IoT Service Layer Standard – Features - Roadmap

Roland Hechwartner, oneM2M TP Chair

Akraino Technical Meetings – Spring

March 1st 2021

Agenda

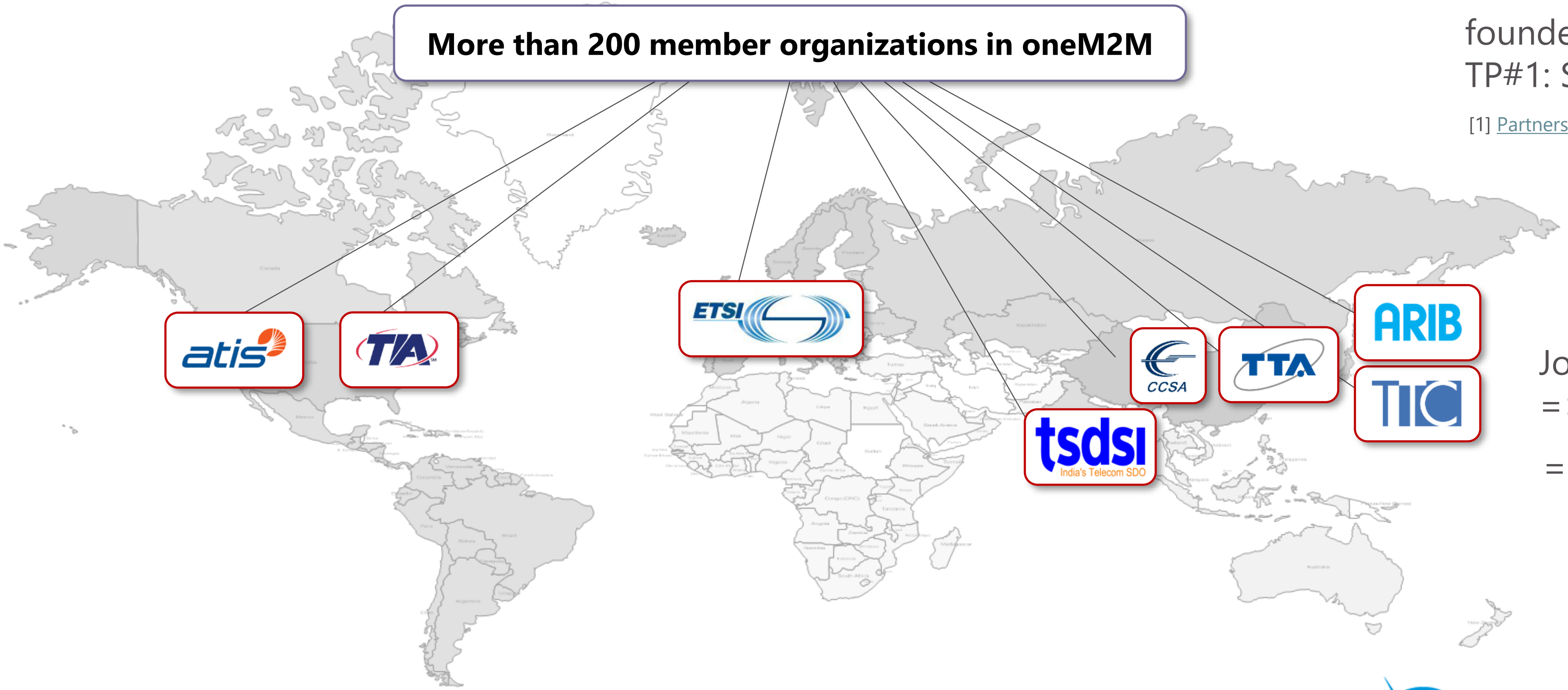
- The oneM2M Partnership Project
- The Service Layer - An Overview
- Basic Architecture
- Abstraction and Interworking
- Work on Semantics
- The 3GPP Interworking
- some more Release 4 Features
- Conclusion and Outlook

The Partnership Project

- Organisation
- The Standard
- The Service Layer

oneM2M Partnership Project

www.oneM2M.org **All documents and specifications are publically available**



More than 200 member organizations in oneM2M

GLOBALPLATFORM
THE STANDARD FOR SECURE DIGITAL SERVICES AND DEVICES

founded[1] July, 24th 2012
TP#1: Sep 24th-29th 2012

[1] Partnership Agreement V 2.0 (Approved March 2013)

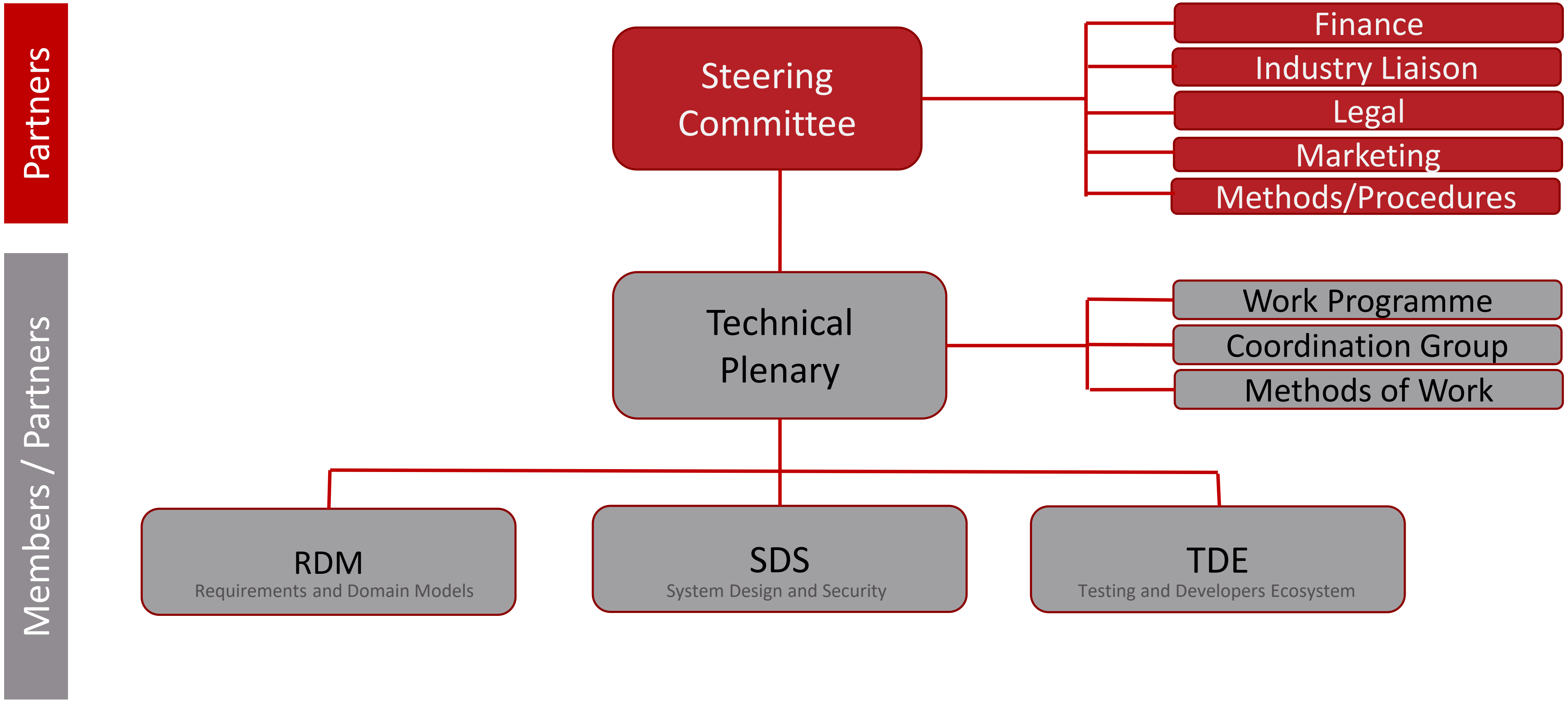
Join forces
=> reduce fragmentation

=> Reuse *e.g.* broadband forum
oma Open Mobile Alliance HGI

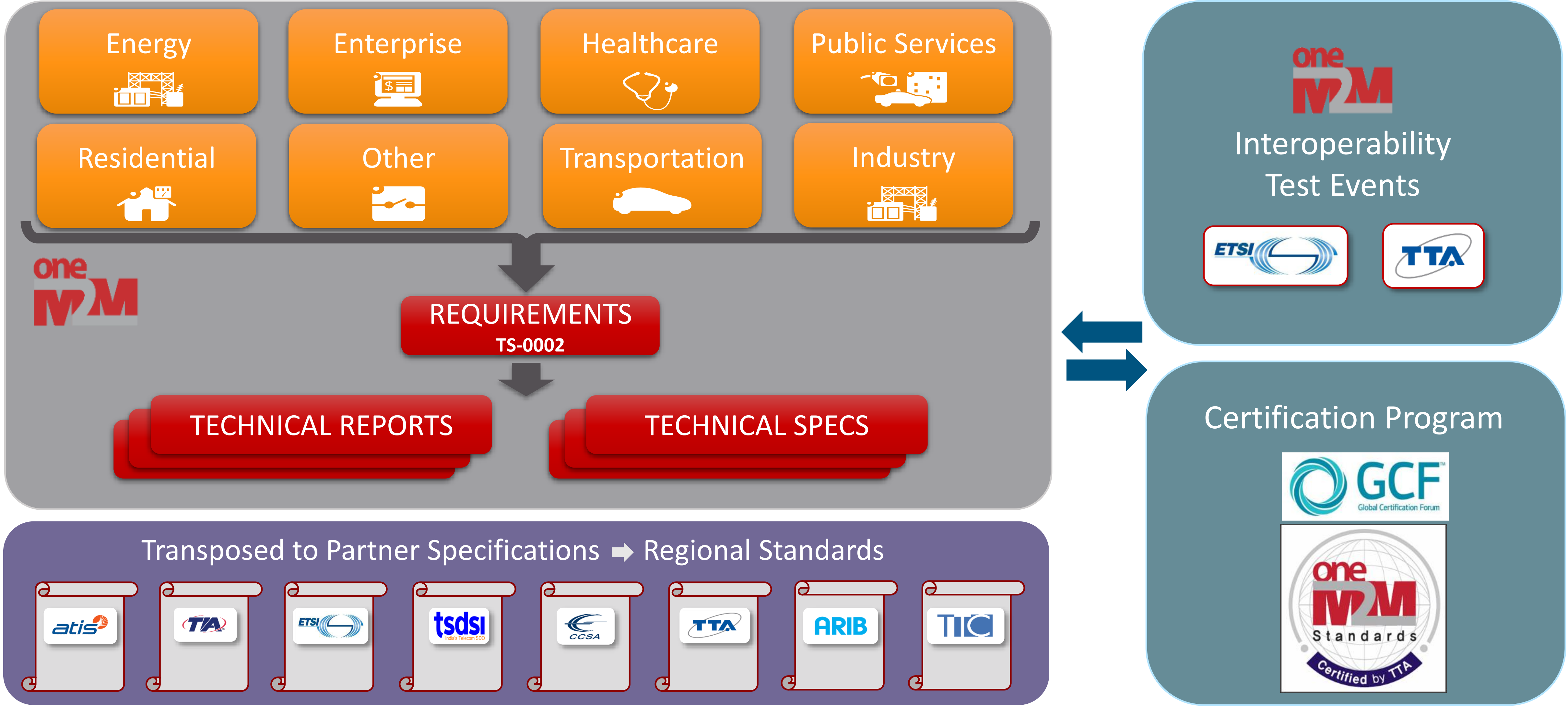
ITU e.g. Release 2 transposition
ITU-T SG20 Y.4500.x

Organization

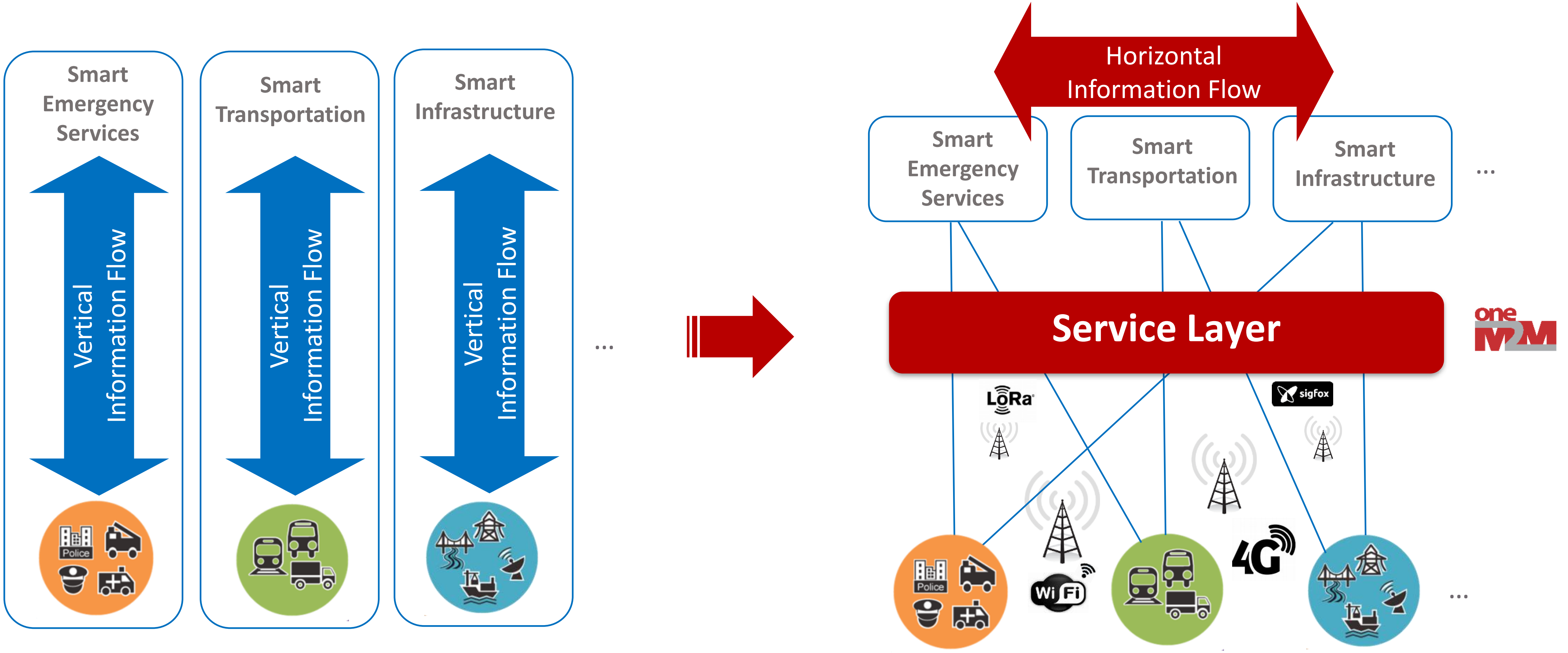
http://onem2m.org/about-onem2m/organisation-and-structure



oneM2M
Standard – Testing – Certification Program



oneM2M Breaks Down the Silos



Smart Emergency Services

Vertical Information Flow

Smart Transportation

Vertical Information Flow

Smart Infrastructure

Vertical Information Flow

…

Horizontal Information Flow

Smart Emergency Services

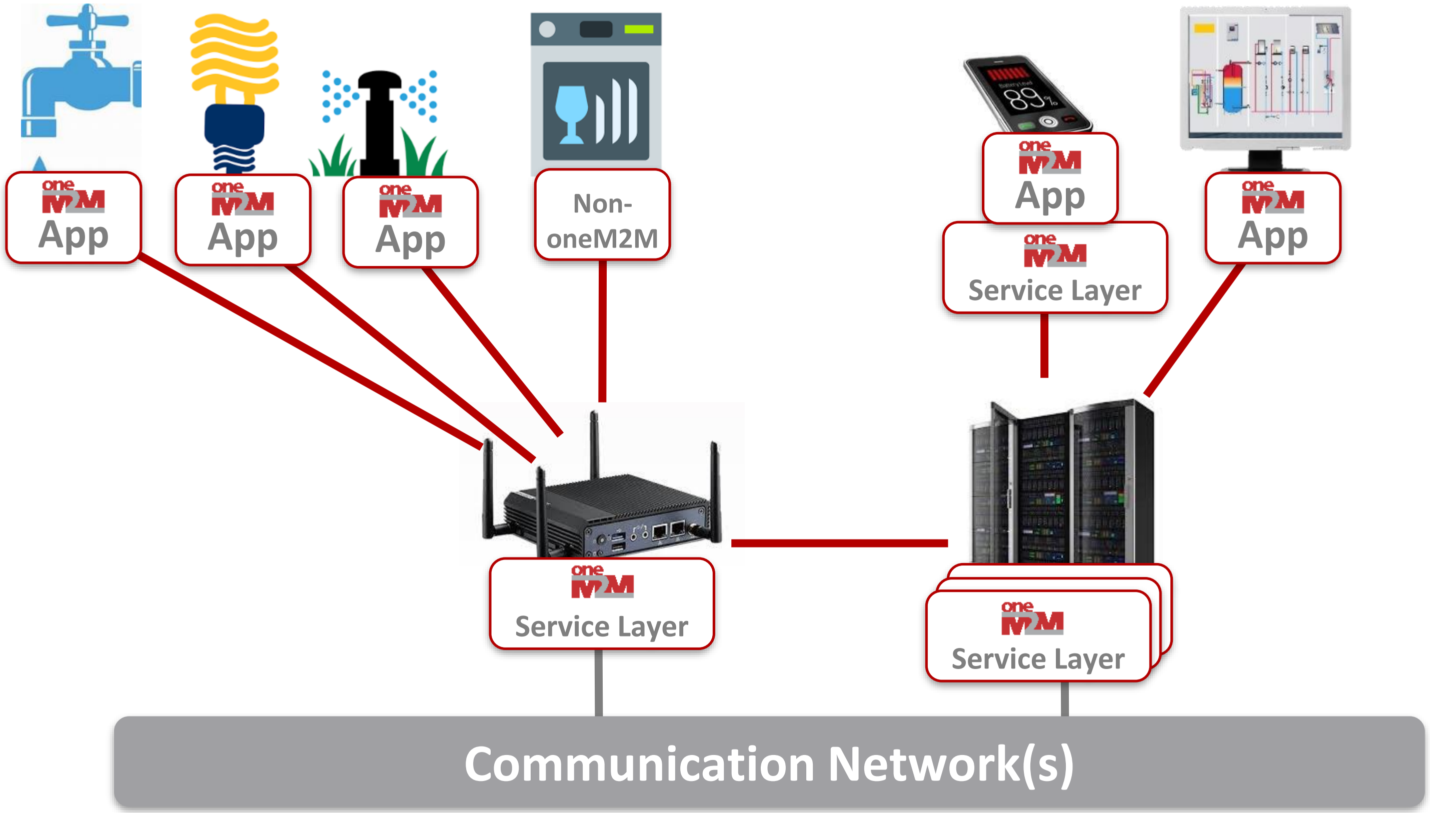
Smart Transportation

Smart Infrastructure

…

Service Layer

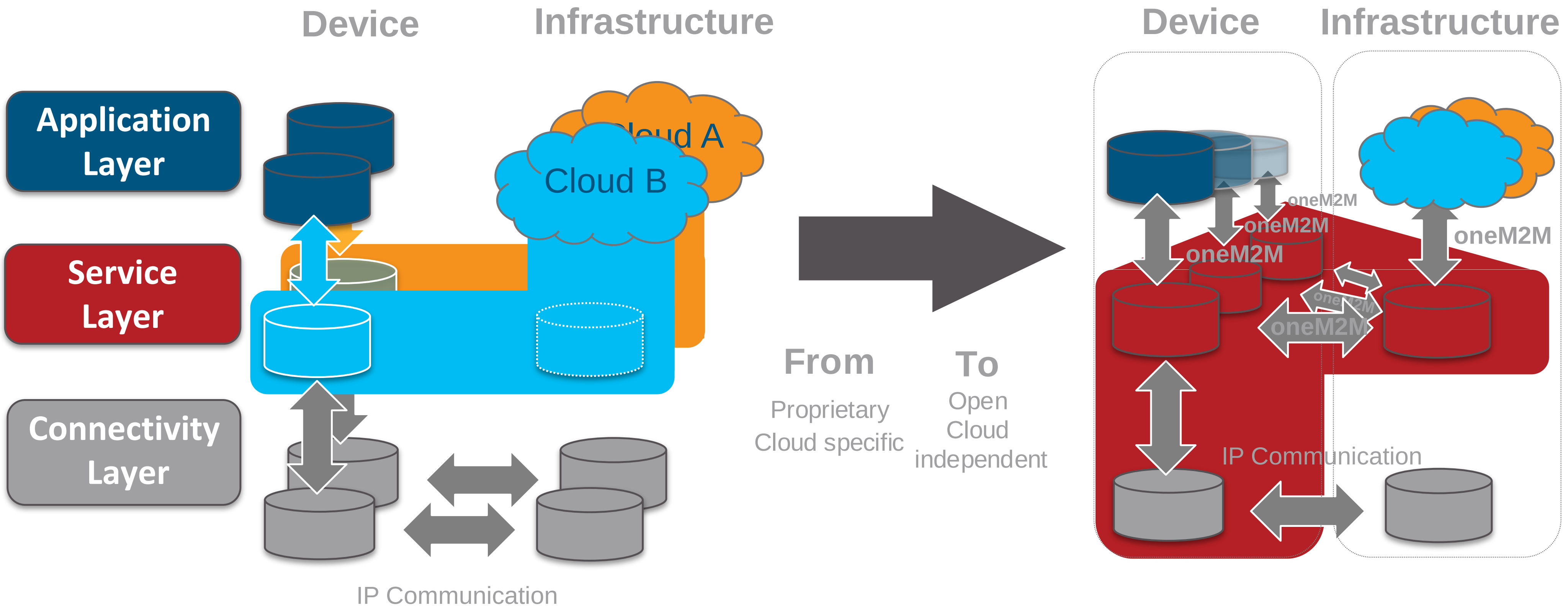
oneM2M is an End-to-End IoT Technology



Flexible Deployment Options

- IoT Cloud / Enterprise
- IoT Gateway
- IoT Edge Device
- IoT User Devices

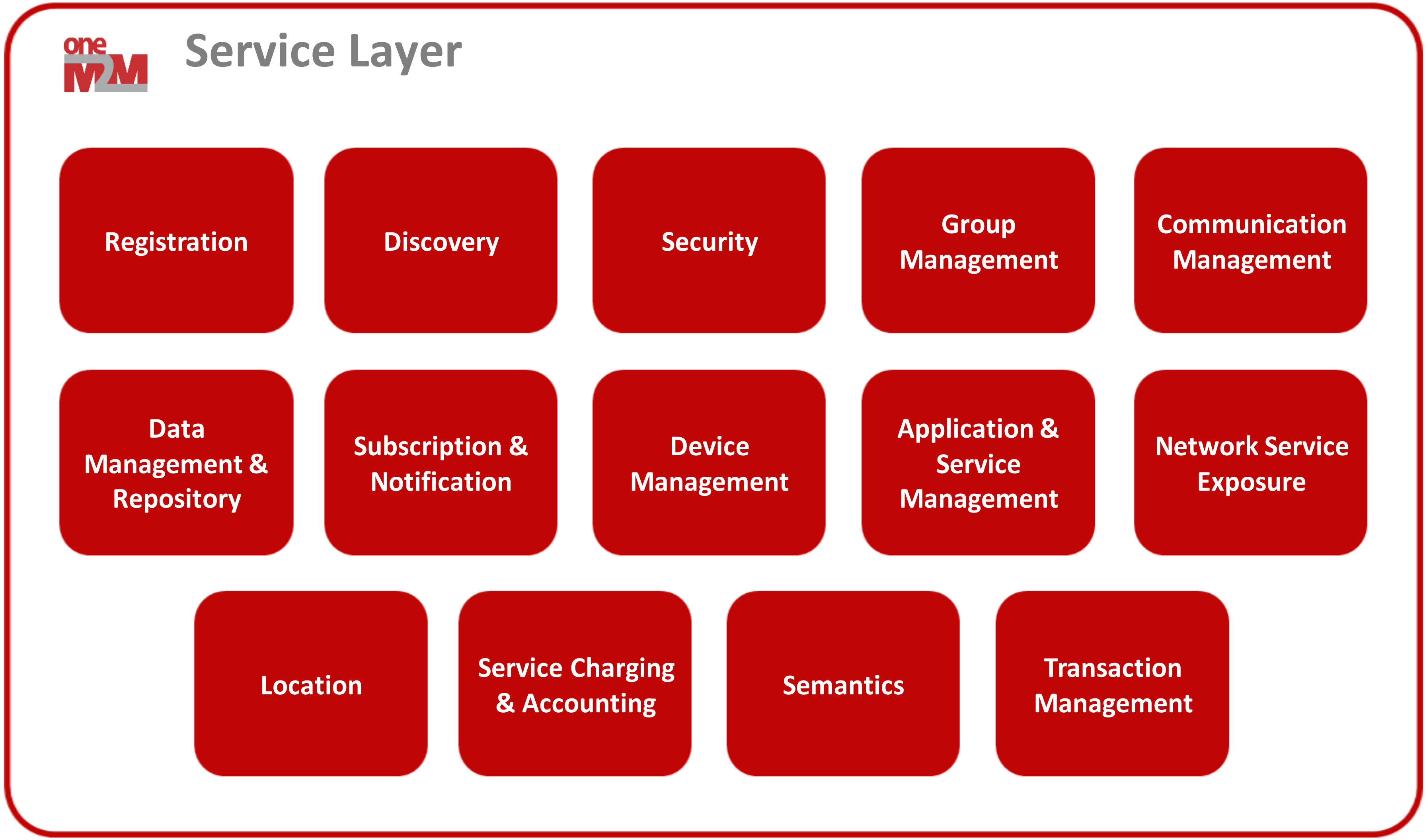
Cloud provider independent



From Fragmentation to Standards - decoupling device, cloud, and application by open interfaces

Source: oneM2M-TR-0057-V-0.6.0 Getting Started with oneM2M

oneM2M's modular service functions fit into a coherent framework



Service Layer

Registration

Discovery

Security

Group Management

Communication Management

Data Management & Repository

Subscription & Notification

Device Management

Application & Service Management

Network Service Exposure

Location

Service Charging & Accounting

Semantics

Transaction Management

oneM2M Feature Summary by Release

The IoT Standard

Release 1

- Registration
- Discovery
- Security
- Group Management
- Data Mgmt. & Repository
- Subscription & Notification
- Device Management
- Communication Mgmt
- Service Charging
- Network Service Exposure
- App & Service Mgmt
- HTTP/CoAP/MQTT Bindings

2015

Release 2

+ Time Series Data
+ Flexible Resources that can be customized by app developers (flex container)
+ Semantics Description & Discovery
+ Security Enhancements
  - Dynamic Authorization
  - Content Security
  - E2E Security
+ WebSocket Binding
+ Ontology for Home Area Information Model
+ oneM2M App-ID Registry
+ oneM2M Interworking
  - LWM2M
  - Alljoyn
  - 3GPP Triggering

2016

Release 3

+ Semantic Querying/Mashup
+ 3GPP SCEF Interworking
  - Non-IP Data Delivery
  - UE reachability Monitoring
  - Device triggering
  - Etc.
+ Transaction Management
+ Service Layer routing
+ Common oneM2M Interworking Framework
  - OCF
  - OPC-UA
  - OSGi
+ oneM2M Conformance Tests and Profiles
+ Security Enhancements
  - Distributed Authorization
  - etc.
+ Ontology Based Interworking

2018

Release 4

(planned)

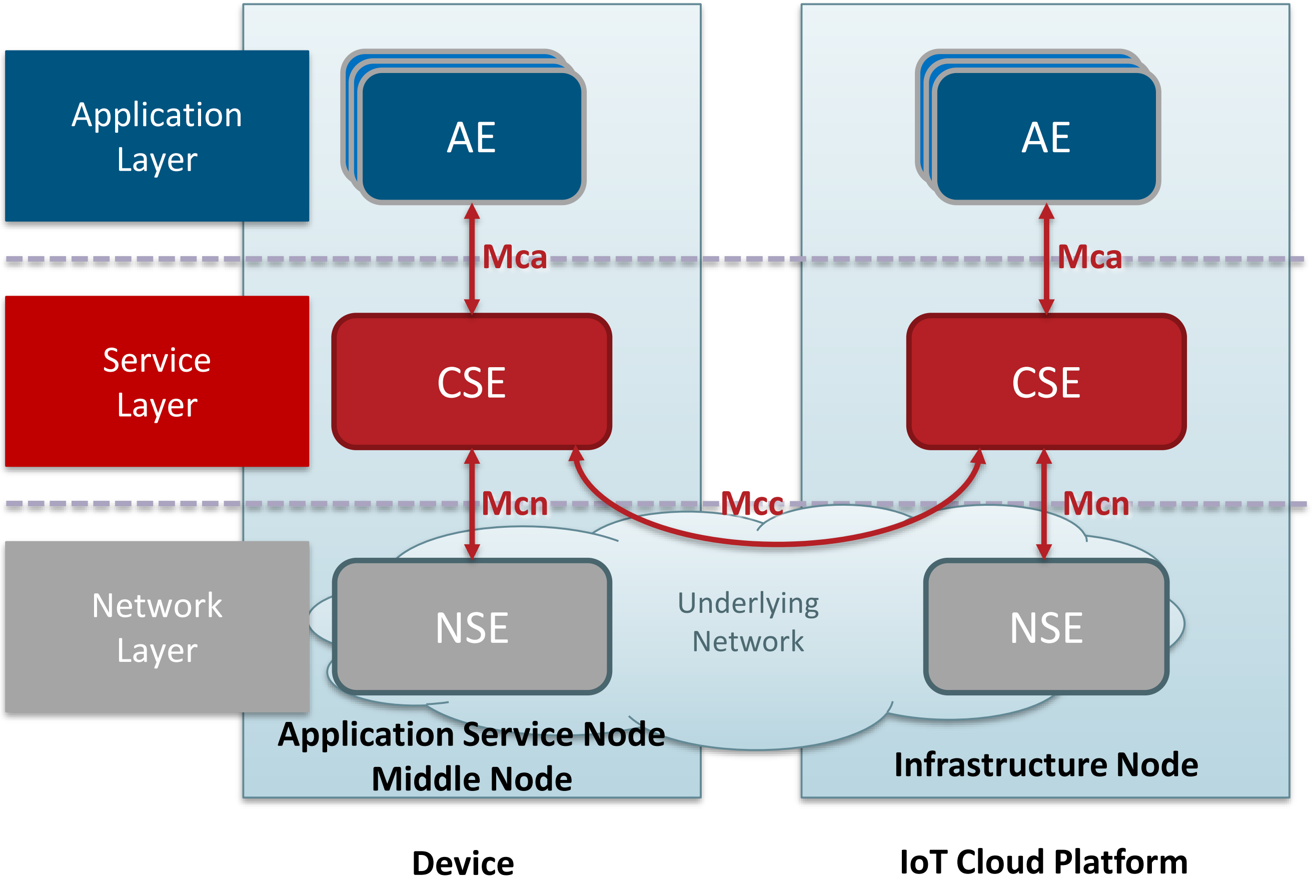
+ SDT 4.0 and the Information Models for Multiple Domains
+ oneM2M Conformance Tests
+ Geo Query
+ Process Management
+ Message Primitive Profiles
+ Semantic Reasoning
+ Time Management
+ Enhanced 3GPP Interworking
  - Session QoS
  - Congestion Monitoring
+ Fog/Edge Computing
  - Software Campaigning
  - Resource Synchronization
+ Service Subscriber Management
+ Security Enhancements
+ Group Anycast/Somecast
+ Modbus Interworking
+ Discovery Based Operations
+ Semantic Ontology Mapping

2021

Basic Architecture

- TS-0001 Functional Architecture

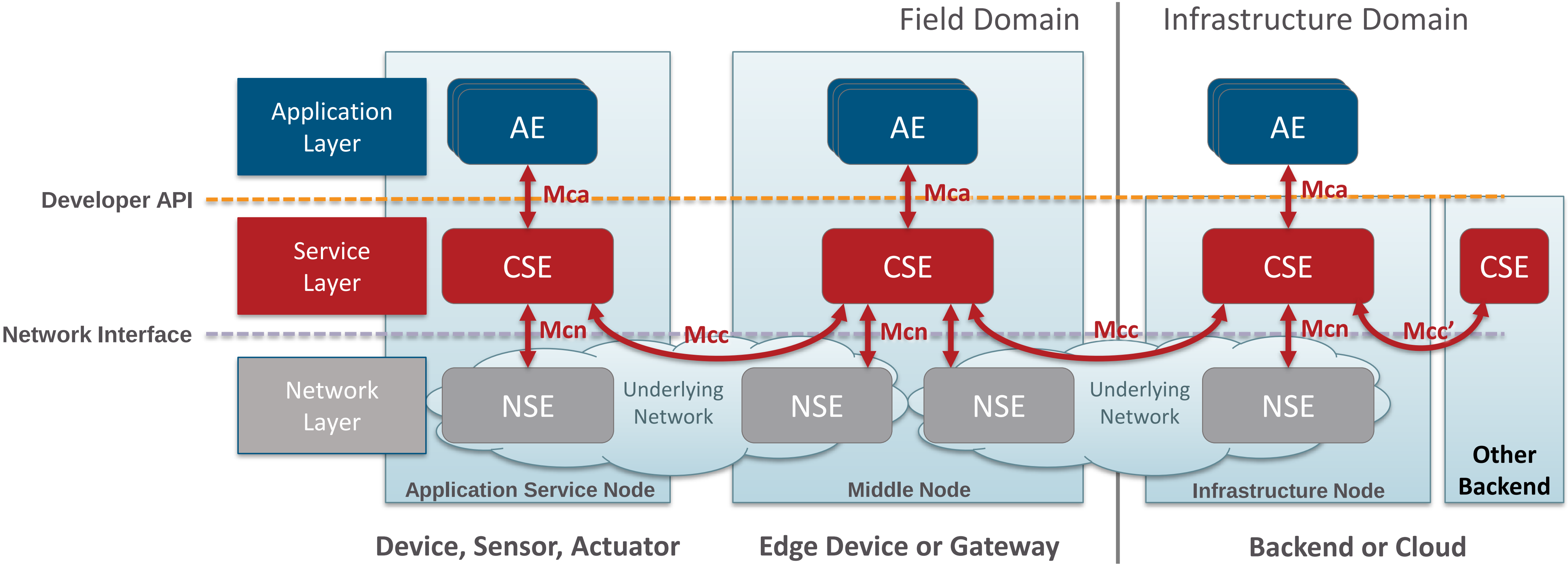
Basic Architecture



- Application Entity (AE)
  Provides application logic for the end-to-end M2M solutions
- Common Services Entity (CSE)
  Provides the set of "service functions" common to the M2M environments
- Network Services Entity (NSE)
  Provides connectivity services to the CSEs besides the pure data transport
- Node
  Logical equivalent of a physical (or possibly virtualized) device
- Reference Point – RESTful APIs
  One or more interfaces -
  - Mca: CSE - AE
  - Mcn: CSE - NSE
  - Mcc: CSE – CSE; Mcc' (between 2 service providers)

onem2m.org, TS-0001 Functional Architecture

A bit more elaborate

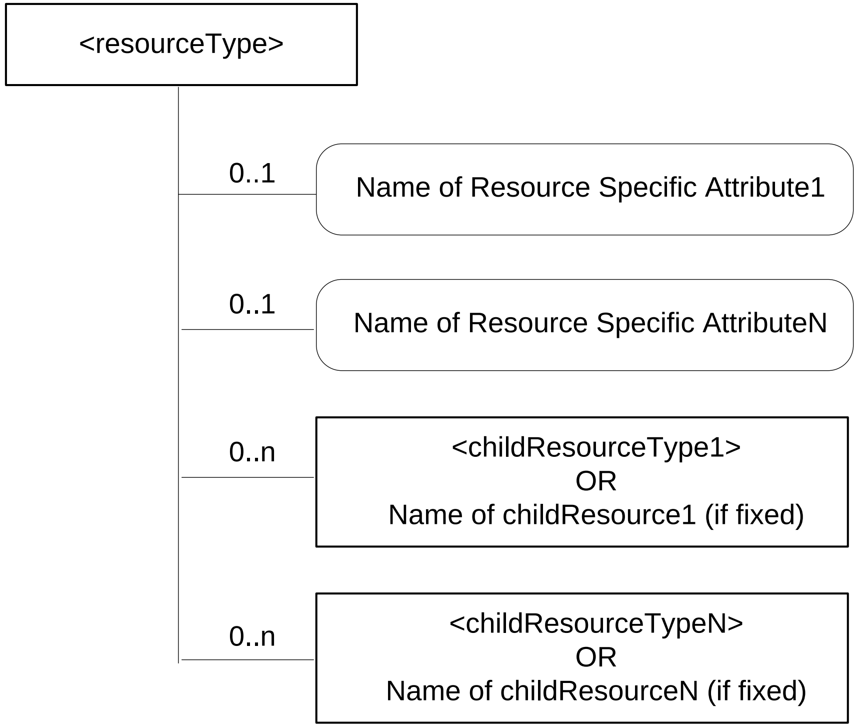


Entities	AE (Application Entity), CSE (Common Services Entity) and NSE (Network Services Entity)
Reference Point	One or more interfaces - Mca, Mcn, Mcc and Mcc'

onem2m.org, TS-0001 Functional Architecture

oneM2M is Resource Oriented

- All entities in the oneM2M System, such as AEs, CSEs, data, etc. are represented as resources.
- A resource structure is specified as a representation of such resources.
- Resources are uniquely addressable. The root of the resource structure in a CSE shall be assigned an absolute address.
- Resources have a type
- Resources are formally defined in XSD.

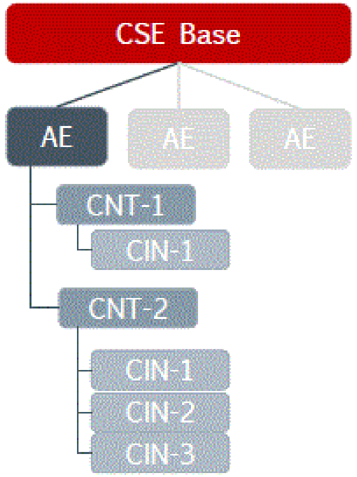

<resourceType>
0..1
Name of Resource Specific Attribute1
0..1
Name of Resource Specific AttributeN
0..n
<childResourceType1>
OR
Name of childResource1 (if fixed)
0..n
<childResourceTypeN>
OR
Name of childResourceN (if fixed)

- Square boxes are used for the resources.
- Square boxes with round corners are used for attributes.

onem2m.org, TS-0001 Functional Architecture

RESTful Architecture Style

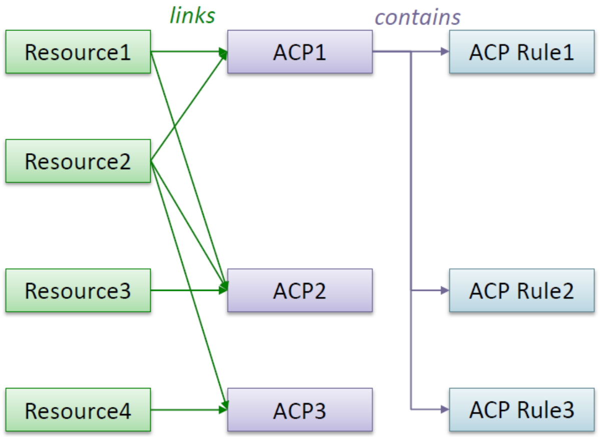
- oneM2M is based on a RESTful architecture
  - API is based on requests to perform an operation on a resource
  - Operations are Create, Retrieve, Update, Delete



Basic Resources

- Common Service Entity *(CSE)*
- Application Entity *(AE)*
- Container *(CNT)*
- Content Instance *(CIN)*
- ….

- oneM2M Service Layer supports **configurable access control policies** that define clear rules dictating, for each resource
  - WHO is authorized to access,
  - WHAT operations are allowed, and under
  - WHICH conditions (e.g. time, location of entity)



Resource access is authorized based upon satisfying at least one Access Control Policy (ACP) rule in one of the linked ACPs

onem2m.org, TS-0001 Functional Architecture

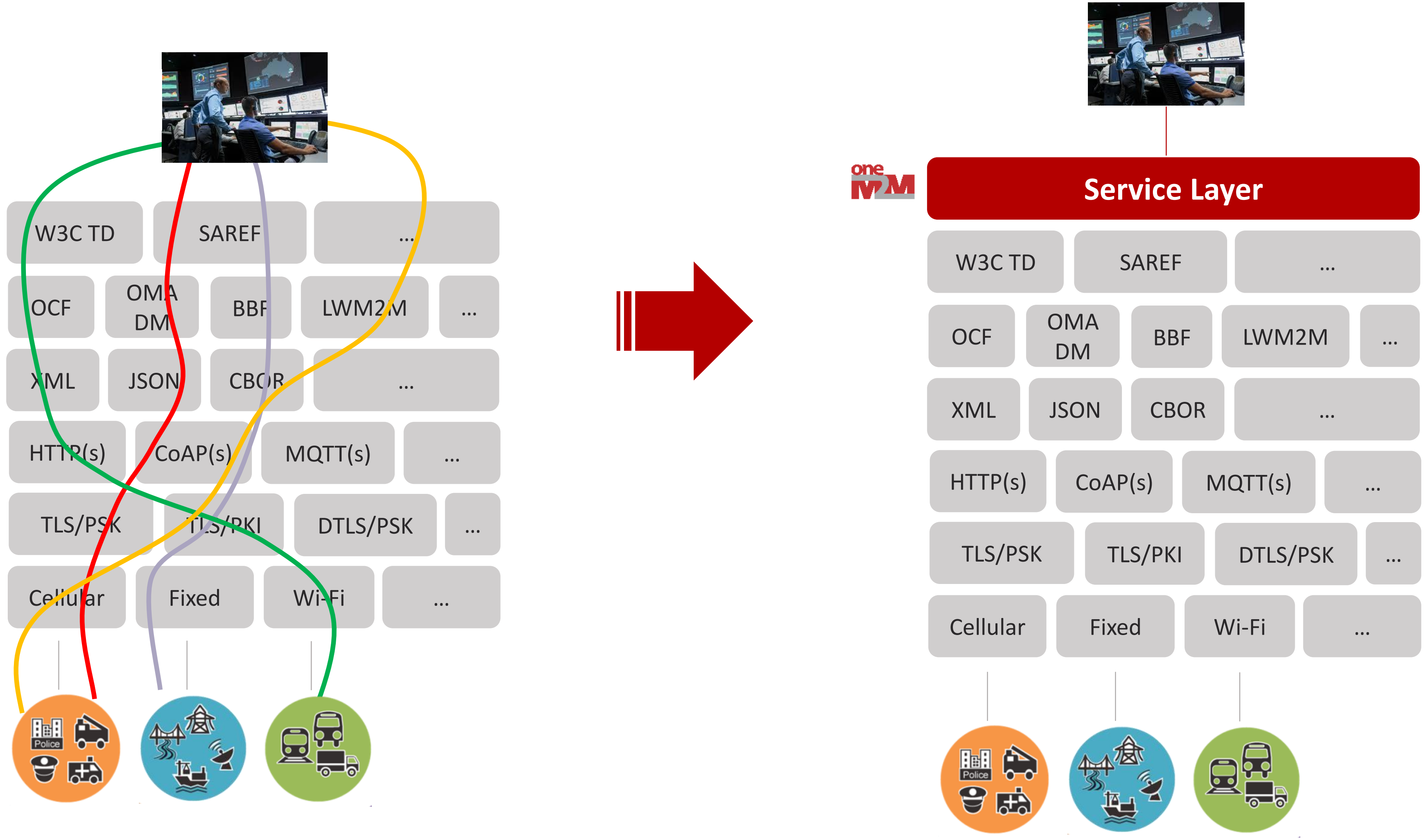
Source: oneM2M Security Webinar

Abstraction and Interworking

- TS-0003 Security Solutions
- TS-0004 Service Layer Core Protocol
- TS-0008 CoAP Protocol Binding
- TS-0009 HTTP Protocol Binding
- TS-0010-MQTT protocol binding
- TS-0020 WebSocket Protocol Binding
- TS-0016 Secure Environment Abstraction
- TS-0026 3GPP Interworking
- TS-0032 MAF and MEF Interface Specification

- TS-0005 Management Enablement (OMA)
- TS-0006 Management Enablement (BBF)
- TS-0014 LWM2M Interworking
- TS-0023 Home Appliances Information Model and Mapping
- TS-0024 OCF Interworking
- TS-0035 OSGi interworking
- TS-0040 Modbus Interworking
- TS-0030 Ontology based Interworking
- TS-0034 Semantics Support
- TS-0033 Interworking Framework

How does oneM2M enable interworking?



W3C TD | SAREF | …

OCF | OMA DM | BBF | LWM2M | …

XML | JSON | CBOR | …

HTTP(s) | CoAP(s) | MQTT(s) | …

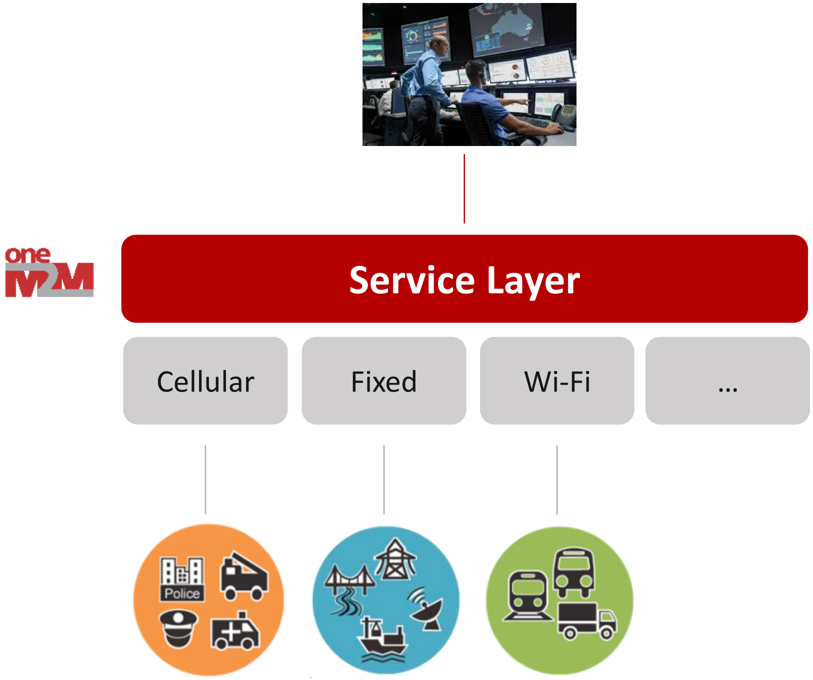
TLS/PSK | TLS/PKI | DTLS/PSK | …

Cellular | Fixed | Wi-Fi | …

Underlying Network Connectivity Abstraction

TS-0026 3GPP Interworking

- oneM2M interworks with underlying network technologies to help manage network connectivity and communication to IoT devices on behalf of the apps
  - Scheduling and buffering of messages based on device reachability
  - Selection of underlying network connectivity options for device communication
  - Triggering of devices to establish a network connection based on when apps need to communicate with devices
  - QoS configuration based on app’s needs

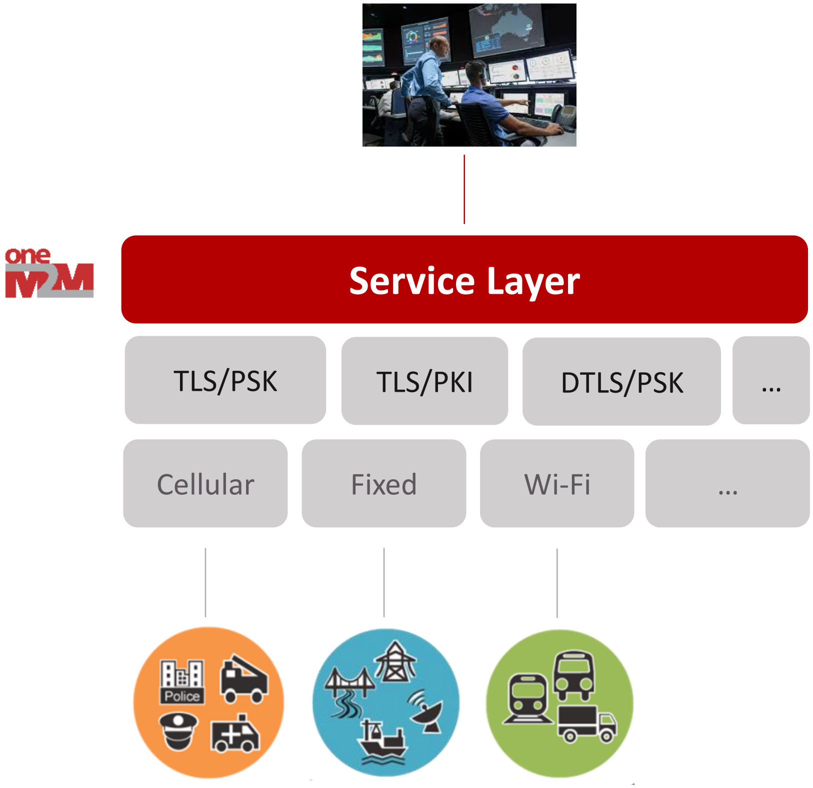


* oneM2M is closely working with 3GPP on interworking via 3GPP defined SCEF API*

IoT Device Security Abstraction

TS-0003 Security Solutions
TS-0016 Secure Environment Abstraction
TS-0032 MAF and MEF Interface Specification

- oneM2M hides the different security frameworks of each IoT device technology from the App Developer.
- A Developer’s app can establish a security association with the oneM2M service layer and via this security association, communicate securely with IoT devices
- The oneM2M service layer establishes and manages the security association with each of the IoT devices on behalf of the app
  - Enrolment, credential bootstrap/management, authentication, integrity, privacy, and authorization network connectivity of the devices from the app developer.



Service Layer

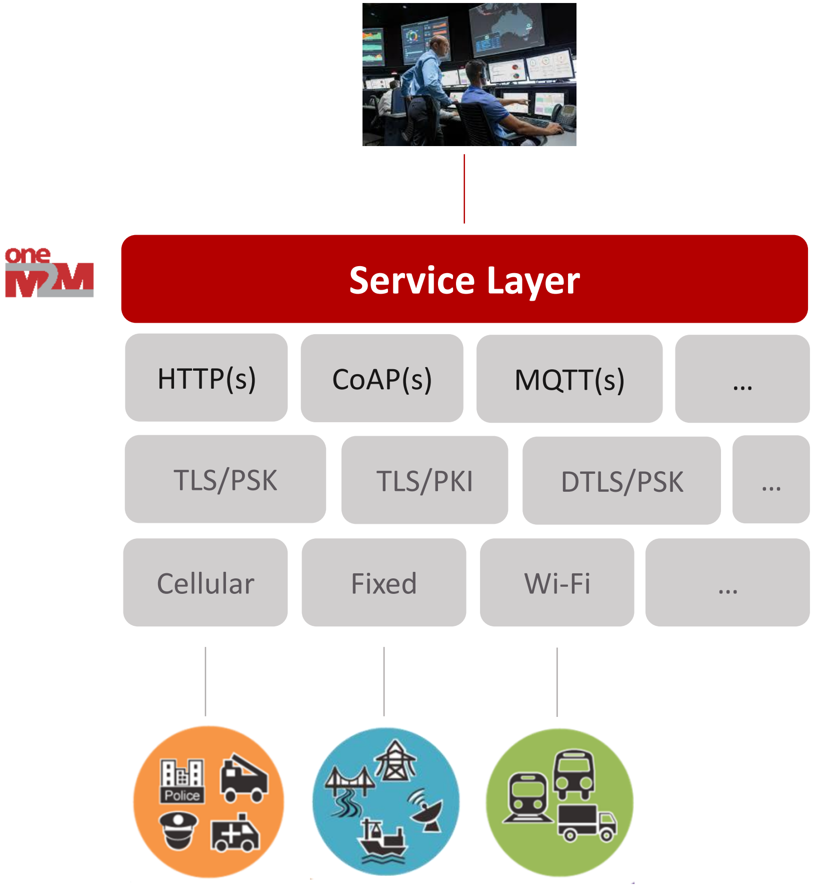
TLS/PSK | TLS/PKI | DTLS/PSK | ...

Cellular | Fixed | Wi-Fi | ...

Transport Protocol Abstraction

TS-0008 CoAP Protocol Binding
TS-0009 HTTP Protocol Binding
TS-0010-MQTT protocol binding
TS-0020 WebSocket Protocol Binding

- oneM2M hides the different transport protocols used by different devices from the App Developer.
- Applications can use different transport protocols than the one or more different devices they choose to communicate with
  - E.g. HTTP(s), CoAP(s), MQTT(s), WebSockets
- oneM2M will handle converting the transport protocol so the App Developer does not need to



Service Layer

HTTP(s) | CoAP(s) | MQTT(s) | ...

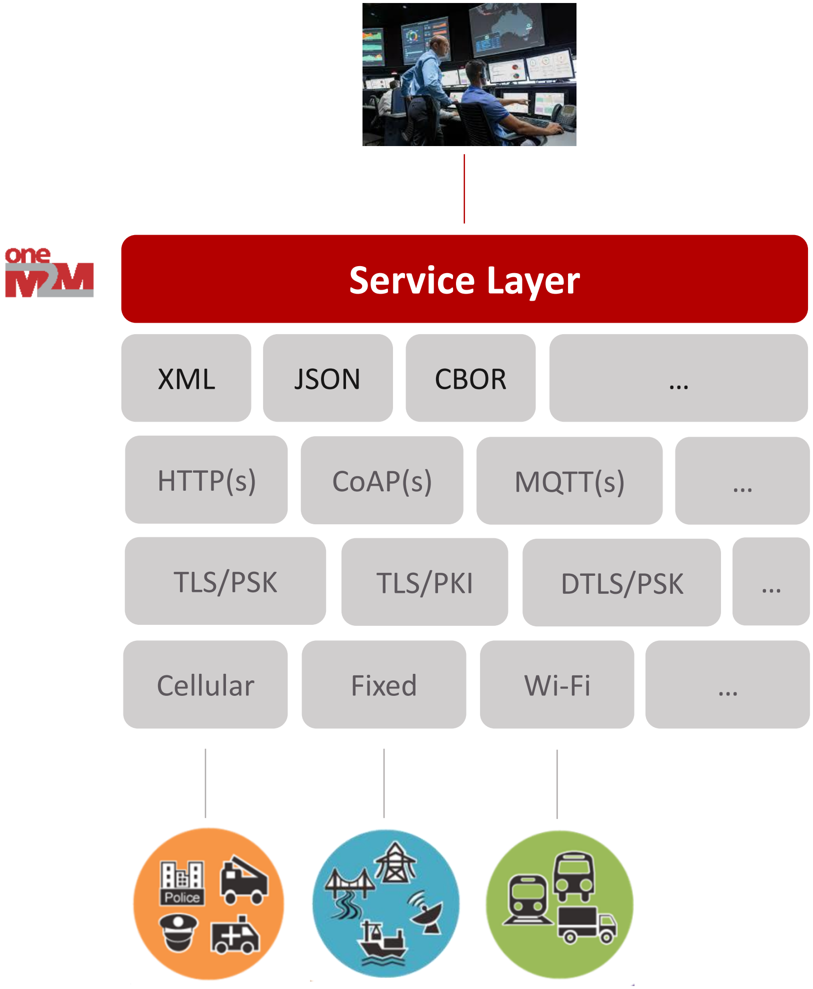
TLS/PSK | TLS/PKI | DTLS/PSK | ...

Cellular | Fixed | Wi-Fi | ...

Content Serialization Abstraction

TS-0004 Service Layer Core Protocol

- oneM2M hides the different content serializations used by the devices from the App Developer.
- Applications can use different types of content serialization formats than the one or more devices they choose to communicate with
  - E.g. XML, JSON, CBOR, Plain-Text
- oneM2M will convert the content serialization format so the App Developer does not have to



Service Layer

XML | JSON | CBOR | ...

HTTP(s) | CoAP(s) | MQTT(s) | ...

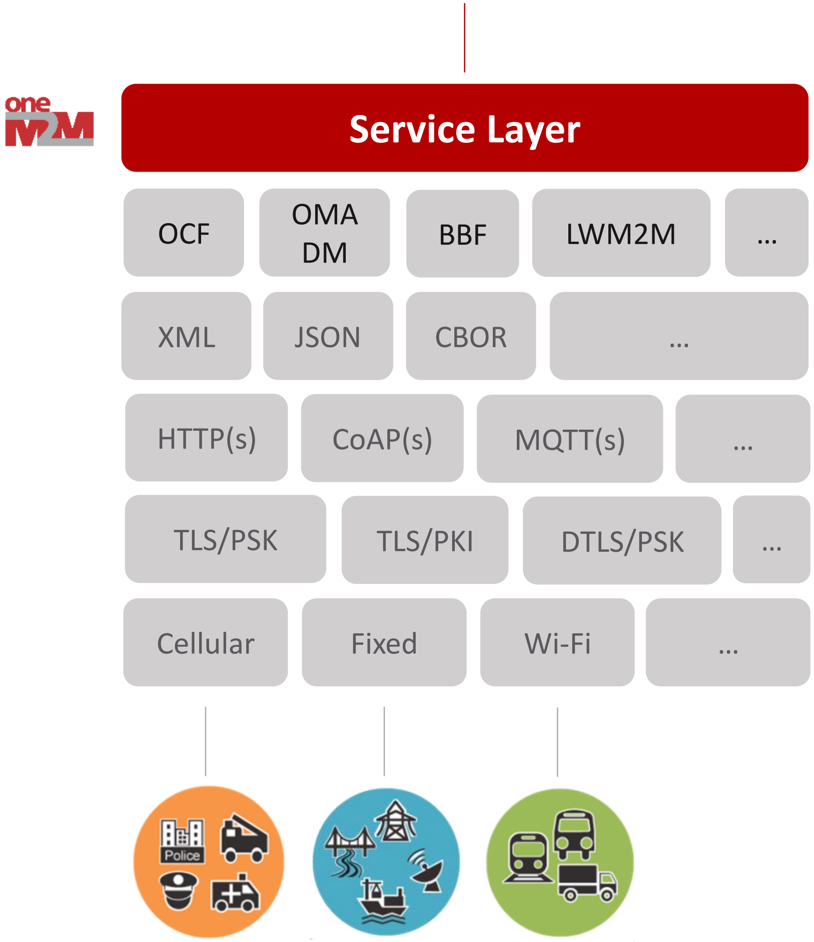
TLS/PSK | TLS/PKI | DTLS/PSK | ...

Cellular | Fixed | Wi-Fi | ...

IoT Data Model Abstraction

TS-0005 Management Enablement (OMA)
TS-0006 Management Enablement (BBF)
TS-0014 LWM2M Interworking
TS-0023 Home Appliances Information Model and Mapping
TS-0024 OCF Interworking
TS-0035 OSGi interworking
TS-0040 Modbus Interworking

- oneM2M interworks different IoT device data models with one another
  - E.g. OCF, LWM2M, …
  - All devices are presented to the App via oneM2M API
  - Via standardized oneM2M API, App developers can use device services and manage devices
- Once the data model is abstracted into oneM2M, App Developers can access all devices in a common manner and make use of oneM2M value-add capabilities such as
  - Resource Discovery
  - Generating Events via subscriptions and notifications
  - Grouping
  - Access Controls



Service Layer

OCF | OMA DM | BBF | LWM2M | …

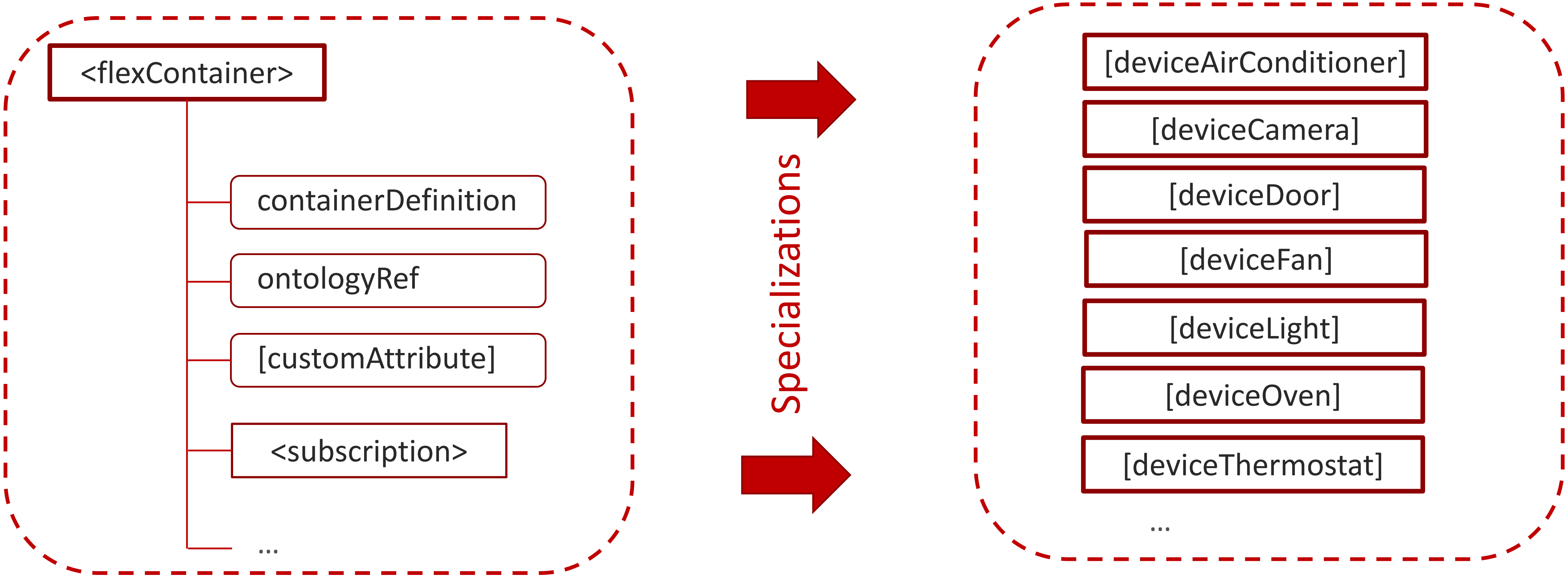
XML | JSON | CBOR | …

HTTP(s) | CoAP(s) | MQTT(s) | …

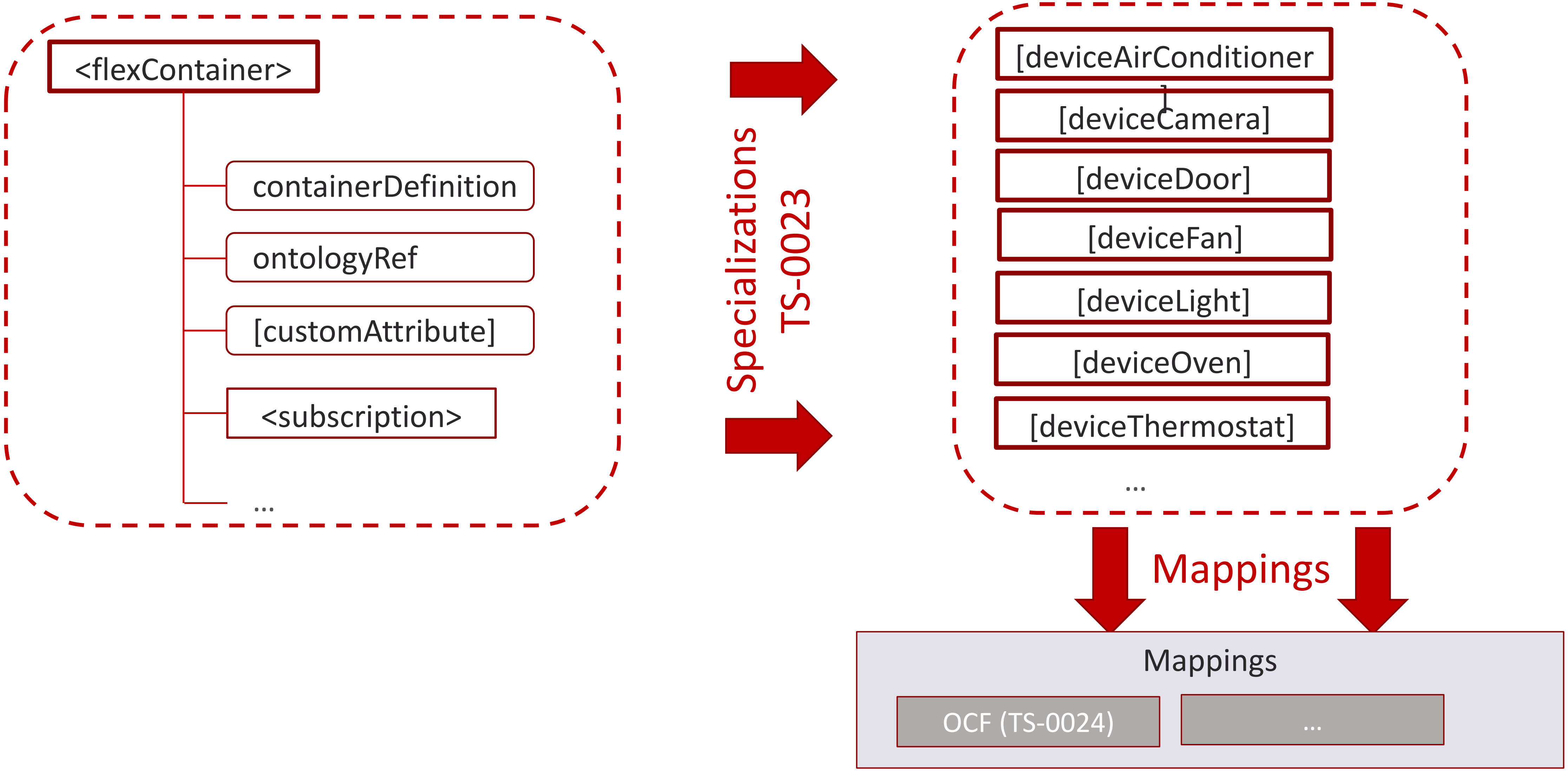
TLS/PSK | TLS/PKI | DTLS/PSK | …

Cellular | Fixed | Wi-Fi | …

oneM2M Abstracted Interworking Information Model



Mapping non-oneM2M Information Models to oneM2M



<flexContainer>

containerDefinition

ontologyRef

[customAttribute]

<subscription>

…

Specializations
TS-0023

[deviceAirConditioner]

[deviceCamera]

[deviceDoor]

[deviceFan]

[deviceLight]

[deviceOven]

[deviceThermostat]

…

Mappings

Mappings

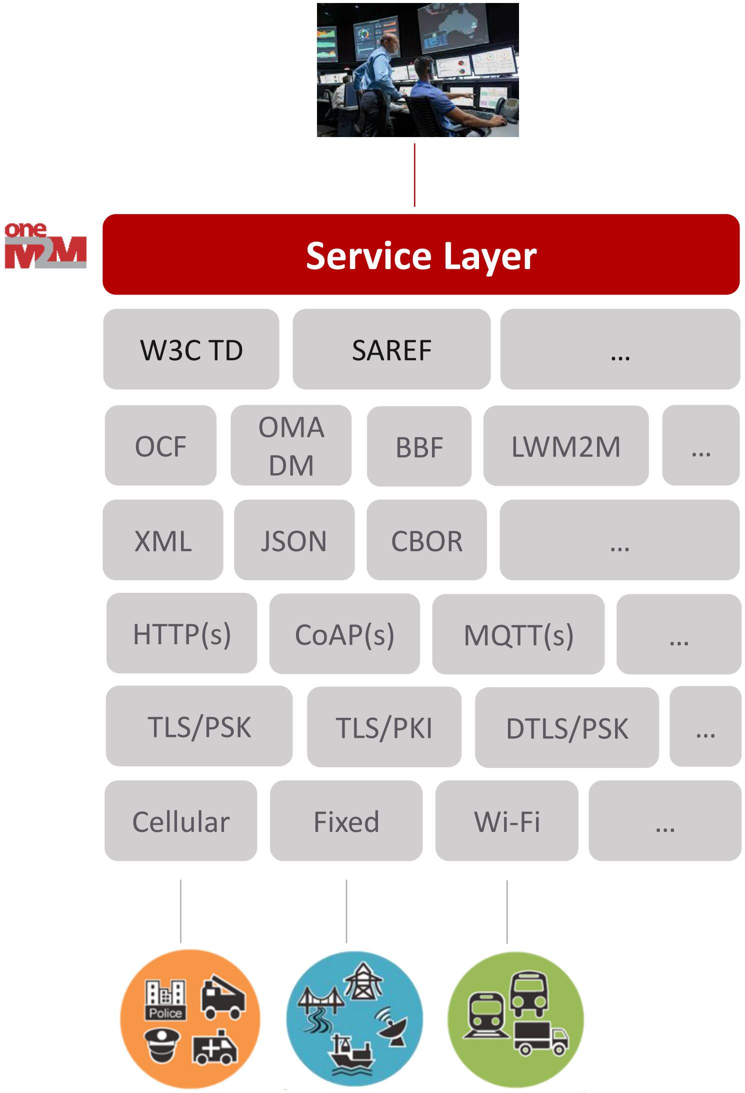
OCF (TS-0024)

…

IoT Semantics Abstraction

TS-0030 Ontology based Interworking
TS-0034 Semantics Support

- oneM2M supports a semantic framework and a oneM2M base ontology
- This framework supports interworking different semantic ontologies together
  - Ontologies defined by other organizations can be interworked with the oneM2M base ontology
- Once interworked, the framework enables semantic ontology abstraction
  - Semantic descriptions expressed in terms of other ontologies can be interworked to oneM2M's Base Ontology to provide abstraction at the semantics level



Service Layer

W3C TD | SAREF | …

OCF | OMA DM | BBF | LWM2M | …

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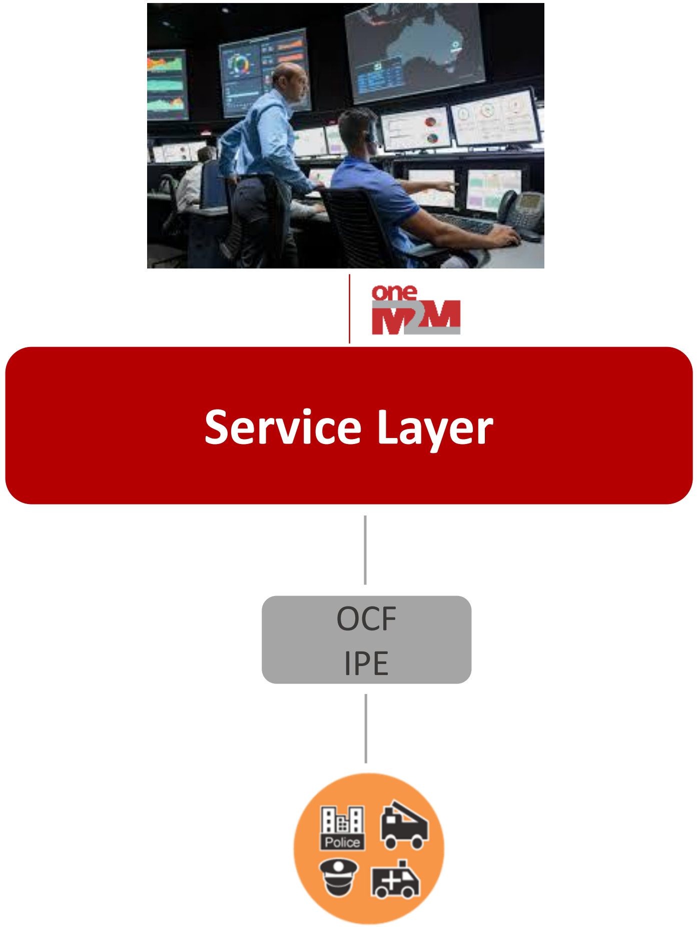
HTTP(s) | CoAP(s) | MQTT(s) | …

TLS/PSK | TLS/PKI | DTLS/PSK | …

Cellular | Fixed | Wi-Fi | …

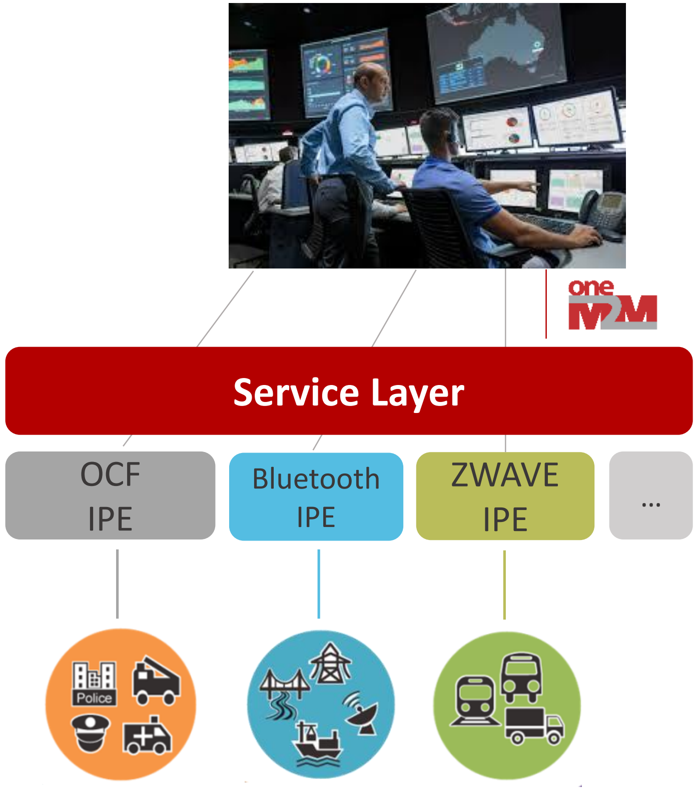
oneM2M Interworking Architecture

TS-0033 Interworking Framework



- oneM2M defines an Interworking Proxy Entity (IPE) for interworking different IoT device technologies (e.g. OCF, …) to the oneM2M service layer
  - IPE functions as an adapter that translates non-oneM2M protocols and data models to oneM2M
    - E.g. OCF ←→ oneM2M translation

oneM2M Interworking Architecture



- oneM2M interworking framework can simultaneously interwork different IoT device technologies with one another
  - E.g. OCF, ZWAVE, Bluetooth, ZigBee, …
- oneM2M provides an abstracted & simplified API for applications to communicate with devices
  - All devices are represented as oneM2M devices regardless of the technology they use
  - Via standardized oneM2M API, App developers can manage devices in a simpler and uniform manner
- Once abstracted into oneM2M, App Developers can sense/control all IoT devices in a common and uniform manner
  - Turn switch on/off, sample sensor reading, etc.

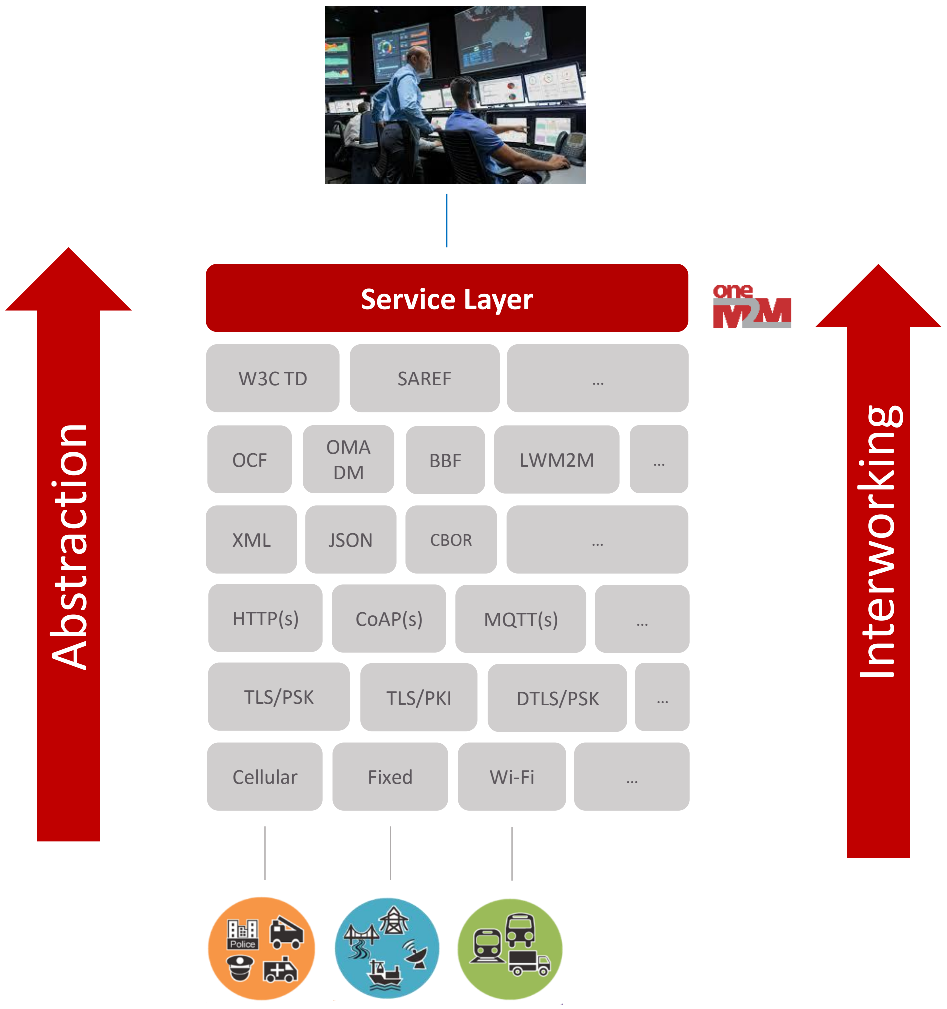
Takeaways

→ Many IoT deployments can have diverse types of IoT sub-systems and platforms that require interworking devices, apps and data all to one another

→ oneM2M interworking and abstraction capabilities, are able to hide the complexity of interworking from IoT app developers

→ oneM2M is able to help future proof IoT deployments by enabling different types of brownfield and greenfield technologies to more seamlessly be deployed together

→ oneM2M is a standard and mitigates vendor lock-in



Work on Semantic

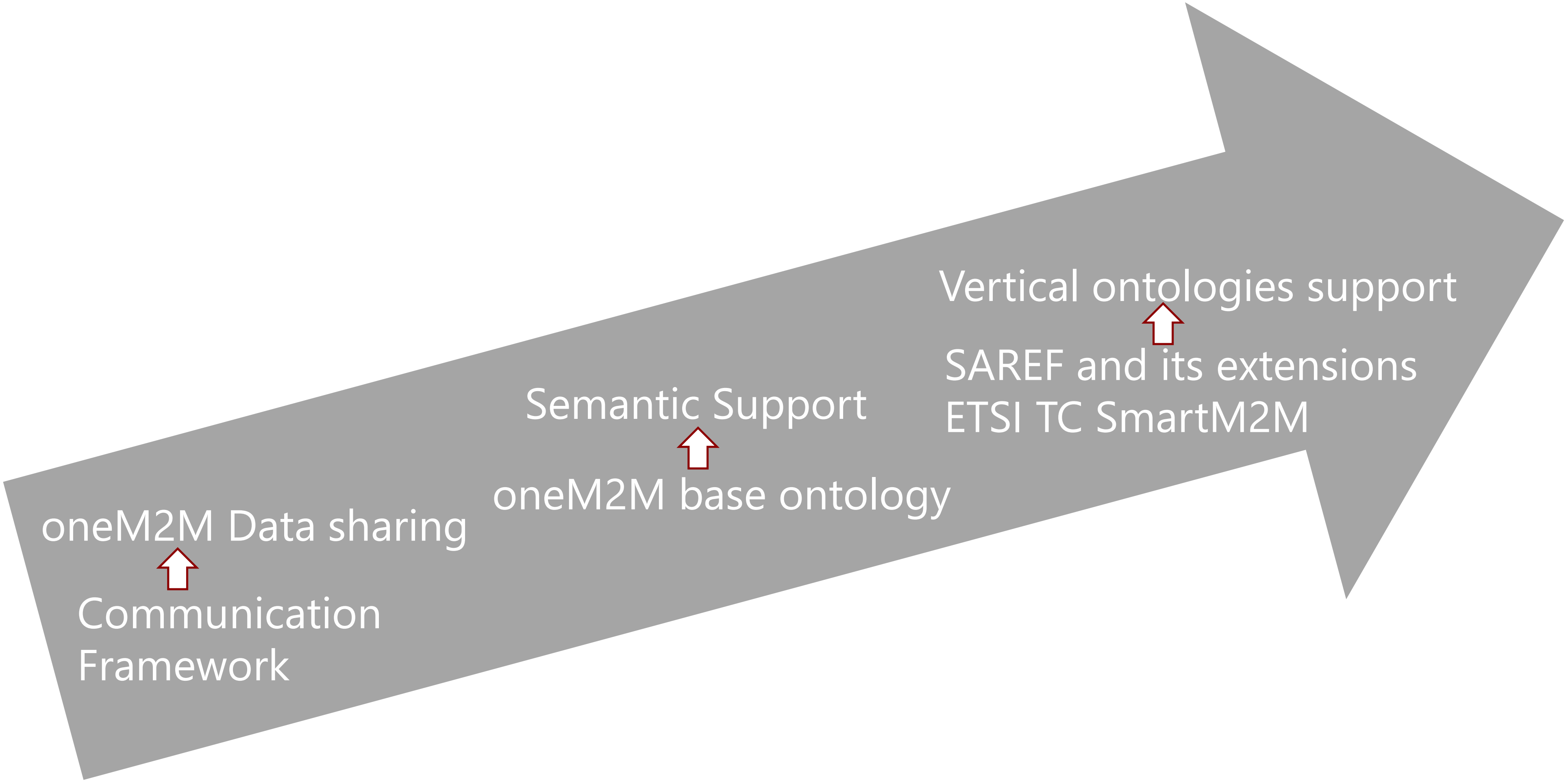
- TS-0012 Base Ontology
- TS-0030 Ontology Based Interworking

Source: Enrico Scarrone, TIM

oneM2M & ETSI

Vision: Interconnecting IoT Things

oneM2M The IoT Standard



Communication Framework

⇧

oneM2M Data sharing

oneM2M base ontology

⇧

Semantic Support

SAREF and its extensions
ETSI TC SmartM2M

⇧

Vertical ontologies support

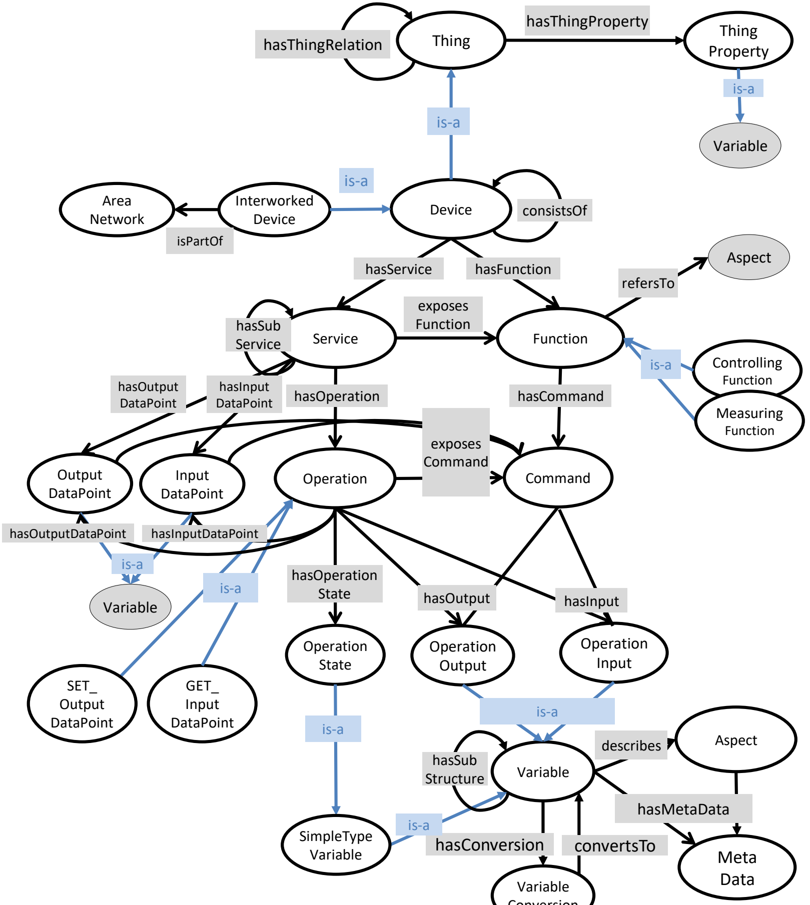
Connecting
the un-connected

Share information
across domains

Source: Enrico Scarrone, TIM

The oneM2M Base Ontology

The oneM2M Base Ontology

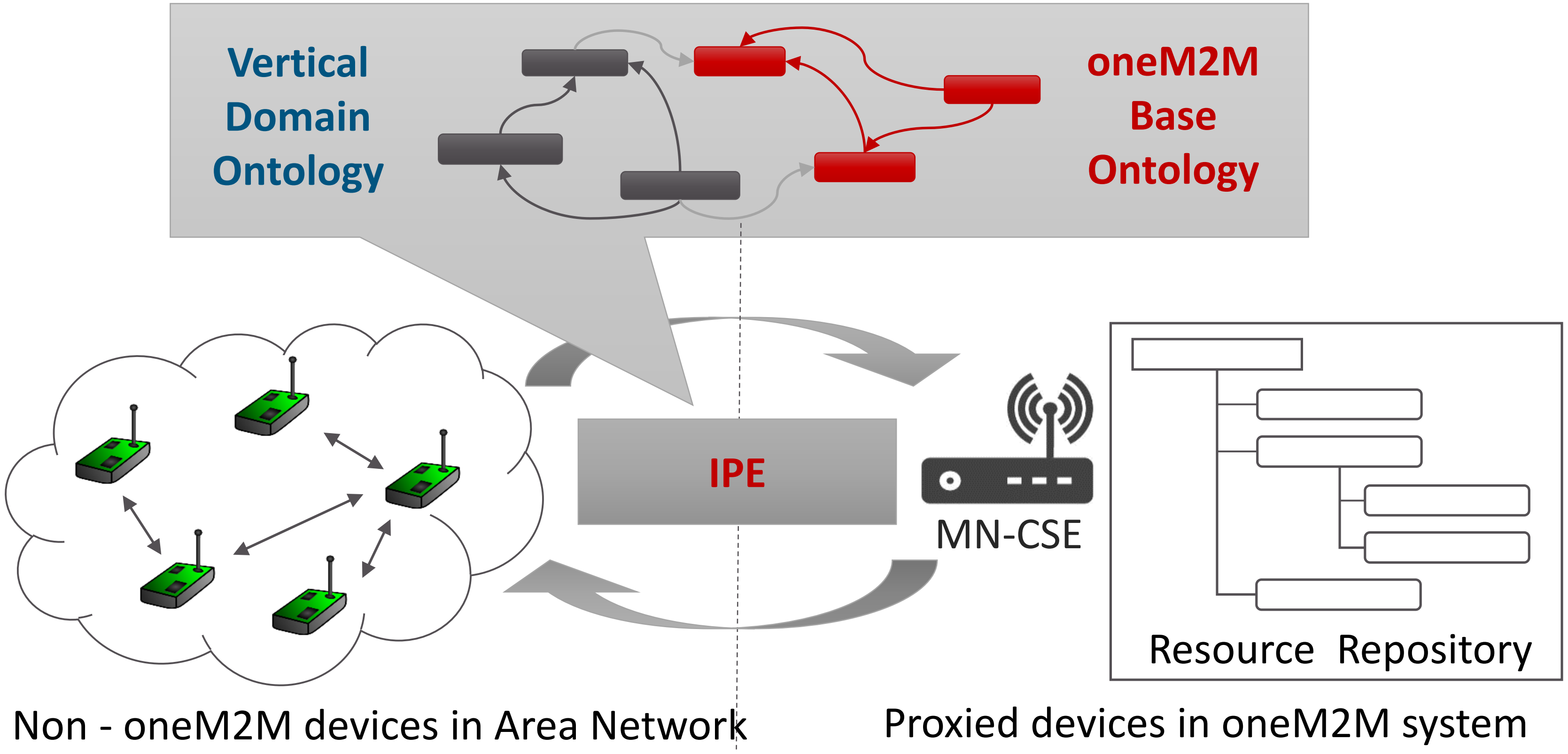


Legend: A class shown with grey shading indicates that the same class appears multiple times in the figure — Variable

- oneM2M allows to annotate application specific resources (IoT data) with semantic description.
  - Uses a specialized resource type <*semanticDescriptor*>
  - Can contain proprietary semantics or
  - Semantics according to a published ontology
- The oneM2M base ontology is a top-level ontology that allows to create sub-classes (or equivalence classes) for application-level ontologies
  - Aligned to Smart App Reference Ontology (SAREF)
- Ontologies can be used in oneM2M to describe the application specific data model of an external system for the purpose of interworking.
  - oneM2M Generic Interworking uses such an ontology to enable interworking of oneM2M entities with devices of the external system

onem2m.org, TS-0012 Base Ontology

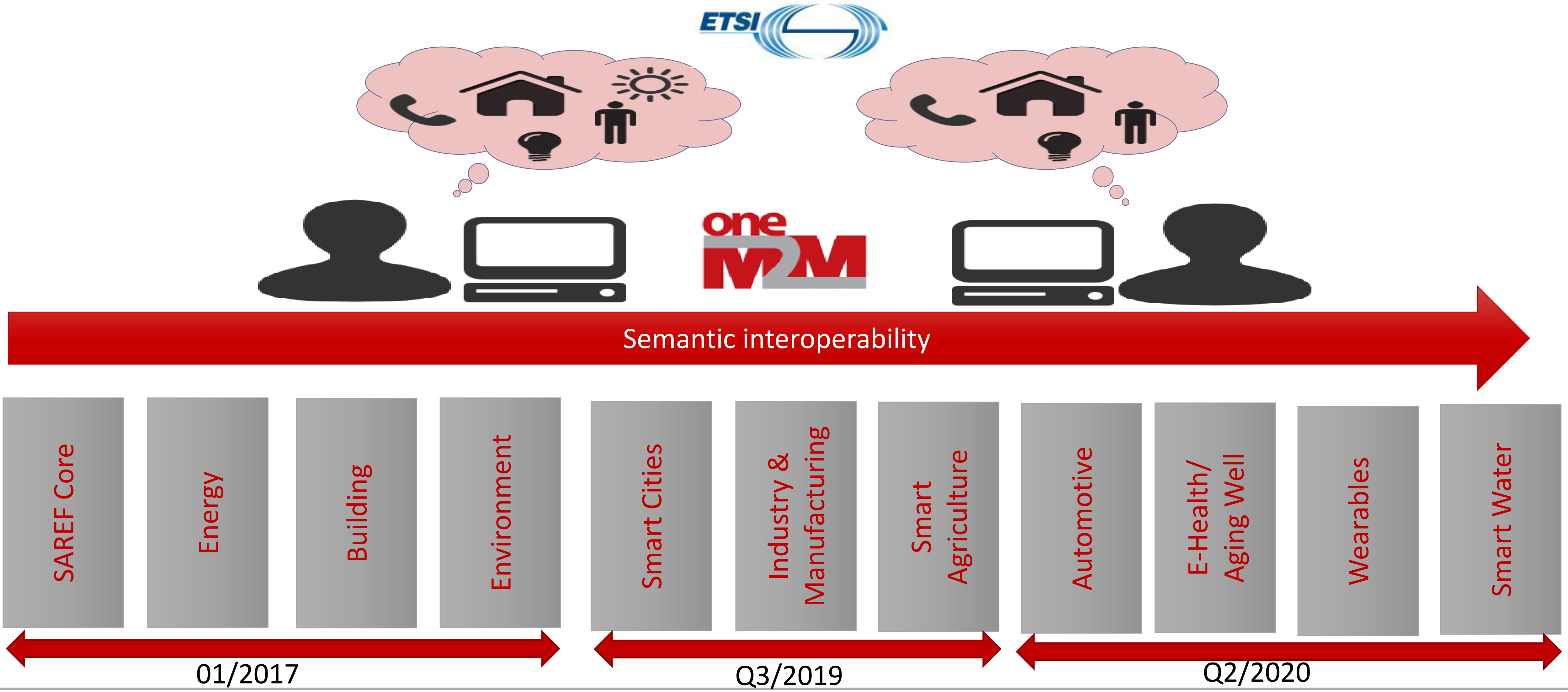
Generic interworking



- Non-oneM2M devices are described using the oneM2M base ontology + domain specific extensions.
- The Interworking Proxy Entity (IPE) translates the ontology instance to resources in the CSE based on pre-defined instantiation rules.

onem2m.org, TS-0030 Ontology Based Interworking

SAREF and its extensions



Semantic interoperability

SAREF Core
Energy
Building
Environment

01/2017

Smart Cities
Industry & Manufacturing
Smart Agriculture

Q3/2019

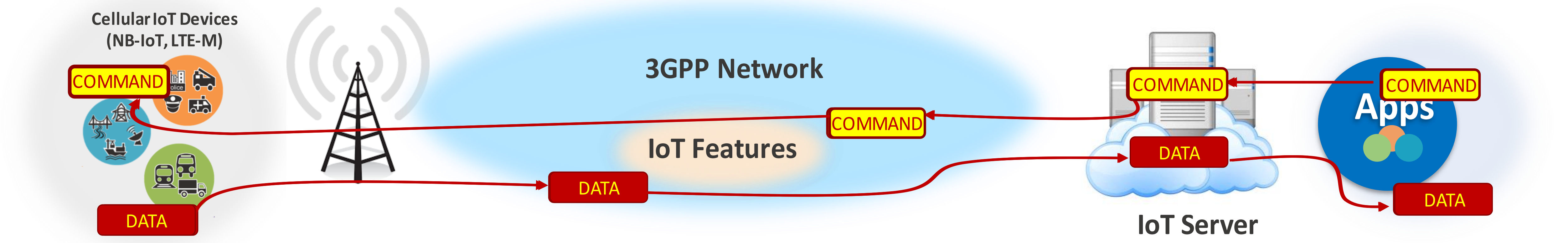
Automotive
E-Health/ Aging Well
Wearables
Smart Water

Q2/2020

3GPP Interworking

- TS-0026 3GPP Interworking
- TR-0057 Getting Started with oneM2M

Typical Cellular IoT Deployment



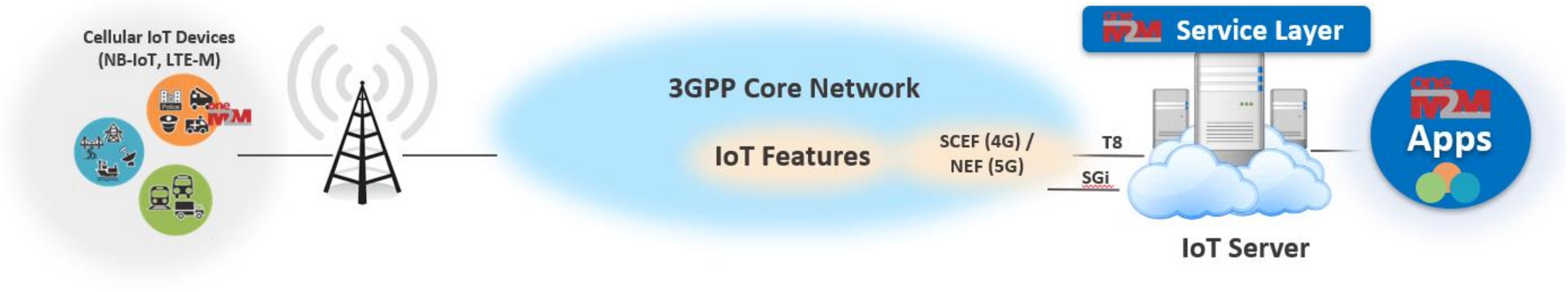
- Use of 3GPP IoT features requires low-level knowledge of 3GPP and a business relationship with operator (E.g. Configuration of IoT device sleep times requires intimate knowledge of 3GPP Power Savings Mode (PSM) or extended Idle Mode DRX (eDRX)

→ This presents a high barrier of use and adoption by typical IoT device manufacturers and app developers

- If devices and apps do not properly use these features, cellular IoT deployments are destined to fail
- Inefficient use of network resources => higher costs and less scalability for operators
- Shortened battery life of devices => inability to deploy cellular IoT devices in many IoT use cases
- Security threats to the network => network, devices and application security will be compromised

Source: Dale Seed: Interworking of oneM2M service layer to underlying 3GPP 4G/5G Networks

oneM2M - 3GPP Interworking using SCEF / NEF



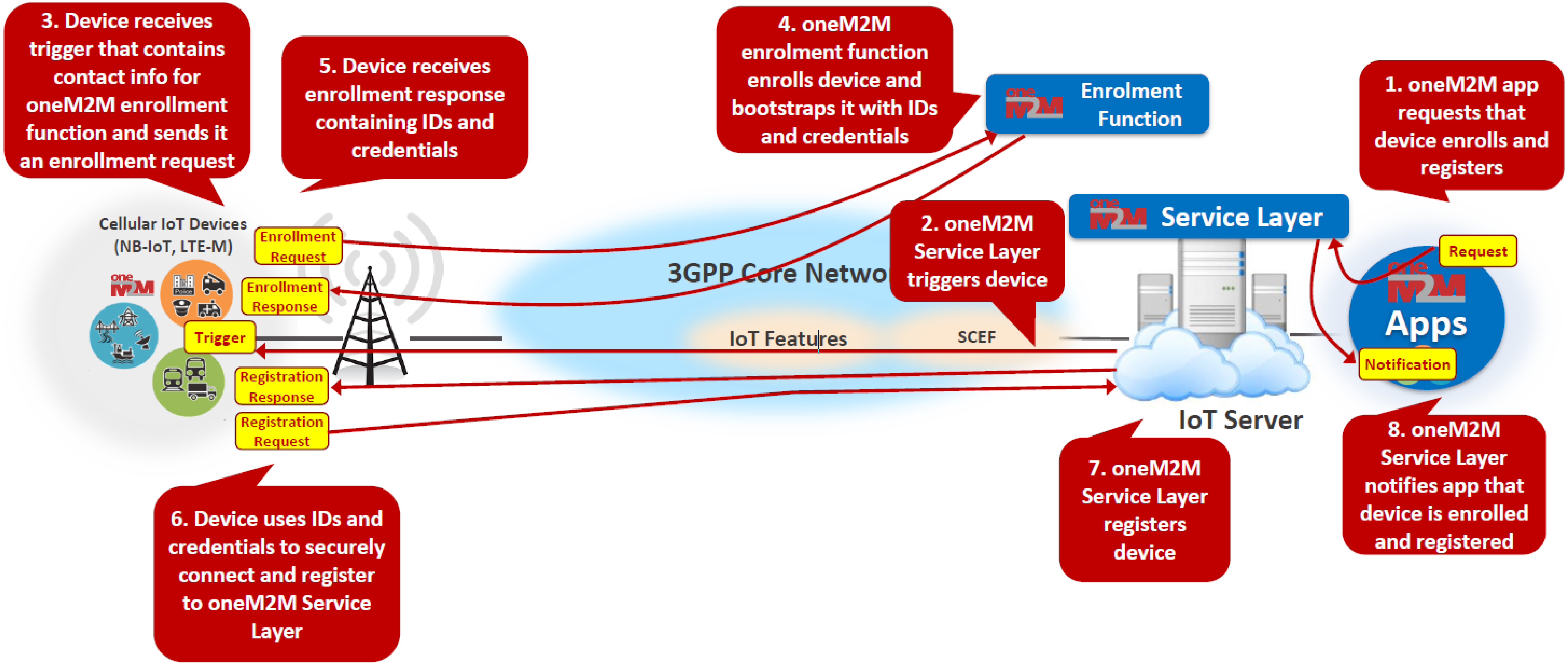
- oneM2M Rel-3 is the first IoT service layer standard to interwork with 3GPP IoT features
- oneM2M provides a complimentary set of value-add services that interwork with 3GPP IoT features
- oneM2M eases the use and adoption of 3GPP IoT features by IoT devices and apps
- oneM2M can be deployed internal or external to an operator’s network
- Enables an operator to move up the value-chain and offer additional value-add IoT services

Some Examples of oneM2M Cellular IoT Value-add Services

- IoT Device Enrollment
- IoT Device Sleep Schedule Management
- IoT Device Location Tracking
- IoT Device Message Delivery Handling
- Network Congestion Control
- Non-IP Data Delivery (NIDD)
- IoT Device Tampering Detection
- Management of Groups of IoT Devices
- IoT Roaming Device Services

Source: Dale Seed: Interworking of oneM2M service layer to underlying 3GPP 4G/5G Networks

IoT Device Service Enrollment



1. oneM2M app requests that device enrolls and registers

2. oneM2M Service Layer triggers device

3. Device receives trigger that contains contact info for oneM2M enrollment function and sends it an enrollment request

4. oneM2M enrolment function enrolls device and bootstraps it with IDs and credentials

5. Device receives enrollment response containing IDs and credentials

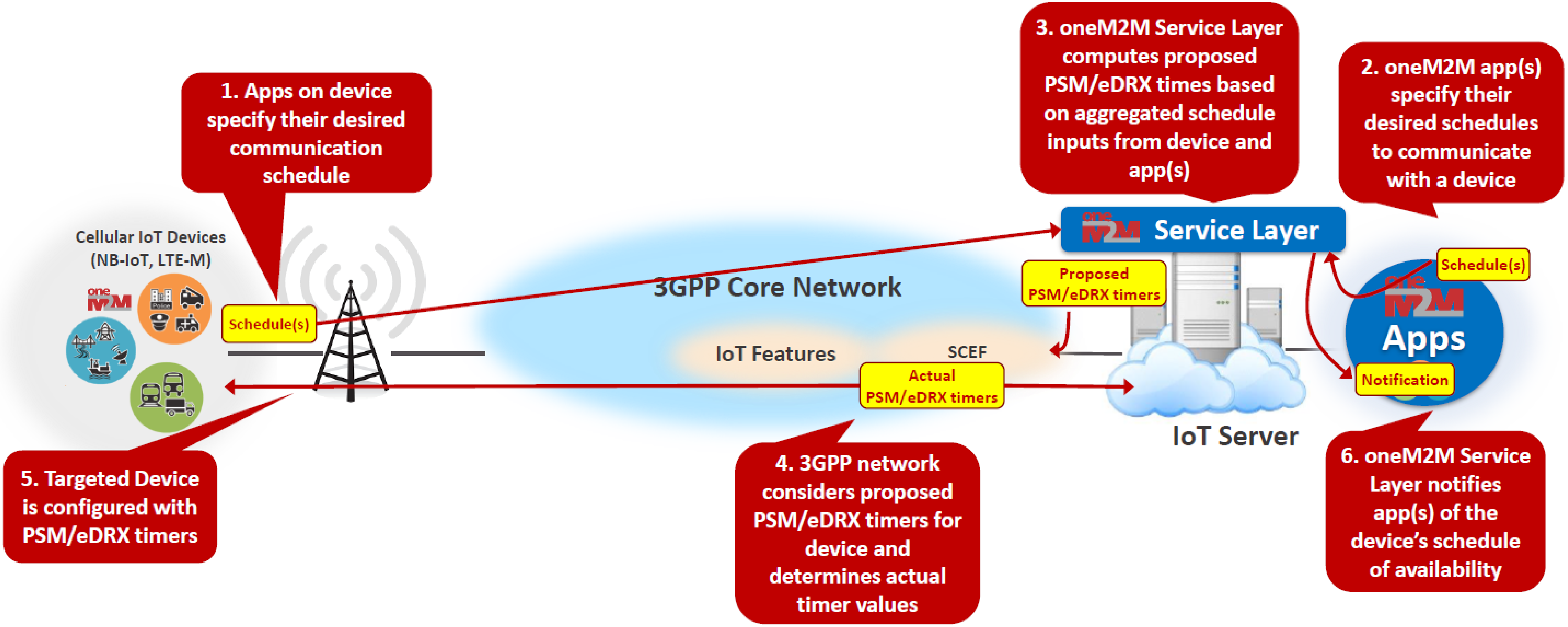
6. Device uses IDs and credentials to securely connect and register to oneM2M Service Layer

7. oneM2M Service Layer registers device

8. oneM2M Service Layer notifies app that device is enrolled and registered

IoT Device Sleep Schedule Management

oneM2M The IoT Standard



1. Apps on device specify their desired communication schedule

2. oneM2M app(s) specify their desired schedules to communicate with a device

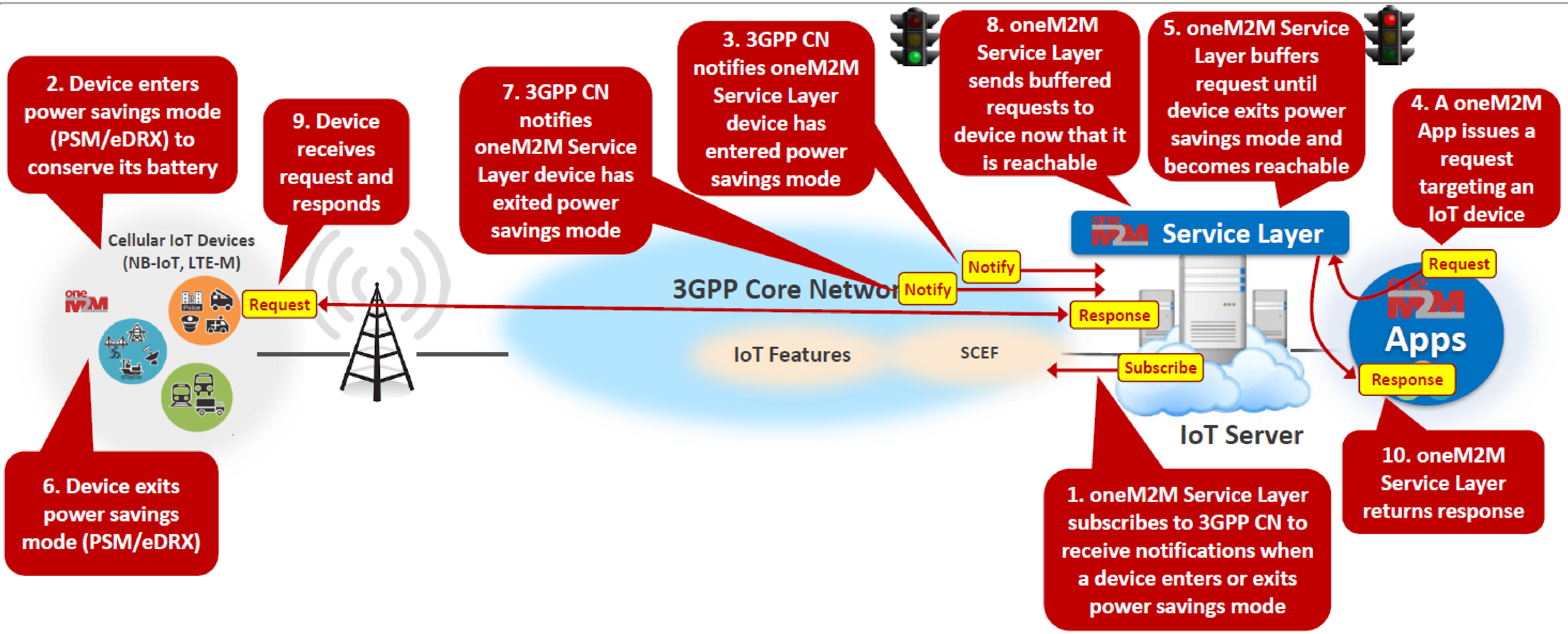
3. oneM2M Service Layer computes proposed PSM/eDRX times based on aggregated schedule inputs from device and app(s)

4. 3GPP network considers proposed PSM/eDRX timers for device and determines actual timer values

5. Targeted Device is configured with PSM/eDRX timers

6. oneM2M Service Layer notifies app(s) of the device's schedule of availability

IoT Device Message Delivery Handling



1. oneM2M Service Layer subscribes to 3GPP CN to receive notifications when a device enters or exits power savings mode

2. Device enters power savings mode (PSM/eDRX) to conserve its battery

3. 3GPP CN notifies oneM2M Service Layer device has entered power savings mode

4. A oneM2M App issues a request targeting an IoT device

5. oneM2M Service Layer buffers request until device exits power savings mode and becomes reachable

6. Device exits power savings mode (PSM/eDRX)

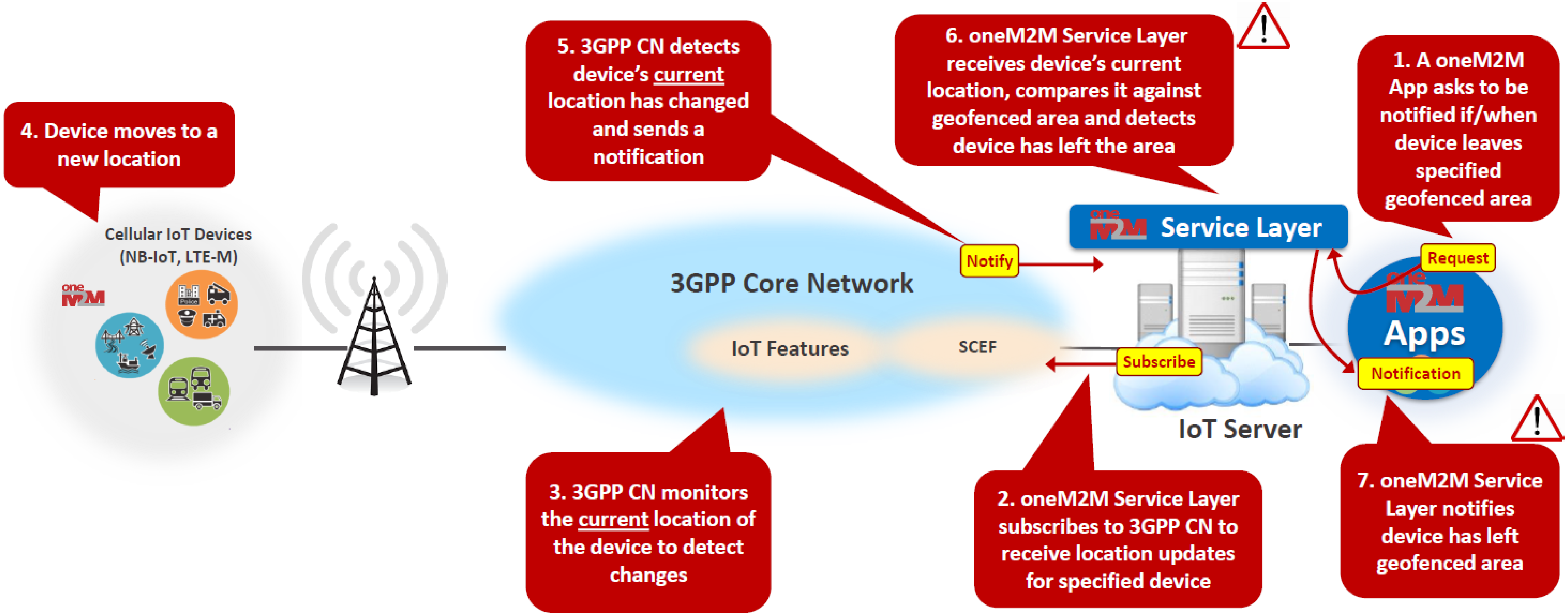
7. 3GPP CN notifies oneM2M Service Layer device has exited power savings mode

8. oneM2M Service Layer sends buffered requests to device now that it is reachable

9. Device receives request and responds

10. oneM2M Service Layer returns response

IoT Device Location Tracking



1. A oneM2M App asks to be notified if/when device leaves specified geofenced area

2. oneM2M Service Layer subscribes to 3GPP CN to receive location updates for specified device

3. 3GPP CN monitors the current location of the device to detect changes

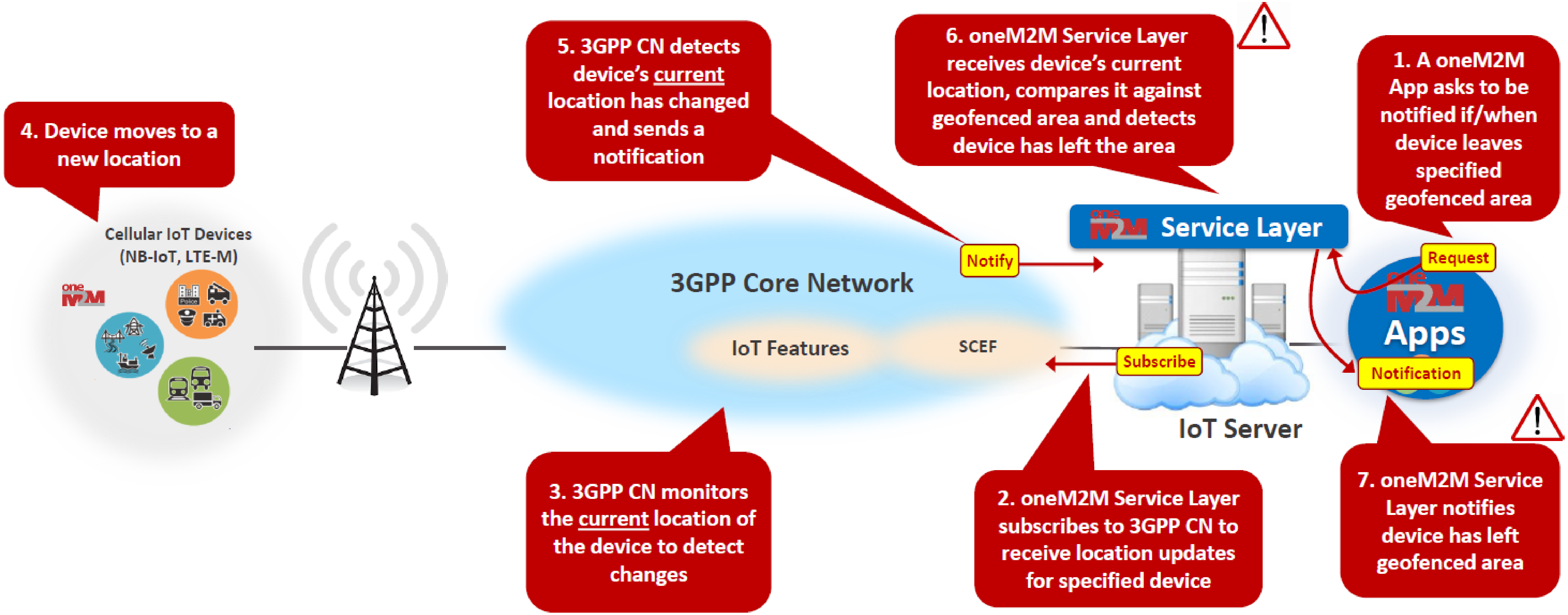
4. Device moves to a new location

5. 3GPP CN detects device's current location has changed and sends a notification

6. oneM2M Service Layer receives device's current location, compares it against geofenced area and detects device has left the area

7. oneM2M Service Layer notifies device has left geofenced area

3GPP Network Congestion Control



1. A oneM2M App asks to be notified if/when device leaves specified geofenced area

2. oneM2M Service Layer subscribes to 3GPP CN to receive location updates for specified device

3. 3GPP CN monitors the current location of the device to detect changes

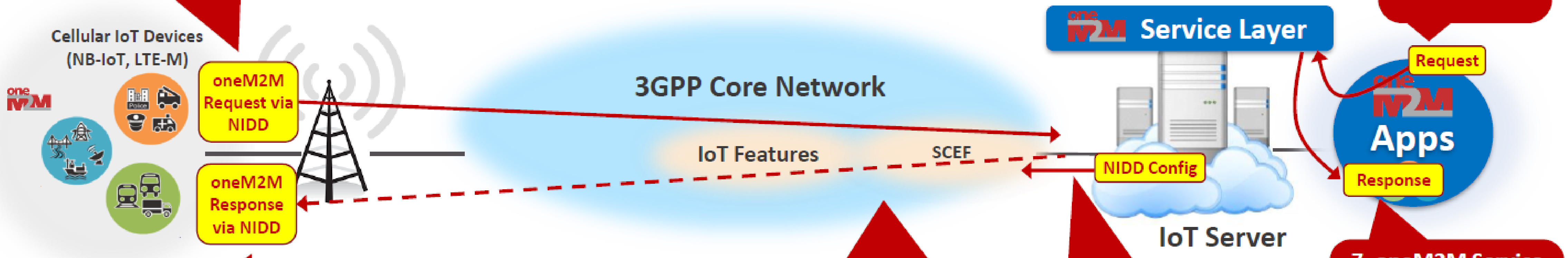
4. Device moves to a new location

5. 3GPP CN detects device's current location has changed and sends a notification

6. oneM2M Service Layer receives device's current location, compares it against geofenced area and detects device has left the area

7. oneM2M Service Layer notifies device has left geofenced area

Non-IP Data Delivery (NIDD)



3. Device sends an uplink oneM2M request over the control plane of 3GPP CN using NIDD (e.g. sensor reading)

4. oneM2M Service Layer processes request and returns a response

6. A oneM2M App samples sensor reading

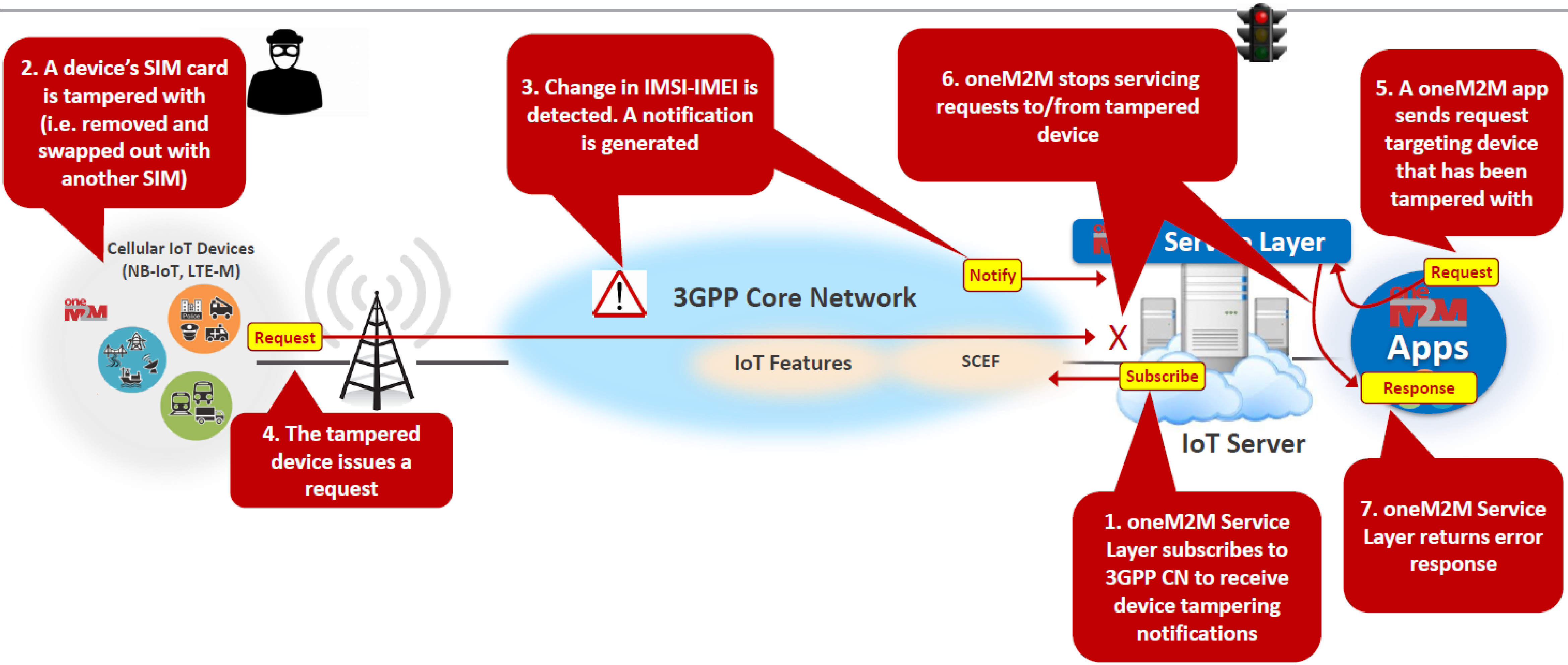
5. (optional) Device receives an downlink oneM2M response via NIDD

2. 3GPP CN processes NIDD configuration and will know where to send NIDD data when the UE establishes a PDN connection

1. oneM2M Service Layer issues NIDD configuration request for device that enrolls with NIDD capability

7. oneM2M Service Layer returns response (e.g. sensor reading)

IoT Device Tampering Detection



2. A device's SIM card is tampered with (i.e. removed and swapped out with another SIM)

3. Change in IMSI-IMEI is detected. A notification is generated

6. oneM2M stops servicing requests to/from tampered device

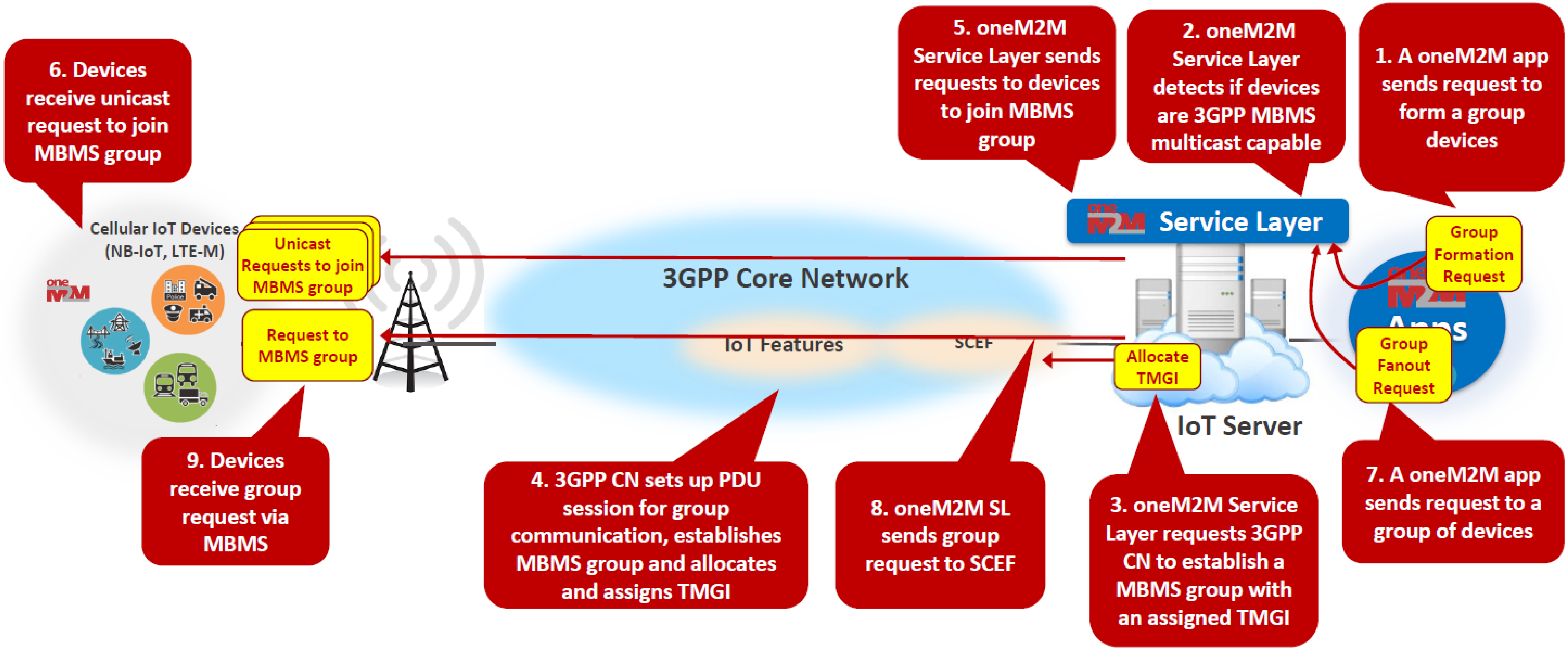
5. A oneM2M app sends request targeting device that has been tampered with

4. The tampered device issues a request

1. oneM2M Service Layer subscribes to 3GPP CN to receive device tampering notifications

7. oneM2M Service Layer returns error response

Management of Groups of IoT Devices



1. A oneM2M app sends request to form a group devices

2. oneM2M Service Layer detects if devices are 3GPP MBMS multicast capable

3. oneM2M Service Layer requests 3GPP CN to establish a MBMS group with an assigned TMGI

4. 3GPP CN sets up PDU session for group communication, establishes MBMS group and allocates and assigns TMGI

5. oneM2M Service Layer sends requests to devices to join MBMS group

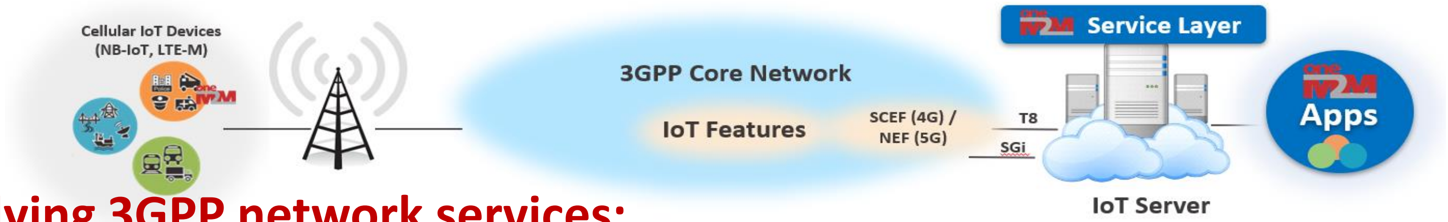
6. Devices receive unicast request to join MBMS group

7. A oneM2M app sends request to a group of devices

8. oneM2M SL sends group request to SCEF

9. Devices receive group request via MBMS

oneM2M - 3GPP Interworking Summary

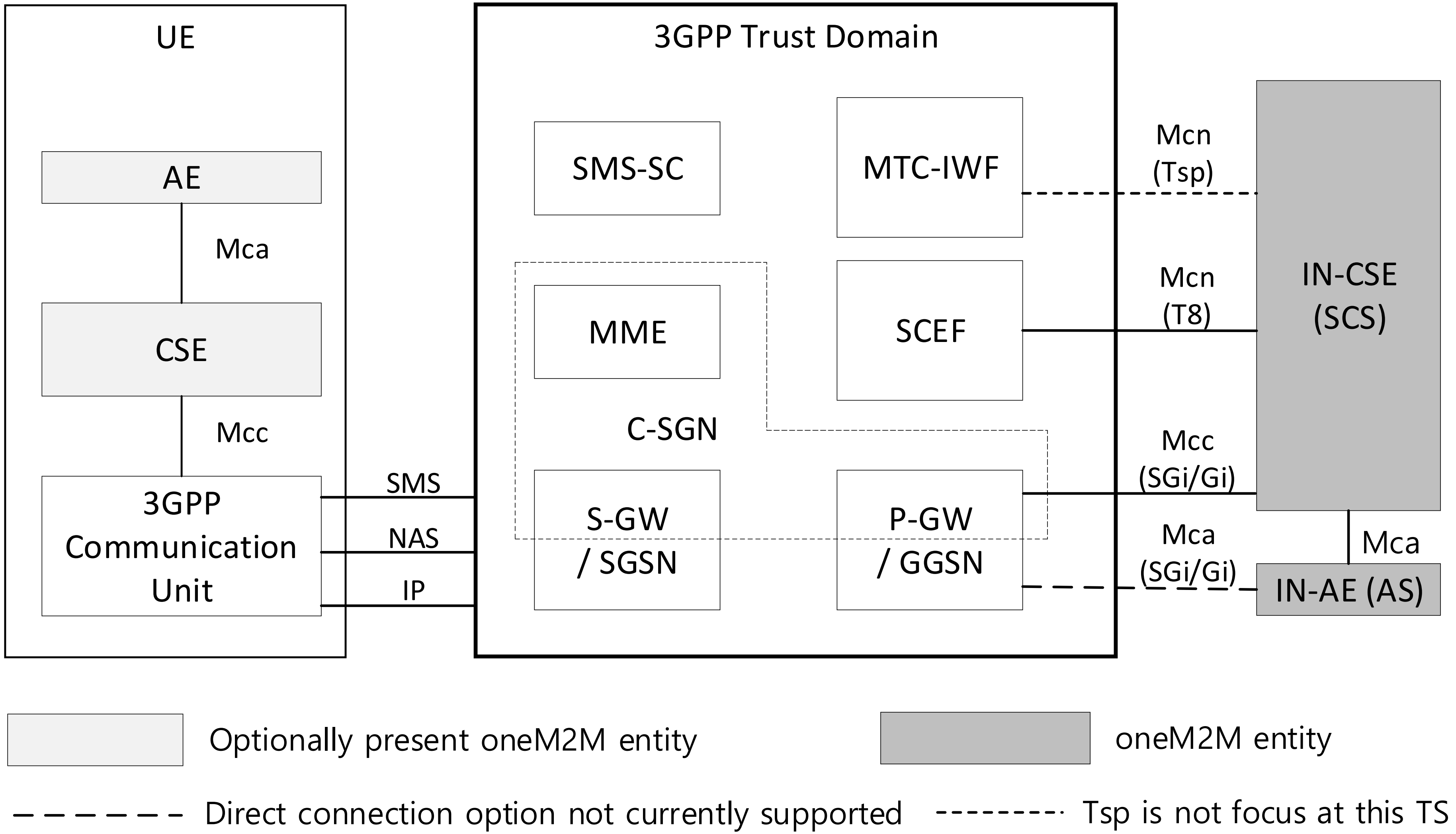


oneM2M supports interworking to underlying 3GPP network services:

- Sending/Receiving request to/from UE over 3GPP control plane (Non-IP Data Delivery NIDD) rather than data plane
- Configuration of UE's Power Savings Mode or extended Idle Mode DRX (PSM/eDRX) parameters based on App requirements
- Scheduling and buffering of messages based on UE's reachability and/or App's backgroung data policies
- Triggering of UE to establish a network connection and/or register or enrol based on App requirements
- Configuration of network QoS parameters based on App requirements
- Querying of UE location and making it available to Apps
- Receiving notifications when the network is congested and scheduling messages to UE accordingly
- Receiving notifications when UE has been tampered with and disabling communication with UE

3GPP Interworking

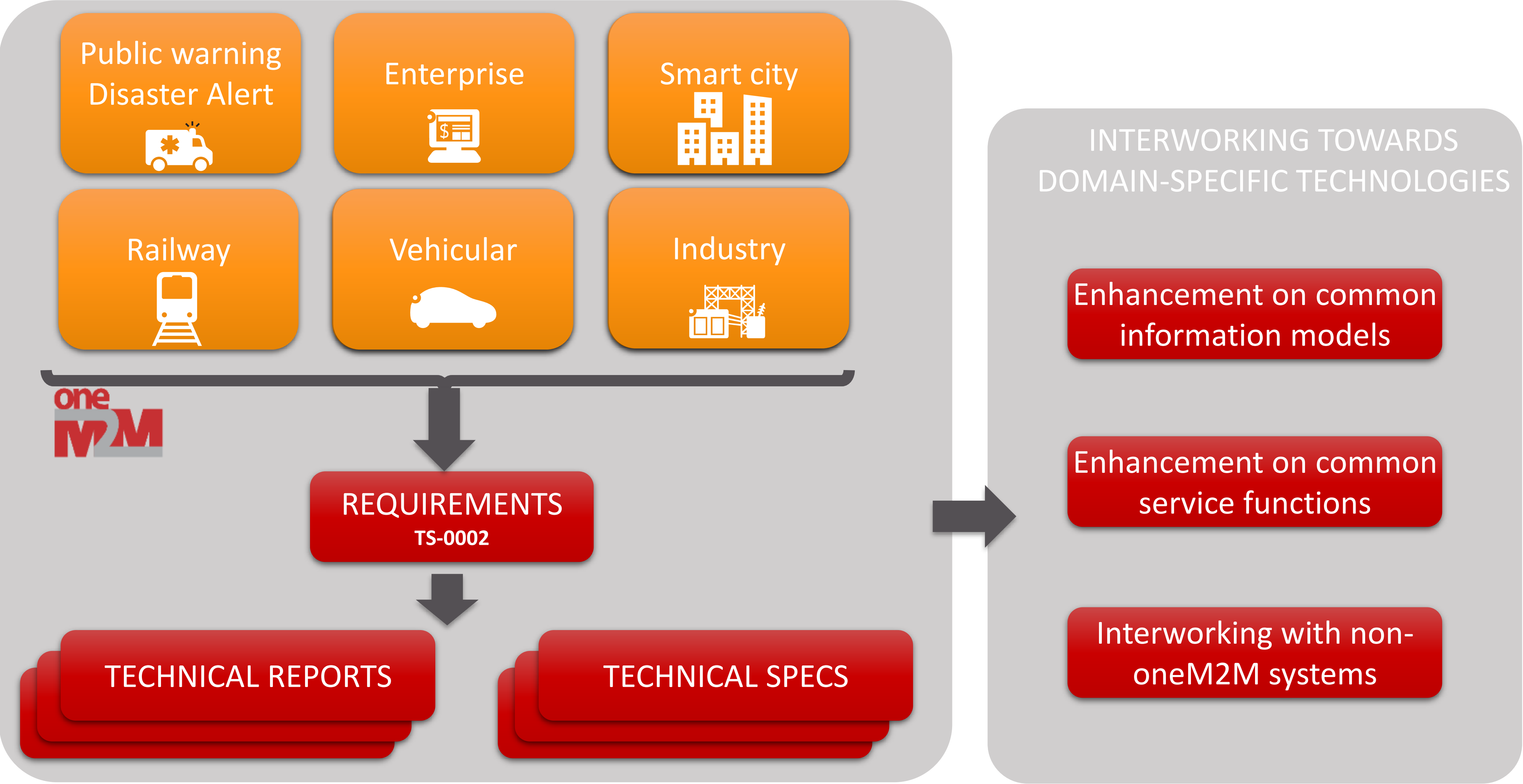
Architecture and functional mapping for the 3GPP Trust Domain



Release 4 – Domain Support

- Vertical Domain Support
- Domain Interworking

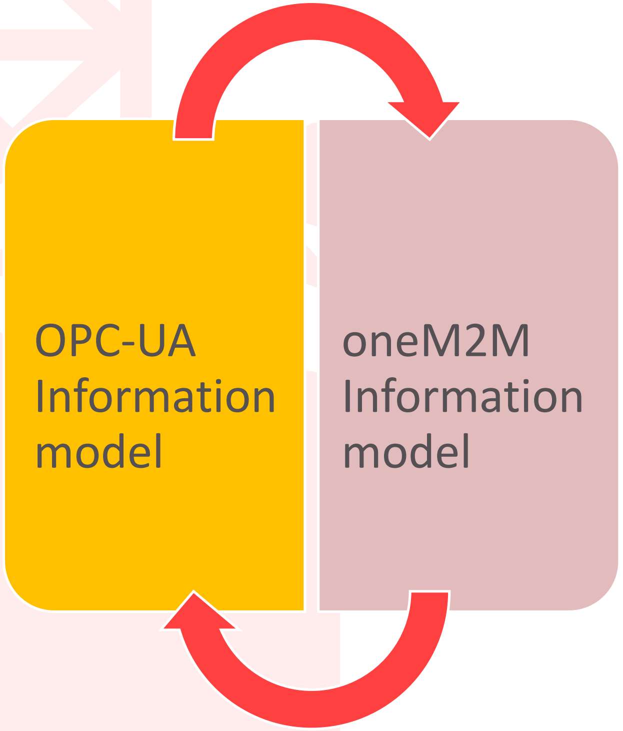
Release 4 - More Vertical Domain Support



Public warning Disaster Alert
Enterprise
Smart city
Railway
Vehicular
Industry
oneM2M
REQUIREMENTS
TS-0002
TECHNICAL REPORTS
TECHNICAL SPECS
INTERWORKING TOWARDS DOMAIN-SPECIFIC TECHNOLOGIES
Enhancement on common information models
Enhancement on common service functions
Interworking with non-oneM2M systems

Domain models enable data interoperability

- Industry domain models



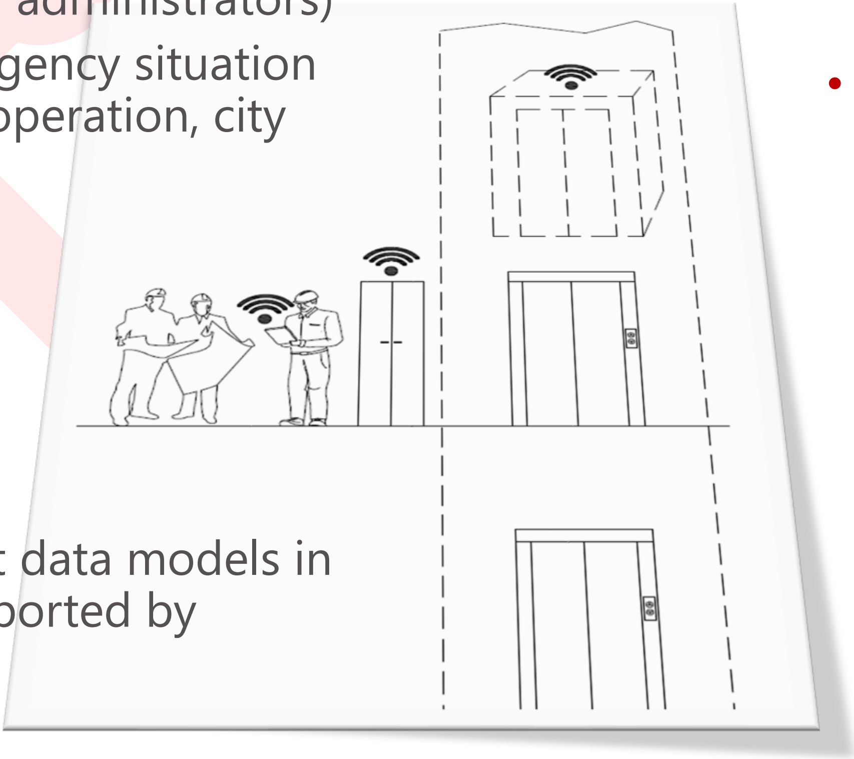
- Railway domain models
  - Use cases and requirements to find gap between the railway domain and oneM2M
  - Discovering information model and mapping to adapting oneM2M

Module Instance Name	Module Class Name	Multiplicity
binarySwitch	binarySwitch	1
clock	clock	1
touchScreen	touchScreen	0..1
emergencyButton	pushButton	0..1
audioVolume	audioVolume	0..1
ticketReader	prePaidCardReader	1
crossingSensor	traceSensor	1
connectivity	connectivity	1
gateState	runState	1
directionPanel	directionPanel	0..1
crossingIndicatorColour	colour	1
crossingIndicatorColourSaturation	colourSaturation	1
crossingIndicatorColourBrightness	brightness	1
crossingBarrier	crossingBarrier	1

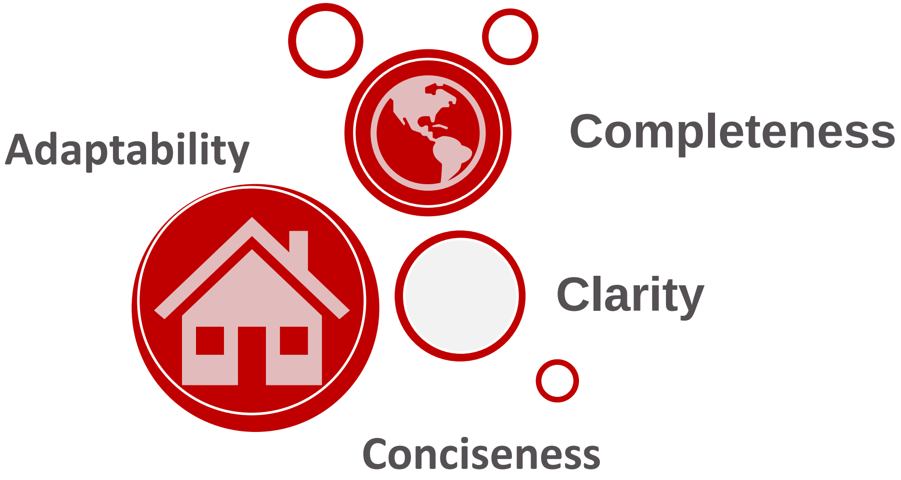
Example: device model of **deviceSmartGate**

Emerging technologies for Smart cities

- Smart Lift
  - Focus on predictive maintenance (operating technician/building owners/users and administrators)
  - Services for emergency situation support, remote operation, city services, etc.
  - Develop smart lift data models in the semantic supported by oneM2M

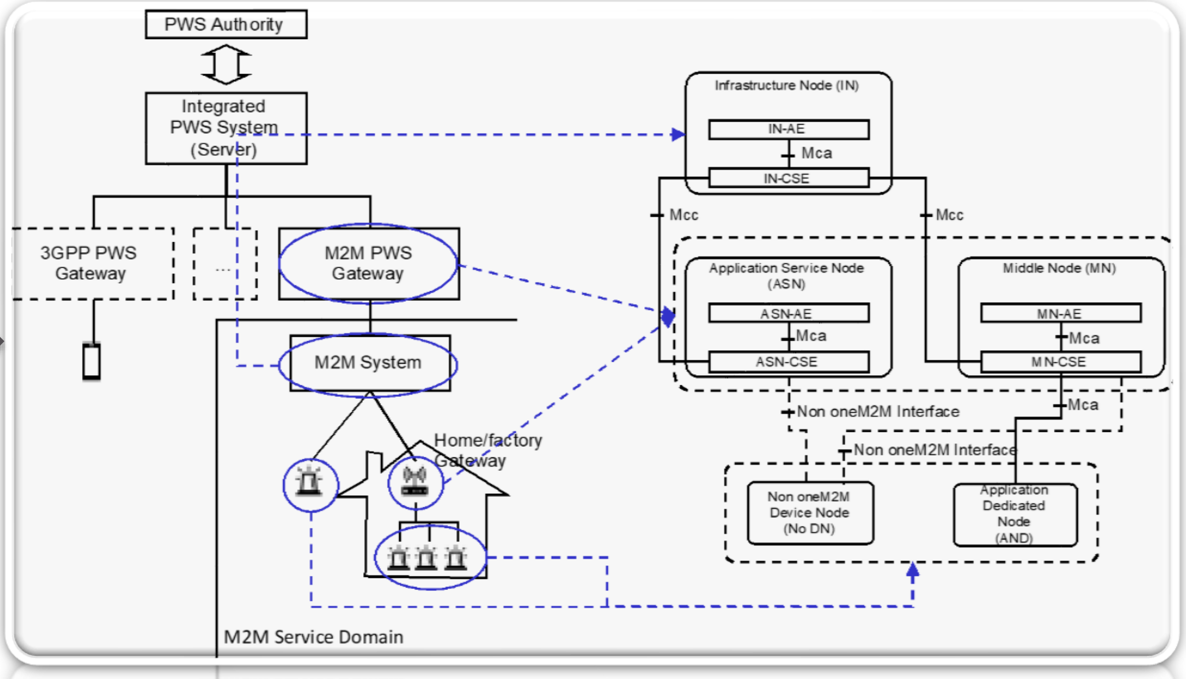


- Ontology on Smart cities
  - Standardize ontologies for Smart City services through integrating SmartM2M SAREF work to oneM2M as the baseline
  - Develop a framework to maintain developed ontologies and get input from various domain actors using a oneM2M SmartCity portal service



Public warning services enablement

- IPAWS in US
- MoWaS in Germany
- CAP in Italy
- CBS in Korea
- J-ALERT in Japan



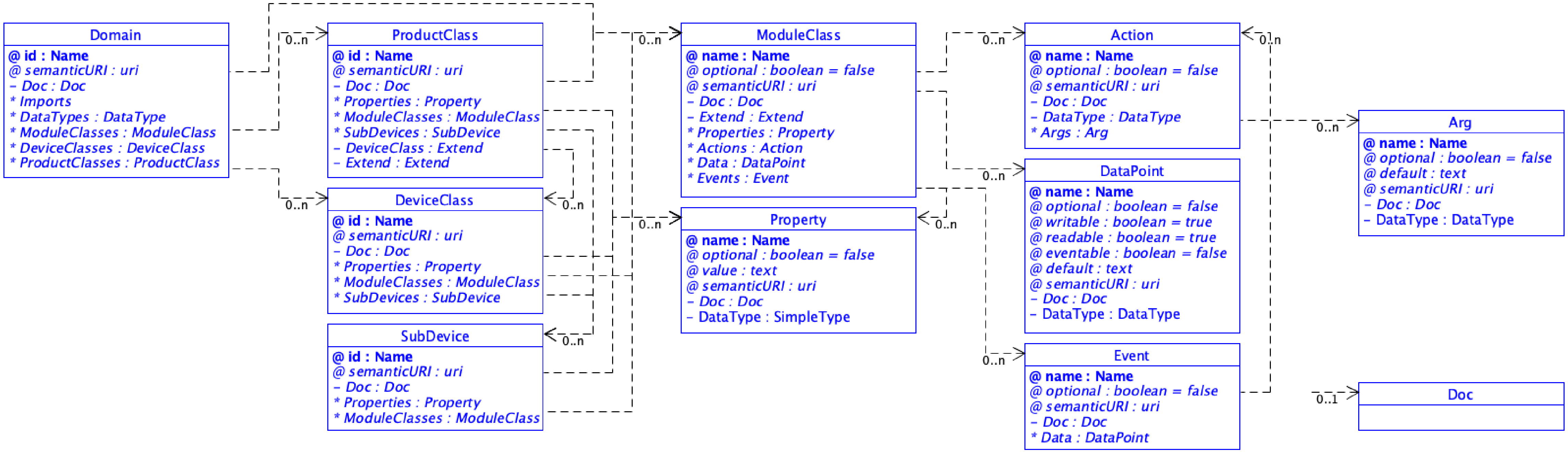
oneM2M architecture enables Public Warning Service

- Public Safety
- Disaster Alert
- Public Health

Source: TR-0046 Study on Public Warning Service Enabler

SDT 4.0: make it easy for IoT developers

- Provides an abstraction layer for connected devices
- Together with other organizations, such as OCF and OMA, oneM2M Rel 3 defines 84 ModuleClasses and 50 Devices with various functionalities
- In Rel 4 (ongoing) SDT is restructured to fit more the verticals (Home, City, Industry, Health, Automotive,…)



Domain
@ id : Name
@ semanticURI : uri
– Doc : Doc
* Imports
* DataTypes : DataType
* ModuleClasses : ModuleClass
* DeviceClasses : DeviceClass
* ProductClasses : ProductClass

ProductClass
@ id : Name
@ semanticURI : uri
– Doc : Doc
* Properties : Property
* ModuleClasses : ModuleClass
* SubDevices : SubDevice
– DeviceClass : Extend
– Extend : Extend

DeviceClass
@ id : Name
@ semanticURI : uri
– Doc : Doc
* Properties : Property
* ModuleClasses : ModuleClass
* SubDevices : SubDevice

SubDevice
@ id : Name
@ semanticURI : uri
– Doc : Doc
* Properties : Property
* ModuleClasses : ModuleClass

ModuleClass
@ name : Name
@ optional : boolean = false
@ semanticURI : uri
– Doc : Doc
– Extend : Extend
* Properties : Property
* Actions : Action
* Data : DataPoint
* Events : Event

Property
@ name : Name
@ optional : boolean = false
@ value : text
@ semanticURI : uri
– Doc : Doc
– DataType : SimpleType

Action
@ name : Name
@ optional : boolean = false
@ semanticURI : uri
– Doc : Doc
– DataType : DataType
* Args : Arg

DataPoint
@ name : Name
@ optional : boolean = false
@ writable : boolean = true
@ readable : boolean = true
@ eventable : boolean = false
@ default : text
@ semanticURI : uri
– Doc : Doc
– DataType : DataType

Event
@ name : Name
@ optional : boolean = false
@ semanticURI : uri
– Doc : Doc
* Data : DataPoint

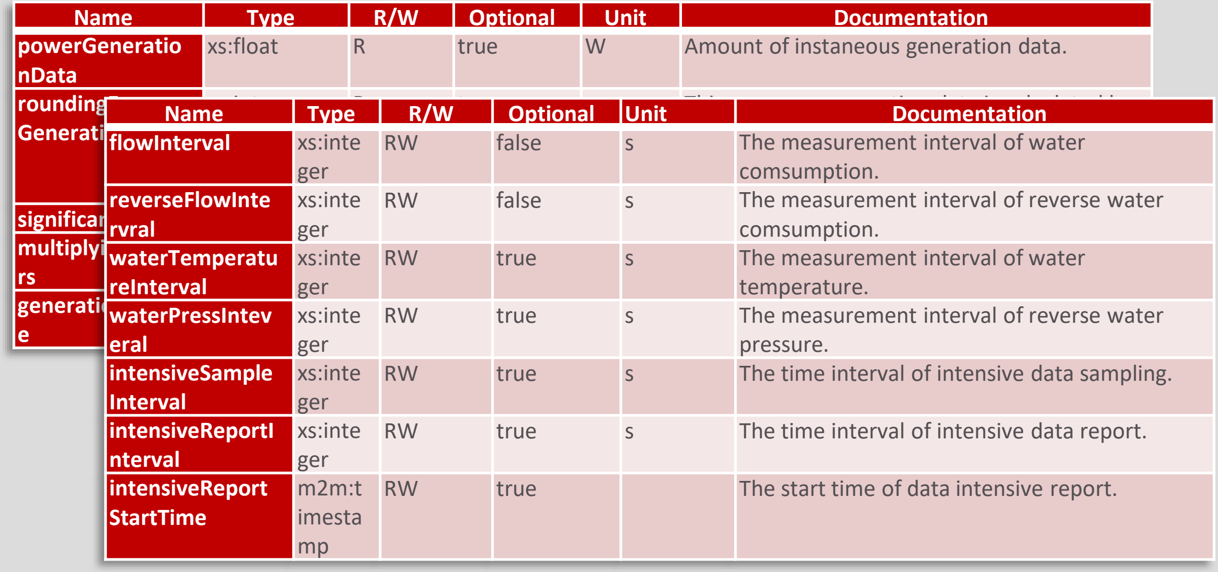
Arg
@ name : Name
@ optional : boolean = false
@ default : text
@ semanticURI : uri
– Doc : Doc
– DataType : DataType

Doc

URL to GitLab: https://git.onem2m.org/MAS/SDT (master)

SDT based Information Models

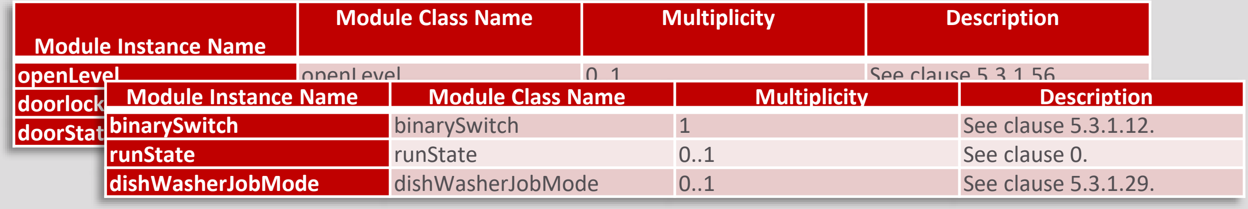
- ModuleClass



Name	Type	R/W	Optional	Unit	Documentation
powerGenerationData	xs:float	R	true	W	Amount of instaneous generation data.
roundingGenerati…					
significa…					
multiplyi… rs					
generati… e					

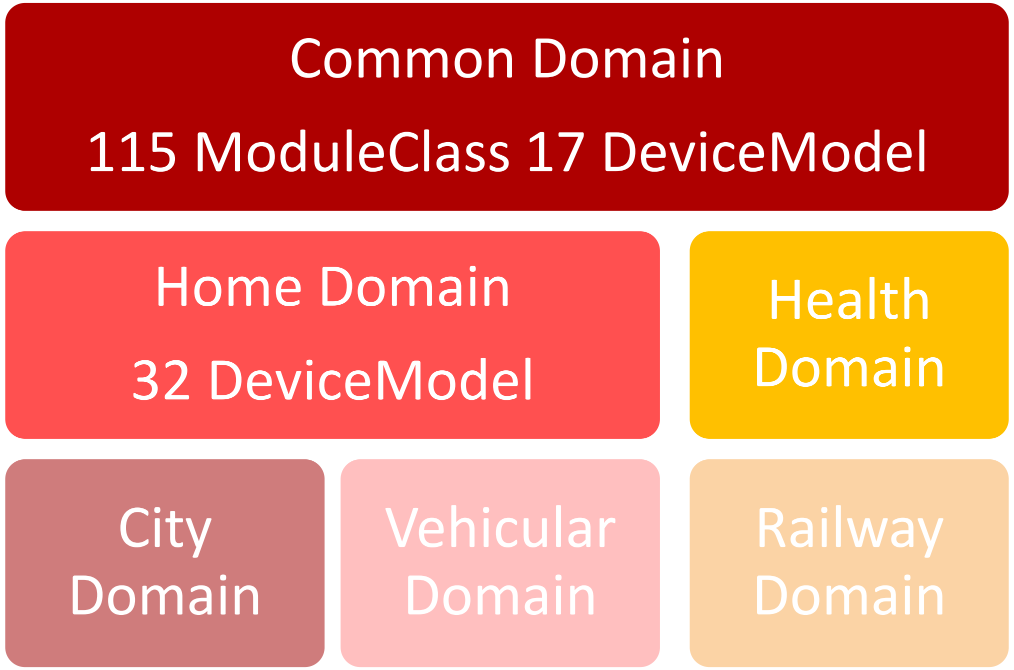
Name	Type	R/W	Optional	Unit	Documentation
flowInterval	xs:integer	RW	false	s	The measurement interval of water cosumption.
reverseFlowInterval	xs:integer	RW	false	s	The measurement interval of reverse water cosumption.
waterTemperatureInterval	xs:integer	RW	true	s	The measurement interval of water temperature.
waterPressInteveral	xs:integer	RW	true	s	The measurement interval of reverse water pressure.
intensiveSampleInterval	xs:integer	RW	true	s	The time interval of intensive data sampling.
intensiveReportInterval	xs:integer	RW	true	s	The time interval of intensive data report.
intensiveReportStartTime	m2m:timestamp	RW	true		The start time of data intensive report.

- DeviceModel



Module Instance Name	Module Class Name	Multiplicity	Description
openLevel	openLevel	0..1	See clause 5.3.1.56
doorlock…			
doorStat…			

Module Instance Name	Module Class Name	Multiplicity	Description
binarySwitch	binarySwitch	1	See clause 5.3.1.12.
runState	runState	0..1	See clause 0.
dishWasherJobMode	dishWasherJobMode	0..1	See clause 5.3.1.29.



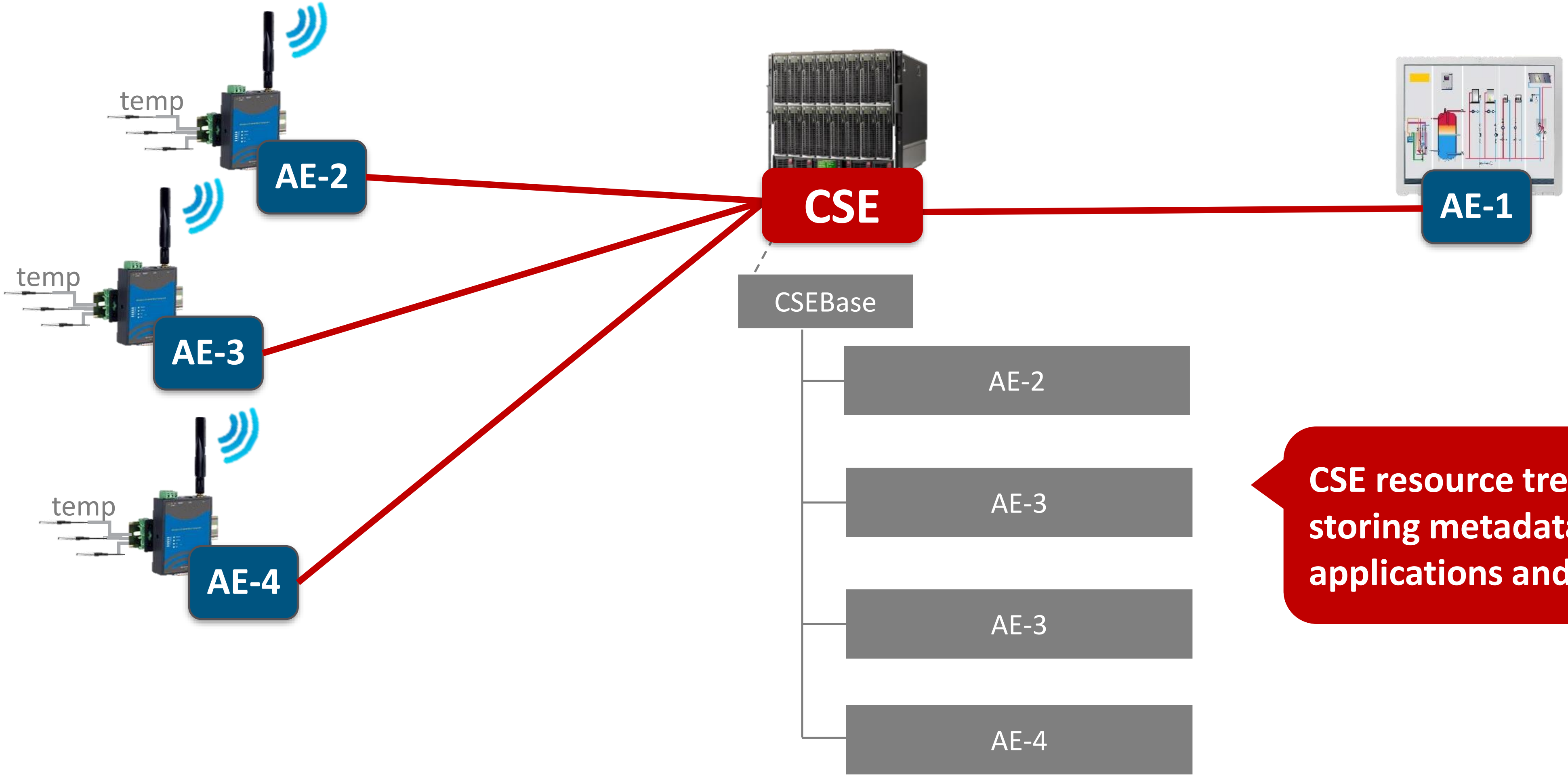
SDT based Information Model and Mapping for Vertical Industries (TS-0023)

Some more exmpl R4 features

- Geo-query
- Software Campaign
- Semantic reasoning
- Modbus oneM2M inter-operability
- Discovery based operations

Source: Dale Seed, Convida Wireless, oneM2M Release 4 Webinar

Quick Overview of oneM2M Entities



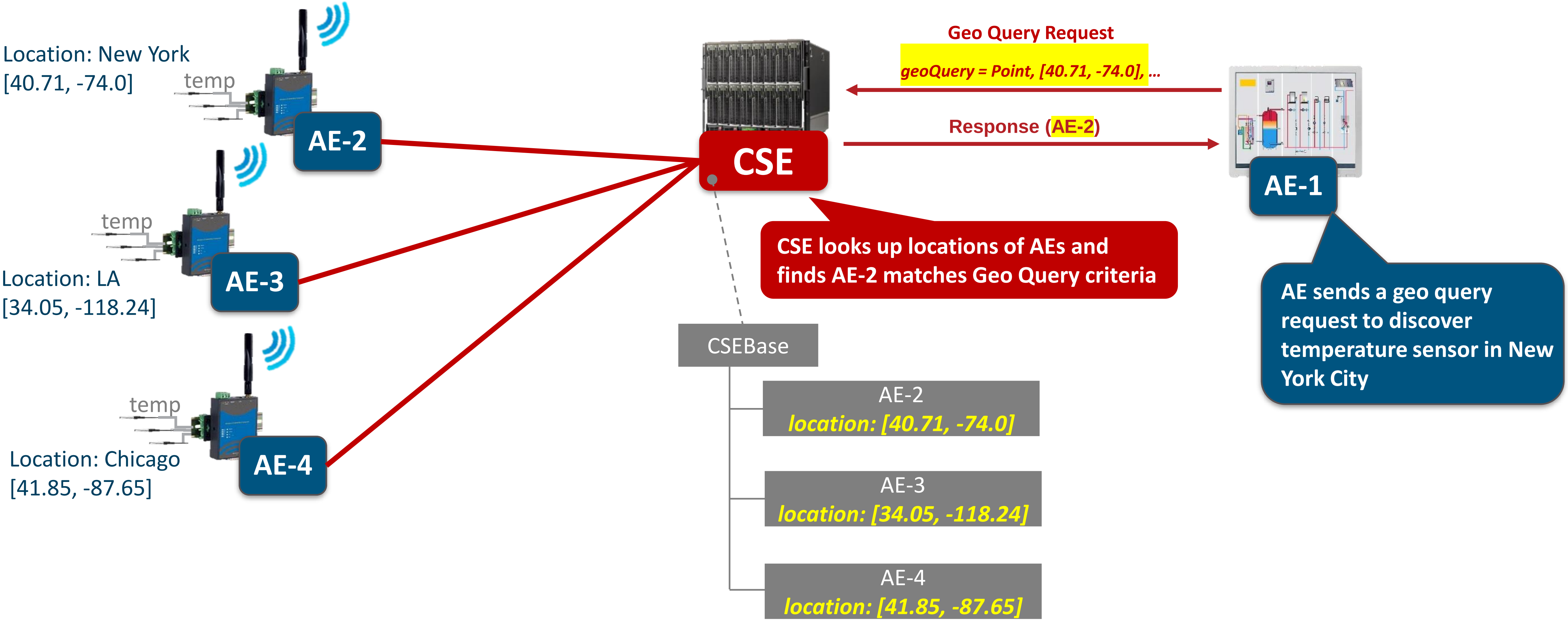
CSE resource tree for storing metadata/data of applications and devices

AE: Application Entity
CSE: Common Services Entity

NEW

Rel-4 Feature

Geo Query



CSE looks up locations of AEs and finds AE-2 matches Geo Query criteria

AE sends a geo query request to discover temperature sensor in New York City

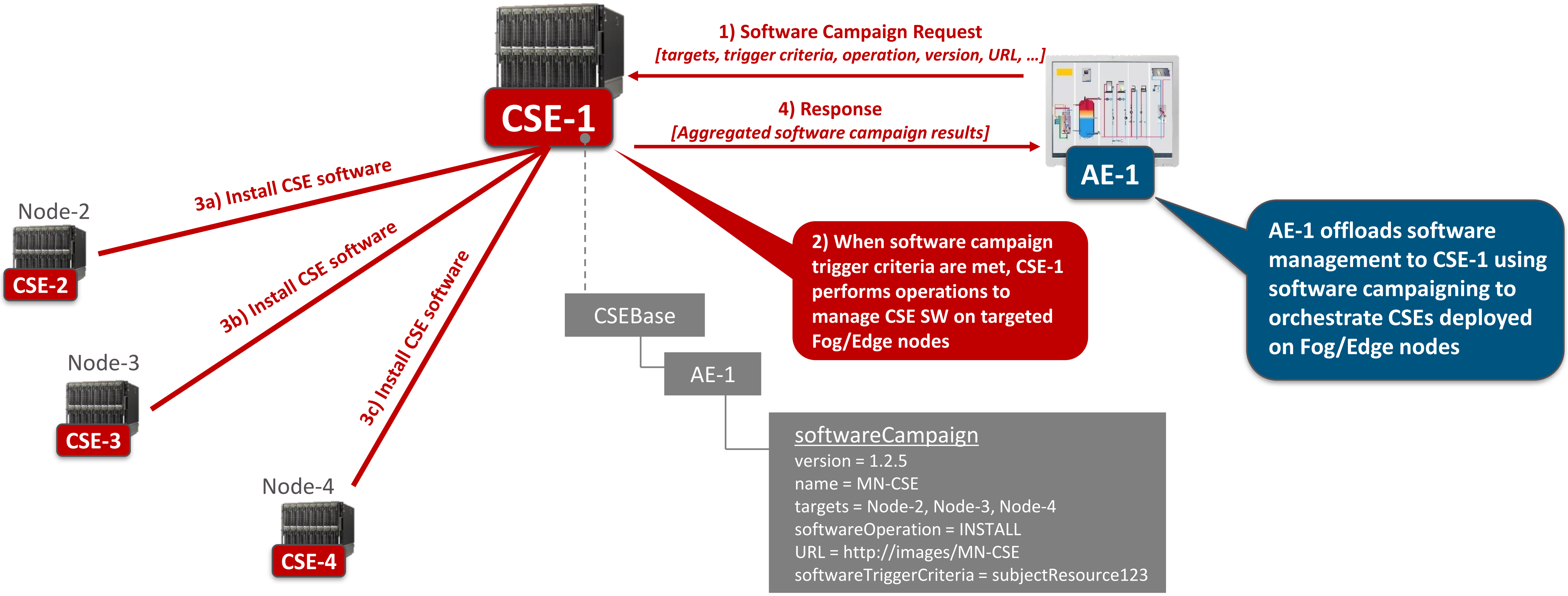
AE: Application Entity

CSE: Common Services Entity

NEW

Rel-4 Feature

Software Campaigning



2) When software campaign trigger criteria are met, CSE-1 performs operations to manage CSE SW on targeted Fog/Edge nodes

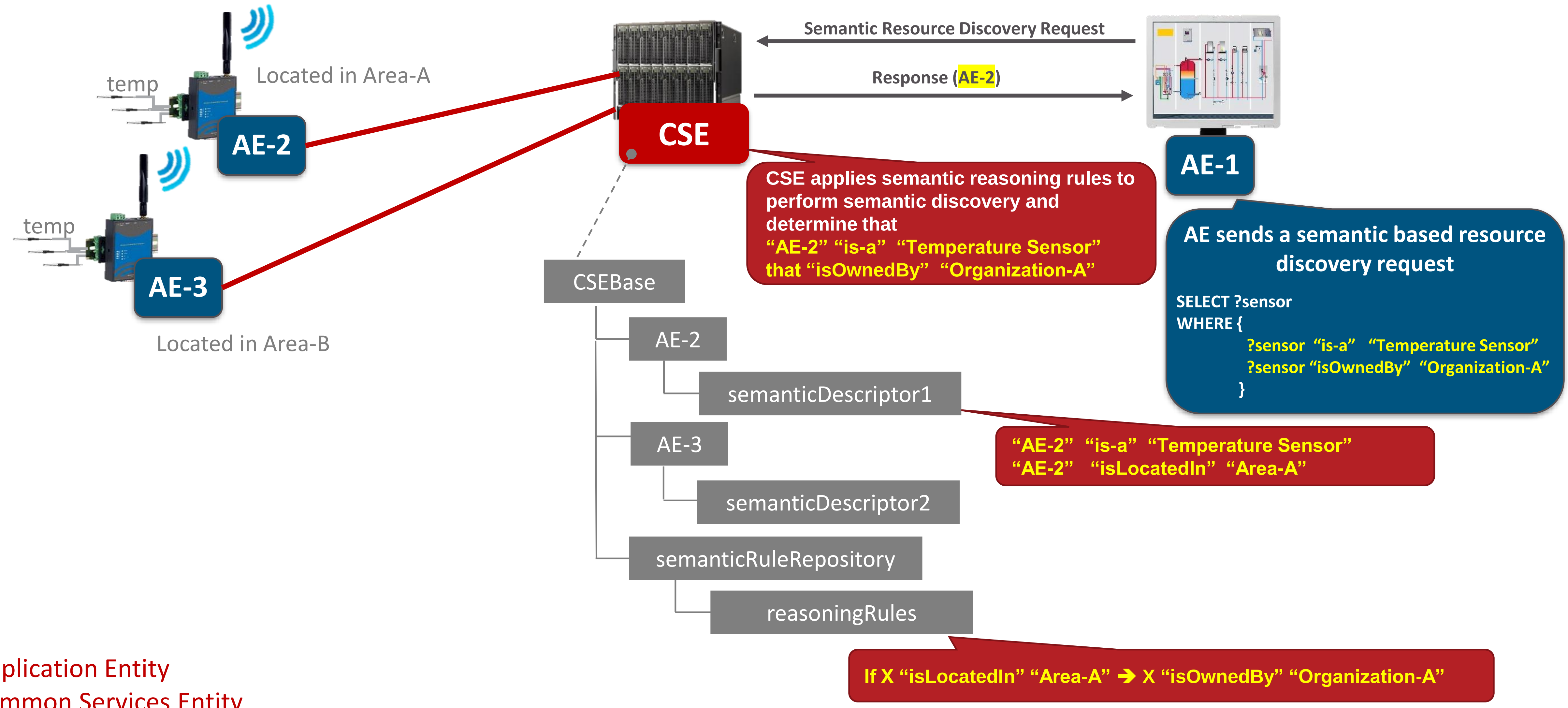
AE-1 offloads software management to CSE-1 using software campaigning to orchestrate CSEs deployed on Fog/Edge nodes

softwareCampaign
version = 1.2.5
name = MN-CSE
targets = Node-2, Node-3, Node-4
softwareOperation = INSTALL
URL = http://images/MN-CSE
softwareTriggerCriteria = subjectResource123

AE: Application Entity
CSE: Common Services Entity

NEW
Rel-4 Feature

Semantic Reasoning



Semantic Resource Discovery Request

Response (AE-2)

CSE applies semantic reasoning rules to perform semantic discovery and determine that
"AE-2" "is-a" "Temperature Sensor" that "isOwnedBy" "Organization-A"

AE sends a semantic based resource discovery request

```
SELECT ?sensor
WHERE {
        ?sensor  "is-a"   "Temperature Sensor"
        ?sensor "isOwnedBy"  "Organization-A"
      }
```

"AE-2" "is-a" "Temperature Sensor"
"AE-2" "isLocatedIn" "Area-A"

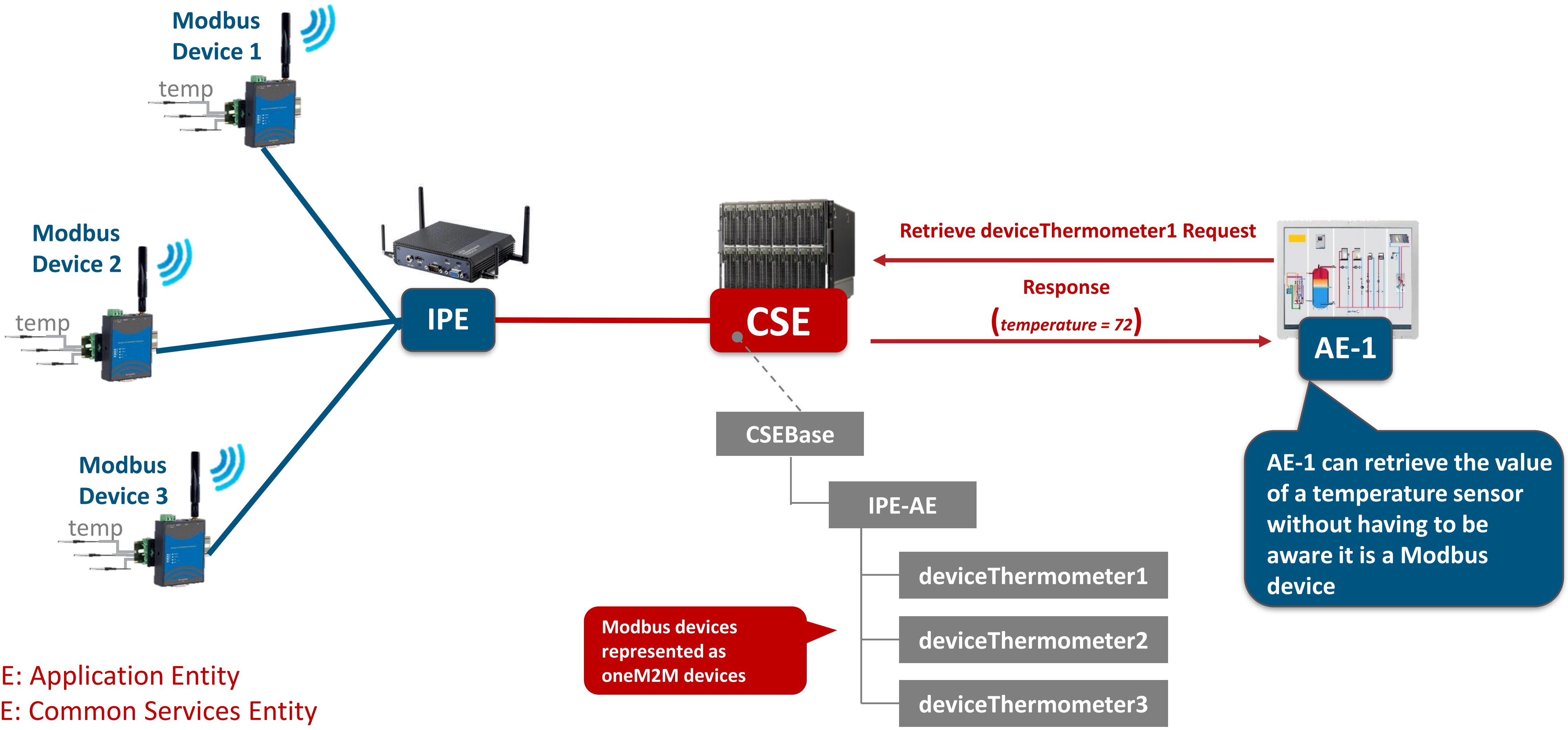
If X "isLocatedIn" "Area-A" ➔ X "isOwnedBy" "Organization-A"

AE: Application Entity
CSE: Common Services Entity

NEW
Rel-4 Feature

Modbus Interworking

oneM2M
The IoT Standard



AE-1 can retrieve the value of a temperature sensor without having to be aware it is a Modbus device

Modbus devices represented as oneM2M devices

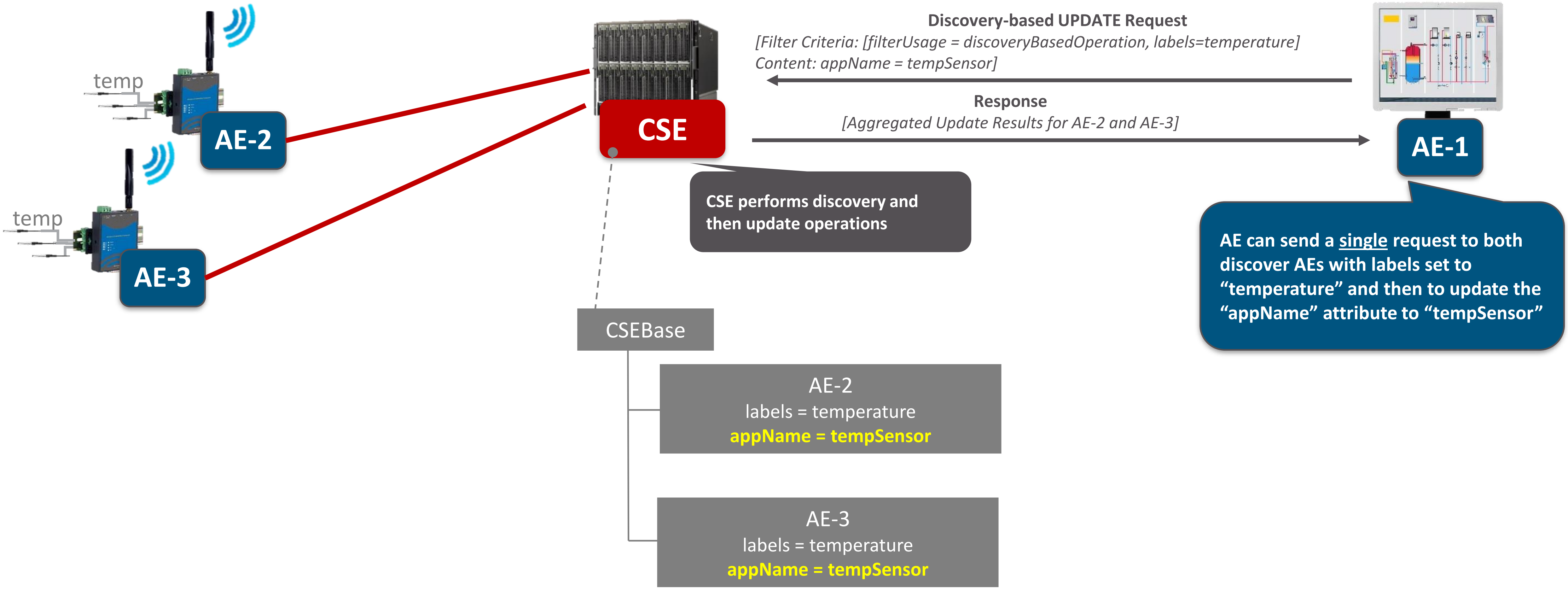
AE: Application Entity
CSE: Common Services Entity
IPE: Interworking Proxy Entity

NEW

Rel-4 Feature

Discovery-based Operations

oneM2M The IoT Standard



Discovery-based UPDATE Request

[Filter Criteria: [filterUsage = discoveryBasedOperation, labels=temperature]
Content: appName = tempSensor]

Response

[Aggregated Update Results for AE-2 and AE-3]

CSE performs discovery and then update operations

AE can send a single request to both discover AEs with labels set to “temperature” and then to update the “appName” attribute to “tempSensor”

AE-2
labels = temperature
appName = tempSensor

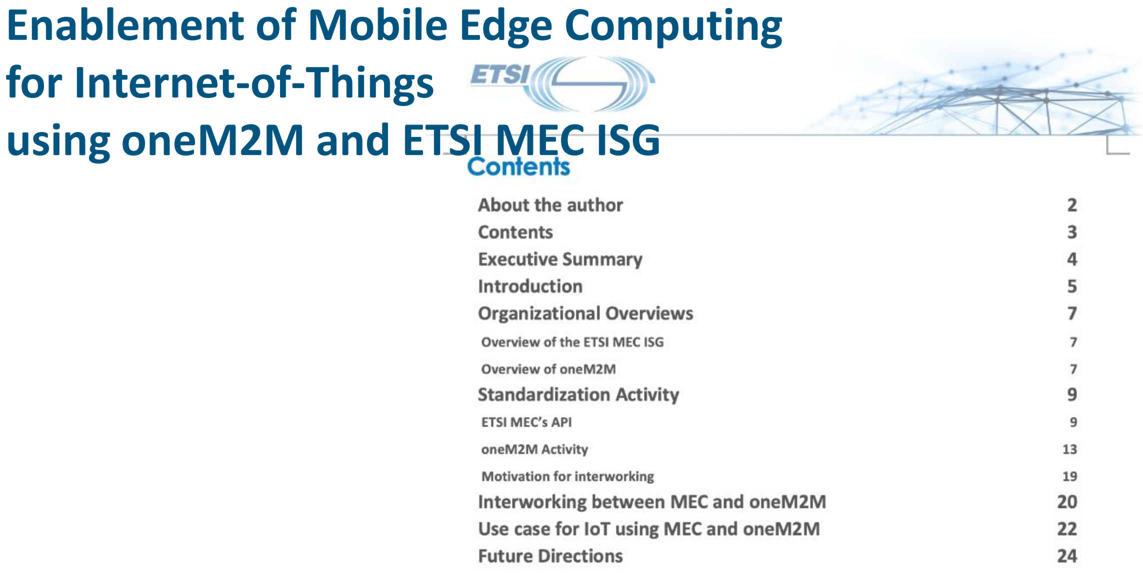
AE-3
labels = temperature
appName = tempSensor

AE: Application Entity
CSE: Common Services Entity

Conclusion and Outlook

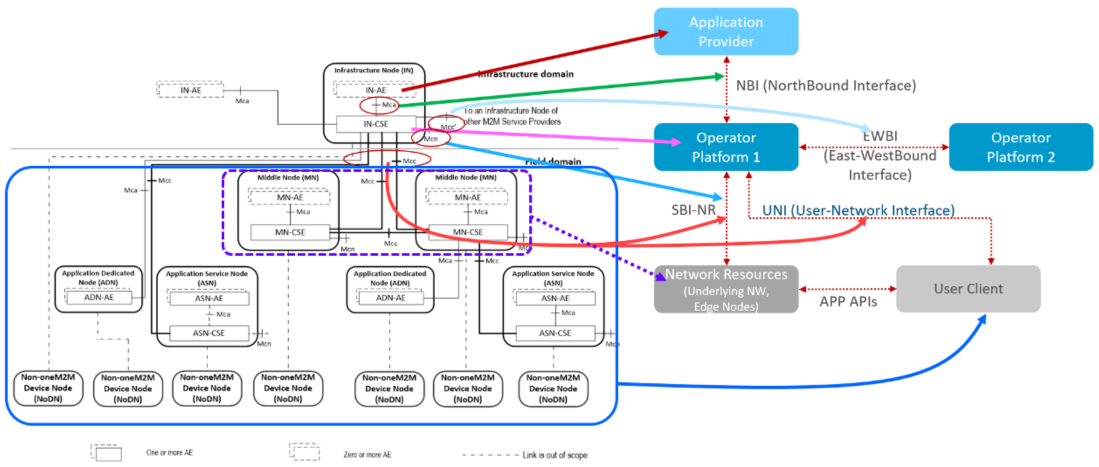
- oneM2M Events Timeline
- oneM2M Release 5 – future features examples
- Takeaways

Collaborations Examples



Enablement of Mobile Edge Computing for Internet-of-Things using oneM2M and ETSI MEC ISG

Contents

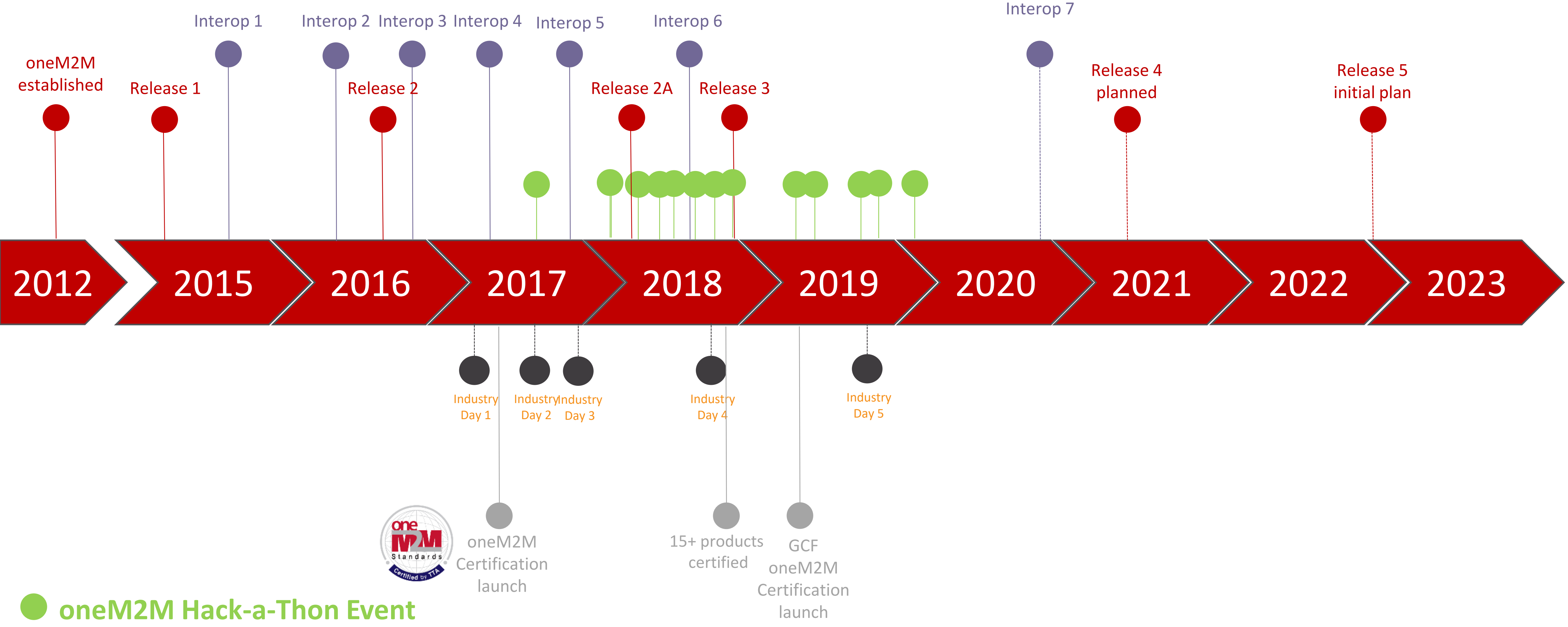


Application Provider
Infrastructure Node (IN)
IN-AE
Mca
IN-CSE
Infrastructure domain
NBI (NorthBound Interface)
To an Infrastructure Node of other M2M Service Providers
Mcc'
Mcn
Mcc
Field domain
Operator Platform 1
EWBI (East-WestBound Interface)
Operator Platform 2
Middle Node (MN)
MN-AE
MN-CSE
SBI-NR
UNI (User-Network Interface)
Application Dedicated Node (ADN)
ADN-AE
Application Service Node (ASN)
ASN-AE
ASN-CSE
Network Resources (Underlying NW, Edge Nodes)
APP APIs
User Client
Non-oneM2M Device Node (NoDN)
One or more AE
Zero or more AE
Link is out of scope

- ETSI ISG MEC
  - oneM2M platform instance can be placed where MEC is running
  - two features allows this to happen:
    - Software Campaign
    - Enhanced resource announcement
  - Joint Whitepaper development (expected Q1 2021)
- GSMA OPG
  - Information exchanged
  - Discussion ongoing

oneM2M Key-events Timeline

The IoT Standard



oneM2M established

Release 1

Interop 1

Interop 2

Release 2

Interop 3

Interop 4

Interop 5

Release 2A

Interop 6

Release 3

Interop 7

Release 4 planned

Release 5 initial plan

2012

2015

2016

2017

2018

2019

2020

2021

2022

2023

Industry Day 1

Industry Day 2

Industry Day 3

Industry Day 4

Industry Day 5

oneM2M Certification launch

15+ products certified

GCF oneM2M Certification launch

● oneM2M Hack-a-Thon Event

oneM2M Implementation Ecosystem

A vibrant and healthy oneM2M ecosystem continues to build

Industry-driven Open source implementations

LAAS-CNRS
OM2M Connecting things

Fraunhofer FOKUS
open mtc

KETI
OCEAN

CISCO
OPEN DAYLIGHT
IotDM

atis
OS-IoT

Examples of Commercial implementations, Prototypes, Trials

LG
सेंटर फॉर डेवलपमेंट ऑफ टेलीमैटिक्स भारत सरकार का दूरसंचार प्रौद्योगिकी केन्द्र सी-डॉट C-DOT Centre for Development of Telematics Telecom Technology Centre of Govt. Of India
SIERRA WIRELESS
INTERDIGITAL
QUALCOMM
Deutsche Telekom
kt
HUAWEI
SK telecom
sensinov Global IoT Platform
MODACOM
LG U+
Hewlett Packard Enterprise
orange
NEC
iREX
SAMSUNG
SAMSUNG SDS
DASAN
HANDYSOFT
GRIDNET
JOHN DEERE
NTT
PILOT THINGS
HEALTHCONNECT
KEPCO
Creative Convergence ntels
TELECOM ITALIA

oneM2M.org lists
66
Deployments
List of deployments

Certification Test Houses and Test Tool Vendors

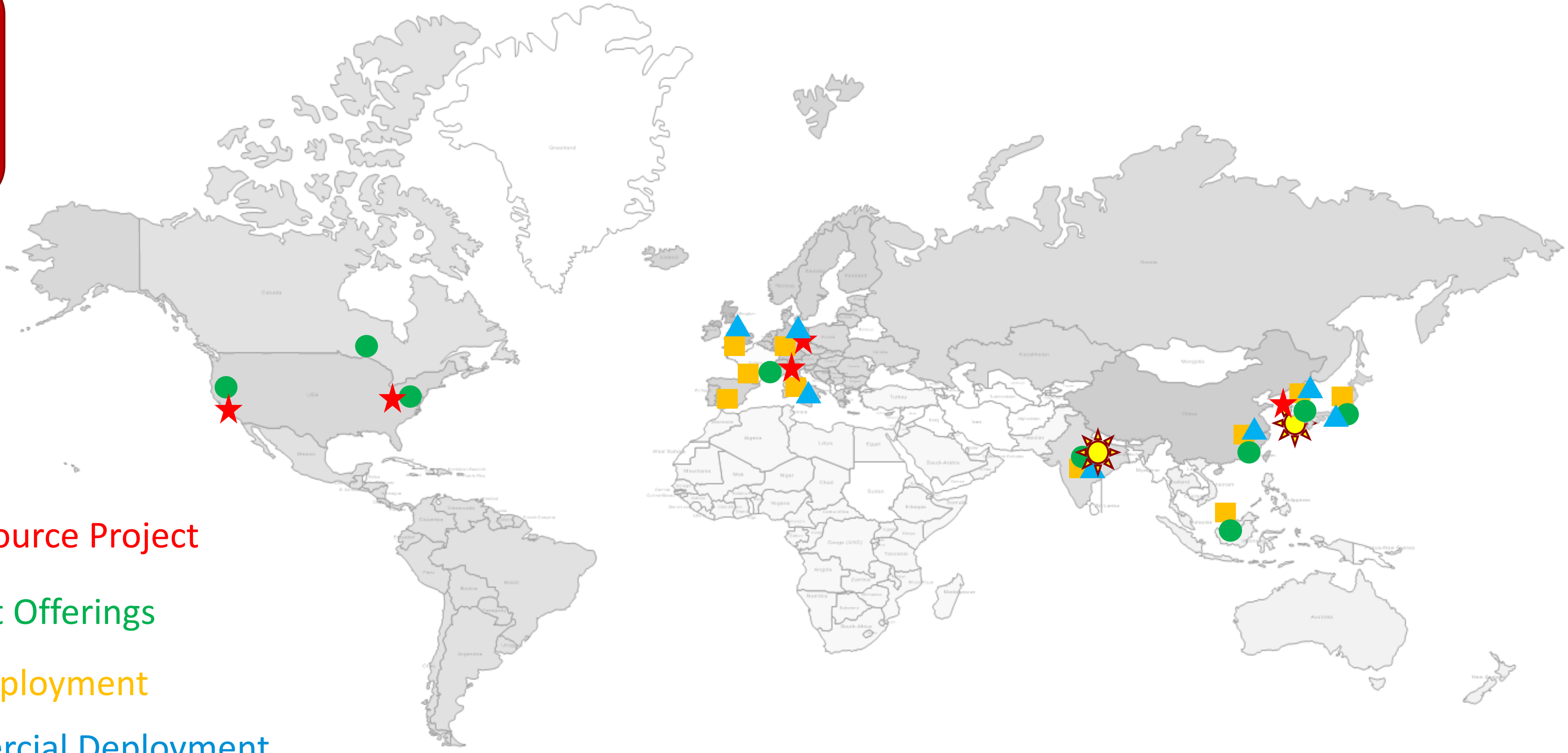
SPIRENT Inspired innovation
TTA
DEKRA
Innowireless
KETI
Dt&C
easy global market

Regular Interop Events (7 Held from 2015-2020)

Based on slides by: Dale Seed, oneM2M Overview 2019

oneM2M Adoption is Global

oneM2M adoption is expanding



★ oneM2M Open Source Project

● oneM2M Product Offerings

■ oneM2M Trial Deployment

▲ oneM2M Commercial Deployment

☼ Use of oneM2M recommended (Smart Cities)

oneM2M Future Feature development

- oneM2M Release 5
  - Use Case and Requirements development
    - Work ongoing in Requirements and Domain Models Working Group
  - Architecture and protocol related work – to be started Q1 2021

Release 5
Work in Progress

oneM2M System Enhancements to Support Data Protection Regulations [WI-0095]

Effective IoT Communication to Protect 3GPP Networks [WI-0096]

oneM2M and SensorThings API [WI-0100]

Advanced Semantic Discovery [WI-0101]

System enhancements to support Data License Management [WI-0102]

…

Takeaways

oneM2M

- is a global open standard, not controlled by a single private company
- specifies a common set of horizontal IoT services
  - architecture, common services functions,
- enables data interoperability
  - Information model, semantics, ontology based interoperability
- interworks with existing IoT technologies
- has interoperability testing and a certification program
- standardized APIs simplify the life for IoT stakeholders
  - minimize development, deployment & maintenance costs
- is a mature and a commercially deployed technology

oneM2M release 4
Expected: Q2 2021

Work in progress on
oneM2M Release 5

oneM2M

The IoT Standard

Q&A

Thank You!

Backup

Publicly Accessible Links

Web Site
http://www.oneM2M.org

Developer Guides
http://www.onem2m.org/developer-guides

Technical Questions
http://www.onem2m.org/technical/technical-questions

Published Specifications
http://www.onem2m.org/technical/published-documents

Webinars
http://www.onem2m.org/technical/webinars

YouTube Channel
https://www.youtube.com/c/onem2morg

Events
http://www.onem2m.org/news-events/events

Certified Products
http://www.onem2mcert.com/sub/sub04_01.php

Smart Device Template
SDT 3.0 is available under Apache 2 License:
https://git.onem2m.org/MAS/SDT

TS-0023 : SDT based Information Model and Mapping for Vertical Industries
The latest published version of TS-0023 is available:
http://www.onem2m.org/technical/published-drafts

Tools
A utility for converting SDT to other formats is the SDTTool:
https://github.com/Homegateway/SDTTool

Twitter
@oneM2M

Stackoverflow
https://stackoverflow.com/questions/tagged/onem2m