物聯網核心技術
物聯網系統架構

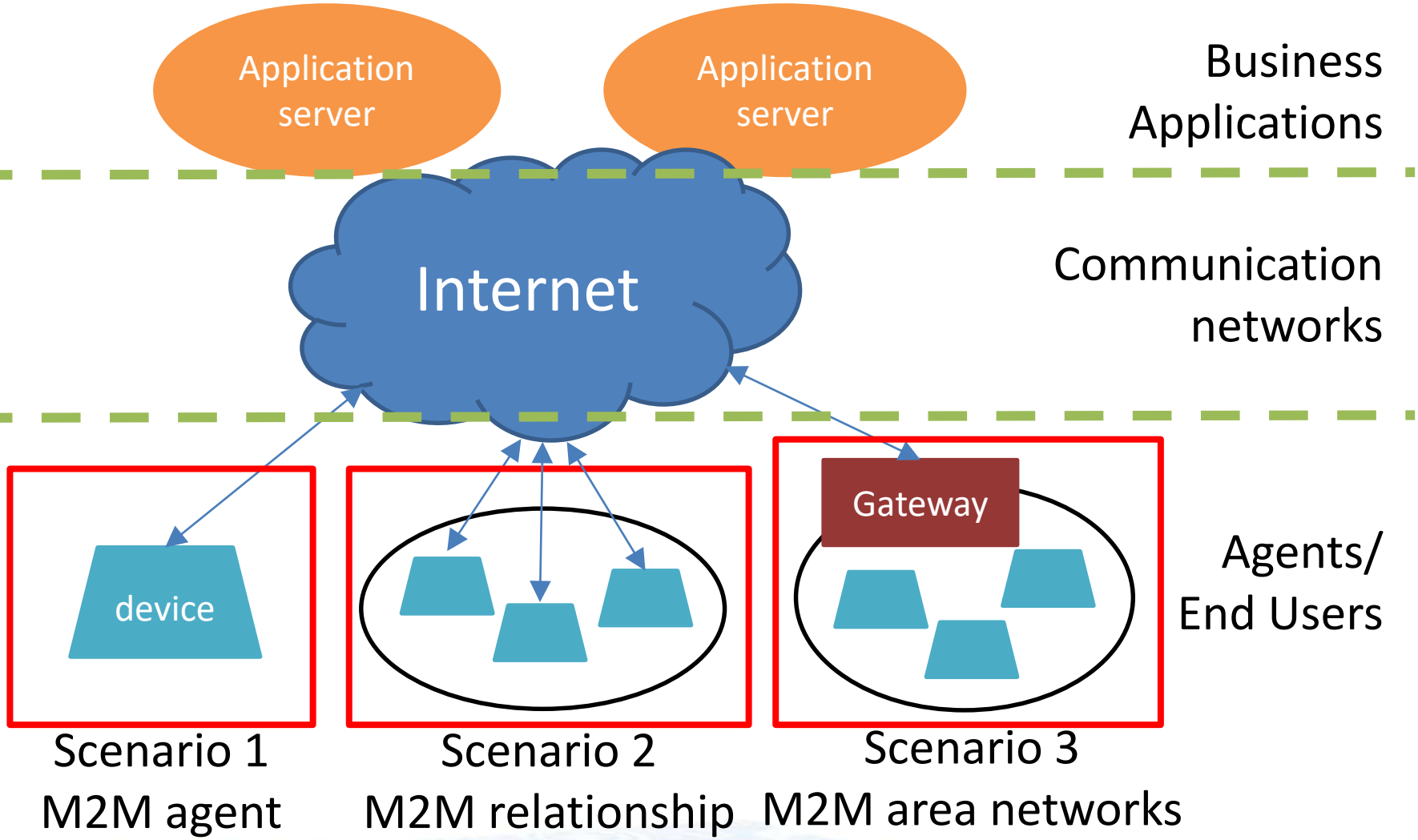
國立中正大學資工系 黃仁竑教授

Outline

- IoT/M2M System Structure
- IoT Standard Organizations
- Introduction to oneM2M
- IoT/M2M Use-Case-Driven Requirements
- IoT/M2M High Level Architecture

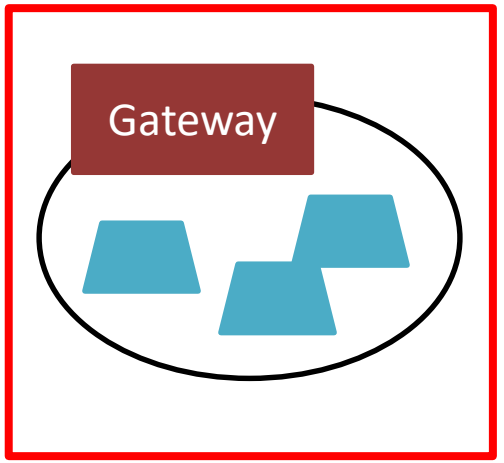
IoT/M2M System Structure

IoT/M2M System Structure



M2M Area Networks

- "M2M area network" is introduced by ETSI.
- Provide PHY and MAC layer connectivity between M2M devices connected to the same M2M area network
- Allow M2M devices to gain access to a public network via a gateway



M2M area network

⇳

devices + gateway

Introduction to ETSI TC M2M

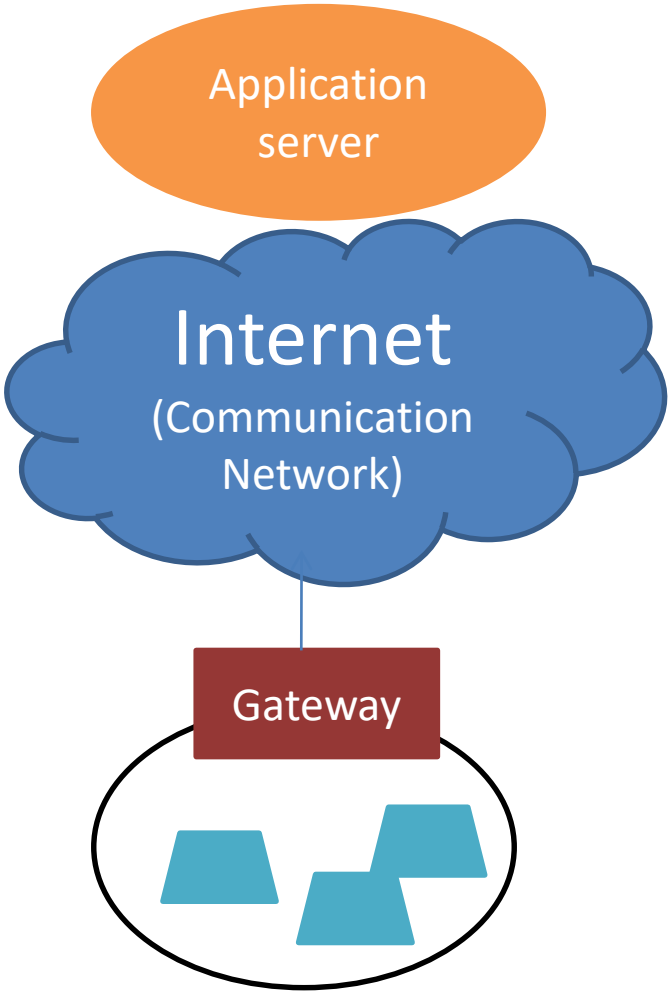
- ETSI (European Telecommunications Standards Institute) TC (Technical Committee) M2M established in Jan 2009
- Active delegates from Europe, North America, China, Korea, and Japan
- Currently about 30% Operators, 60% Manufacturers and 10% others
- 8 plenary meetings per year plus numerous ad-hoc meetings and 3-5 conference calls per week
- Constantly growing number of documents per meeting (300 +)
- Constantly growing plenary participation (70 +)
- Growing membership in M2M email list (400+)

Goals of ETSI TC M2M

- To develop and maintain an end-to-end overall telecommunication high level architecture for M2M
- To identify gaps where existing standards and provide specifications to fill these gaps

Characteristics of M2M

- Information exchange over communication networks
  - Via mobile networks or public internets
- A group of similar devices
  - Devices with limited capacities
  - Hierarchical architecture
  - Autonomous



Characteristics of M2M Applications

- A large amount of devices
  - Scalability issues
  - Non-classical usage patterns in mobile networks
    - E.g., not always active - only be triggered for specific reason and only do things in some fixed time.
- A large variety of devices
  - Diverse requirements, e.g., data exchange rate, latency, reliability
  - Various wireless communication protocols
- Transparency
  - No need for human interference
  - High autonomy
- Intrusiveness: privacy issues
- Criticality: life-savers, life-critical

M2M Devices

- Battery powered
  - E.g., water meters are located outdoors and cannot be easily connected to a power supply.
- Embedded
  - Many devices are deployed in systems with specific operating condition and with limited computation power.
  - E.g., the OBD in car
- Here to stay
  - Many devices are static or with very low mobility.

Challenges

- Fragmentation of solutions
  - It is important to have service platforms that can be reused for multiple applications.
- Network misalignment
  - large numbers of devices generating very small amounts of data transport and potentially a very significant overload of the control and connectivity planes.
- Security and Privacy issues
  - E.g., eHealth, Smart Grid, etc.
  - Data sharing vs. data protection

IoT Standard Organizations

IoT Alliances

Handbook: Internet of Things Alliances and Consortia

Emerging of IoT/M2M Industry Alliances

- AllSeen Alliance
- Open Connectivity Foundation (OCF)
  - Open Interconnect Consortium (OIC)
- Google Weave
- Apple Homekit
- Industrial Internet Consortium

AllSeen Alliance

- AllSeen Alliance provides the AllJoyn™ framework that is open source software that allows for proximity peer to peer over various transports.
- It is written in C++ at its core, and provides multiple language bindings and complete implementations across various operating systems and chipsets.
- The AllJoyn framework provides an object-oriented approach to making peer to peer easy, avoiding the need to ever deal with lower-level network protocols and hardware.

AllSeen Alliance

- The AllJoyn SDK provides a set of APIs that allow a novice developer to create applications that take advantage of AllJoyn's capabilities.
  - Java API
  - C++ API
  - C# Unity API
  - C API

Open Connectivity Foundation (OCF)

- The Open Connectivity Foundation (OCF) is creating a specification and sponsoring an open source project to make this possible.
- OCF will unlock the massive opportunity in the IoT market, accelerate industry innovation and help developers and companies create solutions that map to a single open specification. OCF will help ensure secure interoperability for consumers, business, and industry.

Open Connectivity Foundation (OCF)

- The OCF unifies the entirety of the former Open Interconnect Consortium (OIC) with leading companies at all levels – silicon, software, platform, and finished-goods – dedicated to providing this key interoperability element of an IoT solution.
- The OCF sponsors the IoTivity open source project which includes a reference implementation of our specification available under the Apache 2.0 license.
- The OCF also includes all the activities formerly sponsored by UPnP Forum.

Open Interconnect Consortium (OIC)

- The OIC, led by Intel, Atmel, Broadcom, Dell, and Samsung, is dedicated to defining requirements and ensuring interoperability of all devices in the IoT.
- Specifically, the OIC envisions a highway-like system of connectivity between IoT verticals, and it recently launched IoTivity, an open-source framework based on the Apache 2.0 licensing and governance model.
- The companies that make up the consortium also make security a top priority, though it's unclear how the group will address privacy.
- One differentiator for the OIC is that it wants to deliver a reference implementation of its IoT standards, rather than simply offering the standards themselves.

Google Weave

Brillo, Nest

- Weave is an application-layer protocol for interacting with devices.
- It has three main components:
  - Weave cloud service
  - Device-side library(libweave, libuweave) and wrappers
  - Client library(android, iOS, web)
- It provides turnkey supports:
  - Device discovery
  - Authentication
  - Provisioning
  - Real time communication

THE THREAD GROUP (GOOGLE NEST)

- Formed by Google's Nest Labs, the Thread Group includes more than 80 members, including Samsung, ARM Holdings, Silicon Labs, and Freescale Semiconductor.
- The group's goal is to encourage manufacturers of smart-home devices to use the Thread standard for device communications through a network.
- Unlike other alliances that provide IoT platforms and interconnectivity of existing standards, Thread relies on a low-power radio protocol known as IPv6 over Low power Wireless Personal Area Networks (6LoWPAN) as the base networking protocol.

Apple Homekit

- An iOS(8) framework for home automation
- Discover HomeKit accessories (devices)
- Configure
- Create actions and control devices
- Actions can be grouped and triggered using Siri
- A common database stored on iOS, contains all home information configured. Available to all apps
- App interaction to DB is done through HomeKit
- Access to home devices remotely through iOS connectivity
- HomeKit API can only be used if App is in foreground

Industrial Internet Consortium

- It is a nonprofit partnership of Industry, Government and Academia.
- Founded by AT&T, Cisco, General Electric, Intel and IBM. (150+ members)
- Started in March, 2014, not a standards-setting consortium.
- Utilize existing and create new industry use cases and testbeds for real-world applications.

industrial internet CONSORTIUM

Industrial Internet Consortium

- Deliver best practices, reference architectures, case studies, and standards requirements to ease deployment of connected technologies.
- Influence the global development standards process for internet and industrial systems.
- Facilitate open forums to share and exchange real-world ideas, practices, lessons, and insights.
- Build confidence around new and innovative approaches to security.

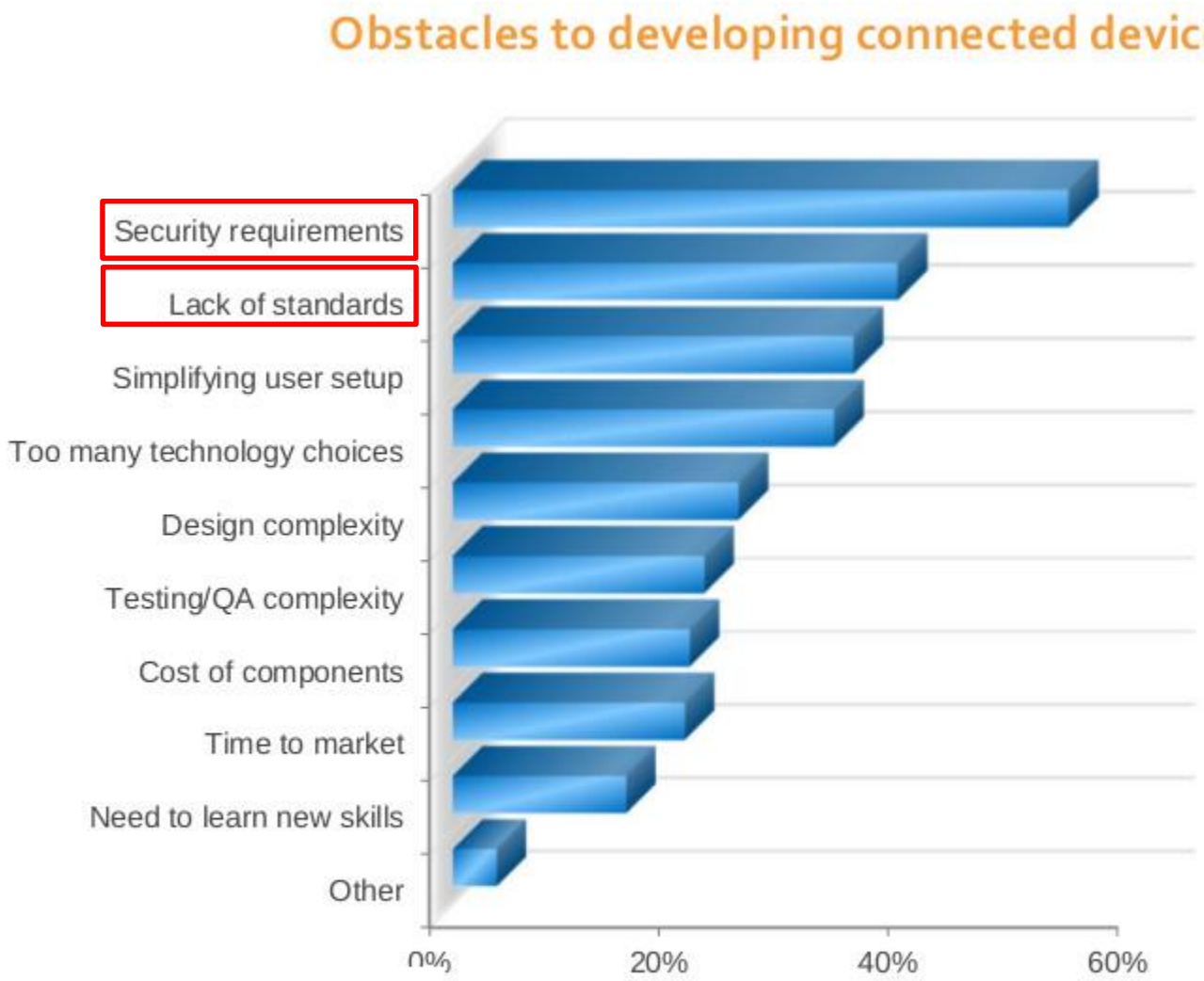
industrial internet CONSORTIUM

物聯網面臨的挑戰

- Numerous incomplete standards
- Big data store and process
- Security and privacy
- Network mismatch (not designed for IoT)
- Network scalability
- Naming and addressing (semantic web)
- …

IDC認為物聯網市場的挑戰

VDC調查物聯網的障礙因素



VDC Research
Insights for the Connected World

物聯網相關之國際標準組織

- ETSI (European Telecommunications Standards Institute)
- Institute of Electrical and Electronics Engineers (IEEE): IEEE-SA IoT Steering Committee
- International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC): ISO/IEC JTC1/SWG 5 (ad hoc group 4)
- US National Institute of Standards and Technology (NIST)
  - Smart Grid framework (SG-FW)
- CCSA, China
- European Standard Organization (ESO)
- Object Management Group (OMG)
- Open Geospatial Consortium (OGC)
- European Commission mandates
  - Smart metering [M/441]
  - RFID and system [M/436]

物聯網重要的新網路協定

- 感測網路
  - IEEE 802.15.4, IEEE 802.15.4e (2012)，IEEE 802.15.4g
  - Bluetooth 4.2 (2014), Bluetooth 5.0 (2016)
  - RFID
  - Power Line Communication (PLC)
  - ANSI C12 (AMI), KNX(home/building), BACNet (building)
  - IETF: 6LoWPAN, RPL
- 長距離傳輸網路
  - LTE-A NB-IoT，RoLa, SigFox
- 應用層
  - CoAP, MQTT

LPWAN: Low Power Wide Area

	SIGFOX	LoRa	clean slate cIoT	NB LTE-M Rel. 13	LTE-M Rel. 12/13	EC-GSM Rel. 13	5G (targets)
Range (outdoor) MCL	<13km 160 dB	<11km 157 dB	<15km 164 dB	<15km 164 dB	<11km 156 dB	<15km 164 dB	<15km 164 dB
Spectrum Bandwidth	Unlicensed 900MHz 100Hz	Unlicensed 900MHz <500kHz	Licensed 7-900MHz 200kHz or dedicated	Licensed 7-900MHz 200kHz or shared	Licensed 7-900MHz 1.4 MHz or shared	Licensed 8-900MHz 2.4 MHz or shared	Licensed 7-900MHz shared
Data rate	<100bps	<10 kbps	<50kbps	<150kbps	<1 Mbps	10kbps	<1 Mbps
Battery life	>10 years	>10 years	>10 years	>10 years	>10 years	>10 years	>10 years
Availability	Today	Today	2016	2016	2016	2016	beyond 2020

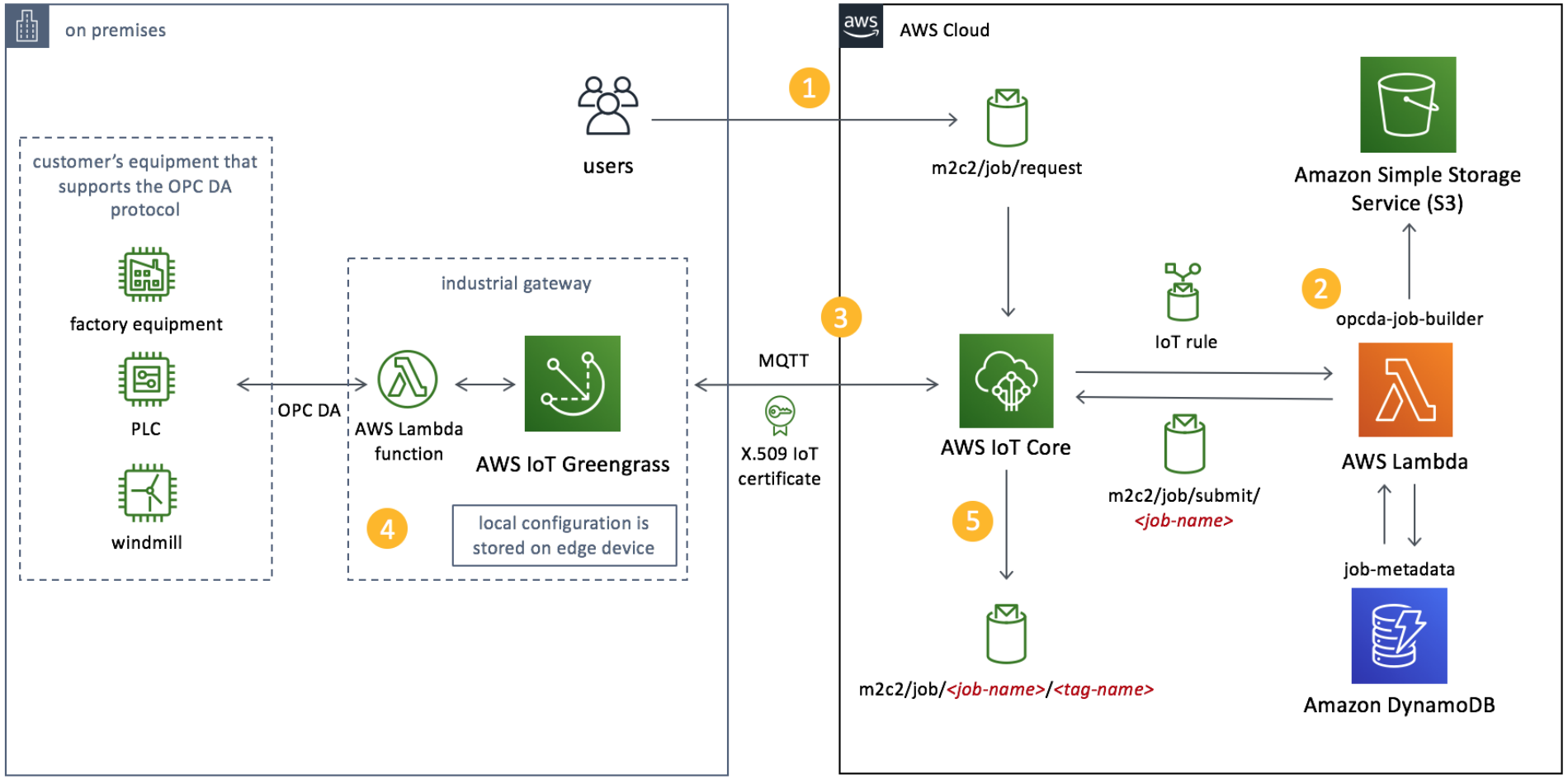
mIoT: massive IoT

IoT Cloud Platforms

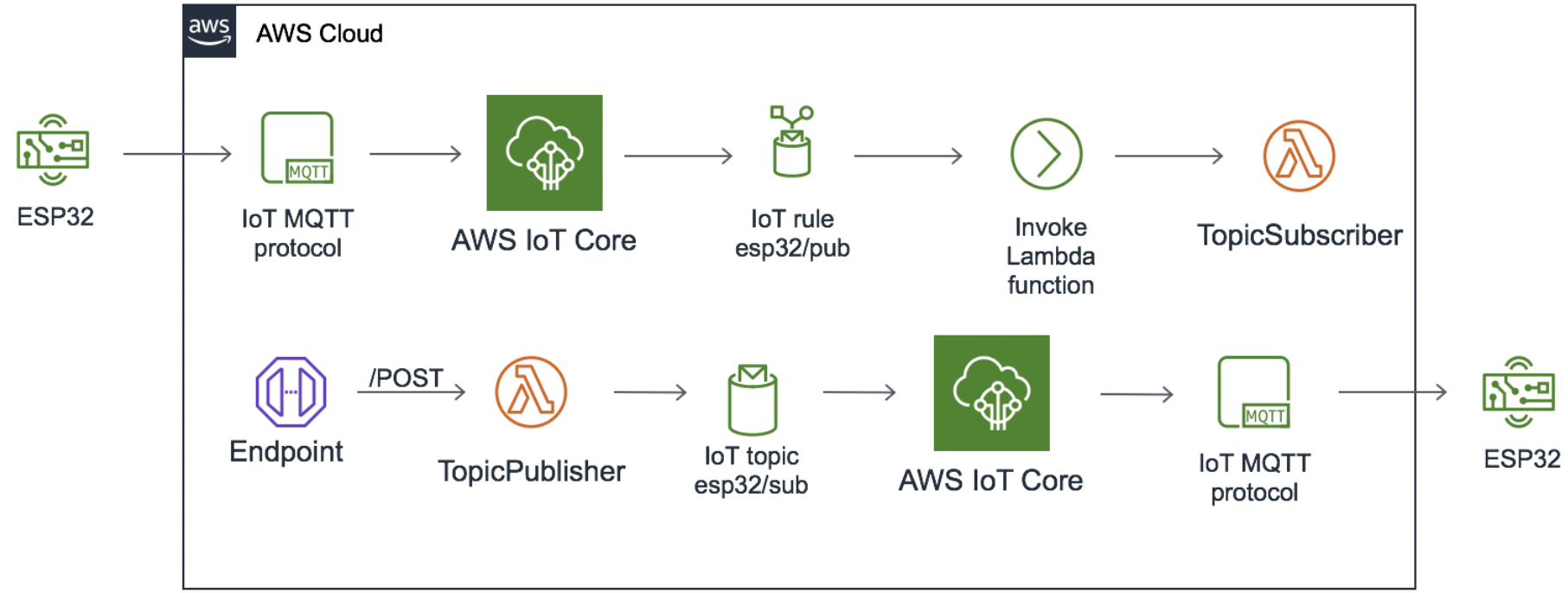
Amazon Web Services IoT Platform

- AWS IoT Core
  - main advantage is its Edge software that is FreeRTOS and Greengrass.
- Features
  - AWS IoT Device SDK
  - Device Gateway
  - Message Broker
  - Authentication and Authorization

Amazon Web Services IoT Platform



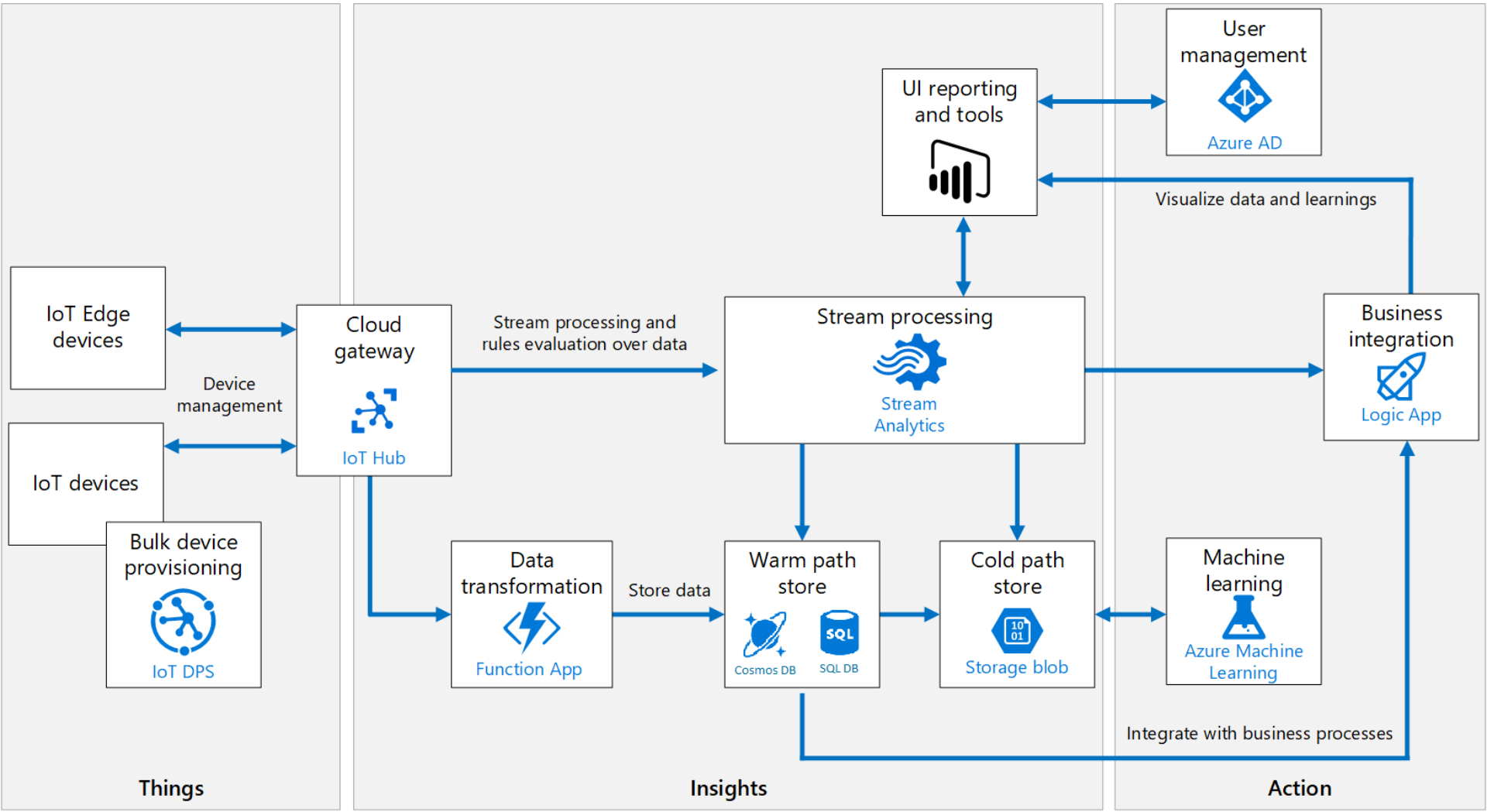
Amazon Web Services IoT Platform



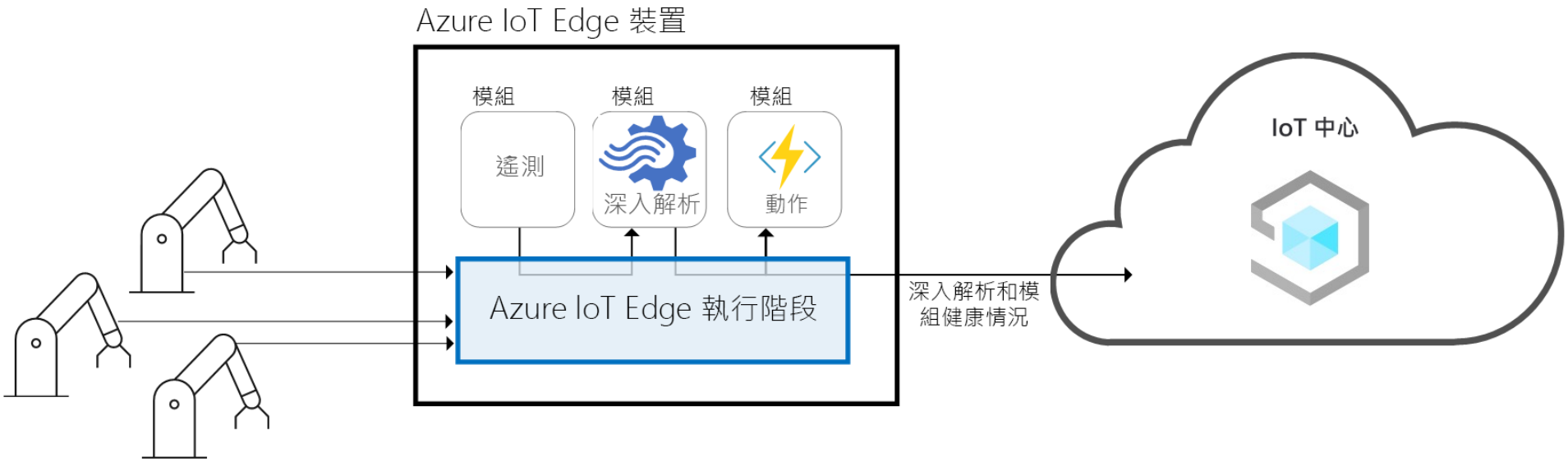
Microsoft Azure IoT Cloud Platform

- A collection of Microsoft-managed cloud services that connect, monitor, and control billions of IoT assets.
- Features
  - Condition Monitoring
  - Facility Management
  - Asset Tracking
  - Azure IoT Solution Accelerator: to increase the efficiency of factory-connected devices

Microsoft Azure IoT Cloud Platform



Microsoft Azure IoT Cloud Platform



Google Cloud IoT Platform

- A complete set of tools to connect, process, store, and analyze data both at the edge and in the cloud.
- This platform supports various of RTOS/IoT OS that work with Debian Linux OS, providing immediate turnkey support for leading device manufacturers such as Intel and Microchip.

Google Cloud IoT Platform

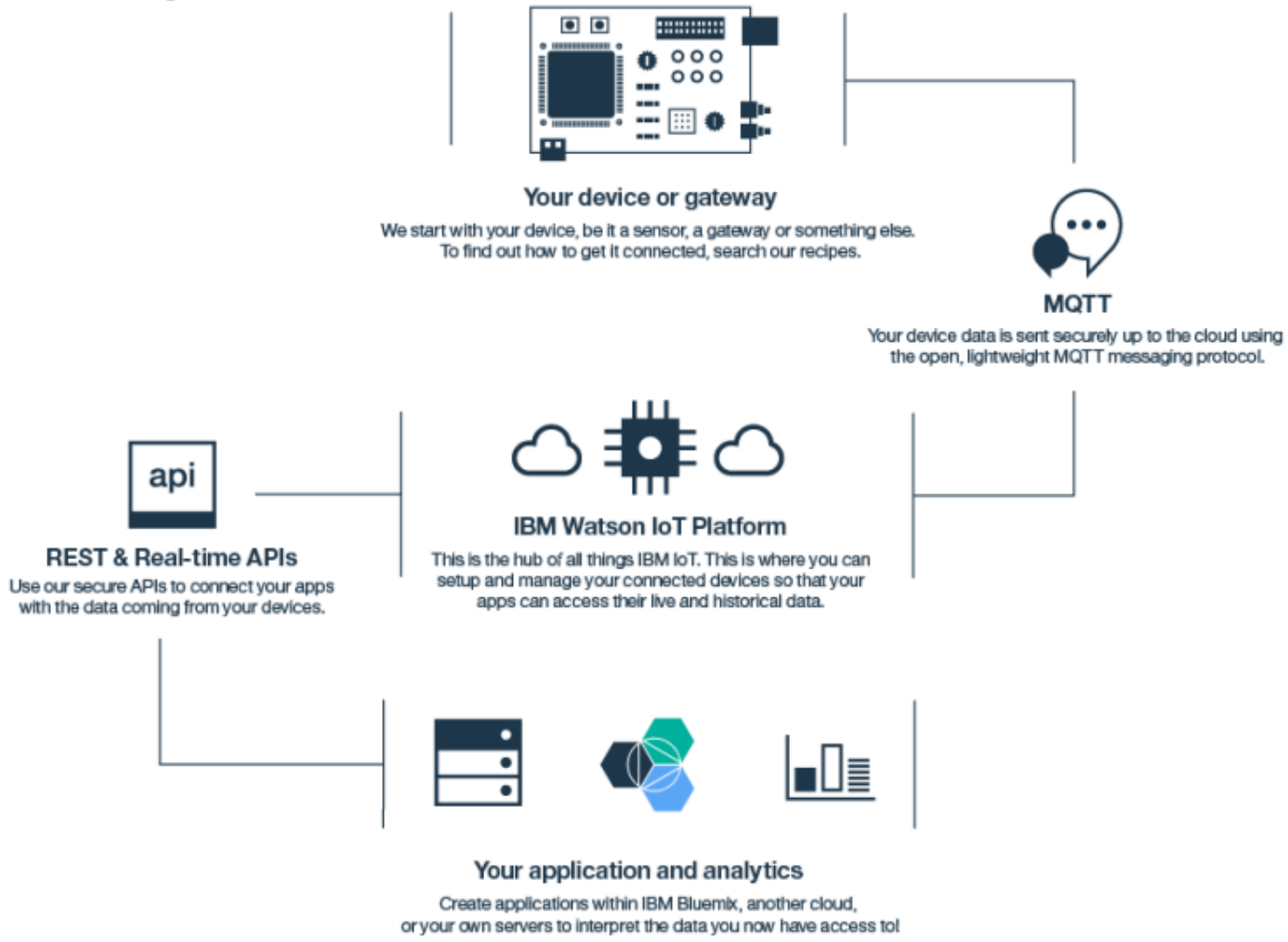
- Features
  - Predictive maintenance
  - Real-time tracking
  - Provides integration with other Google services
  - Support Logistics and Supply Chain Management Fleet management, inventory tracking, cargo integrity monitoring, etc.

IBM Watson IoT Platform

- A ready-to-run, pre-integrated SaaS managed service IoT platform with capabilities in connectivity, data management and advanced analytics.
- Features
  - Device management
  - Responsive, scalability, connectivity
  - Secure communication
  - Data lifecycle management

IBM Watson IoT Platform

Connectivity flow:

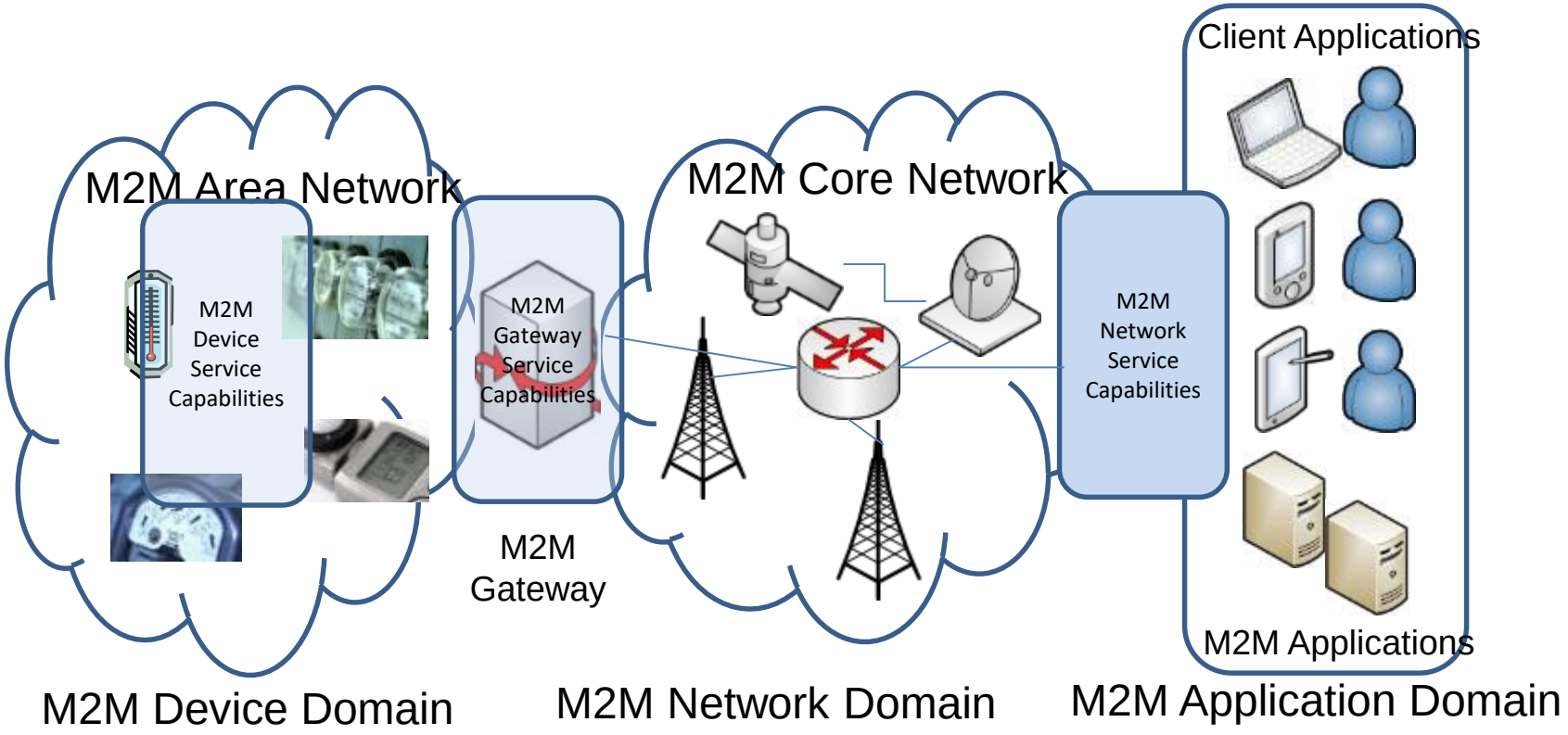


Introduction to oneM2M

Predecessor of oneM2M
ETSI TC M2M

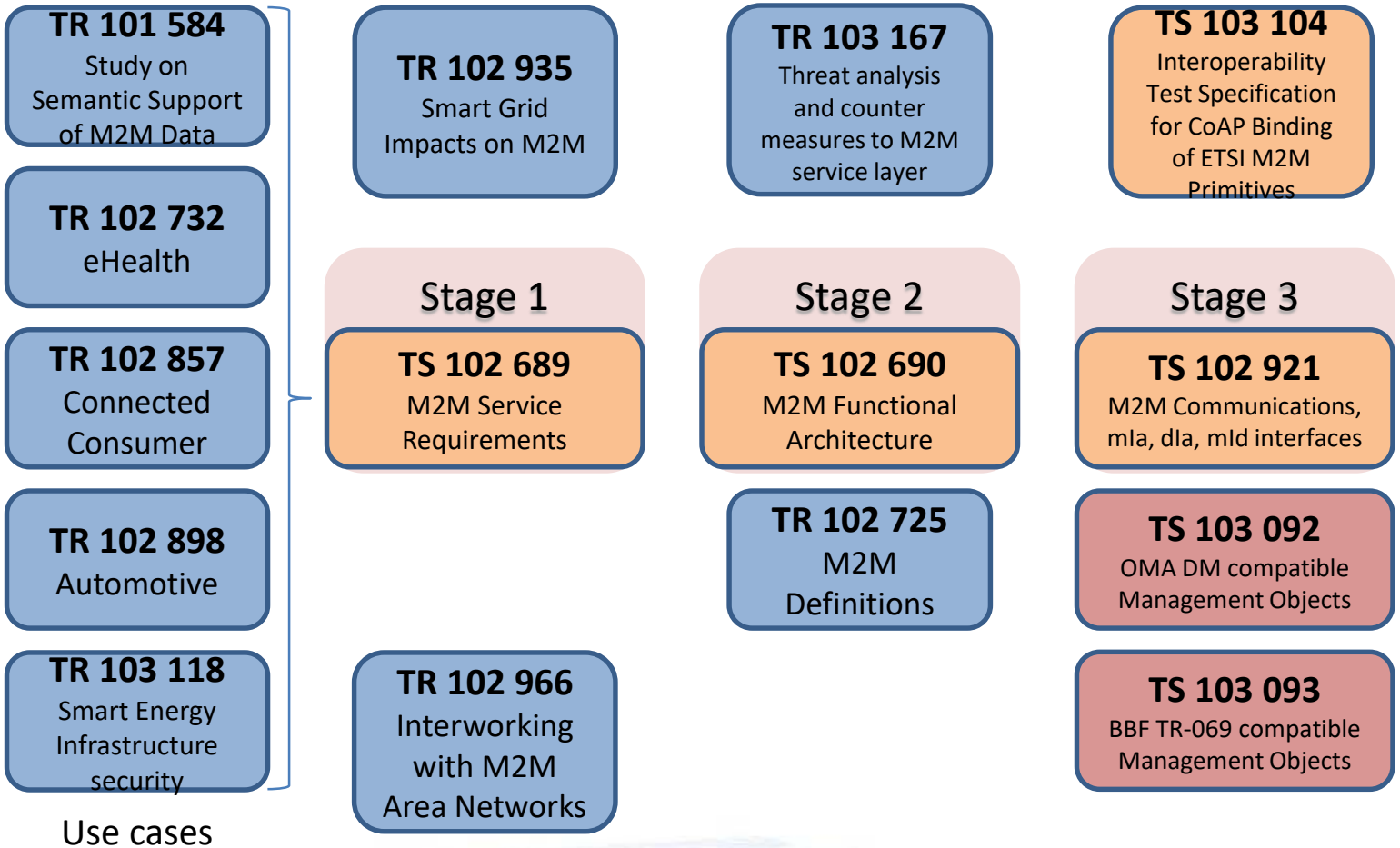
- ETSI (European Telecommunications Standards Institute) TC (Technical Committee) M2M established in Jan. 2009
- To develop and maintain an end-to-end overall telecommunication high level architecture for M2M
- To identify gaps with existing standards and provide specifications to fill these gaps

ETSI M2M Network



ETSI M2M Specification Output

Release 1 (End of 2011), Release 2 (Early 2013)



Transition from ETSI M2M to oneM2M

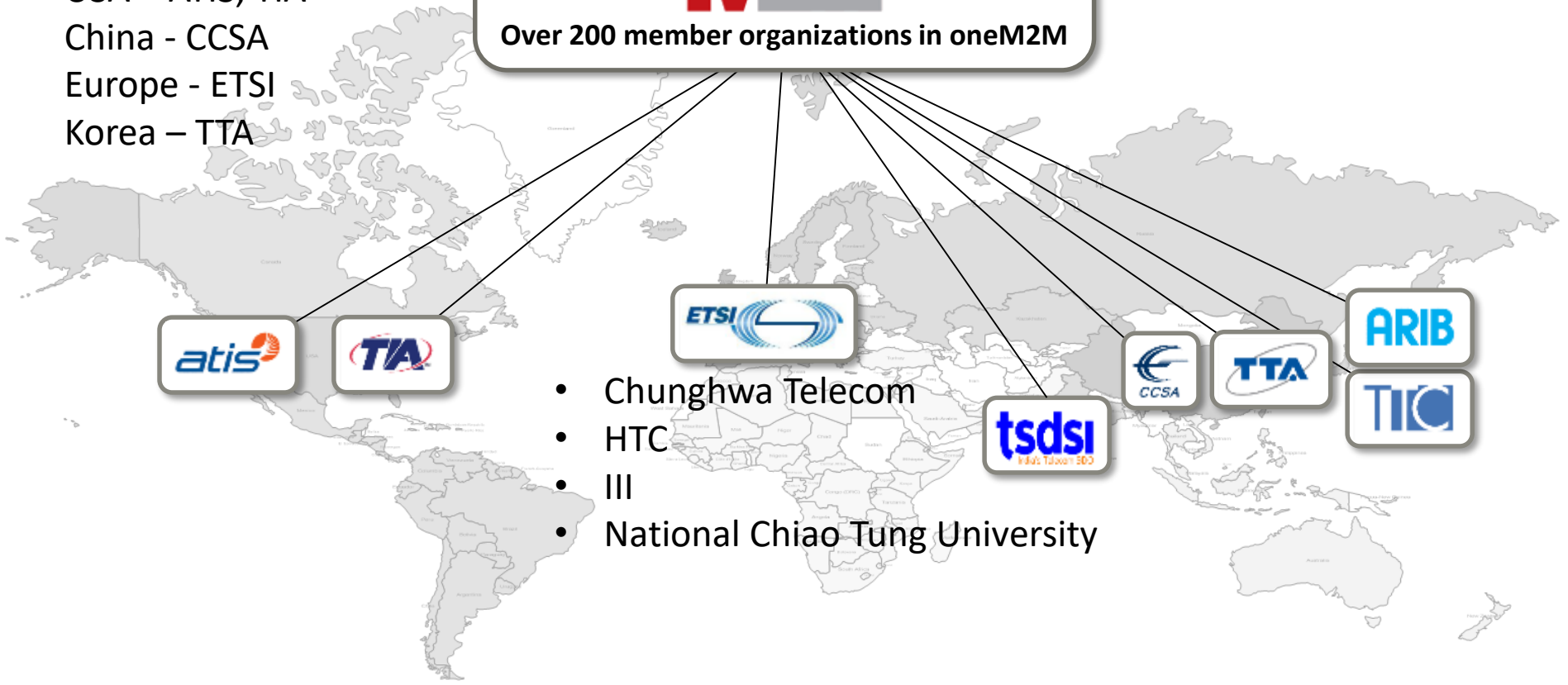
- ETSI worked with other standard development organizations in the world to launch oneM2M Partnership Project In July 2012
  - A global Initiative focused on consolidation and standardization of a common M2M Service Layer which can be embedded in hardware or software
  - Objectives are to enhance interoperability, simplify development of applications, boost economies of scale, and reduce standards overlap.
- ETSI M2M technical specifications have been transferred to oneM2M.
- ETSI TC M2M has been changed to ETSI TC SmartM2M since November 2013 to focus on EU regulations and verticals.

oneM2M Partnership Project

Much like the partnership in 3GPP!

Japan – ARIB, TTC
USA – ATIS, TIA
China - CCSA
Europe - ETSI
Korea – TTA

Over 200 member organizations in oneM2M



- Chunghwa Telecom
- HTC
- III
- National Chiao Tung University

The Purpose and Goal of oneM2M

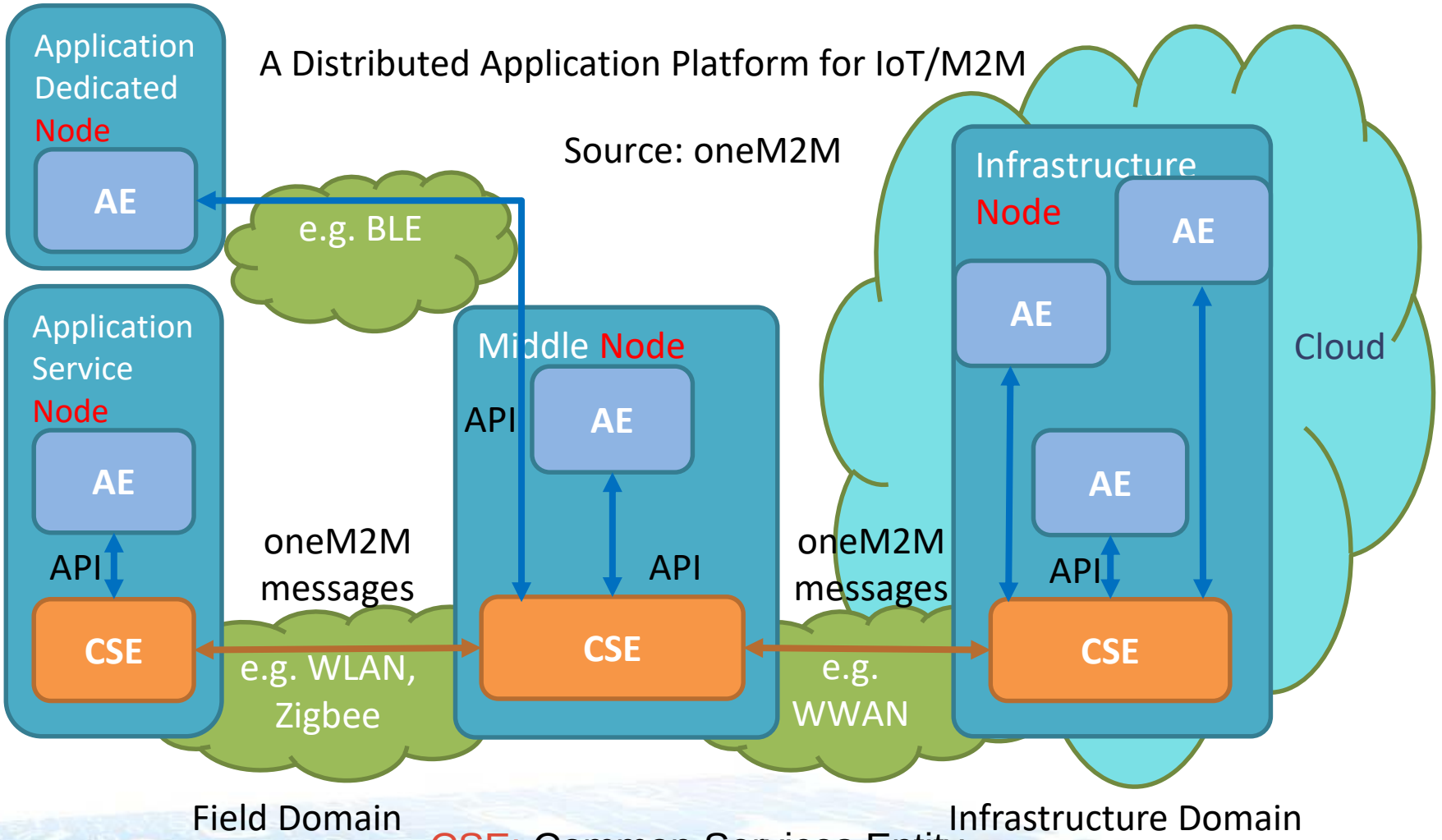
- oneM2M technical specifications are to address the need for a common M2M Service Layer that can be readily embedded within various hardware and software, and relied upon to connect the myriad of devices in the field with M2M application servers worldwide.
- Initially, oneM2M shall prepare, approve and maintain the necessary set of **Technical Specifications** and **Technical Reports** for:
  - Use cases and requirements for a common set of Service Layer capabilities;
  - Service Layer aspects with high level and detailed service architecture, in light of an access independent view of end-to-end services;
  - Protocols/APIs/standard objects based on this architecture (open interfaces & protocols);
  - Security and privacy aspects (authentication, encryption, integrity verification);

Source: oneM2M

The Purpose and Goal of oneM2M (Cont.)

- Reachability and discovery of applications;
- Interoperability, including test and conformance specifications;
- Collection of data for charging records (to be used for billing and statistical purposes);
- Identification and naming of devices and applications;
- Information models and data management (including store and subscribe/notify functionality);
- Management aspects (including remote management of entities);
- Common use cases, terminal/module aspects, including Service Layer interfaces/APIs between Application and Service Layers;
- Service Layer and communication functions

oneM2M Network



Technical Report (TR)

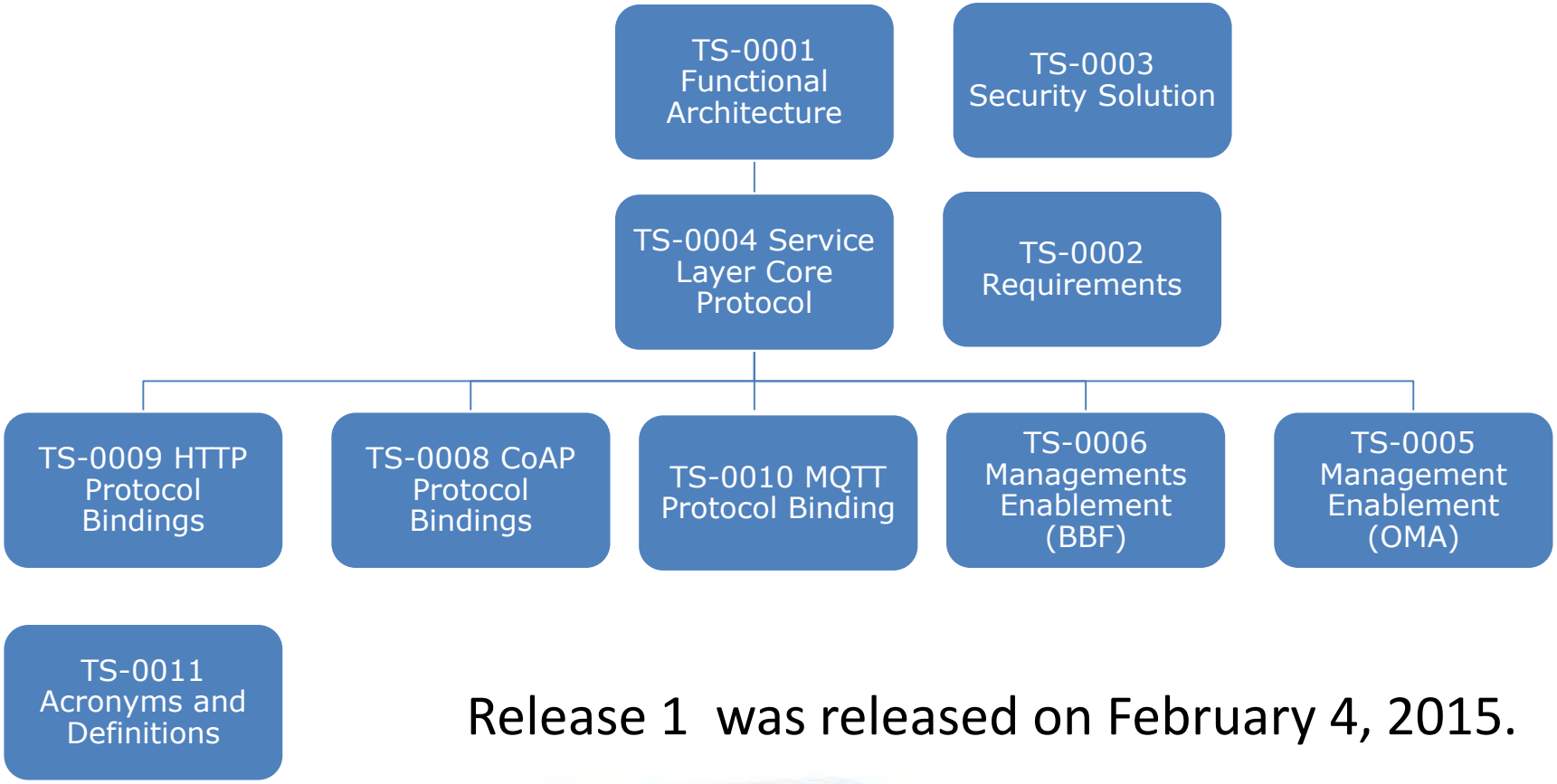
- Study before standards specifications
- These reports are not standards
- The ideas, however, lead to standards specifications.

Technical Specification (TS)

- There are official standards specifications.
- It follows three stages of specification from high level to low level
  - Stage 1: Requirements
  - Stage 2: Architecture
  - Stage 3: Interfaces, APIs

Release 1 Technical Reports

Release 1 Technical Specifications



Release 1 was released on February 4, 2015.

oneM2M Infrastructure Domain

- The infrastructure domain is the M2M core network and normally resides in a cloud environment.
- The infrastructure domain can leverage the existing telecom networks including fixed and mobile networks (4G now or 5G in the future). But, mobile networks will be the primary M2M core.
- The infrastructure node is the M2M server in the core network.
- Common Service Entities (CSE) are network functions defined to support M2M applications.

oneM2M Field Domain

- The field domain is the M2M area network and normally resides at the edge of the network.
- The field domain employs a large variety of wireless and wireline protocols and technologies.
- The field domain consists of both M2M devices and gateways.
- M2M devices have two types: Application Dedicated Node and Application Service Node.
- M2M gateways are also called Middle Nodes.

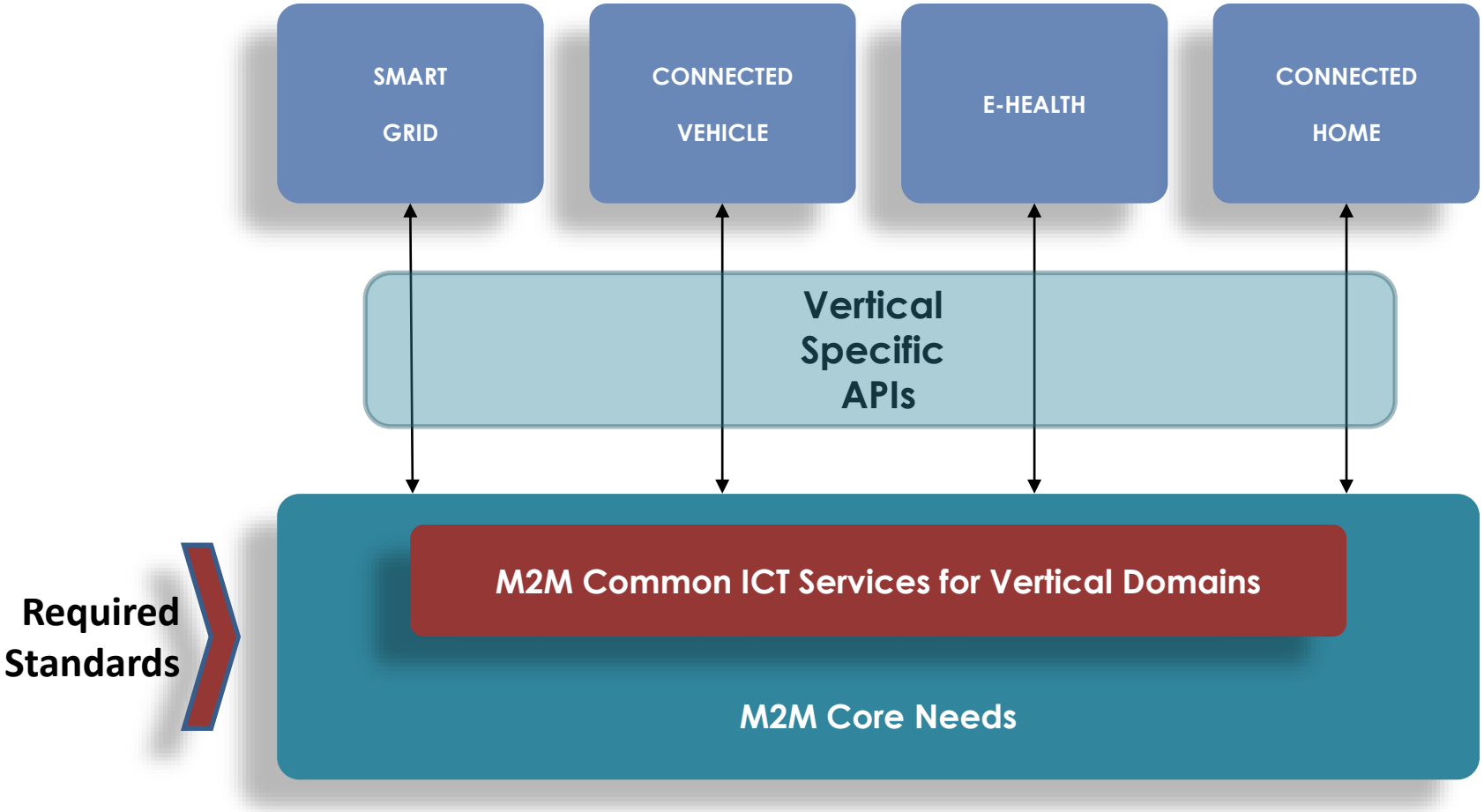
Importance of oneM2M Work

- Create a common service layer for mass-scale M2M applications, covering all domains of M2M, not just one domain in particular.
- It hides the complexity of network usage from applications, thus simplifying the implementation burden for application developers.
- The service layer also controls when communications occur, depending on factors such as the time-sensitivity of communications and the economics of data transfer.

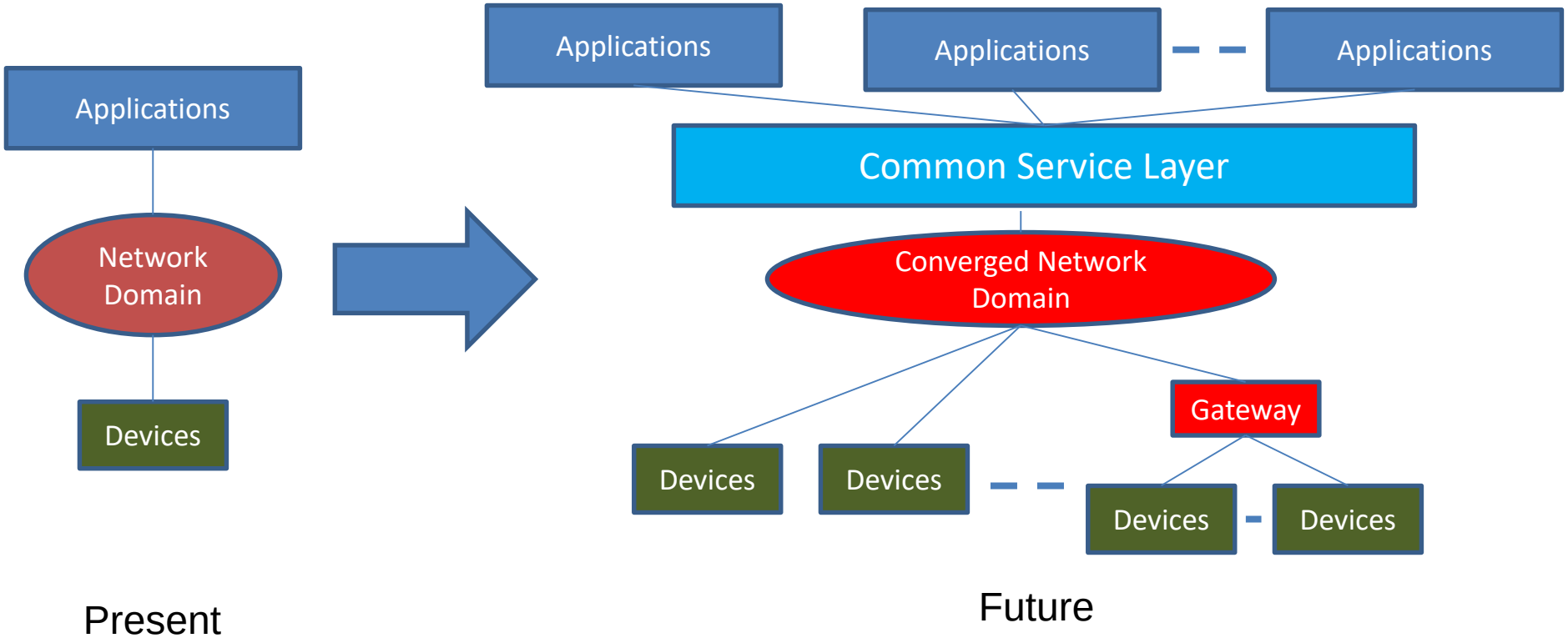
Why M2M Common Service Layer

- Enable the development of M2M applications by focusing on high level functionality than lower level tasks like network access control, authentication or routing.
- Enable data retrieval and control of sensors by any application via a common horizontal service layer.
- Provide network-based services such as charging, security, data publication and subscription. (by infrastructure node)

Common Horizontal Service Layer



Future Vision



IoT/M2M Use-Case-Driven Requirements

What is a Use Case?

- A use case describes the interactions between one or more actors and the system under consideration for achieving certain functions.
- Actors can be a device or a person outside the system.
- The system is treated as a black box where the physical architecture of the system is not important.

Use Cases to Derive oneM2M Requirements in TR-0001

Energy	Wide area energy related measurement & control system for transmission and distribution	Analytics for oneM2M	Smart Meter Reading	Environmental Monitoring for Hydro-Power Generation using Satellite M2M	Oil and Gas Pipeline Cellular/Satellite Gateway		
Enterprise	Smart building						
Healthcare	M2M Healthcare Gateway	Wellness services					
Public Services	Street Light Automation	Devices, Virtual devices and Things	Car/Bicycle Sharing Services	Smart parking			
Residential	Home Energy Management	Home Energy Management System	Plug-In Electrical Charging Vehicles and power feed in home scenario	Real-time Audio/Video Communication	Event Triggered Task Execution		
Transportation	Vehicle Diagnostic & Maintenance Report	Remote Maintenance services	Neighborhood Alerting on Traffic Accident	Fleet management service using Digital Tachograph			
Other	Extending the M2M Access Network using Satellites	Peer communication between M2M devices	M2M data traffic management by underlying network operator	Collection of M2M system data	Optimizing connectivity management parameters with mobile networks	Optimizing mobility management parameters with mobile networks	Sleepy nodes

Methodology Used by oneM2M

Use of a Template to Describe Use Case

1. Description
2. Source
3. Actors
4. Pre-conditions
5. Triggers
6. Normal Flow
7. Alternative flow
8. Post-conditions
9. High Level Illustration
10. Potential Requirements

Smart Metering Reading Use Case

5.3 Smart Meter Reading

5.3.1 Description

This clause provides selected Smart Meter Reading use cases

5.3.2 Source

oneM2M-REQ-2013-0217R02 Smart Meter Reading Use Case
Note: use case information extracted from SGIP/OpenSG REQ-2015-0563 pCR on smart meter reading

5.3.3 Actors

- Smart Meters (SM), Data Aggregation Points (DAPs),
- Advanced Metering Infrastructure (AMI) Head-end,
- Meter Data Management System (MDMS),
- Customer Information System (CIS)

5.3.4 Pre-conditions

Availability of meter data.
Smart Meters which are deployed in a block (e.g. same house, building, community, etc.) with the same behaviour based on default configuration or charging policy could be assigned as a group.

5.3.5 Triggers

Smart meter on-demand or bulk interval meter read request events

5.3.6 Normal Flow

Smart Grid Interoperability Panel (SGIP) (http://www.sgip.org) and OpenSG users group (http://osgug.ucaiug.org/default.aspx) have been leading this effort in North America. An informative document has been submitted to OneM2M based on the SGIP activity. In general, a number of external organizations such as the SGIP or the SGCG (Smart Grid Coordination Group) in Europe have been working to define use cases for Smart Grid (SG). Portals such as the Smart Grid Information Clearing House

5.3.7 Alternative Flow

None

5.3.8 Post-conditions

None

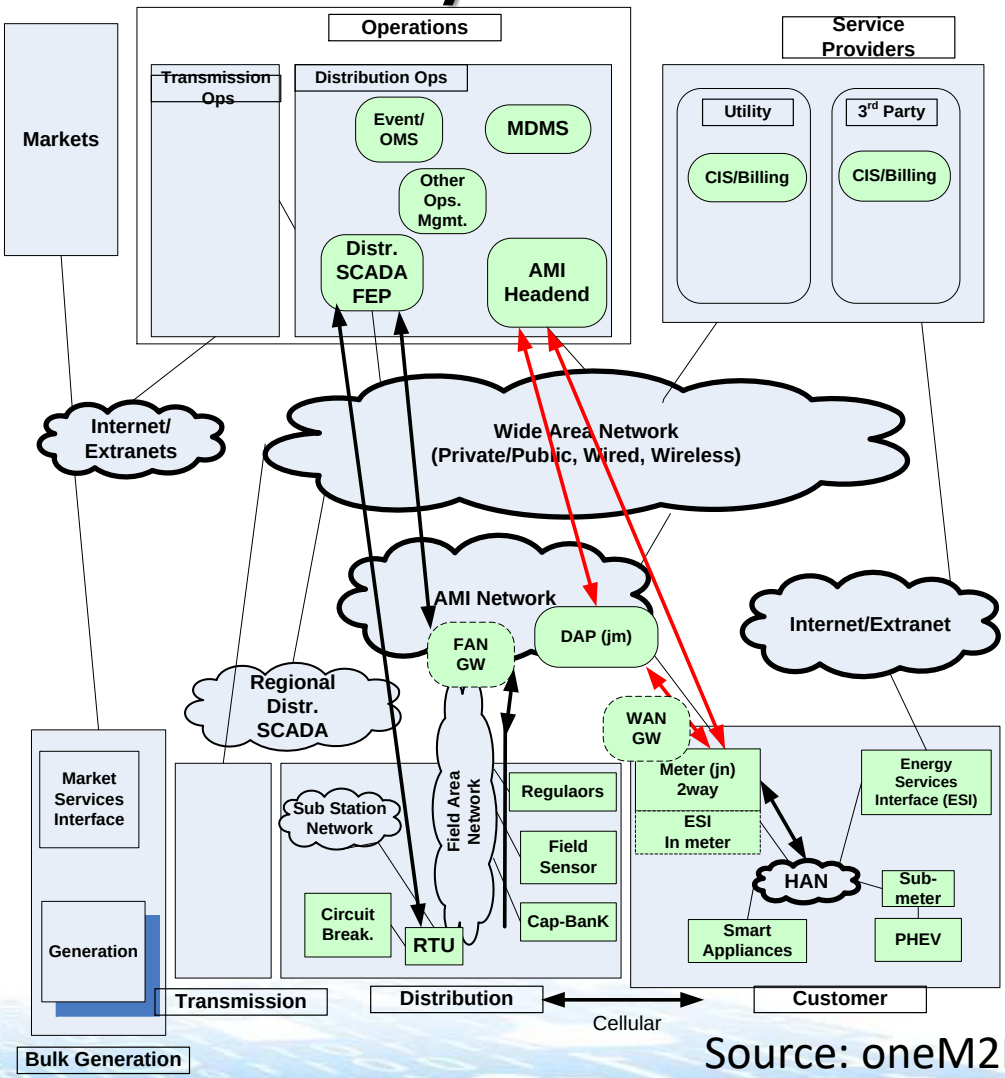
5.3.9 High Level Illustration

None

5.3.10 Potential Requirements

1. The M2M System shall be able to provide identity verification betw
   M2M server.
2. The M2M System shall be able to protect confidentiality of data (i.
   when DAP is deployed by the third party.

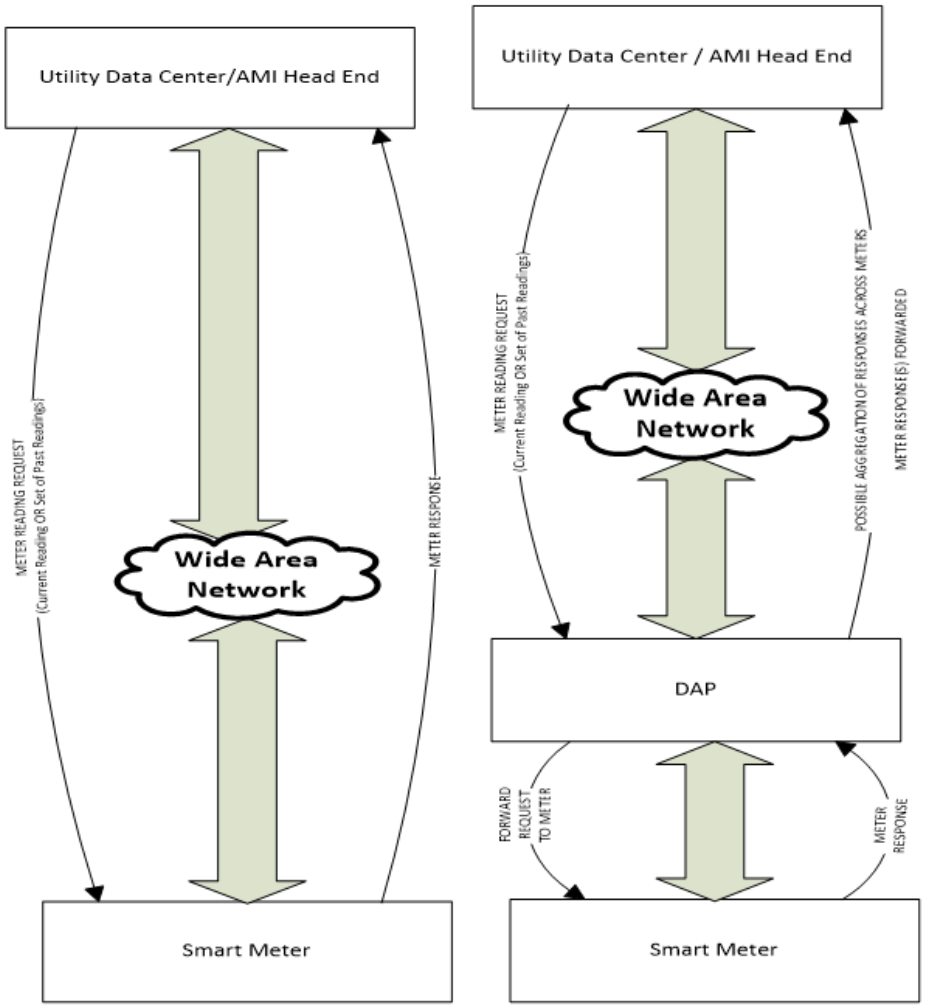
Smart Metering Reading Use Case (1) Conceptual Actors/Data Flow Diagram



Source: oneM2M TR-0001

Smart Metering Reading Use Case (2)

Typical Smart Meter Reading Flows A (on left) and B (on right)



Source: oneM2M TR-0001

Normal Flow

- Two possible flows
  - flow A: the Utility Data Center / AMI Headend can make a request to the Smart Meter directly.
  - flow B, the Utility Data Center / AMI Headend can make a request to the Smart Meter that can be received via the DAP
    - DAP may help distribute requests to all Smart Meters
    - Or DAP may simply act as a router (forwarding unit)
    - DAP entity may be either a physical or virtual processing entity buffering and aggregating meter reading responses

Normal Flow Summary

- Meter reading requests could request a single meter reading or a set of meter readings
- Requests may occur a few times (typically < 10) per day and can be of the order of a few tens of bytes.
- Meter reading responses can be of the order of a few 10s to 100s of bytes
- Meter reading responses are typically expected in the order of a few seconds

Wellness Service Use Case (1)

7.2.1 Description

This use case introduces several services based on wellness data collected by wellness sensor devices via mobile device such as smartphones and tablets which is regarded as M2M gateway.

Some wellness sensor devices are equipped with M2M area network module and measure individual wellness data. The mobile device connects to the wellness sensor devices by using the M2M area network technology, collecting and sending the wellness data to application server.

It is important to consider that mobile device as M2M gateway has mobility. For instance, there are possibilities for a mobile device to simultaneously connect to many wearable wellness sensor devices, and to connect newly to wellness sensor devices which have never connected previously at the location of outside.

This use case illustrates potential requirements from the use case of wellness services utilizing mobile device.

7.2.2 Source

KDDI (TTC)

7.2.3 Actors

- M2M Device: wellness sensor device is blood pressure sensor, heart rate sensor and weight scale, for example. It can measure wellness data of users, may be multi-vendor, and equipped with several kind of communication protocol.
- M2M Area Network: network which connects between M2M device and M2M gateway.
- M2M Gateway: mobile device (e.g. a smart phone) which can receive wellness data from wellness sensor devices and communicate with application servers.
- Mobile Network: network which has functions to communicate wellness data and control message between M2M gateway and M2M service platform.
- M2M Service Platform: platform where management server is located and which is used by the Application Server to communicate with the M2M Gateway.
- Management Server: server which manages the gateway such as mobile device, and controls its configuration such as installing/uninstalling applications.
- Application Server: server which serves the wellness services such as indicating the graph of wellness data trend.
- Note: Definition of some words is in discussion. Therefore, the description of these actors may change.

Source: oneM2M TR-0001

Description

- Use case of wellness services utilizing mobile device
- Services based on wellness data collected by wellness sensor devices via mobile devices (smartphones, tablets) which are regarded as M2M gateways.
- Mobile devices collect and send wellness data to application server

Actors

- M2M Device: 感測器裝置, 如血壓感測器, 心跳感測器等等. 主要用來量測使用者健康資訊, 可能由不同廠商製作, 且具有多種通訊protocol.
- M2M Gateway: 行動裝置(如手機), 可以從感測器接收資料並與應用程式伺服器溝通.
- Mobile Network: 位於M2M Gateway與M2M Service Platform間的網路, 具有傳輸健康資訊與控制訊息的功能
- M2M Service Platform: 管理伺服器位於的平台, 且能被應用伺服器用來與M2M Gateway溝通.
- Management Server: 用來管理行動裝置並控制其設定(如安裝/解除安裝應用程式)的伺服器.
- Application Server: 提供健康服務如顯示健康資訊的趨勢圖的伺服器

Wellness Service Use Case (2)

7.2.4 Pre-conditions

Wellness sensor devices are able to establish a connection to the mobile device in order to send wellness data to M2M Service Platform or Application Server. It is first time to associate the mobile device with the wellness sensor devices.

7.2.5 Triggers

New wellness sensor devices such as weight scale are detected by mobile device. User tries to associate the detected devices. Examples are below:

- User buys several kind of wearable wellness sensor devices such as blood pressure sensor, heart rate sensor. In order to start monitoring vital data using these sensors, User tries setting of these devices simultaneously. Note that please refer to [i.4] ETSI TR 102 732 “Use cases of M2M applications for eHealth”. (Normal Flow)
- User buys wellness sensor devices such as weight scale, and newly deploys them at User’s house to check the wellness status daily. (Normal Flow)
- User goes to a fitness center to do exercise and checks the effect by utilizing equipment which is owned by fitness center and has never connected to User’s mobile device. (Alternative Flow 1)

7.2.6 Normal Flow

Usually wellness sensor devices are bought by Users. These devices are deployed in User’s house, or are worn with User.

1. The mobile device detects new wellness sensor devices and tries to connect to it under User’s permission to connect (pairing between sensor device and mobile device).
2. The mobile device has established a connection to the wellness sensor device, and then the mobile device receives additional information of the wellness sensor device (e.g. type of device, service certificates of the device, required application software …).
3. The mobile device is provided with the appropriate application software from the Management Server and is appropriately configured by the Management Server.
4. When the User measures the data by using wellness sensor device, the mobile device collects the data and sends it to the Application Server.

Source: oneM2M TR-0001

Pre-conditions and Triggers

- Pre-conditions: Wellness sensor devices可以與行動裝置建立連線, 用來傳輸資料到M2M Service Platform或Application Server.
- Triggers: 新的健康感測器(如weight scale) 被行動裝置偵測到或使用者試圖聯繫此新的感測器:
  - 使用者購買許多感測器裝置, 為了能夠取得感測資料, 使用者試圖同時設定這些裝置
  - 使用者購買了感測器裝置如weight scale, 並且布置到家裡來確認日常健康狀況
  - 使用者到健身中心運動並透過使用裝備來確認效果(裝備由健身中心所擁有且從未連接過使用者的行動裝置)

Normal Flow

一般狀況下，感測裝置通常由使用者購買並安裝在使用者家中或穿戴在使用者身上:

1. 行動裝置偵測到新的健康感測裝置,且試圖在使用者的允許下建立連線(配對感測裝置與行動裝置)
2. 行動裝置建立連線後,會收到感測裝置額外的資訊(如裝置類型,服務認證,需要的應用程式等等)
3. 行動裝置會與合適的應用程式軟體一同由Management Server提供且得到合適的設定
4. 當使用者透過健康感測器量測資料時,行動裝置會收集資料並送到Application Server

Wellness Service Use Case (3)

7.2.7 Alternative flow

Alternative Flow 1

1. As indicated in the Normal Flow, usually the wellness service collects the data from wellness sensor devices which the User owns.
2. When the mobile device is brought outside, there is an opportunity to connect new wellness sensor devices (e.g. blood pressure which is set in fitness center).
3. The mobile device detects new wellness sensor devices and tries to connect to them under User's permission to connect.
4. The mobile device has established a connection to the wellness sensor device and then the mobile device receives additional information of the wellness sensor device (e.g. type of device, service certificates of the device, required application software …).
5. The mobile device is provided with the appropriate application software and is appropriately configured by the Management Server.
6. When the User measures the data by using wellness sensor device, the mobile device collects the data and sends it to the Application Server.

Source: oneM2M TR-0001

Alternative Flow

- Alternative flow 1
  - 如同一般流程所說, 通常健康服務會蒐集從感測器偵測而來的資料, 且感測器通常屬於使用者本身
  - 當行動裝置被攜帶出門, 很有機會與新的感測裝置連接(如健身中心的血壓器)
  - 行動裝置身側到新的健康感測裝置, 並試圖在使用者同意下與之連線
  - 行動裝置建立連線後, 會收到感測裝置額外的資訊(如裝置類型, 服務認證, 需要的應用程式等等)
  - 行動裝置會與合適的應用程式軟體一同由Management Server提供且得到合適的設定
  - 當使用者透過健康感測器量測資料時, 行動裝置會收集資料並送到Application Server

Alternative Flow

- Alternative flow 2
  - Wellness service是一收費服務，使用者選購並在Application Server上建立了帳號
  - 使用者第一次使用需激活Application Server上的服務
  - 當mobile device偵測到wellness sensor devices會要求Management Server提供適當的application來設定
  - Management Server確定使用者有購買此service並已激活
  - 有的話就由application server提供服務

Alternative Flow

- Alternative flow 3

  使用者已收集完資料，要mobile device與wellness sensor device斷線，並停用service

  — 如果mobile device不在M2M Area Network範圍內，mobile device自動與wellness sensor device斷線

  — 使用者可主動將mobile device與wellness sensor device斷線或等一段時間後sensor自動斷線

  — 使用者可向Application Server取消服務，Management Server會跟Application Server確認，並de-activate或移除mobile device上的應用程式

Home Energy Management Use Case (1)

- 9.1.1 Description

This use case is to manage energy consumption at home so that consumers can be aware of their daily home energy consumptions and able to control this consumption by remote actions on home appliances. Innovative services can be developed from the data (energy) collection and sent to either the consumers/ equipment or to Business-to-Business market.

The use case focuses on a home Energy Gateway (EGW) that collects energy information from the electrical home network and communicates it to an M2M system for aggregating and processing of the data. Services can then be developed from the collected data.

The EGW performs an initial treatment of the data received from various sources (sensors, context) as follows:

- aggregating and processing the obtained information:
- sending some information to the remote M2M system e.g. sending alerts through the M2M system
- using some information locally for immediate activation of some actuators/appliances
- Is connected (wirelessly or via wireline) to home devices, including the home electrical meter, for information on global or individual consumption of the appliances
- Providing displayable consumed energy-related information to the end-user/consumer terminals (PC, mobile phone, tablet, TV screen, etc)

Ref:[i.6] {HGI-GD017-R3 (Use Cases and Architecture for a Home Energy Management Service}

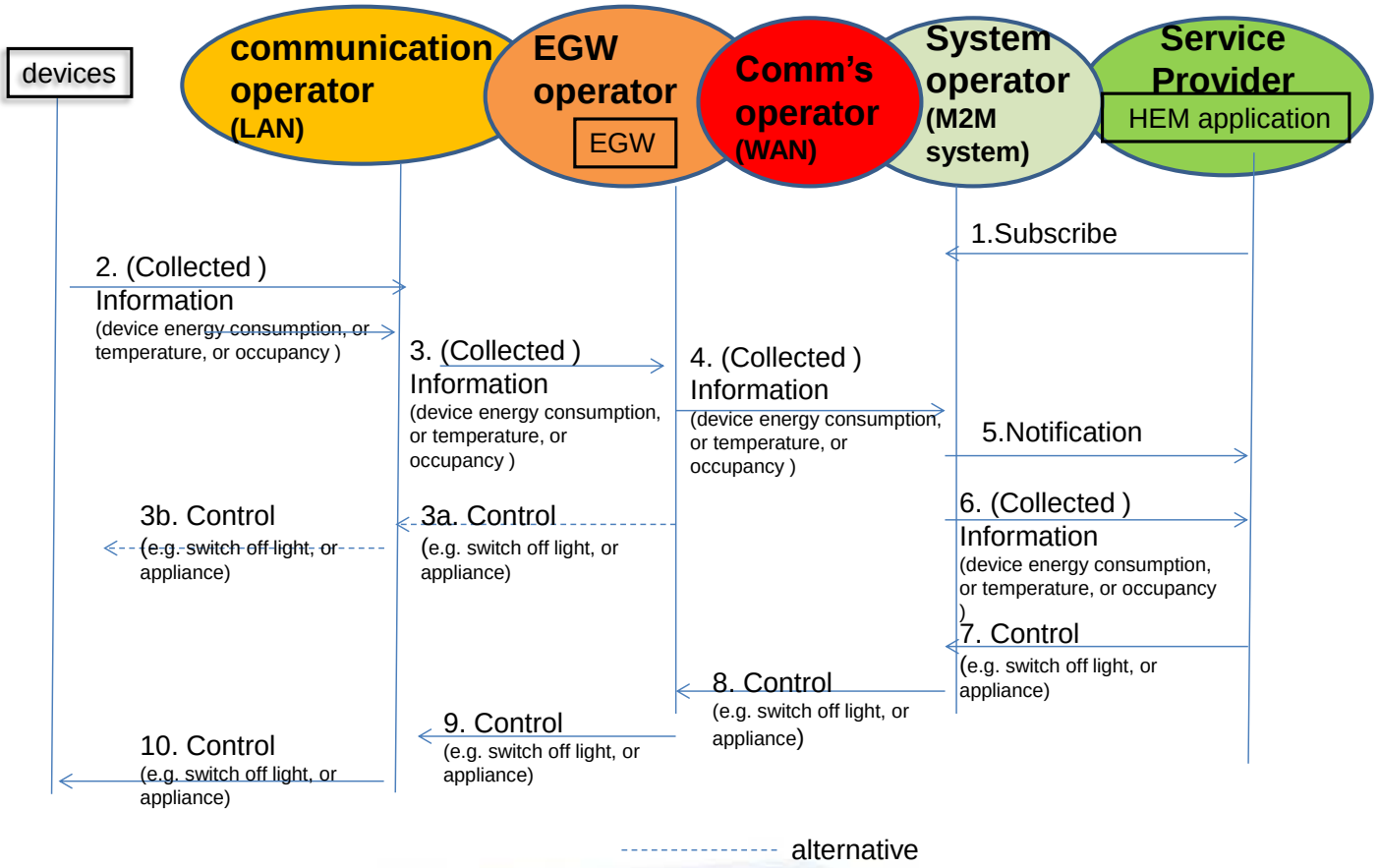
Source: oneM2M TR-0001

Description

- 家裡用電量管理使用案例
- 此案例是用來管理家裡耗電量, 因此客戶可以注意家中的日常用電量且能透過遠端控制家電來掌控耗電量. 創新服務為透過data(電量) 收集與傳送資料至使用者/設備/ 或Business-to-Business market來開發
- 使用案例主要為家中Energy Gateway (EGW), EGW會從electrical home network蒐集電量資訊並且與M2M system溝通來聚集/處理這些資料. 服務便可由這些蒐集的資料來發展與提供
- EGW負責對data(從不同地方蒐集而來, 如sensor, context) 做第一線的處理:
  - 聚集並處理收集到的資料
  - 傳送資訊到遠端的M2M系統
  - 直接使用這些資訊, 讓一些actuators/appliances能夠做立即的動作
  - 會和家裡的裝置連接, 包含electrical meter
  - 提供可顯示電量數據, 由使用者的終端裝置顯示(如PC, 手機, 平板, 電視螢幕等等)

Home Energy Management Use Case (2)

Home Energy Management Normal Flow



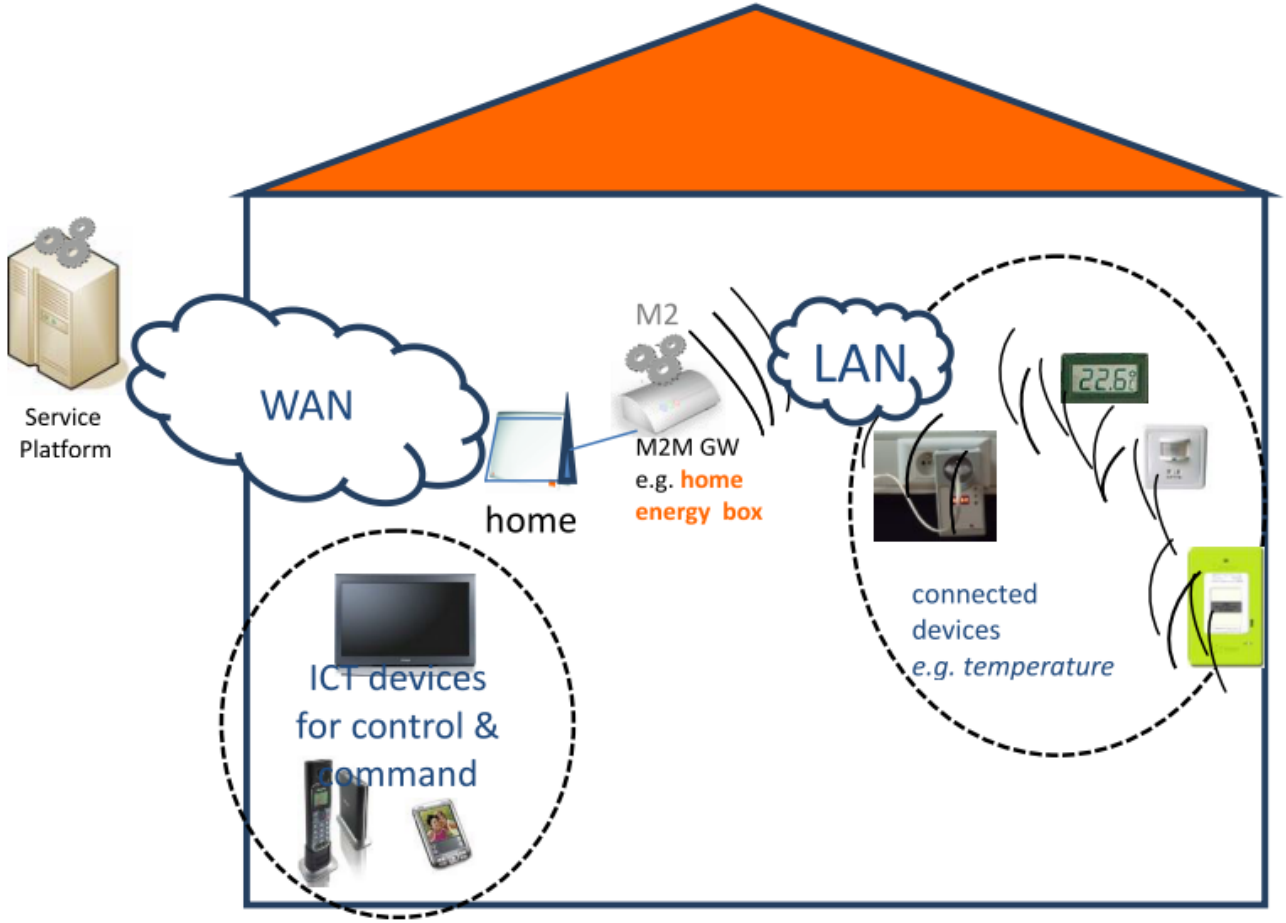
Source: oneM2M TR-0001

Normal Flow

- HEM application (M2M device) subscribe to System Operator/SP for information from home device(s).
- Information from devices which could be M2M devices (smart meters, electric lightening, fridge, washing machine etc.) at home is collected by the Energy Gateway Operator (EGW) via communication network operator. Information may include room, temperature, occupancy, energy consumption.
- Collected information is stored in the EGW SP and may be processed at energy gateway. As a result, control message may be sent back to device from the energy GW depending on policies stored in the energy gateway.
- Collected information may also be sent to system operator which contains the M2M service platform for storage via communication network.
- Subscribed application (HEM) is notified information is available for processing. Its subscribe M2M operator can process the information before sending to HEM application depending on subscription profile.
- HEM application reacts to the shared /collected information and can send control message (e.g. To switch a home device e.g. light /appliance or washing machine) via the system operator.
- Control is propagated back through different operator to appropriate M2M device(s).

Home Energy Management Use Case (3)

Home Energy Management High Level Illustration



TS-0002 M2M Requirements

- Major categories of requirements
  - OSR 72 agreed requirements Overall System Requirements
  - MGR 17 agreed requirements Management Requirements
  - ABR 03 agreed requirements Abstraction Requirements
  - SMR 07 agreed requirements Semantics Requirements
  - SER 26 agreed requirements Security Requirements
  - CHG 06 agreed requirements Charging Requirements
  - OPR 06 agreed requirements Operational Requirements
  - CRPR 05 agreed requirements Comm. Request Processing Requirements
  - NFR 02 agreed requirements Non Functional Requirements

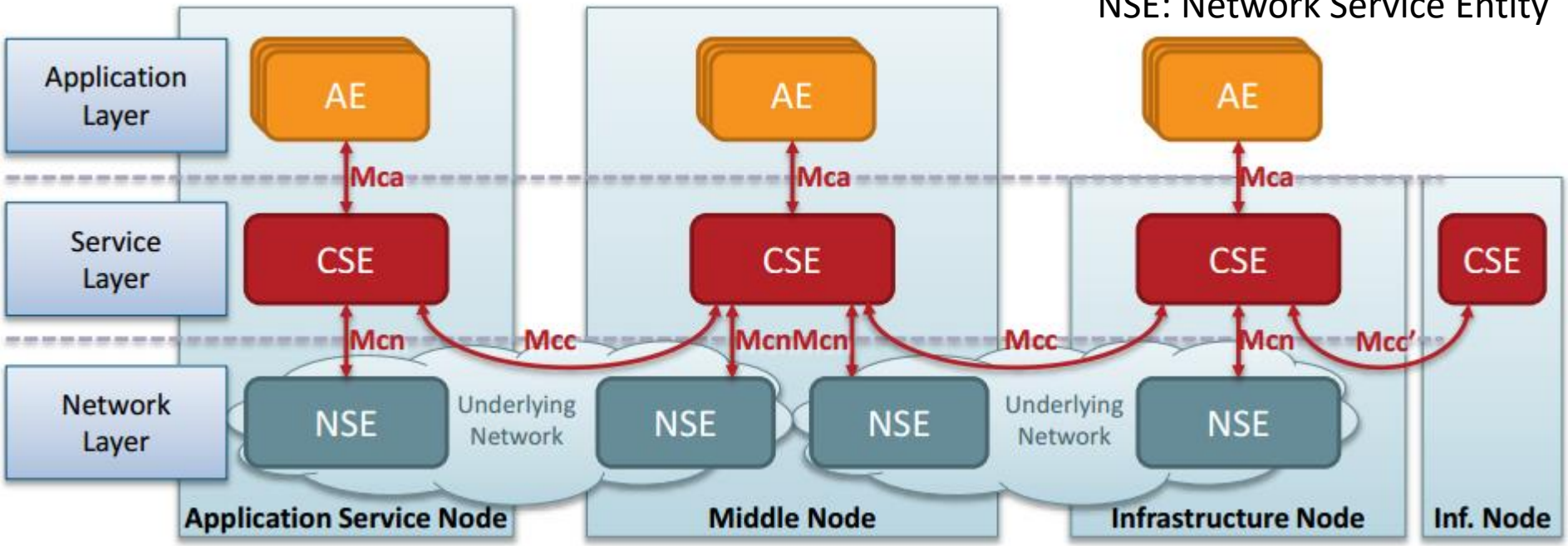
Examples of requirements

- [OSR-001][Overall System Requirements] The M2M System shall be able to allow communication between M2M Applications in the Network Domain & M2M Applications in the Device Domain by using multiple communication means based on IP access.
- [MGR-007][Management Requirements] The M2M System shall provide the capability for monitoring and diagnostics of M2M Gateways/Devices in M2M Area Networks.
- [SER-008][Security Requirements] The M2M system shall support countermeasures against unauthorized access to M2M services and M2M application services.

IoT/M2M High Level Architecture

oneM2M Functional Architecture

AE: Application Entity
CSE: Common Service Entity
NSE: Network Service Entity



A Distributed Application Platform for IoT/M2M

Source: oneM2M

oneM2M Functional Architecture (Cont.)

- Specified in oneM2M TS-0001.
- Three layers of architecture: Application Layer, Service Layer and Network Layer
- Three types of entities:
  - AE: Application Entity
  - CSE: Common Service Entity
  - NSE: Network Service Entity
- Four types of nodes: : Application Dedicated Node, Application Service Node, Middle Node and Infrastructure Node.
- Four Reference Points: Mcc (CSE-CSE), Mca (CSE-AE), Mcn (CSE-NSE) and Mcc' (between 2 service providers).
- Mch, for charging, is also defined (but not shown here) between the IN-CSE and a charging server.

What Are M2M Common Service Entity (CSE)?

- M2M common service entity can reside in Application Service Node, Middle Node and Infrastructure Node.
- There are 12 common functions defined in oneM2M CSE.

oneM2M Common Service Functions

A Distributed Application Platform for IoT/M2M Source: oneM2M

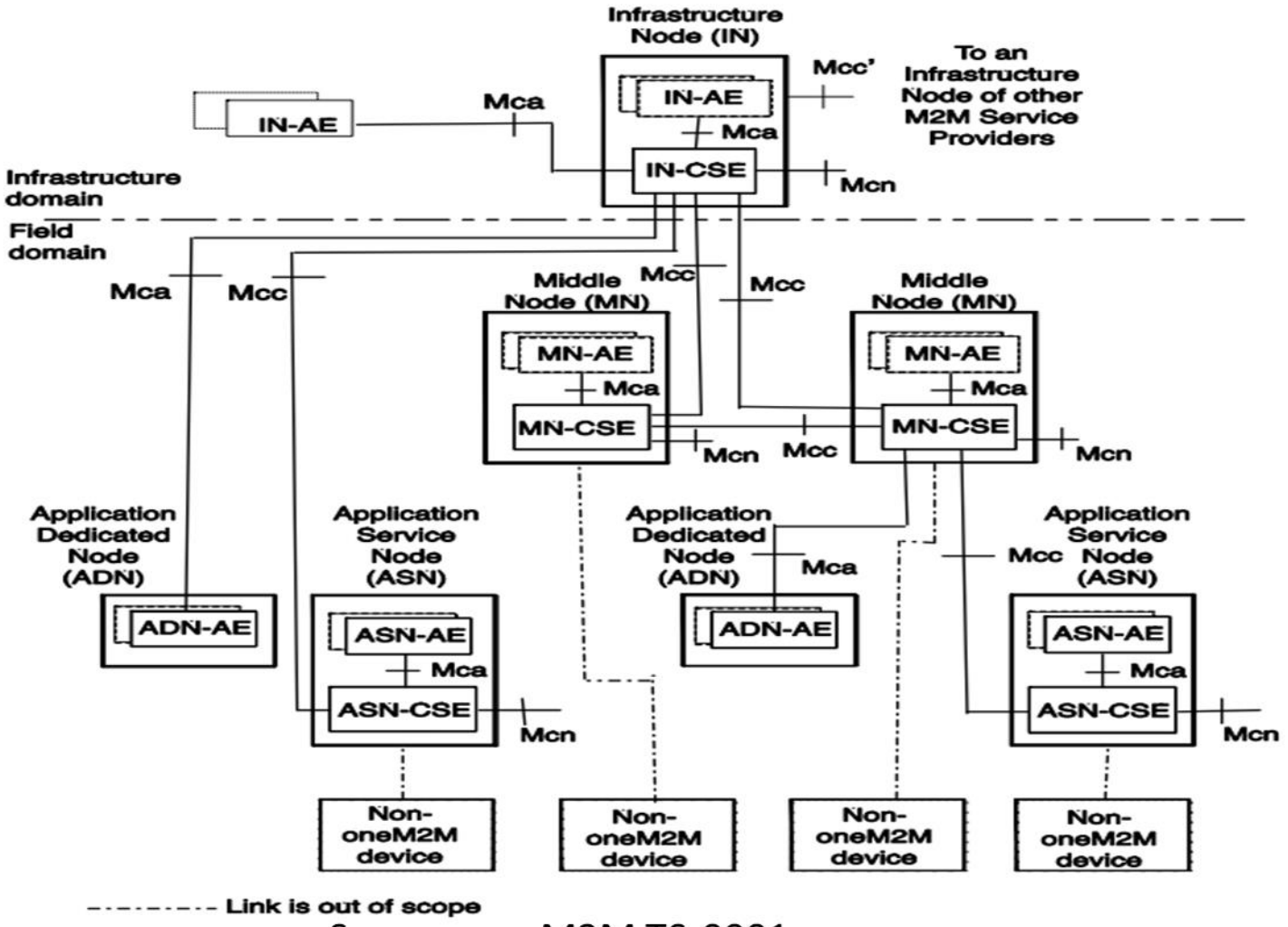
Samples of oneM2M Common Service Functions

- **Registration** CSE-CSE Registration, AE-CSE Registration, …
- **Discovery** Discovery of entities and information/resources
- **Security** confidentiality, integrity, availability, credential/key management, encryption, privacy, authentication, authorization
- **Group Management** Management of groups, support of bulk operations and access
- **Device Management** Firmware updates, configuration settings, topology management, Software installation, logging, monitoring, diagnostics, Reuse of existing DM technologies
- **Subscription & Notification** Support of event-related notifications (change of values)
- **Network Exposure** Abstraction of the underlying network interface, (eg. usage of remote device triggering, location services, …)
- **Comm. Management** Selection of communications channels, scheduling, Store-and-forward, reachability status awareness
- **Location** Manages and provides location information services

Samples of oneM2M Common Service Functions

- 註冊(Registration): CSE對CSE註冊(MN-CSE對IN-CSE), AE對CSE註冊 等等
- 發掘(Discovery): 發掘實體與資訊/資源
- 安全性(Security): 機密性, 一致性, 可取得性, 憑證/鑰匙管理, 加密, 私密性, 認證, 授權
- 群組管理(Group Management):管理群組, 支援大量操作與存取
- 裝置管理(Device Management):韌體更新, 設定, topology管理, 軟體安裝, 紀錄, 監測, 診斷, 現有裝置管理技術的重用
- 訂閱與通知(Subscription & Notification): 支援事件相關的通知(改變數值時)
- 網路揭露(Network Exposure):抽象畫底層的網路介面(如使用遠端裝置觸發, 位置服務等)
- 通訊管理(Comm. Management):選擇通訊頻道, 排程, 儲存與轉送, reachability status awareness
- 位置(Location): 管理與提供位置資訊服務

Overall oneM2M Functional Architecture



Source: oneM2M TS-0001

Concluding Remarks (1)

- oneM2M follows a rigorous process to define a high level architecture for IoT/M2M
- It starts from use case studies across many use cases to capture sufficient requirements.
- Based on these requirements, a high-level IoT/M2M architecture is developed.
- The architecture consists of two domains: field domain and infrastructure domain.

Concluding Remarks (2)

- Four types of nodes are defined : Application Dedicated Node, Application Service Node, Middle Node and Infrastructure Node.
- Four Reference Points are defined: Mcc (CSE-CSE), Mca (CSE-AE), Mcn (CSE-NSE) and Mcc' (between 2 service providers).
- Twelve common service functions are also identified.
- These service functions are distributed in the M2M networks and can reside in Application Service Node, Middle Node and Infrastructure Node to support M2M services.

Where to Find oneM2M Specifications

- oneM2M Published Documents
  - http://www.onem2m.org/technical/published-documents
  - http://www.onem2m.org/images/files/deliverables/Release2/TR-0001-Use_Cases_Collection-V2.4.1.pdf
- oneM2M – Webinars
  - http://www.onem2m.org/insights/webinars