OM2M an Open autonomic and semantic platform for M2M

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Outline

› Definition
› Products and Complex systems
› Standard
› Opensource
› Smart
› Conclusion
What are IoT?

• **Generally**: a network of networks which enables to identify digital entities and physical objects
  - inanimate (including plants) or animate (animals and human beings)
  - standardized electronic identification systems
  - wireless mobile devices
  - possible to retrieve, store, transfer and process data relating to them
  - Strong relation between physical and virtual worlds
  (source: Benghozi, Bureau, Massit-Folléa, 2008)

• **Conceptually**: new identities for objects
  - identities and virtual personalities operating in smart spaces
  - using intelligent interfaces to connect and communicate within social, environmental, and user context
  (source: Epossmart systems working group, M.A Feki- Internet of things design Talks)

• **Technically**: an extension of the Internet
  - convergence of digital identifiers (URL website addresses for instance) and physical elements
  (source: Mohamed Ali - Ecole de printemps sur l’Internet des Objets & Technologies M2M – Hammamet, Tunisie)

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

› Save energy, money?
M2M smart metering application scenario
M2M smart grid application scenario

- **Smart appliances**: Can shut off in response to frequency fluctuations.
- **Demand management**: Use can be shifted to off-peak times to save money.
- **Processors**: Execute special protection schemes in microseconds.
- **Sensors**: Detect fluctuations and disturbances, and can signal for areas to be isolated.
- **Storage**: Energy generated at off-peak times could be stored in batteries for later use.
- **Generators**: Energy from small generators and solar panels can reduce overall demand on the grid.
Smart cities

smart districts

smart building

smart home

Datacenters and cloud for opendata

smart grid

smart citizens

smart transportation

=> Cities\textsuperscript{smart}
IoT market

M2M market revenue for operator

M2M market per domain
First remarks

› Smart objects may fall within the gadget and marketing products
› Smart objects produce a lot of data and need datacenter
› It has a strong business potential with smart objects
› Smart objects can provide solutions to complex problems
› Various fields are tackled with smart objects
› The constraints on the smart objects can be different: security, response time, confidentiality
› Smart cities is a real challenge
Architecture

End user devices

Data Analytic

SCADA Interface

M2M Server

Network domain

Device and Gateway domain
market fragmentation

- The current marketplace is extremely fragmented, which has increased the R&D cost in each specific domain.
- Silo model is not an efficient way to communicate, it is a barrier to further development.
- Many vertical solutions have been designed independently and separately for different applications, which impedes large-scale interoperable deployment.
IoT SDOs and Alliances Landscape (Vertical and Horizontal Domains)

AIOTI WG3 (IoT Standardisation) – Release 1.2
Architecture OneM2M

Reference Point
One or more interfaces - Mca, Mcn, Mcc and Mcc’ (between 2 service providers)

Common Services Entity
Provides the set of "service functions" that are common to the M2M environments

Application Entity
Provides application logic for the end-to-end M2M solutions

Network Services Entity
Provides services to the CSEs besides the pure data transport

Node
Logical equivalent of a physical (or possibly virtualized, especially on the server side) device

From oneM2M Service Layer Platform – Initial Release: Omar Elloumi/Nicolas Damour
Common Service Functions

- Registration
- Discovery
- Security
- Group Management
- Data Management & Repository
- Subscription & Notification
- Device Management
- Application & Service Management
- Communication Management
- Network Service Exposure
- Location
- Service Charging & Accounting

From oneM2M Service Layer Platform – Initial Release: Omar Elloumi / Nicolas Damour
OM2M: Open platform for IoT

- **Compliant** to **SmartM2M** Standard (April 2014) and with **OneM2M** Standard (October 2015)
- **Horizontal** service platform for IoT interoperability
- **Restful** API with a **generic** set of service capabilities
- **OSGi-based** architecture **extensible** via plugins
- Allow developing services **independently** of the underlying network
- Facilitate **deployment** of **vertical** applications
- **Main features:**
  - Machine registration, application deployment, container management, resource discovery, access right authorization, subscription / notification, group management, and resource announcement.
- **Eclipse foundation project**: eclipse.org/om2m
- OM2M is an **open source**
- Member of Eclipse **IoT Working Group**.
# Website stats

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Sessions</th>
<th>Percentage</th>
</tr>
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<tbody>
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<td>France</td>
<td>1676</td>
<td>23.68%</td>
</tr>
<tr>
<td>2</td>
<td>Japan</td>
<td>824</td>
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<tr>
<td>3</td>
<td>Taiwan</td>
<td>567</td>
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<td>4</td>
<td>India</td>
<td>540</td>
<td>7.63%</td>
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<tr>
<td>5</td>
<td>South Korea</td>
<td>531</td>
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<tr>
<td>6</td>
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<tr>
<td>7</td>
<td>Germany</td>
<td>328</td>
<td>4.63%</td>
</tr>
<tr>
<td>8</td>
<td>Portugal</td>
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<td>3.05%</td>
</tr>
<tr>
<td>9</td>
<td>Tunisia</td>
<td>169</td>
<td>2.39%</td>
</tr>
<tr>
<td>10</td>
<td>Italy</td>
<td>163</td>
<td>2.30%</td>
</tr>
</tbody>
</table>

![Website traffic chart](chart.png)
OM2M high level architecture
OM2M resource tree example

Resource Type
- CSE
- Application Entity
- Container
- Content Instance

OM2M resource tree example:

- **MN-CSE-HOME**
  - **AE-SMART-METER**
    - **CNT-DESCRIPTR**
      - **CIN-DESCRIPTION_1**
    - **CNT-DATA**
      - **CIN-MEASUREMENT_3**
      - **CIN-MEASUREMENT_2**
      - **CIN-MEASUREMENT_1**

Server/Cloud (IN-CSE)
End user (DA)

Gateway (MN-CSE)
How the value is retrieved

1. registration
2. AE_ID
3. create Temp_Sensor container
4. raw value
5. Creating standard data representation of the raw value.
6. create contentInstance
7. get last instance of Temp_Sensor
8. redirect request
9. last instance of Temp_Sensor
10. High-level Application
11. Server
12. Gateway
13. IPE
14. Temp_Sensor

www.websequencediagrams.com
OM2M Building Blocks

- OM2M is a java platform running on top of an OSGi runtime
  - Highly extensible via plugins.
  - Flexible OSGi container: Equinox, Knopflerfish, or others.
  - Flexible database: SQL or NoSQL.
- Each CSE includes required plugins and is build as an Eclipse product using maven and Tycho.
OM2M components diagram overview
Second remarks

› Standards can decrease the costs of development and maintenance
› Standards allow to have multiple suppliers
› Standards make it easier for users
› Difficulties to chose the good standard
› A standard like OneM2M allows to hide the heterogeneity
› Opensource increases the numbers of users and create communities
› Opensource increases the visibility of your work
› Opensource helps to extend the capacity of the software
› Opensource can create important feedback to standard
Management of smart system

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

Graph-based modeling and graph rewriting systems

› The state of the system at a given time is represented by an attributed graph.

› System modification are modeled by graph rewriting rules (GRR).

C. Eichler, T. Monteil, P. Stolf, A. Grieco, K. Drira, Enhanced graph rewriting systems for performance aware dynamic software architectures, software & systems modeling – sosym, springer, 2014
Exemple of energy management
Data management Semantic in M2M

- Formal description - Machine process ability
- Reasoning/Computation:
  - semantics enabled search,
  - answering complex queries,
  - hypothesis validation,
  - mining
- Ontology: IoT-O
  ⇒ Base for a proposition for standardisation

Gestion autonomique de ADREAM

- Agents autonomes
- Base de connaissances
- Interface utilisateur

Enrichissement et stockage des données sémantisées

Collecte des données brutes

Réseau d'objets connectés
 Création de contrainte
Enrichissement d'observations

(1)

(2)

Observation → Sensor

Obs.Value → PropertyInst.

Database

Règle inférence: Contrainte ok ?

OutOfBoundProp.

rdf:type

PropertyInst.

PropertyInst.

Diagnosis
Correction

(1)

(2)
Actual Research activities: under the PhD works

- Checkpointing for M2M (2015 François Aissoui)
- Green Energy for cloud (2014 Ines Decourchelle)
- Cloud et antifragile service for M2M (2014 Amal Abid)

Cloud

Models

- Temporal constraints for M2M (2012 Ghada Gharbi)
- Service management for IoT (2015 Guillaume Garzone)

Network

- Software Defined Network for M2M (2015 Chloé Basille)
- Management of QoS from physical layer to application layer under energy constraint (2014 Zongyi Liu)
- Information Centric Network for M2M (2014 Maroua Meddeb)
- Wireless network management with SDN for IoT (2015 Chekra El Fehri)

- QoS management in M2M (2013 Yassine Banouar)
- Semantic for IoT (2015 Nicolas Seydoux)
ADREAM Platform

Instrumented building with photovoltaic production and optimization of energy
Building modularity
Thank you for your attention

www.om2m.org