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Architecture Part 2:
Study for the merging of architectures proposed for consideration by oneM2M

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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Partnership Project oneM2M (oneM2M).

1 Scope

The present document provides an evaluation of existing M2M-related Architecture work undertaken by the founding partners of oneM2M, including: the Association of Radio Industries and Businesses (ARIB) and the Telecommunication Technology Committee (TTC) of Japan; the Alliance for Telecommunications Industry Solutions (ATIS) and the Telecommunications Industry Association (TIA) of the USA; the China Communications Standards Association (CCSA); the European Telecommunications Standards Institute (ETSI); and the Telecommunications Technology Association (TTA) of Korea. Common Functional Entities and Reference Points are identified, as well as critical differences. New functionality will not be considered as part of this study.

The present document is intended to ensure a common understanding of existing M2M Architectural approaches, in order to facilitate future normative work resulting in oneM2M Technical Specifications.

The present document has been prepared under the auspices of the oneM2M Technical Plenary, by the oneM2M Architecture Working Group.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] oneM2M Drafting Rules.

[i.2] ATIS Machine to Machine (M2M) Committee.

[i.3] ETSI Machine to Machine (M2M) Committee.

[i.4] IETF draft-ietf-core-coap: "Constrained Application Protocol (CoAP)".

[i.5] OMA Lightweight M2M.

[i.6] OMA-DM (OMA): "OMA Device Management".

[i.7] Fielding, R.T., (2000), Dissertation: "Architectural Styles and the Design of Network-based Software Architectures, Chapter 5 - Representational State Transfer (REST)". University of California Irvine.

[i.8] TIA TR-50 - M2M: "Smart Device Communications".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3rd Generation Partnership Project
AAA	Authentication, Authorization and Accounting
AAA-SD	Authentication, Authorization and Accounting-subscriber device
API	Application programming Interface
ARC	oneM2M Architecture Working Group
ARIB	Association of Radio Industries and Businesses (JP)
ASP	Application Service provider
ATIS	Alliance for Telecommunications Industry Solutions
CCSA	China Communications Standards Association
CoAP	Constrained Application Protocol
CoRE	Constrained Restful Environments
DA	Device Application
DSCL	Device Service Capability Layer
ETSI	European Telecommunications Standards Institute
GA	Gateway Applications
GSCL	Gateway Service Capability Layer
HATEOAS	Hypermedia As The Engine Of Application State
HTTP	HyperText Transfer Protocol
IETF	Internet Engineering Task Force
IF	Interface
M2M	Machine to Machine (communications)
MAS	M2M Authentication Server
MSBF	M2M Service Bootstrap Function
MSP	Machine to Machine Service Provider
MTC	Machine Type Communication
NA	Network Applications
NSCL	Network Service Capability Layer
NW	Network
OMA LWM2M	Open Mobile Alliance - Light Weight M2M
OMA	Open Mobile Alliance
PoA	Point of Attachment
REST	Representational State Transfer is a style of API interface
RPC	Remote Procedure Call
SOAP	Simple Object Access Protocol
TIA	Telecommunications Industry Association
TP	oneM2M Technical Plenary
TTA	Telecommunications Technology Association
TTC	Telecommunication Technology Committee
WSDL	Web Service Description Language
XML	Extensible Markup Language

4 Conventions

The key words "Shall", "Shall not", "May", "Need not", "Should", "Should not" in the present document are to be interpreted as described in the oneM2M Drafting Rules [i.1].

5 Analysis of Functional Entities

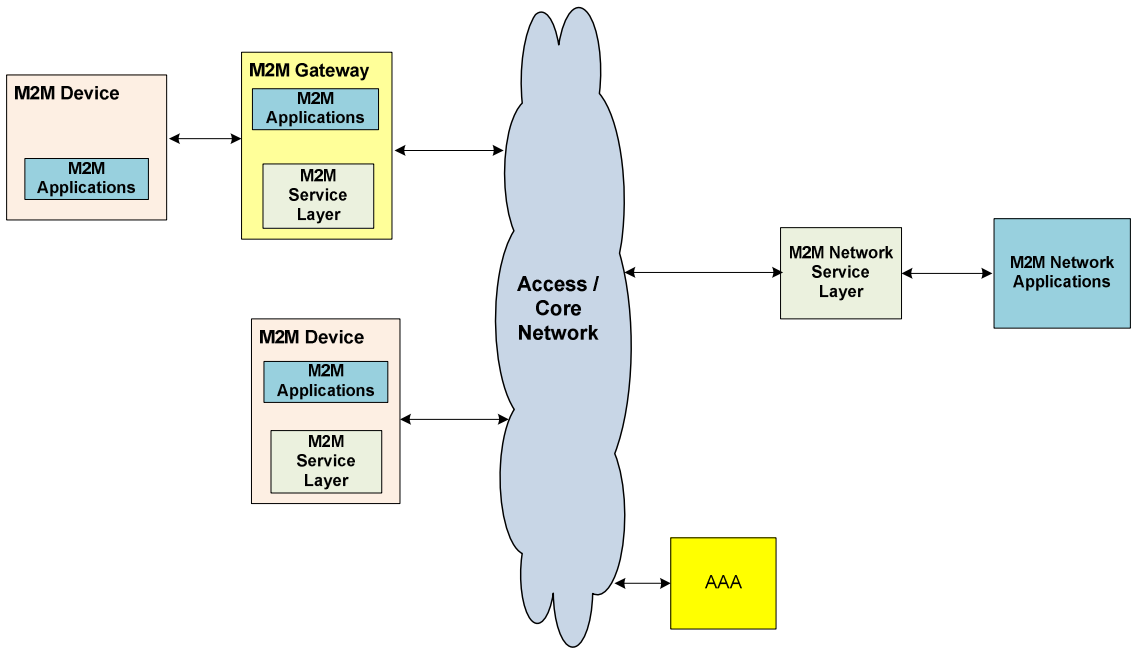
5.1 Existing Functional Entities: ATIS, ETSI, TIA

This clause provides a comparative analysis of existing ATIS M2M [i.2], ETSI M2M [i.3], and TIA TR-50 [i.8], functional architectural entities.

Table 5.1 provides a comparative matrix of the functional architectural entities supported by each architecture.

Table 5.1: TIA, ATIS, and ETSI M2M Functional Entity Comparative Matrix

Functional Entity	TIA TR-50	ATIS	ETSI M2M
M2M Service Capability hosted in the network domain	Yes *Server Container*	Yes *Service Capabilities*	Yes *Network Service Capability Layer (NSCL)*
M2M Service Capability hosted on an intermediary node	Yes *PoA Container*	No	Yes *Gateway Service Capability Layer (GSCL)*
M2M Service Capability hosted on an M2M Device	Yes *PoA Container*	No	Yes *Device Service Capability Layer (DSCL)*
Applications in the network domain	Yes *home applications*	Yes *Applications*	Yes *Network Applications (NA)*
Applications in the intermediary node	Yes *Node Application*	No	Yes *Gateway Application (GA)*
Applications in the M2M Device	Yes *PoA Application*	No	Yes *Device Application (DA)*
M2M Network	Yes *Server*	Yes *Network Service Functions*	Yes *Network Domain*
M2M intermediary node	Yes *PoA Device*	No	Yes *M2M Gateway*
M2M Device	Yes *PoA Device*	Yes *Device*	Yes *Device with Service Capabilities (D)* *Device without Service Capabilities (D')* *Legacy non-ETSI Device (d)*
AAA Server	Yes *AAA-SD*	No	Yes *M2M Authentication Server (MAS), M2M Service Bootstrap function (MSBF)*



NOTE: Functional Elements depicted in this figure may be placed anywhere, not necessarily outside the Access/Core network. The role/placement of AAA Server is for further study.

Figure 5.1: TIA, ATIS, and ETSI M2M Functional Architectural Entities

Figure 5.1 provides a high level overview of the common components when examining TIA TR-50 [i.8], ETSI M2M [i.3], and ATIS M2M [i.2] functional architectural entities.

6 Analysis of existing Reference Points

6.1 Reference Point analysis

This clause provides a comparative analysis of existing TIA TR-50 [i.8], ETSI M2M [i.3], and ATIS M2M [i.2], architectural reference points. Figure 6.1 shows the reference points from each source consolidated into a single functional architecture. Table 6.1 provides a comparative matrix of the reference points supported by each architecture.

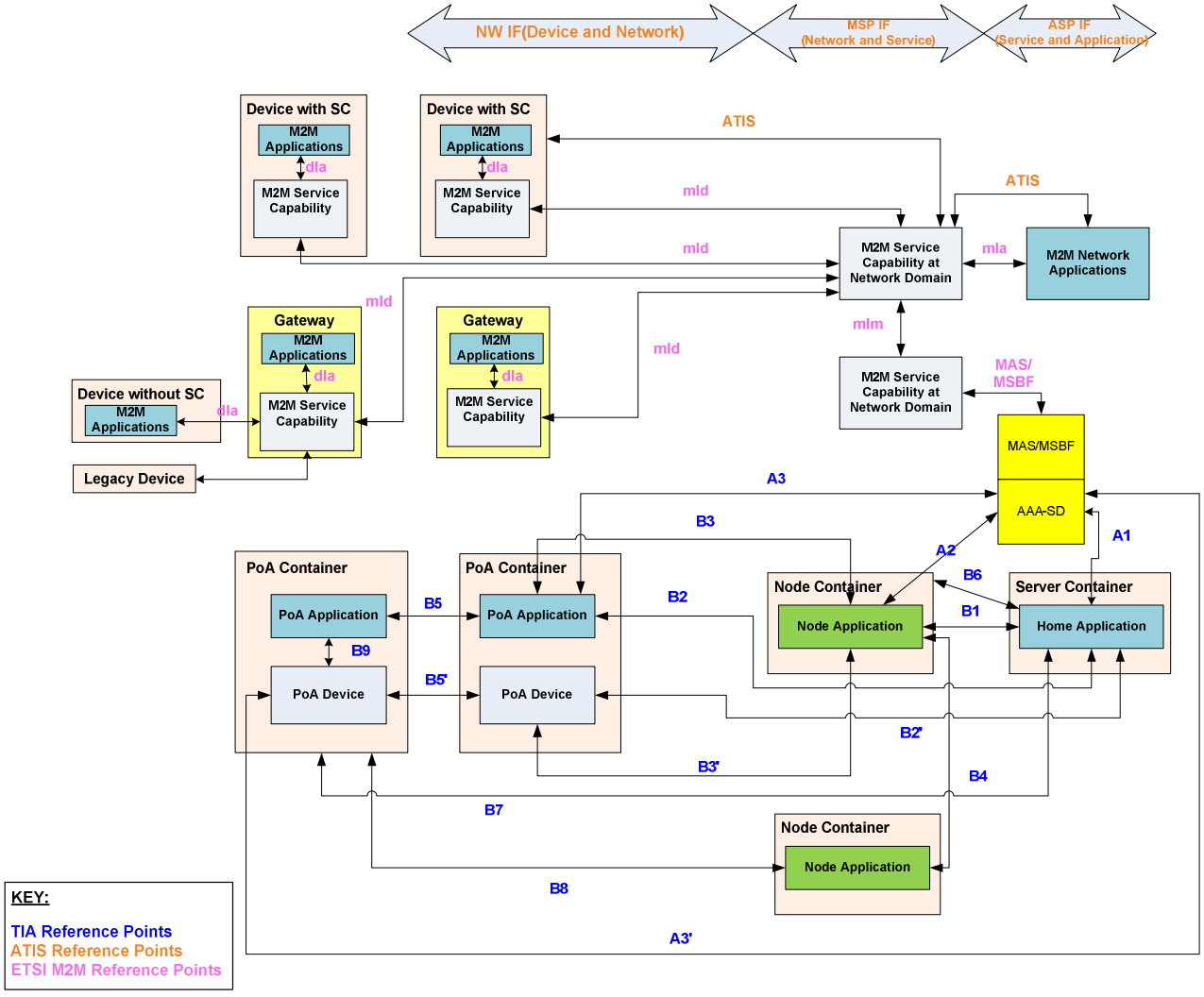


Figure 6.1: TIA, ATIS, and ETSI M2M Reference Point Analysis

Figure 6.1 provides a high level architectural overview with reference points of the common components when examining TIA TR-50, ETSI M2M, and ATIS M2M functional architectural entities.

Details of the reference points are provided in tables 6.1 and 6.2. Table 6.1 also provides details of 3GPP reference points pertaining to Machine Type Communication (MTC).

Table 6.1: TIA, ETSI, ATIS, and 3GPP Reference Point Analysis for M2M

Reference Point/Interface Description	Corresponding Reference Point				Comment
	TIA	ETSI	ATIS	3GPP	
M2M Device Application ↔ M2M Device Application	B5				
M2M Gateway Application ↔ M2M Gateway Application	B4				
M2M Device Application ↔ M2M Gateway Application	B3				
M2M Device Application ↔ M2M Network Application	B2				
M2M Gateway Application ↔ M2M Network Application	B1				
M2M Device Application ↔ M2M Device	B9				
M2M Gateway Application ↔ M2M Device	B3'				
M2M Network Application ↔ M2M Device	B2'		*		* ATIS Shows an interface 'Traffic Flow (Option 2)'
M2M Network Application ↔ Access/Core Network Provider				Gi/Sgi	
M2M Device Application ↔ M2M Device Service Layer		dIa			
M2M Device Application ↔ M2M Gateway Service Layer		dIa			
M2M Gateway Application ↔ M2M Device Service Layer	B8				
M2M Gateway Application ↔ M2M Gateway Service Layer		dIa			
M2M Network Application ↔ M2M Device Service Layer	B7				
M2M Network Application ↔ M2M Gateway Service Layer	B6				
M2M Network Application ↔ M2M Network Service Layer		mIa	ASP IF		
M2M Device Service Layer ↔ M2M Network Service Layer		mId			
M2M Gateway Service Layer ↔ M2M Network Service Layer		mId			
M2M Network Service Layer ↔ M2M Network Service Layer		mIm			
M2M Network Service Layer ↔ M2M Device			*		* ATIS Shows an interfaces 'Traffic Flow (Option 1)' and 'Device Mangement'
M2M Network Service Layer ↔ Access/Core Network Provider			MSP IF	T_{SP}	
M2M Device ↔ M2M Device	B5'				
M2M Device ↔ Access/Core Network Provider			NW IF		
M2M Network Application ↔ AAA Server	A1				
M2M Gateway Application ↔ AAA Server	A2				
M2M Device Application ↔ AAA Server	A3				
M2M Device ↔ AAA Server	A3'				
M2M Network Service Layer ↔ AAA Server		MAS/ MSBF			

6.2 Reference Points vs. Functions

Table 6.2 provides a comparative analysis of the reference points defined by TIA TR-50 [i.8], ATIS M2M [i.2], and ETSI M2M [i.3].

Table 6.2: TIA, ATIS, and ETSI M2M Comparative Reference Point Feature Matrix

Feature	TIA TR-50	ATIS M2M	ETSI M2M
Reference points to support M2M Service Capabilities hosted on a M2M device	Yes (B7, B8)	No	Yes (dIa,mId)
Reference points to support an intermediary M2M gateway/node	Yes (B1,B4,B6,B3,B3',B8, A2)	No	Yes (dIa,mId)
Reference points to support communication with access/core network entities	No	Yes (NW IF, MSP IF)	No
Reference points to support M2M Service Capabilities hosted in the network	No	Yes (MSP IF, ASP IF)	Yes (mIa,mId,mIm)
Reference points to support hierarchical M2M Service Capabilities on Device, Gateway and Network	No	No	Yes (mIa,mId,dIa)
Reference points to support direct application-to-application communication	Yes (B1, B2, B3, B4, B5)	No	No
Reference points to support direct device-to-device communication	Yes (B5')	No	No
Reference points to support communication between two instances of M2M Service Capabilities hosted in the network	No	No	Yes (mIm)
Reference points to support direct communication between network applications and devices and gateways (i.e. bypass M2M Network Service Capabilities)	Yes (B2')	Yes (Optional Traffic Flow option #2)	No
Reference points to support direct communication between network applications and M2M Service Capabilities hosted on devices and gateways (i.e. bypass M2M Network Service Capabilities)	Yes (B6, B7)	No	No

7 Analysis of architecture styles

7.1 REST

REST stands for Representational State Transfer. It is a style of API interface. When the API of a system qualifies REST's features, we say the system is RESTful.

REST was first described by R.T. Fielding in his Doctoral Dissertation [i.7]. The basic notion of REST is resource. Any information in the oneM2M system that can be named and addressed can be a resource: a document or image, a temporal service, a collection of other resources, a non-virtual object, a fragment of data, and so on. REST can be summarised to several basic constraints.

1) Client to Server. Client is separated from the Server by interfaces. As long as the interface stays the same, Client and Server can evolve separately.

2) The interface between client and server is Stateless. The request on the interface contains all the information needed for the server to handle the request.

3) Cache. Cache is used to improve the scalability and performance.

4) Uniform Interface. The resources could be addressed by the same methods. There are four constraints about the Uniform Interface:

   - identification of resources;

   - manipulation of resources through representations;

- self-descriptive messages;
- hypermedia as the engine of application state (HATEOAS).

5) Layered system. The system is divided by several layers. Each layer provides functions to the upper layer by utilise the functions provided by the lower layer. Each layer can evolve separately.

RESTful guarantees that the client needs no prior knowledge of the server. Every client can access to the resources using uniform interfaces. The method to parse the resource is along with the resource. A REST Client can interact with the server entirely using hypermedia provided by the server, which is the concept of HATEOAS. Resources are connected with each other using links. The REST Client can navigate from resources to resources to obtain the information desired. The HATEOAS constraint serves to decouple client and server in a way that allows the server to evolve functionality independently.

More and more architecture designers have adopted RESTful architecture in the M2M area; ETSI M2M [i.3], OMA DM2.0 [i.6], OMA LWM2M [i.5], IETF CoRE CoAP [i.4], etc.

7.2 SOAP

Web services provide a layer of abstraction above existing software, such as application servers, messaging, and packaged applications.

Applications expose interfaces that are described in a machine process-able format, the Web Service Description Language (WSDL). It is also possible for applications to interact through SOAP interfaces which provide a means to describe message format. These messages are often transported over HTTP and encoded using XML.

SOAP is method for exchanging XML based message over the Internet for providing and consuming web services. SOAP message are transferred forming the SOAP-Envelope.

RPC (remote procedure call) is another way of providing and consuming web services. It uses XML to encode and decode the remote procedure call along with its parameters.

8 Conclusions

The present document offers an overview and summary of the most current standards activity related to M2M, with a goal of providing a common understanding of existing M2M Architectural approaches.

The present document may be used to facilitate future normative work resulting in oneM2M Technical Specifications.

Annex A: Bibliography

- ETSI TR 118 502 (oneM2M TR-0002): "Architecture Part 1: Analysis of the architectures proposed for transfer to oneM2M".
- 3GPP2 X.P0068: "Network Enhancements for Machine to Machine) that relate to the architectural enhancements and deployment models for supporting Machine to Machine services in 3GPP2 networks".

History

Document history		
V1.0.0	April 2015	Publication