HOP Ubiquitous Overview

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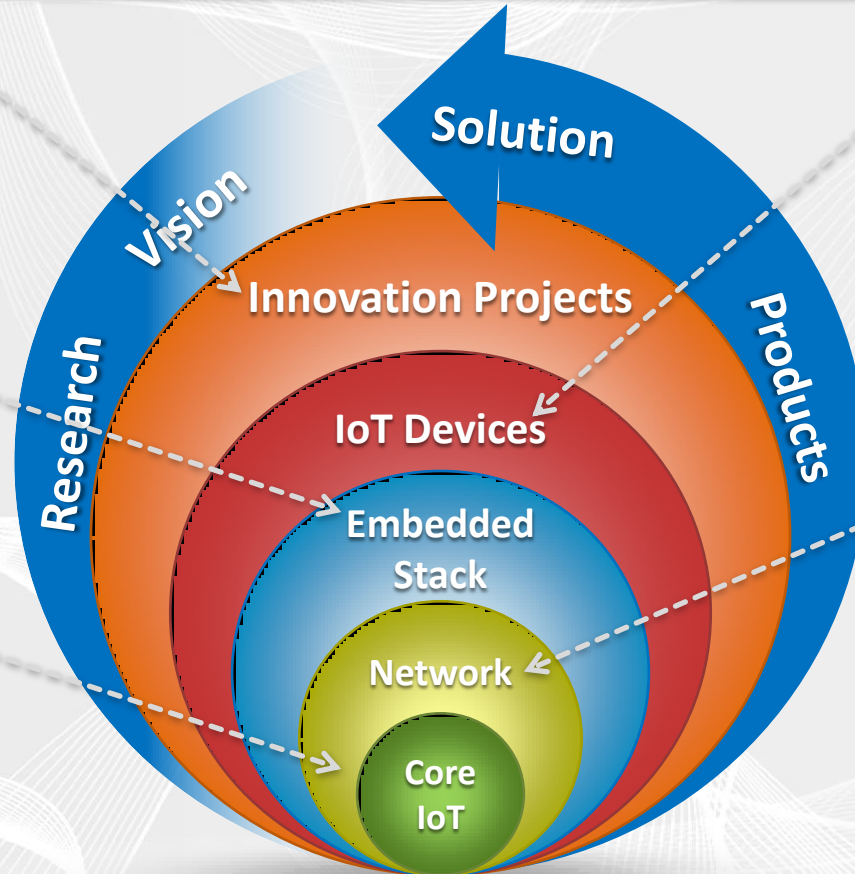# HOP Ubiquitous

Innovation Projects

- H2020 INPUT
- ENIAC SAFESENS
- EIT ICT LAB

Embedded Stack

- Advanced Security & management
- Ease-to-use enabler
- Cloud Connectivity
- Standards

IoT

- >8 years experience
- World-wide IoT reputation/recognition
- Vision & expertise

IoT Devices

- Bluetooth Smart
- Ubibox (Gateway)
- Mobile Set-up tool
- HOP Basic (Enabler)
- HOP Extended (All in one: Sensors and Kit)
- HOP Core (haku)

Network

- IPv6: GLoWBAL IPv6
- Security: Shifting Primes ECC and EAP
- Maintenance: TEPANOM
- OMA Device Mgmt.

Solution

Vision

Research

Products

Innovation Projects

IoT Devices

Embedded Stack

Network

Core IoT

HOP Products Ecosystem

OMA
Open Mobile Alliance
For a Connected World

OMA LWM2M App

RESTFul / CoAP communication between the Applications and Objects

OMA LWM2M Server

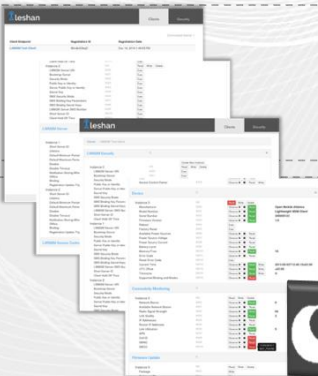**Device Management**, *Repository, Directory, Bootstraping Server, Security*

Application Enablementt

homard
OMA Resources Dashboard

Network

Interworking: Cellular & Capillary Configuration tools

LWM2M **mobile**
HOP Configurator

OMA LWM2M Client

OMA Web Objects *(Resources)*
Temperature, battery, firmware…

CLOUD
CONNECTED PLATFORM

IPv6 / UDP / CoAP / DTLS

OMA LWM2M

Applications

Services

Network

Things
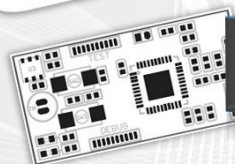
LWM2M
DevKit

LWM2M **sensor**

LWM2M **sensor**

haku

hop

1

HOP Basic

Connectivity
(IPv6 / REST)

Interoperability
(Android & iOS)

Versatility
(Configurable)

Integrability
(Tiny & comm int.)

2

HOP keyring

OPEN · IoT
Powered by HOP

3

HOP Core

4

HOP Wear

5

HOP Haku

haku
Powered by HOP

6

HOP Extended
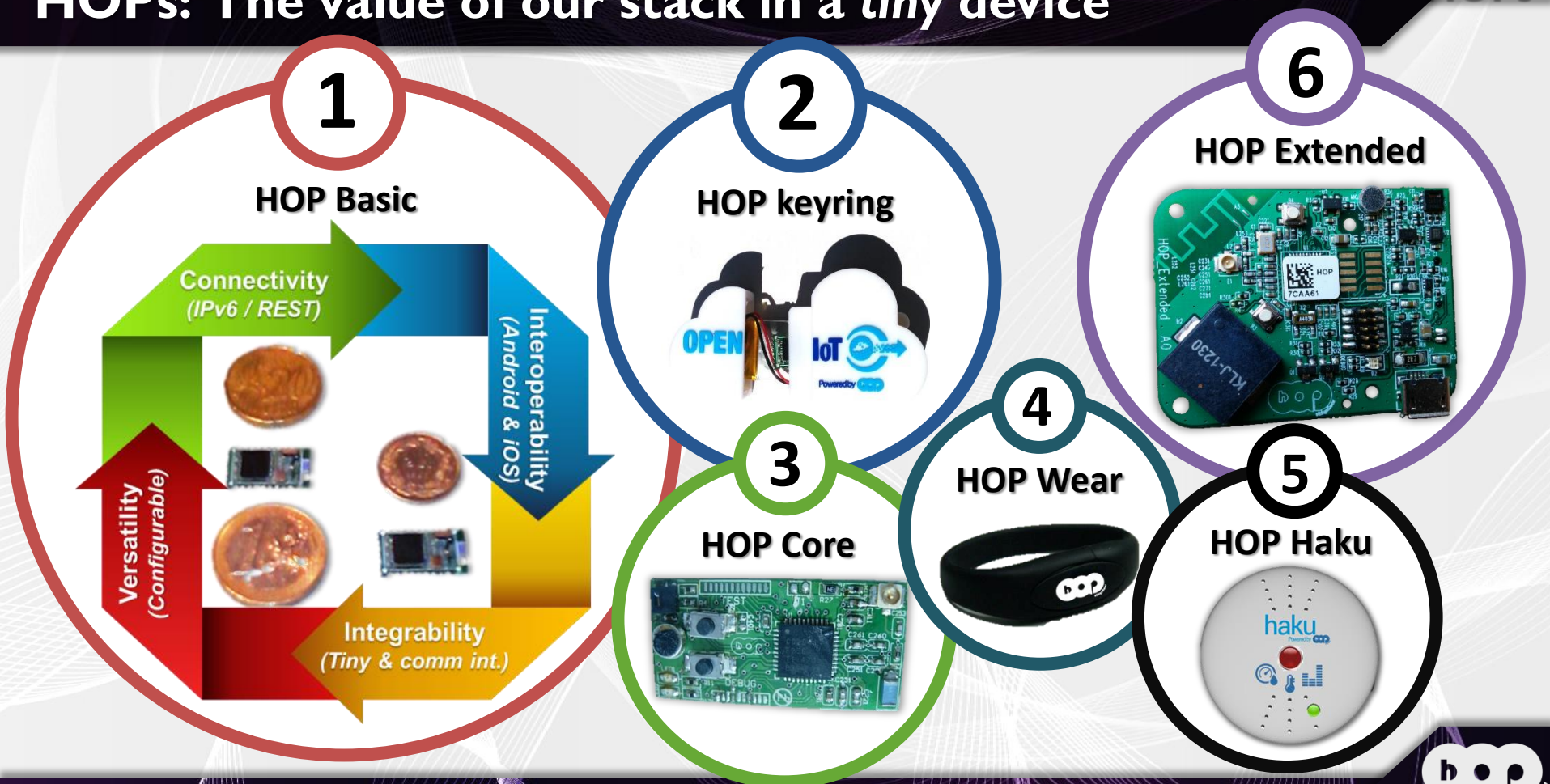
LWM2M Sensor: HOP Core *30 x 15mm*

GPIO

General Purpose Inputs and Outputs

Temperature & Humidty

Environmental monitor

External Antenna

IPEX Connector for external Antenna for infrastructure deployments (10 – 90 meters coverage)

Microphone

Activity analysis based on noise

LEDs

Notifications and status indication
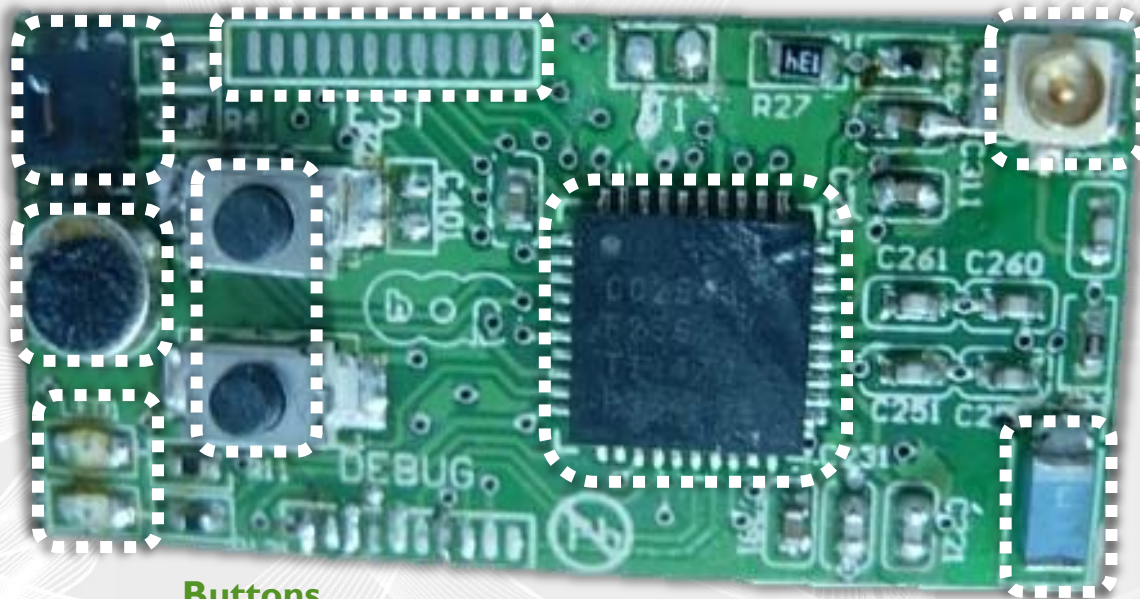
Antenna

Ceramic Antenna for personal area and proximity solutions (1 – 10 meters coverage)

Buttons

Interaction with the User

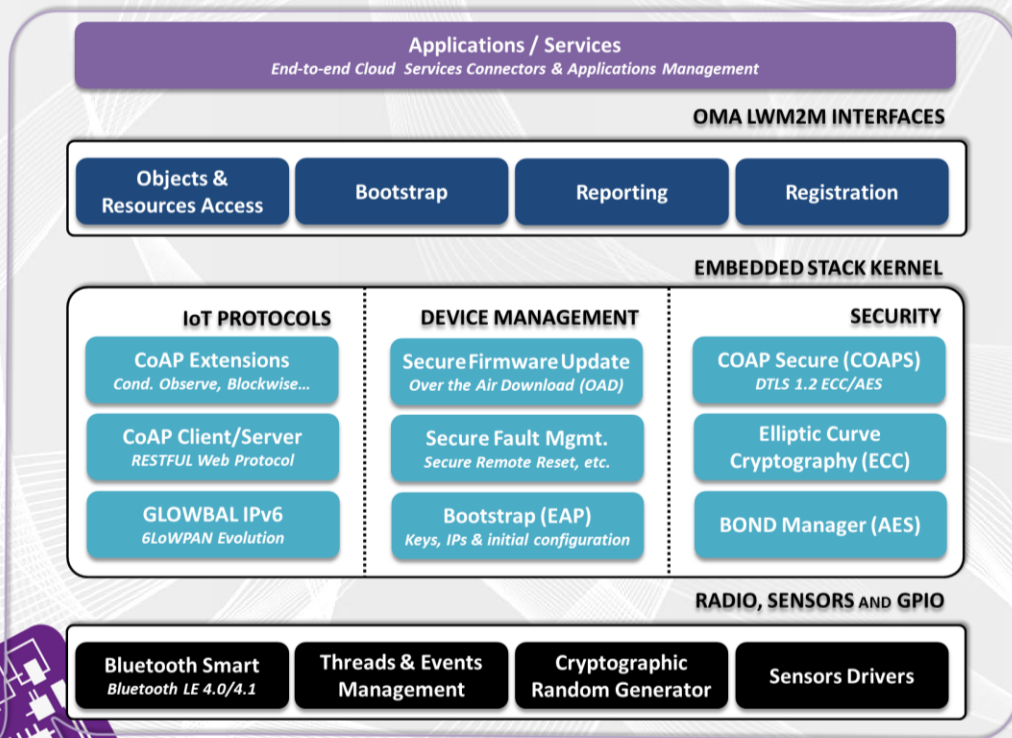**Bluetooth Smart**

System on Chip Bluetooth Smart and OMA LWM2M / CoAP / IPv6 transceiver

IoT Embedded Stack: OMA Client

Applications / Services
End-to-end Cloud Services Connectors & Applications Management

OMA LWM2M INTERFACES

Objects & Resources Access	Bootstrap	Reporting	Registration

EMBEDDED STACK KERNEL

IoT PROTOCOLS

CoAP Extensions
Cond. Observe, Blockwise...

CoAP Client/Server
RESTFUL Web Protocol

GLOWBAL IPv6
6LoWPAN Evolution

DEVICE MANAGEMENT

Secure Firmware Update
Over the Air Download (OAD)

Secure Fault Mgmt.
Secure Remote Reset, etc.

Bootstrap (EAP)
Keys, IPs & initial configuration

SECURITY

COAP Secure (COAPS)
DTLS 1.2 ECC/AES

Elliptic Curve Cryptography (ECC)

BOND Manager (AES)

RADIO, SENSORS and GPIO

Bluetooth Smart *Bluetooth LE 4.0/4.1*	Threads & Events Management	Cryptographic Random Generator	Sensors Drivers

1. IPv6-oriented *(CoAP/UDP/DTLS)*
2. OMA LWM2M
3. Security by design
4. Bluetooth 4.2 (IPv6 and ECC)
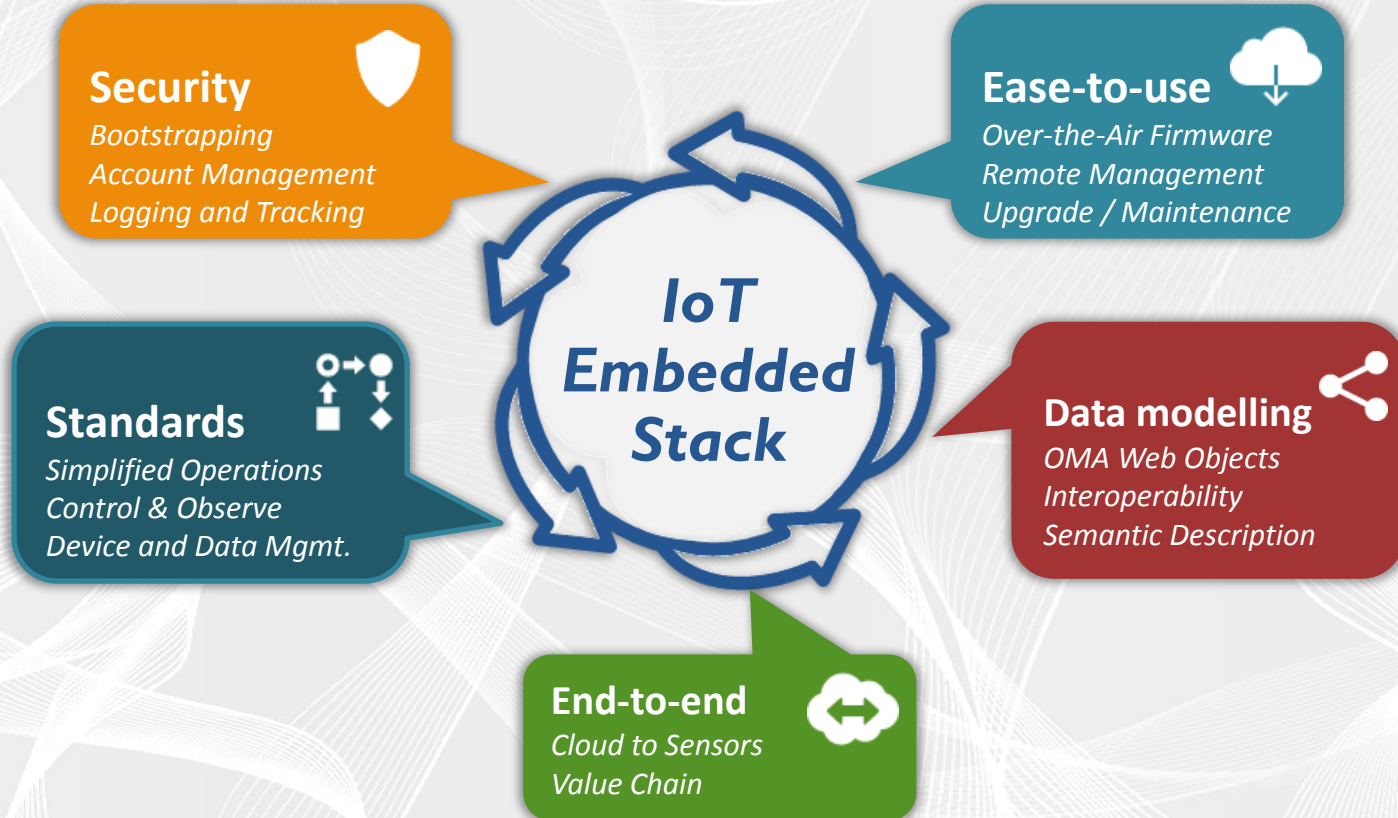5. HOP Configurator *(Mobile Tool)*
6. Stream support *(Real Time, Pub-Sub, Management)*

IoT Embedded Stack (OMA LWM2M-compliant)

Security
Bootstrapping
Account Management
Logging and Tracking

Ease-to-use
Over-the-Air Firmware
Remote Management
Upgrade / Maintenance

IoT Embedded Stack

Standards
Simplified Operations
Control & Observe
Device and Data Mgmt.

Data modelling
OMA Web Objects
Interoperability
Semantic Description

End-to-end
Cloud to Sensors
Value Chain

Commissioning & management Tools

HOP Engineer Tool

HOP

HOP Configurator

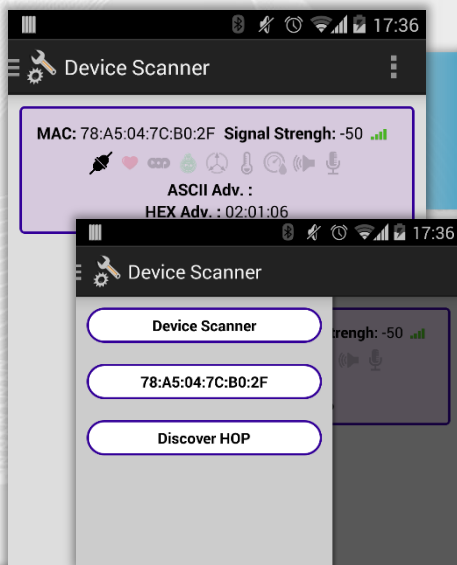An engineering tool that presents the capabilities from HOP Ubiquitous for device management

Discovery & commissioning

Scan, discovery and set-up of security / bonding

Services Analysis

Services description, interfaces for read/set and subscription
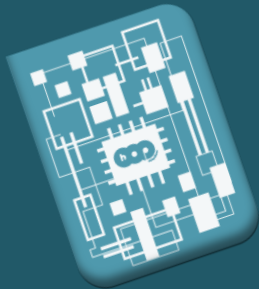
Interfaces

Interfaces Tests and Sensors interfaces

Firmware OTA

Cloud Repository & firmware update
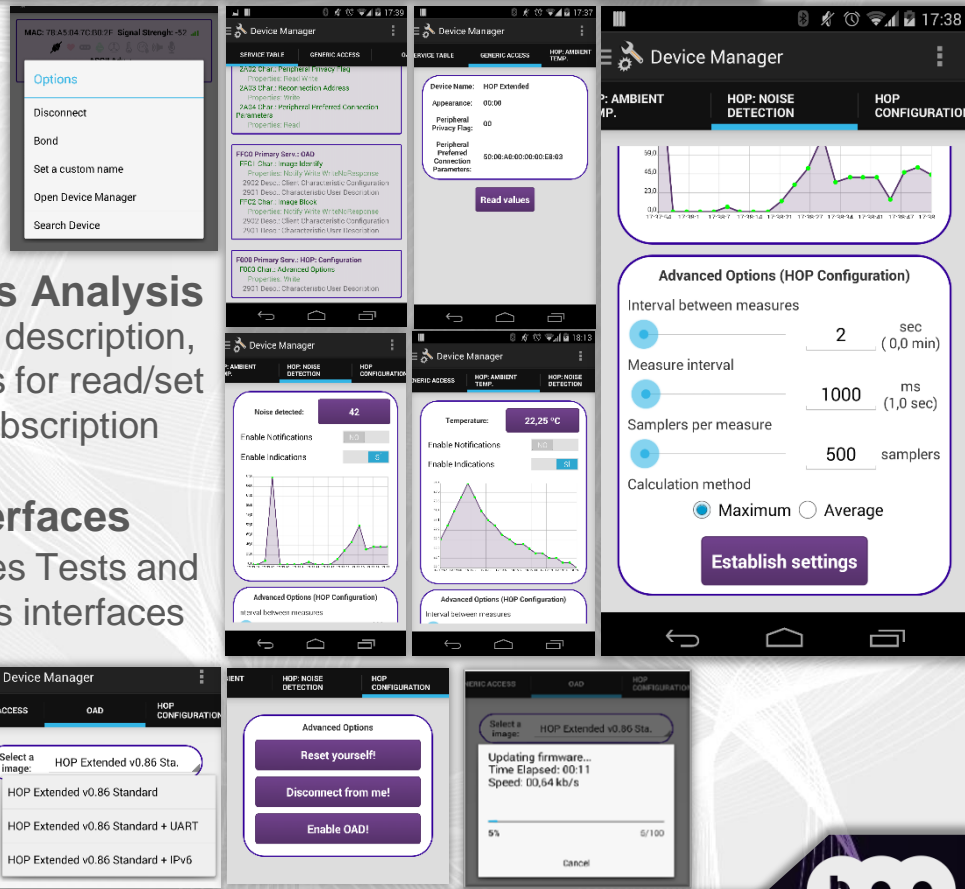
Cloud integration

Why is required to connect Things to the Cloud?

THING
SMART OBJECT : HOP

Connectivity
Maintain a device session

Control and Healing
Set and monitor of device status

Management
Account / Devices / Applications

Real-time Stream Processing
Complex Events Processing (Alerts)

Persistant Data Storage
Historical Data Analytics (Insights)

Cooperation
WEB APIs and Interoperability

CLOUD
CONNECTED PLATFORM

IoT Services Platform: oneM2M

Background

The M2M market is highly fragmented with many players across numerous vertical domains.

oneM2M members are working on a standardized horizontal service platform for M2M interoperability (coordination role among the key regional Standardization organizations: *ETSI/ARIB/ATIS/CCSA/TIA/TTA/TTC*

Globalization

Global standards with over 200 member organizations

Functionalities across different industry segments/silos

Interworking between cellular and capillary providers (broadband forum, ZigBee Alliance, IPSO Alliance, Continua Alliance, Home Gateway Imitative...)

Horizontal architecture to combat fragmentation

IoT/M2M service layer

oneM2M Provides a Common Service y Layer including a set of common services for IoT/M2M interoperability

Software layer between the M2M application and the communication HW/SW hat provides data transport

It is designed for enabling distributed intelligence (device, gateway, clouds)

All the communications enabled with IP and Restful Web APIs

Tech. Specifications

TS-0001: Functional Architecture

TS-0002: Requirements

TS-0003: Security Solutions

TS-0005: Management – OMA LWM2M

TS-0006: Management – BBF

TS-0007: Service components

Re-use IP-based protocols
TS-0004: Service layer core protocols

Mapping:
TS-0008: CoAP
TS-0009: HTTP
TS-0010: MQTT *(coming)*

Architecture Overview: Applications Enablement

Standards-based **SERVICES** provide value-add functionality to IoT devices and applications

Applications

Common APIs

Horizontal Standards-Based IoT Service Layer

Data Management & Repository	Subscriptions, Events, Notifications	Group Management
Resource Discovery	Device Management	Security
Message Delivery Handling and Scheduling	Registration	Service Layer Management
Optimized Connectivity and Transport	Service Charging & Accounting	Addressing & Identification

Other Service Layers

Common APIs

Standards-based common **APIs** enable interoperable communications between diverse IoT applications as well as devices

Common APIs

Transport Network(s)

Local Network

Local Network

Local Network

Devices

Devices

OMA LWM2M: Introduction

Open Mobile Alliance (OMA) was established in 2002

OMA LWM2M is the evolution of the expertise from OMA in Device Management (DM) for addressing the new requirements from constrained devices and fill the gap between 3GPP, IETF CoAP, ETSI and OMA-DM

Background

Define interfaces, protocols (SMS, CoAP) and security support between machines and the server/cloud

Define a Object and Resources Data Model (Semantic)

Leverage the expertise in Device Management with support for firmware update, connectivity, discovery, access control, bootstrapping and remote management

Goals

Bootstrapping: Pre-provisioned of security credentials (keys, tokens) , configuration of LWM2M Servers IP, etc.

Registration: Register the Client and its OMA Web Objects in the Resource Directory (Local or Cloud)

Management and Service: Operational mode to read, update, and manage objects/resources

Information Reporting: Observation of Resources for events notification

Functions/Interfaces

A device can have multiple Objects. An Object is a collection of resources. A resource is the atomic piece of data (e.g., temperature value, sampling frequency)

OMA and other SDOs [1] can define and register Objects

Object Data Model presents a highly efficient payload

Objects and Resources can have multiple instances.
/{Obj. ID}/{Obj. Instance}/{Res. ID}/

Supported meta-data for security control such as Access Control List (ACL)

LWM2M Client		
Object 0		
Resource 1	R, W, E	
Resource 2	R	ACL
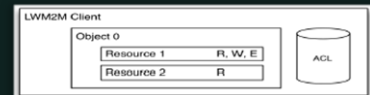
1- HOP Ubiquitous is member of IPSO Alliance & OMA Web Objects Builder.

Object Data Model

OMA LWM2M: Example of communication exchange

Bootstrapping

Request bootstrap for endpoint name →

Provision LWM2M Server Object(s) ←

thing   cloud

Subscription

GET 5/1/1 Observe ←

2.05 Content Observe →

thing   cloud

Management/Read

Read 2/0/0 ←

Success / OMA Object →

thing   cloud

Maintenance

Firmware Update ←

Execute ←

thing   cloud

CLOUD
CONNECTED PLATFORM

time

THING
SMART OBJECT : HOP

POST /rd?ep=12&q →

2.01 Created ←

thing   cloud

Registration

2.04 Changed Observed →

2.04 Changed Observed →

thing   cloud

Reporting

Write 3/0/1 Status off →

Success ←

thing   cloud

Management/Write

HeartBeat →

HeartBeat →

thing   cloud

Keep-alive

Architecture Overview *(Standards-driven perspective)*

IETF

OMA Open Mobile Alliance
For a Connected World

one M2M

Clients

***Web**, RESTFul
(CoAP, HTTP),
Browsers*

OMA LWM2M App

*RESTFul / CoAP communication
between the Applications and Objects*

Application Entity (AE)

*Fleet tracking App
remote blood sugar App
Power metering App*

Mca

Backend

***Servers**,
Data Centers, Cloud*

OMA LWM2M Server

***Device Management**, Repository,
Directory, Bootstraping Server, Security*

Common Services Entity (CSE)

*Data Mgmt, Device Mgmt,
M2M Subscription, Location Service*

Mcc

CLOUD
CONNECTED PLATFORM

Mcn

Routers

Connectivity & security:
*Routers, Switches,
NATs, Firewalls…*

Network

Interworking:
Cellular & Capillary

Network Services Entity (NSE)

*Device Mgmt, Device Triggering,
Addressing, Routing, QoS, Security*

IPv6 / UDP-TCP / CoAP-HTTP / DTLS
OMA LWM2M

Resources

*IP(v6) **Addressing**,
Transport (UDP/TCP),
Security (DTLS)*

OMA LWM2M Client

***OMA Web Objects** (Resources)
Temperature, battery, firmware…*

Application Dedicated Node (ADN)

***Sensors** / Appliances
Machines / Actuators*

hop *ubiquitous*

IoT Services platform (cloud-enabled)

Apps Enablement

- **Assemble / Compose** *(Builder)*
- **App Engine** *(Templates & Enablers)*
- **Marketplace** *(Services/Apps/3ed party)*

Analytics & Visualization

- **Rules Engine** *(CEP & Real-time Alerts)*
- **Big Data & Visualization** *(Insights)*

Maintenance

- **Device Virtualization** *(In-network Functions)*
- **Registration & Discovery**
- **Over The Air Firmware Upgrade**

Security

- **Account Mgmt.** *(Identity Mgmt. & Identification)*
- **Commissioning / Bootstrapping**
- **Data Security** *(DTLS, TLS, HTTPS)*

Management

- **Device Mgmt.**
- **Group Mgmt.**
- **Communication Mgmt. & Delivery**
- **Application and Service Layer Mgmt.**
- **Notification & Reporting** *(Pub/Sub)*
- **Data Mgmt.** *(Data model & Semantic)*

Monetization

- **Service Charging & accouting**
- **Connection Mgmt.** *(Pay as you go/per device)*
- **Logging & Tracking** *(Visibility)*

Connectivity

- **Connection API** *(CoAP / MQTT / HTTP)*
- **Device onboarding** *(Embedded Stack)*
- **Device Protocol Interpreter** *(Abstraction)*
- **Network Service Exposure** *(Scalability)*
- **Session Maintain** *(Heartbeat - Push)*
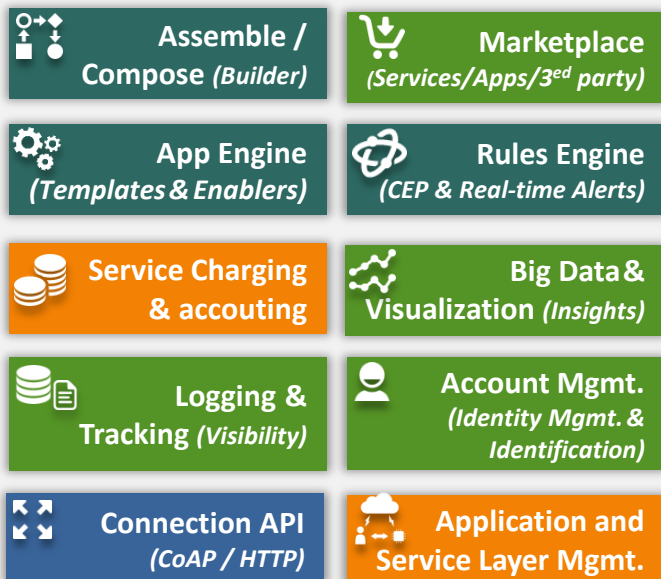
Legend:
- oneM2M (OMA LWM2M)
- oneM2M
- Added Value
- General
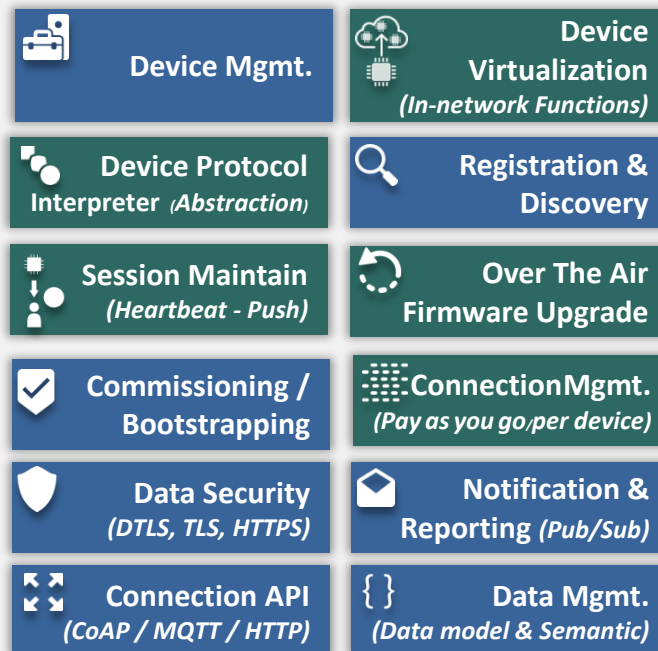
Potential synergies with Windows Azure

IoT Platform = Services Platform + IoT/OMA LWM2M

oneM2M

Services Platform

Windows Azure

Assemble / Compose *(Builder)*	**Marketplace** *(Services/Apps/3ed party)*
App Engine *(Templates & Enablers)*	**Rules Engine** *(CEP & Real-time Alerts)*
Service Charging & accouting	**Big Data & Visualization** *(Insights)*
Logging & Tracking *(Visibility)*	**Account Mgmt.** *(Identity Mgmt. & Identification)*
Connection API *(CoAP / HTTP)*	**Application and Service Layer Mgmt.**

IoT / OMA LWM2M

Device Mgmt.	**Device Virtualization** *(In-network Functions)*
Device Protocol Interpreter *(Abstraction)*	**Registration & Discovery**
Session Maintain *(Heartbeat - Push)*	**Over The Air Firmware Upgrade**
Commissioning / Bootstrapping	**ConnectionMgmt.** *(Pay as you go/per device)*
Data Security *(DTLS, TLS, HTTPS)*	**Notification & Reporting** *(Pub/Sub)*
Connection API *(CoAP / MQTT / HTTP)*	**Data Mgmt.** *(Data model & Semantic)*

Current collaborations in Cloud Computing and IoT integration

INPUT

In-Network Programmability for next-generation personal cloUd service supporT

Virtual Image
Things virtualization to provide functionalities (protocols, algorithms...) through the cloud Offloading storage and computational tasks from the end-device
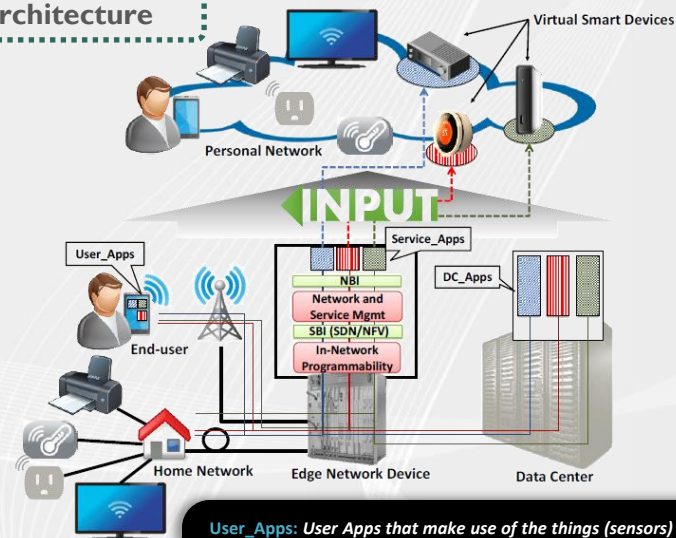
Personal Cloud
Private clouds closer to the user (in-network)

Orchestration
Cooperation of edge-network with backend (Data Centers / Cloud)

Architecture

Virtual Smart Devices
Personal Network
INPUT
User_Apps
Service_Apps
DC_Apps
NBI
Network and Service Mgmt
SBI (SDN/NFV)
In-Network Programmability
End-user
Home Network
Edge Network Device
Data Center

User_Apps: *User Apps that make use of the things (sensors) via the Northbound Interface (NBI) offered by the Edge-Network*
Service_Apps: *Virtualized functionalies in the edge-network of the Things - programmble with the Southbound Interface (SBI)*
DC_Apps: *Virtualized functions in the cloud that requires higher storage and computing capabilities*

Start Date: 01/2015
Kick-off Meeting : 2nd February 2015
Months: 36 months

CΠΙΤ   ERICSSON   TELECOM ITALIA
HORIZON 2020
UBITECH *ubiquitous solutions*   COSMOTE   DUBLIN CITY UNIVERSITY   hop *ubiquitou*   Julius-Maximilians- UNIVERSITÄT WÜRZBURG   Infocom s.r.l

A Real Business case with Fujitsu

Morrisons: Operational Efficiency

Dimensions

Information Technology

Analytics, reporting, audit, composition, data sharing and process integration

Operational Technology

Automation, optimization, performance enhancement and alerts detection

Sensor

Sensing, user interaction, device management, data modeling, security and monitoring

Functions & Benefits

- Problems Prevention
- Events Forecasting
- Data Reuse/share
- Assets Management

- Automation & Monitoring
- Control & Events detection

- Connectivity & Management
- Sensors & Actuators

Solution

Prevent
Monitor
Audit
Interact
Protect
Connect
Manage

CLOUD
CONNECTED PLATFORM

OMA LWM2M

haku

Applications & Services
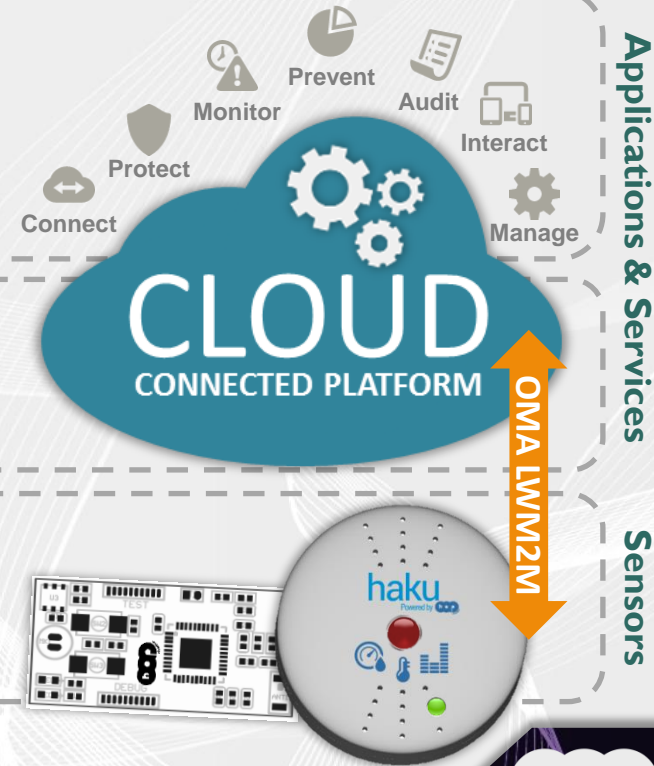
Sensors

Morrisons: Ambient Monitor *(haku)*

Cloud Connectivity

HTTP/CoAP with enhanced security and OMA LWM2M (oneM2M) for scalable device management, remote monitoring and interoperability

Sensors and operational monitoring

Sensing capabilities for monitoring the cold chain and detection of anomalies based on activity (e.g. noise)
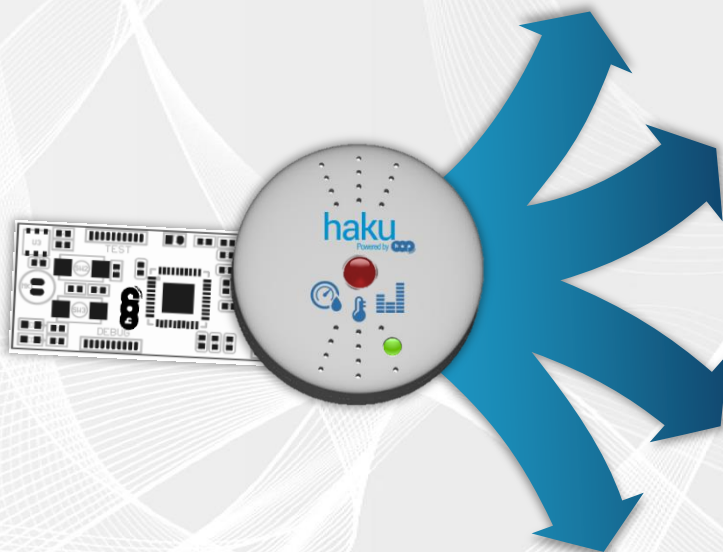
Humidity   Temperature   Activity

User interaction

Interaction with the customers through the red button, in order to inform about problems, stockout, request help…

Services Beyond: *iBeacon – proximity marketing*

Haku is based on Bluetooth Smart and enabled with iBeacon technology for propagating marketing information to smart phones (iOS / Android OS)

Morrisons: Process

Automation
- Report every 60s of humidity, activity, and temperature for logging and audit purpose.

Analytics
- Operational efficiency with the correlation of event to provide real-time decisions

Anticipate problems
- Predictive maintenance of assets to optimize maintenance costs and eliminate breakdowns

Sensing → **Alerting** → **Checking** → **Fixing** → **Preventing**

Events Detection
- The sensor detects anomalies such as when the temperature goes over a threshold

Actuation
- Contact the technicians (SMS/email), order assets (ERP), and proactively schedule maintenance (external services)

Contact details

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