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BSI Standards Publication

Communication networks and systems for power utility automation —

Part 80-1: Guideline to exchanging information from a CDC-based data model using IEC 60870-5-101 or IEC 60870-5-104

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National foreword

This Draft for Development is the UK implementation of CLC/TS 61850-80-1:2010. It is identical to IEC/TS 61850-80-1:2008. It supersedes DD IEC/TS 61850-80-1:2009 which is withdrawn.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature. It should be applied on this provisional basis, so that information and experience of its practical application can be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion to a European standard. A review of this publication will be initiated not later than three years after its publication by the European organization so that a decision can be taken on its status. Notification of the start of the review period will be made in an announcement in the appropriate issue of Update Standards.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the Technical Specification or to withdraw it. Comments should be sent to the Secretary of the responsible BSI Technical Committee at British Standards House, 389 Chiswick High Road, London W4 4AL.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power systems management and associated information exchange.

A list of organizations represented on this committee can be obtained on request to its secretary.

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**Communication networks and systems for power utility automation -
Part 80-1: Guideline to exchanging information from a CDC-based data
model using IEC 60870-5-101 or IEC 60870-5-104
(IEC/TS 61850-80-1:2008)**

Kommunikationsnetze und -systeme für
die Automatisierung in der elektrischen
Energieversorgung -
Teil 80-1: Leitfaden
zum Informationsaustausch
mit einer Datenbasis,
die auf gemeinsamen Datenklassen
beruht, mit Hilfe von IEC 60870-5-101
oder IEC 60870-5-104
(IEC/TS 61850-80-1:2008)

This Technical Specification was approved by CENELEC on 2009-12-11.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

This Technical Specification consists of the text of the International Technical Specification IEC 61850-80-1:2008 prepared by IEC TC 57, Power systems management and associated information exchange.

It was circulated for voting in accordance with the Internal Regulations, Part 2, Subclause 11.3.3.3 and was accepted as a CENELEC Technical Specification on 2009-12-11.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following date was fixed:

- latest date by which the existence of the CLC/TS
has to be announced at national level (doa) 2010-06-11

Annex ZA has been added by CENELEC.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60870-5-3	-	Telecontrol equipment and systems Part 5-3: Transmission protocols - General structure of application data	EN 60870-5-3	-
IEC 60870-5-4	1993	Telecontrol equipment and systems Part 5-4: Transmission protocols – Definition and coding of application information elements	EN 60870-5-4	1993
IEC 60870-5-5	1995	Telecontrol equipment and systems Part 5-5: Transmission protocols - Basic application functions	EN 60870-5-5	1995
IEC 60870-5-101	2003	Telecontrol equipment and systems Part 5-101: Transmission protocols - Companion standard for basic telecontrol tasks	EN 60870-5-101	2003
IEC 60870-5-104	2006	Telecontrol equipment and systems Part 5-101: Transmission protocols - Network access for IEC 60870-5-101 using standard transport profiles	EN 60870-5-104	2006
IEC 61400-25-2	-	Wind turbines Part 25-2: Communications for monitoring and control of wind power plants - Information models	EN 61400-25-2	-
IEC 61850	Series	Communication networks and systems in substations	EN 61850	Series
IEC 61850-6	-	Communication networks and systems in substations Part 6: Configuration description language for communication in electrical substations related to IEDs	EN 61850-6	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61850-7-2	2003	Communication networks and systems in substations Part 7-2: Basic communication structure for substation and feeder equipment - Abstract communication service interface (ACSI)	EN 61850-7-2	2003
IEC 61850-7-3	-	Communication networks and systems in substations Part 7-3: Basic communication structure for substation and feeder equipment - Common data classes	EN 61850-7-3	-
IEC 61850-8-1	-	Communication networks and systems in substations Part 8-1: Specific Communication Service Mapping (SCSM) - Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3	EN 61850-8-1	-
57/963/INF	-	IEC 61850 – Technical issues (www.tissue.iec61850.com)	-	-
IEEE 754	2008	Binary floating-point arithmetic	-	-
RFC 2200	June 1997	Internet official protocol standards – Request for comments 2200	-	-

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 80-1: Guideline to exchanging information from a CDC- based data model using IEC 60870-5-101 or IEC 60870-5-104

1 Scope and object

This technical specification gives a guideline on how to exchange information from a CDC-based data model (for example IEC 61850) using IEC 60870-5-101 or IEC 60870-5-104 between substation(s) and control center(s). Mostly guidelines for functions needed in a substation gateway device are given.

The goal of this technical specification is to describe standardized mapping of device-oriented data models (for example IEC 61850) with already defined attributes of CDC's and services (for example IEC 61850-7) onto the already defined ASDU's and services of IEC 60870-5-104 or IEC 60870-5-101. It is not the goal of this technical specification to add any extensions to published standards (for example IEC 61850 or IEC 60870-5-104 or IEC 60870-5-101).

After an introduction giving a basic description of the mapping, the mapping of the information model with associated data classes, and the mapping of services are described. Clause 9 shows how the mapped data and services according to the IEC 60870-5-104 and IEC 60870-5-101 protocol are marked (selected) in the interoperability sheet.

The scope of this technical specification is to achieve real-time exchange of process information required for operational purposes between a substation using a CDC-based data model (for example IEC 61850) and (a) control centre(s) using a communication link over a wide area network (WAN) compliant to the definitions of IEC 60870-5-101 or IEC 60870-5-104. The amount of real-time information provided by the substation-gateway device can vary dependent on the operational needs. Actors could be regional and nationwide control centers that receive real-time information in order to monitor and control geographically widespread processes. The described mapping can be used for several fields of application of power utilities, such as substations, hydro and wind power plants, and decentralized energy resources DER. The mapping is based on the definitions of the standard series IEC 61850 Edition 1.0 and IEC 60870-5-104:2006/IEC 60870-5-101:2003. The scope of the mapped IEC 60870-5-104 and IEC 60870-5-101 subset is given in Clause 9.

This technical specification focuses mainly on defining rules and functions of a gateway device as a part of the substation. However, the rules and functions are also valid when an IED may optionally be connected directly to a WAN compliant with IEC 60870-5-101 or IEC 60870-5-104 and therefore, the mapping has to be done inside the IED.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60870-5-3, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 3: General structure of application data*

IEC 60870-5-4:1993, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 4: Definition and coding of application information elements*

IEC 60870-5-5:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 5: Basic application functions*

IEC 60870-5-101:2003, *Telecontrol equipment and systems – Part 5-101: Transmission protocols – Companion standard for basic telecontrol tasks*

IEC 60870-5-104:2006, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IEC 61850 (all parts), *Communication networks and systems in substations*

IEC 61850-6, *Communication networks and systems in substations – Part 6: Configuration description language for communication in electrical substations related to IEDs*

IEC 61850-7-2:2003, *Communication networks and systems in substations – Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI)*

IEC 61850-7-3, *Communication networks and systems in substations – Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes*

IEC 61850-8-1, *Communication networks and systems in substations – Part 8-1: Specific Communications Service Mapping (SCSM) – Mapping to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

Document 57/963/INF: *IEC 61850 – Technical issues* (see www.tissue.iec61850.com)

IEC 61400-25-2, *Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models*

IEEE 754:2008, *IEEE Standard for Binary Floating-Point Arithmetic*

RFC 2200, *Internet Official Protocol Standards, Request for Comments 2200* (June 1997)

3 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

ACSI	Abstract communication service interface (defined for example in IEC 61850-7-2)
ASDU	Application service data unit
CASDU	Common address of ASDU
CDC	Common data class (defined for example in IEC 61850-7-3)
CI	Counter interrogation
COT	Cause of transmission
GI	General interrogation
GOOSE	Generic object oriented substation event
HMI	Human machine interface
IED	Intelligent electronic device
IOA	Information object address
LD	Logical device

LN	Logical node
PI	Process image
P/N	Positive/negative
QOI	Qualifier of interrogation
QDS	Quality descriptor
RFC	Request for comments
S/E	Select/execute
SCADA	Supervisory control and data acquisition
SCSM	Specific communication service mapping (defined for example in IEC 61850-8-1)
SCL	Substation configuration language (defined for example in IEC 61850-6)
TCP	Transmission control protocol
TI	Type Identification
TISSUE	Technical issue as part of the maintenance process of IEC 61850
WAN	Wide area network
XML	Extensible mark-up language

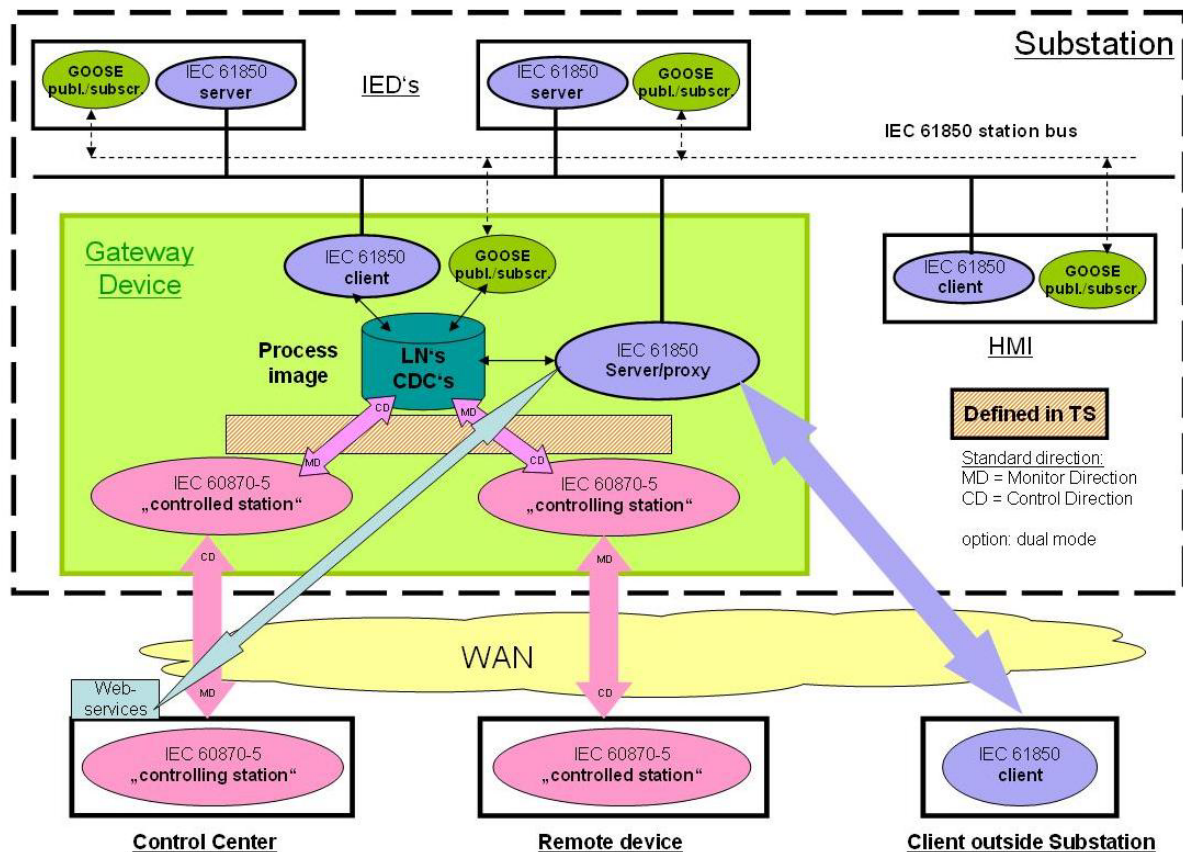
4 The mapping architecture

The mapping architecture consists of 5 parts:

- 1) conceptual architecture of a gateway device and associated use cases;
- 2) conceptual architecture of an IED directly connected to a WAN (optional);
- 3) mapping of the information model;
- 4) mapping of the data (which is in fact part of the information model);
- 5) mapping of the services.

5 Conceptual architectures and associated use cases

5.1 Conceptual architecture of a gateway device



IEC 2255/08

Figure 1 – Conceptual architecture of a gateway device

Figure 1 describes the conceptual architecture of a gateway device within a substation. The gateway device is decoupling the IEC 61850 station bus from the IEC 60870-5-101 or IEC 60870-5-104 WAN via a process image (PI). The advantage of this approach is that only services for control model interaction need to be mapped.

The PI is organized according the data model of IEC 61850 (LDs, LNs, CDCs).

The IEC 61850 client/GOOSE subscriber is used to update the PI with process data made available by the IEDs.

The IEC 61850 server/proxy is used to:

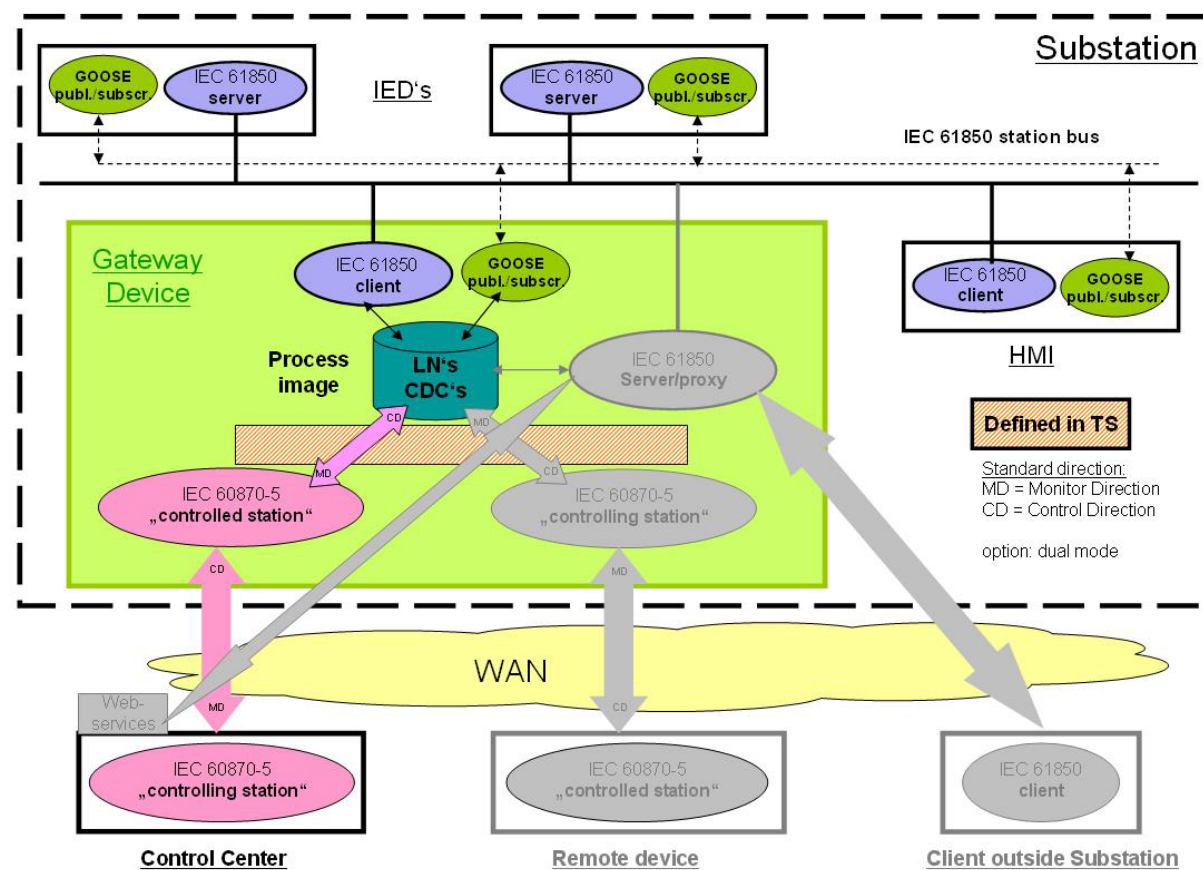
- make process data coming from remote devices available for IEDs inside the substation;
- retrieve the data model for:
 - IEC 61850 clients **inside** the **substation** (for example HMI);
 - IEC 61850 clients **outside** the **substation** (for example future control centers);
 - existing **control centers** using IEC 60870-5-101 or IEC 60870-5-104 for WAN communication by using **additional services** (for example SCL extensions or web services).

The IEC 60870-5-101 or IEC 60870-5-104 controlled and controlling functionality makes use of the attributes of CDCs in a defined way to build up ASDUs to communicate with control centers or “devices on the WAN network” using WAN communication based on IEC 60870-5-101 or IEC 60870-5-104 (including redundant connections).

The IEC 60870-5-101 or IEC 60870-5-104 controlling functionality inside the gateway device is used to connect “devices on the WAN network” with IEC 60870-5-101 or IEC 60870-5-104 controlled functionality to the substation.

The gateway device can optionally act as a “mediator” between the substation and all “devices on the WAN network”. When IEC 60870-5-101 or IEC 60870-5-104 “dual mode functionality” is used, the same ASDUs are used in the monitor and the control direction on the WAN.

5.1.1 Use case a) for a gateway device



IEC 2256/08

Figure 2 – Use case a) for a gateway device

Figure 2 describes use case a) using a subset of functions of the conceptual architecture. The IEC 61850 client/GOOSE subscriber is used to update the PI with process data made available by the IEDs.

The IEC 60870-5-101 or IEC 60870-5-104 controlled functionality makes use of the attributes of CDCs in a defined way to build up ASDUs to communicate with control centers using WAN communication based on IEC 60870-5-101 or IEC 60870-5-104 (including redundant connections).

5.1.2 Use case b) for a gateway device

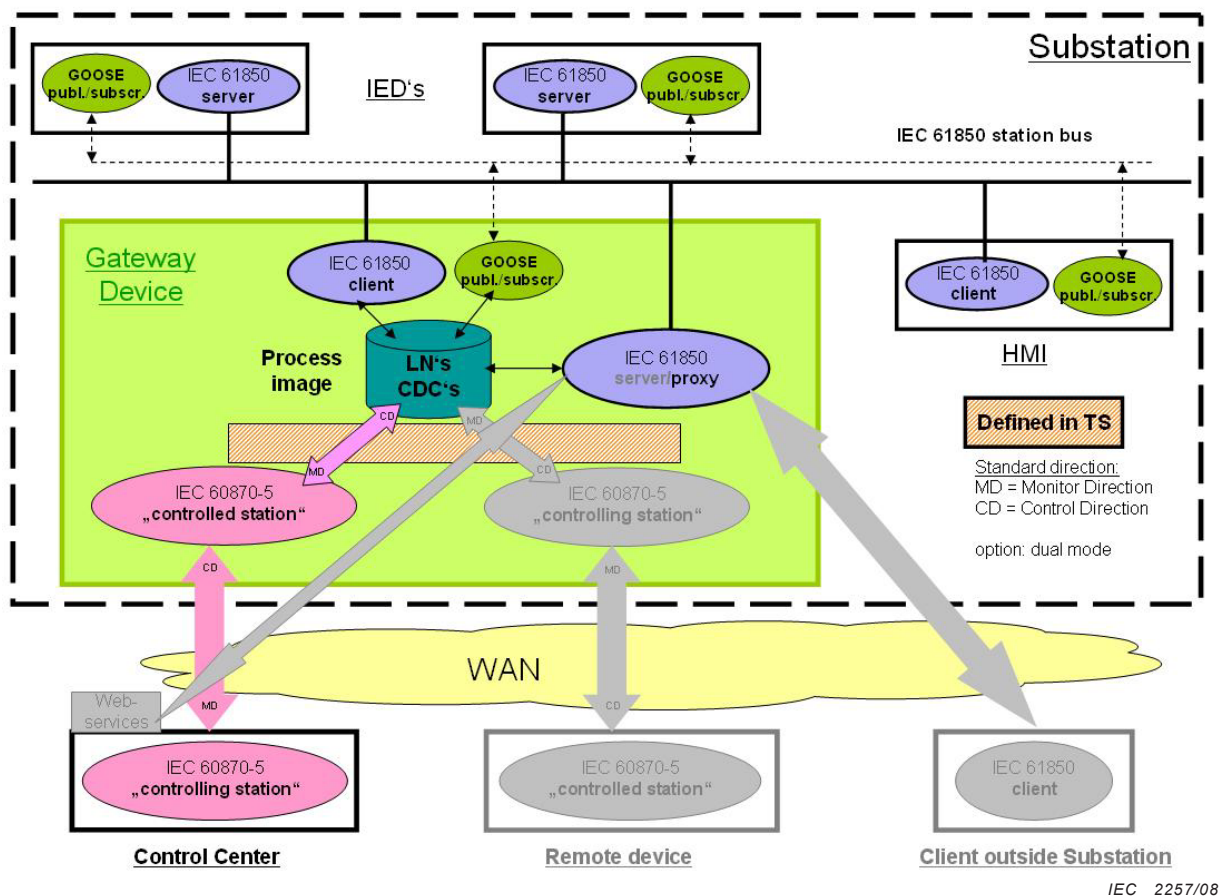


Figure 3 – Use case b) for a gateway device

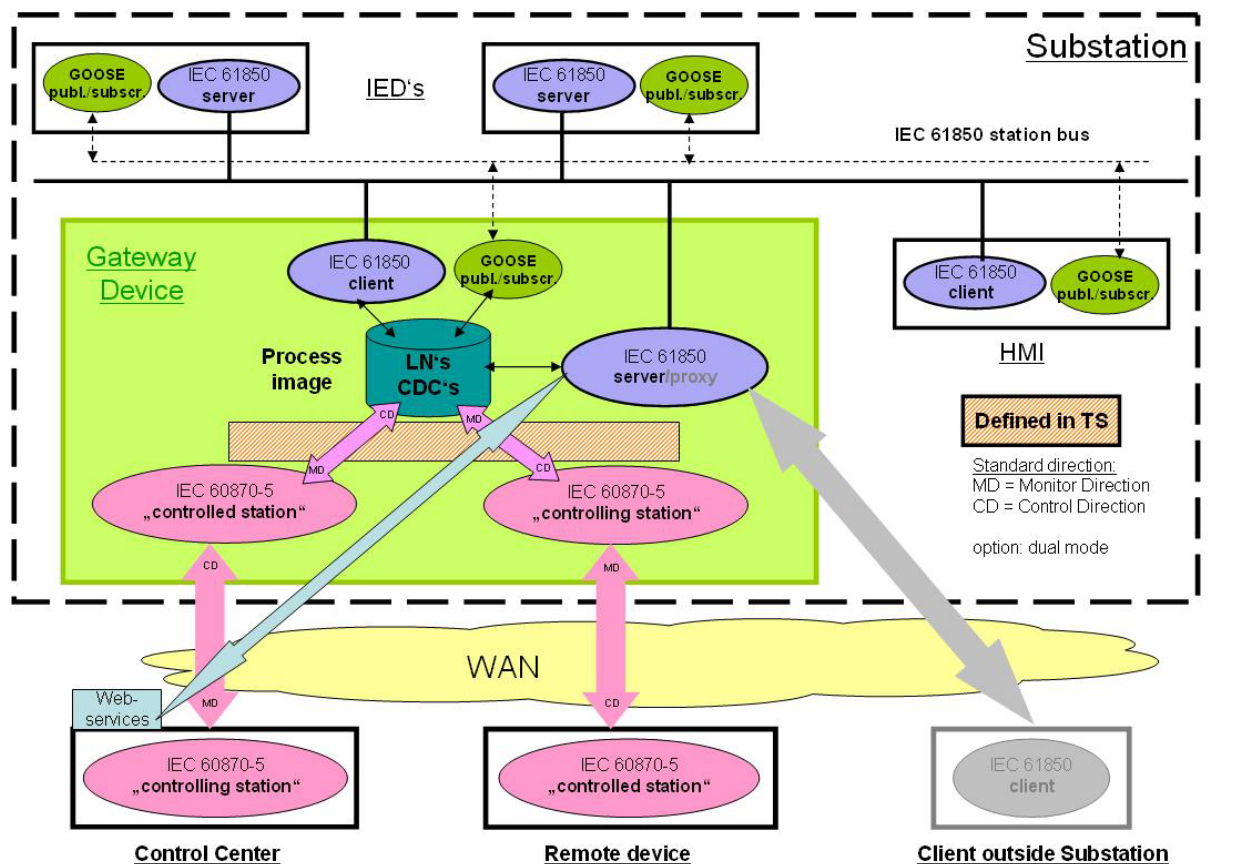
Figure 3 describes use case b) using an extended subset of functions of the conceptual architecture.

The IEC 61850 client/GOOSE subscriber is used to update the PI with process data made available by the IEDs.

The IEC 61850 proxy is used to retrieve the data model for IEC 61850 clients inside the substation (for example HMI).

The IEC 60870-5-101 or IEC 60870-5-104 controlled functionality makes use of the attributes of CDCs in a defined way to build up ASDUs to communicate with control centers using WAN communication based on IEC 60870-5-101 or IEC 60870-5-104 (including redundant connections).

5.1.3 Use case c) for a gateway device



IEC 2258/08

Figure 4 – Use case c) for a gateway device

Figure 4 describes use case c) using nearly all functions of the conceptual architecture. The IEC 61850 client/GOOSE subscriber is used to update the PI with process data made available by the IEDs.

The IEC 61850 server is used to:

- make process data coming from remote devices available for IEDs inside the substation;
- retrieve the data model for:
 - IEC 61850 clients inside substation (for example HMI);
 - existing control centers using IEC 60870-5-101 or IEC 60870-5-104 for WAN communication by using additional services (for example SCL extensions or web services).

The IEC 60870-5-101 or IEC 60870-5-104 controlled and controlling functionality makes use of the attributes of CDCs in a defined way to build up ASDUs to communicate with control centers or “devices on the WAN network” using WAN communication based on IEC 60870-5-101 or IEC 60870-5-104 (including redundant connections).

The IEC 60870-5-101 or IEC 60870-5-104 controlling functionality inside the gateway device is used to connect “devices on the WAN network” with IEC 60870-5-101 or IEC 60870-5-104 controlled functionality to the substation.

The gateway device can optionally act as a “mediator” between the substation and all “devices on the WAN network”. When IEC 60870-5-101 or IEC 60870-5-104 “dual mode functionality” is used, the same ASDUs are used in the monitor and the control direction on the WAN.

5.2 Conceptual architecture of an IED directly connected to a WAN (optional)

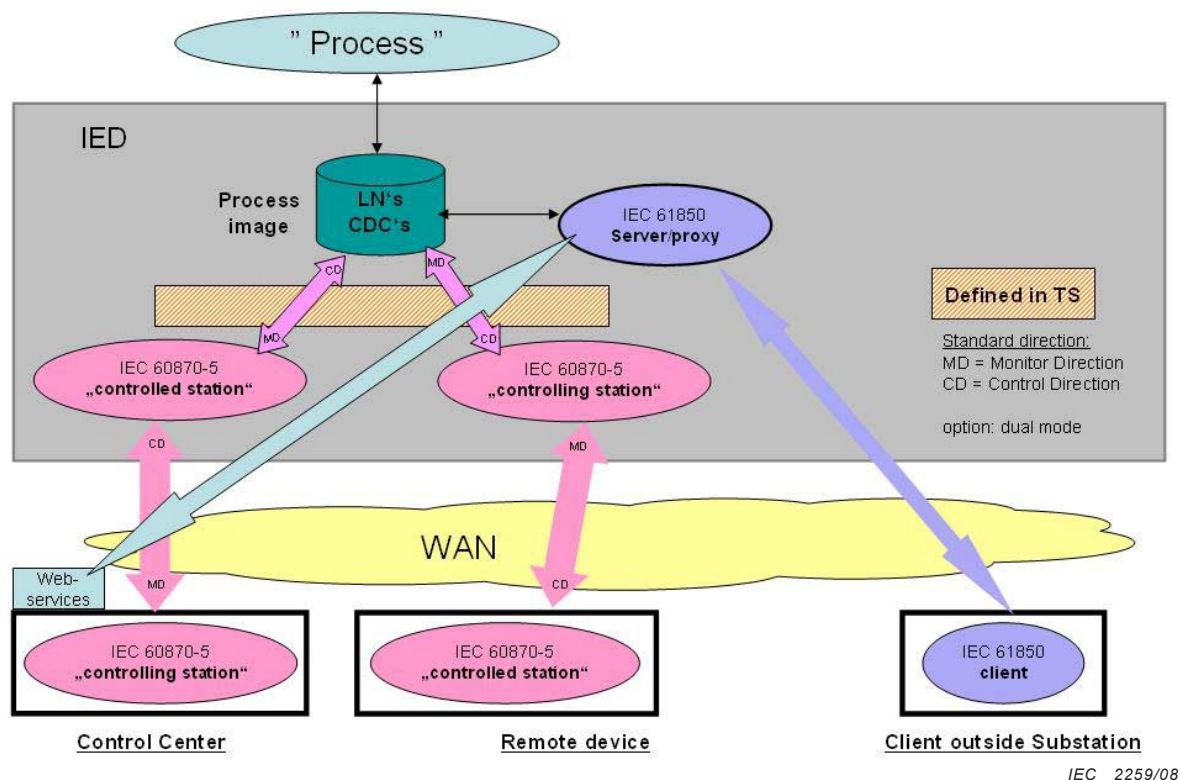


Figure 5 – Conceptual architecture of an IED

Figure 5 is showing the conceptual architecture of an IED which optionally maybe connected directly to a WAN compliant to IEC 60870-5-104 or IEC 60870-5-101. However, the rules and functions defined for a gateway device as a part of a substation are also valid for the mapping inside an IED.

The IED is decoupling the process information from the IEC 60870-5-101 or IEC 60870-5-104 WAN via a process image (PI). The advantage of this approach is that only services for control model interaction need to be mapped.

The PI is organized according the data model of IEC 61850 (LDs, LNs, CDCs).

The IEC 61850 server/proxy is used to:

- make process data coming from remote devices available for the process connected to the IED;
- retrieve the data model for:
 - IEC 61850 clients outside the substation (for example future control centers);
 - existing control centers using IEC 60870-5-101 or IEC 60870-5-104 for WAN communication by using additional services (for example SCL extensions or web services).

The IEC 60870-5-101 or IEC 60870-5-104 controlled and controlling functionality makes use of the attributes of CDCs in a defined way to build up ASDUs to communicate with control centers or “devices on the WAN network” using WAN communication based on IEC 60870-5-101 or IEC 60870-5-104.

The IEC 60870-5-101 or IEC 60870-5-104 controlling functionality inside the IED is used to connect “devices on the WAN network” with IEC 60870-5-101 or IEC 60870-5-104 controlled functionality to the IED.

The IED can optionally act as a “mediator” between the IED and all “devices on the WAN network”. When IEC 60870-5-101 or IEC 60870-5-104 “dual mode functionality” is used, the same ASDUs are used in the monitor and the control direction on the WAN.

6 Mapping of a device-oriented information model to IEC 60870-5-104 or IEC 60870-5-101

6.1 General

The defined mapping for a device-oriented information model is based on using existing functionalities in IEC 60870-5-104 or IEC 60870-5-101 by using the

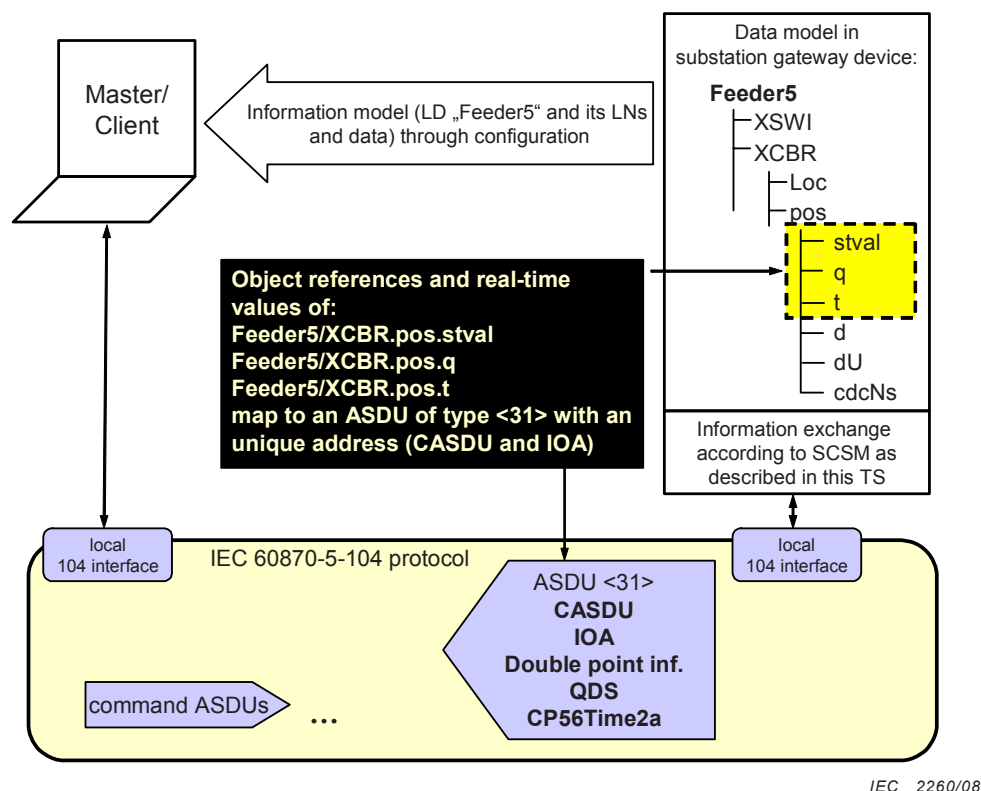
- common address of ASDU (CASDU), and the
- information object address (IOA)

to accommodate the device model using LD (logical device) and LN (logical node) and transfer of real-time information (data) using standardized ASDUs. The same is applicable for the services and the basic application functions in IEC 60870-5-104 or IEC 60870-5-101.

6.2 Mapping of a device-oriented information model reference

The device-oriented information model (for example IEC 61850) shall be mapped to a hierarchical structure. The conceptual mapping is depicted in Figure 6. The device-oriented information model (for example IEC 61850) is intended to be preserved when mapped to IEC 60870-5-104 or IEC 60870-5-101. This especially means that

- the server/proxy implements the hierarchical device-oriented information model of, for example, IEC 61850 that can be retrieved by the services according to Clause 8;
- the client implements the device-oriented information model by configuration. That can be done in different ways:
 - by using the SCL file, specifying the implemented information model, mapping and addressing details according to the rules in IEC 61850-6;
 - by other configuration methods.
- the master/client station (“controlling station”) accesses the hierarchical device-oriented information model of, for example, IEC 61850 through the services provided by IEC 60870-5-104 or IEC 60870-5-101 to exchange real-time data.



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Figure 6 – Mapping architecture (conceptual)

6.3 Logical device class mapping

The logical device reference shall map to the common address of ASDU (CASDU).

NOTE The CASDU may be structured or unstructured. For example, the CASDU may identify the station ID and the logical device instance ID. It is recommended to make an addressing scheme in order to have unique address for the specific station. For example, for small stations, one CASDU can be assigned for a station, all LD will then have the same CASDU. For a large station several CASDU can be used to identify each LD. The maximum number of CASDU for one link is 65 534.

6.4 Logical node class mapping

The logical node instance ID and data attribute reference shall map to the information object address (IOA).

NOTE All attributes of the LN class are implicitly defined and visible. The IOA may be structured or unstructured. For both cases, a decimal approach for defining the IOA addresses is recommended. The maximum number of IOA addresses per CASDU is 65 536.

7 Mapping of the common data classes (CDC)

7.1 List of CDC, type Identifications and corresponding mappings for IEC 61850

Each common data class consists of one or more data attributes of a specific data type. Each data attribute shall be mapped to one specific IOA (as in 6.4). In IEC 60870-5-104 or IEC 60870-5-101, each IOA is directly related to a specific ASDU type (with or without time). Therefore, the CDC is basically mapped as in Table 1.

The mapping shown in Table 1 shall be considered as a default mapping – carefully selected out of a variety of mapping possibilities.

NOTE 1 The requirements for the mapping of LD, LN onto CASDU, IOA can vary in different fields of application. The most suitable way of mapping should be defined on a utility or project basis depending on the specific needs.

CASDU and IOA in IEC 60870-5-101 or IEC 60870-5-104 are just numbers which have to be unique within one Utility/project.

Table 1 – Mapping structure CDC onto ASDU type

CDCs defined in IEC 61850-7-3	
CDC (Attribute data types)	ASDU type
SPS Single point status	<i>monitor direction (status):</i> TI<30> as event TI<1> as part of GI
DPS Double point status	<i>monitor direction (status):</i> TI<31> as event TI<3> as part of GI
INS Integer status	<i>monitor direction (status):</i> TI<35> or TI <33> or TI <30> as event TI<11> or TI<7> or TI <1> as part of GI
ACT Protection activation information	<i>monitor direction (status):</i> TI<39> as event or TI<30> as event TI<1> as part of GI
ACD Directional protection activation Information	<i>monitor direction (status):</i> TI<40> as event or TI<30> as event TI<1> as part of GI
SEC Security violation counting	<i>monitor direction (status):</i> TI<37> as event or as part of CI
BCR Binary counter reading	<i>monitor direction (status):</i> TI<37> as event or as part of CI
MV Measured value	<i>monitor direction (status):</i> TI<36> or TI<35> as event TI<13> or TI<11> as part of GI
CMV Complex measured value	<i>monitor direction (status):</i> TI<36> or TI<35> as event TI<13> or TI<11> as part of GI
WYE Phase to ground related measured values in a three phase system	<i>monitor direction (status):</i> via CMV to TI<36> as event TI<13> as part of GI
DEL Phase to phase related measured values in a three phase system	<i>monitor direction (status):</i> via CMV to TI<36> as event TI<13> as part of GI
SEQ Sequence	<i>monitor direction (status):</i> via CMV to TI<36> as event TI<13> as part of GI
HMV Harmonic value	<i>monitor direction (status):</i> TI<36> as event TI<13> as part of GI
HWYE Harmonic value for WYE	<i>monitor direction (status):</i> via CMV to TI<36> as event TI<13> as part of GI
HDEL Harmonic value for DEL	<i>monitor direction (status):</i> via CMV to TI<36> as event TI<13> as part of GI
SPC Controllable single point	<i>monitor direction (status):</i> TI<30> as event TI<1> as part of GI <i>control direction (command):</i> TI<45> (without time tag) or TI<58> (with time tag)
DPC Controllable double point	<i>monitor direction (status):</i> TI<31> as event TI<3> as part of GI <i>control direction (command):</i> TI<46> (without time tag) or TI<59> (with time tag)

CDCs defined in IEC 61850-7-3	
CDC (Attribute data types)	ASDU type
INC Controllable integer status	<i>monitor direction (status):</i> TI<35> as event TI<11> as part of GI <i>control direction (command):</i> TI<49> (without time tag) or TI<62> (with time tag)
BSC Binary controlled step position information	<i>monitor direction (status):</i> TI<32> as event TI<5> as part of GI <i>control direction (command):</i> TI<47> (without time tag) or TI<60> (with time tag)
ISC Integer-controlled step position information	<i>monitor direction (status):</i> TI<32> as event TI<5> as part of GI <i>control direction (setpoint):</i> TI<49> (without time tag) or TI<62> (with time tag)
APC Controllable analogue set point information	<i>monitor direction (status):</i> TI<36> as event TI<13> as part of GI <i>control direction (command):</i> TI<50> (without time tag) or TI<63> (with time tag)
SPG Single point setting	<i>control direction (command):</i> TI<45> (without time tag) or TI<58> (with time tag)
ING Integer status setting	<i>control direction (setpoint):</i> TI<49> (without time tag) or TI<62> (with time tag)
ASG Analogue setting	<i>control direction (setpoint):</i> TI<50> (without time tag) or TI<63> (with time tag)
Additional CDCs defined in IEC 61400-25-2	
CDC (Attribute data types)	ASDU type
STV Status value	Mapped via CDC INS Integer status
SPV Setpoint value	Mapped via CDC APC Controllable analogue set point information
ALM Alarm	Mapped via CDC INS Integer status for Data Attribute actVal CDC SPC Controllable single point for Data Attribute almAck
CMD Command	Mapped via CDC INC Controllable integer status
CTE Event counting	Mapped via CDC INS Integer status for DataAttribute actCtVal CDC SPC Controllable single point for DataAttribute manRs
TMS State timing	Mapped via CDC SPC Controllable single point for DataAttribute manRs CDC INS Integer status for DataAttribute actTmVal and for DataAttribute oldTmVal
TI:= Type Identification GI:= General Interrogation or station interrogation ASDU TI <100> CI:= Counter interrogation ASDU TI <101>	

Common data classes CURVE, DPL, LPL, CSD and SAV from IEC 61850-7-3 and ASS from IEC 61400-25-4 cannot be mapped to ASDU's of IEC 60870-5-104 or IEC 60870-5-101.

NOTE 2 The mappings shown include the timestamp and are applicable for the monitor information if sent as an event. If the information is sent as part of GI (general interrogation/station interrogation) or CI (counter interrogation), the complete mapping is applicable, apart from the timestamp. All GI and CI data is sent excluding a timestamp.

7.2 CDC single point status (SPS)

The data attributes of the common data class SPS depicted in Table 2 shall be mapped as shown in Table 3.

Table 2 – CDC: Single point status (SPS)

SPS class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
Data attribute					
status					
stVal	BOOLEAN	ST	dchg	TRUE FALSE	M
t	TimeStamp	ST		Time value	M
q	Quality	ST	qchg	Quality	M

The signal [stVal + t + q] shall map to the ASDU TI <30> "Single point information with time tag CP56Time2a" as specified in Table 3.

Table 3 – CDC: Single point status (SPS) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
SPS		TI <30>	
Attribute name	Attribute type	information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
stVal	BOOLEAN	SIQ	SPI:<0> OFF = FALSE <1> ON = TRUE
q	Quality		validity -> IV good invalid -> valid invalid questionable -> NTI source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg

7.3 CDC double point status (DPS)

The data attributes of the common data class DPS depicted in Table 4 shall be mapped as shown in Table 5.

Table 4 – CDC: Double point status (DPS)

DPS class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
status					
stVal	CODED ENUM	ST	dchg	intermediate state off on bad state	M
t	TimeStamp	ST		Time	M
q	Quality	ST	qchg	Quality	M

The signals [stVal + t + q] shall map to the ASDU TI <31> "Double point information with time tag CP56Time2a" as specified in Table 5.

Table 5 – CDC: Double point status (DPS) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
DPS		TI <31>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
stVal	CODED ENUM	DIQ	DPI <0> intermediate state = intermediate-state <1> determined state OFF = OFF <2> determined state ON = ON <3> indeterminate = bad.state
q	Quality		validity -> IV good invalid -> valid invalid questionable -> NT source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
t	TimeStamp		Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg

7.4 CDC integer status (INS)

The DataAttributes of the common data class INS depicted in Table 6 shall be mapped as shown in Table 7.

Table 6 – CDC: Integer status (INS)

INS class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
status					
stVal	INT32	ST	dchg		M
t	TimeStamp	ST		Time	M
q	Quality	ST	qchg	Quality	M

The signals [stVal + t + q] shall map to either ASDU TI <35> "Measured value, scaled value with time tag CP56Time2a" or optionally ASDU TI <33> "Bitstring of 32 bits with time tag CP56Time2a" as specified in Table 7.

For the special use case that the attribute EEHealth of a logical node with the CDC INS has to be mapped onto one single status to meet the requirements of existing control center systems, the signals [stVal + t + q] shall map to ASDU TI <30> "Single point information with time tag CP56Time2a".

NOTE The mapping of CDC INS to ASDU TI<33> (binary state information) is optional. It may be used if the value range for the default mapping to ASDU TI<35> (scaled value) is not sufficient.

Table 7 – CDC: Integer status (INS) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
INS		TI <35>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
stVal	INT32	SVA = Scaled value	SVA $16 \times 2^{15} \dots 2^{15}-1$ 0 map on 0 Valid range for INT32 is $<-2^{15} \dots +2^{15}-1$
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality	QDS = Quality descriptor	validity -> IV good invalid -> valid invalid questionable -> NT detailQual -> OV overflow -> overflow source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
INS		TI <33>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
stVal	INT32	BSI = Binary state information	BSI:= 32BS1[1..32]<0,1>
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality	QDS = Quality descriptor	validity -> IV good invalid -> valid invalid questionable -> NT detailQual -> OV overflow -> overflow source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
INS		TI <30>	
Attribute nme	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
stVal	INT32	SIQ	stVal:= <1> ok -> SPI:=<0> OFF = FALSE stVal:= <3> Alarm -> SPI:= <1> ON = TRUE
q	Quality		validity -> IV good invalid -> valid invalid questionable -> NTI source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg

7.5 CDC protection activated information (ACT)

The data attributes of the common data class ACT depicted in Table 8 shall be mapped as shown in Table 9.

Table 8 – CDC: Protection activated information (ACT)

ACT class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
status					
general	BOOLEAN	ST	dchg	TRUE FALSE	M
phsA	BOOLEAN	ST	dchg	TRUE FALSE	O
phsB	BOOLEAN	ST	dchg	TRUE FALSE	O
phsC	BOOLEAN	ST	dchg	TRUE FALSE	O
neut	BOOLEAN	ST	dchg	TRUE FALSE	O
t	TimeStamp	ST		Time value	M
q	Quality	ST	qchg	Quality	M

The signals [general + phsA + phsB + phsC + neut + t + q] shall map to the ASDU TI <39> "Packed start events of protection equipment with time tag CP56Time2a" or multiple ASDUs TI <30> "Single point information with time tag CP56time 2a" as specified in Table 9.

Table 9 – CDC: Protection activated information (ACT) mapping

a) Mapping to ASDU TI <39>			
CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
ACT		TI <39>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
general	BOOLEAN	SPE	GS = general start of operation:= BS1[1]<0..1> FALSE = <0>:= no general start of operation TRUE = <1>:= general start of operation
phsA	BOOLEAN	SPE	SL1 = start of operation phase L1:= BS1[2]<0..1> FALSE = <0>:= no start of operation L1 TRUE = <1>:= start of operation L1
phsB	BOOLEAN	SPE	SL2 = start of operation phase L2:= BS1[3]<0..1> FALSE = <0>:= no start of operation L2 TRUE = <1>:= start of operation L2
phsC	BOOLEAN	SPE	SL3 = start of operation phase L3:= BS1[4]<0..1> FALSE = <0>:= no start of operation L3 TRUE = <1>:= start of operation L3
neut	BOOLEAN	SPE	SIE = start of operation IE (earth current) FALSE = <0>:= no start of operation IE TRUE = <1>:= start of operation IE
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality	QDP	validity -> IV good invalid -> valid invalid questionable -> NT EI not used:= set to zero . = elapsed time valid source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
b) Mapping to ASDU TI<30>			
CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
ACT		TI <30>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
general	BOOLEAN	SIQ	SPI <0> OFF = FALSE <1> ON = TRUE
phsA	BOOLEAN	SIQ	SPI <0> OFF = FALSE <1> ON = TRUE
phsB	BOOLEAN	SIQ	SPI <0> OFF = FALSE <1> ON = TRUE
phsC	BOOLEAN	SIQ	SPI <0> OFF = FALSE <1> ON = TRUE
neut	BOOLEAN	SIQ	SPI <0> OFF = FALSE <1> ON = TRUE
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality	SIQ	validity -> IV good invalid -> valid invalid questionable -> NT source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked

Each attribute maps to one ASDU TI <30> "Single point information with time tag CP56Time2a" as specified in Table 3 using consecutive indices:

IOA n := general
 IOA n+1 := phsA
 IOA n+2 := phsB
 IOA n+3 := phsC
 IOA n+4 := neut

7.6 CDC directional protection activation information (ACD)

The data attributes of the common data class ACD depicted in Table 10 shall be mapped as shown in Table 11.

Table 10 – CDC: Protection activated information (ACD)

ACD class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
general	BOOLEAN	ST	dchg	TRUE FALSE	M
dirGeneral	Enumerated	ST	dchg	unknown,forward,backward,both	M
phsA	BOOLEAN	ST	dchg	TRUE FALSE	GC_2(1)
dirPhsA	Enumerated	ST	dchg	unknown,forward,backward,both	GC_2(1)
phsB	BOOLEAN	ST	dchg	TRUE FALSE	GC_2(2)
dirPhsB	Enumerated	ST	dchg	unknown,forward,backward,both	GC_2(2)
phsC	BOOLEAN	ST	dchg	TRUE FALSE	GC_2(3)
dirPhsC	Enumerated	ST	dchg	unknown,forward,backward,both	GC_2(3)
neut	BOOLEAN	ST	dchg	TRUE FALSE	GC_2(4)
dirNeut	Enumerated	ST	dchg	unknown,forward,backward,both	GC_2(4)
t	TimeStamp	ST		Time value	M
q	Quality	ST	qchg	Quality	M

The signals [general + phsA + phsB + phsC + neut + t + q] shall map to the ASDU TI <40> "Packed output circuit information of protection equipment with time tag CP56Time2a" or multiple ASDUs TI <30> "Single point information with time tag CP56time 2a as specified in Table 11.

Table 11 – CDC: Directional protection activated information (ACD) mapping

a) without using directional attribute

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
ACD		TI <40>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
general	BOOLEAN	OCI	GC = general command to output circuit:= BS1[1]<0..1> FALSE = <0>:= no general command to output circuit TRUE = <1>:= general command to output circuit
phsA	BOOLEAN	OCI	CL1 = command to output circuit phase L1:= BS1[2]<0..1> FALSE = <0>:= no command to output circuit phase L1 TRUE = <1>:= command to output circuit phase L1
phsB	BOOLEAN	OCI	CL2 = command to output circuit phase L2:= BS1[3]<0..1> FALSE = <0>:= no command to output circuit phase L2 TRUE = <1>:= command to output circuit phase L2
phsC	BOOLEAN	OCI	CL3 = command to output circuit phase L3:= BS1[4]<0..1> FALSE = <0>:= no command to output circuit phase L3 TRUE = <1>:= command to output circuit phase L3
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality	QDP	validity -> IV good invalid -> valid invalid questionable -> NT EI not used:= set to zero:= elapsed time valid source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked

b) Use of directional attribute

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
ACD		TI <30>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
general	BOOLEAN	SIQ	SPI <0> OFF:= FALSE <1> ON:= TRUE
phsA	BOOLEAN	SIQ	SPI <0> OFF:= FALSE <1> ON:= TRUE
phsB	BOOLEAN	SIQ	SPI <0> OFF:= FALSE <1> ON:= TRUE
phsC	BOOLEAN	SIQ	SPI <0> OFF:= FALSE <1> ON:= TRUE
neut	BOOLEAN	SIQ	SPI <0> OFF:= FALSE <1> ON:= TRUE
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence for object
q	Quality	SIQ	validity -> IV good invalid -> valid invalid questionable -> NT source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked

Each value of direction attribute maps to one ASDU TI <30> "Single point information with time tag CP56Time2a" as specified in Table 3 using consecutive indices:

IOA n := general + unknown
 IOA n+1 := general + forward
 IOA n+2 := general + backward
 IOA n+3 := general + both
 IOA n+4 := phsA + unknown
 ..
 IOA n+7 := phsA + both
 IOA n+8 := phsB + unknown
 ..
 IOA n+11 := phsB + both
 IOA n+12 := phsC + unknown
 ..
 IOA n+15 := phsC + both
 IOA n+16 := neut + unknown
 ..
 IOA n+19 := neut + both

7.7 CDC Security violation counting (SEC)

The data attribute of the common data class SEC depicted in Table 12 shall be mapped as shown in Table 13.

Table 12 – CDC: Security violation counting (SEC)

SEC class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
status					
cnt	INT32U	ST	dchg		M
t	TimeStamp	ST		Time value	M

The signal [cnt + t] shall map to the ASDU TI <37> "Integrated totals with time tag CP56Time2a" as specified in Table 13.

Table 13 – CDC: Security violation counting (SEC) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
SEC		TI <37>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
cnt	INT32U	BCR	Counter reading ... I32 <-2 ³¹ ..+2 ³¹ -1>
t	TimeStamp		Seven octet binary time, CP56Time2a – Time of occurrence of dchg
		BCR->sequence notation	SQ:= sequence number = set to zero CY:= carry = set to zero CA:= counter was adjusted = set to zero IV:= validity good -> valid

7.8 CDC binary counter reading (BCR)

The data attribute of the common data class BCR depicted in Table 14 shall be mapped as shown in Table 15.

Table 14 – CDC: Binary counter reading (BCR)

BCR class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
status					
actVal	INT128	ST	dchg		M
frVal	INT128	ST	dupd		GC_2(1)
frTm	TimeStamp	ST	dupd	Time value	GC_2(1)
t	TimeStamp	ST		Time value	M
q	Quality	ST	qchg	Quality	M

The signal [actVal + t + q] shall map to ASDU TI <37> "Integrated totals with time tag CP56Time2a" with IOA n and the *optional* signal [frVal + frTm + q] shall map to ASDU TI <37> "Integrated totals with time tag CP56Time2a" with IOA n+1 as specified in Table 15.

Table 15 – CDC: Binary counter reading (BCR) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
BCR		TI <37>	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
actVal	INT128	BCR = Binary Counter Reading	counter reading I32 <-2 ³¹ .. +2 ³¹ -1>
t	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality	BCR->sequence notation	SQ:= sequence number = set to zero CY:= carry = set to zero CA:= counter was adjusted = set to zero IV:= validity good -> valid
frVal	INT128	BCR = Binary Counter Reading	counter reading I32 <-2 ³¹ .. +2 ³¹ -1>
frTm	TimeStamp	CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dupd, dchg or qchg
q	Quality	BCR->sequence notation	SQ:= sequence number = set to zero CY:= carry = set to zero CA:= counter was adjusted = set to zero IV:= validity good -> valid

7.9 CDC measured value (MV)

The data attributes of the common data class MV depicted in Table 16 shall be mapped as shown in Table 17.

Table 16 – CDC: Measured value (MV)

MV class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
measured attributes					
mag	AnalogueValue	MX	dchg		M
t	TimeStamp	MX		Time value	M
q	Quality	MX	qchg	Quality	M
configuration, description and extension					
db	INT32U	CF		0 ... 100 000	O

The signal [mag + t + q] shall map to the either ASDU TI <36> "Measured value, short floating point value with time tage CP56time2a" or ASDU <35> "Measured value, scaled value with time tag CP56time2a" as specified in Table 17.

Table 17 – CDC: Measured value (MV) mapping

CDC class			IEC 60870-5-101 or IEC 60870-5-104 mapping	
MV			TI <36> or TI<35>	
Attribute name	Attribute type	DAComponent	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
a) mag	AnalogueValue	mag.f FLOAT32	IEEE STD 754	R32.23{Fraction,Exponent,Sign}
b) mag	AnalogueValue	mag.i INT32	SVA	$16 \times 2^{15} \dots + 2^{15} - 1$ 0 map on 0 Valid range for INT32 is $< -2^{15} \dots + 2^{15} - 1 >$
t	TimeStamp		CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality		QDS	validity -> IV good invalid -> valid invalid questionable -> NT detailQual -> OV overflow -> overflow source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked

Either a) or b) shall be mapped.

The optional configuration attribute "db" can be optionally set by ASDU TI<111> "Parameter of measured value, scaled value" or ASDU TI<112> "Parameter of measured value, short floating point value" as described in Clause 8.

7.10 CDC complex measured value (CMV)

The data attributes of the common data class CMV depicted in Table 18 shall be mapped as shown in Table 19.

Table 18 – CDC: Complex measured value (CMV)

CMV class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
measured attributes					
cVal	Vector	MX	dchg		M
q	Quality	MX	qchg		M
t	TimeStamp	MX			M
configuration, description and extension					
db	INT32U	CF		0 ... 100 000	O

Table 19 defines the mapping for data attributes of common data class CMV. The data attributes [cVal + t + q] shall map to IEC 60870-5-104 or IEC 60870-5-101 ASDU TI<36> "Measured value, short floating point value with time tag CP56Time2a" or ASDU TI<35> "Measured value, scaled value with time tag CP56Time2a".

Table 19 – CDC: Complex measured value (CMV) mapping

CDC class			IEC 60870-5-101 or IEC 60870-5-104 mapping	
CMV			TI <36> or TI<35>	
Attribute name	Attribute type	DAComponent	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
a) cVal	Vector	cVal.mag.f FLOAT32	IEEE STD 754	R32.23{Fraction,Exponent,Sign}
b) cVal	Vector	cVal.mag.i INT32	SVA	$116 < -2^{15} \dots +2^{15} - 1 >$ 0 map on 0 Valid range for INT32 is $< -2^{15} \dots +2^{15} - 1 >$
t	TimeStamp		CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence for object
q	Quality		QDS	validity -> IV good invalid -> valid invalid questionable -> NT detailQual -> OV overflow -> overflow source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked
a) cVal	Vector	cVal.ang.f FLOAT32	IEEE STD 754	R32.23{Fraction,Exponent,Sign}
b) cVal	Vector	cVal.ang.i INT32	SVA	$116 < -2^{15} \dots +2^{15} - 1 >$ 0 map on 0 Valid range for INT32 is $< -2^{15} \dots +2^{15} - 1 >$
t	TimeStamp		CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg or qchg
q	Quality		QDS	validity -> IV good invalid -> valid invalid questionable -> NT detailQual -> OV overflow -> overflow source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked

Either a) or b) shall be mapped in both cases.

If both attributes (mag and angle) have to be mapped, two consecutive IOA addresses shall be used.

IOA n := CMV.cVal.mag.f or CMV.cVal.mag.i

IOA n+1 := CMV.cVal.ang.f or CMV.cVal.ang.i

The optional configuration attribute "db" can be optionally set by ASDU TI<111> "Parameter of measured value, scaled value" or ASDU TI<112> "Parameter of measured value, short floating point value" as described in Clause 8.

7.11 CDC Phase to ground related measured values of a three-phase system (WYE)

The data attributes of the common data class WYE depicted in Table 20 shall be mapped as multiple mappings of the common data Class CMV as shown in Table 19.

Table 20 – CDC: Phase to ground related measured values of a three-phase system (WYE)

WYE class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from Data Class (see IEC 61850-7-2)				
Data					
phsA	CMV				GC_1
phsB	CMV				GC_1
phsC	CMV				GC_1
neut	CMV				GC_1
net	CMV				GC_1
res	CMV				GC_1

Each data attributes (of common data class CMV) shall map to the ASDU TI <36> "Measured value, short floating point value with time tag CP56Time2a" or ASDU TI<35> "Measured value, scaled value with time tag CP56Time2a". Six ASDU's of TI <36> or TI <35> shall be used with consecutive IOA indices:

IOA n := CMV phsA
 IOA n+1 := CMV phsB
 IOA n+2 := CMV phsC
 IOA n+3 := CMV neut
 IOA n+4 := CMV net
 IOA n+5 := CMV res

If both attributes (mag and angle) of every attribute of attribute type CMV have to be mapped, two consecutive IOA addresses have to be used for each attribute. In that case twelve ASDU's of TI <36> shall be used with consecutive IOA indices:

IOA n := CMV phsA.cVal.mag.f
 IOA n+1 := CMV phsA.cVal.ang.f
 IOA n+2 := CMV phsB.cVal.mag.f
 IOA n+3 := CMV phsB.cVal.ang.f
 IOA n+4 := CMV phsC.cVal.mag.f
 IOA n+5 := CMV phsC.cVal.ang.f
 IOA n+6 := CMV neut.cVal.mag.f
 IOA n+7 := CMV neut.cVal.ang.f
 IOA n+8 := CMV net.cVal.mag.f
 IOA n+9 := CMV net.cVal.ang.f
 IOA n+10 := CMV res.cVal.mag.f
 IOA n+11 := CMV res.cVal.ang.f

The mapping of common data class CMV is shown in detail in Table 19.

7.12 CDC phase to phase measured values of a three phase system (DEL)

The data attributes of the common data class DEL depicted in Table 21 shall be mapped as multiple mappings of the common data class CMV as shown in Table 19.

Table 21 – CDC: Phase to phase measured values of a three phase system (DEL)

DEL class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from data class (see IEC 61850-7-2)				
Data					
phsAB	CMV				GC_1
phsBC	CMV				GC_1
phsCA	CMV				GC_1

Each data attribute (of common data class CMV) shall map to the ASDU TI <36> "Measured value, short floating point value with time tag CP56Time2a" or ASDU TI<35> "Measured value, scaled value with time tag CP56Time2a". Three ASDU's of TI <36> or TI <35> shall be used with consecutive IOA indices:

IOA n := CMV phsAB

IOA n+1 := CMV phsBC

IOA n+2 := CMV phsCA

If both attributes (mag and angle) of every attribute of attribute type CMV have to be mapped, two consecutive IOA addresses have to be used for each attribute. In that case, six ASDU's of TI <36> shall be used with consecutive IOA indices:

IOA n := CMV phsAB.cVal.mag.f

IOA n+1 := CMV phsAB.cVal.ang.f

IOA n+2 := CMV phsBC.cVal.mag.f

IOA n+3 := CMV phsBC.cVal.ang.f

IOA n+4 := CMV phsCA.cVal.mag.f

IOA n+5 := CMV phsCA.cVal.ang.f

The mapping of common data class CMV is shown in detail in Table 19.

7.13 CDC sequence (SEQ)

The data attributes of the common data class SEQ depicted in Table 22 shall be mapped as multiple mappings of the common data class CMV as shown in Table 19.

Table 22 – CDC: Sequence (SEQ)

SEQ class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from data class (see IEC 61850-7-2)				
Data					
c1	CMV				M
c2	CMV				M
c3	CMV				M

Each data attribute (of common data class CMV) shall map to the ASDU TI <36> "Measured value, short floating point value with time tag CP56Time2a" or ASDU TI<35> "Measured value, scaled value with time tag CP56Time2a". Three ASDU's of TI <36> or TI <35> shall be used with consecutive IOA indices:

IOA n := c1

IOA n+1 := c2

IOA n+2 := c3

If both attributes (mag and angle) of every attribute of attribute type CMV have to be mapped, two consecutive IOA addresses have to be used for each attribute. In that case, six ASDU's of TI <36> shall be used with consecutive IOA indices:

IOA n := CMV c1.cVal.mag.f
 IOA n+1 := CMV c1.cVal.ang.f
 IOA n+2 := CMV c2.cVal.mag.f
 IOA n+3 := CMV c2.cVal.ang.f
 IOA n+4 := CMV c3.cVal.mag.f
 IOA n+5 := CMV c3.cVal.ang.f

The mapping of common data class CMV is shown in detail in Table 19.

7.14 CDC harmonic value (HMV)

The data attributes of the common data class HMV depicted in Table 23 shall be mapped as shown in Table 24.

Table 23 – CDC: Harmonic value (HMV)

HMV class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
Harmonics and interharmonics					
har	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
basics					
q	Quality	MX	qchg	Quality	M
t	TimeStamp	MX		Time value	M

Table 24 defines the mapping for data attributes of common data class HMV. The number of "har" attributes is variable (numHar:= 1...n). The signals [har(n).mag + t + q] shall map to IEC 60870-5-104 or IEC 60870-5-101 ASDU TI<36> "Measured value, short floating point value with time tag CP56Time2a".

Table 24 – CDC: Harmonic value (HMV) mapping

CDC class			IEC 60870-5-101 or IEC 60870-5-104 mapping	
HMV			TI <36>	
Attribute name	Attribute type	DAComponent	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
har	Vector	har.mag.f FLOAT32	IEEE STD 754	R32.23{Fraction,Exponent,Sign}
t	TimeStamp		CP56Time2a	Seven octet binary time, CP56Time2a – Time of occurrence of dchg, dupd or qchg
q	Quality		QDS	validity -> IV good invalid -> valid invalid questionable -> NT detailQual -> OV overflow -> overflow source -> SB substituted -> substituted operatorBlocked -> BL blocked -> blocked

Each data attribute "har" (of attribute type vector) shall map to the ASDU TI <36> "Measured value, short floating point value with time tag CP56Time2a". The amount of ASDU's of TI <36> for the mapping is defined by the configuration attribute "numHar". The IOA addresses for all necessary ASDUs shall be used with consecutive IOA indices:

IOA n := har[0].mag
 IOA n+1 := har[1].mag
 IOA n+(numHar-1):= har[numHar-1]

7.15 CDC harmonic value for WYE (HWYE)

The data attributes of the common data class HWYE depicted in Table 25 shall be mapped as multiple mappings of the common data class HMV as shown in Table 24.

Table 25 – CDC: Harmonic value for WYE (HWYE)

HWYE class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
Harmonics and interharmonics					
phsAHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
phsBHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
phsCHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
neutHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
netHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
resHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		O
basics					
q	Quality	MX	qchg	Quality	M
t	TimeStamp	MX		Time value	M

Each used data attribute of the CDC HWYE shall be mapped in the same way as it is defined for the CDC HMV.

The mapping of common data class HMV is shown in detail in Table 24.

7.16 CDC harmonic value for DEL (HDEL)

The data attributes of the common data class HDEL depicted in Table 26 shall be mapped as multiple mappings of the common data class HMV as shown in Table 24.

Table 26 – CDC: Harmonic value for DEL (HDEL)

HDEL class					
Attribute name	Attribute type	FC	TrgOp	Explanation and value / Range	M/O
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
Harmonics and interharmonics					
phsABHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
phsBCHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
phsCAHar	ARRAY[0..numHar] OF Vector	MX	dchg, dupd		M
basics					
q	Quality	MX	qchg	Quality	M
t	TimeStamp	MX		Time value	M

Each data attribute of the CDC HDEL shall be mapped in the same way as it is defined for the CDC HMV.

The mapping of common data class HMV is shown in detail in Table 24.

7.17 CDC controllable single point (SPC)

The data attributes of the common data class SPC depicted in Table 27 shall be mapped as shown in Table 3 (for the attributes with the functional constraint ST) and Table 28 (for the attributes with the functional constraint CO).

Table 27 – CDC: Controllable single point (SPC)

SPC class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	BOOLEAN	CO		off (FALSE) on (TRUE)	AC_CO_M
origin	Originator	CO,ST			AC_CO_O
stVal	BOOLEAN	ST	dchg	FALSE TRUE	AC_ST
q	Quality	ST	qchg		AC_ST
t	TimeStamp	ST			AC_ST
Configuration, description and extension					
ctlModel	ctlModels	CF			M

Table 3 defines the mapping for the data attributes with the functional constraint ST. [stVal + t + q].

Table 28 defines the mapping for data attributes with the functional constraint CO. The data attribute [ctlVal + origin] or [ctlVal + origin + T] shall map to IEC 60870-5-104 or IEC 60870-5-101 ASDU TI<45> "Single command" or to IEC 60870-5-104 ASDU TI<58> "Single command with time tag CP56Time2a".

NOTE The attributes T and ctrlModel are defined in Clause 17 of IEC 61850-7-2:2003.

Table 28 – CDC: Controllable single point (SPC) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
SPC		TI <45> (without time tag) or TI <58> (with time tag)	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
ctlVal	BOOLEAN	SCO	SCS (Single command state) <0> OFF:= off (FALSE) <1> ON:= on (TRUE) simple SPC -> QU <0> no additional definition other QU values are not used IEC 60870-5-104 and IEC 60870-5-101 support the following modes of the IEC 61850 Control Model (ctlModel): direct control with normal security direct control with enhanced security S/E <0>:= direct control SBO control with enhanced security S/E <1>:= select and execute for details see Subclause 8.8
origin.orIdent	OCTET STRING64	COT	Originator Address:= UI8[9..16] <0..255> <0>:= default <1..255>:= number of originator address The number of originator address shall be mapped to attribute orIdent (OCTET STRING64). NOTE Only values of the length of one octet of orIdent can be mapped to Originator Address because of the limitation in value range.
origin.orCat	ENUMERATED	COT	Cause:= UI6[1..6] <0..63> <u>Valid for FC = CO:</u> remote control <-> activation <6> <u>Valid for FC = ST:</u> not supported <-> not used <0> remote control <-> return information caused by remote command <11> automatic-remote -> return information caused by remote command <11> bay control <-> return information caused by local command <12> station control, automatic bay, automatic station -> return information caused by local command <12> process <-> spontaneous <3> maintenance -> spontaneous <3>

7.18 CDC controllable double point (DPC)

The data attributes of the common data class DPC depicted in Table 29 shall be mapped as shown in Table 5 (for the attributes with the functional constraint ST) and Table 30 (for the attributes with the functional constraint CO).

Table 29 – CDC: Controllable double point (DPC)

DPC class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataSetName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	BOOLEAN	CO		off (FALSE) on (TRUE)	AC_CO_M
origin	Originator	CO,ST			AC_CO_O
stVal	CODED ENUM	ST	dchg	intermediate-state off on bad-state	M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
Configuration, description and extension					
ctlModel	ctlModels	CF			M

Table 5 defines the mapping for data attributes of DPC with the functional constraint ST [stVal + t + q].

Table 30 defines the mapping for data attributes of DPC with the functional constraint CO. The data attribute [ctlVal+ origin] or [ctlVal + origin + T] shall map to IEC 60870-5-104 or IEC 60870-5-101 ASDU TI<46> "Double point command" " or to IEC 60870-5-104 ASDU TI<59> "Double command with time tag CP56Time2a.

NOTE The attributes T and ctrlModel are defined in Clause 17 of IEC 61850-7-2:2003.

Table 30 – CDC: Controllable double point (DPC) mapping

CDC class		IEC 60870-5-101 or IEC 60870-5-104 mapping	
DPC		TI <46> (without time tag) or TI <59> (with time tag)	
Attribute name	Attribute type	Information element	IEC 60870-5-104 or IEC 60870-5-101 object group mapping
ctlVal	BOOLEAN	DCO	DCS (Double command state) <0> not permitted <1> OFF:= off (FALSE) <2> ON:= on (TRUE) <3> not permitted simple DPC -> QU <0> no additional definition other QU values are not used IEC 60870-5-104 and IEC 60870-5-101 support the following modes of the IEC 61850 Control Model (ctlModel): direct control with normal security direct control with enhanced security S/E <0>:= direct control SBO control with enhanced security S/E <1>:= select and execute for details see Subclause 8.8
origin.orIdent	OCTET STRING64	COT	Originator Address:= UI8[9..16] <0..255> <0>:= default <1..255>:= number of originator address The number of originator address shall be mapped to attribute orIdent (OCTET STRING64). NOTE Only values of the length of one octet of orIdent can be mapped to Originator Address because of the limitation in value range.
origin.orCat	ENUMERATED	COT	Cause:= UI6[1..6] <0..63> <u>Valid for FC = CO:</u> remote control <-> activation <6> <u>Valid for FC = ST:</u> not supported <-> not used <0> remote control <-> return information caused by remote command <11> automatic-remote -> return information caused by remote command <11> bay control <-> return information caused by local command <12> station control, automatic bay, automatic station -> return information caused by local command <12> process <-> spontaneous <3> maintenance -> spontaneous <3>

7.19 CDC controllable integer status (INC)

The data attributes of the common data class INC depicted in Table 31 shall be mapped as shown in Table 7 (for the attributes with the functional constraint ST) and Table 32 (for the attributes with the functional constraint CO).

Table 31 – CDC: Controllable integer status (INC)

INC class					
Attribute name	Attribute type	FC	TrgOp	Value/Value range	M/O/C
DataName	Inherited from data class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	INT32	CO			AC_CO_M
origin	Originator	CO,ST			AC_CO_O
stVal	INT32	ST	dchg		M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
Configuration, description and extension					
ctlModel	ctlModels	CF			M

Table 7 defines the mapping for data attributes of INC with the functional constraint ST [stVal + t + q].

Table 32 defines the mapping for data attributes of INC with the functional constraint CO. The data attribute [ctlVal + origin] or [ctlVal + origin + T] shall map to IEC 60870-5-104 or IEC 60870-5-101 ASDU TI<49> "Set point command, scaled value" or to IEC 60870-5-104 ASDU TI<62> "Set point command, scaled value with time tag CP56Time2a".

NOTE The attributes T and ctrlModel are defined in Clause 17 of IEC 61850-7-2:2003.