

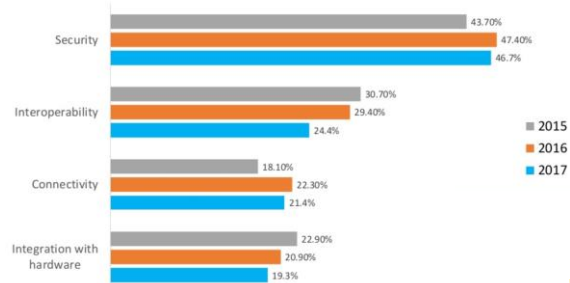
MTS WG TST MOTIVATION

Axel Rennoch, Sascha Kretschmann, Michael Wagner
MTS#72, Göttingen, September 26, 2017



TRENDS IN IOT

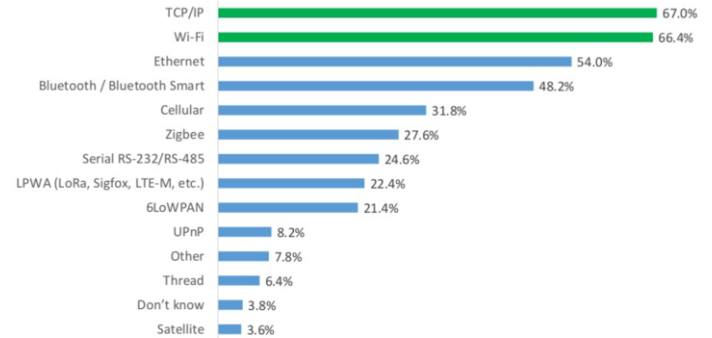
TOP IOT CONCERNS / TRENDS 2015-2017



IoT Developer Survey 2017 - Copyright Eclipse Foundation, Inc.

CONNECTIVITY PROTOCOLS

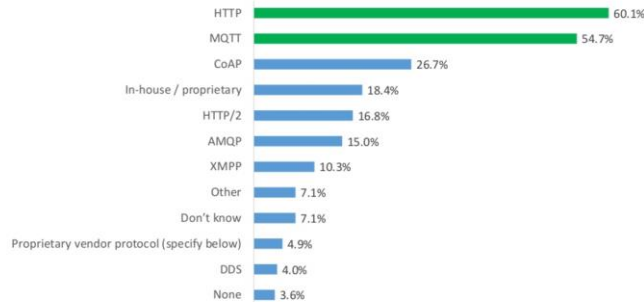
What connectivity protocol(s) do you use for your IoT solution?



IoT Developer Survey 2017 - Copyright Eclipse Foundation, Inc.

MESSAGING STANDARDS

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



IoT Developer Survey 2017 - Copyright Eclipse Foundation, Inc.

REFERENCE MODEL (ONE OF MANY)

IOT PRINCIPAL COMMUNICATION ARCHITECTURE

APPLICATION LEVEL

Endpoints and Applications
(User interfaces and access)

Processes
(Collaboration and business processes)

Services
(Reporting, command and control)

Control center and cockpits

Service and application frameworks

PLATFORM LEVEL

Data Analytics and Visualization
(Aggregation, mash ups, etc.)

*Remote computation
(learning, constraint solving, rule engines, decision management, etc.)*

Data Storage
(Accumulation)

*Also data from other sources
incl. open data*

NETWORK LEVEL

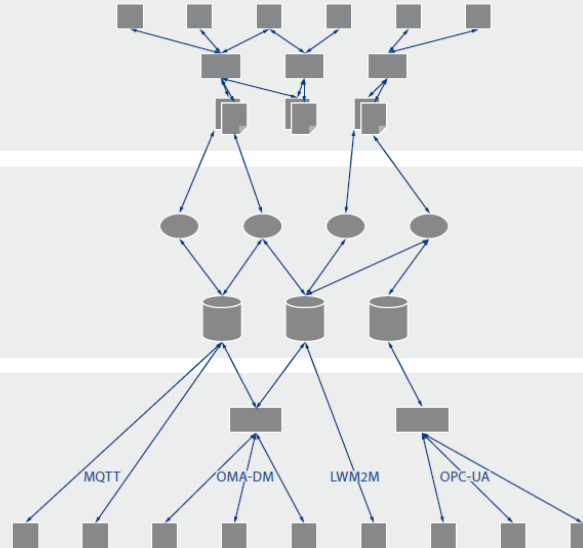
Edge Computing
(Node data analysis)

Local computation

Node Connectivity
(Interoperable, heterogeneous)

Also CoAP, HTTP, or proprietary

Edge Nodes (Intelligent, of all types –
sensors, devices, machines)



TEST OBJECTS

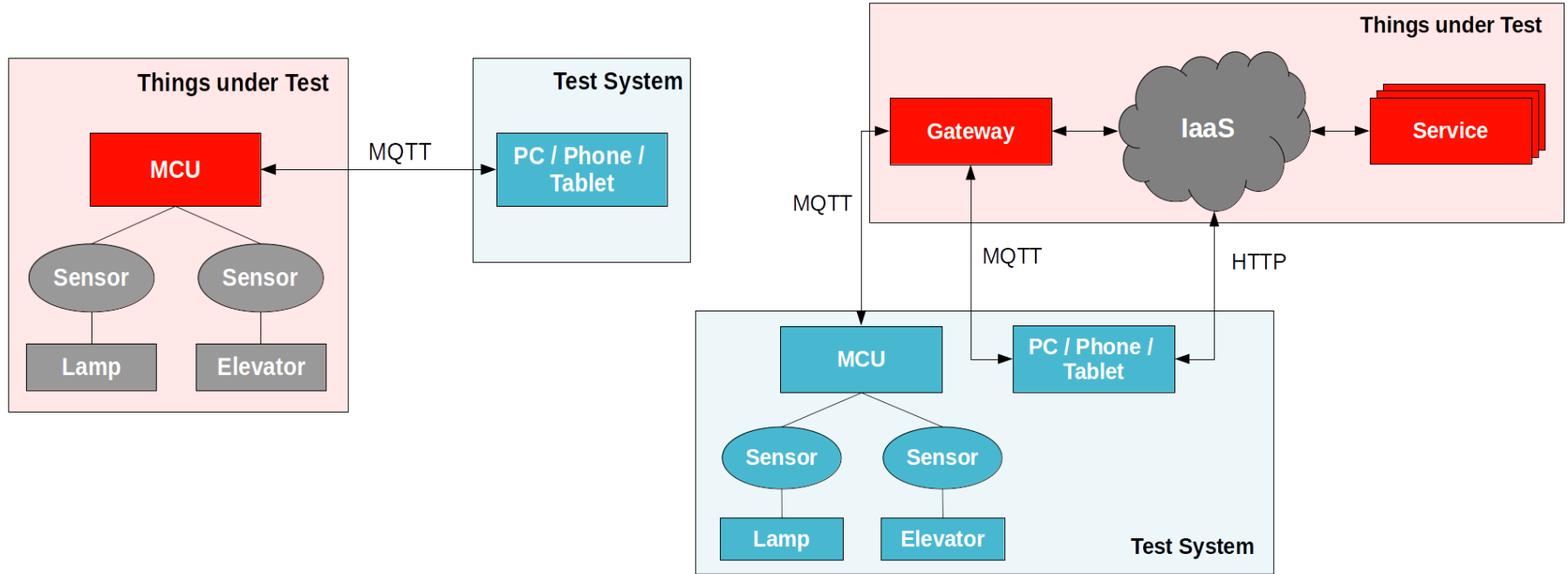
- IoT devices,
 - Mikrocontroller (**MCU**),
 - **Gateways** (Bosch XDK, IoT starterkits)
- IoT platforms
 - RIOT, relayr, Thread, mbed...
 - service layer (oneM2M, FiWare)
- IoT protocols
 - Constrained Application Protocol (**CoAP**)
 - MQ Telemetry Transport (**MQTT**)



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

MULTIPLE TEST CONFIGURATION (SAMPLES)



TESTWARE

- **Toolset** (*selection of available means*)

Protocol tester/monitor (Eclipse Titan, Wireshark)

Test devices (RFID kit, Bluetooth test device)

GUI tester (Selenium, SikuliX, Chrome headless)

Web services tester (soapUI)

...

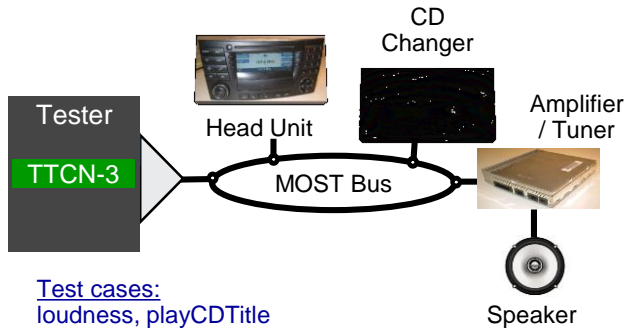
- **Public Testsuites** (*in preparation*)
 - Application of a standardized notation
 - Abstract and platform-independent



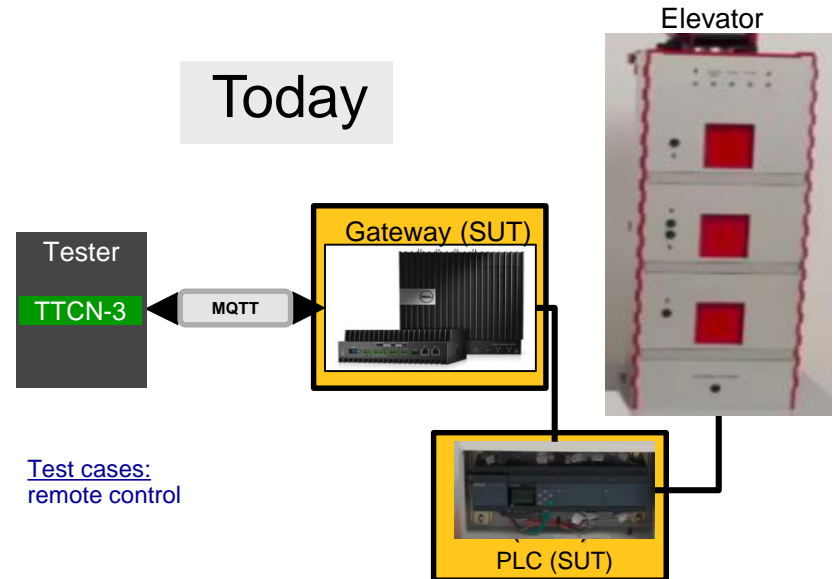
TTCN-3 FOR IOT

- Test technology address **various protocols** and **interfaces**
- Control of **real** and/or **virtual devices**
(special hardware-interfaces, simulators)

Earlier days



Today



CONTRIBUTION TO IOT TESTING

What else?



THE CONTEXT

The screenshot shows the Eclipse IoT Projects website. At the top left is the 'iot eclipse.org' logo. The navigation menu includes 'GETTING STARTED', 'TECHNOLOGY', 'COMMUNITY', 'WORKING GROUP', and a 'Follow' button with a Twitter icon. The main heading is 'Projects', followed by a description: 'Eclipse IoT open source projects help you build IoT Devices, Gateways ("Smart Objects"), Cloud backends, and more. Use the list below to find the project that's right for you.' Below this is a search bar with the placeholder text 'Start typing to filter projects...'. There are two sorting buttons: 'Sort by downloads' and 'Sort by name'. A row of category buttons includes 'Devices', 'Gateways', 'Cloud', 'Standards', 'Tools', 'Ontologies', and 'Security'. The 'Eclipse Paho' project is highlighted, with sub-categories 'Standards' and 'Devices'. The description for Paho states: 'The Paho project provides reliable open-source implementations of open and standard messaging protocols aimed at new, existing, and emerging applications for Machine-to-Machine (M2M) and Internet of Things (IoT). Paho reflects the inherent physical [...]'. To the right of the description, it shows 'Monthly downloads: 32.7 k' and 'Latest release: 1.3.0 (Oxygen)'.

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 in cooperation with**
relayr GmbH, Ericsson, LAAS/CNRS, itemis AG, Spirent Communications,
Easy Global Market, Iskratel/Sintesio, ...



IOT-TESTWARE



GETTING STARTED MEMBERS PROJECTS MORE ▾

Create account Log in

Google Custom Search

DOWNLOAD

HOME / PROJECTS / TECHNOLOGY PROJECT / ECLIPSE IOT-TESTWARE / ECLIPSE IOT-TESTWARE

This proposal has been approved and the **Eclipse IoT-Testware** project has been created.

Eclipse IoT-Testware

BASICS

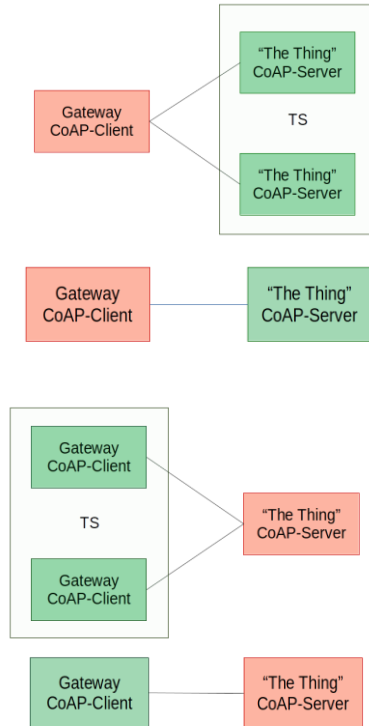
This proposal is in the Project Proposal Phase (as defined in the **Eclipse Development Process**) and is written to declare its intent and scope. We solicit additional participation and input from the community. Please login and add your feedback in the comments section.

Parent Project:
Technology Project

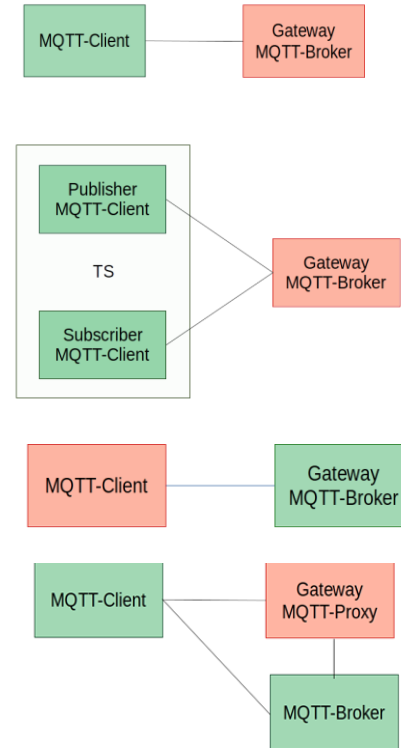


TEST CONFIGURATIONS

CoAP



MQTT



TESTSUITE STRUCTURE

CoAP

Test Suite Structure

Server as SUT

- All mandatory message data fields
 - Support all defined method codes and understand regular and illegal or corrupted data along with them
- Protocol features
 - General
 - Block transfer
 - Piggybacked responses
 - Message Types (ACK, CON, NON-con, ReSeT)
 - Options
 - Max-Age
 - Token option
 - Several URI-path options
 - Several URI-query options
 - Lossy context
 - Discovery service
 - Error handling

MQTT

Test Suite Structure

Broker as SUT

- All mandatory message data fields
 - Regular and illegal/corrupted data
 - Fixed Header
 - Variable Header
 - Payload
 - Client identifier length restriction (up to 65535 bytes)
 - UTF-8 encoding
- Protocol features
 - General
 - QoS levels
 - Delivery retransmission
 - Retained messages
 - Message ordering
 - Anonymous client identifier
 - Connect/disconnect (session handling)
 - Credentials
 - Session initiation
 - Session states
 - Subscribe
 - Unsubscribe
 - Immediate publish (w/o awaiting for CONNACK)
 - Last Will and Testament (LWT) message
 - Heartbeats: keepAlive values (max timeout between message exchange)
 - Topic names/filters
 - Error handling

Client as SUT

- All mandatory message data fields
 - Regular and illegal/corrupted data
 - UTF-8 encoded Strings

TEST PURPOSES

CoAP

TP-ID	TP_CoAP_Server_001
Selection	PIC_Server
Summary	The IUT is responding on a RESET message.
Reference	RFC7252#section4.2
Initial condition	none
Test purpose	
Ensure that the IUT on receipt of an EMPTY message containing msg_type := 0 (CONFIRMABLE) containing code := 0.00 sends a RESPONSE message containing msg_type := 3 (ReSeT)	
Comments	

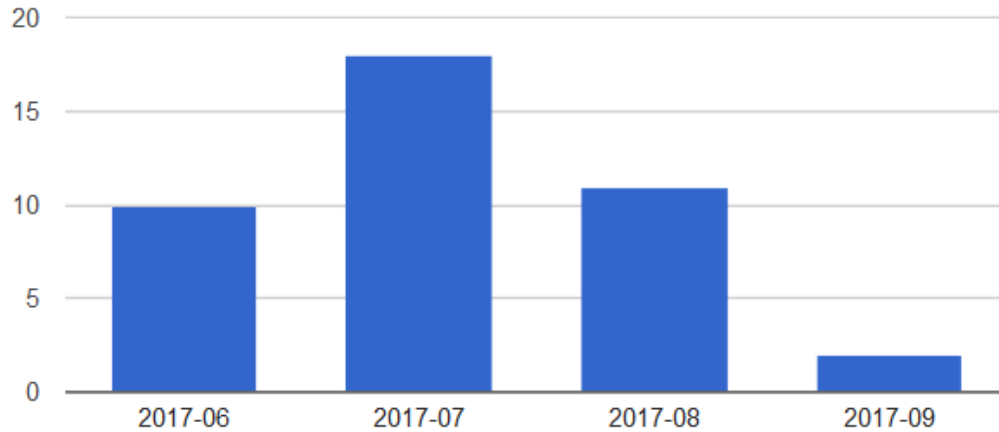
MQTT

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	

TTCN-3 REPOSITORY

Contribution Activity:

Commits on this project (last 12 months).



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

THE TEST EXECUTION TOOL



Create account Log in

Google Custom Search

DONATE

GETTING STARTED MEMBERS PROJECTS MORE

HOME / PROJECTS / TOOLS PROJECT / ECLIPSE TITAN

Eclipse Titan

Overview Downloads Who's Involved Developer Resources Governance Contact Us

Titan is a TTCN-3 compilation and execution environment with an Eclipse-based IDE. TTCN-3 is a modular language specifically designed for testing (the acronym itself stands for Test and Test Conformance Notation), standardized by ETSI (see www.ttcn-3.org) and endorsed by ITU. The user of the tool can develop test cases, test execution logic and build the executable test suite for several platforms. Titan consists of a core part, executing in a Unix/Linux-like environment and a set of Eclipse plug-ins.

Titan



MQTT BROKER EVALUATION WITH IOT-TESTWARE (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%

Tabelle 1: MQTT Broker Evaluation mit MQTT-Titan-Test Suite (Juli 2017)

APPROACH

✓ Advanced + mature testing technology: 

✓ (open source) community: 

✓ Standardized basis (for certification): 

CALENDAR TO PROMOTE THE WG

- **STV17/INTUITEST** workshops: **10.10.2017**
- **UCAAT** conference: **11-13.10.2017**
- **ETSI IoT-Week**: **23-26.10.2017**

- Industrial IoT Forum: **08.11.2017**
- **ASQF** Quality Day: **29.11.2017**

Thank you for your attention!

CONTACTS

Fraunhofer FOKUS

Business Unit Quality Engineering (SQC)

Kaiserin-Augusta-Allee 31

10589 Berlin, Germany

<https://www.fokus.fraunhofer.de/sqc>

Axel Rennoch

axel.rennoch@fokus.fraunhofer.de

phone +49 30 3463-7344