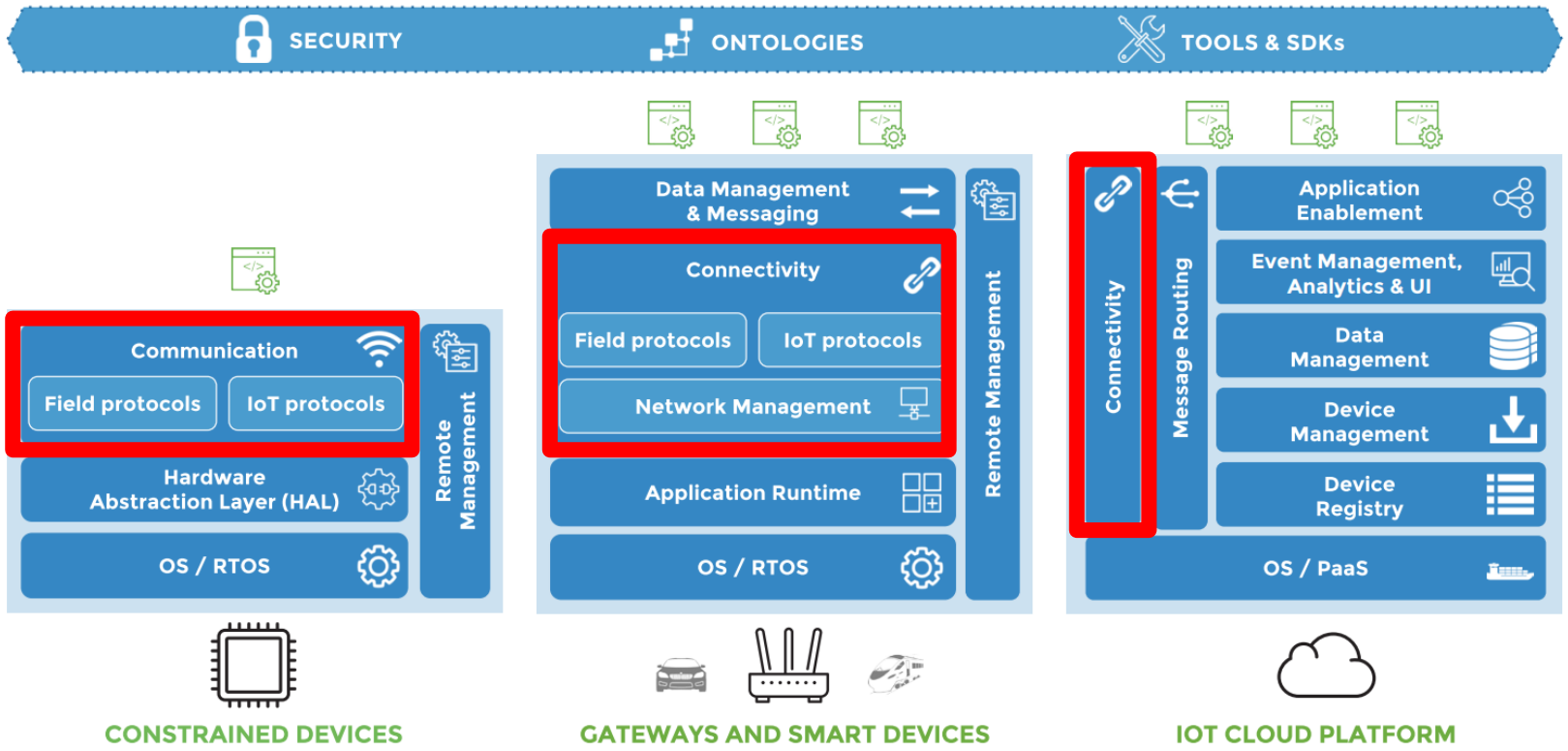
IoT-Testware Scope



The Three Software Stacks Required for IoT Architectures, Eclipse IoT Working Group, September 2016

Scope of IoT-Testware

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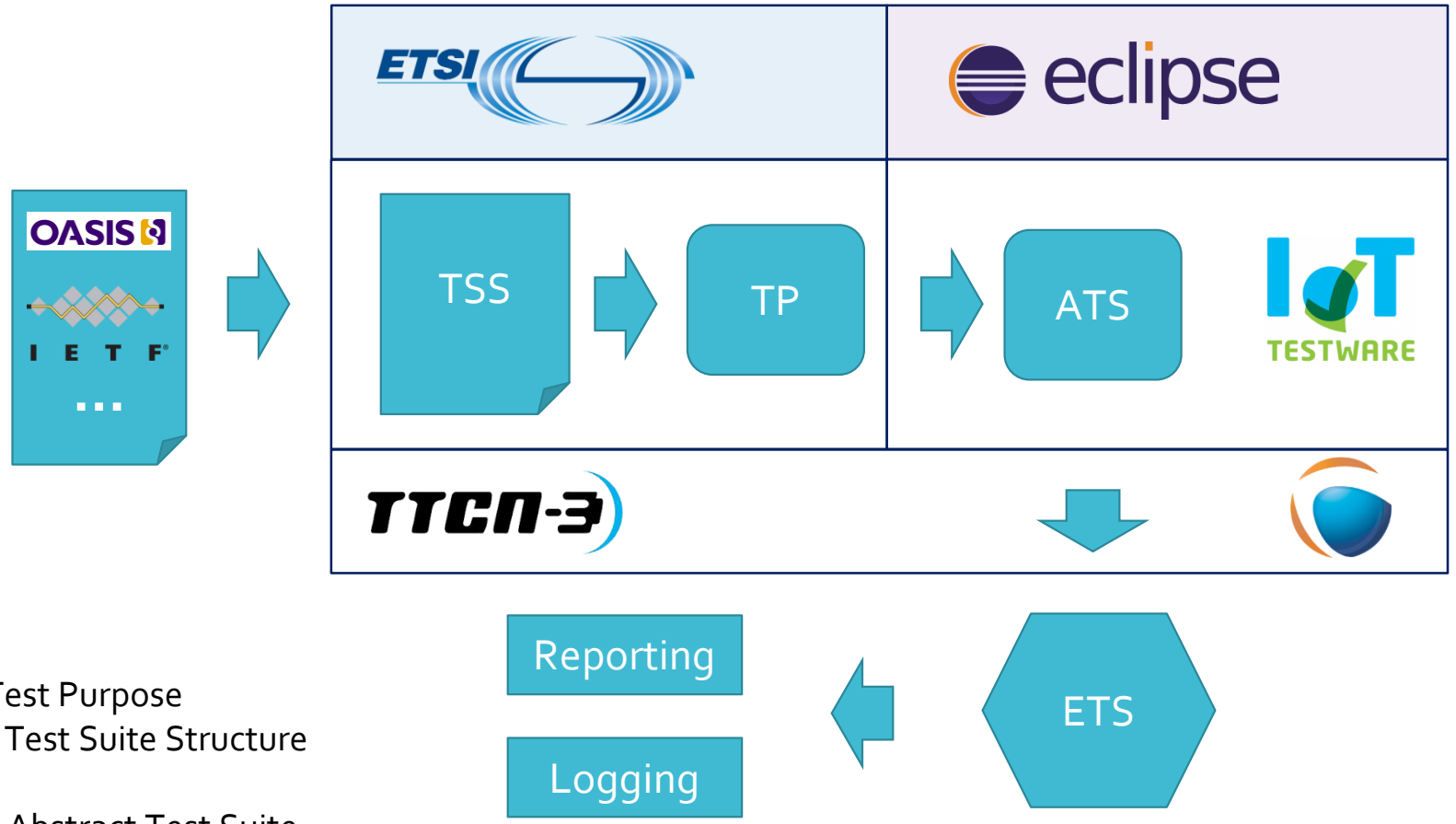
IoT-Testware Big Picture



TP: Test Purpose
TSS: Test Suite Structure

ATS: Abstract Test Suite
ETS: Executable TS
SUT: System Under Test

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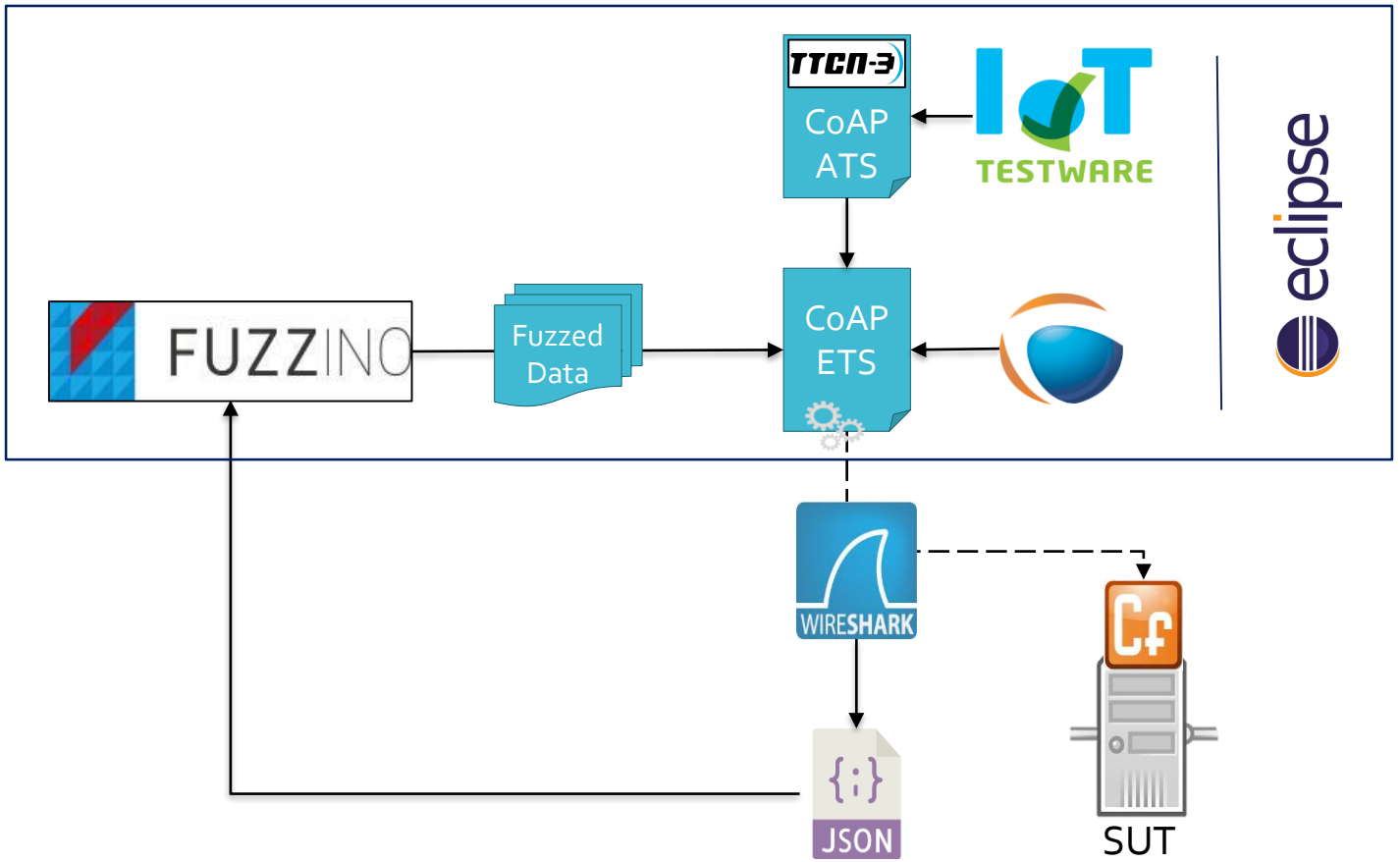
Fuzzing Approach



ATS: Abstract Test Suite
ETS: Executable TS

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Additional Tooling for IoT-Testware

Take available software and tools …

… and adding public testuites as a result of insights from IoT testing:

LoraWAN OPC-UA

MQTT CoAP

TESTWARE

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IoT

IoT-Testware Use Cases

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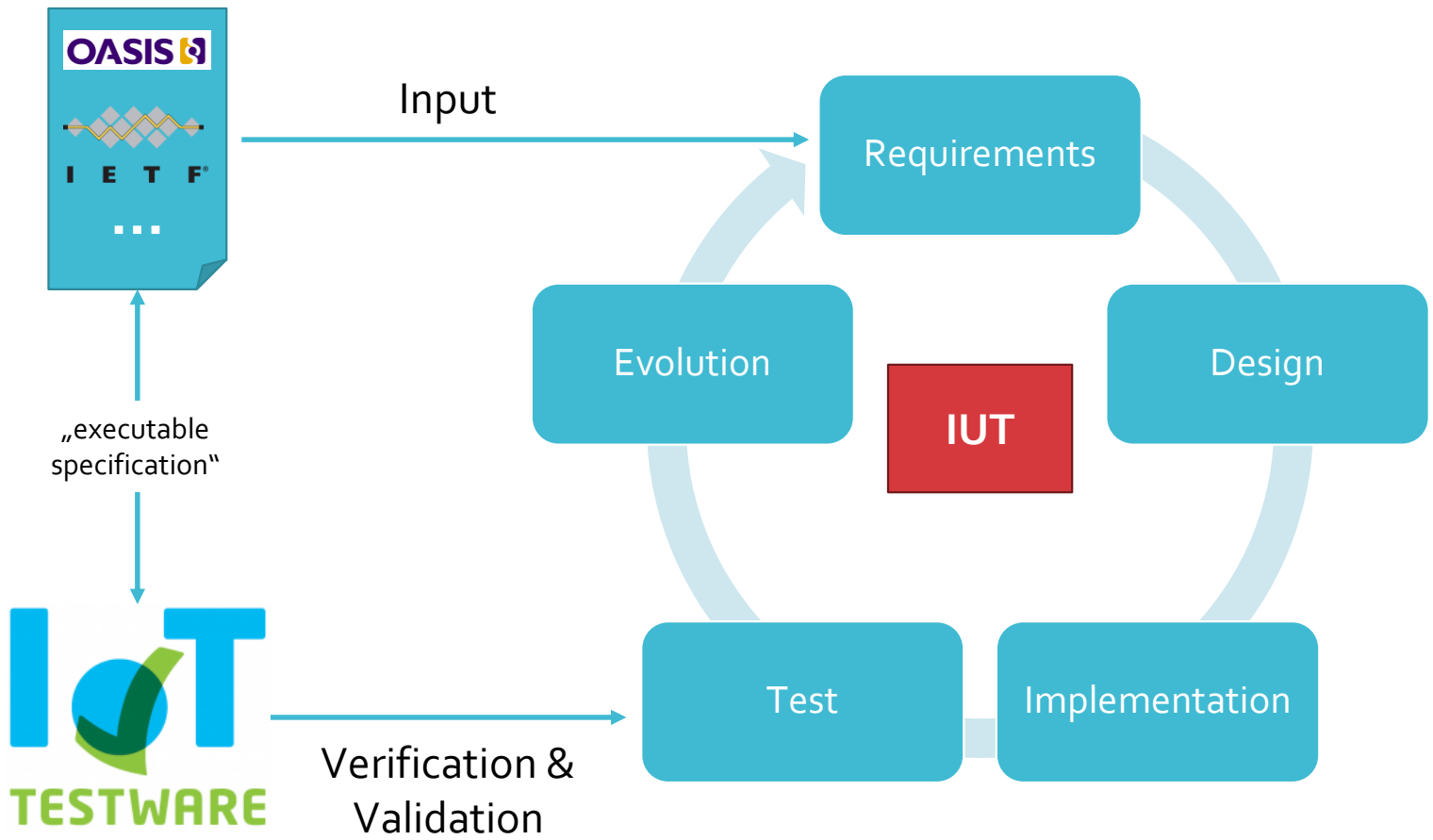
Implementation



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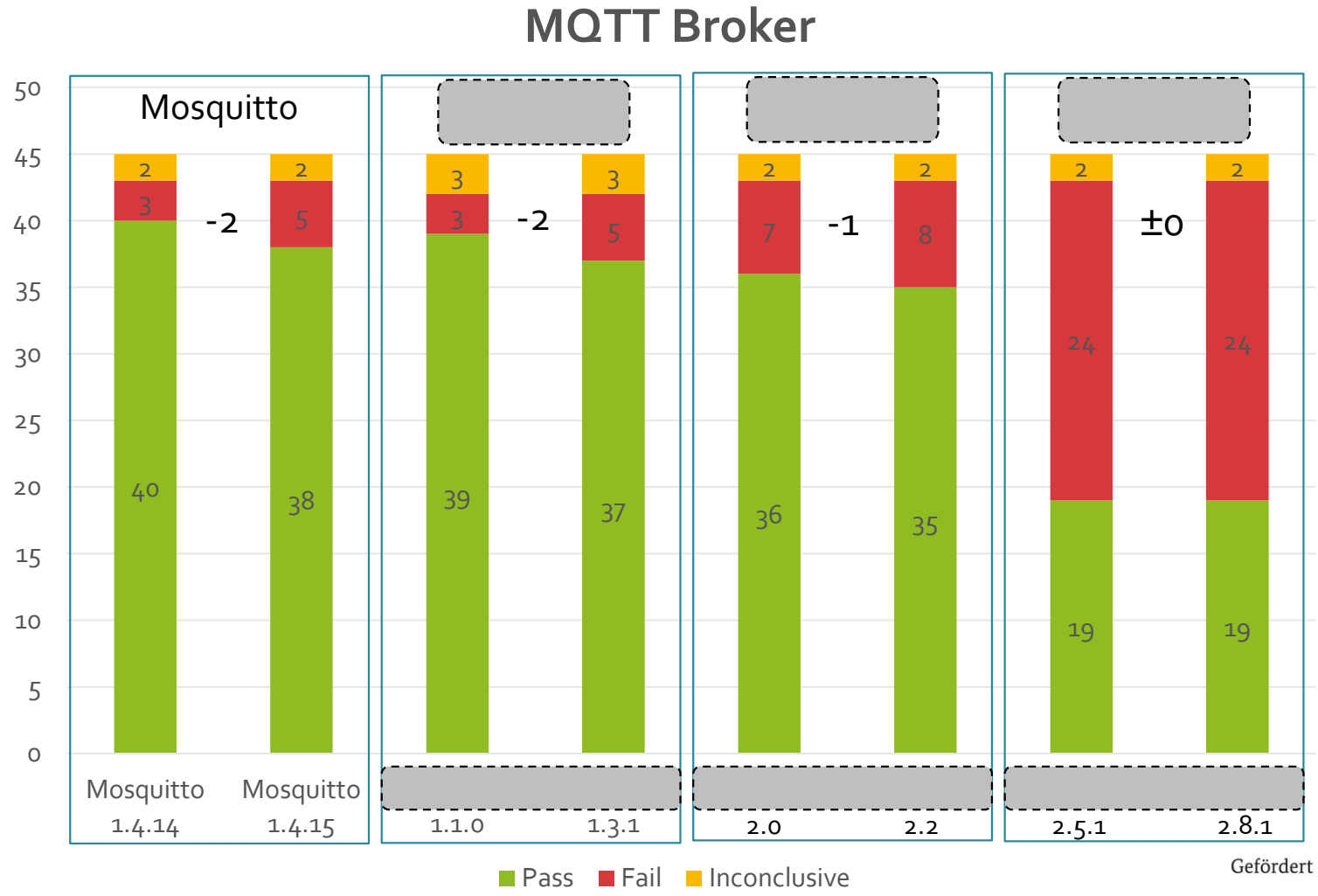
Conformance Comparison



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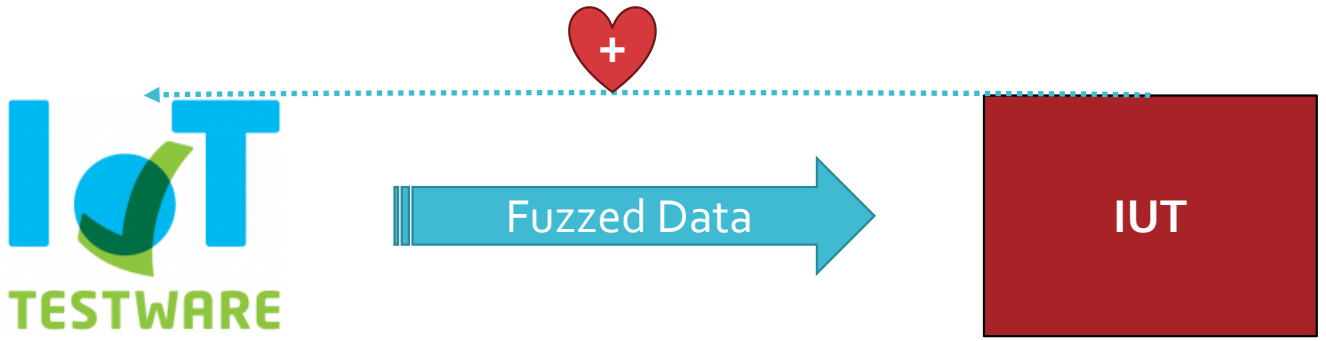
Security & Robustness



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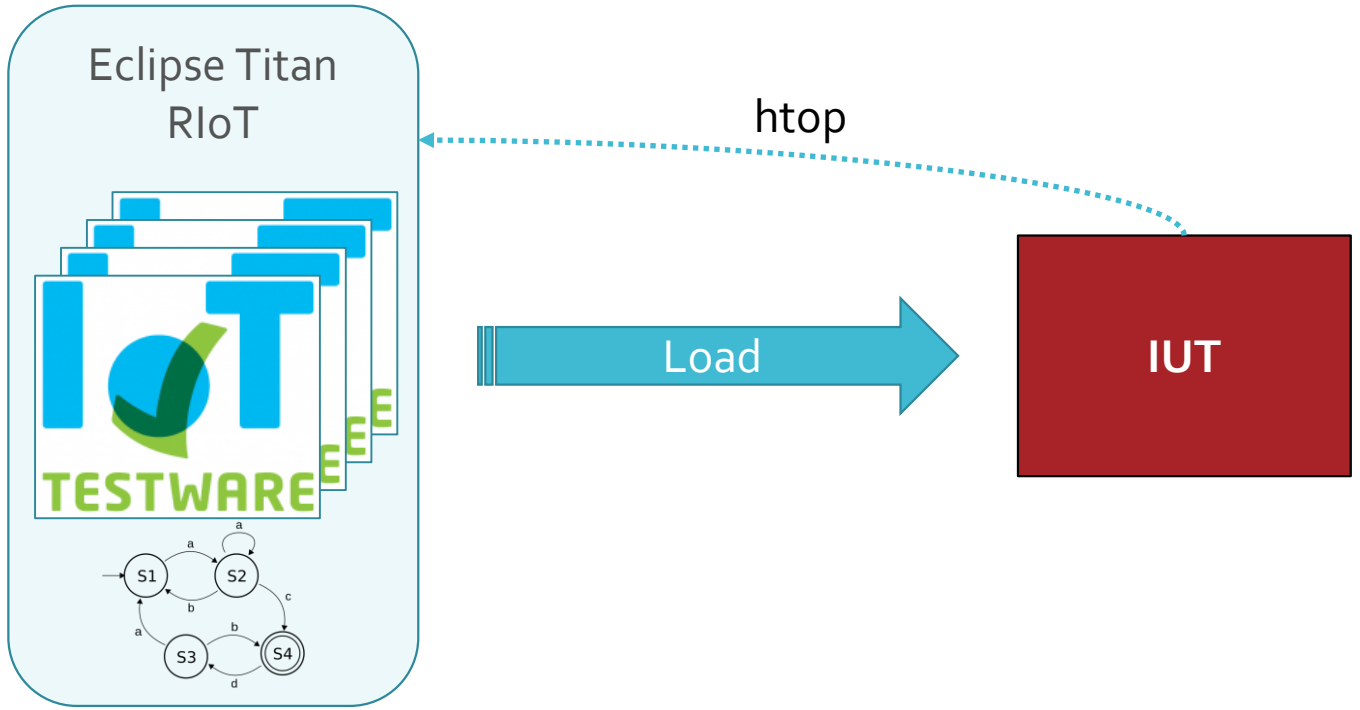
Performance



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Demo

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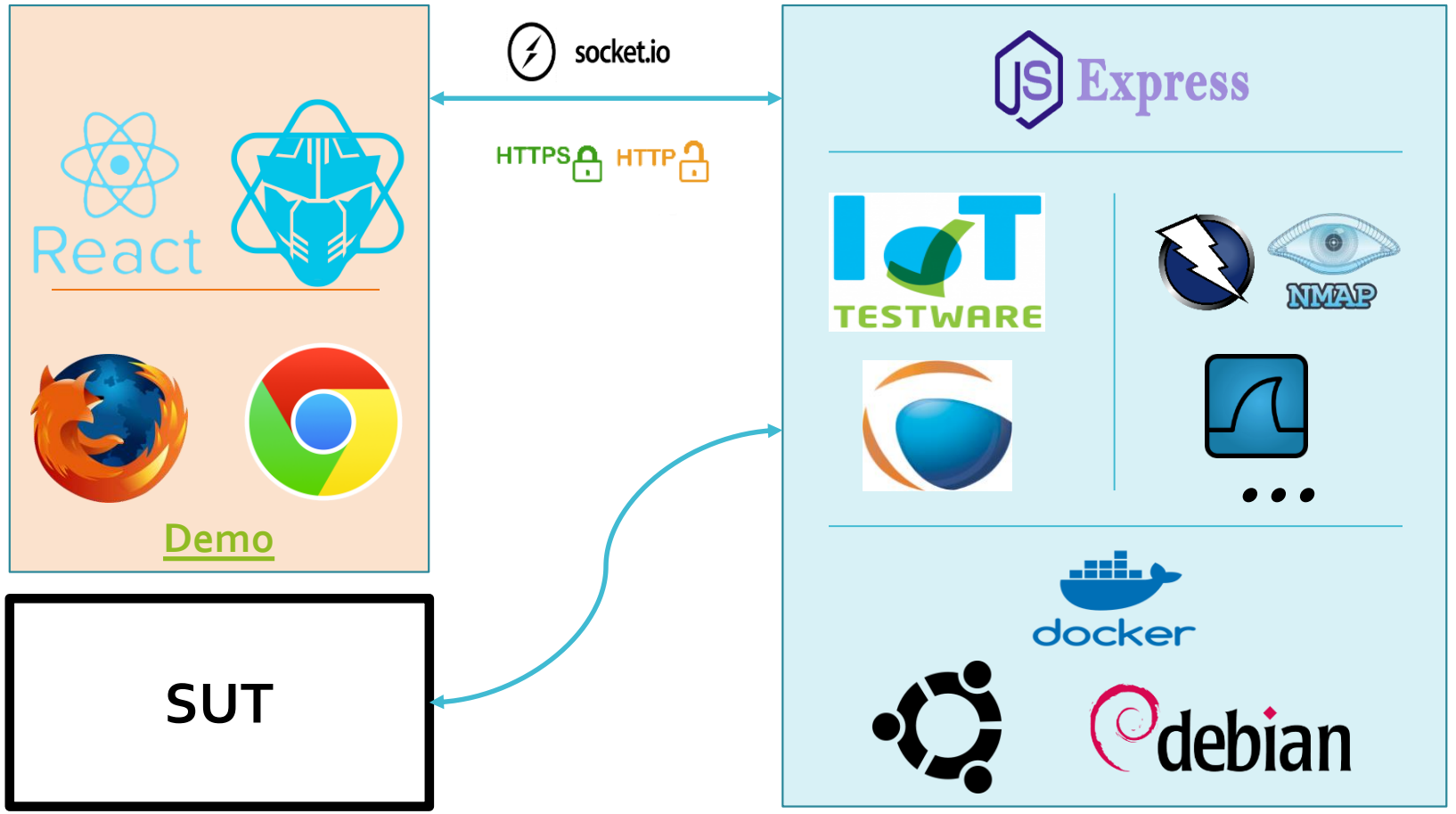
IoT-Testware Webserver



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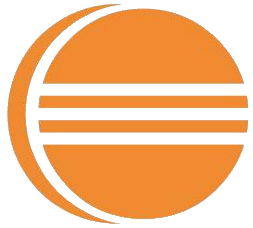

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Backup Slides

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Tools

IoT-Testware

Start Tools Test Suites Reporting Icons Settings

It is the aim of the project to supply a rich set of TTCN-3 test suites and test cases for IoT technologies to enable developers in setting up a comprehensive test environment of their own, if needed from the beginning of a project. TTCN-3 has been defined and standardized by the European Telecommunication Standards Institute in ETSI ES 201873 and related extension packages. It is implemented and supported in Eclipse IoT by the Titan project.

The initial contribution of IoT-Testware to Eclipse will focus on protocols like CoAP and MQTT. This list will be extended during the project. To ensure test and implementation technology independence, and the test suites will be realized in TTCN-3 and implemented with Titan. The test suites will contain tests for conformance, interoperability, robustness, and security aspects.

Eclipse Titan has already protocol modules for IoT including type systems and codec. IoT-Testware will rely on these type systems and develop codec libraries and test cases based on them.

The IoT-Testware test suites will have a well-defined test suite structure (TSS) and a set of protocol implementation conformance statements (PICS) as well as protocol implementation extra information for testing (PIXIT). The work will follow the standardized approach as defined in ISO “Conformance Test Methodology and Framework” ISO 9646 and the best practices as described by ETSI White Paper No 3 “Achieving Technical Interoperability – the ETSI Approach”.

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MQTT Test Suite

Host

Host

Port

PIXIT

Username

Password

Client ID

Topic Name

Test cases

- PICS_BROKER_BASIC
- PICS_BROKER_LWT
- PICS_BROKER_RTND
- PICS_BROKER_AUTH
- PICS_BROKER_QOS_1
- PICS_BROKER_QOS_2

Run

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CoAP Test Suite

Host

Host

Port

Resource Creator

GET POST UPDATE DELETE

Resource ID

URI

+

Resources

Test cases

PIC_Server

Run

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Conformance Test: MQTT

Finished
Test Run finished

Expand all Off

#	Test Case	Verdict	Reason
❯	TC_MQTT_BROKER_CONNECT_001	pass	IUT closed the Network Connection correctly
❯	TC_MQTT_BROKER_CONNECT_002	pass	IUT does not accept incorrect Protocol Names
❯	TC_MQTT_BROKER_CONNECT_003	pass	IUT answered correctly with ACK and return code 0x00
❯	TC_MQTT_BROKER_CONNECT_004	pass	IUT closed the Network Connection correctly
❯	TC_MQTT_BROKER_CONNECT_005	pass	IUT closed the Network Connection correctly

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Browse Test Purposes for MQTT

#	ID	Objective
▼	TP_MQTT_Broker_CONNECT_001	The IUT MUST close the network connection if fixed header flags in CONNECT Control Packet are invalid

TP ID:	TP_MQTT_Broker_CONNECT_001
Test Objective:	The IUT MUST close the network connection if fixed header flags in CONNECT Control Packet are invalid
Reference:	[MQTT-2.2.2-1], [MQTT-2.2.2-2], [MQTT-3.1.4-1], [MQTT-3.2.2-6]
PICS:	PICS_BROKER_BASIC

Expected Behaviour:

```
ensure that {
        when {
                the IUT entity receives a CONNECT message containing
                header_flags indicating value '1111'B;
        }
        then {
                the IUT entity closes the TCP_CONNECTION
        }
}
```

▶	TP_MQTT_Broker_CONNECT_002	If the Protocol Name is incorrect the IUT MAY disconnect the Client or it MAY continue processing the CONNECT packet.
▶	TP_MQTT_Broker_CONNECT_003	The IUT MUST respond to Protocol Levels which it supports (in scope: MQTT-3.1.1) with return code 0x00
▶	TP_MQTT_Broker_CONNECT_004	The IUT MUST validate that the reserved flag in the CONNECT Control Packet is set to zero and disconnect the Client if it is not zero
▶	TP_MQTT_Broker_CONNECT_005	If the Will Flag is set to 1, the Will QoS and Will Retain fields in the Connect Flags will be used by the IUT, and the Will Topic and Will Message fields MUST be present in the payload.

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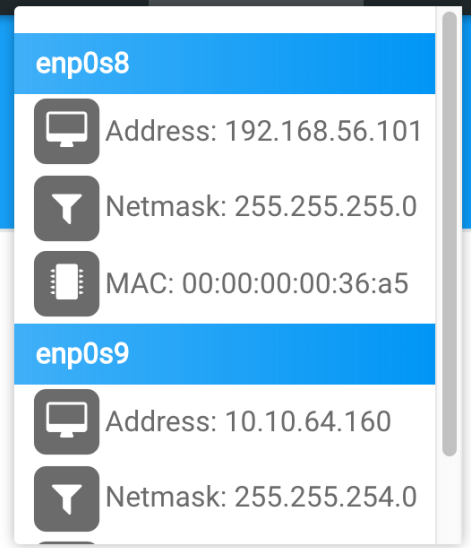
Test Run History

Browse Historical Files

Selected: None

History	
Name	Date
MQTT	15/10/2018, 16:36:35
iottestware.mqtt.alexander-VirtualBox-hc.log	15/10/2018, 16:36:35
iottestware.mqtt.alexander-VirtualBox-mtc.log	15/10/2018, 16:36:35
mqtt.cfg	15/10/2018, 16:36:35
report.pdf	15/10/2018, 16:36:35
tcpdump.pcap	15/10/2018, 16:36:35
MQTT	15/10/2018, 16:04:33
MQTT	15/10/2018, 16:03:06
CoAP	15/10/2018, 16:01:02
coap.cfg	15/10/2018, 16:01:02
iottestware.coap.alexander-VirtualBox-hc.log	15/10/2018, 16:01:02
iottestware.coap.alexander-VirtualBox-mtc.log	15/10/2018, 16:01:02
report.pdf	15/10/2018, 16:01:02



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ping
nmap

Ping Tool

Host

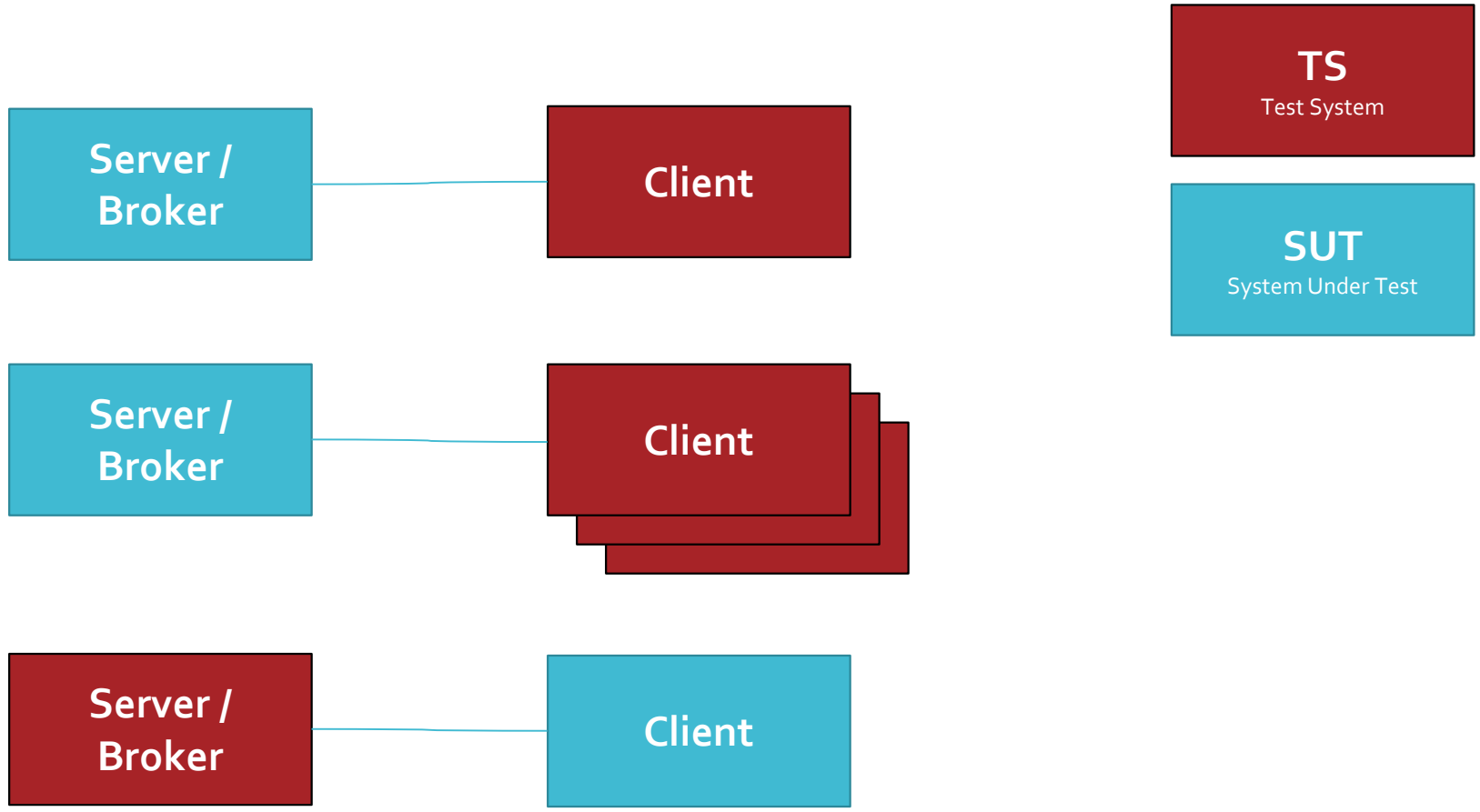
Host

5

Select Interface

Run

Test Configurations



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Test Purpose Table

TP Id	**TP_MQTT_Broker_CONNECT_001**
Test Objective	The IUT MUST close the network connection if fixed header flags in CONNECT Control Packet are invalid
Reference	[MQTT-2.2.2-1], [MQTT-2.2.2-2], [MQTT-3.1.4-1], [MQTT-3.2.2-6]
PICS Selection	PIC_BROKER_BASIC
Initial Conditions	
Expected Behaviour	
ensure that { **when {** **the IUT receives a CONNECT message containing** **header_flags indicating value '1111'B;** **} then {** **the IUT closes the TCP_CONNECTION** **}** **}**	
Final Conditions	

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Test Purpose TDL

```
Test Purpose {
    TP Id TP_MQTT_Broker_CONNECT_001
    Test objective "The IUT MUST close the network connection if fixed
                    header flags in CONNECT Control Packet are invalid"
    Reference "[MQTT-2.2.2-1], [MQTT-2.2.2-2], [MQTT-3.1.4-1],
               [MQTT-3.2.2-6]"
    PICS Selection PICS_BROKER_BASIC
    Expected behaviour
    ensure that {
          when {
                the IUT entity receives a CONNECT message containing
                              header_flags indicating value '1111'B;
          } then {
                the IUT entity closes the TCP_CONNECTION
    }}}
```

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