

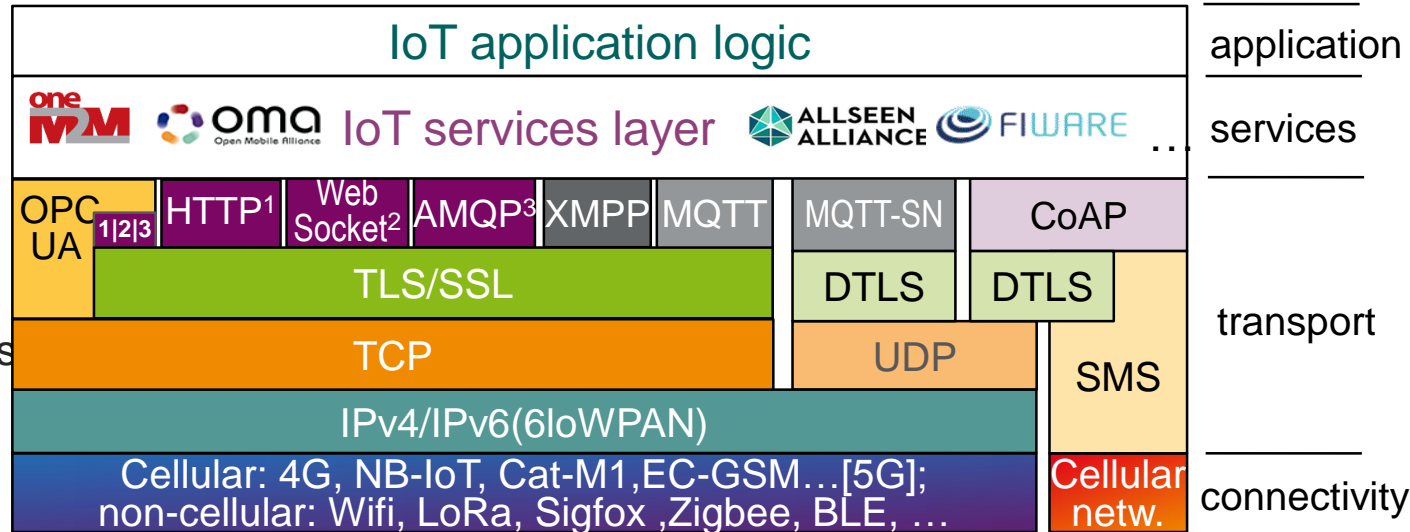
THE ECLIPSE OPEN-SOURCE IOT TEST ECOSYSTEM

György Réthy, Ericsson
Axel Rennoch, Fraunhofer FOKUS

ETSI IoTweek, Sophia Antipolis, October 25th, 2017

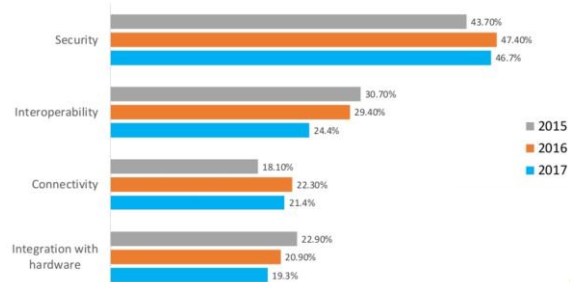
CHALLENGES IN IOT

- Wide portfolio of competences required
 - Devices (sensors, HW, embedded SW)
 - Platforms (Cloud, platform domain knowledge)
 - Applications (SW, dashboard, business logic)
- IoT platforms
 - 360+ worldwide
- IoT protocols
 - Rich selection
 - IP-based
 - non-IP based
- Connectivity options
 - Throughput
 - Latency
 - Power efficiency
 - Packet size



TRENDS IN IOT

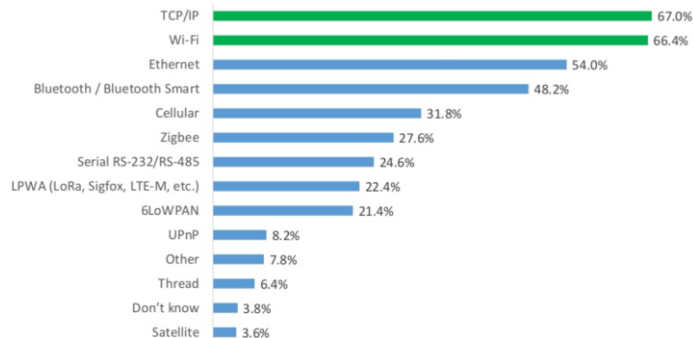
TOP IOT CONCERNS / TRENDS 2015-2017



IoT Developer Survey 2017 - Copyright Eclipse Foundation, Inc.

CONNECTIVITY PROTOCOLS

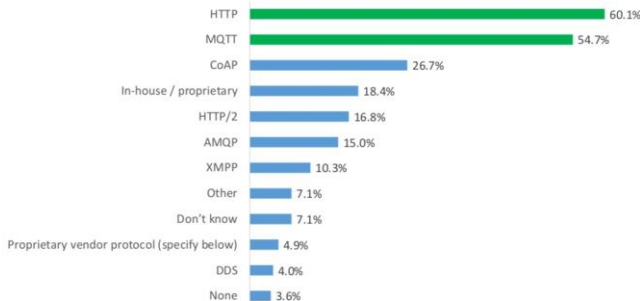
What connectivity protocol(s) do you use for your IoT solution?



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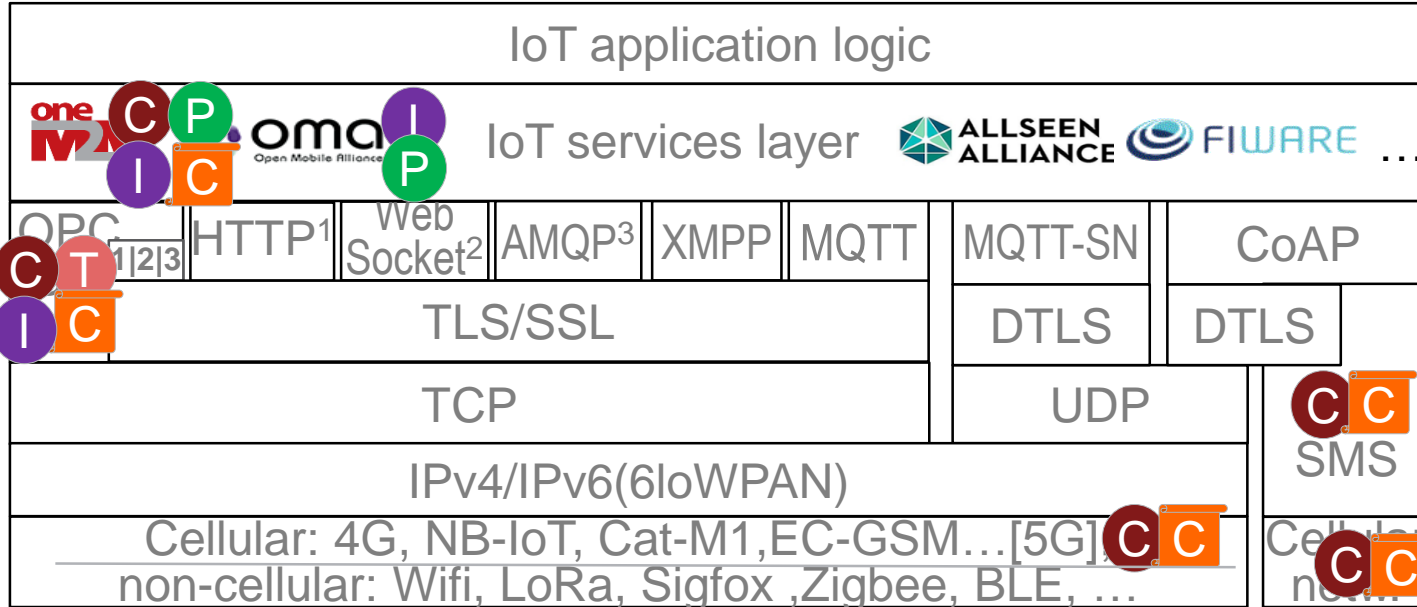
MESSAGING STANDARDS

What messaging protocol(s) do you use for your IoT solution?



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TEST COVERAGE BY SDO-S



C Conformance tests

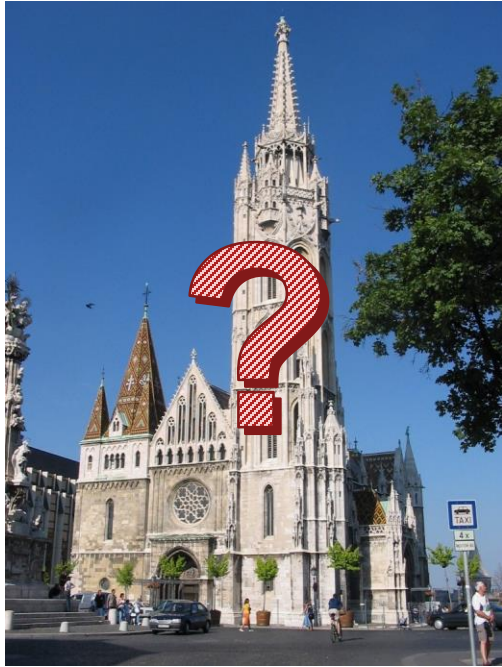
I Interoperability tests

P PlugFest/Interoperability test event

T Compliance tool

C Certification

QUO VADIS IOT?



Cathedral
OR
Bazaar?



TEST OBJECTS

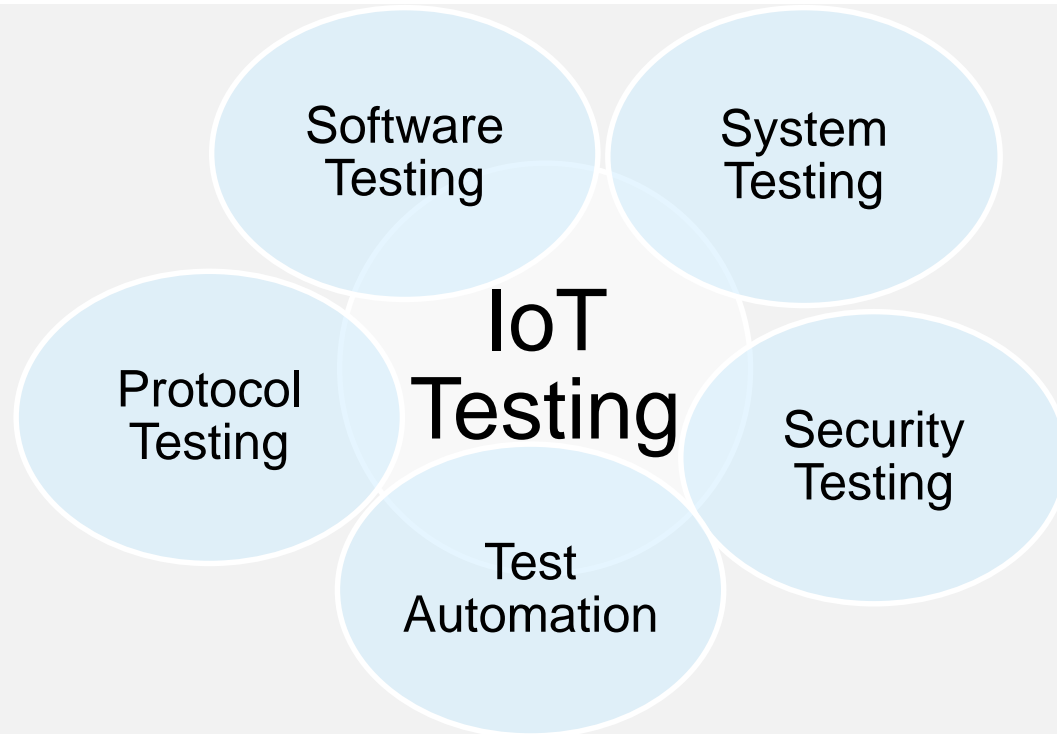
- IoT devices,
 - Mikrocontroller (**MCU**),
 - **Gateways** (Bosch XDK, IoT starterkits)
- IoT platforms
 - RIOT, relayr, Thread, mbed...
 - service layer (oneM2M, FiWare)
- IoT protocols
 - Constrained Application Protocol (**CoAP**)
 - MQ Telemetry Transport (**MQTT**)



oneM2M	
HTTP, AMQP, MQTT	CoAP
TCP	UDP
IPv4, IPv6, 6LoWPAN	
MAC, IEEE 802.15.4	LPWAN
PHY	LoRa

IoT challenges: complexity, asynchronism, long operation phase, resource constraints

INTEGRATION OF SEVERAL TESTING APPROACHES



TEST AUTOMATION

- Less **resources** needed (time and money)
- **Avoid** human **mistakes** due to manually testing
- During test **development and execution**
- **Speed-up** of **regression** tests and product **time-to-market**

DESIGN PRINCIPLES OF TTCN-3

- **One test technology for different tests**

- Distributed, platform-independent testing
- Integrated graphical test development, documentation and analysis
- Adaptable, open test environment



Did you know that **YOUR PHONE...**



- **Areas of Testing**

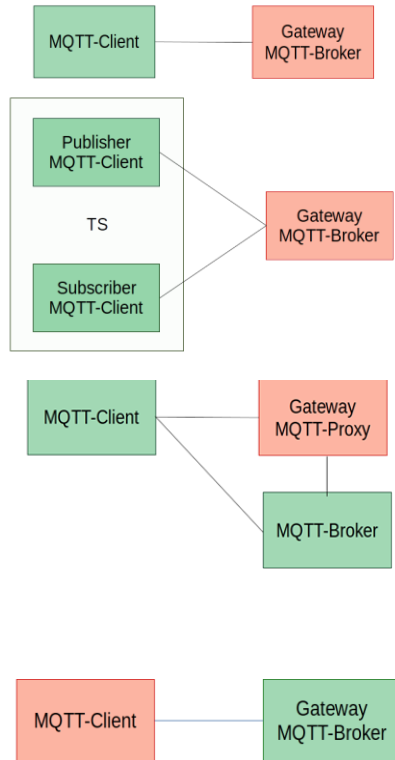
- *Conformance* and *functional* testing
- *Interoperability* and *integration* testing
- *Real-time*, *performance*, *load* and *stress* testing
- *Security* testing
- *Regression* testing

THE ECLIPSE PROJECT

- **Supplement to running Eclipse projects**
 - Paho, OM2M, Titan
- **New project at Eclipse Foundation:**
<https://projects.eclipse.org/projects/technology.iottestware>
 - TTCN-3 test suites for **CoAP, MQTT, OPC-UA**, LoRa?
- Assured **licenses** for users
- **Currently a cooperation of**
relayr GmbH, Ericsson, LAAS/CNRS, itemis AG, Spirent Communications,
Easy Global Market, Iskratel/Sintesis, Fraunhofer FOKUS, ...



SAMPLE TESTSUITE STRUCTURE: MQTT



– **Broker as SUT**

- All mandatory message data fields
 - Regular and illegal data (Fixed/variable header, payload)
- Protocol features
 - General
 - Connect/disconnect (session)
 - Subscribe/unsubscribe
 - Immediate publish
 - Last will and Testament (LWT)
 - Heartbeats keepAlive values
 - Topic
 - Error handling

– **Client as SUT**

– ...

TEST DEVELOPMENT SAMPLE: MQTT

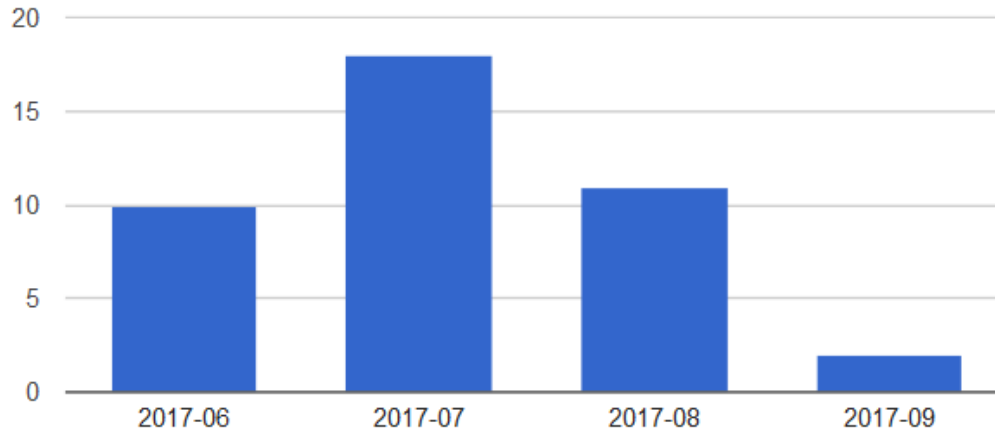
- ✓ **Test configurations**
- ✓ **Test Suite Structure**
- ✓ **Test purpose (catalogue)**
- ✓ **Test implementation (TTCN-3)**

TP-ID	TP_MQTT_Broker_CONNECT_001
Selection	PIC_Broker
Summary	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]
Initial condition	
Test purpose	
Ensure that the IUT on receipt of an CONNECT message containing header_flags := '1111'B sends no RESPONSE message and closes the Network Connection	
Comments	

STATUS: ECLIPSE IOT-TESTWARE REPOSITORY

Contribution Activity:

Commits on this project (last 12 months).



<https://github.com/eclipse/iottestware.git>

MQTT BROKER EVALUATION (JULY 2017)

Broker	Version	PASS		FAIL		INCONCLUSIVE	
		#	%	#	%	#	%
Mosquitto	1.4.14	40	88,89%	3	6,67%	2	4,44%
VerneMQ	1.1.0	39	86,67%	3	6,67%	3	6,67%
HiveMQ	broker.hivemq.org	39	86,67%	4	8,89%	2	4,44%
EMQ	2.0	36	80,00%	7	15,56%	2	4,44%
Iannister	?	31	68,89%	12	26,67%	2	4,44%
ActiveMQ	5.14.5	31	68,89%	12	26,67%	2	4,44%
RSMB	?	26	57,78%	17	37,78%	2	4,44%
RabbitMQ	3.5.7	21	46,67%	24	53,33%	0	0,00%
Mosca	2.5.1	19	42,22%	24	53,33%	2	4,44%
Moquette	0.10	16	35,56%	29	64,44%	0	0,00%
HBMQTT	0.9	15	33,33%	30	66,67%	0	0,00%

ECLIPSE TITAN - THE TEST EXECUTION TOOL

TTCN-3

THE standard test language

Functional testing: conformance, function, interoperability, end-to-end, regression
Performance and stress tests
Security testing



Programming language designed for testing: multi-process, timers, alternative responses, matching to wildcards

Abstract: reusable code, independent of environment

Continuous maintenance and extensions

Directly supports **ASN.1**



Test types and domains



Functional



Telco



Performance



Automotive 

IoT



Model-based



Smart metering 

Security

Web services 

and more...



Ecosystem

Code development
Designer
Titanium

Test execution
Executor

Test result & log analysis
LogViewer

Compiler XSD2TTCN MC Utilities

Protocol support

50+ protocols
Automotive: CAN-bus
C-ITS: all protocols
IoT: HTMLS, MQTT
CoAPs, WebSocket
Auto-codex generation:
text, binary, ASN.1BER,
XML, JSON

Users

ERICSSON

EfficiOS

osmocom



UNIVERSITY OF AMSTERDAM



APPROACH

✓ Advanced testing technology:



✓ (Open source) IoT-Testware (code):

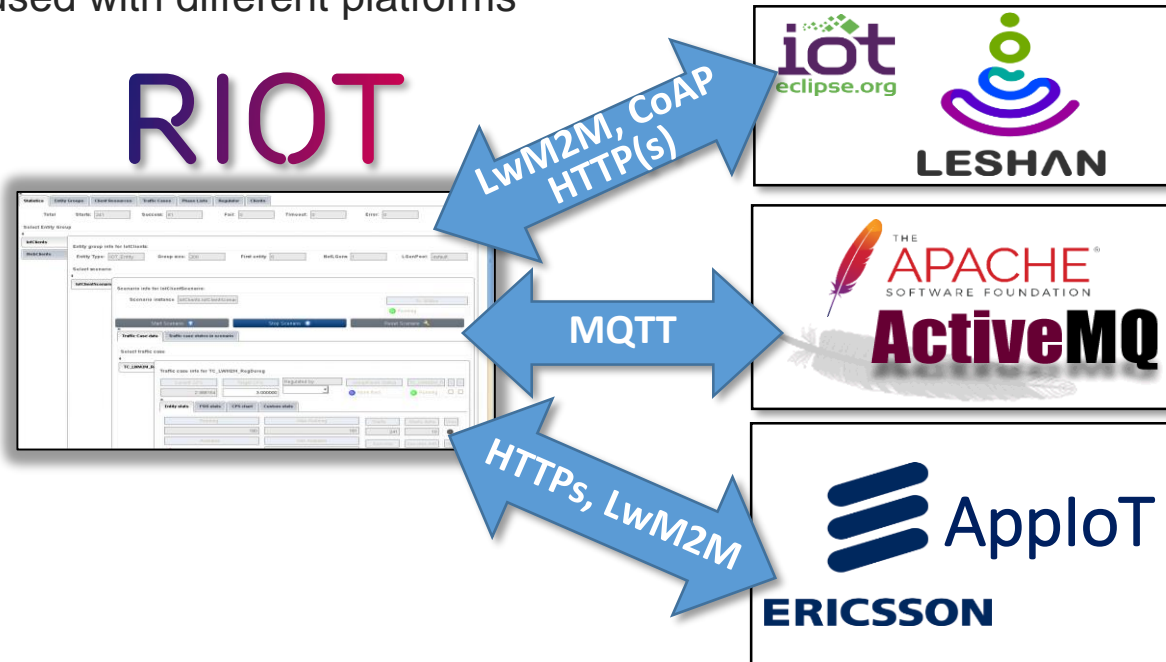


✓ Standardized IoT test purposes:



FUTURE: PERFORMANCE TESTS, VULNERABILITY TESTING

- RIoT: IoT performance/load tester
 - Open sourcing is ongoing
 - Has been used with different platforms



ETSI TC MTS

- **New Working Group (TST)** will develop IoT test catalogues and specifications (not covered elsewhere).
- The types of testing include conformance, interoperability, security and performance testing.
- The initial technical focus will be:
 - IoT network layer (communication protocols, node connectivity, edge computing etc.),
 - IoT layer (data accumulation and aggregation),
 - Application layer (interfaces, business processes etc.).



CONTACTS

Thank you for your attention!

György Réthy

Ericsson

gyorgy.rethy@ericsson.com

Axel Rennoch

Fraunhofer FOKUS

axel.rennoch@fokus.fraunhofer.de