

## 1. Title

Standard-based IoT platform for cross-domain interoperability

## 2. Duration

Half day (4 hours)

## 3. Abstract

The tutorial will present the IoT vision, challenges, and efforts achieved by the standardization bodies to design a globally agreed IoT service platform. The *oneM2M* standard will be introduced as a promising solution for IoT cross-domain interoperability. The participants will be asked to follow practical sessions to learn how to integrate heterogeneous devices based on the *oneM2M* API, and quickly develop *oneM2M* applications in smart building use cases.

## 4. Motivations and target audience

Today, sensors, actuators, tags, vehicles, and intelligent things all have the ability to communicate. The number of IoT devices is continuously increasing, and it has been predicted to see billions of connected objects interconnected in a near future. IoT applications provide advantages in various domains from smart cities, factories of the future, connected cars, home automation, e-health to precision agriculture. This fast-growing ecosystem is leading IoT towards a promising future. However, IoT market expansion opportunities are not straightforward. A set of challenges should be overcome to enable IoT mass-scale deployment across various industries including interoperability, complexity, and scalability issues.

Currently, the IoT market is suffering from a high vertical fragmentation affecting the majority of business sectors. In fact, various vendor-specific IoT solutions have been designed independently for specific applications, which led to serious interoperability issues. To address this challenge, the seven most important SDOs in the world established in 2009 an international partnership project called *oneM2M* [1,2]. Figure 1 illustrates the initiative led by the *oneM2M* consortium to provide a common architecture for IoT cross-domain interoperability in terms of communication and semantic data [3].

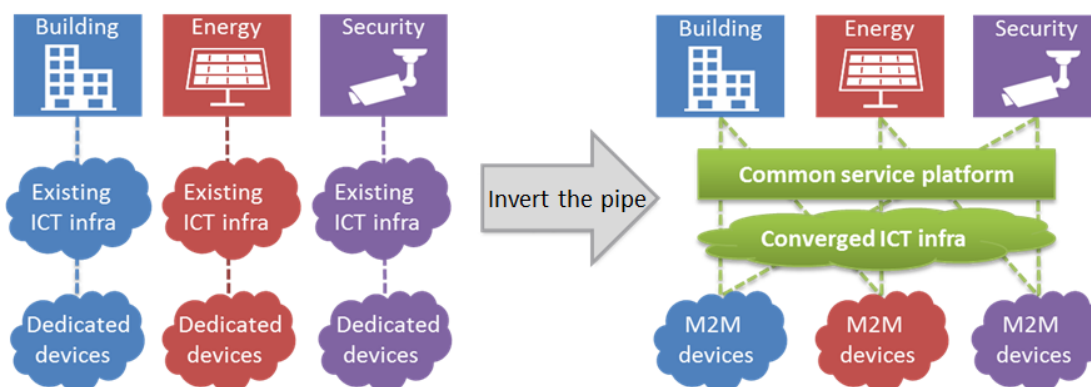


Figure 1: IoT cross-domain interoperability

Eclipse OM2M [4] offers a full open source implementation of the oneM2M standard. It supports all types of interfaces and nodes defined in the standard including “Infrastructure Node” (IN), “Middle Node” (MN), and “Application Service Node” (ASN) and “Application Dedicated Node” (AND). Each node may host a set of applications and a Common Service Entity (CSE) (at the exception of the ADN) including capabilities for communication protocol bindings, device interworking, management, security, etc. Figure 2 depicts the Eclipse OM2M functional architecture.

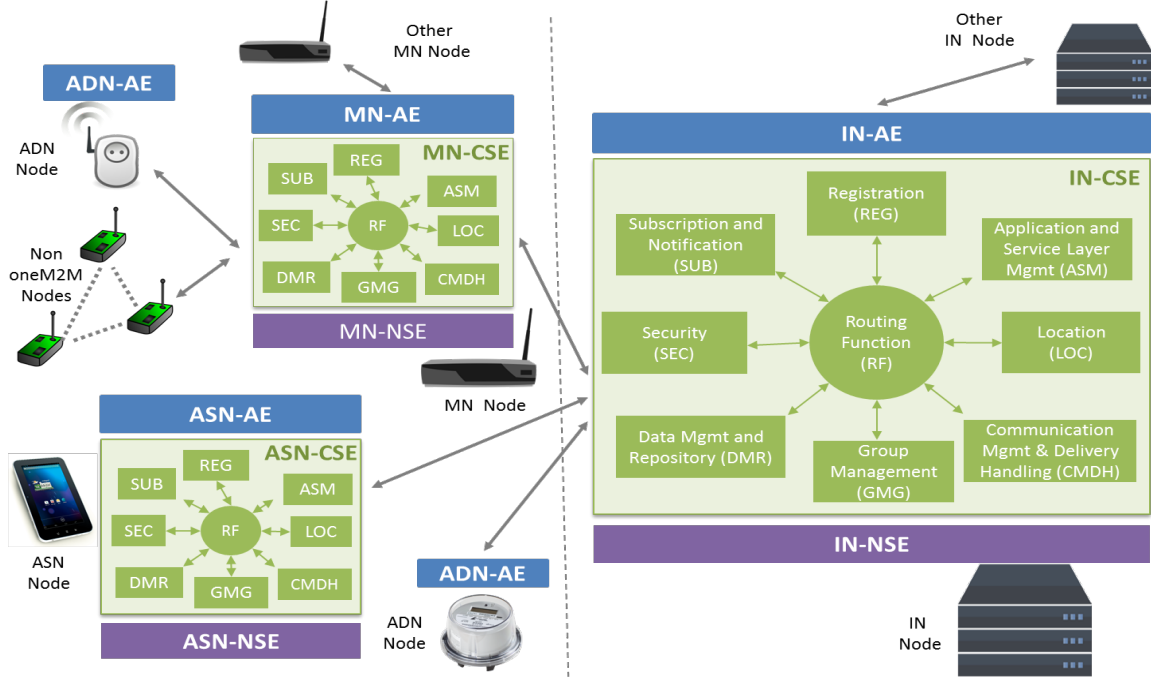


Figure 2 Eclipse OM2M functional architecture

Eclipse OM2M relies on a modular architecture, designed on top of a protocol-independent kernel, running on top of an OSGi layer and highly extensible via plugins which make a promising candidate for integration and experimentation. Figure 3 shows Eclipse OM2M main building blocks.

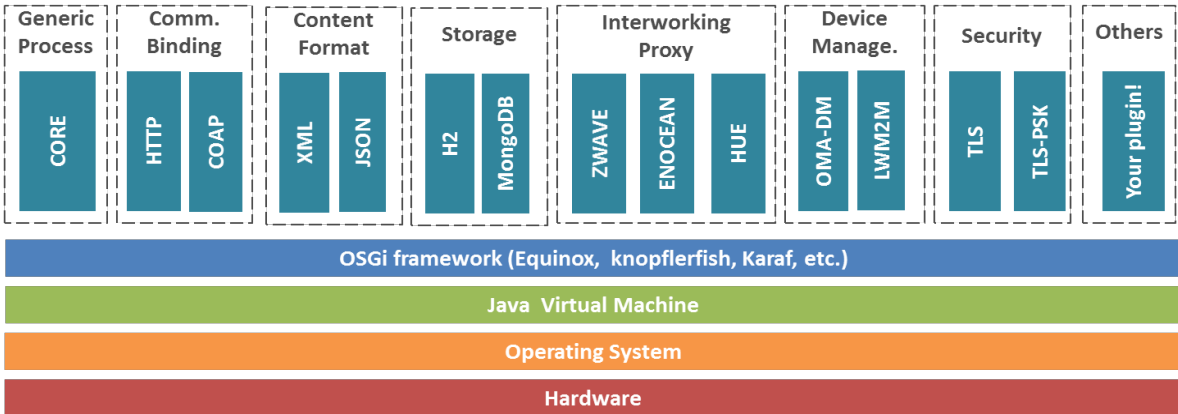


Figure 3 Eclipse OM2M building blocks

The audience targeted by this tutorial includes software architects and developers as well as academic and industrial researchers, and PhD students who can benefit from the different parts of the tutorial including the theoretical as well as the technical aspects related to IoT standards. Following each presentation, several questions were raised by the audience to gain deeper insights about oneM2M use cases, system architecture, and features.

## 5. Outline of the tutorial

The tutorial will be structured in two main parts. In the first part, we will develop the foundations and the technical background that will be useful for the attendees for getting started with oneM2M common architecture main concepts, features and interfaces. In the second part, we will conduct the technical learning part. This will consist in an interactive training that will address the different issues necessary for developers. This includes API understanding and manipulation for developing applications and integrating devices on top of Eclipse OM2M platform.

The structure of the tutorial is he following:

### Technical Presentations (1h30h)

- IoT, Vision and Challenges
- oneM2M Common Architecture for IoT
- Eclipse OM2M, Open Source oneM2M-based Platform

### Demonstrations and API manipulations (2h30)

- Hands On oneM2M, develop your IoT Applications
- Interworking with legacy and vendor-specific technologies
- Towards Semantic IoT, oneM2M Base Ontology

## 6. Specific goals and objectives

After completing the tutorial, the participants will

- Master the oneM2M standard: architecture, features and APIs
- Master the Eclipse OM2M open source project: design, applications and interworking plugins.

## 7. Expected background of the audience

Participants are expected to have some familiarity with web application development and RESTful APIs.

## 8. biographical sketch of the presenters.

- **Dr. Mahdi BEN ALAYA** is Founder and CEO of Sensinov. He obtained a Ph.D in systems architectures from the Federal University of Toulouse in France. He is Vice Chairman of the oneM2M Testing Group. He is co-founder and technical manager of the open source project OM2M at the Eclipse foundation. He is selected as expert by ETSI to develop interoperability

tests for various IoT standards and to develop extensions and conformance tests for SAREF ontology. He organized various schools on IoT in France, Taiwan and Korea. He initiated and managed several R&D projects at LAAS-CNRS and Sensinov including H2020-LSP5-AUTOPILOT, ITEA2-USENET and ITEA2-A2NETS. He has authored more than 20 publications in international journals and conferences and more than 40 contributions in M2M standards. [benalaya@sensinov.com](mailto:benalaya@sensinov.com)

- **Dr. Khalil DRIRA**, Ph.D. Univ. of Toulouse, is Research Director, a full-time research position at the French National Center for Scientific Research (CNRS). His research interests include formal design, implementation, and provisioning of distributed communicating systems and cooperative networked services. His research activity addresses different topics in this field focusing on model-based analysis and design of correctness properties including robustness, adaptability and reconfiguration. He is or has been involved in different European and French R&D projects (FP6, FP7, ITEA, H2020, PIA, ANR, ...) in the field of distributed system engineering, collaborative activities, distributed systems, IoT/M2M and software architectures. He has organized and chaired several international conferences including IEEE-WETICE, ECSA, SESOS. He has been guest editors of different journal special issued including JSS, FGCS, Wiley Concurrency and Computation. More information is available on: <http://homepages.laas.fr/khalil>
- **Dr. Ghada GHARBI** obtained a Ph.D in Networks and Telecom from the Federal University of Toulouse in France. She is selected as expert by the ETSI to develop an interoperable devkit system offering testing and debugging tools for IoT ecosystem. She is committer in the open source project OM2M at the Eclipse foundation. She was contractual professor at INSA of Toulouse and participated in the constitution and the establishment of a training unit around the IoT. She also participated in the organization of several schools on IoT worldwide. [ghada.gharbi@sensinov.com](mailto:ghada.gharbi@sensinov.com)

## References

1. Boswarthick, D., Elloumi, O., & Hersent, O. (Eds.). (2012). *M2M communications: a systems approach*. John Wiley & Sons.
2. Swetina, J., Lu, G., Jacobs, P., Ennesser, F., & Song, J. (2014). Toward a standardized common M2M service layer platform: Introduction to oneM2M. *IEEE Wireless Communications*, 21(3), 20-26.
3. Mahdi Ben Alaya, Samir Medjiah, Thierry Monteil, Khalil Drira. Toward semantic interoperability in oneM2M architecture. *IEEE Communications Magazine*, Volume: 53, Issue: 12, Dec. 2015.
4. Alaya, M. B., Banouar, Y., Monteil, T., Chassot, C., & Drira, K. (2014). OM2M: Extensible ETSI-compliant M2M service platform with self-configuration capability. *Procedia Computer Science*, 32