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Internet of things and smart cities and communities –
Frameworks, architectures and protocols

oneM2M – MQTT protocol binding

Recommendation ITU-T Y.4500.10

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General	Y.100–Y.199
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Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899

INTERNET PROTOCOL ASPECTS

General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999

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Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Enhancements to NGN	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
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Security	Y.2700–Y.2799
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Definitions and terminologies	Y.4050–Y.4099
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Infrastructure, connectivity and networks	Y.4250–Y.4399
Frameworks, architectures and protocols	Y.4400–Y.4549
Services, applications, computation and data processing	Y.4550–Y.4699
Management, control and performance	Y.4700–Y.4799
Identification and security	Y.4800–Y.4899
Evaluation and assessment	Y.4900–Y.4999

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Recommendation ITU-T Y.4500.10

oneM2M – MQTT protocol binding

Summary

Recommendation ITU-T Y.4500.10 specifies the binding of Mca and Mcc primitives (message flows), defined in the service layer core protocol, on to the MQTT transport protocol.

History

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1.0	ITU-T Y.4500.10	2018-03-01	20	11.1002/1000/13505

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* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

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NOTE – This Recommendation departs slightly from the usual editorial style of ITU-T Recommendations to preserve existing cross-referencing from external documents.

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Table of Contents

		Page
1	Scope.....	1
2	References.....	1
3	Definitions	2
3.1	Terms defined elsewhere	2
3.2	Terms defined in this Recommendation	2
4	Abbreviations and acronyms	2
5	Conventions	3
6	Introduction.....	3
6.1	Use of MQTT	3
6.2	Binding overview	4
7	Protocol binding.....	12
7.1	Introduction	12
7.2	Use of MQTT	12
7.3	Connecting to MQTT	13
7.4	Sending and receiving messages	15
7.5	Primitive mapping	19
7.6	Format used in <i>pointOfAccess</i> strings	21
8	Security	21
8.1	Introduction	21
8.2	Authorization	22
8.3	Authentication	22
8.4	Authorization by the MQTT server	23
8.5	General considerations	24
	Annex A – oneM2M specification update and maintenance control procedure.....	25
	Appendix I – Overview of MQTT	26
I.0	Introduction.....	26
I.1	MQTT features	26
I.2	MQTT implementations	27
I.3	MQTT details	27
	Bibliography.....	30

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Recommendation ITU-T Y.4500.10

oneM2M – MQTT protocol binding

1 Scope

This Recommendation specifies the binding of Mca and Mcc primitives (message flows) on to the message queuing telemetry transport (MQTT) protocol. It specifies how:

- 1) a common services entity (CSE) or application entity (AE) connects to MQTT;
- 2) an Originator (CSE or AE) formulates a request as an MQTT message, and transmits it to its intended receiver;
- 3) a receiver listens for incoming requests;
- 4) that receiver can formulate and transmit a response.

The Recommendation contains oneM2M Release 2 specification – oneM2M MQTT protocol binding V2.4.1 and is equivalent to standards of oneM2M partners including ARIB, ATIS [b-ATIS.oneM2M.TS0010V241], CCSA [b-CCSA M2M-TS-0010], ETSI [b-ETSI TS 118 110], TTA, TSDSI [b-TSDSI STD T1.oneM2M TS-0010-2.4.1], TTA [b-TTAT.MM-TS.0010] and TTC [b-TTC TS-M2M-0010].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- | | |
|-------------------|---|
| [ITU-T Y.4500.1] | Recommendation ITU-T Y.4500.1 (2018), <i>oneM2M – Functional architecture</i> . |
| [ITU-T Y.4500.4] | Recommendation ITU-T Y. 4500.4 (2018), <i>oneM2M – Service layer core protocol specification</i> . |
| [ETSI TS 118 103] | ETSI TS 118 103 V2.4.1 (2016), <i>oneM2M; Security solutions (oneM2M TS-0003 version 2.4.1 Release 2)</i> . |
| [IETF RFC 793] | IETF RFC 793 (1981), <i>Transmission control protocol – DARPA internet program – Protocol specification</i> . |
| [IETF RFC 3986] | IETF RFC 3986 (2005), <i>Uniform resource identifier (URI): Generic syntax</i> . |
| [IETF RFC 5246] | IETF RFC 5246 (2008), <i>The transport layer security (TLS) protocol – Version 1.2</i> . |
| [IETF RFC 6455] | IETF RFC 6455 (2011), <i>The WebSocket protocol</i> . |
| [OASIS MQTT] | OASIS (2014), <i>MQTT standard Version 3.1.1</i> . |

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application entity (AE): [b-ITU-T Y.4500.11] Represents an instantiation of application logic for end-to-end M2M solutions.

3.1.2 common services entity (CSE): [b-ITU-T Y.4500.11] Represents an instantiation of a set of common service functions of the M2M environments. Such service functions are exposed to other entities through reference points.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 originator: Actor that initiates a request.

NOTE – An originator can either be an application or a common services entity.

3.2.2 receiver: Actor that receives the request.

NOTE – A receiver can be a common services entity or an application.

3.2.3 resource: Entity in the oneM2M system that is uniquely addressable, e.g., by the use of a uniform resource identifier (URI).

NOTE – A resource can be accessed and manipulated by using the specified procedures.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ADN	Application Dedicated Node
ADN-AE	Application Dedicated Node-Application Entity
AE	Application Entity
ASN	Application Service Node
CBOR	Concise Binary Object Representation
CRUD	Create-Read-Update-Delete
CSE	Common Service Entity
HTTP	Hypertext Transfer Protocol
ID	Identifier
IN	Infrastructure Node
IN-AE	Infrastructure Node- Application Entity
IN-CSE	Infrastructure Node-Common Service Entity
IoT	Internet of Things
IP	Internet Protocol
JSON	JavaScript Object Notation
M2M	Machine to Machine
MN	Middle Node
MN-CSE	Middle Node-Common Service Entity

MQTT	Message Queuing Telemetry Transport
NAT	Network Address Translation
QoS	Quality of Service
SP	Service Provider
TCP	Transmission Control Protocol
TLS	Transport Level Security
URI	Uniform Resource Identifier
XML	Extensible Markup Language

5 Conventions

The keywords "shall", "shall not", "may", "need not", "should", "should not" in this Recommendation are to be interpreted as follows.

Shall/shall not:

Requirements:

- 1) effect on this Recommendation: this Recommendation needs to describe the required feature (i.e., specify a technical solution for the requirement);
- 2) effect on products: every implementation (M2M solution that complies with this this Recommendation) must support it;
- 3) effect on deployments: every deployment (M2M service based on this Recommendation) must use the standardized feature where applicable – otherwise interoperability problems with other services could arise for example.

Should/should not:

Recommendation

- 1) effect on this Recommendation: this Recommendation needs to describe a solution that allows the presence and the absence of the feature;
- 2) effect on products: an implementation may or may not support it, however support is recommended;
- 3) effect on deployments: a deployment may or may not use it, however usage is recommended.

May/need not:

Permission/option

- 1) effect on this Recommendation: this Recommendation needs to describe a solution that allows the presence and the absence of the required feature;
- 2) effect on products: an implementation may or may not support it;
- 3) effect on deployments: A deployment may or may not use it.

6 Introduction

6.1 Use of MQTT

This binding makes use of MQTT to provide reliable two-way communications between two parties (AEs and CSEs). It uses the following features of MQTT.

- Durable sessions, providing store and forward in cases where network connectivity is not available.

- MQTT's "QoS 1" message reliability level. This provides reliability without incurring the overhead implied by QoS 2.
- Network address translation (NAT) traversal [neither of the two parties is required to have prior knowledge of the other party's Internet protocol (IP) address].
- Dynamic topic creation and wild-carded subscription filters.

It does not use the following features:

- one-to-many publish or subscribe;
- retained messages;
- will messages;
- QoS 0 or QoS 2 message reliability levels.

6.2 Binding overview

6.2.1 Introduction

The MQTT protocol binding specifies how the Mca or Mcc request and response messages are transported across the MQTT protocol. Both communicating parties (AEs and CSEs) typically make use of an MQTT client library, and the communications are mediated via the MQTT server. There is no need for the client libraries or the server to be provided by the same supplier, since the protocol they use to talk to each other is defined by the MQTT specification [OASIS MQTT].

Furthermore, the binding does not assume that the MQTT client libraries or server implementations are necessarily aware that they are being used to carry Mca, Mcc or any other oneM2M-defined primitives.

The binding is defined in terms of the MQTT protocol flows that take place between the client libraries and the MQTT server in order to effect the transport of an Mca or Mcc message.

There are two scenarios depending on the location of MQTT server: MQTT server co-located within a node and MQTT server located independently from nodes.

6.2.2 Scenarios

6.2.2.1 MQTT server co-located scenario

Figure 6.2.2.1-1 shows a protocol segment view of the MQTT server co-located scenario, in which all oneM2M nodes [application dedicated node (ADN), application service node (ASN), middle node (MN), infrastructure node (IN)] include one or more MQTT clients. MQTT servers are provided within MNs and INs.

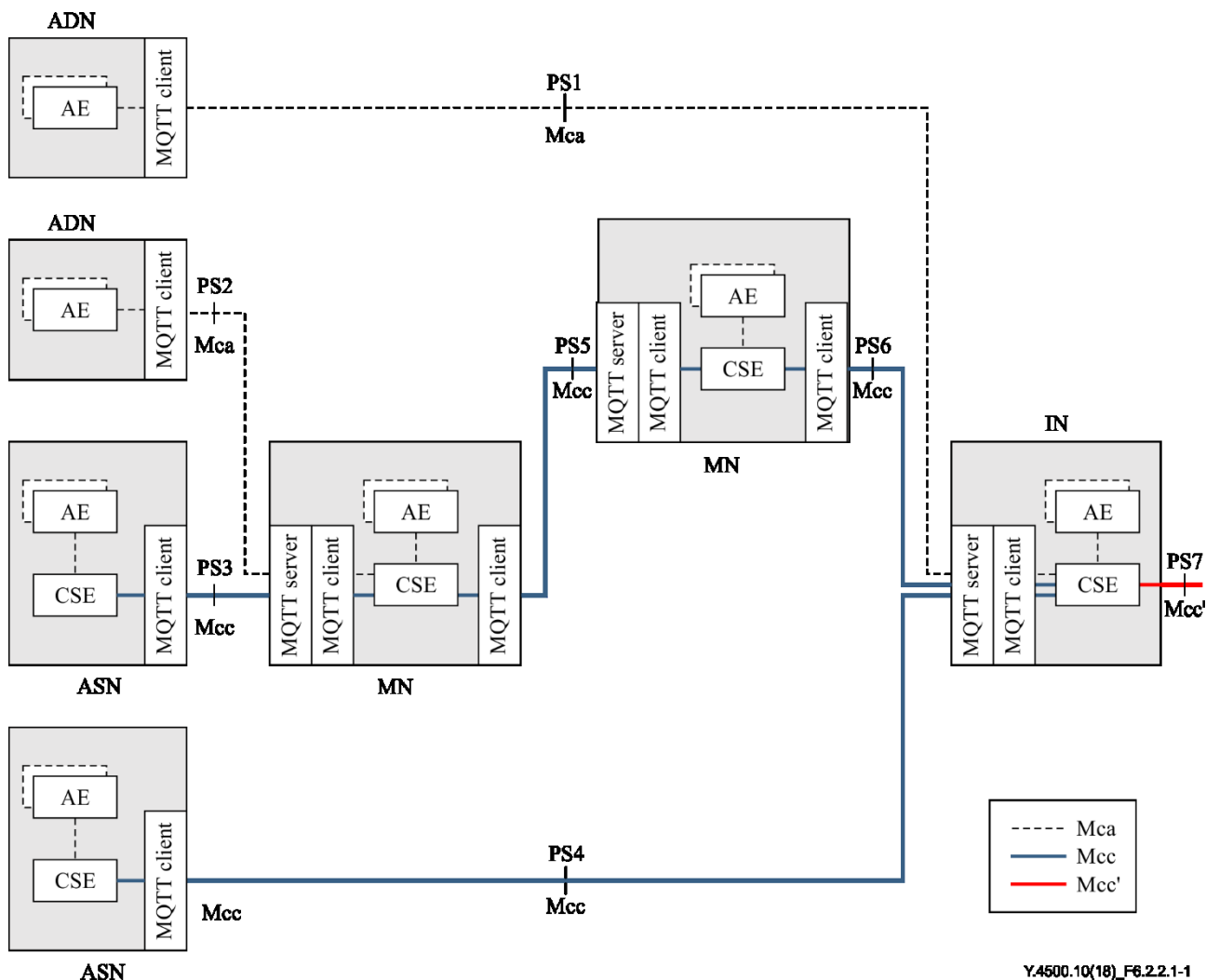


Figure 6.2.2.1-1 – MQTT server co-located scenario

In this scenario, the protocol segments are as listed in Table 6.2.2.1-1.

Table 6.2.2.1-1 – Protocol segment for MQTT server co-located scenario

Protocol Segment	oneM2M Message Transported	MQTT Interaction
PS1	Mca (AE of ADN to CSE of IN)	Client in ADN to Server in IN
PS2	Mca (AE of ADN to CSE of MN)	Client in ADN to Server in MN
PS3	Mcc (CSE of ASN to CSE of MN)	Client in ASN to Server in MN
PS4	Mcc (CSE of ASN to CSE of IN)	Client in ASN to Server in IN
PS5	Mcc (CSE of MN to CSE of MN)	Client in MN to Server in MN
PS6	Mcc (CSE of MN to CSE of IN)	Client in MN to Server in IN
PS7	Mcc' (CSE of IN to CSE of IN)	Client in IN to Server in IN

6.2.2.2 MQTT server independently located scenario

Figure 6.2.2.2-1 shows a protocol segment view in which the MQTT server is located independently from the oneM2M nodes. In this scenario, all oneM2M nodes (ADN, ASN, MN, IN) include one or more MQTT clients. MQTT servers exist independently, which means the servers are located outside the nodes.

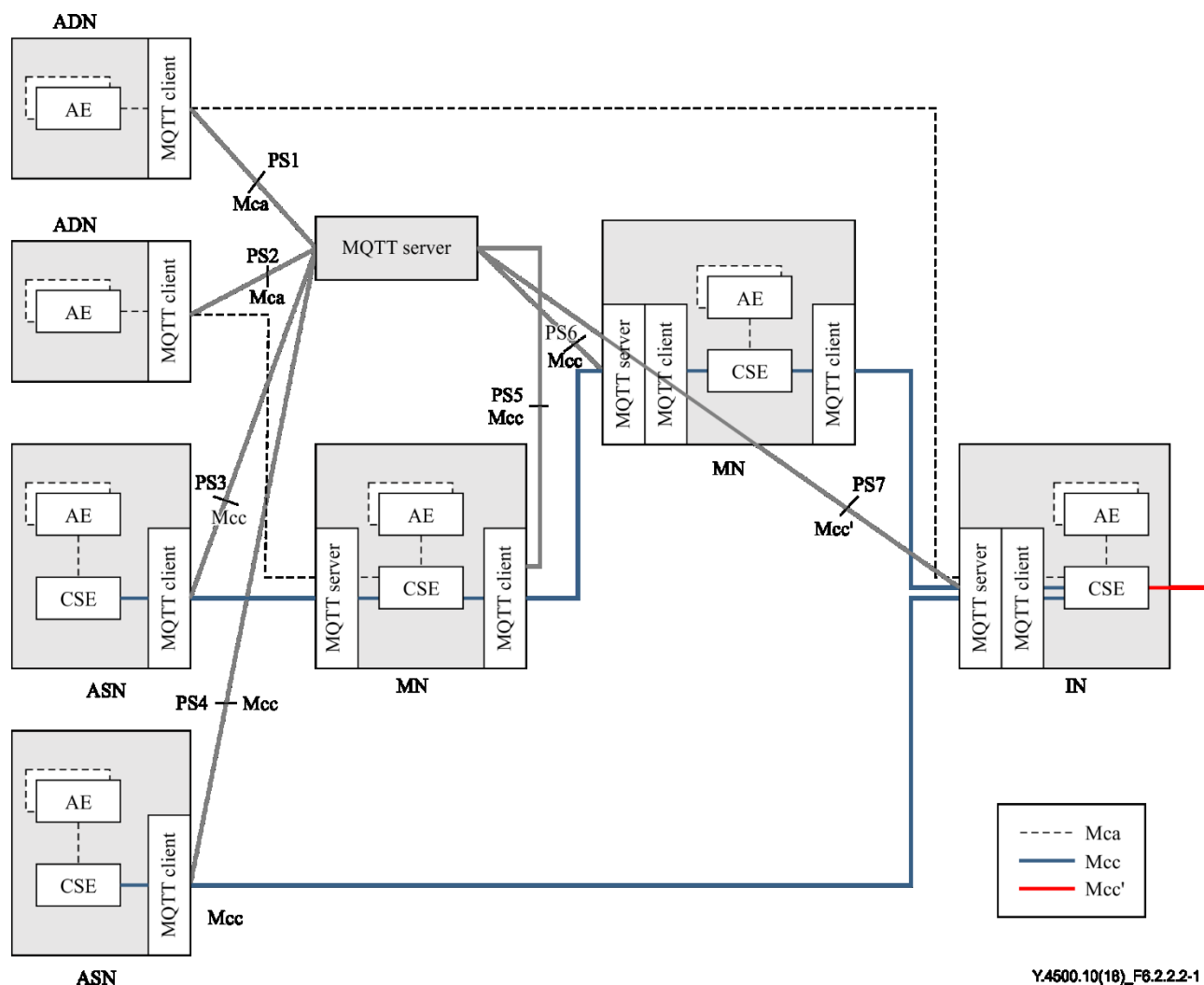


Figure 6.2.2.2-1 – MQTT server independently located scenario

In this scenario, the protocol segments are as listed in Table 6.2.2.2-1.

Table 6.2.2.2-1 – Protocol segment for MQTT server independently located scenario

Protocol Segment	oneM2M Message Transported	MQTT Interaction
PS1	Mca (AE of ADN to CSE of IN)	Client in ADN to Server
PS2	Mca (AE of ADN to CSE of MN)	Client in ADN to Server
PS3	Mcc (CSE of ASN to CSE of MN)	Client in ASN to Server
PS4	Mcc (CSE of ASN to CSE of IN)	Client in ASN to Server
PS5	Mcc (CSE of MN to CSE of MN) Mcc (CSE of MN to CSE of ASN) Mca (CSE of MN to AE of ADN)	Client in MN to Server
PS6	Mcc (CSE of MN to CSE of MN) Mcc (CSE of MN to CSE of IN)	Client in MN to Server
PS7	Mcc (CSE of IN to CSE of MN) Mcc (CSE of IN to CSE of ASN) Mca (CSE of IN to AE of ADN)	Client in IN to Server

Clauses 6.2.3.1 to 6.2.3.4 show the four configurations in which the MQTT binding can be used in the co-located scenario, followed by similar configurations in the independently located scenario.

NOTE – Other configurations are possible, but they currently lie outside the scope of this Recommendation.

6.2.3 Configurations

6.2.3.1 AE to IN

This configuration, illustrated in Figure 6.2.3.1-1, allows an AE to connect to an IN via MQTT.