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TECHNICAL SPECIFICATION

Methods for Testing and Specification (MTS);
Test Specification for CoAP;
Part 1: Conformance Tests

ETSI

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Methods for Testing and Specification (MTS).

The present document is part 1 of a multi-part deliverable covering the Constrained Application Protocol (CoAP), as identified below:

Part 1:   **"Conformance Tests";**

Part 2:   "Security Tests";

Part 3:   "Performance Tests".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

While the Internet of Things (IoT) is on the rise, the quality assurance of interconnected systems becomes an ever-increasing challenge. Within the last years, many different IoT protocols came to the fore.

The present document provides a test specification, i.e. an overall test suite structure and catalogue of test purposes for the Constrained Application Protocol (CoAP). It will be a reference base for both client-side test campaigns and server-side test campaigns addressing the conformance issues.

In the present document the conformance testing is presented. It provides a basis for interoperability testing and performance testing. The latter is presented in ETSI TS 103 536-3 [i.3].

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1   Scope

The present document provides a test specification, i.e. an overall test suite structure and catalogue of test purposes for the Constrained Application Protocol (CoAP). It will be a reference base for both client-side test campaigns and server-side test campaigns addressing the conformance issues.

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 referenced document (including any amendments) applies.

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

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 necessary for the application of the present document.

[1]   IETF RFC 7252: "The Constrained Application Protocol (CoAP)".

[2]   ETSI ES 203 119-4: "Methods for Testing and Specification (MTS); The Test Description Language (TDL); Part 4: Structured Test Objective Specification (Extension)".

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 referenced 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]   ISO/IEC 9646-1: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

[i.2]   ETSI ES 202 951: "Methods for Testing and Specification (MTS); Model-Based Testing (MBT); Requirements for Modelling Notations".

[i.3]   ETSI TS 103 596-3: "Methods for Testing and Specification (MTS); Test Specification for CoAP; Part 3: Performance Tests".

3   Definition of terms, symbols and abbreviations

3.1   Terms

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

conformance: extent to which an implementation of a standard satisfies the requirements expressed in that standard

conformance testing: process to verify to what extent the IUT conforms to the standard

content format: encoded format for converting a specific type of data to displayable information

NOTE: See IETF RFC 7252 [1].

implementation under test: implementation of one or more Open Systems Interconnection (OSI) protocols in an adjacent user/provider relationship, being the part of a real open system, which is to be studied by testing

NOTE: See ISO/IEC 9646-1 [i.1].

proxy: server that acts as an intermediary for requests from clients seeking resources from other servers

system under test: real open system in which the implementation under test resides

NOTE: See ETSI ES 202 951 [i.2].

test purpose: non-formal high-level description of a test, mainly using text

test suite structure: document defining (hierarchical) grouping of test cases according to some rules

3.2   Symbols

Void.

3.3   Abbreviations

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

CoAP	Constrained Application Protocol
ETAG	Entity Tag
HTTP	Hypertext Transfer Protocol
IUT	Implementation Under Test
RST	Reset
SD	Service Discover
SUT	System Under Test
TDL	Test Description Language
TDL-TO	Test Description Language - Test Objectives
TP	Test Purpose
TSS	Test Suite Structure
URI	Uniform Resource Identifier

4   Test Suite Structure

4.0   Introduction

The following two clauses describe the TSS. In the first one a CoAP server as SUT is considered and in the latter, a CoAP client as SUT is considered.

As the base CoAP IETF RFC 7252 [1] contain no explicit requirements for testing, neither provide concrete conformance statements, the TPs were generated because of analysis of the mentioned RFC. The structure itself is partly derived from the CoAP spec [1] but changed due to overlapping functions that cannot be tested separately.

4.1   Server as SUT

1)   Message format:

    a)   Support all defined method codes and understand regular and illegal or corrupted data along with them

2)   Protocol features:

    a)   Separate/Piggybacked

    b)   Options

    c)   Content format

    d)   Error handling

3)   Optional:

    a)   Proxying

4.2   Client as SUT

1)   Message format:

    a)   Support all defined method codes and understand regular and illegal or corrupted data along with them

2)   Protocol features:

    a)   Separate/Piggybacked

    b)   Options

    c)   Content format

    d)   Error handling

4.3   TP naming convention

TPs are numbered, starting at 001, within each main scope. The main scopes are organized according to the TSS. Some
TPs may not have a second level scope.

Table 1: TP identifier naming convention scheme

Identifier: **TP_<protocol>_<iut>_<scope>_<2nd_lvl_scope>*_<field>_<value>_<number>**				
TP	=	Test Purpose	Fixed to TP	
<protocol>	=	Protocol name	Fixed to CoAP	
<iut>	=	Type of IUT	Client or Server	
<scope>	=	Main scope	Scope of the protocol (feature)	
			MessageFormat	Mandatory Message Format
			Separate	Separate Messages
			Options	CoAP Messages with Options
			Payload	CoAP Message with Payload
			Proxy	Communication with a proxy
			ServiceDiscovery	CoAP Message concerning SD
<2nd_lvl_scope >*	=	Second level scope	Header	CoAP Header fields
			Response	CoAP response
<field>*	=	Field of the scope	Field of the given scope to be tested	
<value>*	=	Value of the field	Value of the given field to be tested	
<number>	=	Sequential number	Optional, from 001 to 999	
*optional				

4.4   TP structure

Each TP has been written in TDL-TO and thus in a structured manner which is consistent with all other TPs. The intention of this is to make the TPs more formal. In addition, a more readable format is provided by generating tables out of the TDL-TO format. The defined structure, that has been used, is illustrated in table 2. This table should be read in conjunction with any TP, i.e. please use a TP as an example to facilitate the full comprehension of table 2. All structures are defined formally in the TDL specification ETSI ES 203 119-4 [2].

Table 2: Structure of a single TP

TP part	Text	Example
Header	<Identifier> <Test objective> <Reference> <PICS reference>	*see table 1* *"The IUT is responding on a correctly set …"* *IETF RFC 7252* *PIC_Server*
Initial condition (optional)	Free text description of the condition that the IUT has reached before the test purpose applies.	*… the IUT is in the initial state …*
Start point	Describes the full logic of the test purpose. Includes trigger and expected behaviour of the IUT.	*Expected behaviour* *ensure that { … }*
Trigger	One or more actions that trigger an expected response of the IUT. Mostly a set of different messages the IUT receives.	*when {* * the IUT entity receives a request message containing version indicating value 1 …* *}*
Expected behaviour	Describes the response that the IUT sends after receiving a certain (set of) messages. This response describes the pass criteria	*then {* * the IUT entity sends a response message containing version indicating value 1 …* *}*

5 Test Purposes for CoAP Server

TP Id	TP_CoAP_MessageFormat_Header_Version_001
Test Objective	The IUT is responding on a correctly set version number.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	

Expected Behaviour

ensure that {
  when {
     the IUT receives a request message containing
      version indicating value 1,
      msg_type indicating value 0, //Confirmable
      token_length indicating value 0,
      code indicating value 0.00, //Empty Message
      msg_id corresponding to MSG_ID1;
  }
  then {
     the IUT sends a response message containing
      version indicating value 1,
      msg_type indicating value 3, //Reset
      token_length indicating value 0,
      code indicating value 0.00, //Empty Message
      msg_id corresponding to MSG_ID1;
    or the client times_out
  }
}

Final Conditions

TP Id	TP_CoAP_MessageFormat_Header_Version_002
Test Objective	The IUT silently ignores an incorrectly set version number.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	
Expected Behaviour	

ensure that {
  when {
      the IUT receives a request message containing
        version indicating value 3, //reserved
        msg_type indicating value 0, //Confirmable
        token_length indicating value 0,
        code indicating value 0.00, //Empty Message
        msg_id corresponding to MSG_ID1;
  }
  then {
      the client times_out
  }
}

| **Final Conditions** | |
| | |

TP Id	TP_CoAP_MessageFormat_Header_Type_CON_001
Test Objective	The IUT is acknowledging on a Confirmable message correctly.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	
Expected Behaviour	

ensure that {
  when {
      the IUT receives a request message containing
        version indicating value 1,
        msg_type indicating value 0, //Confirmable
        token_length indicating value 0,
        code indicating value 0.01, //GET request
        msg_id corresponding to MSG_ID1;
  }
  then {
      the IUT sends a response message containing
        version indicating value 1,
        msg_type indicating value 2, //Acknowledge, from IETF RFC 7252 section 4.2 (a)
        token_length indicating value 0,
        code indicating value 2.05, //Success (Content)
        msg_id corresponding to MSG_ID1;
  }
}

| **Final Conditions** | |
| | |

TP Id	TP_CoAP_MessageFormat_Header_Type_CON_002
Test Objective	The IUT is rejecting a Confirmable message that is carrying a response.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	

Initial Conditions

Expected Behaviour

ensure that {
  when {
    the IUT receives a request message containing
     version indicating value 1,
     msg_type indicating value 0, //Confirmable
     token_length indicating value 0,
     code indicating value 2.03, //Valid, response code
     msg_id corresponding to MSG_ID1;
  }
  then {
    the IUT sends a response message containing
     version indicating value 1,
     msg_type indicating value 3, //Reset
     token_length indicating value 0,
     code indicating value 0.00, //Empty Message
     msg_id corresponding to MSG_ID1;
    or the client times_out
  }
}

Final Conditions

TP Id	TP_CoAP_MessageFormat_Header_Type_CON_003
Test Objective	The IUT is rejecting a Confirmable message that lacks context to process the message properly. The message carries a reserved class.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server

Initial Conditions

Expected Behaviour

ensure that {
  when {
    the IUT receives a request message containing
     version indicating value 1,
     msg_type indicating value 0, //Confirmable
     token_length indicating value 0,
     code indicating value 1.00, //reserved
     msg_id corresponding to MSG_ID1;
  }
  then {
    the IUT sends a response message containing
     version indicating value 1,
     msg_type indicating value 3, //Reset
     token_length indicating value 0,
     code indicating value 0.00, //Empty Message
     msg_id corresponding to MSG_ID1;
    or the client times_out
  }
}

Final Conditions

TP Id	TP_CoAP_MessageFormat_Header_Type_NON_001
Test Objective	The IUT is acknowledging on a Non-confirmable message correctly.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	
Expected Behaviour	

```
ensure that {
    when {
        the IUT receives a request message containing
            version indicating value 1,
            msg_type indicating value 1, //Non-confirmable
            token_length indicating value 0,
            code indicating value 0.01, //GET request
            msg_id corresponding to MSG_ID1;
    }
    then {
        the IUT sends a response message containing
            version indicating value 1,
            msg_type indicating value 1, //Non-confirmable
            token_length indicating value 0,
            code indicating value 2.05, //Success (Content)
            msg_id corresponding to MSG_ID2;
    }
}
```

Final Conditions	

TP Id	TP_CoAP_MessageFormat_Header_Type_NON_002
Test Objective	The IUT is rejecting a Non-confirmable message that is Empty.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	
Expected Behaviour	

```
ensure that {
    when {
        the IUT receives a request message containing
            version indicating value 1,
            msg_type indicating value 1, //Non-confirmable
            token_length indicating value 0,
            code indicating value 0.00, //Empty Message
            msg_id corresponding to MSG_ID1;
    }
    then {
        the client times_out
    }
}
```

Final Conditions	

TP Id	TP_CoAP_MessageFormat_Header_Type_NON_003
Test Objective	The IUT is rejecting a Non-confirmable message that is carrying a response.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	

Expected Behaviour

ensure that {
  when {
    the IUT receives a request message containing
      version indicating value 1,
      msg_type indicating value 1, //Non-confirmable
      token_length indicating value 0,
      code indicating value 2.03, //Success (Valid)
      msg_id corresponding to MSG_ID1;
  }
  then {
    the client times_out
  }
}

Final Conditions

TP Id	TP_CoAP_MessageFormat_Header_Type_NON_004
Test Objective	The IUT is rejecting a NON-confirmable message that lacks context to process the message properly. The message carries a reserved class.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	

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Expected Behaviour

ensure that {
  when {
    the IUT receives a request message containing
      version indicating value 1,
      msg_type indicating value 0, //Confirmable
      token_length indicating value 0,
      code indicating value 6.00, //reserved
      msg_id corresponding to MSG_ID1;
  }
  then {
    the client times_out
  }
}

Final Conditions

TP Id	TP_CoAP_MessageFormat_Header_Type_ACK_001
Test Objective	The IUT is rejecting an Acknowledgement message that is carrying a request.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	

Expected Behaviour

ensure that {
   when {
       the IUT receives a request message containing
         version indicating value 1,
         msg_type indicating value 2, //Acknowledgement
         token_length indicating value 0,
         code indicating value 0.02, //POST request
         msg_id corresponding to MSG_ID1;
   }
   then {
       the client times_out
   }
}

Final Conditions

TP Id	TP_CoAP_MessageFormat_Header_Type_ACK_002
Test Objective	The IUT is rejecting an Acknowledgement message that carries a reserved class.
Reference	IETF RFC 7252 [1]
PICS Selection	PIC_Server
Initial Conditions	

Expected Behaviour

ensure that {
   when {
       the IUT receives a request message containing
         version indicating value 1,
         msg_type indicating value 2, //Acknowledgement
         token_length indicating value 0,
         code indicating value 7.00, //reserved
         msg_id corresponding to MSG_ID1;
   }
   then {
       the client times_out
   }
}

Final Conditions