OM2M une implémentation opensource de la norme ETSI-M2M: Expérience dans le bâtiment ADREAM

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Outline

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- Definition
- An example : the ADREAM project and building
- Problematic
- OM2M
- Research activity
- Conclusion

What are IoT? M2M?

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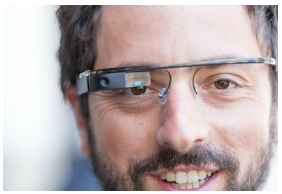
IoT ?



- ***Generally:*** a network of networks which enables to identify digital entities and physical objects
  - ⇒ *Whether they are inanimate (including plants) or animate (animals and human beings) – directly and without ambiguity, via standardized electronic identification systems and wireless mobile devices, and thus make it possible to retrieve, store, transfer and process data relating to them, without discontinuity between the physical and virtual worlds"* (Benghozi, Bureau, Massit-Folléa, 2008)
- ***Conceptually:*** new identities for objects
  - ⇒ "Things *having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts"* (*(Eposssmart systems working group, M.A Feki- Internet of things design Talks)*
- ***Technically:*** an extension of the Internet
  - ⇒ Naming system and reveals a convergence of digital identifiers in the sense that it is possible to identify digital information (URL website addresses for instance) and physical elements (like a pallet in a warehouse, or a sheep in a herd) in a standardized way (Mohamed Ali - Ecole de printemps sur l'Internet des Objets & Technologies M2M – Hammamet, Tunisie)

IoT? M2M?

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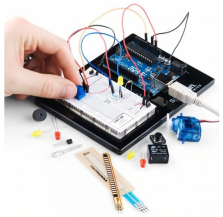
IoT ?

M2M?



- ***From the user point of view:*** a new space for general innovative services linked to the real world

- ***Architecture of communication services***

⇒ *"The role of M2M is to establish the conditions that allow a device to (bidirectionally) exchange information with a business application via a communication network", (M2M communications – a system approach, D. Boswarthick, O. Elloumi, O. Hersent, wiley ISBN 978-1-119-99475-6)*

The ADREAM project

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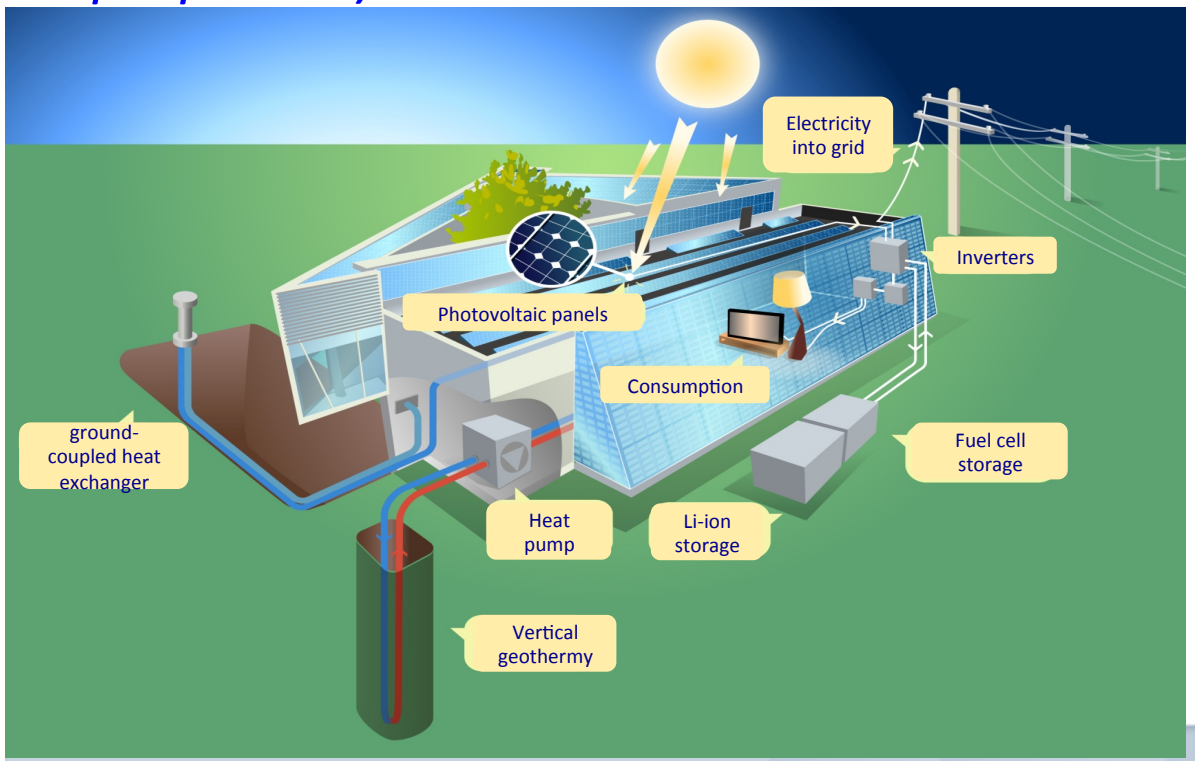
Architectures Dynamiques Reconfigurables de systèmes Embarqués Autonomes Mobiles *(Architectures for Dynamic and Reconfigurable Embedded systems having Autonomy and Mobililty properties)*



The ADREAM Smart Building
The full ADREAM Platform

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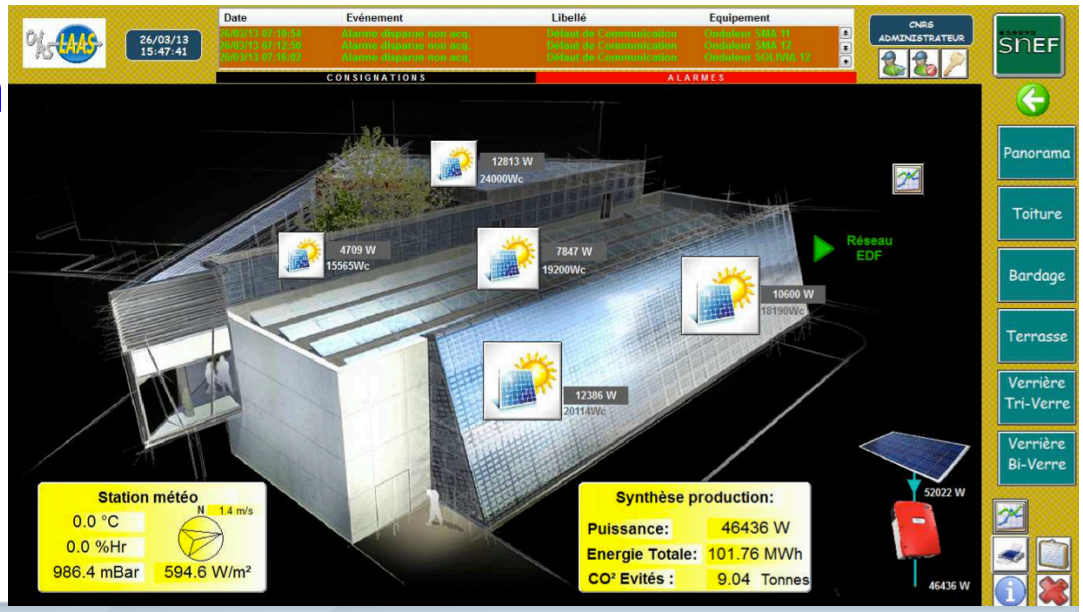
- **Combining several renewable energy sources** :
  - Photovoltaic panels on roofs and south-oriented walls
  - Ground-coupled heat exchanger
  - 3 heat pumps coupled to Geothermic probes

- And Also
- a "**Living lab" of 1700m²**
  - Technical platforms: 500m², including a flat, sensors, robots …
  - Offices: 700m²

ADREAM: supervision system

- Database:
  - Building operation parameter setting : T°, time slots, etc
  - Building supervision
  - Data collection every 1 to 5 min of 7000 inputs coming from all sensors
- Open supervision system
  - PCVUE software
  - Coupled to a database
  - Data command/control



ADREAM: measurements

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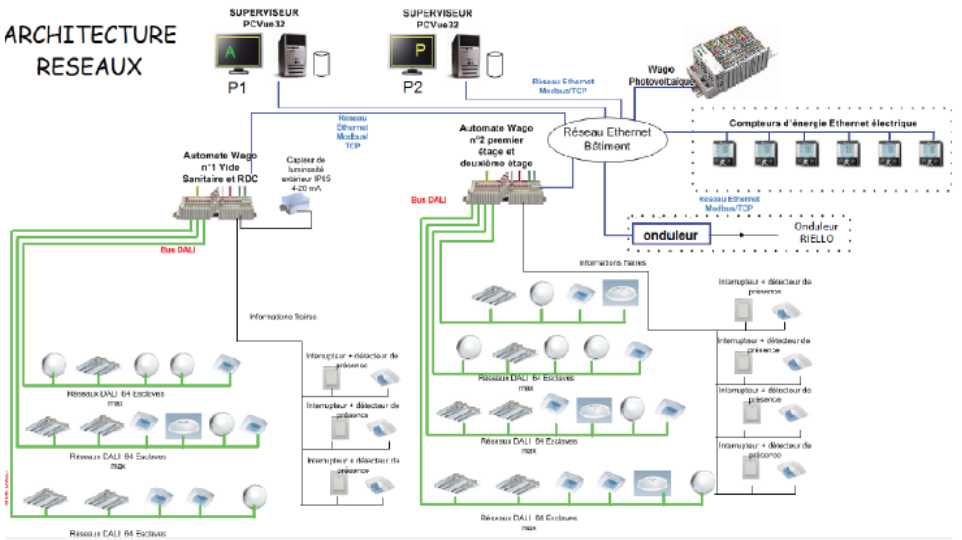
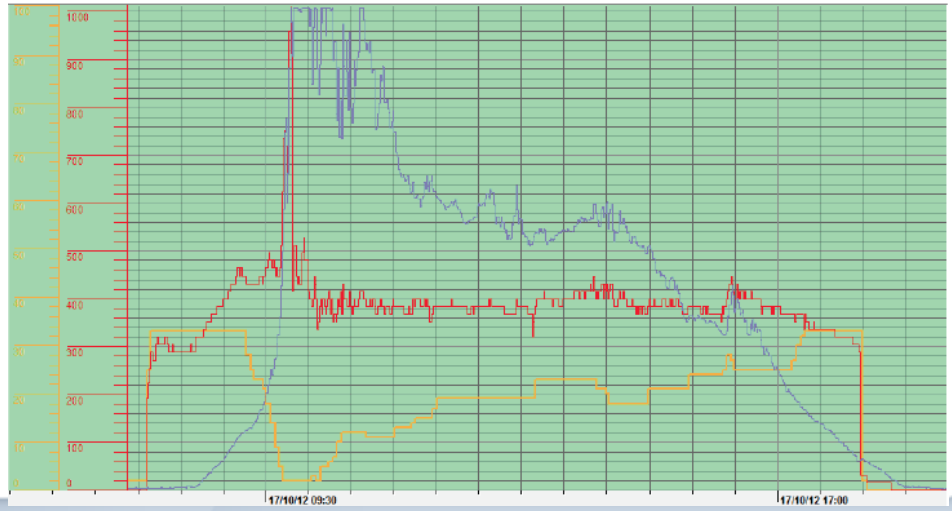
- Heating, Ventilation, Air Conditioning
  - 650 points of measurement and regulation
- Lighting: 3700 measurement points
  - Movement and illumination sensors
- Electricity: 500 data collected
  - power consumption, production
- Environmental data
  - Irradiance, Solar spectrum, Atmospheric pressure, …





zolertia

- Plateform WSN.
- Low powered.
- Compatible PHIDGETS.
- Support Contiki et TinyOS

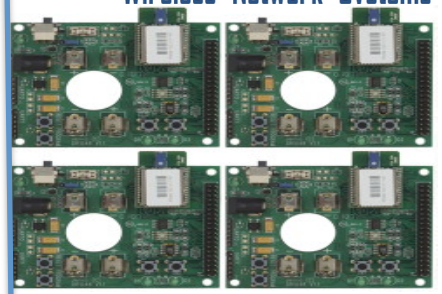
CLEODE

- Plateform WSN domotic Certifiées ZigBee Pro 2007.
- Zigbee Home Automation et Zigbee Smart Energy.

Cocoon™

- Plateform M2M semi-open source RESTful.
- Norme ETSI M2M.
- Interoperability with Zigbee and 6LowPan.

BEENETIC
Wireless Network Systems



- Plateform WSN 802.15.4 BEENETIC.
- Made forLAAS
- Low powered.

phidgets

- Microcontroler 454 MHz 1GB Linux Debian 7.0.
- Numerical and anlogical I/O
- Java,Phyton, C/C++,…

AXIS COMMUNICATIONS

D-Link
Building Networks for People

- Cameras PTZ HD
- Resolution 720p HDTV and H.264.
- Microphone and HP
- Sensor presence

KINECT

- Detect moving.
- Micro

somfy.

- Electrical shutter
- Remote command with Zigbee.

ADREAM: A complex system of system

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- Several companies from equipment to programming
- Who is "responsible" in the chain: bug, maintenance, responsibility
- Latency in correcting problems
- All generally "open" but with some black boxes
- Industrial lack of experience in this kind of software integration (initially they had ten separate software and data bases)

=> Need of standardized architecture

ADREAM: Life of the building

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- Difficulty to maintain:
  - Alteration of the building
  - Specific need for experiments
- Problems related to the sensors:
  - Outside sensors Temperature changed
  - Faulty thermostatic sensors atmosphere
  - Model not properly informed
- Problem on automata:
  - Bad programming
  - Controller itself

⇒ Need to manage the dynamic configuration of the building

ADREAM: complex data

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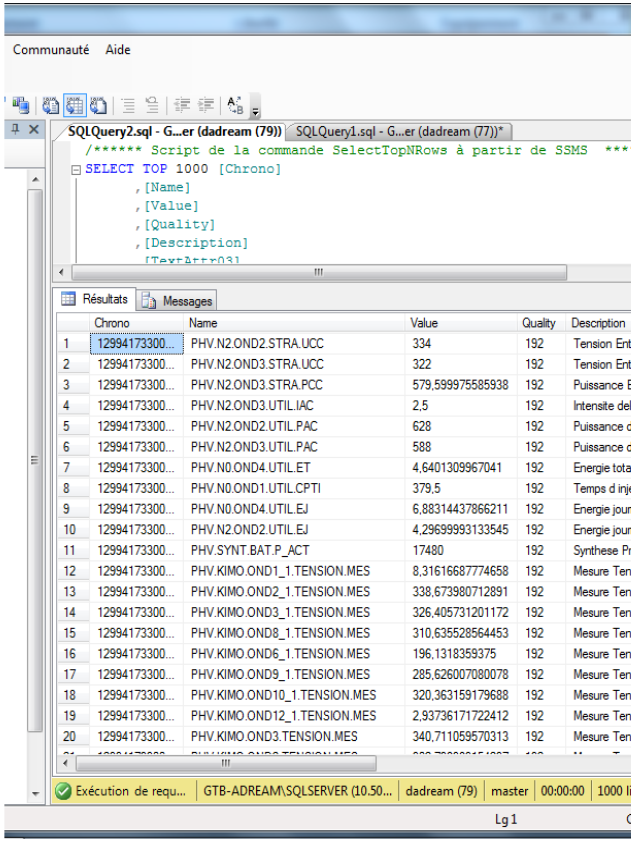
- Non-intuitive or badly named data (PHV.N2.OND2.UTIL.EJ)
- Interface/GUI:
  - Errors in positioning equipment
  - Unusable data without the GUI
  - Data with bad units caused display errors: Example: W, kW, ...
- Computational problem of software
- Electric meters installed but not configured correctly (factor * 10, * 1000 ....): Setting "empirical"



⇒ Strong Needs to improve data management

=> Need of standardized architecture

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- M2M promotes to connect billions of machines in near future covering multiple domains
- The M2M market is highly fragmented with many players across numerous vertical domains
- ETSI M2M and OneM2M are working on a standardized horizontal service platform for M2M interoperability
- Create an OpenSource community on IoT
- Produce an OpenSource platform
  - Need to have a large number of contributors
  - Follow the technology

Source: ETSI M2M

What is OM2M ?

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The OM2M – Open M2M platform

Open Source -> Eclipse Project

Standardized -> ETSI-compliant

Interoperable -> RESTful API

Extensible -> OSGI-based

M2M service platform

OM2M functional architecture

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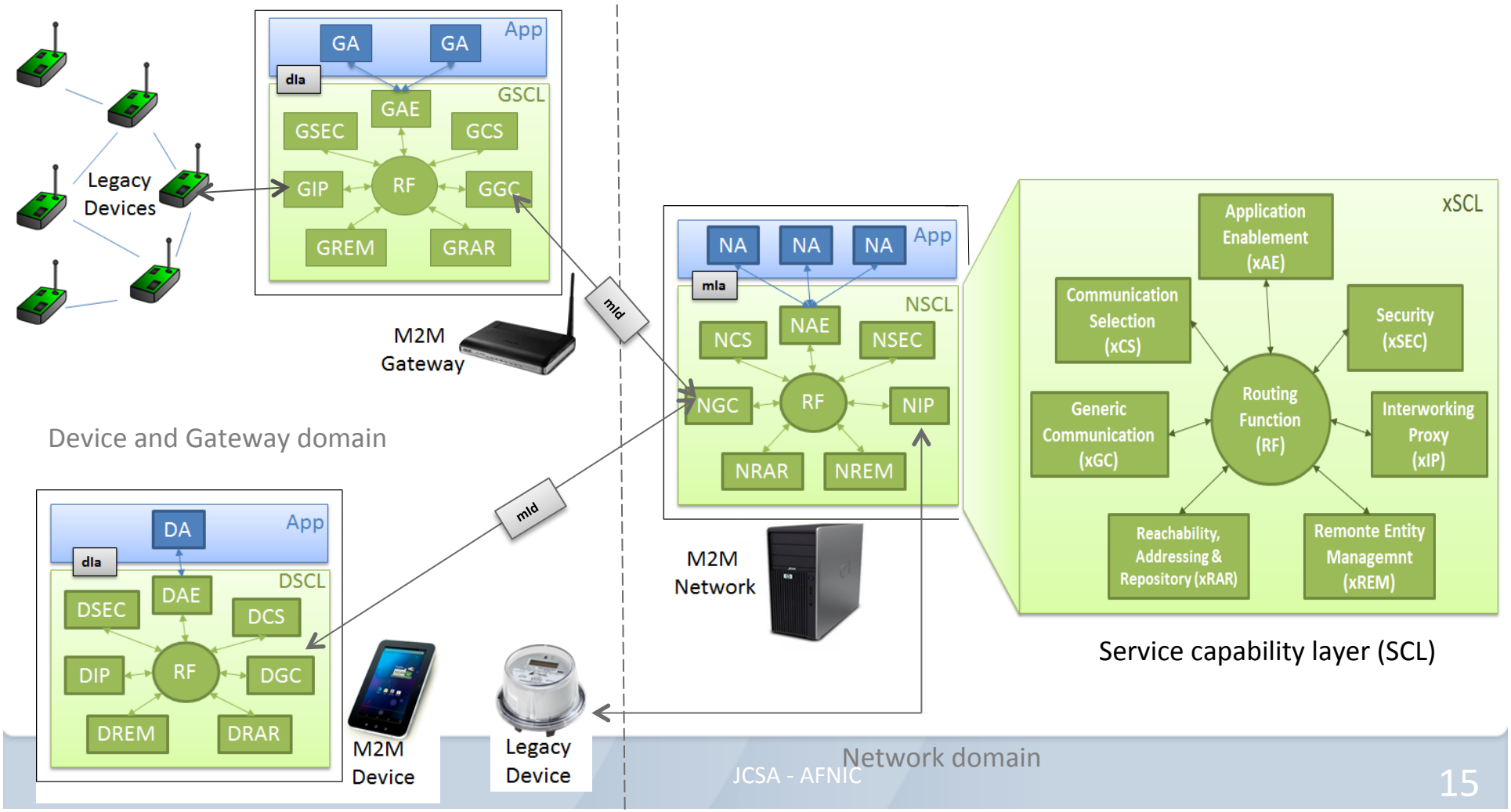
- Service Capability Layer (SCL) including a set of common services for M2M interoperability.
- An SCL can be deployed on the Network domain, or on the Device and Gateway domain.



OM2M primitive procedures

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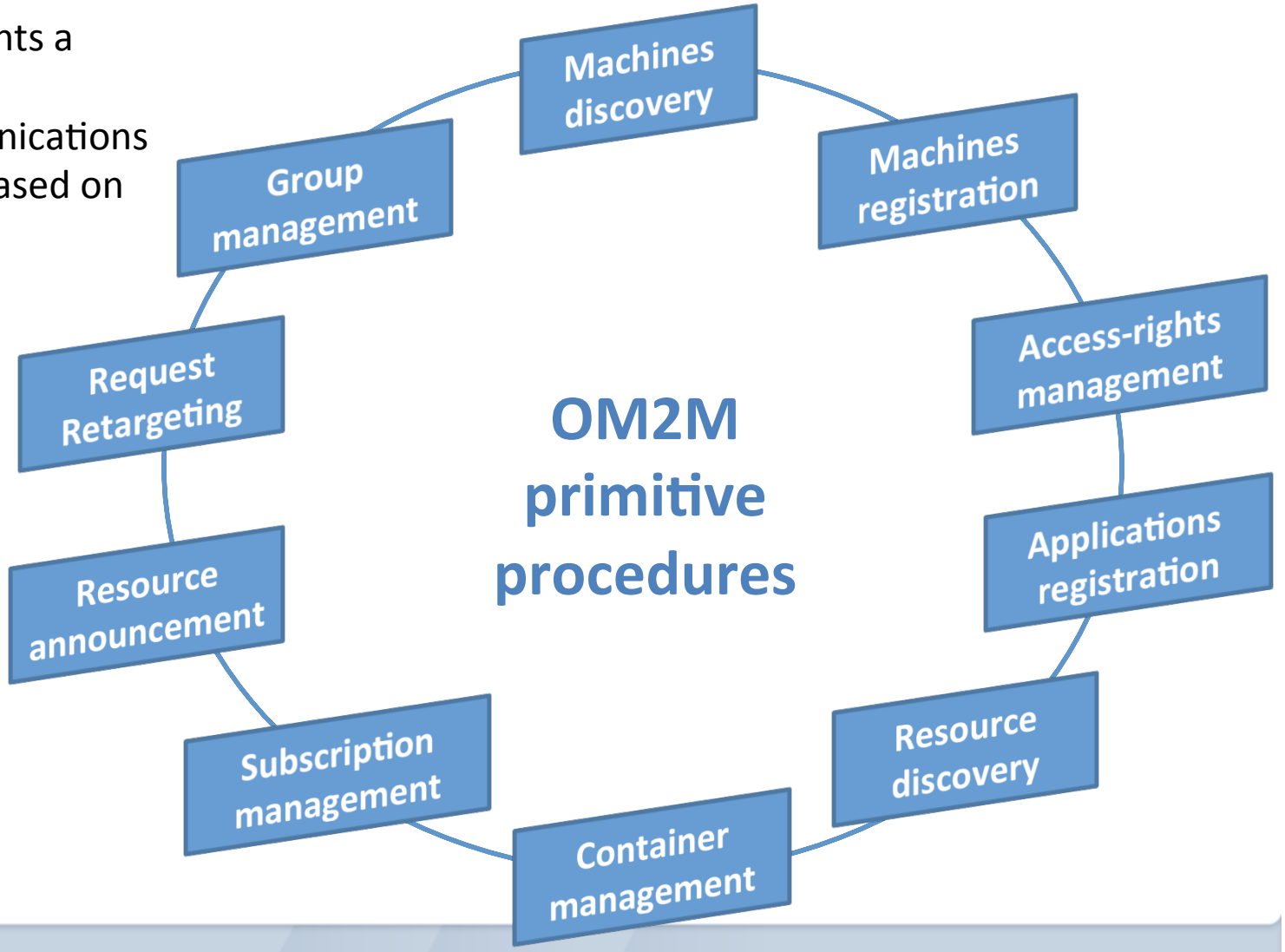
- OM2M implements a RESTful API.
- All M2M communications are performed based on simple primitive procedures.



ETSI M2M hierarchical resource tree structure

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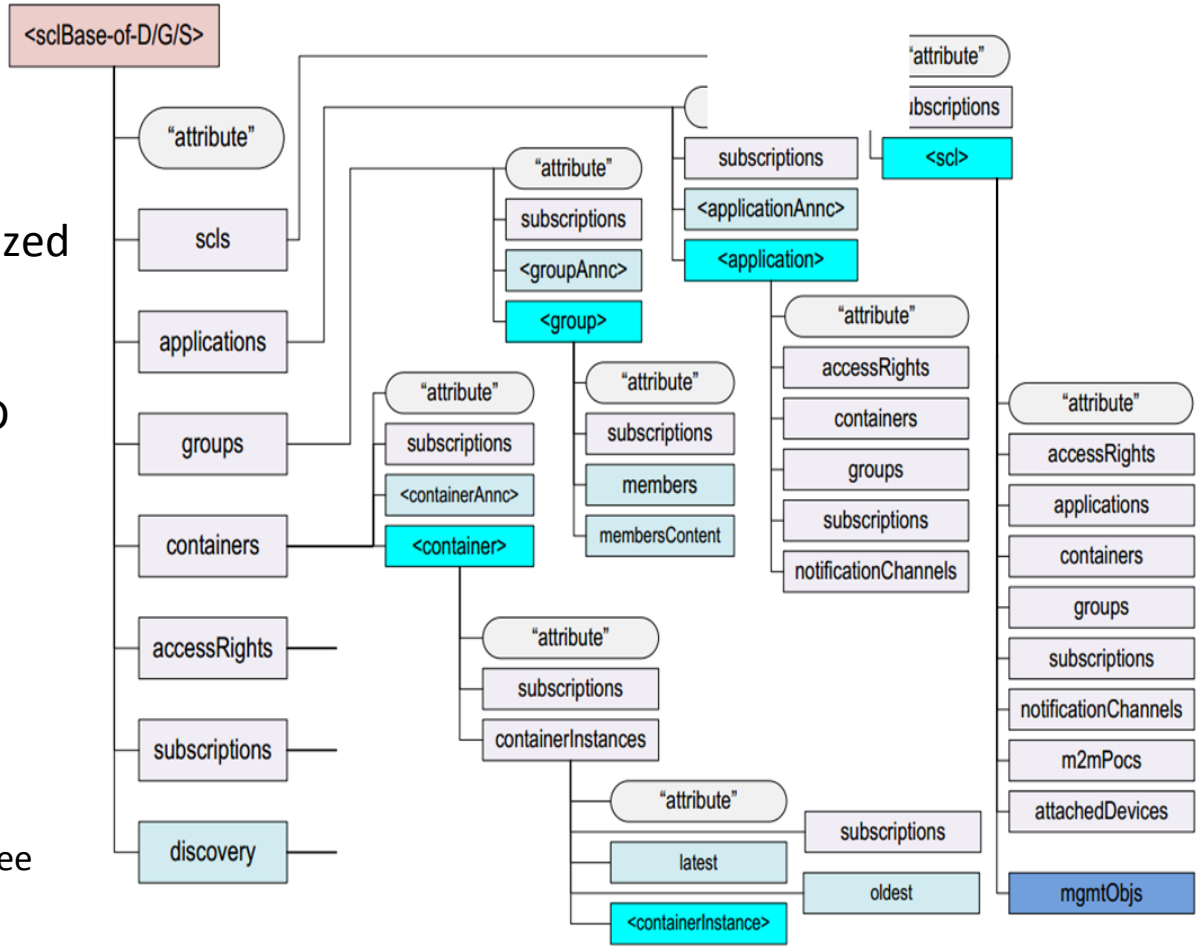
- Each SCL data model is structured using a standardized resource tree.
- The resource can be easily triggered using simple CRUD requests.



Service capability layer resource tree

OM2M resources tree: AJAX web interface

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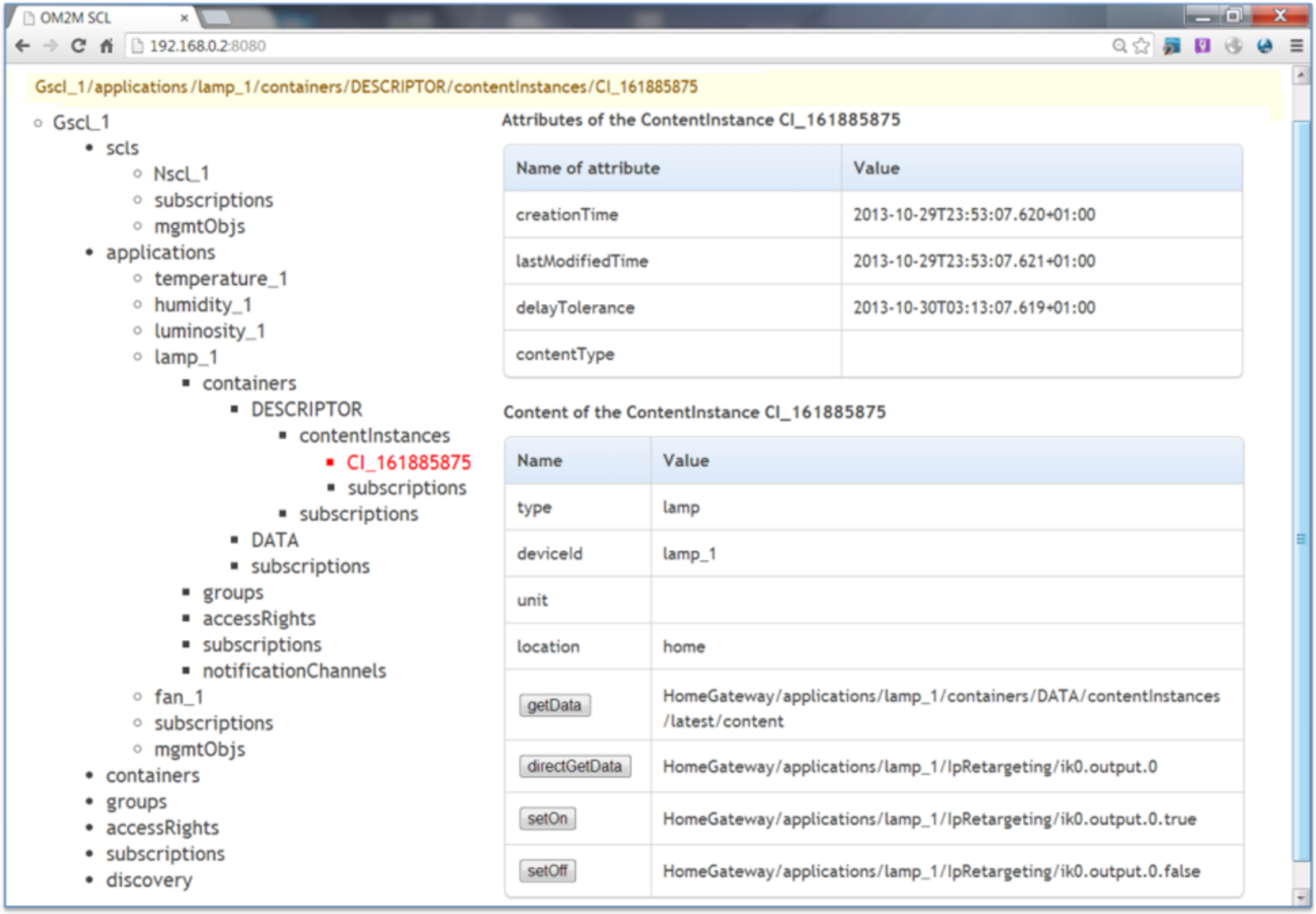

oBIX: Open Building Information Exchange

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*"**oBIX** is a standard for RESTful Web Services-based interfaces to building control systems. oBIX is about reading and writing data over a network of device using XML and URIs, within a framework specifically designed for building automation."*

Wikipedia

- open – all technical details freely available
- Building – any and all building systems
- Information – pertinent system data
- eXchange – interoperability

oBIX™ Open Building Information Xchange

OASIS Advancing open standards for the information society

OM2M building blocks

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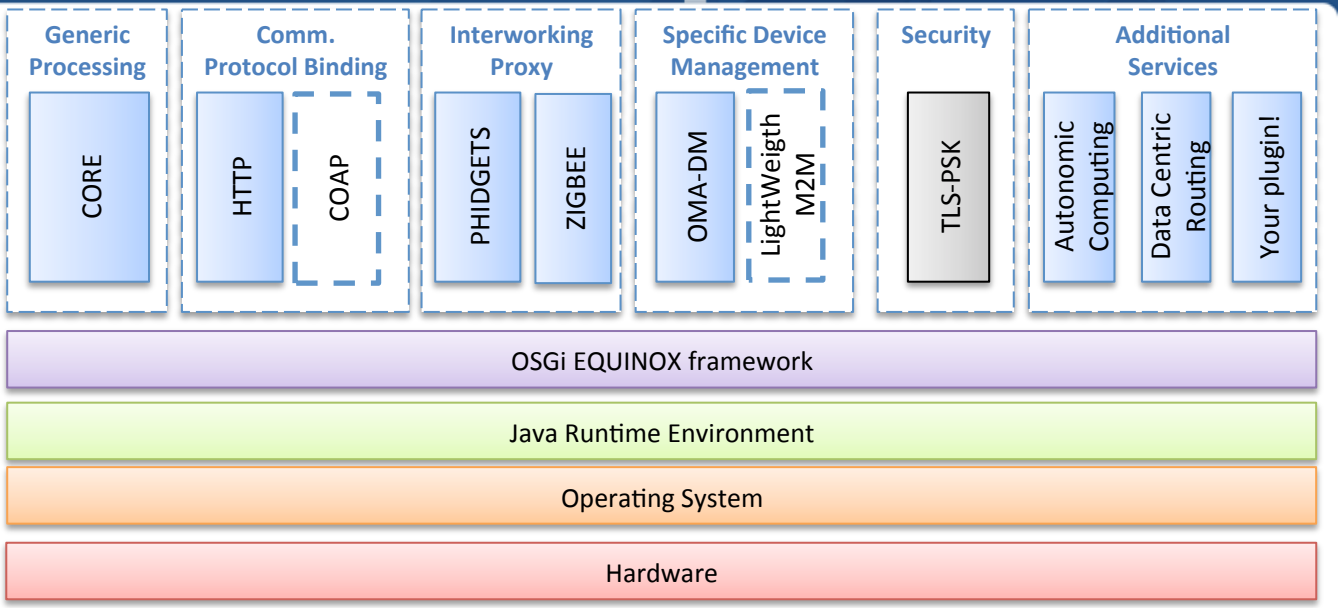
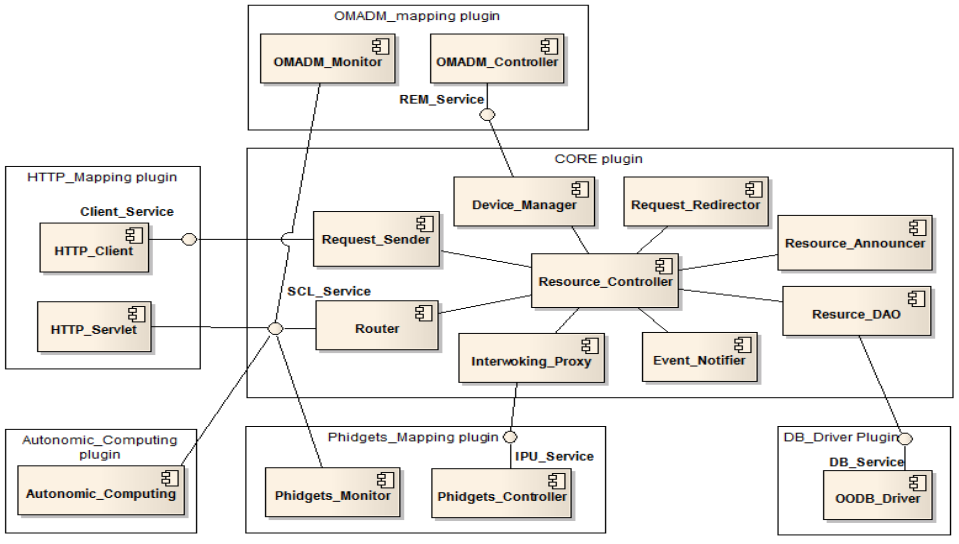
- OM2M runs on top of an OSGi Equinox runtime.
- Each SCL includes required plugins and is build as an Eclipse product using Tycho.



OM2M main components diagram



- The CORE plugin routes received request to the correct controller.
- It checks access rights, persist data, notifies interested subscribers, do request redirect or resource announcement if needed.
- It discovers and interfaces with other plugins.

Communication protocol binding plugin

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HTTP Request

- **URI:** http:192.168.0.3:8080 / context/resourceURI
- **Method:** GET, POST, PUT, DELETE
- **Headers**: Authorization, etc.
- **Body** : XML

HTTP client

HTTP Request

HTTP Request

HTTP Response

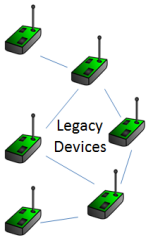
StatusCode: 200, 201,404
Headers: Location, etc.
Body : XML

COAP Request

HTTP Request

COAP client

Other Machine



Mapping

Request

- **TargetID:** resourceURI
- **Method:** RETRIEVE/ CREATE/ UPDATE/ DELETE / EXECUTE
- **RequestingEntity** username/ password
- **Representation**: XML

Protocol independent Request

CORE

Response

- **Status:** OK, CREATED/ NOT_FOUND, Etc.
- **URI**: location
- **Representation:** XML

Protocol independent Response

Service Capability Layer (SCL)

OM2M building blocks

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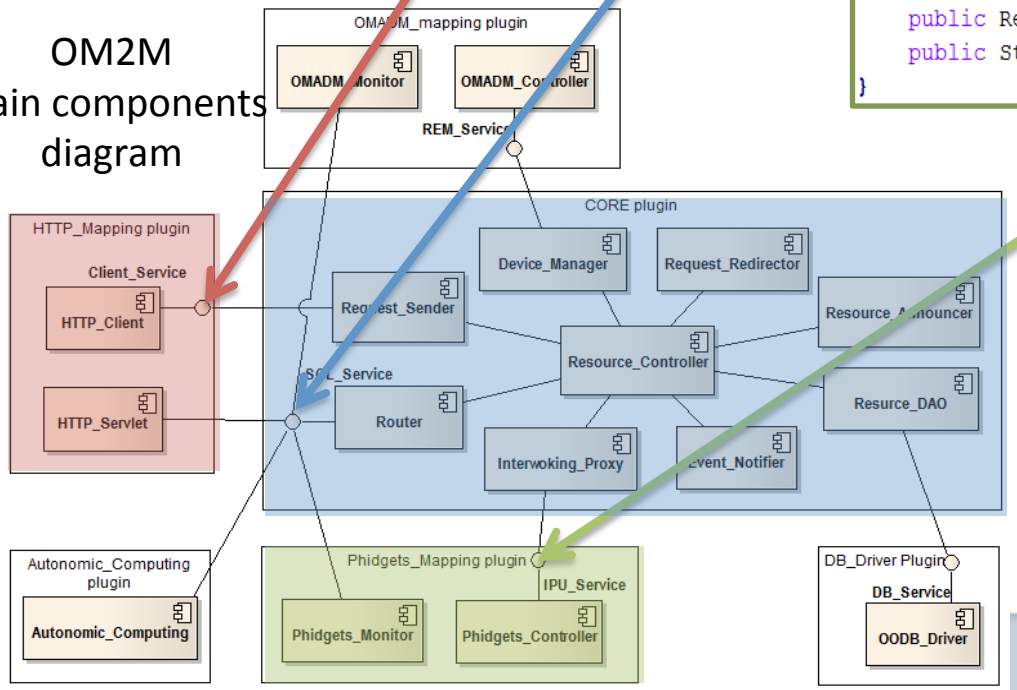
```
public interface ClientService {
    public ResponseConfirm sendRequest(RequestIndication requestIndication);
    public String getProtocol();
}
```

```
public interface SclService {
    public ResponseConfirm doRequest(RequestIndication requestIndication);
}
```

```
public interface IpuService {
    public ResponseConfirm doCreate(RequestIndication requestIndication);
    public ResponseConfirm doRetrieve(RequestIndication requestIndication);
    public ResponseConfirm doUpdate(RequestIndication requestIndication);
    public ResponseConfirm doExecute(RequestIndication requestIndication);
    public ResponseConfirm doDelete(RequestIndication requestIndication);
    public String getAPOCPath();
}
```

OM2M main components diagram



=> Need to manage the dynamic configuration / building

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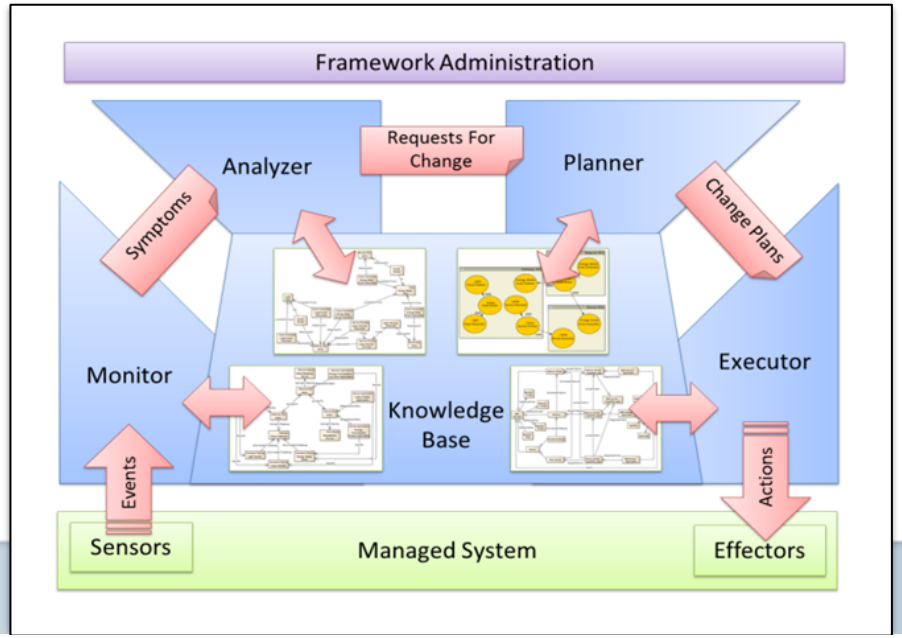
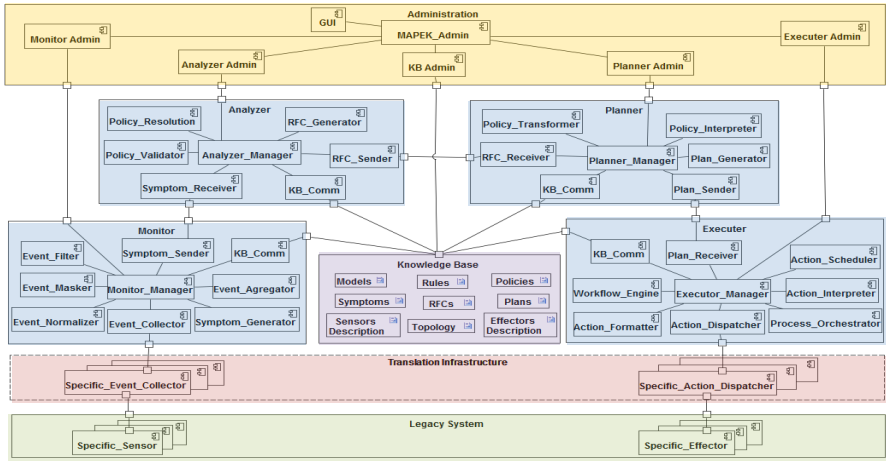
- Autonomic computing:
  - Self-configuration, Self-healing, Self-optimization, Self-protection
  - FRAMESELF: Multi-model autonomic loop
  - Logics, graph grammars, queuing models, timed automata





FRAMESELF

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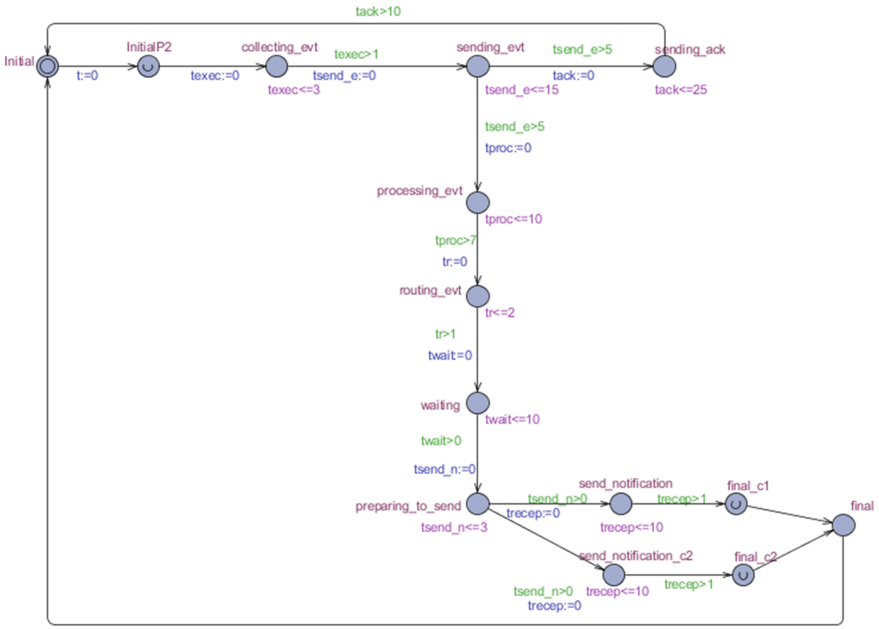
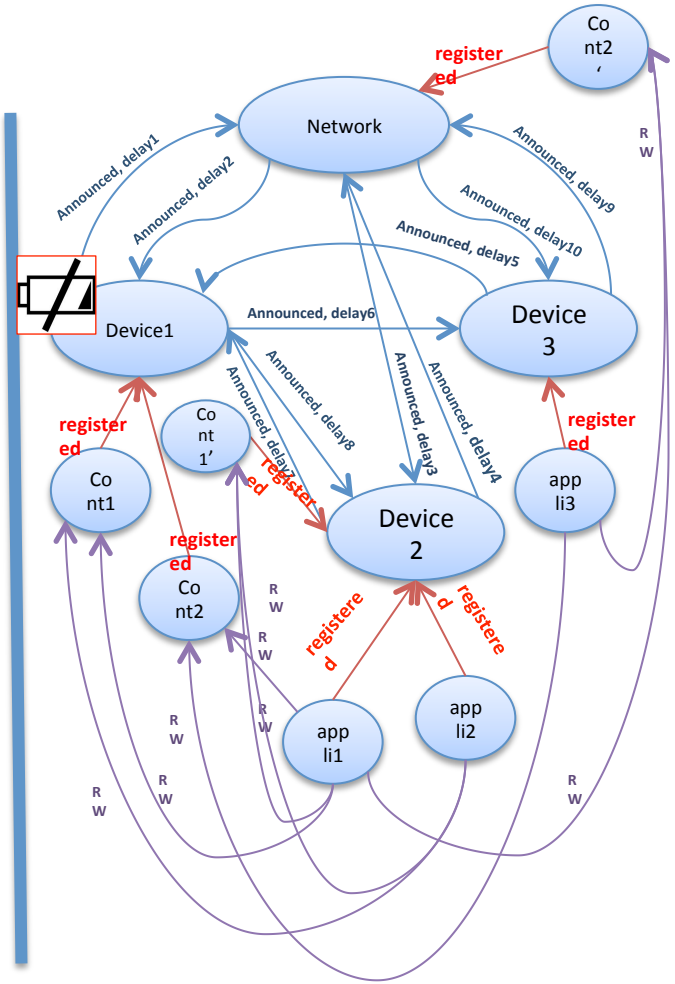
– Models for FRAMESELF

- Logics
- Graph grammars
- Queuing models
- Timed automata





⇒ Need to improve management of data

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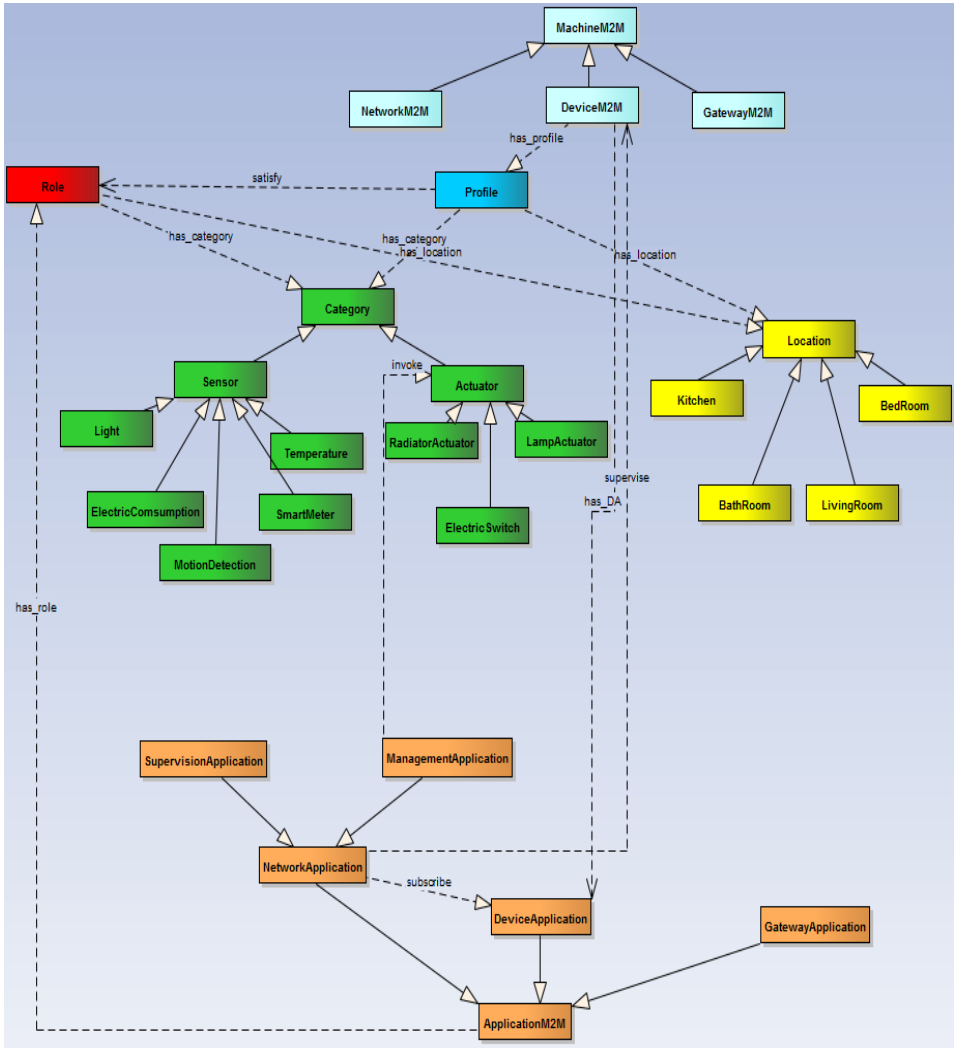
- Semantics in M2M
- Formal description - Machine processability
- Reasoning/Computation:
  - semantics enabled search,
  - answering complex queries,
  - mining,
  - hypothesis validation,
  - ….
- Management of data: ADREAM
  - Validity of data
  - Unit
  - Type
  - …
- First work:
  - Models based on Ontology and SWRL (Semantic Web Rule Language)
  - Web Ontology Language (OWL)
  - Jess (Java Expert System Shell)



Conclusion

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- **Very complex domain**
  - Several knowledge: electronics, networking, telecommunications, information technologies, control, ….
- **Maturity of base technologies**
- **A domain of many challenges**: networks, energy, data, architectures, process development, services, place of human, ….
- **OneM2M an adequate and good solution if adopted by industry and people**
  - International vision
  - Network interaction
  - Semantics
- **Research and implementation of the LAAS – SARA group focus on:**
  - **Dynamic management**
  - **QoS**
  - **Models for IoT**
  - **Semantics**
  - **Autonomous Networking**

Thank you for your attention

www.om2m.org