TECHNICAL REPORT

Companion Specification
for Energy Metering

DLMS/COSEM

Conformance Testing Process

DLMS User Association

device
language
message
specification

Reference number: EXCERPT FROM DLMS UA 1001-1:2010, Fourth Edition

Table of Contents

Foreword

Copyright

Acknowledgement

The actual document has been established by the WG CT of the DLMS UA.

1. Scope

This document specifies the methods and processes for conformance testing and certification of metering equipment implementing the DLMS/COSEM specification for meter data exchange.

This document only focuses on testing and certifying the implementation of the DLMS/COSEM specification. Other functional and performance tests are outside the scope of this document.

This Edition 4 cancels and replaces Edition 3, published in 2007.

2. Introduction

2.1 Referenced documents

Ref.	Reference No.	Title
[1]	DLMS UA 1000-1:2010, Ed. 10.0	COSEM Identification System and Interface Classes “Blue Book”
[2]	DLMS UA 1000-2: 2009, Ed. 7.0	DLMS/COSEM Architecture and Protocols “Green Book”
[3]	DLMS UA 1001-1:2007, Ed. 3.0	DLMS/COSEM Conformance Testing Process “Yellow book”
[4]	DLMS UA 1002:2003, Ed. 1.0	Glossary of terms
[5]	DLMS UA 1001-3:2010, V5.0	DLMS/COSEM conformance testing – Conformance test plans – Data link layer using HDLC protocol
[6]	DLMS UA 1001-4:2010, V5.0	DLMS/COSEM conformance testing – Conformance test plans – DLMS/COSEM application layer
[7]	DLMS UA 1001-5:2010, V5.0	DLMS/COSEM conformance testing – Conformance test plans – COSEM Interface objects
[8]	DLMS UA 1001-7	COSEM conformance testing – Object definition tables
[9]	X.290 (1995)	OSI conformance testing methodology and framework for protocol recommendations for IUT-T applications – General concepts
[10]	X. 291 (1995)	OSI conformance testing methodology and framework for protocol recommendations for IUT-T applications – Abstract test suite specification
[11]	X.293 (1995)	OSI conformance testing methodology and framework for protocol recommendations for IUT-T applications – Test realization
NOTE 1 For the actual version of the DLMS UA documents, check the DLMS UA website at http://www.dlms.com/ NOTE 2 X.290 is technically aligned with ISO/IEC 9646-1. NOTE 3 For other relevant standards see the Bibliography.		

2.2 Terms and definitions

For the purposes of this document the following definitions apply:

NOTE Most of the following definitions have been taken from ITU-T Recommendation X.290. Some definitions have been modified to better adapt to the DLMS/COSEM conformance assessment process.

3.2.1
abnormal (test case) termination
The term used to describe the result of execution of an abstract test case when it has been prematurely terminated by the test system. [X.290 3.3.1]

3.2.2
abstract test case
A complete and independent specification of the actions required to achieve a specific test purpose, defined at the level of abstraction of a particular Abstract Test Method, starting in a stable testing state and ending in a stable testing state. This specification may involve one or more consecutive or concurrent connections.

NOTES

1 The specification should be complete in the sense that it is sufficient to enable a test verdict to be assigned unambiguously to each potentially observable test outcome (i.e. sequence of test events).

2 The specification should be independent in the sense that it should be possible to execute the derived executable test case in isolation from other such test cases (i.e. the specification should always include the possibility of starting and finishing in the “idle” state).

[X.290 3.3.3]

3.2.3
abstract test case error
A test case error resulting from an error in the abstract test case. [X.290 3.3.4]

3.2.4
(abstract) test method (ATM)
The description of how an IUT is to be tested, given at an appropriate level of abstraction to make the description independent of any particular realization of a Means of Testing, but with enough detail to enable abstract test cases to be specified for this test method. [X.290 3.3.5]

3.2.5
abstract test suite (ATS)
A test suite composed of abstract test cases. [X.290 3.3.6]

3.2.6
abstract test suite (ATS) specification
A specification that contains a standardized ATS together with related information. [X.290 3.3.7]

3.2.7
base specification
A specification of a protocol, abstract syntax, encoding rules, or information object. [X.290 3.3.10]

3.2.8
basic interconnection test (BIT)

A test of an IUT, which has limited scope to determine whether or not there is sufficient conformance to the relevant protocol(s) for interconnection to be possible, without trying to perform thorough testing. [X.290 3.3.11]

3.2.9
behaviour test
A test to determine the extent to which one or more dynamic conformance requirements are met by the IUT. [X.290 3.3.12]

3.2.10
capability (of an implementation)
A set of functions in the relevant protocol(s), which is supported by the implementation. [X.290 3.3.13]

3.2.11
capability test
A test to verify the existence of one or more claimed capabilities of an IUT.

NOTE Capability testing involves checking all mandatory capabilities and those optional ones that are stated in the ICS as supported, but not checking those optional ones which are stated in the ICS as not supported by the IUT.

[X.290 3.3.14]

3.2.12
conformance assessment process
The complete process of accomplishing all conformance testing activities necessary to assess the conformance of an implementation or a system to one or more OSI specifications. [X.290 3.3.19]

3.2.13
conformance log
A human-readable record of information produced as a result of a test campaign, which is sufficient to record the observed test outcomes and verify the assignment of test results (including test verdicts). [X.290 3.3.20]

3.2.14
conformance test information (CTI)
A statement made by the supplier or implementor of an IUT integrating the PICS, the PIXIT, the information object ICS and the information object ICT into a single document.

3.2.15
(conformance) test suite
A complete set of test cases possibly combined into nested test groups, that is needed to perform dynamic conformance testing for one or more OSI protocols.

NOTE It should cover both capability testing and behaviour testing. It may be qualified by the adjectives: abstract or executable, as appropriate. Unless stated otherwise, an “abstract test suite” is meant.

[X.290 3.3.22]

3.2.16
conformance testing
Testing the extent to which an IUT is a conforming implementation. [X.290 3.3.23]

3.2.17
conforming implementation
An IUT, which satisfies both static and dynamic conformance requirements, consistent with the capabilities stated in the ICS(s).

NOTE In case of DLMS/COSEM, the capabilities are partly declared in the CTI and they are partly provided by the IUT.

[X.290 3.3.25 modified]

3.2.18
executable test case
A realization of an abstract test case. [X.290 3.3.31]

3.2.19
executable test case error
A test case error in the realization of an abstract test case. [X.290 3.3.32]

3.2.20
executable test suite (ETS)
A test suite composed of executable test cases. [X.290 3.3.33]

3.2.21
fail (verdict)
A test verdict given when the observed test outcome either demonstrates non-conformance with respect to (at least one of) the conformance requirement(s) on which the test purpose of the test case is focused, or contains at least one invalid test event, with respect to the relevant specification(s). [X.290 3.3.34]

3.2.22
foreseen test outcome
An observed test outcome identified in the abstract test case. [X.290 3.3.35]

NOTE A foreseen test outcome may include an unidentified test event.

3.2.23
idle testing state
A stable testing state in which there is no established connection of the relevant protocol(s) and in which the state of the IUT is independent of any previously executed test cases. [X.290 3.3.38]

3.2.24
implementation conformance statement (ICS)
A statement made by the supplier of an implementation or system claimed to conform to a given specification, stating which capabilities have been implemented. The ICS can take several forms: protocol ICS, profile ICS, profile specific ICS, and information object ICS. [X.290 3.3.39]

3.2.25
implementation extra information for testing (IXIT)
A statement made by a supplier or implementor of an IUT which contains or references all of the information (in addition to that given in the ICS) related to the IUT and its testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT. An IXIT can take several forms: protocol IXIT, profile IXIT, profile specific IXIT, and information object IXIT. [X.290 3.3.41 modified]

3.2.26
implementation under test (IUT)
An implementation of one or more OSI protocols in an adjacent user/provider relationship, being that part of a real open system which is to be studied by testing. [X.290 3.3.43]

3.2.27
inapplicable test
A test case, which cannot be performed because the necessary conditions are not available.

3.2.28
inconclusive (verdict)
A test verdict given when the observed test outcome is such that neither a pass nor a fail verdict can be given. [X.290 3.3.44]

3.2.29
information object implementation conformance statement; information object ICS
An ICS for an implementation or system claimed to conform to a given information object specification. [X.290 3.3.45]

3.2.30
information object implementation extra information for testing; information object IXIT
An IXIT for an implementation or system claimed to conform to a given information object specification. [X.290 3.3.46]

3.2.31
initial testing state
The testing state in which a test body starts.

NOTE This may be either a stable testing state or a transient state.

[X.290 3.3.47]

3.2.32
inopportune test event
A test event which occurs when not allowed to do so by the relevant specification(s) to which conformance is being tested. [X.290 3.3.48]

3.2.33
invalid test event
A test event that violates at least one conformance requirement of the relevant specification(s) to which conformance is being tested. [X.290 3.3.49]

3.2.34
means of testing (MOT) (IUTs)
The combination of equipment and procedures that can perform the derivation, selection, parameterization and execution of test cases, in conformance with a reference standardized ATS, and can produce a conformance log. [X.290 3.3.54]

3.2.35
negative test
Test to verify the correct response of the IUT on:

- DLMS/COSEM conformant information and services, which are not implemented;
- non conformant communication traffic.

3.2.36
(observed) test outcome
The sequence of test events, together with associated data and/or parameter values, which occurred during test execution of a specific parameterized executable test case. [X.290 3.3.58]

3.2.37
parameterized executable test case
An executable test case, in which all appropriate parameters have been supplied with values in accordance with specific ICS(s) and IXIT(s), as appropriate, and corresponding to a parameterized abstract test case. [X.290 3.3.61]

3.2.38
pass (verdict)
A test verdict given when the observed test outcome gives evidence of conformance to the conformance requirement(s) on which the test purpose of the test case is focused, and when no invalid test event has been detected. [X.290 3.3.63]

3.2.39
positive test
test to ensure the correct implementation of the capabilities of the IUT as defined by the supplier. A positive test has a described and defined response.

3.2.40
preliminary result
Information to be recorded in the conformance log and to be used in determining the test verdict. [X.290 3.3.65]

3.2.41
protocol conformance test report (PCTR)
A document produced at the end of a conformance assessment process, giving the details of the testing carried out using a particular ATS. It lists all of the abstract test cases and identifies those for which corresponding executable test cases were run, together with the verdicts assigned. [X.290 3.3.79]

3.2.42
protocol implementation conformance statement (PICS)
An ICS for an implementation or system claimed to conform to a given protocol specification. [X.290 3.3.80]

3.2.43
protocol implementation extra information for testing (PIXIT)
An IXIT related to testing for conformance to a given protocol specification. [X.290 3.3.81]

3.2.44
reference (standardized) abstract test suite; reference (standardized) ATS
The standardized ATS for which a Means of Testing is realized. [X.290 3.3.84]

3.2.45
repeatability (of results)
Characteristic of a test case, such that repeated executions on the same IUT under the same conditions lead to the same test verdict, and by extension a characteristic of a test suite. [X.290 3.3.86]

3.2.46
semantically invalid test event
A test event which is neither inopportune nor syntactically invalid, but which contains a semantic error with respect to the relevant protocol specification (e.g. a PDU containing a parameter value outside the negotiated range for that parameter). [X.290 3.3.90]

3.2.47
stable testing state
A testing state which can be maintained, without prescribed Lower Tester behaviour, sufficiently long to span the gap between one test case and the next in a test campaign. [X.290 3.3.93]

3.2.48
standardized abstract test suite; standardized ATS
An ATS specified within an ITU-T or ISO/IEC published specification or, in the absence of such a specification, within a publicly available specification which is in the process of being standardized within ITU-T or ISO/IEC, and which has the highest standardization status available, and which has the status of at least a Committee Draft or equivalent. [X.290 3.3.94]

3.2.48
static conformance review
A review of the extent to which the static conformance requirements are claimed to be supported by the IUT. [X.290 3.3.96 modified]

3.2.49
syntactically invalid test event
A test event which is not allowed syntactically by the relevant specification(s) to which conformance is claimed. [X.290 3.3.99]

3.2.50
test body
The sequences of test events that achieve the test purpose. [X.290 3.3.105]

3.2.50
test campaign
The process of executing the Parameterized Executable Test Suite for a particular IUT and producing the conformance log. [X.290 3.3.106]

3.2.50
test case
An abstract or executable test case.

NOTE In general the use of the word “test” will imply its normal English meaning. Sometimes it may be used as an abbreviation for abstract test case or executable test case. The context should make the meaning clear.

[X.290 3.3.107 modified]

3.2.51
test case error
The term used to describe the result of execution of a test case when an error is detected in the test case itself. [X.290 3.3.108]

3.2.52
test event
An indivisible unit of test specification at the level of abstraction of the specification (e.g. sending or receiving a single PDU). [X.290 3.3.110]

3.2.53
test group
A named set of related test cases. [X.290 3.3.111]

3.2.54
test group objective
A prose description of the common objective which the test purposes within a specific test group are designed to achieve. [X.290 3.3.112]

3.2.55
test laboratory
An organization that carries out conformance testing. This can be a third party, a user organization, a telecommunications administration or recognized private operating agency, or an identifiable part of a supplier organization. [X.290 3.3.113]

3.2.56
(test) postamble
The sequences of test events from the end of the test body up to the finishing stable testing state(s) for the test case. [X.290 3.3.116]

3.2.57
(test) preamble
The sequences of test events from the starting stable testing state of the test case up to the initial testing state from which the test body will start. [X.290 3.3.117]

3.2.58
test purpose
A prose description of a well defined objective of testing, focusing on a single conformance requirement or a set of related conformance requirements as specified in the appropriate OSI specification (e.g. verifying the support of a specific value of a specific parameter). [X.290 3.3.118]

3.2.59
test step (sub-test)
A named subdivision of a test case, constructed from test events and/or other test steps. [X.290 3.3.122]

3.2.60
(test) verdict
A statement of “pass”, “fail” or “inconclusive”, as specified in an abstract test case, concerning conformance of an IUT with respect to that test case when it is executed. [X.290 3.3.124]

3.2.61
unforeseen test outcome
An observed test outcome not specified in the abstract test case.

NOTE An unforeseen test outcome can only lead to a test case error or an abnormal test case termination.

[X.290 3.3.127]

3.2.62
valid test event
A test event which is allowed by the protocol specification, being both syntactically and semantically correct, and occurring when allowed to do so by the protocol specification.

[X.290 3.3.130]

2.3 Abbreviations

Abbreviation	Explanation
AA	Application Association
AARE	Application Association Response
AARQ	Application Association ReQuest
ACSE	Association Control Service Element
AL	Application layer
ANSI	American National Standards Institute
APDU	Application Protocol Data Unit
ASE	Application Service Element
ATS	Abstract Test Suite
A-XDR	Adapted Extended Data Representation
base_name	The short_name corresponding to the first attribute (“logical_name”) of a COSEM object
CHAP	Challenge Handshake Authentication Protocol
Class_id	Interface class identification code
COSEM	Companion Specification for Energy Metering
COSEM object	An instance of an interface class
CTI	Conformance Test Information
CtoS	Client to Server challenge
CTT	Conformance Test Tool
DHCP	Dynamic Host Control Protocol
DLMS	Device Language Message Specification
DNS	Domain Name Server
EAP	Extensible Authentication Protocol
ETS	Executable Test Suite
GMT	Greenwich Mean Time
GPS	Global Positioning System
HLS	High Level Security
IANA	Internet Assigned Numbers Authority
IC	Interface Class
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISO	International Organization for Standardization
ITU	International Telecommunication Union
IUT	Implementation Under Test
IPCP	Internet Protocol Control Protocol
LCP	Link Control Protocol
LD	Logical Device
LLS	Low Level Security
LN	Logical Name

Abbreviation	Explanation
LSB	Least Significant Bit
m	mandatory, used in conjunction with attribute and method definitions
MD5	Message Digest Algorithm 5
MOT	Means of Testing
MSB	Most Significant Bit
NDM	Normal Disconnected Mode (HDLC)
NRM	Normal Response Mode (HDLC)
o	optional, used in conjunction with attribute and method definitions
OBIS	OBject Identification System
PAP	Password Authentication Protocol
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
PLMN	Public Land Mobile Network
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
ROHC	Robust Header Compression
SAP	Service Access Point
SHA-1	Secure Hash Algorithm
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SN	Short Name
StoC	Server to Client Challenge
UTC	Universal Time Co-ordinated

3. Conformance testing - overview

3.1 OSI conformance testing

The concept and methodology of OSI Conformance testing is described in the IUT-T X.290 Recommendation [9].

The objective of conformance testing is to establish whether the Implementation Under Test (IUT) conforms to the relevant specification(s).

Practical limitations make it impossible to be exhaustive, and economic considerations may restrict testing still further.

The primary purpose of conformance testing is to increase the probability that different implementations are able to interwork. While conformance is a necessary condition, it is not on its own a sufficient condition to guarantee interworking capability. Even if two implementations conform to the same protocol specification, they may fail to interwork fully.

What conformance testing does do is give confidence that an implementation has the required capabilities and that its behaviour conforms consistently in representative instances of communication.

3.2 DLMS/COSEM conformance testing

The DLMS/COSEM specification, as a global standard for data exchange with utility metering equipment, includes standardised conformance tests to ensure that suppliers comply with applicable requirements. It is based on the principles developed for OSI conformance testing.

The main elements of the DLMS/COSEM specification are the following:

- the Blue Book, specifying COSEM interface object model, see [1];
- the Green Book, specifying communication profiles, see [2]; and
- the Yellow book – this document – specifying the conformance testing process.

NOTE The contents of the Blue Book and the Green Book are internationally standardized, see the Bibliography.

The DLMS/COSEM conformance testing process comprises the following:

- the conformance test plans;
- the Conformance Test Tool (CTT);
- the conformance assessment process;
- the certification process;
- the quality program.

It is illustrated on Figure 1.

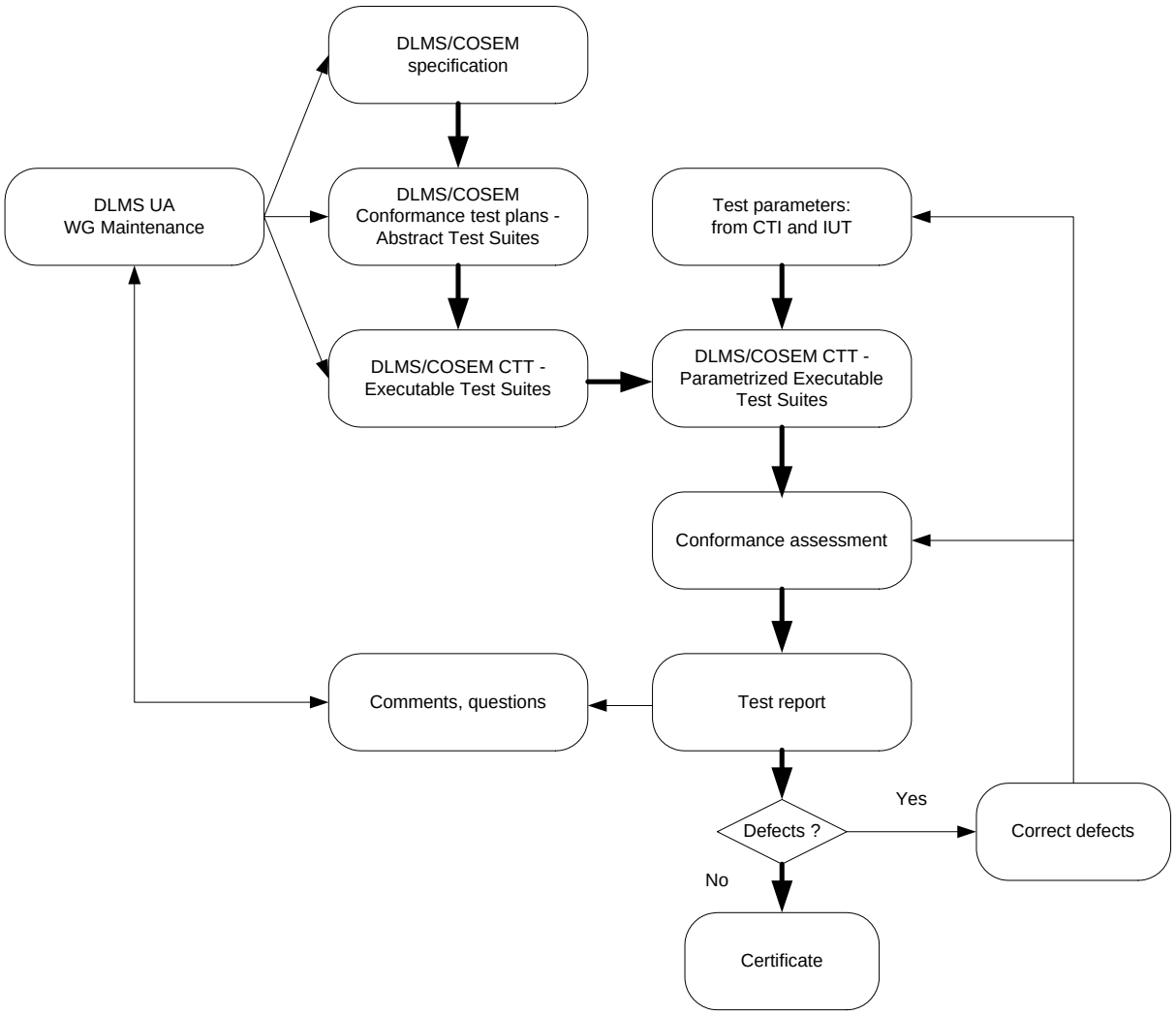

Figure 1 – DLMS/COSEM conformance testing process

The conformance test plans – Abstract Test Suites (ATS) – describe, at the level of abstraction, the test to be performed. See clause 4.

The Conformance Test Tool (CTT) implements the Abstract Test Suites in the form of Executable Test Suites. See clause 5.

The conformance assessment process consists of the phases of preparation for testing, test operations and conformance test report production. See clause 6.

The certification process consists of examining conformance test reports and publication of Certificates. See clause 7.

The quality program includes handling comments and questions and initiating the maintenance of the specification, the conformance test plans and/ or the CTT as appropriate. See clause 8.

3.3 Main features of DLMS/COSEM conformance testing

The main features of the DLMS/COSEM conformance testing process are summarized below:

- it covers servers implementing the COSEM interface object model and one or more DLMS based communication profiles;
- it is limited to the server's functionality as presented at the communication interface(s). Other functions of the server are out of the Scope of conformance testing;
- the conformance test plans and the CTT are provided by the DLMS UA. They are available to all members of the DLMS UA;
- the CTT can be used for self-testing and third party testing, at the conditions published at the homepage of the DLMS UA, at www.dlms.com;
- the certification process can be initiated by any member of the DLMS UA;
- to obtain a Certificate, the manufacturer of the IUT shall possess a registered three-letter manufacturer ID; see http://dlms.com/organization/flagmanufacturesids/index.html;
- the CTT automatically generates the documents necessary for the Certification;
- the Certification is issued by the DLMS UA;
- the DLMS UA operates a Quality program to maintain the test plans and the CTT.

4. The conformance test plans

4.1 Scope of testing

The communication model of DLMS/COSEM servers to be tested is shown in Figure 2.

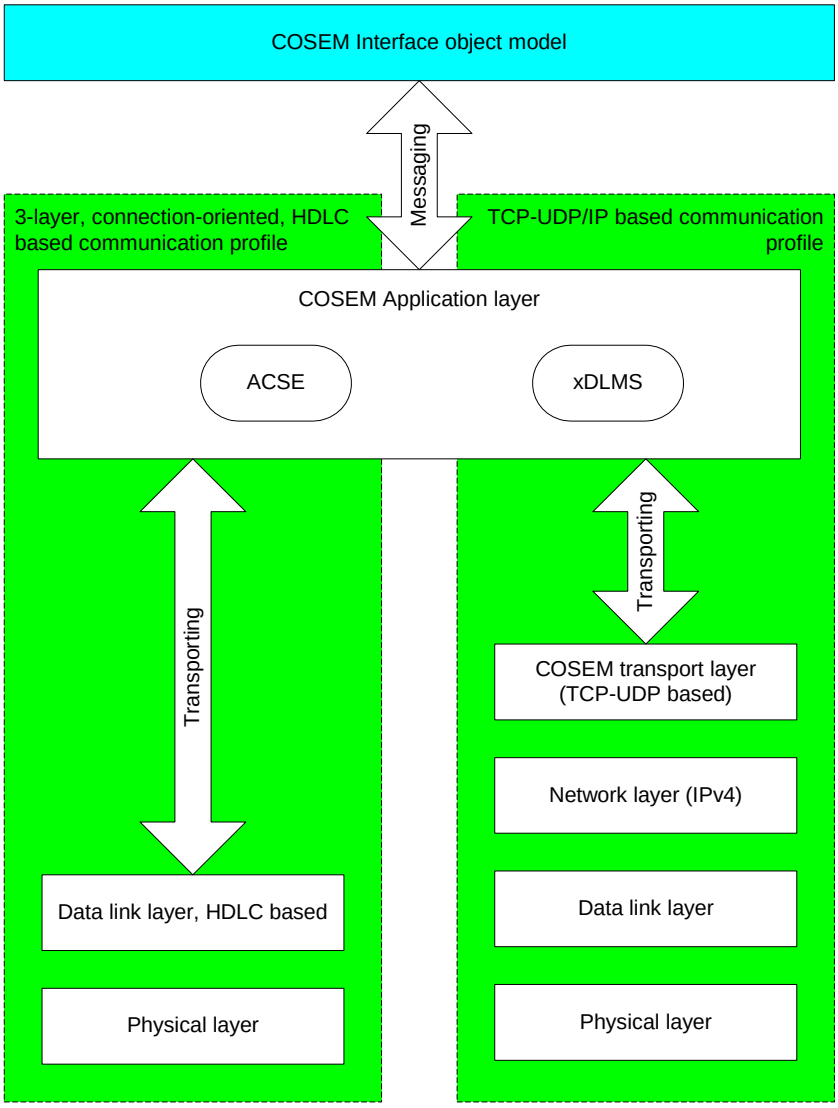

Figure 2 – DLMS/COSEM interface object model and communication profiles

The COSEM Interface object model, specified in [1] and the COSEM Application layer specified in Clause 9 of [2] are used in all implementations.

The selection of lower layers depends on the communication profile:

- in the 3-layer, connection-oriented, HDLC based communication profile, the DLMS/COSEM Application layer is supported by the data link layer using HDLC protocol, specified in Clause 8 of [2] and the physical layer specified in clause 5 of [2];

- in the TCP-UDP/IP based communication profile the DLMS/COSEM Application layer is supported by the DLMS/COSEM transport layer specified in clause 7 of [2], and this is supported by a set of lower layers appropriate for the communication media.

The conformance test plans covers:

- the COSEM Interface objects;
- the DLMS/COSEM Application layer;
- the data link layer using HDLC protocol.

All other protocol layers are implicitly tested.

4.2 Device testing

A single device is conformance tested against a single test source.

For the purposes of testing, the IUT is considered as a black box. The test consists of sending messages to the IUT and observing the responses.

As access to layer boundaries is not available, the interface object model and the protocol stack are tested in combination. Therefore, the following assumptions are made:

- for testing the data link layer using HDLC protocol, it is assumed that the physical layer works correctly;
- for testing the DLMS/COSEM Application layer, it is assumed that the supporting layers work correctly;
- for testing the COSEM Interface object model, it is assumed that the protocol stack works correctly.

4.3 Structure of the conformance test plans

Each test plan comprises an abstract test suite (ATS).

NOTE The remaining part of clause 5.3 and clause 5.4 applies strictly to the protocol layer test plans only.

Test suites have a hierarchical structure (see Figure 3) in which an important level is the test case.

Each test case has a specified test purpose, such as verifying that the IUT has a certain required capability (e.g. the ability to support certain packet sizes) or exhibit a certain required behaviour (e.g. behave as required when a particular event occurs in a particular state).

Within a test suite, nested test groups are used to provide a logical ordering of the test cases.

Associated with each test group is a test group objective.

Test cases may be modularised by using named subdivisions called subtests.

Test events are indivisible units of specification within a test step (e.g. the transfer of a single PDU to or from the IUT).

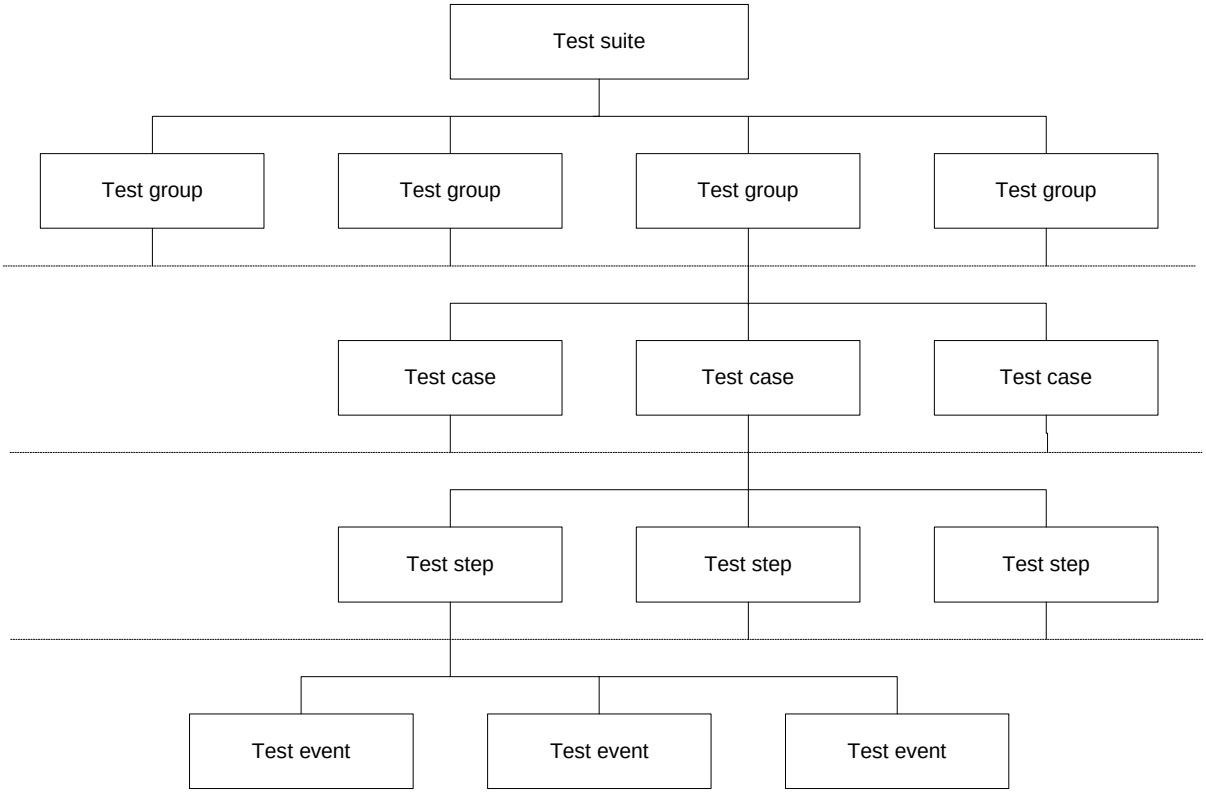

Figure 3 – Test suite structure

Test suites include test cases falling in the following categories (the list is not exhaustive):

- capability tests;
- behaviour tests of valid behaviour (positive tests);
- behaviour tests of syntactically invalid or inopportune behaviour (negative tests);
- test focusing on PDUs sent to and received from the IUT;
- test related to each protocol phase;
- timing;
- PDU encoding variations;
- variations in values of individual parameters and/or combination of parameters.

4.4 Abstract test cases

An abstract test case is derived from a test purpose and from the relevant specifications. An abstract test case:

- has a *Test case* name, used as a reference and relating the test case to the test group and the test suite;
- gives the *References* pointing to the relevant clauses of the Blue Book [1] and/or the Green Book [2], constituting the base specification, the test case is related to and derived from;
- specifies the *Test purpose*;
- specifies the expected behaviour of the IUT; this comprises the *Expected result*;
- specifies, if the initial testing state required by the test body is not the desired starting stable state of the test case, the sequence of events to put the IUT to the initial testing state for the test body; this test sequence comprises the *Preamble*;
- specifies the sequences of foreseen test events necessary in order to achieve the test purpose. These sequences comprise the *Test body*. It may consist of one or more subtests;

- specifies, if the test body can end without the IUT being returned to the desired stable testing state, the sequence of events to return the IUT to the desired stable testing state; this test sequence comprises the *Postamble*;
- specifies the verdict to be assigned to each foreseen test outcome.

The abstract test cases are formatted using the template shown in Table 1.

Table 1 – Template for test cases

Test case	
References	
Test purpose	
Expected result	
Preamble	
Test body	
Postamble	
Comments	

4.5 Test outcomes and verdicts

The test outcome is the series of events, which occurred during execution of a test case.

A foreseen test outcome is one, which has been defined by the abstract test case i.e. the events which occurred during execution of the test case matched a sequence of test events defined in the abstract test case. A foreseen test outcome always results in the assignment of a test verdict to the test case.

The test verdict will be PASSED, FAILED or INCONCLUSIVE:

- PASSED – Means that the observed test outcome gives evidence of conformance to the conformance requirement(s) on which the test purpose of the test case is focused, and is valid with respect to the relevant specification(s);
- FAILED – Means that the observed test outcome either demonstrates non-conformance with respect to (at least one of) the conformance requirement(s) on which the test purpose of the test case is focused, or contains at least one invalid test event, with respect to the relevant specification(s);
- INCONCLUSIVE – Means that the observed test outcome is such that neither a pass nor a fail verdict can be given.

An unforeseen test outcome is one, which has not been identified by the abstract test case, i.e. the events, which occurred during execution of the test case did not match any sequence of test events defined in the abstract test case. An unforeseen test outcome always results in the recording of a test case error or an abnormal test case termination for the test case.

A test case error is recorded if an error is detected either in the abstract test case itself, (i.e. an abstract test case error) or in its realization, (i.e. an executable test case error).

An abnormal test case termination is recorded if the execution of the test case is prematurely terminated by the test system for reasons other than test case error.

The results of executing the relevant individual test cases will be recorded in the conformance test report.

4.6 Conformance test plan for the Data link layer using HDLC protocol

The data link layer ATS is specified in [5]. Its structure is shown on Figure 4.

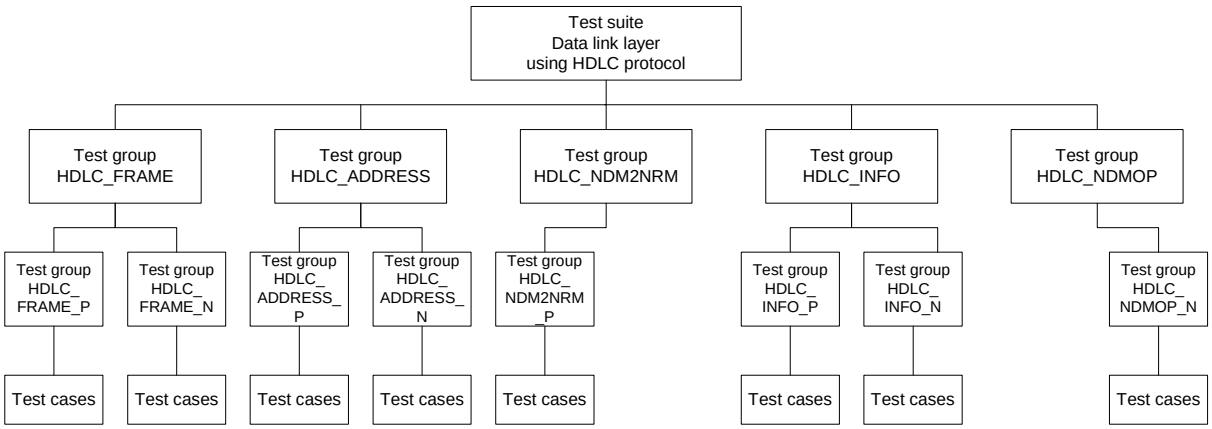

Figure 4 – Structure of the conformance test plan for the Data link layer using HDLC protocol

4.7 Conformance test plan for the DLMS/COSEM application layer

The DLMS/COSEM application layer ATS is specified in [6]. Its structure is shown on Figure 5.

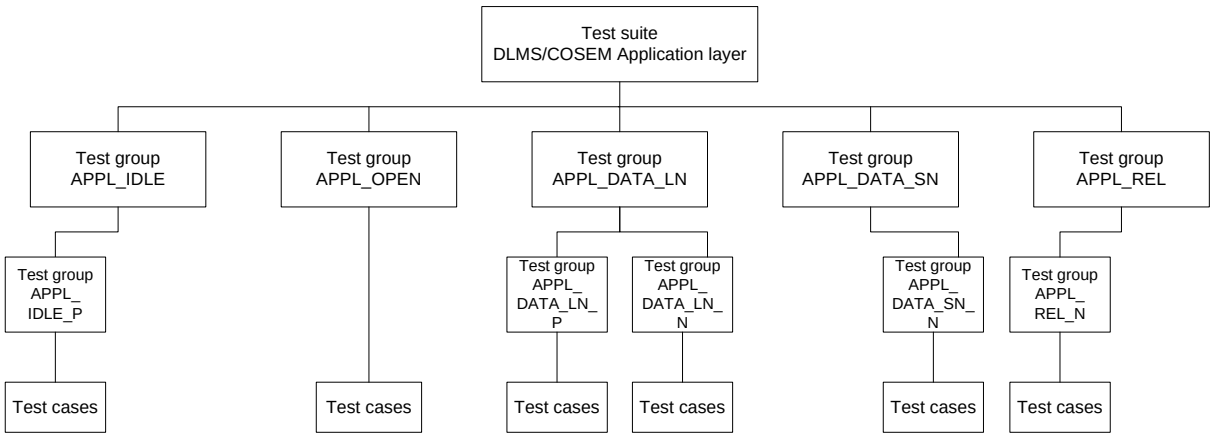

Figure 5 – Structure of the conformance test plan for the COSEM Application layer

4.8 Conformance test plan for COSEM interface objects

The COSEM interface objects ATS s specified in [7]. Its structure is shown on Figure 6.

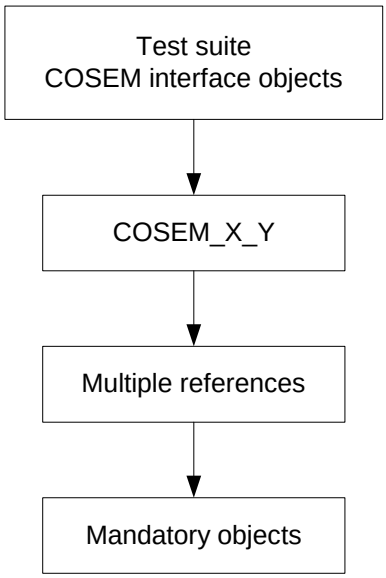

Figure 6 – Structure of the conformance test plan for the COSEM interface objects

5. The DLMS/COSEM conformance test tool

5.1 Introduction

The DLMS/COSEM conformance test tool (CTT) is an implementation of the abstract test suites (ATS) in the form of executable test suites (ETS). It can perform the following:

- the selection of test cases;
- the parametrization of the test cases;
- the execution of test cases; and
- the production of the Conformance test report and a Conformance log.

The CTT therefore is a Means of testing (MOT) as defined in 3.2.32.

more details, see complete Yellow Book …

5.2 Licensing the CTT

The CTT can be licensed with or without the log module, by any member of the DLMS UA from Euro DCS: http://www.eurodcs.de. The conditions are published at the homepage of the DLMS UA, at www.dlms.com.

6. The conformance assessment process

6.1 Overview

The conformance assessment process is the complete process of accomplishing all conformance testing activities necessary to enable the conformance of the IUT to be assessed.

It may be performed by an identifiable part of a manufacturer's organization (self-testing), a user or an independent test house (third party testing).

An overview of the conformance assessment process is given in Figure 7.

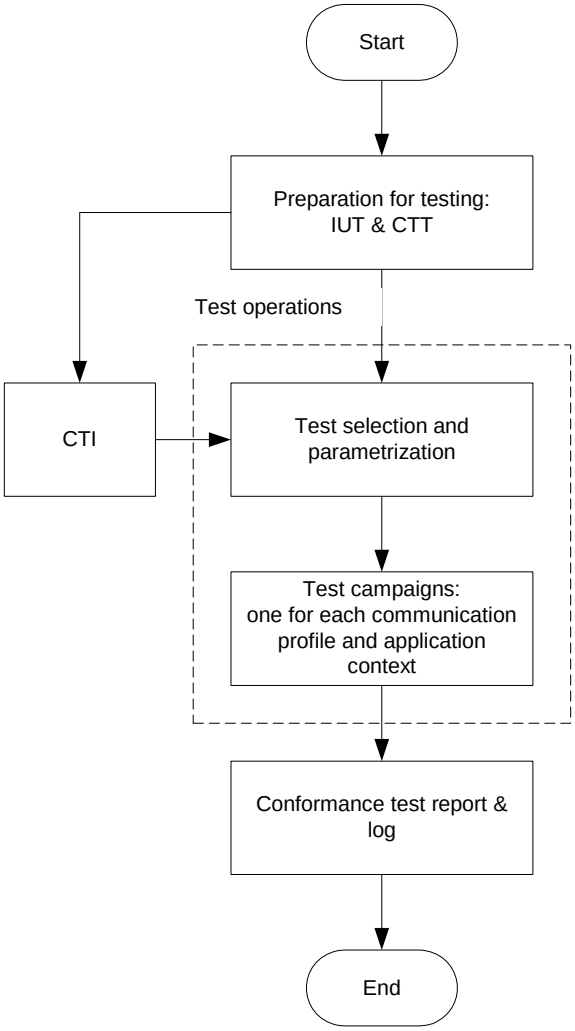

Figure 7 – Conformance assessment process overview

The preparation for testing phase involves:

- the preparation of the IUT;
- the production of the CTI file;
- the preparation of the CTT.

The test operations include:

- review of the CTI;
- test selection and parameterization;
- one or more “test campaigns”.

At the end of each test campaign, a conformance test report is produced.

In the following, the elements of the conformance test process are described and the use of the CTT is explained.

6.2 Preparation for testing

6.2.1 Preparation of the IUT

The IUT shall be prepared for testing with a configuration representative for the intended application and a sufficient amount of data so that all the tests can be performed. The following provides a guideline:

- if the IUT supports more than one logical device, then at least two logical devices should be configured;
- if it is claimed that the IUT supports more than one authentication context, then at least one AA should be present for each authentication context. These can be in the same logical device or spread across the logical devices;
- if the purpose of the conformance assessment process is to obtain a Certificate, then the mandatory Management Logical Device shall be present and shall support a Public AA;
- instances of each standard interface class supported shall be present. The set of interface objects available should be representative for the intended application;
- the AAs shall provide access to the objects and attributes to be tested, with appropriate access rights and authentication;
- it is the responsibility of the manufacturer to restrict access rights to attributes, which must not be modified during the test. This can be done by providing extra information in the CTI;
- if load profile with selective access are to be tested, then a sufficient amount of data should be present. The conditions are specified in [7];
- the set of xDLMS services should be representative for the intended application.

See also Clause 7.5, Scope and validity of the certification.

6.2.2 Production of the CTI

To evaluate the conformance of an IUT, it is necessary to have a statement on the capabilities and options, which have been implemented in the IUT, so that it can be tested against relevant requirements, and against those requirements only. Such a statement is known as an Implementation Conformance Statement (ICS).

It also necessary to have information relating to the IUT and its testing environment, like addresses, timeouts, baud rates, passwords. This information is known as Implementation Extra Information for testing (IXIT).

The Conformance Test Information (CTI) file, in addition to the identification of the manufacturer and the IUT, includes the ICS and the IXIT. It can be prepared using the template provided by the CTT. The template can be loaded from the **View** menu. A **Help,** explaining the contents and the syntax of the CTI is provided. The CTI editor has a built in syntax checker.

more details, see complete Yellow Book …

6.3 Test operations

6.3.1 Review of the CTI

Before the testing is started, the CTI file shall be reviewed:

- it shall be checked, if the necessary informative declarations are present;
- it shall be checked if the conformance statements are present and coherent;
- it shall be checked if the mandatory extra information elements are present.

6.3.2 Test selection and parameterization

The test suites and test cases to be performed can be selected.

If the purpose of the test campaign is to obtain a Certificate, then all COSEM object tests “ALL COSEM” and all application layer tests “ALL APPL” shall be selected. If the IUT uses the 3-layer, connection-oriented, HDLC based communication profile, the all Data link layer tests shall be selected as well.

Based on the information taken from the IUT and the CTI, the CTT executes only the tests applicable. The test cases are automatically parameterized.

6.3.3 Test campaigns

If the IUT supports more than one communication profiles, then a test campaign is needed for each communication profile for which compliance is claimed.

If the IUT supports more than one communication interfaces, then a test campaign may be run on each interface.

If the IUT supports more than one application context, then a test campaign is needed for each application context for which compliance is claimed.

From the **View** menu, the line traffic shall be selected, and then the test campaign shall be started from the **Run** menu. If necessary, the test can be stopped using **Abort**.

The progress of the test can be followed on the Conformance test report, Conformance log and Line traffic windows. It may happen, that during the test campaign, an exception occurs, terminating the test. The possible causes and measures are explained in the **Help** menu.

more details, see complete Yellow Book …

6.4 Documents generated by the CTT

6.4.1 Conformance test report

The conformance test report is automatically generated during each test campaign. It is a digitally signed text file, containing the following elements.

- date of testing;
- identification of the test tool and license owner;
- identification of the manufacturer as declared in the CTI file;
- identification of the IUT as declared in the CTI file;
- a summary of results for each test suite;
- the result of each test case;
- a copy of the CTI file;
- a digital signature, allowing to check the authenticity of the conformance test report.

more details, see complete Yellow Book …

6.4.2 Conformance log

The following Figures show the screen with basic logging, with HDLC logging enabled and with both HDLC and APDU logging enabled.

more details, see complete Yellow Book …

6.4.3 Line traffic

The line traffic window can be opened from the **View** menu. As the test progresses, it shows the telegrams sent to (in green) and the received from (in red) the IUT. It can be copied to a text file for further analysis.

more details, see complete Yellow Book …

6.4.4 Viewing the conformance test plans

To help analysing the results, the conformance test plans and the test scripts can be viewed from the CTT.

The test plans can be opened from the View menu.

more details, see complete Yellow Book …

6.4.5 Viewing the test scripts

Similarly, the test scripts can be opened from the **View** menu. Alternatively, they can be opened from either the Test report or the Test log window. To do this, a test case name has to be selected, and then clicking right opens a contextual menu.

more details, see complete Yellow Book …

6.4.6 The “Create snapshot” feature

In the **Help** menu, a **Create snapshot** function is available. When activated, the contents of the conformance test report, conformance log and line traffic windows, together with the CTI file are saved in a single zip file.

This feature is useful if an exception occurs during the test.

more details, see complete Yellow Book …

6.4.7 The “Create certification report” feature

At the end of a successful test campaign, the conformance test report, conformance log and line traffic window, together with the CTI file can be packaged into a single zip file using the **Create Certification report** feature.

more details, see complete Yellow Book …

6.5 Repeatability of results

In order to achieve the objective of credible conformance testing, it is clear that the result of executing a test case on an IUT should be the same whenever it is performed. Experience shows that it may not be possible to execute a complete conformance test suite and observed test outcomes which are identical to those obtained on another occasion.

Nevertheless, at the test case level, every effort has been made to minimize the possibility that a test case produces different test outcomes on different occasions.

6.6 Requirements for test laboratories

Conformance assessment may be performed by a vendor, a user or a third party.

If the test is done by the vendor – which is the preferred method – the test laboratory shall be an identifiable part of the vendor’s organisation.

7. The certification process

7.1 General

The purpose of the certification process is to obtain a “DLMS/COSEM compliant” Certificate. This clause describes the necessary steps.

7.2 Initiation of the certification process

The certification process may be initiated by any member of the DLMS UA.

The manufacturer of the device to be certified shall be also a member of the DLMS UA and shall possess a three-letter manufacturer ID.

7.3 Submission of conformance test documents

The test results for each communication profile and application context for a given type shall be submitted to the DLMS UA at info@dlms.com.

The DLMS UA verifies the contents and the authenticity of the conformance test report(s). The documents submitted are used as supporting documentation for the Certificate.

The DLMS UA maintains the right to discuss the contents of the conformance test report with the organization having initiated the certification process.

7.4 The certification

A Certificate may be issued only if the test specimen passed all applicable tests. The Certificate contains the following elements, *as found* in the conformance test report as applicable:

- a unique Certificate number assigned by the DLMS UA;
- the identification of the IUT as declared in the CTI;
- the identification of the management Logical Device (SAP = 1);
- the identification of the manufacturer as declared in the CTI;
- the identification of the CTT version used for testing;
- the identification of the license owner;
- the version of the COSEM Object definitions file selected in “options” for testing;
- for each test performed:
    - the communication profile(s) used for testing;
    - the opening mode (in the case of the 3-layer HDLC based profile);
    - the application context;
    - the date of testing; and
    - the digital signature of the test report.
- an indication that the Certificate is only valid for the functions successfully tested;

- an indication that the test is executed on one specimen of the product and that the test results may not be applicable for other test specimens;
- any remarks added by the DLMS UA, as seen fit;
- date of issue and signature.

The template of the Certificate is included as Annex A.

Information on the configuration and functions tested is available in the test report.

The DLMS UA publishes the Certificate on its website at www.dlms.com.

The Certificate entitles the manufacturer to place the “DLMS/COSEM compliant mark” on its products and documentation.

The test results are filed, but not published.

7.5 Scope and validity of the certification

The DLMS/COSEM Certificate certifies, that the IUT as identified by the manufacturer / test house passed the tests applicable for the given configuration.

The supporting evidence is the conformance test report with the conformance log and line traffic.

DLMS/COSEM compliance can be claimed only for the features tested.

The DLMS UA does not control if the meters manufactured are identical to the meter tested.

The Certification remains valid as long as no design or manufacturing changes in communication hard- and software with essential influence on the implementation have been made. If changes have been made, a re-test is necessary.

7.6 Disclaimer

The DLMS UA takes all possible effort to ensure that the conformance test plans and the conformance test tool are line with the DLMS/COSEM specification and provide a reasonable depth of testing.

The Certificate does not mean however that an absolute proof of conformance is given.

7.7 Reproduction of conformance tests by the DLMS UA

If required either by the manufacturer, a user or a third party tester, the DLMS UA will reproduce, at agreed conditions, the test using a test specimen made available and reproducing the test conditions as far as possible.

8. The quality program

8.1 General

An important element of the DLMS/COSEM conformance testing process is the quality program. It includes:

- validation of the conformance test plans and the CTT;
- the support provided to users;
- maintenance.

8.2 Validation of the conformance test plans and the CTT

The validation of the conformance test plans and the CTT has been done in several steps:

1. the test plans have been written by experts from different members of the DLMS UA WG Maintenance based on the Blue Book [1] and the Green Book [2];
2. all test scripts, implementing the abstract test cases have been validated by running them against several implementations.

8.3 Assistance provided to users

The DLMS UA, upon request, provides support to the users of the tool. For this purpose, test results can be sent to the DLMS UA: ctt-support@dlms.com.

8.4 Maintenance

The DLMS UA maintains the conformance testing process to eliminate any problems with the tool found during testing, to enhance tests and to accommodate changes in the standards.

The procedure is the following:

1. a proposal, together with a justification is made to add or modify a test. This can be initiated by any member of the DLMS UA or by the DLMS UA itself;
2. the request is investigated by the DLMS UA;
3. if the request is accepted, the conformance test plans are amended by the DLMS UA;
4. the new test cases are implemented by the tool developer;
5. the new test cases are validated by the DLMS UA;
6. the amended conformance test plans are published;
7. a new version of the CTT is made available to the licensed tool users.

This process is supported by the DLMS UA website.

In the following, the process is illustrated by use cases.

8.5 Use cases

8.5.1 Use case 1 – introducing a new standard OBIS code

A vendor needs a new standard OBIS code to support a new functionality in the metering equipment.

The proposal is submitted to the DLMS UA. The DLMS UA checks if the proposal is in line with the standards. If approved, the COSEM Object definition tables [8] are amended and a new .dat file is made available for download.

8.5.2 Use case 2 – modification of an existing test

If it is found that despite of careful validation, any test case is not fully compliant with the standard, or it is necessary to enhance a test, then a proposal may be submitted to the DLMS UA by the vendor or the user and the process described above is followed.

8.5.3 Use case 3 – adding a test for a new standard feature

A vendor implements a feature described in the DLMS/COSEM specification, but which is not yet covered in the CTT.

The vendor submits the proposed test plan to the DLMS UA and the process described above is followed.

8.5.4 Use case 4 – revision of the specification

The DLMS UA initiates a revision or amendment of the DLMS/COSEM specification (e.g. introducing a new protocol stack).

The conformance requirements and the test plans are prepared together with the standard, but at least upon the acceptance of the new standard.

The DLMS UA initiates the maintenance of the tool.

Annex A
Certificate template

DLMS User Association

Chemin de Merdisel 9 Tel. +41 22 980 980 0
CH-1242 Satigny-Geneva Fax +41 22 980 980 9
Switzerland dlms@dlms.com

Certification No.

This is to certify that the metering equipment identified as:

Type:
Mgmt. LDN:

manufactured by:

has successfully passed the DLMS/COSEM Conformance test, under the following conditions:

- CTT version: CTT 2.3
- Licensed to:
- COSEM object definitions file version:

Test performed	Communication profile	Opening mode	Application context	Date and time	Digital signature of the test report
Test 1					
Test 2					

The authenticity of the test report(s) has been verified by the DLMS User Association and the metering equipment identified above is listed on its web site at: http://www.dlms.com.

With this, the manufacturer is entitled to display the DLMS/COSEM Compliant mark – shown below – on its product duly identified and on its product literature.

The test reports are filed by the DLMS UA. Copies are available from the manufacturer.

This Certificate is only valid for the functions successfully tested. The test has been executed on one specimen of the product, as identified by the Management Logical Device Name reported. Results may not be applicable for other test specimens.

Date: Geneva, the

Paul Fuchs
General Secretary

Annex B
Conformance test plans

Conformance test plans are kept as separate documents. The most recent version can be downloaded from www.dlms.com (members only).

Actually, three test plans exist:

DLMS/COSEM conformance testing – Conformance test plans - Data link layer using HDLC protocol

more details, see complete Yellow Book …

DLMS/COSEM conformance testing – Conformance test plans - COSEM application layer

more details, see complete Yellow Book …

DLMS/COSEM conformance testing – Conformance test plans - COSEM Interface objects

more details, see complete Yellow Book …

Note: Conformance test specification - Physical layer (DLMS UA 1001-2) does not exist any more. The Physical layer is implicitly tested by testing the higher layers.

Annex C
Bibliography

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IEC 62056-21: 2002, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 21: Direct local data exchange*

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IEC 62056-47: 2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 47: COSEM transport layer*

IEC 62056-53:2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: COSEM Application layer*

IEC 62056-61:2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 61: OBIS Object identification system*

IEC 62056-62: 2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 62: Interface objects*

EN 13757-1: 2002, Communication system for meters and remote reading of meters - Part 1: Data exchange