



DPC: 24 / 30482957 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Project No. 2023/02686

Responsible committee: PEL/57 Power systems management and associated information exchange

Interested committees:

Title: BS EN IEC 61850-10/AMD1 Communication networks and systems for power utility automation Part 10:
Conformance testing

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Responsible Committee Secretary: **Ms Andreea Vieru (BSI)**
Direct tel: **0208 996 7432**
E-mail: **andreea.vieru@bsigroup.com**

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

PROJECT NUMBER:

IEC 61850-10/AMD1 ED2

DATE OF CIRCULATION:

2023-12-29

CLOSING DATE FOR VOTING:

2024-03-22

SUPERSEDES DOCUMENTS:

57/2607/RR

IEC TC 57 : POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE

SECRETARIAT:

Germany

SECRETARY:

Mr Heiko Englert

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☒ QUALITY ASSURANCE☐ SAFETY☒ SUBMITTED FOR CENELEC PARALLEL VOTING☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING**Attention IEC-CENELEC parallel voting**

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (See [AC/22/2007](#) or [NEW GUIDANCE DOC](#)).

TITLE:

Amendment 1 – Communication networks and systems for power utility automation – Part 10: Conformance testing

PROPOSED STABILITY DATE: 2025

NOTE FROM TC/SC OFFICERS:

In addition to this Amendment, the working group has as well prepared a so-called consolidated edition 2.1 based on the amendment and the existing Ed.2. The document with the consolidated version is circulated in parallel to this CDV as 57/2629/INF so that national committees can see the implications of the amendment to the existing edition. After the complete CDV/FDIS approval process the consolidated edition will be published together with the amendment under reference IEC 61850-10, Ed.2.1.

When preparing their comments, National Committees are kindly asked to refer to the line numbers in the consolidated version for simplicity.

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Document history

Any person intervening in the present document is invited to complete the table below before sending the document elsewhere. The purpose is to allow all actors to see all changes introduced and the intervening persons.

Any important message to IEC editors should also be included in the table below.

Name of intervening person	Document received		Brief description of the changes introduced	Document sent	
	From	Date		To	Date
Ch. Brunner	R. Schimmel	4.8.23	Added this first page; sent document to secretary	N. Heidger	23.10.23

This table will be removed by IEC editors before FDIS circulation (in case of IS) or before final publication (in case of TS or TR).

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMUNICATION NETWORKS AND SYSTEMS
FOR POWER UTILITY AUTOMATION –
Part 10: Conformance testing****AMENDMENT 1****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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Amendment 1 to International Standard IEC 61850-10 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The major changes in this amendment are as follows:

- server device conformance test procedures have been updated;
- client device conformance test procedures have been updated;
- sampled values test procedures have been merged into server;
- server IED configuration tool related conformance test procedures have been updated;
- GOOSE performance test procedures have been updated.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/xxxx/FDIS	57/xxxx/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61850 series, under the general title *Communication networks and systems for power utility automation*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

1 Scope

Insert after the first paragraph:

Cyber security extensions provided by IEC 62351 shall be conformance tested against the IEC 62351-100-4 and IEC 62351-100-6.

2 Normative references

Insert:

IEC/IEEE 61850-9-3:2016, Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility

IEC 61869-9:2016, Instrument transformers – Part 9: Digital interface for instrument transformers

Remove:

IEC 62439-3:2012, Industrial communication networks – High availability automation networks – Part 3: Parallel Redundancy Protocol (PRP) and High Availability Seamless Redundancy (HSR)

4 Abbreviated terms

Insert:

PTP Precision Time Protocol

5 Introduction to conformance testing

No change

6 Device related conformance testing

Replace the existing Clause 6 by the following text:

6.1 Test methodology

Communication testing needs at least two devices to communicate with each other. Comprehensive interoperability testing of all possible products is not feasible. Therefore, the test concept shall include test devices, test configurations, and test scenarios. The dynamic behaviour should be tested properly by using well-defined test cases.

Messages are generated to test the communication capabilities. Hardwired stimuli (contacts, voltages, currents, etc.) and stimuli coming over a serial link if applicable should be used if applicable.

Special attention shall be given to communication equipment such as star-couplers, switches, etc. which shall support all requested features of the standard but not introduce additional contingencies and limitations. The impact of the communication method (client-server, GOOSE, SV, etc.) used by the DUT shall be considered properly in the test procedures. Verification of functional applications (use of GOOSE messages) is not part of a conformance test even if advanced tools may offer such analysis.

6.2 Conformance test procedures

6.2.1 General

This subclause describes the test procedure requirements, test structure, the abstract test cases (what is to be tested). The format and a few examples of detailed test procedures (how to perform the test) are given in Annex A.

6.2.2 Test procedure requirements

The test procedure requirements are:

- The abstract test cases describe what shall be tested, the detailed test procedures describe how a test engineer, or a test system shall perform the test.
- Test cases include a reference to the applicable paragraph(s) in the referenced document(s).
- The test results shall be reproducible in the same test lab and in other test labs.
- Support automated testing with minimal human intervention, as far as reasonably possible.
- The tests shall focus on situations that cannot easily be tested during, for example, a factory or site acceptance test, and prevent inter-operability risks, for example:
 - check behaviour of the device on delayed, lost, double and out of order packets,
 - configuration, implementation, operation risks,
 - mismatching names, parameters, settings, or data types,
 - exceeding certain limits, ranges or timeouts,
 - force situations to test negative responses,
 - check all (control) state machine paths, and
 - force simultaneous control operations from multiple clients.
- The ACSI tests focus on the application layer (mapping).
- The device under test (DUT) is considered as a black box. The I/O and the communication interface are used for testing.
- The test includes testing the versions, data model and configuration file, and the use of applicable ISO/IEC 9646 series terminology.

The test procedures shall be formatted as outlined in Figure 2. With this format, the test procedures document can also be used as test report. A few test procedure examples are depicted in Annex A.

<u>Test reference</u>	<u>Test purpose</u>	☐ Passed ☐ Failed ☐ Inconclusive
<u>Ref. Part Clause and Subclause of IEC 61850</u>		
<u>Expected result</u>		
<u>Test description</u>		
<u>Comment</u>		

Figure 2 – Test procedure format

6.2.3 Test structure

- The test cases are structured as follows:
- documentation and version control (IEC 61850-4);
 - configuration file (IEC 61850-6);
 - data model (IEC 61850-7-3 and IEC 61850-7-4);
 - mapping of ACSI models and services (IEC 61850-7-2 and applicable SCSM).

6.2.4 Test cases to test a server device

6.2.4.1 General

This part of the IEC 61850 series specifies the test system architecture and abstract test cases for server devices. The abstract test cases shall be used for the definition of test procedures to run in tests.

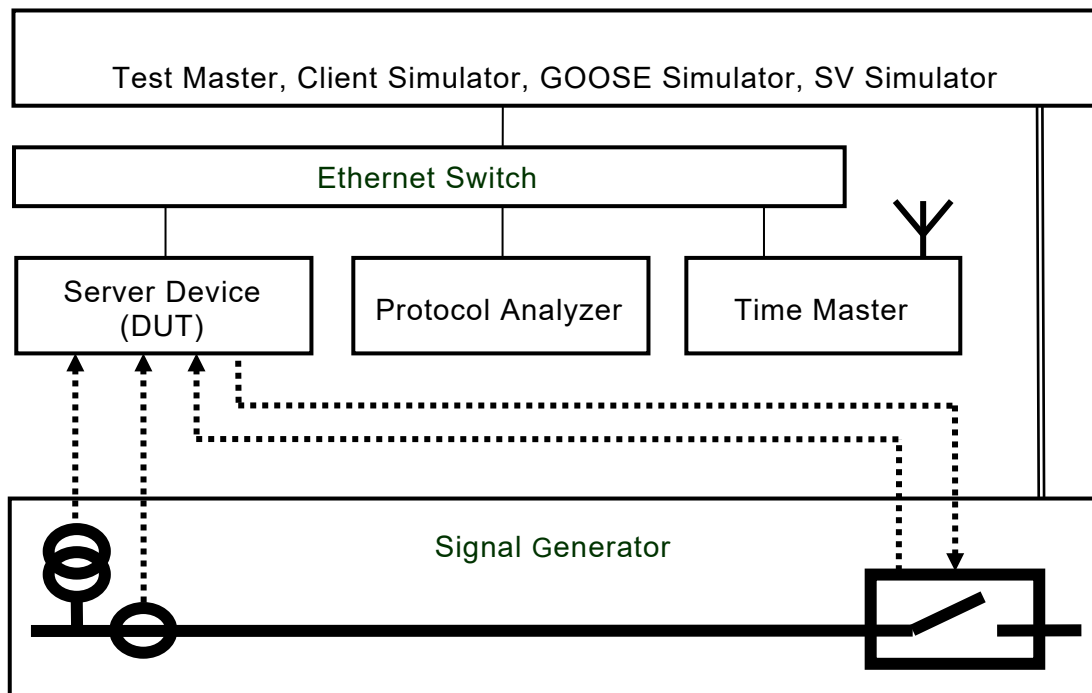
NOTE The SCSM specific test procedures are provided by test facilities agreed upon by the market participants.

6.2.4.2 Test system architecture to test a server device

In order to be able to perform a server device test, a minimum test set-up is necessary. The test architecture contains (see Figure 3):

- DUT;
- client simulator to initiate and generate TPAA messages;

- 87 – GOOSE simulator to send correct and incorrect GOOSE messages;
 88 – SV simulator to send correct and incorrect SV messages;
 89 – test master to start/stop test cases, start/stop the analyzer and archive test results;
 90 – time master;
 91 – engineering tool to configure the DUT;
 92 – protocol analyzer to store all the network traffic for each test case;
 93 – signal generator to force binary and analogue events, controlled by the test master or test
 94 engineer.



IEC 2356/12

Figure 3 – Test system architecture to test a server device

The test system shall include documentation regarding test system hardware and test system software.

6.2.4.3 Documentation and version control test procedure overview

The test cases listed in Table 1 shall apply.

Table 1 – Server documentation test cases

Test case	Test case description
sDoc1	Check if the major/minor software version in the PICS documentation and the DUT do match (IEC 61850-4). PICS shall contain: - ACSI conformance statement according to IEC 61850-7-2 Annex A - IEC 61850-9-3 PICS (when supported) - IEC 61869-9 conformance class a, b, c or d (when supported)
sDoc2	Check if the major/minor software version in the PIXIT documentation and software version of the DUT does match (IEC 61850-4). PIXIT shall indicate the required information as requested in the test cases

Test case	Test case description
sDoc3	Check if the major/minor software version in the MICS documentation and software version of the DUT does match (IEC 61850-4). MICS shall indicate the semantics of all non-standard Logical Nodes, Data Objects, Data Attributes and enumeration. MICS may contain other items in additional sections of the MICS.
sDoc4	Check if the major/minor software version in the TICS documentation and software version of the DUT does match (IEC 61850-4). TICS shall indicate that the mandatory and applicable technical issues are implemented .
sDoc5	Check the ICD if the server capabilities in the IED “services” section(s) do correspond with the ACSI services specified in the PICS

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103 **6.2.4.4 Configuration file test cases**

104 The test cases listed in Table 2 shall apply.

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Table 2 – Server configuration file test cases

Test case	Test case description
sCnf1	Verify the SCL version = "2007", revision = "B", release = "4"
sCnf2	Verify the XML encoding is UTF-8 or utf-8; <?xml version="1.0" encoding="UTF-8"?>
sCnf3	Verify that the ICD validates according to SCL schema: version 2007, revision B, release 4
sCnf4	Use the ICT tool to export an ICD file. When ICD is not supported export IID file. Use this file for the remaining tests. It is not allowed to change this SCL file with general purpose tools such as an XML editor. Condition: when the ICD is not fixed
sCnf5	Import the ICD or IID file from sCnf4 into SCT SIMULATOR and generate SCD file as follows: • update IED name • change IP/MAC address • change SubNetwork name • add DataSet's (when supported) • add ReportControl's (when supported) • add GSEControl's (when supported) • add SampledValueControl's (when supported) • add data flows (ExtRef's) from other IED's (when nolctBinding=F) Import the SCD file into the ICT tool and select the IED to be handled from IED's named in the SCD file by IED name
sCnf6	Complete the GOOSE and SV subscribe from sCnf5 and export the IID file. Verify that the ExtRef intAddr does not change when the external binding changes. The intAddr should not contain external data. Condition: when GOOSE and/or SV subscribe is supported
sCnf10	Verify the ICD has at most one Substation or Line or Process exists at SCL level and the attribute "name" is "TEMPLATE". Condition: when Substation or Line or Process section is present
sCnf11	Verify the ICD has none of the LNode bound to an IED different from "TEMPLATE" or "none" Condition: when Substation section is present
sCnf20	Verify that the "Communication" element exists: • IED/Services/DynAssociation or IED/AccessPoint/Services/DynAssociation is declared) and IED/AccessPoint/ Server is declared or • LN0/GSEControl element exist or • LN0/SampledValueControl element exist
sCnf21	For each ConnectedAP/Address element: Verify that exactly one "P" element with attribute type="OSI-PSEL" with a valid value (non-empty, even number of characters, maximum 16 characters 0-9,A-F) Verify that exactly one "P" element with attribute type="OSI-SSEL" with a valid value (non-empty, even number of characters, maximum 16 characters 0-9,A-F) Verify that exactly one "P" element with attribute type="OSI-TSEL" with a valid value (non-empty, even number of characters, maximum 8 characters 0-9,A-F) (Note that if xsi:type mechanism is used then schema validator can automatically verify the type) Condition: IED/Services/DynAssociation is declared

sCnf22	Verify that for each accesspoint no more than one "P" element with attribute type="OSI-AP-Title" and "OSI-AE-Qualifier and "IP" and "IP-SUBNET", "IP-GATEWAY", OSI-NSAP, OSI-AP-Invoke, OSI-AE-Invoke and DNSName exists. For each of these that exist: Verify OSI-AP-Title value contains only decimal digits and non-repeating commas Verify OSI-AE-Qualifier value is decimal representation from 0-65535 Verify IP and IP-SUBNET and IP-GATEWAY contain a "standard dotted-decimal" for Ipv4 Verify Ipv6 and Ipv6-SUBNET and Ipv6-GATEWAY contain a RFC 4291 address with leading zeros for Ipv6 Verify OSI-AP-Invoke and OSI-AE-Invoke values are between 0 and 65535.
sCnf23	For each GSE element: Address/P[type=MAC-Address] right digit of first octet is odd (1,3,5,7,9,B,D,F) (multicast). Address/P[type=VLAN-ID] present Address/P[type=PRIORITY] present Address/P[type=APPID] = 0000-3FFF or 8000-BFFF Condition: when GSE element is present
sCnf24	For each SMV element referencing a SampledValueControl whose attribute multicast=true or missing, verify Address/P[type=MAC-Address] right digit of first octet is odd (1,3,5,7,9,B,D,F) (multicast) For each SMV element referencing a SampledValueControl whose attribute multicast=false, verify Address/P[type=MAC-Address] right digit of first octet is even (0,2,4,6,8,A,C,E) (unicast) For each SMV element in the ICD: - Address/P[type=VLAN-ID] present - Address/P[type=PRIORITY] = present - Address/P[type=APPID] = 4000-7FFF Condition: when SMV element is present
sCnf25	Verify the ICD that each Subnetwork/ConnectedAP@iedName is "TEMPLATE"
sCnf26	Verify each Subnetwork/ConnectedAP@apName matches one of IED/AccessPoint@name
sCnf27	Verify for each GSE element, the GSE@cbName points to a GSEControl within the AccessPoint pointed to by GSE//@apName and GSE@IdInst. Condition: when GSE element is present
sCnf28	Verify for each SMV element, the SMV@cbName points to a SampledValueControl within the AccessPoint pointed to by SMV//@apName and SMV@IdInst. Condition: when SMV element is present
sCnf29	Verify that at least one SubNetwork type has value "8-MMS" when type is present or type is absent
sCnf40	Verify the ICD has exactly one IED element and that the attribute "name" of the element is "TEMPLATE"

sCnf41	Verify all FCDA elements reference existing data and that doName and (optional) daName contain correct references. (ref 61850-6 §9.3.7 Table 22). - Verify attributes IdInst, InClass, doName, and fc are declared. - Verify attribute InInst is declared if InClass is not "LLN0". - Verify first component of doName references a DO@name and second component (if any) references a SDO@name within DO referenced by first component - Verify first component of daName (if present) references a DA@name and other component (if any) references a BDA@name within structure hierarchy of the DA referenced by first component - Verify that at most one component of doName/daName contains an index and that ix attribute is identical to this index (see 61850-6 Table 22). Valid example: <FCDA IdInst="LD0" InClass="MHAI" InInst="1" fc="MX" doName="HA.phsAHar(0)" daName="cVal.mag.f" ix="0" />
sCnf42	Verify DOI/SDI/DAI structures match DataTypeTemplates (DOI@name is valid DO in LD/LN and DAI@name is a leaf within that DO and SDI@name form hierarchy between DOI and DAI)
sCnf43	Verify that the ICD has none of the ExtRef references IEDs different from TEMPLATE or "@" Condition: when ExtRef iedName attribute is present
sCnf44	Verify that the ICD has no ClientLN elements exist within ReportControl and no IEDName elements within GSEControl and SampledValueControl
sCnf45	Verify all GSEControl/SampledValueControl/ReportControl have confRev>0 when datSet is not empty
sCnf46	Verify IED@originalScIVersion, IED@originalScIRevision and IED@originalScIRelease attributes match corresponding attributes of SCL element (SCL@version, SCL@revision and SCL@release)
sCnf47	Verify multiple identically named DOI/SDI/DAI elements at the same level differ by "ix" attribute (either different "ix" or "ix" attribute not present). Condition: when DOI/SDI/DAI ix attribute is present
sCnf48	Verify multiple LLN0.SGCB do not appear in the same logical device hierarchy (defined by LLN0.GrRef which references the parent logical device) Condition: when multiple SGCB are present
sCnf49	Verify element "Log" exists only in LLN0 Condition: when Log is present
sCnf50	Verify that the name length of IED, Logical Devices, Logical Nodes, data objects, data attributes, data sets and control blocks do not exceed the maximum length as specified in IEC 61850-7-2 clause 22.2 and SCSM
sCnf51	Verify that logical node LPHD is present in each root logical device (IEC 61850-7-1 clause 8.2.5)
sCnf52	Verify that DUT/tool can import file with GSEControl in multiple LN0 Add one GSEControl to first and last LN0 in the configuration of the device Condition: Services/GSESettings attribute cbName is not "fix" or absent and multiple Logical Devices exist and GOOSE max > 1
sCnf60	Verify that the attribute nameLength="64" exists in the IED/Services element
sCnf61	Verify that the Services section must not contradict existing control block and data sets; - Nr of DataSet elements <= ConfDataSet.max (if provided). - Nr of ReportControl instances <= ConfReportControl.max (if provided) - Nr of Buffered ReportControl instances <= ConfReportControl.maxBuf (if provided) - Nr of GSEControl <= GOOSE.max (if provided) - Nr of SMVControl <= SMVsc.max (if provided) - Nr of LogControl <= ConfLogControl.max (if provided) - Nr of LGOS instances <= SupSubscription.maxGo (if provided) - Nr of LSVS instances <= SupSubscription.maxSv (if provided)

sCnf62	Verify the AccessPoint/Services element does not contain the attribute nameLength Condition: when AccessPoint Services element is present
sCnf63	Verify AccessPoint/Services element does not contain any of the elements ConfLNs, and ConfLdName Condition: when AccessPoint Services element is present
sCnf64	Verify that in case SupSubscription is claimed to be supported at least one instance of LGOS or LSVS must be in the ICD. Condition: when SupSubscription element is present
sCnf65	Verify that if serviceType=GOOSE is specified for ExtRef the ClientServices.goose=true or ClientServices_rGOOSE=true. For serviceType=SMV the ClientServices.sv=true or ClientServices.rSV=true Condition: when serviceType=GOOSE or serviceType=SMV is present
sCnf70	Verify for each DAType/BDA or DOType/DA with attribute "bType"=Struct has attribute "type" whose value matches DAType@id; does not declare valKind and does not contain a <Val> element
sCnf71	Verify for each DAType/BDA or DOType/DA with attribute "bType"=Enum has attribute "type" whose value matches EnumType@id
sCnf72	Verify type names do not exceed 255 characters, contain no "whitespace" characters and contain only characters from Basic-Latin and Latin-1-Supplement
sCnf73	Verify that each DOType element contains at least one SDO or DA element
sCnf74	Verify for each DA with FC="CO" (except "SBO") that the associated DAType contains the element <ProtNs type="8-MMS">IEC 61850-8-1:2003</ProtNs> Verify for each DA name="SBO" (FC="CO") contains the ProtNS element Note: type default value is 8-MMS so it's optional
sCnf75	Verify for each (instance of) DOType/DA[name=ctlModel] whose associated EnumType contains direct-with-normal-security has in the DOType a DA named "Oper". If ctlModel has valKind=RO and valImport=missing/false then use the configured ctlModel value instead of EnumType. Similar for sbo-with-normal-security, Oper, Cancel and SBO Similar for direct-with-enhanced-security, Oper Similar for sbo-with-enhanced-security, Oper, Cancel and SBOw
sCnf76	Deprecated same as sMdl18
sCnf80	Verify that <Val> element values actually match a value in the corresponding EnumType, "ord" shall not be used, only EnumVal element values. Ref IEC 61850-6 Table 45.
sCnf81	Verify that <Val> elements values match IEC 61850-6 Table "Data type mapping" (if no table rows then Val element is not allowed at all)
sCnf82	Verify for each LLN0 that if LLN0.NamPit.InNs is present it shall have value IEC 61850-7-4:2007B (and IdNs is valid domain name space), otherwise LLN0.NamPit.IdNs shall have value IEC 61850-7-4:2007B.
sCnf83	Verify each ctlModel has an associated <Val> element
sCnf84	Verify CDC=ORG references use the ACSI format (with ".", no "\$" and no functional constraint) and that the reference does exist Condition: when a data object with CDC=ORG is present
sCnf85	Verify for each Logical Device whose LLN0 does not contain GrRef, the existence of Data Object LLN0.NamPit Verify for each LLN0 which contains the DO NamPit, the existence and non-null value for Data Attribute LLN0.NamPit.configRev
IEC 61869-9 configuration file test cases	

sCnf100	Check if the server "ClientServices" capabilities in the ICD "services" section do match with the IED capabilities: - sv=true - maxSMV = supported number of SV streams Condition: when IEC 61869 SV subscribe is supported
sCnf120	Verify that all LDevice's with an IEC 61869 MSVCB have inst=MUnn where nn are digits.
sCnf121	Verify the existence of LPHD extension Data Objects: NamVariant, NamHzRtg, NamAuxVRtg (optional), NamHoldRtg and NamMaxDIRtg (table 903) and MaxDI (part 7-4 Ed2 Amd1) Verify the existence of LPHD.PhyNam data attributes: vendor, model, serNum, hwRev, swRev and d and that these attributes have valKind read-only. The effective logical node namespace: InNs = IEC 61869-9:2016[A]
sCnf122	Verify the existence of TCTR extension Data Objects: NamAccRtg, NamARtg, NamClipRtg (table 905) and Clip, HoldTmms (part 7-4 Ed2 Amd1) The effective logical node namespace: InNs= IEC 61869-9:2016[A]
sCnf123	Verify the existence of TVTR extension Data Objects: NamAccRtg, NamVRtg, NamClipRtg (table 907) and Clip, HoldTmms (part 7-4 Ed2 Amd1) The effective logical node namespace: InNs= IEC 61869-9:2016[A]
sCnf124	Verify for the logical nodes TCTR and TVTR naming; For the backwards compatible configuration: InnATCTR1, InnBTCTR2, InnCTCTR3, InnNTCTR4, UnnATVTR1, UnnBTVTR2, UnnCTVTR3, UnnNTVTR4 For the preferred rates: InnpTCTRn and UnnpTVTRn, where nn is a number and p is the phase (IEC 61869-9 Clause 6.903.7 and 6.903.8)
sCnf125	Verify the sampled value control block: For backward compatible configuration: - If name is MSVCB01; smpMod=SmpPerPeriod or absent, smpRate=80, confRev=1, nofASDU=1, smvID=xxxxMUnn01 - If name is MSVCB02; smpMod=SmpPerPeriod or absent, smpRate=256, confRev=1, nofASDU=8, smvID=xxxxMUnn02 - Name = MSVCBxx smpMod=SmpPerPeriod or absent, smpRate = 96 (the Japanese variant) where xx is not 01 nor 02 For preferred rates: - Name = MSVCBxx, smpMod=SmpPerSec where xx is not 01 nor 02 Verify the SmvOpts (clause 6.903.1 and IEC 61850-6 Table 31) - SmvOpt: sampleSynchronized="true" or absent; refreshTime="false" or absent; sampleRate="false" or absent; dataSet="false" or absent; security="false" or absent
sCnf126	Verify the SV dataset naming and elements For backward compatible configuration: PhsMeas1 Dataset elements as specified in clause 6.903.10 For preferred rates: PhsMeas2..99 (clause 6.903.10) Dataset elements sequence shall be i/q/i/q... and current proceeds voltage if both are present. Where multiple current or multiple voltage members for a common measurement point exist, they shall be adjacent and in the sequence: A, AB, B, BC, C, CA, N. The number of current and voltage elements shall match the number in the variant code currently under test.
sCnf127	Verify the AmpSv units, offset and scaleFactor attribute values match 61869-9 table 904, read-only and not vallImport=T Verify the VolSv units, offset and scaleFactor attribute values match 61869-9 table 906, read-only and not vallImport=T

sCnf128	Verify that if the device does not supply all samples for the backwards compatible rate(s), 'dummy' SAV data attributes might be referenced in the data set. To detect the difference between dummy and real samples in the SCL, the ICD shall have all LN's included but the ones that are not supported have the LN Mode preconfigured to "Off". Condition: a not supported channel
sCnf129	Check if the server "SMVSettings" capabilities in the ICD "services" section does match: • SamplesPerSec is present • SmpRate is present • SecPerSamples is absent • kdaParticipant / McSecurity is false or absent • pdcTimeStamp is false or absent • synchSrcId is absent/false/true (IEC 61850-9-2 Ed2 Amd1)

6.2.4.5 Data model test cases

The test cases listed in Table 3 shall apply.

Table 3 – Server data model test cases

Test case	Test case description
sMdl1	Verify presence of mandatory data objects for each LN type and data attributes for each DO type. Passed when all objects/attributes are present
sMdl2	Verify presence of conditional presence true data objects for each LN type and data attributes for each DO type. Passed when all objects/attributes are present
sMdl3	Verify non-presence of conditional presence false data objects for each LN type and data attributes for each DO type. Passed when these objects/attributes are not present
sMdl4	Verify data model mapping according to applicable SCSM concerning name length and object expansion. Passed when mapping is according to applicable SCSM
sMdl5	Verify data model mapping according to applicable SCSM concerning organisation of functional components.
sMdl6	Verify data model mapping according to applicable SCSM concerning naming of control blocks and logs. Passed when mapping is according to applicable SCSM.
sMdl7	Verify type of all data objects for each LN type and all data attributes for each DO type. Passed when type of all objects/attributes do match with the IEC 61850-7-3, IEC 61850-7-4 and the applicable SCSM
sMdl8	Verify that the enum types and values from the SCL and in the device are in specified range. Passed when all enum types and values match the 2007B.nsd.
sMdl9	Check if manufacturer specific data model extensions are implemented according to the extension rules in IEC 61850-7-1 clause 14.
sMdl10	Check if the order of the data attributes with the same functional constraint of the DO type match with IEC 61850-7-3. Passed when all attributes are in matching order
sMdl11	Moved to sCnf50
sMdl12	Check that the rules for multiple data object instantiation are kept (IEC 61850-7-1,14.6, IEC 61850-7-4)
sMdl13	Moved to sCnf82
sMdl14	Check the correct use of name spaces for non-substation power utility applications like for example Hydro and DER; Condition: when non-substation name space is used
sMdl15	Check if the SCL configuration file used to configure the DUT corresponds with the actual data object references, data types, data sets and pre-configured data values (settings) exposed by the DUT on the network.
sMdl16	Change one parameter/setting with valImport=True of each configurable data type and FC (FC can be DC, CF or SP) using the SCT SIMULATOR Change one parameter/setting when valImport=False or absent of each configurable data type and FC (FC can be DC, CF or SP) using the supplied IED configuration tool Check the updated online parameter/setting values correspond with the configured values in the SCL. Document the tested parameters in the test report. Condition when a parameter/setting is configurable
sMdl17	Check the "IdName" naming structure when supported. All online object references (including data sets, control block references and object references – CDC ORG) shall start with the "LDevice IdName" value instead of the "IED name" + "LDevice inst" Condition when Services ConfLdName is present
sMdl18	Verify that the indicated trigger option: <DA dchg, qchg, dupd > is conformant with the IEC 61850-7-3 standardized Trigger Option.

sMdl19	Configure IED attribute name in server resulting in a 64-character MMS domain name for the longest IdInst and verify online domain name agrees with configuration.
sMdl20	If ICD/IID file contains any valKind=Conf: Verify that online data model does not contain empty data structures as a result of all contained attributes being valKind=Conf
sMdl21	Modify some LN prefix / instance number in the SCD file, reconfigure the IED and load onto the IED. Browse the IED data model and check that changes are in, Condition: when Services ConfLNs fixPrefix=false or fixLnInst=false
sMdl22	Verify that at least one Logical Device has LPHDx.Proxy=false. Verify each tracking Data Object in LTRK (example: SpcTrk) appears in at most one LTRK Logical Node in all Logical Devices which have LPHDx.Proxy=false. For Logical Device with LPHDx.Proxy=true, no tests are required
sMdl23	Modify valKind from Set to RO in the SCD file, reconfigure the IED and load onto the IED. Browse the IED data model and check that the attributes are readonly. Condition: when Services ValueHandling setToRO=true, SICS-I211
sMdl24	Import a master clock device in the SCD file, reconfigure the IED and load onto the IED. Check that the IED synch to the master clock. Condition: SICS-I24 out-of-scope need clarification
sMdl25	Instantiate 2 new LGOS in the SCD file (IEC 61850-6 Annex G) one from a GOOSE control block from a logical device with IdName and one without. Reconfigure the IED and load onto the IED. Browse the IED data model and check that the LGOS is present. Condition: when Services SupSubscription maxGo>0
sMdl26	Instantiate a new LSVS in the SCD file (IEC 61850-6 Annex G) one from a Sampled Value control block from a logical device with IdName and one without. Reconfigure the IED and load onto the IED. Browse the IED data model and check that the LSVS is present. Condition: when Services SupSubscription maxSv>0
sMdl27	Verify that the IED can subscribe to a GOOSE published at the connectedAP of ServerAt accesspoint of another IED Condition: when GOOSE subscribe is supported

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112 6.2.4.6 Mapping of ACSI models and services test cases

113 Test items shall be grouped together in tables. The tables shall reflect the applicable service
114 models specified in Figure 3 of IEC 61850-7-2:

- 115 – application association (sAss);
- 116 – server, Logical device, Logical node, Data, and Data Attribute model (sSrv);
- 117 – data set model (sDs);
- 118 – service tracking (sTrk);
- 119 – substitution model (sSub);
- 120 – setting group model (sSg);
- 121 – unbuffered report control model (sRp);
- 122 – buffered report control model (sBr);
- 123 – log control model (sLog);
- 124 – generic object oriented substation events (sGop and sGos);

- 125 – control model (sCtl);
- 126 – time and time synchronisation model (sTm);
- 127 – file transfer model (sFt);
- 128 – Samples Values publishing (sSvp);
- 129 – Samples Values subscribing (sSvs);

130 Test cases are defined for each ACSI model and services in the following categories:

- 131 • positive = verification of normal conditions, typically resulting in response+
- 132 • negative = verification of abnormal conditions, typically resulting in response–

133 A test case is mandatory when the applicable ACSI model and ACSI service is supported by
 134 the DUT. This is specified in the PICS according to IEC 61850-7-2, Annex A. The test result
 135 interpretation (passed/failed) depends on the declared IED capabilities e.g. in the ICD file as
 136 well as on the test result.

137 6.2.4.7 Application association model

138 6.2.4.7.1 Positive test cases

139 The test cases listed in Table 4 shall apply.

140 **Table 4 – Association positive test cases**

Test case	Test case description
sAss1	Associate and client-release a TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss2	Associate and client-abort TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss3	Associate with maximum number of clients simultaneously (PIXIT)
sAss4	Verify the negotiation of MMS initiate parameters
sAss5	Verify the server initiates the Associate

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142 6.2.4.7.2 Negative test cases

143 The test cases listed in Table 5 shall apply.

144 **Table 5 – Association negative test cases**

Test case	Test case description
sAssN1	Check that with incorrect authentication parameters and authentication turned on at server the association fails, and with authentication turned off the server associates (IEC 61850-7-2 Subclause 8.3)
sAssN2	Check that with incorrect association parameters at server or client the association fails (IEC 61850-7-2 Subclause 8.3, PIXIT)
sAssN3	Set up maximum+1 associations, verify the last associate is refused
sAssN4	Disconnect the communication interface, the DUT shall detect association lost within a specified period
sAssN5	Interrupt and restore the power supply, the DUT shall accept an association request when ready
sAssN6	Verify the re-use of dropped association resources
sAssN7	Server Associate with mismatching association parameters

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146 **6.2.4.8 Server, logical device, logical node, and data model**

147 **6.2.4.8.1 Positive test cases**

148 The test cases listed in Table 6 shall apply.

149 **Table 6 – Server positive test cases**

Test case	Test case description
sSrv1	Request GetServerDirectory(LOGICAL-DEVICE) and check response (IEC 61850-7-2 Subclause 7.2.2)
sSrv2	For each GetServerDirectory(LOGICAL-DEVICE) response issue a GetLogicalDeviceDirectory request and check response (IEC 61850-7-2 Subclause 9.2.1)
sSrv3	For each GetLogicalDeviceDirectory response issue a GetLogicalNodeDirectory(DATA) request and check response (IEC 61850-7-2 Subclause 10.2.2)
sSrv4	For each GetLogicalNodeDirectory(DATA) response issue a GetDataDirectory request and check response (IEC 61850-7-2 Subclause 11.4.4) GetDataDefinition request and check response (IEC 61850-7-2 Subclause 11.4.5) GetDataValues request and check response (IEC 61850-7-2 Subclause 11.4.2)
sSrv5	Issue one GetDataValues request with different data reference hierarchy
sSrv6	For each write enabled DATA object issue a SetDataValues request and check response (IEC 61850-7-2 Subclause 11.4.3)
sSrv7	Issue one SetDataValues request with the maximum number of data values and check response. (Deprecated, this is not a valid SetDataValues request)
sSrv8	Request GetAllDataValues for each functional constraint and check response (IEC 61850-7-2 Subclause 10.2.3)
sSrv9	Evaluate the semantic of selected (volt/amp) analogue measurements: Verify analogue value (plausibility check, not accuracy) Verify quality bits, force situations to set specific quality bits Verify (UTC) timestamp value and quality (plausibility check, not accuracy) Verify scaling, range and units, change a setting and verify resulting value Verify dead band, change dead band and verify result Verify limit indications
sSrv10	Evaluate the semantic of selected status points: Verify status value Verify quality bits, force situations to set specific quality bits Verify (UTC) timestamp value and quality (plausibility check, not accuracy)
sSrv11	Verify that when blkEna is set to true by an operator the quality bit oldData and operatorBlocked is set by the server and the process data is not updated anymore (IEC 61850-7-3 Subclause 6.2.6)
sSrv12	Verify Mod/Beh values: off, test, blocked When Mod/Beh is off process data is not updated, Mod and Beh are updated, quality is set to invalid When Mod/Beh is test or test-blocked the process data quality test is set When Mod/Beh is blocked the process data quality is valid (IEC 61850-7-4 Annex A)
sSrv13	Verify logical device hierarchy; the LLNO.GrRef shall reference a valid logical device, the reference shall not result in a hierarchy loop, Beh value at higher level influences the lower levels correctly (i.e. like LD Beh influences LN behaviour dependent on LN Mod)
sSrv14	Verify blocking by operator using blkEna (deprecated)
sSrv15	Verify timestamps are identical for each phase in a WYE, DEL, SEQ data object

6.2.4.8.2 Negative test cases

The test cases listed in Table 7 shall apply.

Table 7 – Server negative test cases

Test case	Test case description
sSrvN1	Request following data services with wrong parameters (unknown object, name case mismatch, wrong logical device or wrong logical node) and verify response– service error – GetServerDirectory(LOGICAL-DEVICE) (IEC 61850-7-2 Subclause 7.2.2) – GetLogicalDeviceDirectory (IEC 61850-7-2 Subclause 9.2.1) – GetLogicalNodeDirectory(DATA) (IEC 61850-7-2 Subclause 10.2.2) – GetAllDataValues (IEC 61850-7-2 Subclause 10.2.3) – GetDataValues (IEC 61850-7-2 Subclause 11.4.2) – SetDataValues (IEC 61850-7-2 Subclause 11.4.3) – GetDataDirectory (IEC 61850-7-2 Subclause 11.4.4) – GetDataDefinition (IEC 61850-7-2 Subclause 11.4.5)
sSrvN2	Request SetDataValues of ENUMERATED data with out-of-range value and verify response– service error (IEC 61850-7-2 Subclause 11.4.3)
sSrvN3	Request SetDataValues with mismatching data type (e.g. int-float) and verify response– service error (IEC 61850-7-2 Subclause 11.4.3)
sSrvN4	Request SetDataValues for read-only data values and verify response– service error (IEC 61850-7-2 Subclause 11.4.3)

6.2.4.9 Data set model**6.2.4.9.1 Positive test cases**

The test cases listed in Table 8 shall apply.

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Table 8 – Data set positive test cases

Test case	Test case description
sDs1	Request GetLogicalNodeDirectory(DATA-SET) and check response (IEC 61850-7-2 Subclause 10.2.2) For each response issue a – GetDataSetValues request and check response (IEC 61850-7-2 Subclause 13.3.2) – GetDataSetDirectory request and check response (IEC 61850-7-2 Subclause 13.3.6)
sDs2	Request a persistent CreateDataSet with one member and with maximum possible members and check response (IEC 61850-7-2 Subclause 13.3.4) and verify that the persistent data set is visible for another client
sDs3	Request a non-persistent CreateDataSet with one, maximum members and check response (IEC 61850-7-2 Subclause 13.3.4) and verify that the persistent data set is not visible for another client
sDs4	Create and delete a persistent dataset, create the dataset again with the same name with one extra data value / re-ordered member and check the members
sDs5	Create and delete a non-persistent dataset, create the dataset again with the same name with one extra data value / re-ordered member and check the members
sDs6	Create a non-persistent dataset, release/abort the association, associate again and check the dataset has been deleted (IEC 61850-7-2 Subclause 13.1)
sDs7	Create a persistent dataset, release/abort the association, associate again and check the dataset is still present (IEC 61850-7-2 Subclause 13.1)
sDs8	Create and delete a persistent data set several times and verify every data set can be created normally
sDs9	Create and delete a non-persistent data set several times and verify every data set can be created normally
sDs10	Verify SetDataSetValues / GetDataSetValues with GetDataValues and SetDataValues
sDs11	Verify that the maximum number of persistent data sets with the maximum number of members can be created as specified in SCL
sDs12	Verify that the maximum number of non-persistent data sets with the maximum number of members can be created as specified in SCL
sDs13	Verify that a persistent data set can be created with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)
sDs14	Verify that a non-persistent data set can be created with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)
sDs15	Verify that the DUT supports data sets containing elements with different data hierarchy levels

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