On Management, Abstraction & Semantics

Yongjing Zhang
Standard Research Lead, Carrier Software BU, Huawei Technologies Co., Ltd.
zhangyongjing@huawei.com
oneM2M www.onem2m.org
Agenda

• Concepts about M.A.S.
• The Management Capabilities in oneM2M
  – Architecture
  – Resource modeling
  – Protocol mapping
• The Generic Abstraction & Semantic Capabilities in oneM2M
  – Resource modeling
  – Interworking framework
  – Semantic enhancement
  – Evolution roadmap
• Conclusion
Why M.A.S.

IoT Applications

- Home
- Transport
- Health
- Energy
- Retail
- ...

ABSTRACTed APIs

- ZigBee
- KNX
- BLE
- ZWave
- mBus
- 3GPP/2
- OMA
- BBF
- ...

Common Information Model & SEMANTICS

Common Service Functions (e.g. MANAGEMENT)

Heterogeneous Networks, Devices, Interfaces

ABSTRACTed APIs

- ZigBee
- KNX
- BLE
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- 3GPP/2
- OMA
- BBF
- ...

Common Information Model & SEMANTICS

Common Service Functions (e.g. MANAGEMENT)
Concepts - Abstraction

- **Abstraction**: generalizing the information model
  - to hide the complexity of the specific technologies by providing a single format to represent devices and unified methods directly usable by the applications.
- **Interworking**: mapping between two specific technologies
  - to enable the information exchange between heterogeneous systems
  - Applications may still need to understand the native information model (e.g. Zigbee profile)
## Concepts - Semantics

**Semantics:** adding the meaning and relationships between concepts (e.g. data, devices, things) and their instances

- to enable machine understandable interoperability without a-priori agreement or configuration between communication parties
- the formal specification of a conceptualization is done by 'ontology', which provides unambiguous vocabulary and model about objects, measurands, their properties and relationships.

### Levels of meaningfulness

- **Data**
  - Room: bedroomA, indoor-temperature
  - Temperature 20,5 °C
  - Float: 20,5
  - Raw Data: 0101101010 10101010

- **Device Description**
  - Measures indoor temperature of bedroomA
  - Device Type: Temperature Sensor
  - Manufacturer Energy Management...
  - Returns a float value
  - Sensor_18

### Abstraction vs. Semantic

1. **Application-level command**
   - e.g. "lower the living room temperature"
   - **Semantic support**
     - helps understanding the original data, and the relationships between things, data,…

2. **Abstract device-level command**
   - e.g. "switch off the radiator with ID=00007"
   - **Abstraction of the specific technologies**
     - (syntactic support)

3. **Techno-specific device-level command**
   - e.g. "send the command <ZigBee Specific Command> to endpoint ID=<ZigBee specific ID>"

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**Semantics is the evolution of Abstraction**
### Concepts - Management

- **Management**: the management (configuration, monitoring, trouble shooting, upgrade, etc.) of devices (ADN/ASN/NoDN), applications (AEs) and common service entities (CSEs)
  - to provide *Abstracted* unified & simplified management APIs for M2M applications.

- Management is essentially a specific aspect of oneM2M Abstraction framework:
  - **Data models**: the resources describing the mgmt capabilities, properties and status
  - **Operations**: the actions performing mgmt tasks, e.g. download (firmware), get (status) or set (properties), execute (software installation)

**Management is a specific aspect of Abstraction**
Management Capabilities

- Application & Service Layer Management (ASM CSF)
  - Configuration (e.g. CMDH Policy configuration)
  - Software Management (e.g. download/install/activation):
    - Configuration Function (CF)
    - Software Management Function (SMF)

- Device Management (DMG CSF)
  - Device Configuration (e.g. enable/disable capabilities, provisioning)
  - Device Diagnostics and Monitoring (e.g. memory, battery, event logs, reboot)
  - Device Firmware Management
  - Device Topology Management (e.g. Area Network topology & characteristics)
Management Architecture

IN-DMG-MA
• Protocol Translation
• Interaction with the Management Server
• Management Server selection
• Discovery of external management objects

Device in M2M Area Network
• Managing Area Network & Devices (technology specific)

Proxy Management Client

Management Proxy

Management Client

Management Adapter

MN/ASN
CSE
DMG

IN
CSE
DMG

Management Adapter
Management Server

IN-AE

• oneM2M abstracted management APIs (HTTP/CoAP/MQTT)

• Invoking underlying management server functions,
• Receiving management results

Out of Scope

• Performing actual management tasks by reusing existing techs (e.g. OMA, BBF)
Management Architecture

MN-DMG-MA or ASN-DMG-MA
- Mapping between the DMG and Management Client
- Interaction with the Mgmt Client

- Mgmt resource creation,
- Service layer mgmt

- Local mgmt objects discovery

Device in M2M Area Network
Proxy Management Client

Out of Scope

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Management Abstraction

oneM2M TS-0001 (ARC)/ TS-0004 (PRO)

<mgmtObj>

Generic Mgmt Resource Model

1

mgmtDefinition

→ A specialized mgmt func. type (e.g. "software")

0..1 (L)

objectIDs

→ Tech-specific mapping info

0..1 (L)

objectPaths

→ Link to sub-resources

0..1 (L)

mgmtLink

→ Attributes to be specialized for a specific mgmt func.

0..1 (L)

(objectAttribute)

0..1

description

0..n

<subscription>

Specialization

Application & Service Layer Mgmt

[software] [cmdhPolicy]

Device Mgmt

[firmware] [deviceInfo] [deviceCapability]

[eventLog] [battery] [memory] [reboot]

[areaNwkInfo] [areaNwkDeviceInfo]
Management Abstraction

oneM2M TS-0001 (ARC)/ TS-0004 (PRO)

<mgmtObj>

Generic Mgmt Resource Model

- A specialized mgmt func. type (e.g. "software")
- Tech-specific mapping info
- Link to sub-resources
- Attributes to be specialized for a specific mgmt func.

Specialization

Application & Service Layer Mgmt

- [software]
- [cmdhPolicy]

Device Mgmt

- [firmware]
- [deviceInfo]
- [deviceCapability]
- [eventLog]
- [battery]
- [memory]
- [reboot]
- [areaNwkInfo]
- [areaNwkDeviceInfo]

Mapping

oneM2M TS-0005 (OMA)

OMA DM 1.X

- FUMO
- SCOMO
- DevInfo
- DiagMO
- ...

OMA DM 2.0

OMA LWM2M

- Device Object
- Firmware Update Object
- Software Mgmt Object
- ...

BBF TR069/TR181

- DeviceInfo
- SoftwareModules
- X_oneM2M...
- ...

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Management Abstraction

<mgmtCmd>

- description
- cmdType (0..1)
- execReqArgs (0..1)
- execEnable (1)
- execTarget (0..1)
- execMode (0..1)
- execFrequency (0..1)
- execDelay (0..1)
- execNumber (0..1)
- execInstance (1)
- subscription (0..n)

<execInstance>

- execStatus (1)
- execResult (0..1)
- execDisable (1)
- execTarget (0..1)
- execMode (0..1)
- execFrequency (0..1)
- execDelay (0..1)
- execNumber (0..1)
- execReqArgs (0..n)

Generic Resource Model for RPC-like mgmt commands (BBF TR069)

- RPC cmd type (e.g. "download")
- Cmd arguments (opaque)
- Trigger of execution (by 'UPDATE')
- Target device(s) (<node> or <group> URI)
- Execution mode (e.g. 'repeated')
- In association with execution mode

* Each execution creates a <execInstance> to maintain the execution status and result

→ Cancel a pending cmd

→ Inherit from the parent <mgmtCmd>

oneM2M TS-0001 (ARC)/ TS-0004 (PRO)

oneM2M TS-0001 (ARC)/ TS-0004 (PRO)
Management Abstraction

Generic Resource Model for RPC-like mgmt commands (BBF TR069)

- **<mgmtCmd>**
  - 0..1 **description**
  - 1 **cmdType**
  - 0..1 **execReqArgs**
  - 1 **execEnable**
  - 1 **execTarget**
  - 0..1 **execMode**
  - 0..1 **execFrequency**
  - 0..1 **execDelay**
  - 0..1 **execNumber**
  - 0..n **<subscription>**
  - 1 **<execInstance>**

  - **→ RPC cmd type (e.g. "download")**
  - **→ Cmd arguments (opaque)**
  - **→ Trigger of execution (by 'UPDATE')**
  - **→ Target device(s) (<node> or <group> URI)**
  - **→ Execution mode(e.g. 'repeated')**
  - **→ In association with execution mode**

- **<execInstance>**
  - 1 **execStatus**
  - 1 **execResult**
  - 0..1 **execDisable**
  - 1 **execTarget**
  - 0..1 **execMode**
  - 0..1 **execFrequency**
  - 0..1 **execDelay**
  - 0..1 **execNumber**
  - 0..n **<subscription>**

  - **→ Cancel a pending cmd**
  - **→ Inherit from the parent <mgmtCmd>**

* Each execution creates a **<execInstance>** to maintain the execution status and result

Mapping

oneM2M TS-0006 (BBF)

BBF TR069

- **•RESET**
- **•REBOOT**
- **•DOWNLOAD**
- **•SOFTWAREINSTALL**
- **•SOFTWAREUNINSTALL**
Management Example Flow

Registration, CREATE <ASN-node>

Resource creation

CREATE <deviceInfo>, <battery>, <firmware>...

Resource creation

Keep in sync by UPDATE

Invoke battery monitoring

Battery info

Mgmt Session (e.g. DM/TR069)

[battery] update

OK

Mgmt Session (e.g. DM/TR069)

UPDATE [firmware]

Invoke firmware update

OK

Mgmt Session (e.g. DM/TR069)

RETRIEVE [battery]

[battery] representation
✓ Resource types <AE>, <container> & <contentInstance> are used for the abstraction of M2M applications, data collection and instances.

- **Application**
  - <AE>
    - appName
    - App-ID
    - AE-ID
    - pointOfAccess
    - ontologyRef

- **Data collection**
  - <container>
    - creator
    - maxNrOfInstances
    - maxByteSize
    - ontologyRef

- **Data instance**
  - <contentInstance>
    - typeOfContent
    - contentSize
    - ontologyRef
    - content

- **Hierarchical data collection**
  - <container>

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**Generic Abstraction/Semantics**

- **Common Services Entity (CSE)**
  - Application and Service Layer Management
  - Communication Management/ Delivery Handling
  - Group Management
  - Security
  - Service Charging & Accounting
  - Subscription and Notification

- **Application Entity (AE)**

- **Mca Reference Point**

- **Mcn Reference Point**

- **Underlying Network Service Entity (NSE)**

- **Hierarchical data collection**

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✓ Resource types `<AE>`, `<container>` & `<contentInstance>` are used for the abstraction of M2M applications, data collection and instances.

✓ Attribute 'ontologyRef' is to provide the semantic annotation (meaning) for application and data. It's the rudimentary step towards semantic capability enablement.
Interworking with non-oneM2M (Informative)

✓ The Inter-working Proxy Application Entity (IPE) abstracts and maps the non-oneM2M data model to the oneM2M resources exposed via the Mca reference point.

Translation of non-oneM2M Data Model to oneM2M Specific Data Model

Generic data modeling of interworking

- ZigBee
- DLMS/COSEM
- Zwave
- BACnet
- ANSI C12
- mBus
Interworking Enhancement with Semantics

A generic semantic concept model (ontology) representing an Area Network

An example of mapping to oneM2M resources

* Attribute 'ontologyRef' links to the ontology definition of each concept (e.g. 'FunctionBlock').
Roadmap to Semantic Enablement

(Informative)

1. Semantic Modeling (Ontology)

2. Semantic Annotation

3. Use of Semantic Technologies for specific Platform Functionalities

4. Full Semantic Platform
Roadmap to Semantic Enablement (Informative)

1. Semantic Modeling (Ontology)
Roadmap to Semantic Enablement (Informative)

2. Semantic Annotation
3. Use of Semantic Technologies for specific Platform Functionalities
Roadmap to Semantic Enablement

(Informative)

4. Full Semantic Platform
Conclusion

Abstraction

Annotations

Ontology

Query

Reasoning

Mash-up

... [battery], [memory], [deviceInfo], [software], [firmware], ...

Interworking

<AE> (e.g. IPE), <container>, <contentInstance>, ...

<mgmtObj>, <mgmtCmd>

Technology-specific

ZigBee

KNX

OMA

BBF

...
Join us at the oneM2M showcase event

- OneM2M project partners, rationale and goals
- OneM2M Service Layer Specification release
- Showcase demos that demonstrate oneM2M “live"

9 December 2014, Sophia-Antipolis, France
(free of charge, but online registration is required)

http://www.onem2m.org/Showcase

Followed by the ETSI M2M workshop
Thank You!

Q&A