Requirements and System Architecture of the IoT/M2M
物聯網需求與系統架構

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Outline

1. Introduction to oneM2M
2. IoT/M2M Use-Case-Driven Requirements
3. IoT/M2M High Level Architecture
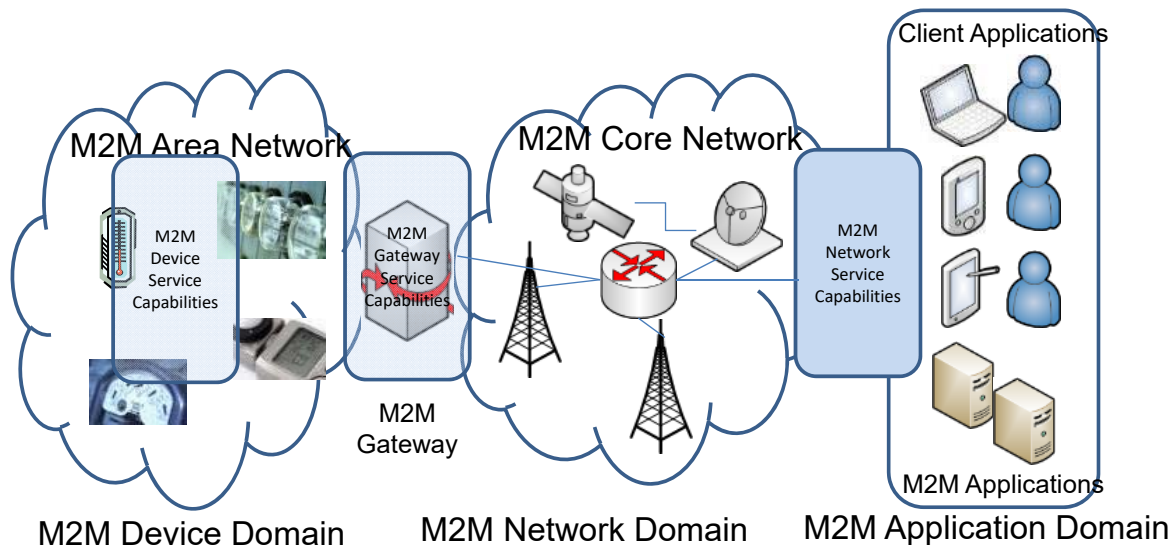
Introduction to oneM2M

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
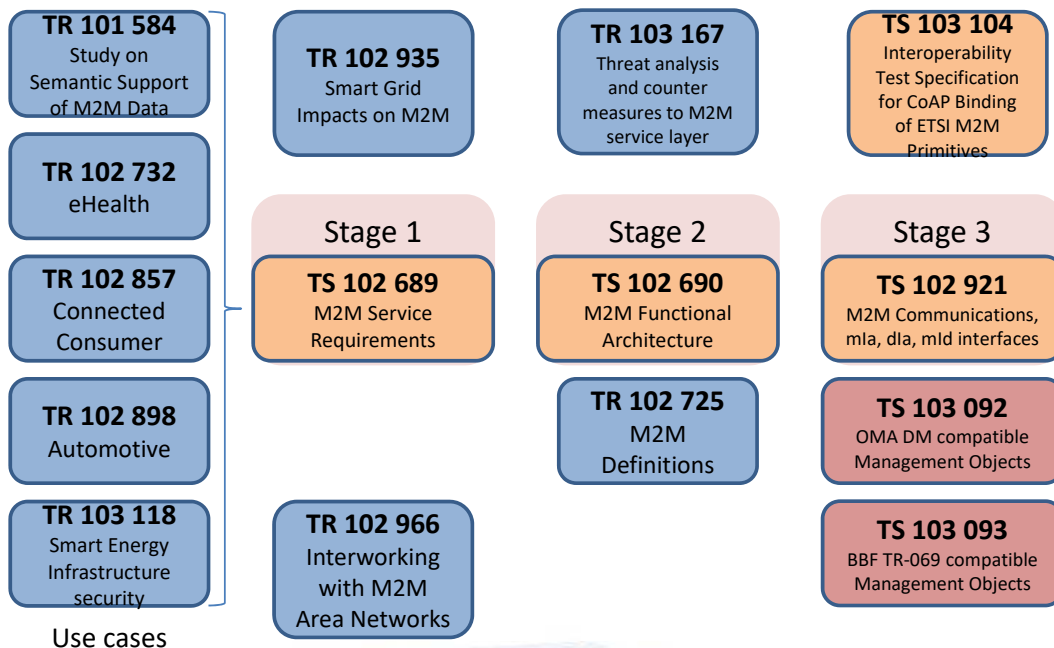
ETSI M2M Network

ETSI M2M Specification Output
Release 1 (End of 2011), Release 2 (Early 2013)

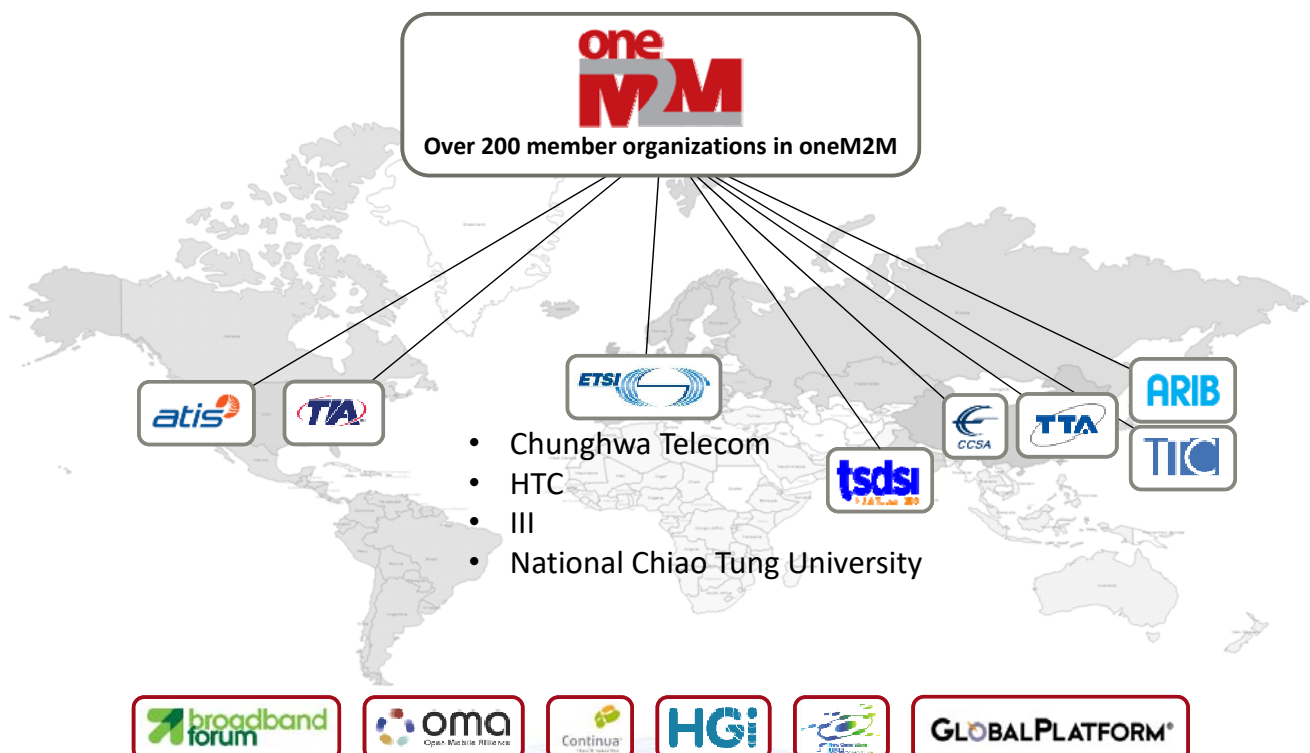|			
TR 101 584 Study on Semantic Support of M2M Data	**TR 102 935** Smart Grid Impacts on M2M	**TR 103 167** Threat analysis and counter measures to M2M service layer	**TS 103 104** Interoperability Test Specification for CoAP Binding of ETSI M2M Primitives
TR 102 732 eHealth			
TR 102 857 Connected Consumer	Stage 1	Stage 2	Stage 3
	TS 102 689 M2M Service Requirements	**TS 102 690** M2M Functional Architecture	**TS 102 921** M2M Communications, mIa, dIa, mId interfaces
TR 102 898 Automotive		**TR 102 725** M2M Definitions	**TS 103 092** OMA DM compatible Management Objects
TR 103 118 Smart Energy Infrastructure security	**TR 102 966** Interworking with M2M Area Networks		**TS 103 093** BBF TR-069 compatible Management Objects
Use cases			

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

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);
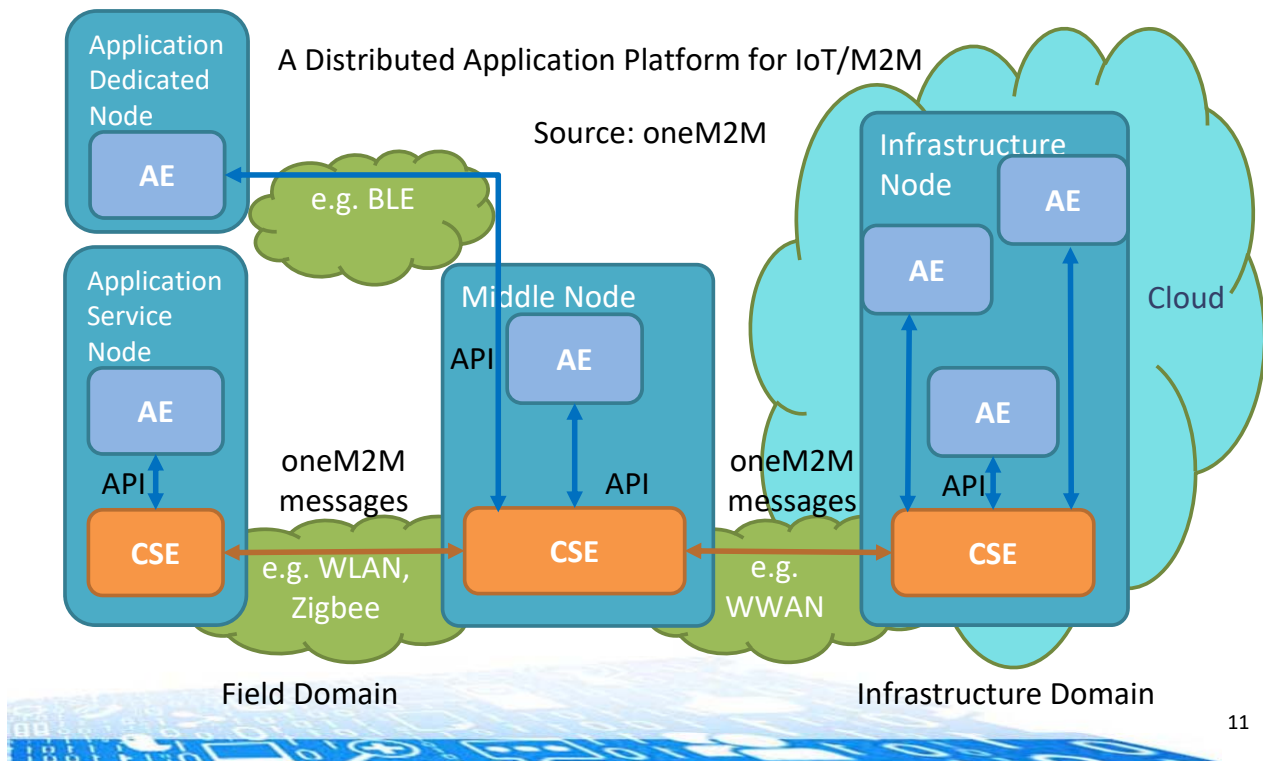
Source: oneM2M

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); and
- Common use cases, terminal/module aspects, including Service Layer interfaces/APIs between Application and Service Layers;
- Service Layer and communication functions

Source: oneM2M

oneM2M Network

A Distributed Application Platform for IoT/M2M

Source: oneM2M

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
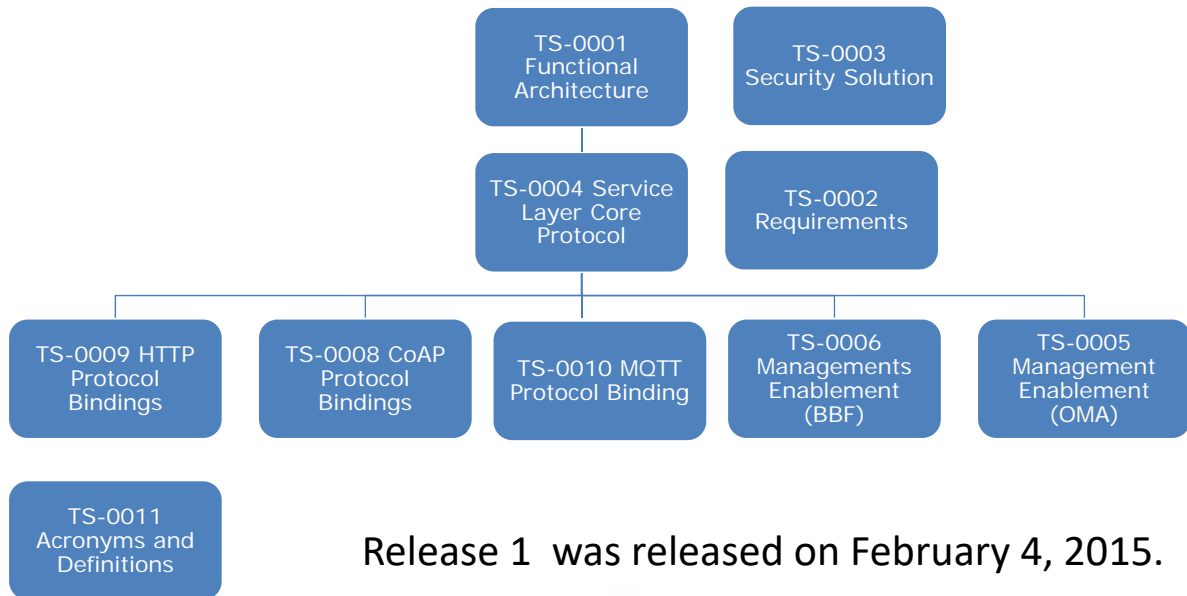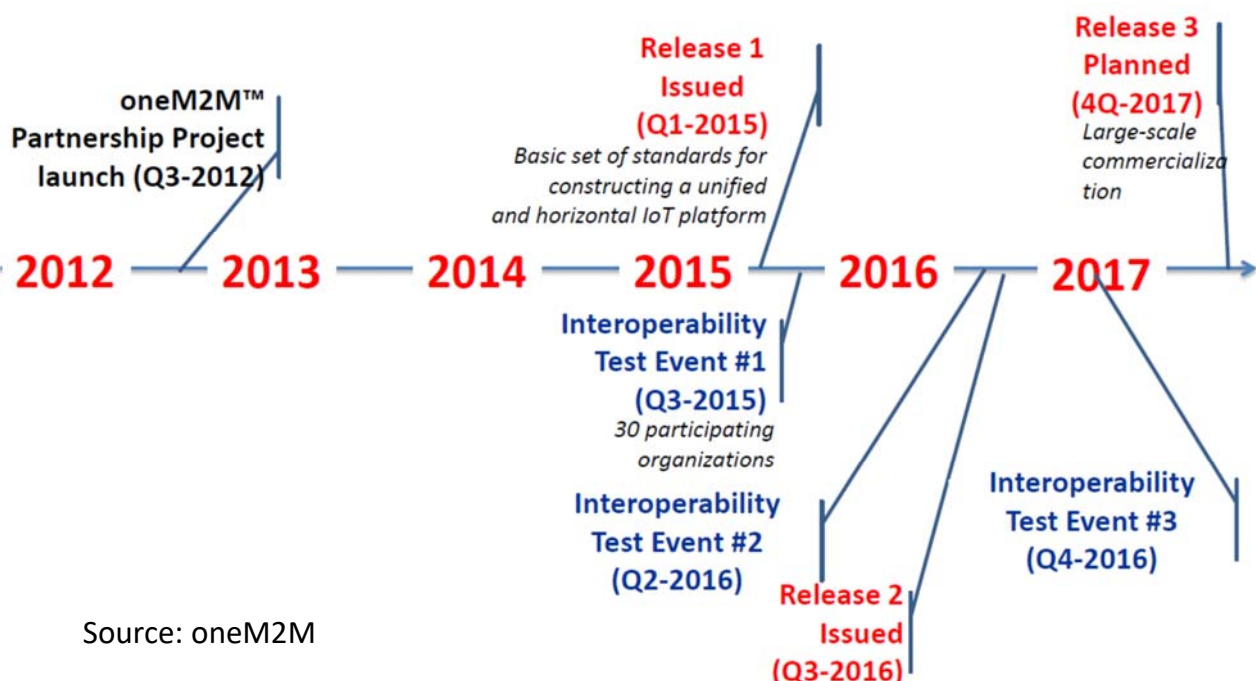 - Stage 3: Interfaces, APIs

Release 1 Technical Reports

Architecture Analysis 1 TR-0002 (WI-0002)	Use Cases TR-0001 (WI-0001)	Architecture Analysis 2 TR-0003 (WI-0002)	
Protocol Analysis TR-0009 (WI-0008)	Study of Mgt Capab. Enabl^{nt} TR-0006 (WI-0004)	Abstraction & Semantics TR-0007 (WI-0005)	Security Analysis TR-0008 (WI-0007)
Roles & Focus Areas TR-0005 (WI-0003)	Use Cases v2 TR-0011 (WI-0014)	E2E Security & Group Authent. TR-0012 (WI-0011)	

Release 1 Technical Specifications

Release 1 was released on February 4, 2015.

Timeline of oneM2M Key Events

Source: oneM2M

oneM2M Release 2 Features

Industrial domain enablement
- "Real-time" data collection
- redundancy and fault tolerance
- enablers for analytics

Home domain enablement
- Home appliance information models
- Ontologies and mapping to existing standards

Application developer APIs and guidelines

Semantic interoperability
- Base ontology, link to domain specific ontologies
- Semantic descriptions
- Semantic discovery
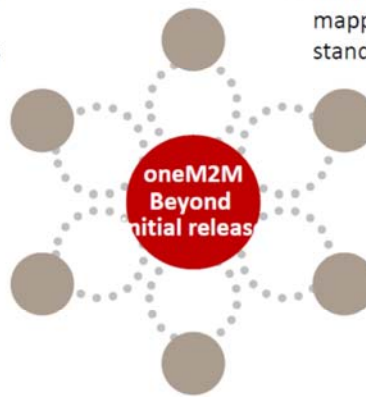
oneM2M Beyond initial release

oneM2M™ as generic interworking framework
- AllJoyn/AllSeen
- OIC
- LightWeight M2M (LWM2M)

Dynamic authorizations and end to end security
- Device onboarding and provisioning

Source: oneM2M

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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.
- The former have two types: Application Dedicated Node and Application Service Node.
- The latter 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 how communications occur, depending on factors such as the time-sensitivity of communications and the economics of data transfer.
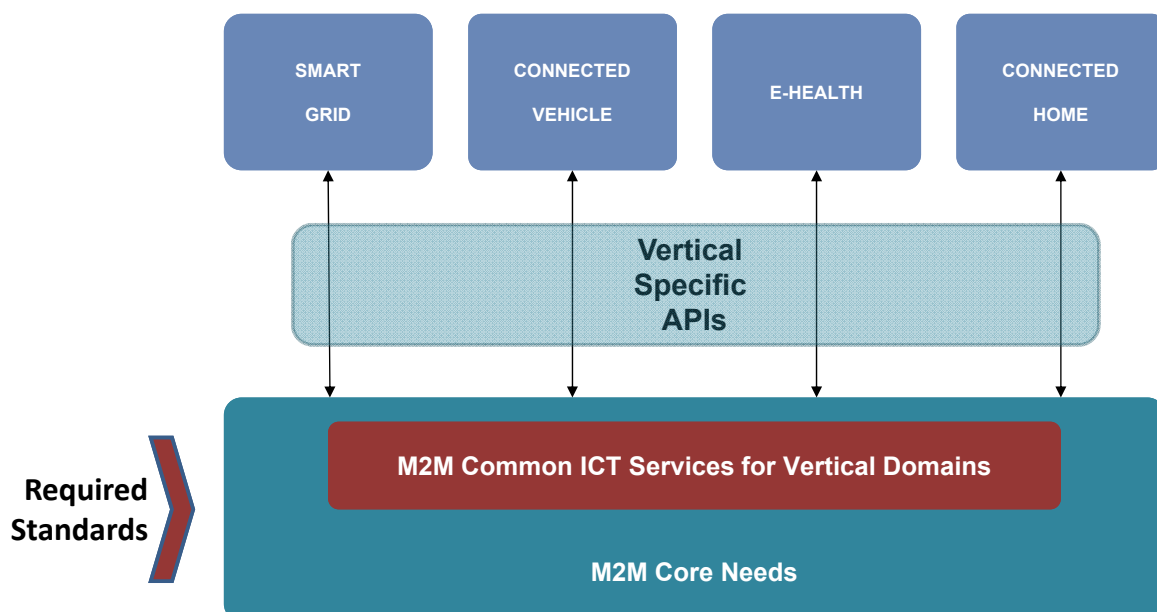
Why M2M Common Service Layer

- 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.

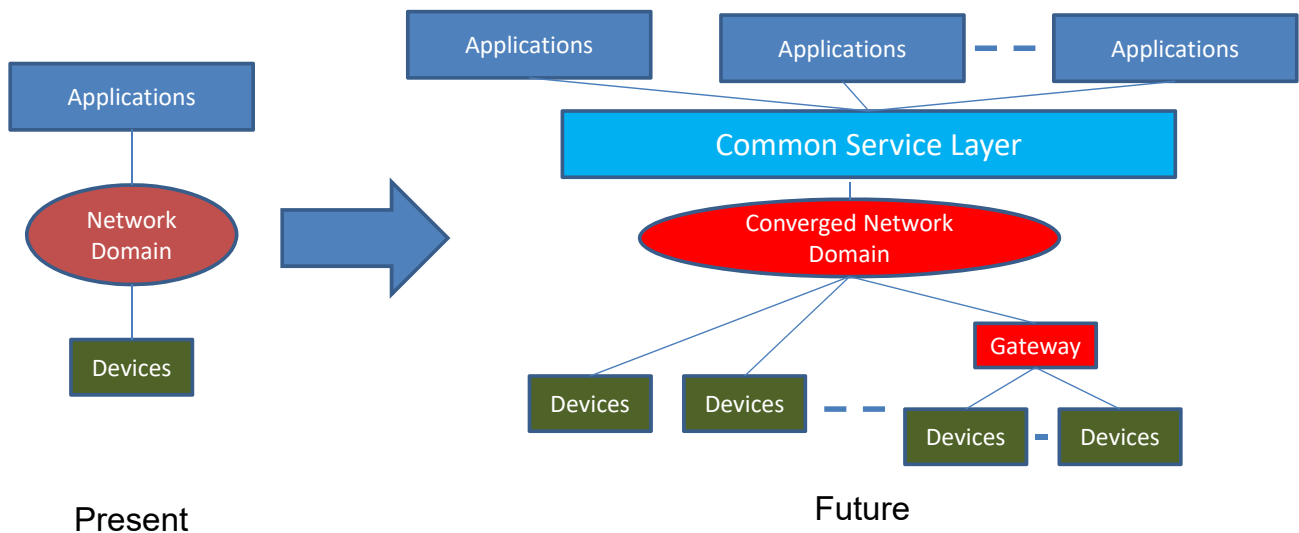- Provide network-based services such as charging, security, data publication and subscription.

Common Horizontal Service Layer

oneM2M Vision

Applications

Applications — — Applications

Applications

Common Service Layer

Network Domain

Converged Network Domain

Devices

Gateway

Devices

Devices — — Devices - Devices

Present

Future

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

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] 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] The M2M System shall provide the capability for monitoring and diagnostics of M2M Gateways/Devices in M2M Area Networks.
- [SER-008] The M2M system shall support countermeasures against unauthorized access to M2M services and M2M application services.

Concluding Remarks

- oneM2M follows a rigorous process to define a high level architecture for IoT/M2M
- It starts from use case studies across many areas 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.
- Four types of nodes are defined : Application Dedicated Node, Application Service Node, Middle Node and Infrastructure Node.
- 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
- oneM2M – Webinars
  - http://www.onem2m.org/insights/webinars