A FLEXIBLE, MULTI-PURPOSE, OPEN SOURCE TEST PLATFORM FOR IOT TESTING

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CONNECTED DEVICES IN 2022

29 BILLION

18.1 BILLION M2M/IOT DEVICES

8.6 BILLION MOBILE PHONES

3 BILLION PC/TABLET/LAPTOOP/FIXED PHONES

5.6 BILLION IN 2016

Machine to Machine

Connect autonomous devices to an application server
(device ↔ server)

Internet of Things

Connect autonomous devices to each other as well
(device ↔ device)

Source: Ericsson Mobility Report November 2016
IOT/M2M COMMUNICATION
- EVOLVING WITH WIDE RANGE OF REQUIREMENTS

MASSIVE IOT
- SMART BUILDING
- LOGISTICS, TRACKING AND FLEET MANAGEMENT
- SMART METER
- SMART AGRICULTURE
- CAPILLARY NETWORKS

CELLULAR M2M TODAY
- ELECTRICITY METERS
- CONNECTED CARS
- POS TERMINALS
- ETC

~400 million cellular M2M connections today
- Majority over GPRS

CRITICAL IOT
- REMOTE HEALTH CARE
- TRAFFIC SAFETY & CONTROL
- INDUSTRIAL APPLICATION & CONTROL
- REMOTE MANUFACTURING, TRAINING, SURGERY

Massive IoT Radio Access
- LOW COST, LOW ENERGY
- SMALL DATA VOLUMES
- MASSIVE NUMBERS

4G Evolution & 5G
- ULTRA RELIABLE
- VERY LOW LATENCY
- VERY HIGH AVAILABILITY
Cellular for Massive IoT
Meeting diversity of use case requirements

<table>
<thead>
<tr>
<th>Technology</th>
<th>Bandwidth</th>
<th>Coverage</th>
<th>Battery Life</th>
<th>Throughput (peak)</th>
<th>Security</th>
<th>Mobility</th>
<th>Deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat-M1</td>
<td>1.4MHz</td>
<td>160dB (+15dB)</td>
<td>10+ Year</td>
<td>0.8/1 Mbps full duplex</td>
<td>SW</td>
<td>SW</td>
<td>SW</td>
</tr>
<tr>
<td>NB-IoT</td>
<td>200kHz</td>
<td>164dB (+20dB)</td>
<td>10+ Year</td>
<td>227/250kbps multi-tone UL</td>
<td>SW</td>
<td>SW</td>
<td>SW</td>
</tr>
<tr>
<td>EC-GSM-IoT</td>
<td>600kHz</td>
<td>164dB (+20dB)</td>
<td>10+ Year</td>
<td>473/473kbps</td>
<td>SW</td>
<td>SW</td>
<td>SW</td>
</tr>
</tbody>
</table>
Massive IoT in Ericsson

- **Massive IoT Infrastructure**
  - LTE-M
  - NB-IoT
  - EC-GSM
  - GPRS
  - LTE CAT1-4
  - LoRa

- **Wi-Fi**
- **Thread**
- **BLE**
- **Capillary networks for non-3GPP devices**

- **Mobile Broadband**

- **3GPP LPWA access**

- **Non-3GPP LPWA access**

- **IoT Cloud Services**
  - DCP
  - IoT Platform
  - IoT Apps

- Typically delivered as a service

- Delivered either on-premises or partly as a service
System under test: things

Massive IoT Infrastructure

Delivered either on-premises or partly as a service

Mobile Broadband

Typically delivered as a service

IoT Cloud Services

3GPP LPWA access

Non-3GPP LPWA access

Capillary networks for non-3GPP devices

LTE-M

NB-IoT

EC-GSM

LTE CAT1-4

GPRS

LTE

Wi-Fi

Thread

BLE

LoRa

Capillary networks for non-3GPP devices

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System under test: infrastructure

Massive IoT Infrastructure

Delivered either on-premises or partly as a service

Typically delivered as a service

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System under test: platform

Massive IoT Infrastructure

Mobile Broadband

Typically delivered as a service

Delivered either on-premises or partly as a service

IoT Cloud Services

3GPP LPWA access

Non-3GPP LPWA access

Wi-Fi

Thread

BLE

Capillary networks for non-3GPP devices

LTE - LTE-M, NB-IoT, EC-GSM

LTE CAT1-4

GPRS

LTE

IoT Apps

IoT Platform

DCP

GPRS

Capillary networks for non-3GPP devices

LoRa

Non-3GPP LPWA access

Mobile Broadband
Testing challenges

1. Scaling-up to millions of IoT devices with new traffic patterns
   - Capacity, Scalability Tests

2. IoT traffic may cause disturbances for other mobile subscribers
   - Coexistence Tests

3. Diverse set of IoT functionalities and applied technologies
   - Functional Tests

4. New security risks
   - Security Tests
IOT FUNCTION TESTING WITH TITAN
IoT testing with Titan

Titan: open-source TTCN-3 test automation framework

- Developed at Ericsson Hungary

Titan supports IoT protocols

- TCP/HTTP, TCP/MQTT, UDP/DTLS/CoAP, SMS/CoAP ...

oneM2M

- global consortium for standardizing IoT common services
- chosen Titan as the basis for oneM2M Tester

https://projects.eclipse.org/projects/tools.titan
“Internet of Lego”
Architecture of Lego truck

- **CONTROL LOGIC**
- **TITAN**
- **RASPBERRY PI 3**
- **HARDWARE (motors)**

- **MQTT** (Internet)
- **HTTP**

- **IoT**
- **App**

- io.eclipse.org
IOT TRAFFIC SIMULATION WITH RIOT
IoT traffic with RIOT (TTCN-3)

**Protocol Stacks**
- Finite State Machine based
- Simulating huge number of instances

**Protocol Stacks**
- Non-blocking functions
- Handling large number of sessions

**Core Load Library**
- Load generator components
- Resource mgmt.
- Scheduling
- REST API for presentation
IoT traffic with RIOT (TTCN-3)

- Protocol Stacks
  - Finite State Machine based
  - Simulating huge number of instances

- Core Load Library
  - Load generator components
  - Resource mgmt.
  - Scheduling
  - REST API for presentation

Will be open sourced soon!
IoT traffic with RIOT
IoT traffic example

RIOT

- Device Simulation (FSMs)
  - LwM2M Devices
  - Web Clients
- LwM2M Library
- CoAP Library
- Core Load Library

traffic

LESHAN

eclipse.org
IoT traffic example
IoT traffic example
IoT traffic example
IoT traffic example

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IoT traffic example
**IoT traffic example**