

Simulation framework for oneM2M standard*

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Agenda

- Context and objectives of the work
 - **# world # preoccupations**
- Filling the gap between standard & implementation
 - **OneM2M initiative**
 - **Rapid prototyping of oneM2M applications**
- OneM2M Platform simulation
 - **Definition & code generation**
 - **OneM2M Domain Specific Language**
 - **OneM2M Simulation in OMNeT++**
- Summary & Next steps

In the world of standards

oneM2M's area of expertise

- **Standardized model and specifications :**
 - IoT system infrastructure
 - Distributed IoT nodes
 - Interoperability capabilities between nodes
 - Model of Data (data formats)

- **Collection of multi-domain expertise and requirements**
 - Industrial uses cases
 - Elicitation of requirements

- **Supports for development of oneM2M standardized objects**
 - Device
 - Platform
 - Applications

- **Supports for integration & testing of full oneM2M solution**

In the world of IoT system engineering

IoT system implementation

- Effective IoT system infrastructure
 - Decentralized nodes
 - Gateways (edge computing, semi-local constraints)
 - Server on the cloud
 - Applications : apps, servers, objects
- IoT behaviours
 - Sensing and actioning on real-time information / physical environment
 - Embedded sensing, computing,
 - Decentralized and static/mobile services
 - Data integrations over different environments
- Heterogeneous constraints on deployment
 - **functionnal** : fonctionnal description, Privacy and Security Challenge
 - **Non-fonctionnal** : power consumption, time , memory, processing resources

Filling the gap between standards and SE

IoT Systems challenges

- *Needs for a high-level modeling of devices/systems in the design cycle*
 - Specification and modeling of OneM2M Logical architecture
 - Efficient deployment wrt performances (KPIs),
 - Simulation & Verification at model level
 - From model to Implementation
- *oneM2M standard evaluation and evolutions*
 - Specification -> coverage
 - Implementation of the standard

How to fill the gap :

OneM2M initiative

Testing Task Force T019 on Performance Evaluation and Analysis for oneM2M Planning and Deployment

- **Develop POC** allowing to simulate / emulate a oneM2M platform within a targeted ecosystem
- **Provide** an adequate **quality of service metrics** to evaluate standard and implementation
- **Introduction of methodological guidelines** to drive the planning of an efficient deployment of oneM2M-based IoT solutions
- **Testing Task Force T019**
 - Starting: September 2022
 - Duration 3 years

How to fill the gap : our approach*

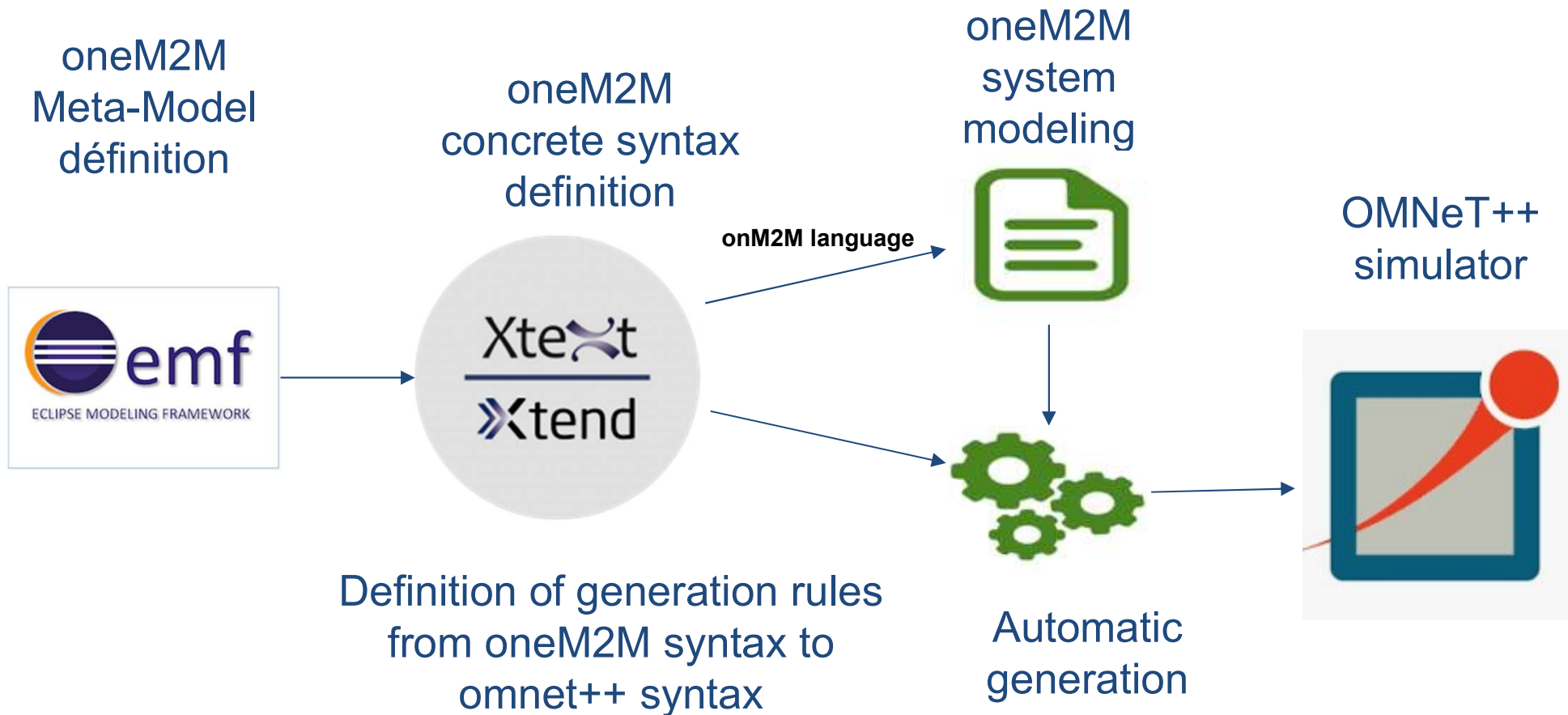
Model Driven Engineering approach for Rapid prototyping of IoT systems and applications

- **Development of a DSL (Domain Specific Language) for oneM2M to define:**
 - High level modeling of IoT application -> the logical infrastructure of the system
 - Compliance with oneM2M Standard -> The oneM2M nodes & services (CRUD)
 - Performance Evaluation -> object and communications behaviors
 - Scalable modeling -> programmatic definition of the infrastructure
- **Evaluation of a oneM2M system By simulation**
 - Automatic Generation of executable models (Omnet++ simulator)
 - Application behavior (periodic sporadic calls to services)
 - Communication latencies
 - Effective Performances of oneM2M platform implementations

oneM2M
executable specifications

* INRIA Kairos team as TTF019 partner

OneM2M Domain Specific Language definition & code generation



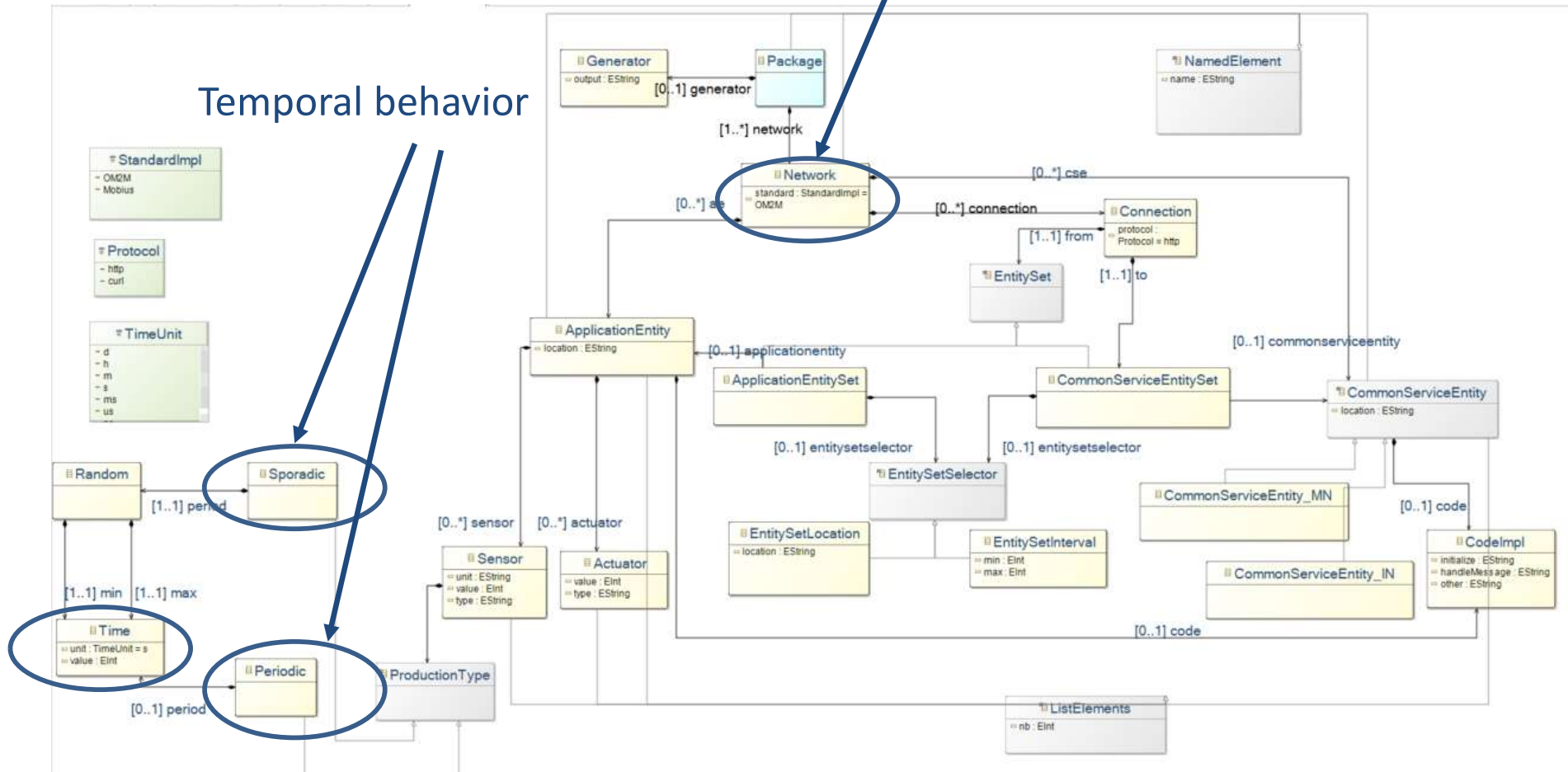
OneM2M Domain Specific Language



oneM2M
Meta-Model
Application Behaviour

Deployment platform

Temporal behavior



OneM2M Domain Specific Language System specification

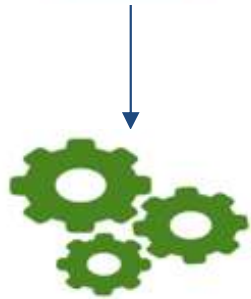
oneM2M
concrete syntax
definition



```
Package exemple {  
  Network Petit {  
    standard Mobius  
  
    ApplicationEntity ae1 {  
      Sensor [2] {  
        unit "%"   
        value 5  
        production Sporadic {  
          period 1us..10ms  
        }  
      }  
    }  
  
    CommonServiceEntity_IN cin {  
      location "INRIA"  
    }  
  
    Connection {  
      protocol curl  
      from ae ae1  
      to cse cin  
    }  
  }  
}
```

OneM2M Simulation in OMNeT++

oneM2M
system
modeling

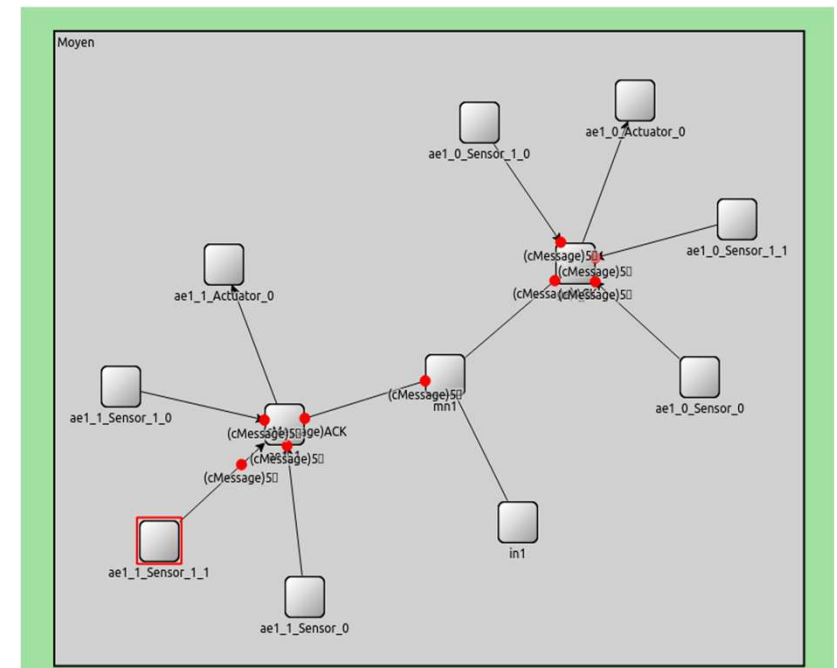
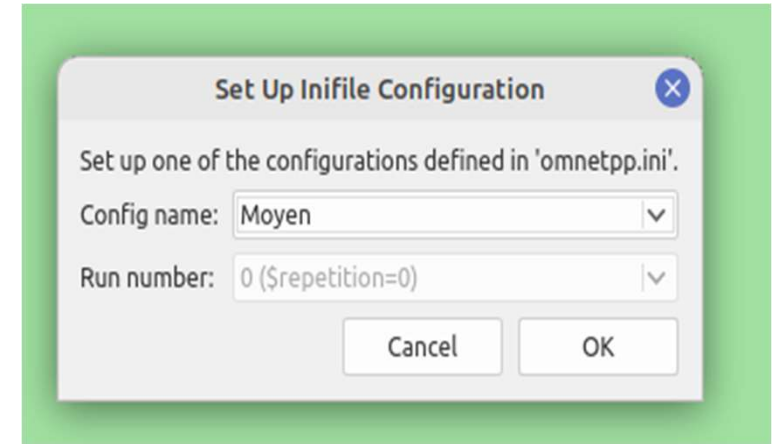


Automatic
generation

Generation of Ned and Ini
and files for OMNeT++

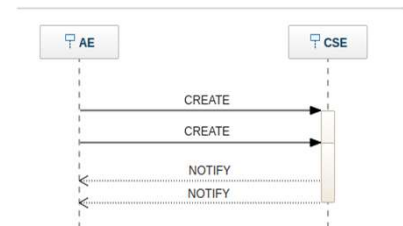
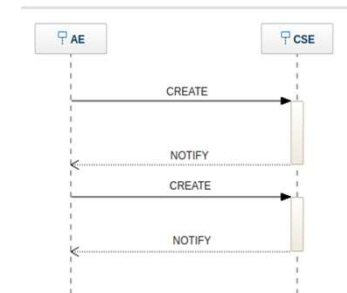
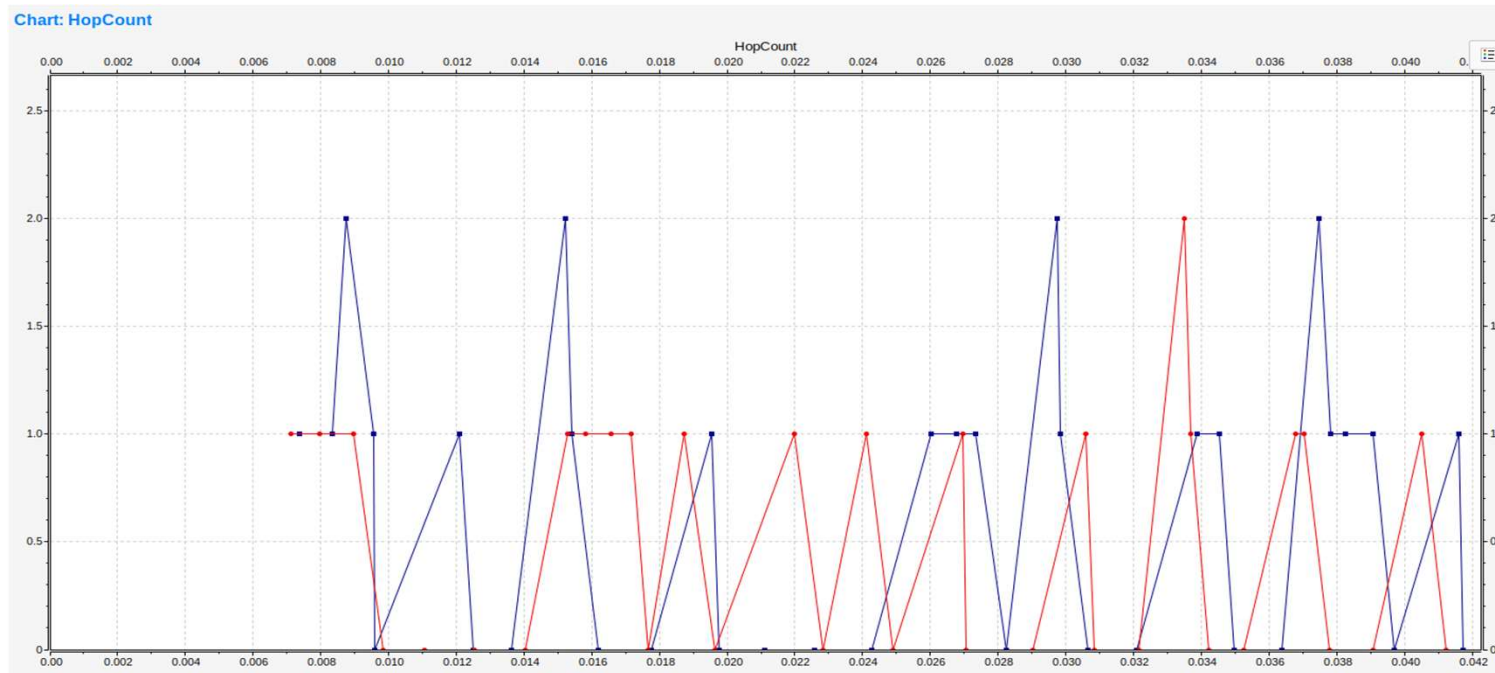
```
Package exemple {  
  Network Petit {  
    standard Mobius  
  
    ApplicationEntity ae1 {  
      Sensor [2] {  
        unit "%"  
        value 5  
        production Sporadic {  
          period 1us..10ms  
        }  
      }  
    }  
  
    CommonServiceEntity_IN cin {  
      location "INRIA"  
    }  
  
    Connection {  
      protocol curl  
      from ae ae1  
      to cse cin  
    }  
  }  
}
```

- example
 - results
 - Actuator.cc
 - Actuator.h
 - AE.cc
 - AE.h
 - CSE.cc
 - CSE.h
 - Sensor.cc
 - Sensor.h
 - Actuator.ned
 - AE.ned
 - CSE.ned
 - Grand.ned
 - Moyen.anf
 - Moyen.ned
 - omnetpp.ini
 - package.ned
 - Petit.ned
 - Sensor.ned



Simulation in OMNeT++ (2)

- Execution traces and scenario validation



Summary

- Modeling and simulation of CPS & IoT systems
- Preliminary results on oneM2M systems evaluation
 - Specification of oneM2M infrastructure & application
 - Deployment platform characteristics
 - Hypothetic CRUD response time of platforms
 - Targets : ACME, om2m, Mobius, ...
 - Simulation & Validation
 - Automatic generation
 - OMNeT ++ discret event simulation

Next Steps

- Follow-up of this preliminary work
 - Evaluation of extended services from CRUD
 - discovery services
 - Access Control Policy
 - Notification
 - Definition of KPI (key performance Indicators)

**Thank you for your attention
Questions ?**