INTERNATIONAL STANDARD

IEC 61400-25-3

First edition
2006-12

Wind turbines –

Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models

Reference number
IEC 61400-25-3:2006(E)

Publication numbering

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International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE V

For price, see current catalogue

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WIND TURBINES –

Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models

FOREWORD

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International Standard IEC 61400-25-3 has been prepared by IEC technical committee 88: Wind turbines.

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

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

FDIS	Report on voting
88/276/FDIS	88/282/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.

A list of all parts of the IEC 61400 series, under the general title *Wind turbines* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The IEC 61400-25 series defines communications for monitoring and control of wind power plants. The modeling approach of the IEC 61400-25 series has been selected to provide abstract definitions of classes and services such that the specifications are independent of specific protocol stacks, implementations, and operating systems. The mapping of these abstract classes and services to a specific communication profile is not inside the scope of this part (IEC 61400-25-3) but inside the scope of IEC 61400-25-4[1].

This part of IEC 61400-25 defines services of the model of the information exchange of intelligent electronic devices in wind power plants. The services are referred to as the Abstract Communication Service Interface (ACSI). The ACSI has been defined so as to be independent of the underlying communication systems.

The information exchange model is defined in terms of

– a hierarchical class model of all information that can be accessed,

– information exchange services that operate on these classes,

– parameters associated with each information exchange service.

The ACSI description technique abstracts away from all the different approaches to implement the cooperation of the various devices.

These abstract service definitions shall be mapped into concrete object definitions that are to be used for a particular protocol. Mapping to specific protocol stacks is specified in IEC 61400-25-4.

NOTE 1 Abstraction in ACSI has two meanings. Firstly, only those aspects of a real device (for example, a rotor) or a real function that are visible and accessible over a communication network are modelled. This abstraction leads to the hierarchical class models and their behaviour defined in IEC 61400-25-2. Secondly, the ACSI abstracts from the aspect of concrete definitions on how the devices exchange information; only a conceptual cooperation is defined. The concrete information exchange is defined in IEC 61400-25-4.

NOTE 2 Performance of the IEC 61400-25 series implementations are application specific. The IEC 61400-25 series does not guarantee a certain level of performance. This is beyond the scope of the IEC 61400-25 series. However, there is no underlying limitation in the communications technology to prevent high speed application (millisecond level responses).

[1] To be published.

WIND TURBINES –

Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models

1 Scope

The focus of the IEC 61400-25 series is on the communications between wind power plant components such as wind turbines and actors such as SCADA Systems. Internal communication within wind power plant components is outside the scope of the IEC 61400-25 series.

The IEC 61400-25 series is designed for a communication environment supported by a client-server model. Three areas are defined, that are modelled separately to ensure the scalability of implementations: (1) wind power plant information models, (2) information exchange model, and (3) mapping of these two models to a standard communication profile.

The wind power plant information model and the information exchange model, viewed together, constitute an interface between client and server. In this conjunction, the wind power plant information model serves as an interpretation frame for accessible wind power plant data. The wind power plant information model is used by the server to offer the client a uniform, component-oriented view of the wind power plant data. The information exchange model reflects the whole active functionality of the server. The IEC 61400-25 series enables connectivity between a heterogeneous combination of client and servers from different manufacturers and suppliers.

As depicted in Figure 1, the IEC 61400-25 series defines a server with the following aspects:

– information provided by a wind power plant component, e. g., “wind turbine rotor speed” or “total power production of a certain time interval” is modelled and made available for access. The information modelled in the IEC 61400-25 series is defined in IEC 61400-25-2;

– services to exchange values of the modelled information defined in part IEC 61400-25-3;

– mapping to a communication profile, providing a protocol stack to carry the exchanged values from the modelled information (part IEC 61400-25-4).

The IEC 61400-25 series only defines how to model the information, information exchange and mapping to specific communication protocols. The IEC 61400-25 series excludes a definition of how and where to implement the communication interface, the application program interface and implementation recommendations. However, the objective of the IEC 61400-25 series is that the information associated with a single wind power plant component (such as a wind turbine) is accessible through a corresponding logical device.

This part of IEC 61400-25 specifies an abstract communication service interface describing the information exchange between a client and a server for:

– data access and retrieval,

– device control,

– event reporting and logging,

– publisher/subscriber,

– self-description of devices (device data dictionary),

– data typing and discovery of data types.

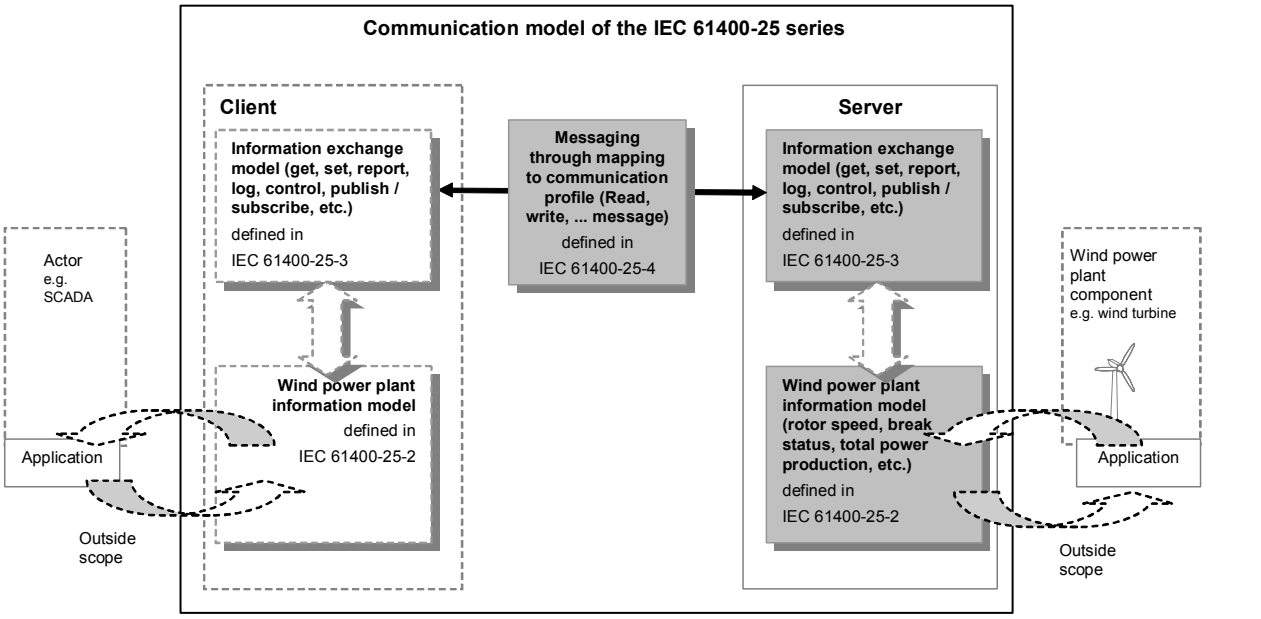

Figure 1 – Conceptual communication model of the IEC 61400-25 series

2 Normative references

The following referenced documents are indispensable for the application of this part of the IEC 61400-25 series. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61400-25 (all parts), *Wind turbines – Part 25: Communications for monitoring and control of wind power plants*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
actor
role a system plays in the context of monitoring and control, while it is not directly involved in wind power plant operation, such as Supervisory Control and Data Acquisition System (SCADA)

NOTE There are many other designations, for example, Central Management System, Monitoring and Control System, Remote Control System.

3.2
alarm
state information. Statement of safety intervention by the wind turbine control system (i.e on/off)

3.3
command
controllable data for system behaviour (enable/disable, active/deactivate, etc.)

3.4
communication function
used by an actor to configure, perform and monitor the information exchange with wind power plants, for example operational and management function

3.5
control
operational function used for changing and modifying, intervening, switching, controlling, parameterisation and optimising of wind power plants

3.6
data retrieval
operational function used for collecting of wind power plant data

3.7
diagnostics
management function used to set up and provide for self-monitoring of the communication system

3.8
event
state transition (status, alarm, command)

3.9
intelligent Electronic Device
IED
any device incorporating one or more processors, with the capability to receive data from an external sender or to send data to an external receiver

NOTE For example, wind turbine controller. An IED may have connections as a client, or as a server, or both, with other IED.

3.10
information
content of communication. Information is defined as data (usually processed and derived data, and information describing other data). The basic element is raw data from the wind power plant component, which should be processed into specified information according to the IEC 61400-25 series

NOTE Wind power plant information categories: source information (analogue and state information), control information, derived information (statistical and historical information).

3.11
information exchange
communication process between two systems, such as wind power component and actor, with the goal to provide and to get relevant information. Requires specific communication functions, consisting of one or more services

3.12
log
historical information. Chronological list of source information for a period of time

3.13
logging
operational function The praxis of recording sequential data often chronologically. The result of the logging is a log

3.14
logical device
Entity that represent a set of typical wind power plant functions

3.15
management function
function required for the administration of the information exchange in a certain level

NOTE Management functions are user/access management, time synchronisation, diagnostics, and configuration.

3.16
mandatory
defined content shall be provided in compliance with the IEC 61400-25 series

3.17
measured data
sampled value of a process quantity with associated data attributes such as time stamp and quality

3.18
meteorological system
component of a wind power plant responsible for the monitoring of the ambient conditions, for example the wind speed, wind direction, pressure, temperature etc. It supplies data for various purposes for example to correlate the meteorological data to the electrical energy output by individual wind turbines to the potentially usable wind energy

3.19
monitoring
operational function used for local or remote observation of a system or a process for any changes which may occur over time. The term can also be used for observation of the behaviour of a data value or a group of data values

3.20
operational function
function to obtain information and to send instructions for the normal daily operation of wind power plants. Types: monitoring, logging and reporting, data retrieval, control

3.21
optional
defined content can be optionally provided in compliance to the IEC 61400-25 series

3.22
parameter
controllable information intended for obtaining or correcting system behaviour

3.23
processed value
measured value, with the associated data attributes such as time stamp and quality, which have been processed according the calculation method attribute (10m-average/…)

3.24
report
actual information sent by the function reporting

3.25
reporting
operational function to transfer data from a server to a client, initiated by a server application process

3.26
Supervisory Control and Data Acquisition
SCADA
system based on a processor unit which receives information from IEDs, determines the control requirements and sends commands to IEDs. A computer system that for example the dispatchers use to monitor the power distribution throughout a service or control area

3.27
status
state condition of a component or system (st1/st2/..stn)

3.28
three phase data
measured value in a three phase electrical circuit with associated data attributes such as time stamp, quality and calculation method

3.29
user/access management
management function used for setting up, modifying, deleting users (administratively), assigning access rights (administratively) and monitoring access

3.30
wind power plant
complete system consisting of any number of technical subsystems referred to in the IEC 61400-25 series as wind power plant components, for example one or more wind turbines. The main objective of a wind power plant is to generate electrical energy from the wind

3.31
wind power plant analogue information
continuous information concerning the actual condition or behaviour of a component or system

NOTE Types are, for example, measured value, processed value, three phase value, setpoint, parameter.

3.32
wind power plant component
technical system employed in the operation of wind power plants, such as wind turbine, meteorological, electrical and wind power plant management system

3.33
wind power plant management system
component of a wind power plant, which is responsible to ensure that the complete system adapts itself to the static and dynamic conditions and requirements of the electrical power connection (i.e., interoperation of the WTs with substation and other power network related devices)

NOTE A wind power plant management system may include other functions (for example shadow control functionality, noise or sound reduction, ice warning, lightning protection) not modelled in the IEC 61400-25 series.

3.34
wind turbine
main component of a wind power plant. It is responsible for generating energy and meets the task of using the wind potential of a certain location that converts kinetic wind energy into electric energy

4 Abbreviated terms

ACSI	Abstract Communication Service Interface (defined for example in IEC 61850-7-2)
FCD	Functionally Constrained Data
FCDA	Functionally Constrained Data Attribute
IED	Intelligent Electronic Device
IEM	Information Exchange Model
LCB	Log Control Block
LD	Logical Device
LN	Logical Node
LOG	Log
LPHD	Logical Node Physical Device
RCB	Report Control Block
SCADA	Supervisory Control and Data Acquisition
SCSM	Specific Communication Service Mapping (defined for example in IEC 61850-8-1)
SG	Setting Group
WPP	Wind Power Plant
WT	Wind Turbine
XML	Extensible Mark-up Language
GUI	Graphical User Interface

5 General

This part of IEC 61400-25 provides the information exchange models that can be applied by a client and a server to access the content and structure of the wind power plant information model defined in IEC 61400-25-2.

Clause 6 gives an overview of the information exchange models for operational functions and management functions.

Clause 7 introduces the information exchange models for operational functions: authorisation, control, monitoring, and reporting and logging.

Clause 8 gives an overview of the information exchange models for management functions.

Clause 9 provides the details of the services for the following service model classes:

- Application association,
- Server class,
- Logical Device class (retrieve the self-description, etc.),
- Logical Node class (retrieve the self-description, etc.),
- Data class (get values, set values, retrieve the self-description, etc.),
- DataSet class (get values, set values, create data sets, retrieve the self-description, etc.),
- Report Control Block class (get attributes, set attributes, report, etc.),
- Log Control Block and Log classes (get attributes, set attributes, retrieve log entries, etc.),
- Control class (select, operate, etc.).

Annex A provides examples of the reporting and logging services required.

Annex B provides Relationship between ACSI Services and Functional Constraints.

Annex C provides Relationship between ACSI defined in IEC 61850-7-2 and IEC 61400-25-3.

6 Information exchange models overview

The information exchange models provide services for communication functions that are grouped as follows:

- Operational functions,
- Management functions.

These two groups are introduced and described in more detail in the following clauses.

The mandatory services for each information exchange model are indicated in the corresponding service tables in Clause 9.

An instance of the wind power plant information model of a wind power plant (logical device, logical node, data, data attributes and control block objects) shall be accessed by instances of the information exchange models listed in Table 1. The first two columns of the table enumerate the functional groups and their information exchange models, which are summarily described in the third column. The forth and fifth columns identify which data kinds and transfer principles are applicable for each information exchange model. The last column indicates the ACSI service models used for the corresponding information exchange models.

Table 1 – Information exchange models

Functional group	Information exchange model	Short description	Information categories	Transfer principles	ACSI service models
Operational (see Clause 7)	Authorisation (see 7.2)	Authentication and restriction of access to operational and management functions.	Short text messages	Data transfer on demand Command transfer	ASSOCIATION
	Control (see 7.3)	Control of operational devices.	Setpoints Commands	Command transfer Set point transfer	CONTROL
	Monitoring (see 7.4)	Monitoring of current data and change of data of operational devices.	Measured Data Processed data (Average Values, Min/Max) Status Alarms Events Timer Counter Setpoints Parameters Commands Time Series Data (i.e. Alarm/Event Log, Command Log, Setpoint Log) (Analogue Values, Binary Values)	Periodic data transfer (all data or only data that has changed since last transfer) Data transfer on demand Event driven data transfer (spontaneous)	LOGICAL-DEVICE LOGICAL-NODE DATA DATA-SET BUFFERED-REPORT-CONTROL UNBUFFERED-REPORT-CONTROL LOG LOG-CONTROL (see 9 for details of the ACSI services)
	Reporting and logging (see 7.4)	Trigger controlled continuous scanning and recording of values and events.	Histories (Logs) Reports Statistics Curves Trends Events Short text messages		
Management (see Clause 8)	Diagnostics (see 8.5)	Self-monitoring of devices.	*Monitoring, and reporting and logging information categories apply*		
	User and access management (see 8.2)	Setting up users, access rights and monitoring access.	*System specific*		
	Setup (see 8.3)	Device configuration management.	*System specific*		
	Time synchronisation (see 8.4)	Synchronization of device clocks.	*SCSM specific*		

The information exchange models shall be realised by the corresponding ACSI models and associated services (as depicted in the last column in Table 1). The intent of the table is to give an overview applying the commonly used terminology of the wind power plant domain.

7 Operational functions

7.1 General

The information exchange models for operational functions described in this Clause are as follows

- Association and authorisation model,
- Control model,
- Monitoring, reporting and logging model.

Functional constraints of the ACSI services are specified in Annex B.

7.2 Association and authorisation model

The intention of the association and authorisation model is to provide a secure information exchange via an association between a client and a server. The model provides client authentication and controls the access to server functions. The conceptual mechanism is shown in Figure 2.

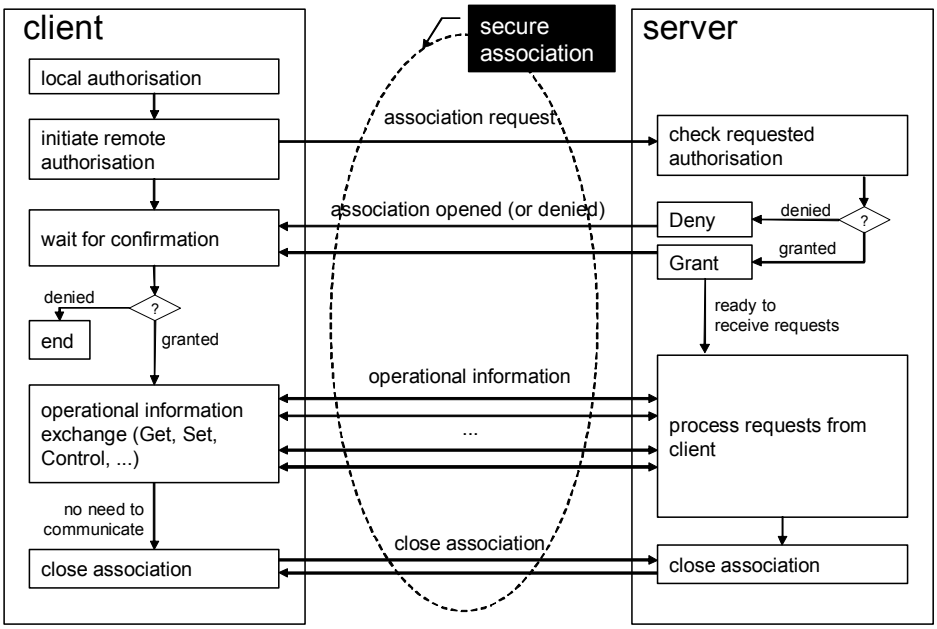

Figure 2 – Association and authorisation model (conceptual)

The requirements to be fulfilled by an association between a client and as server are as follows:

– **authentication:** determining the identity of the users/client,

– **authorisation and access control:** ensure that the entity has the proper access rights (a minimum is to provide a user name and a password),

– **integrity:** messages and the computer infrastructure are protected against unauthorised modification or destruction,

– **confidentiality:** objects of the Wind power plant information model are protected and only disclosed to appropriate users/clients,

– **non-repudiation:** preventing a user/client involved in a data exchange from denying that it participated in the exchange,

– **prevention of denial of device:** preventing a client/server from blocking access to authorised users.

The real services of the authorisation model is provided by the specific mappings given in IEC 61400-25-4. Based on the specific mapping selected, the actual level of security and the specific services supported might be different.

7.3 Control model

The control model defines the Information Exchange models for commands and controlling of a group of set points contained in an operational device. The conceptual mechanism is shown in Figure 3.

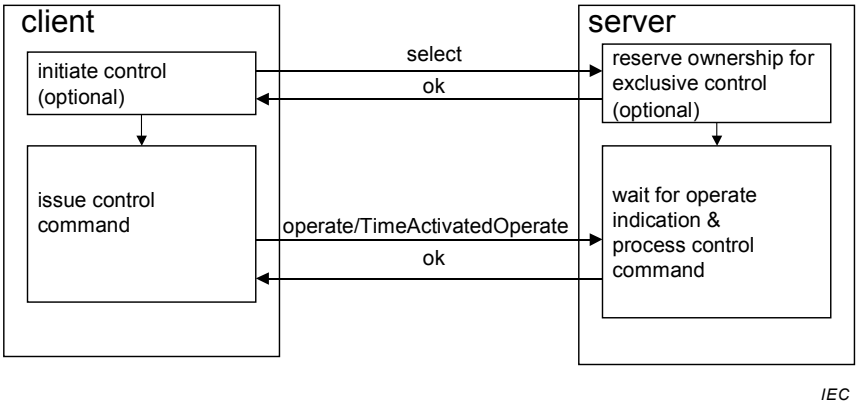

Figure 3 – Control model (conceptual)

The control model comprises the control of an operational device. Control functions might be available to allow one client to have the exclusive right to control a device at a specific time.

The operate command “sets” the value of a controllable data (derived from controllable common data classes).

NOTE The process to control the physical object is a local issue of the device that hosts the server. The IEC 61400-25 series defines just the external visible behaviour of the device. The control model as defined for the server provides several parameters that determine the controlling process. The behaviour of the client is complementary to the behaviour of the server.

The TimeActivatedOperate command is processed automatically by the server when the time given by the service request is met.

7.4 Monitoring, reporting and logging model

The conceptual Information exchange models for monitoring, reporting and logging are shown in Figure 4. The models comprise three independent information retrieval methods:

1) Values can be retrieved on demand by a client (upper part of the figure). This is commonly known as Get or Read; the response will be transmitted immediately.
2) Values can be reported to the client, following a publisher/subscriber reporting model (in the middle of the figure). The server is configured (locally or by means of a service) to transmit values spontaneously or periodically. The client receives messages (reports) whenever trigger conditions are met at the server. The publisher/subscriber model may buffer events in case the communication link is down and transmit all buffered events in sequence once the link is operating again, in case of a buffered report. In the case of an unbuffered report, the delivery of events, in the case of a communication link failure is not guaranteed.

3) Values can be logged at the device. The logging model (at the bottom of the figure) allows buffering and delivery of events in correct sequence. Logging values from multiple sources of data (via configuration of Data Sets) may be logged and each source can be configured independently of other sources. The client can query the log for entries between two timestamps or for all entries after a certain entry.

The reporting and logging models include:

a) a Data Set class (DS), for referencing groups of data to be logged or reported,

b) Control Block class (report control block class or log control block class), for controlling the dynamic behaviour of the information logging or reporting, and

c) a Log class, for definition of log storage.

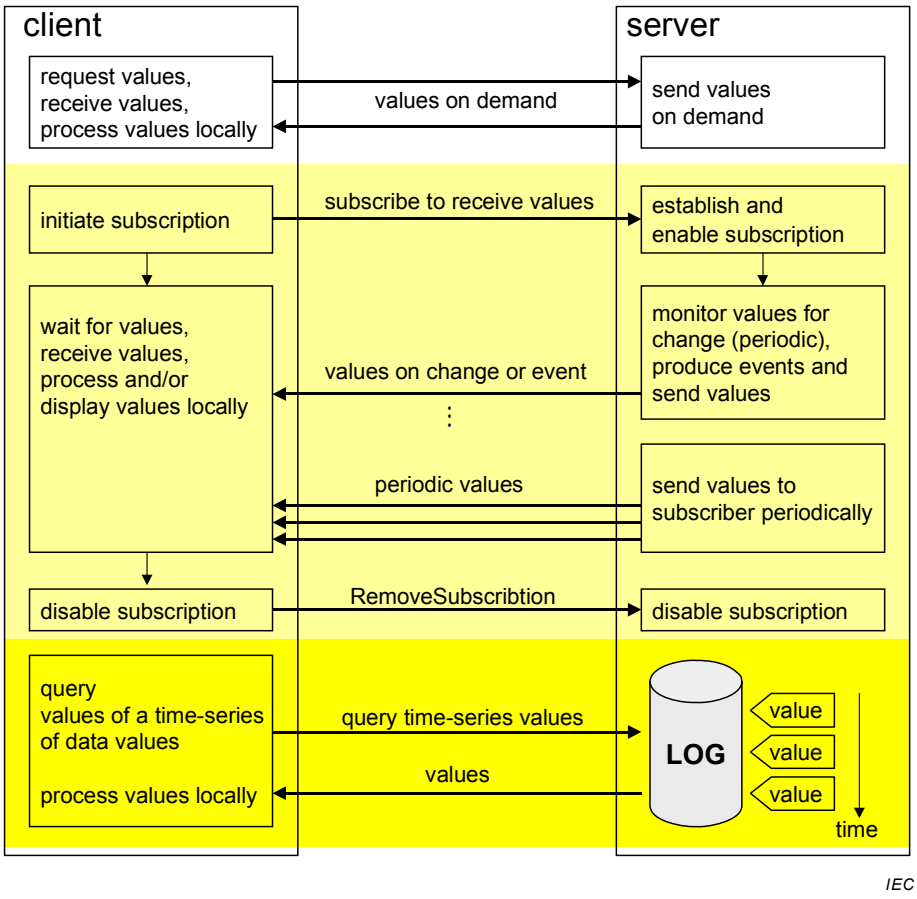

Figure 4 – Monitoring, reporting and logging model (conceptual)

The retrieval methods have the characteristics given in Table 2.

Table 2 – Comparison of the information retrieval methods

Retrieval method		Time-critical information exchange	Can lose changes (of sequence)	Multiple clients to receive information	Last change of data stored by	Typical client (but not exclusively)
Data on demand		NO	YES	YES	-	Browser
Reporting	**Subscription**	YES	YES/NO	YES	Server	Real-time GUI
	Unbuffered reporting	YES	YES	YES	-	Real-time GUI
	Buffered reporting*	YES	NO	YES	Server	Data concentrator
Logging		NO	NO	YES	Client	Plant operation, engineering stations

Each of the retrieval methods has specific characteristics. There is no single method that meets all application requirements. During system design, the designer shall analyse the requirements and to check them against the (implemented) methods provided by a device compliant with the IEC 61400-25 series.

8 Management functions

8.1 General

The management function models described in this Clause are used to set-up or evolve (maintain) a system. The system configuration and maintenance functions include the setting and changing of configuration data and the retrieval of configuration information from the system. The management function models described are as follows

- User management/access security model,
- Setup model,
- Time synchronisation model,
- Diagnostic (self monitoring) model.

Functional constraints of the ACSI services are specified in Annex B.

8.2 User management/access security model

Apart from the service requirements given in 7.2 these functions are an implementation-specific issue.

8.3 Setup model

Apart from the service requirements given in 7.2 these functions are an implementation-specific issue.

8.4 Time synchronisation model

The synchronisation of the various clocks in a system is a matter of the specific mapping selected and specified in IEC 61400-25-4.

8.5 Diagnostic (self-monitoring) model

The diagnostic or self-monitoring functions, are intended for detection of the system status for example if a device is fully operational, partially operational, or not operational. The diagnosis information is defined in the logical node LPHD defined in IEC 61400-25-2.

9 The ACSI for wind power plant information models

9.1 General

The information exchanges models specified in Clause 7 and 8 create an overview of the models required to be compliant with the IEC 61400-25 series. Clause 9 contains the detailed description of all service required.

The basic information exchange models are depicted in Figure 5, illustrating the various components of the ACSI services. This figure is used to provide a narrative description of how a typical device interacts with the outside world using these services.

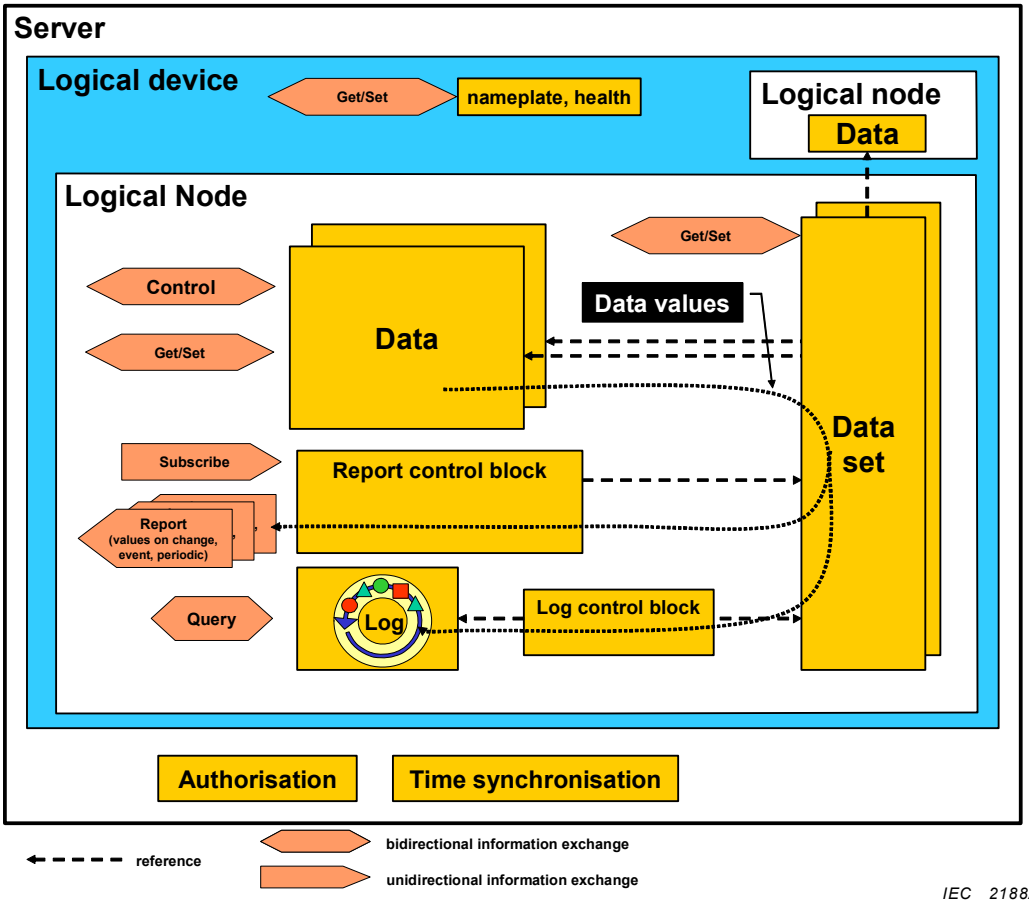

Figure 5 – Conceptual information exchange model for a wind power plant

The specification in this Clause provides a high level definition of services. The normative definition of the details of the ACSI models and services are defined in IEC 61850-7-2.

9.2 Services of Association and authorisation

The application association model consists of provisions on how the communication between the various types of devices is achieved. The model comprises:

- Class definitions of associations, and
- Access control concepts (how to restrict access to instances in a server).

The application association model defines the services provided for managing associations between client and server (two-party application association).

NOTE The details of an application association model are defined in the SCSMs.

The access control model provides the capability to restrict the access of a specific client to class instances, class instance attributes, and ACSI services acting upon class instances of a specific server.

The services listed in Table 3 are defined for Two-Party-Application-Association.

Table 3 – Two-Party-Application-Association

Services for TWO-PARTY-APPLICATION-ASSOCIATION	M/O
Associate	M
Abort	O
Release	O

The details of the Two-Party-Application-Association class shall be as defined in Clause 7 of IEC 61850-7-2.

9.3 Services of Server class

A Server represents the externally visible behaviour of a device. A client shall use the GetServerDirectory service to retrieve a list of the names of all Logical Devices made visible and thus accessible to the requesting client by the addressed Server as shown in Table 4.

Table 4 – Server

Services for SERVER	M/O
GetServerDirectory	O

The details of the Server class are defined in Clause 6 of IEC 61850-7-2.

9.4 Services of Logical Device class

Logical Device (for example, a wind turbine controller) is a collection of Logical Nodes (for example, rotor, transmission and generator). Each Logical Device has a meaning in the context of its use. Instances of Logical Devices (i.e., its Logical Nodes and DATA) can be accessed directly by the services provided by Logical Nodes and DATA. The Logical Device can be browsed to get the names of all Logical Nodes it contains as shown in Table 5.

Table 5 – Logical Device

Services for LOGICAL-DEVICE	M/O
GetLogicalDeviceDirectory	O

The details of the Logical Device class shall be as defined in Clause 8 of IEC 61850-7-2.

9.5 Services of Logical Node class

Logical Node (for example, a transmission) is a collection of Data (for example, transmission gear temperature). Each Logical Node has a meaning in the context of its use. Instances of Logical Nodes (i.e., its DATA) can be accessed directly by the services provided by DATA. The Logical Node can be browsed to get the names of all the different kind of information that it contains as shown in Table 6.

Table 6 – Logical Node

Services for LOGICAL-NODE	M/O
GetLogicalNodeDirectory	O

The details of the Logical Node class shall be as defined in Clause 9 of IEC 61850-7-2.

9.6 Services of Data class

DATA (for example, status of a rotor) is a collection of DataAtributes (for example, actual status value, quality, timestamp). Each DATA has a meaning in the context of its use. Instances of DATA (i.e., its DataAttributes) can be accessed directly by the services shown in Table 7.

Table 7 – DATA

Services for DATA	M/O
GetDataValues	M
SetDataValues	M
GetDataDirectory	O
GetDataDefinition	O

The details of the Data class shall be as defined in Clause 10 of IEC 61850-7-2.

EXAMPLE GetDataValue “WindPowerPlant12/WGEN.PwrAt.phsA.cVal.mag.f[MX]” returns the floating point value of the current value.

9.7 Services of DataSet class

DATA-SET is a group of references to DATA. Instances of DATA-SETs can be accessed directly by the services shown in Table 8. Instances of DATA-SETs can be used by Report Control Blocks to specify which DATA to be monitored and reported depending on some specific criteria (defined with the DATA or the Report Control Block respectively).

Table 8 – DATA-SET

Services for DATA-SETs	M/O
GetDataSetValues	M
SetDataSetValues	O
CreateDataSet	O
DeleteDataSet	O
GetDataSetDirectory	O

The details of the Data Set class shall be as defined in Clause 11 of IEC 61850-7-2.

NOTE 1 The DATA-SET just references the DATA – it does not contain the DATA. If the DATA-SET is deleted, the DATA is still there.

NOTE 2 The DATA-SET could be understood as providing a short-hand reference (name) to many instances of DATA that can be accessed by one reference – instead of a list of references. DATA-SETs are referenced by control blocks for reporting and logging.

9.8 Services of Report Control Block class

9.8.1 ACSI conformant services

REPORT-CONTROL provides the mechanism of spontaneously report data values on specific criteria (for example, on change of value, on change of quality information, or simply periodically). The behaviour of a REPORT-CONTROL is determined by the values of its attributes (for example, enable/disable reporting, use of sequence number). The REPORT-CONTROL references an instance of a DATA-SET. The REPORT-CONTROL provides the spontaneous Report service; the attributes of an instance of a REPORT-CONTROL can be accessed directly by the services shown in Table 9.

The BRCB (BUFFERED-REPORT-CONTROL-BLOCK) provides the functionality to ensure that a server sends a sequence-of-events even if the communication is temporarily interrupted. With the URCB (UNBUFFERED-REPORT-CONTROL-BLOCK) a server does not need to buffer events in case of communication interruption.

Table 9 – REPORT-CONTROL

Services	M/O
Report	O
GetBRCBValues	O
SetBRCBValues	O
GetURCBValues	O
SetURCBValues	O
AddSubscription [a]	O
RemoveSubscription [a]	O
[a] The services AddSubscription and RemoveSubscription have been added as a specialisation of the reporting model defined in 14.2 of IEC 61850-7-2..	

The details of the REPORT-CONTROL class shall be as defined in 14.2 of IEC 61850-7-2.

NOTE The reporting model is composed by two independent classes: the report control block class and the data set class. Firstly, a data set may be predefined (configured) or dynamically defined by the service CreateDataSet. Secondly, a reference to the data set – as an attribute of the report control block – needs to be set (either by a SetBRCBValues (SetURCBValues) service. These two steps are combined in the service AddSubscription.

The basic reporting mechanism is shown in Figure 2. The buffered and unbuffered reporting starts with the configuration of the report control blocks. The reporting starts with setting the enable buffered RCB attribute to TRUE; setting it to FALSE stops the reporting. The reporting methods are simple and provide an efficient way to spontaneously transmit changes.

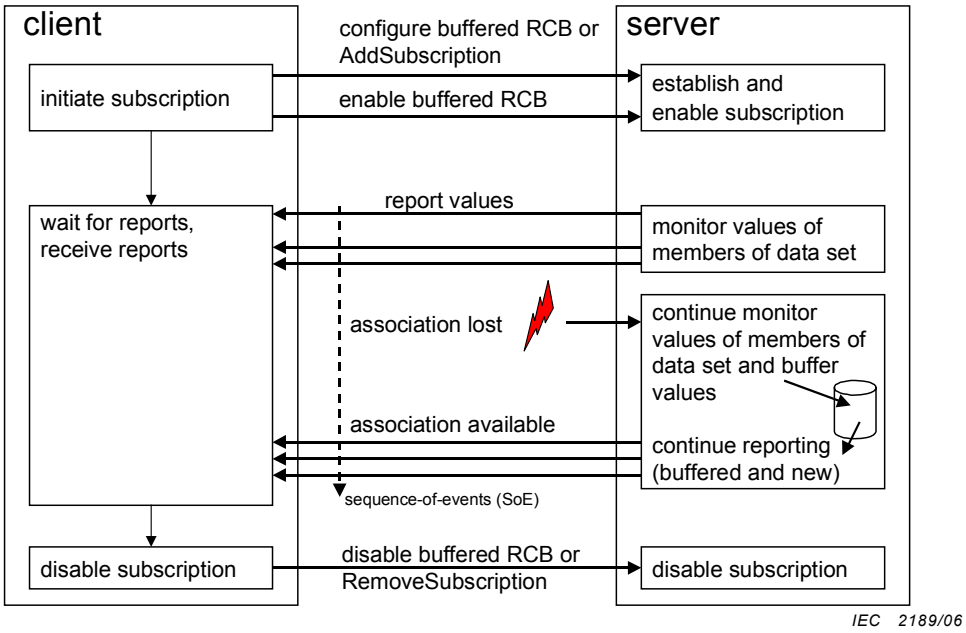

Figure 6 – Buffered report control block – conceptual

9.8.2 AddSubscription

The client shall use the AddSubscription service to request the server: (1) to create a DATA-SET with a list of members defined with the Functionally Constrained Data (FCD) or Functionally Constrained Data Attribute (FCDA) made visible and thus accessible to the requesting client, (2) to set the attributes of the corresponding report control block, and (3) to start monitoring and reporting values immediately. DATA-SETs created using AddSubscription services follow the rules of the DATA-SET model.

After processing of the service AddSubscription, the server shall start one single General interrogation as defined in 14.2 of IEC 61850-7-2 to synchronise the process image of the client with the current image of the server.

The AddSubscription service shall be defined as shown in Table 10.

Table 10 – AddSubscription service

Parameter name	Description
Request	
RCBRef	Report Control Block ObjectReference The parameter RCBRef shall specify the ObjectReference of the report control block to be chosen.
RCBType	report control block type The parameter RCBType shall specify the selection of the report control block type, either URCB or BRCB.
ReportIdentifier [0..1]	ReportIdentifier The parameter ReportIdentifier shall contain the value for the corresponding attribute RptID of the referenced BRCB/URCB as defined in 14.2 of IEC 61850-7-2.
ReportEnable [0..1]	ReportEnable The parameter ReportEnable shall contain the value for the corresponding attribute RptEna of the referenced BRCB/URCB as defined in 14.2 of IEC 61850-7-2. For URCB it shall be always implicitly set to TRUE.
DataSetReference	DataSetReference The parameter DataSetReference shall be used to create a DATA-SET in case the DATA-SET does not exist, otherwise it refers to an existing DATA-SET that shall be used for Reporting. The parameter DataSetReference shall be used to set the value for the corresponding attribute DatSet of the referenced BRCB/URCB as defined in 14.2 of

Parameter name	Description
	IEC 61850-7-2.
OptionalFields [0..1]	OptionalFields The parameter OptionalFields shall contain the value for the corresponding attribute OptFlds of the referenced BRCB/URCB as defined in 14.2 of IEC 61850-7-2.
BufferTime [0..1]	BufferTime The parameter BufferTime shall contain the value for the corresponding attribute BufTm of the referenced BRCB/URCB as defined in 14.2 of IEC 61850-7-2.
TriggerOptions [0..1]	TriggerOptions The parameter TriggerOptions shall contain the value for the corresponding attribute TrgOp of the referenced BRCB/URCB as defined in 14.2 of IEC 61850-7-2.
IntegrityPeriod [0..1]	IntegrityPeriod The parameter IntegrityPeriod shall contain the value for the corresponding attribute IntgPd of the referenced BRCB/URCB as defined in 14.2 of IEC 61850-7-2.
DSMemberRef [0..n]	Data set member ObjectReference The parameter DSMemberRef shall specify the functionally constrained data (FCD) or functionally constrained data attribute (FCDA) of a DATA as defined in Clause 11 of IEC 61850-7-2.
Response+	The parameter Response+ shall indicate that the service request succeeded. If one of the referenced functionally constrained data (FCD) are not available to that client, then the service shall fail.
Response–	The parameter Response– shall indicate that the service request failed.
ServiceError	The appropriate ServiceError shall be returned.

9.8.3 RemoveSubscription

The client shall use the RemoveSubscription service to request the server to disable the corresponding report control block and to order the deletion of the DATA-SET referenced by its DataSet attribute. In the removal of the DATA-SET, the same rules of the DeleteDataSet service should be applied.

The RemoveSubscription service shall be defined as shown in Table 11.

Table 11 – RemoveSubscription service

Parameter name	Description
Request	
RCBRef	Report Control Block ObjectReference The parameter shall specify the ObjectReference of the report control block to be chosen to be disabled. The DATA-SET referenced by this report control block shall be removed.
Response+	The parameter Response+ shall indicate that the service request succeeded.
Response–	The parameter Response– shall indicate that the service request failed.
ServiceError	The appropriate ServiceError shall be returned.

9.9 Services of Log Control Block and Log classes

LOG-CONTROL provides the mechanism of spontaneously log data values on specific criteria (for example, on change of value, on change of quality information, on updates of a counter, or simply periodically) to a log. The behaviour of a LOG-CONTROL is determined by the values of its attributes (for example, enable/disable logging). The LOG-CONTROL references an instance of a DATA-SET.

The LOG provides the query service to receive data values stored between two times given by the query; the attributes of an instance of a LOG can be accessed directly by the services shown in Table 12.

Table 12 – LOG and LOG-CONTROL

Services for LOG Control Block	M/O
GetLCBValues	O
SetLCBValues	O
Services for LOGs	
GetLogStatusValues	O
QueryLogByTime [a]	O
QueryLogAfter [a]	O
[a] Service shall provide – as a specialisation of the LOG as defined in 14.3 of IEC 61850-7-2 – a filter parameter to select one or more functionally constrained data (FCD) or functionally constrained data attribute (FCDA) of a DATA to be queried.	

The details of the LOG-CONTROL class and LOG class shall be as defined in 14.3 of IEC 61850-7-2.

The DataFilter according Table 13 shall be added to the QueryLogByTime request and QueryLogAfter request.

Table 13 – Data filter

DataFilter [0..n]	data filter ObjectReference The parameter DataFilter shall specify the functionally constrained data (FCD) or functionally constrained data attribute (FCDA) of a DATA. If the data filter parameter is not included [0] then no data filtering is applied. Only the RangeStartTime parameter together with the RangeStopTime or Entry parameters are used to select the DATA.

The parameter ListOfLogEntries of the QueryLogByTime response and QueryLogAfter response shall contain the list of log entries that are (1) selected by the DataFilter and that are (2) in the range as specified with the parameters RangeStartTime and RangeStopTime of the service request.

NOTE The filter parameter allows to reduce the amount of information to be returned considerably.

Figure 7 shows an example of a log and three log control blocks. The first step is to establish an association with the server and to configure and enable log control blocks. After enabling the log control blocks, the association with the server may be closed. The log entries are stored into the log as they arrive. The logs entries are stored in a time sequenced order, therefore allowing retrieval of a sequence-of-events (SoE) list.

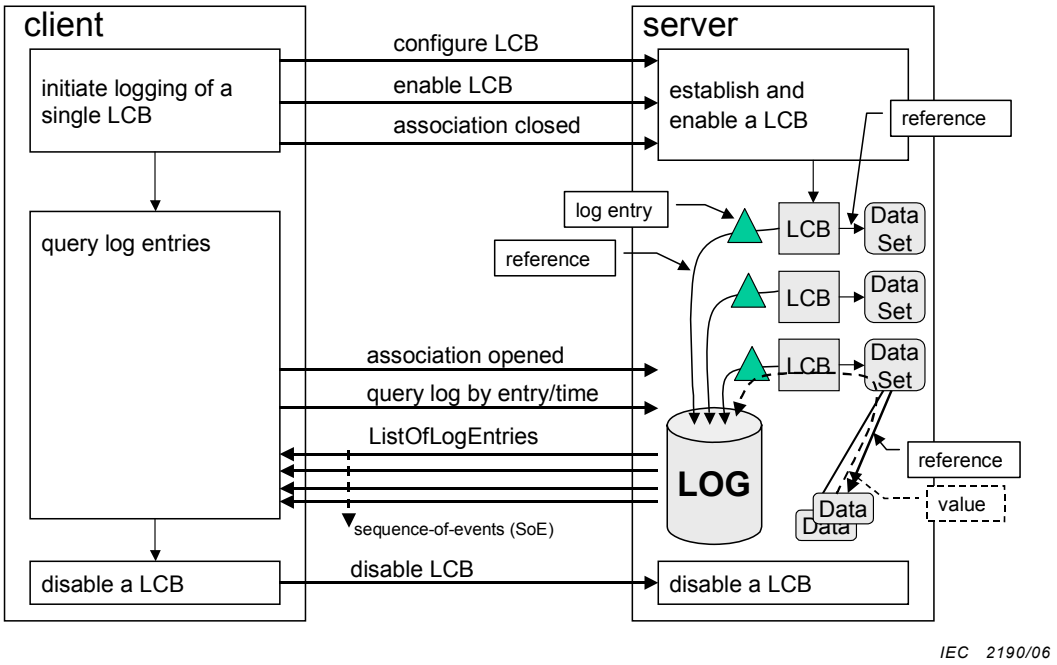

Figure 7 – Log control block – conceptual

The log is enabled at any time, which means that log entries will be added to the log whether there are any client associations open or not. The different log control blocks allow controlling storage of information from different data sets. Each log control block is independent of the other control blocks.

9.10 Services of control class

CONTROL model provides the mechanism to control functions and real devices represented by a server.

The CONTROL provides the services shown in Table 14.

Table 14 – CONTROL

Services	M/O
Select	O
SelectWithValue	O
Cancel	O
Operate	M
CommandTermination	O
TimeActivatedOperate	O

The details of the CONTROL class shall be as defined in Clause 17 of IEC 61850-7-2.

Annex A
(informative)

Examples of reporting and logging services

A.1 Reporting example

A report service example is shown in Figure A.1. The values to be reported are derived from the members of a Data Set, in this case “MyDS”. The position of each member in the Data Set is defined as shown and known by both the client and server.

In this example. the report carries only the values that have changed since the last report of the same data. The next value change will trigger a new report carrying the new value. Since only changed values are sent with the report, an indication of which data the values correspond to is included in a so-called “inclusion bitstring”. This bitstring has as many bits as the Data Set has members. The value of the first member has changed and therefore the first bit has been set to TRUE. The receiver can determine that the value has been derived from the data “WindPowerPlant12/WGEN.W.phsA.cVal.mag.f ” through the position in the bitstring.

The full object identifier “WindPowerPlant12/WGEN.W.phsA.cVal.mag.f” may optionally be transmitted – but this is not required.

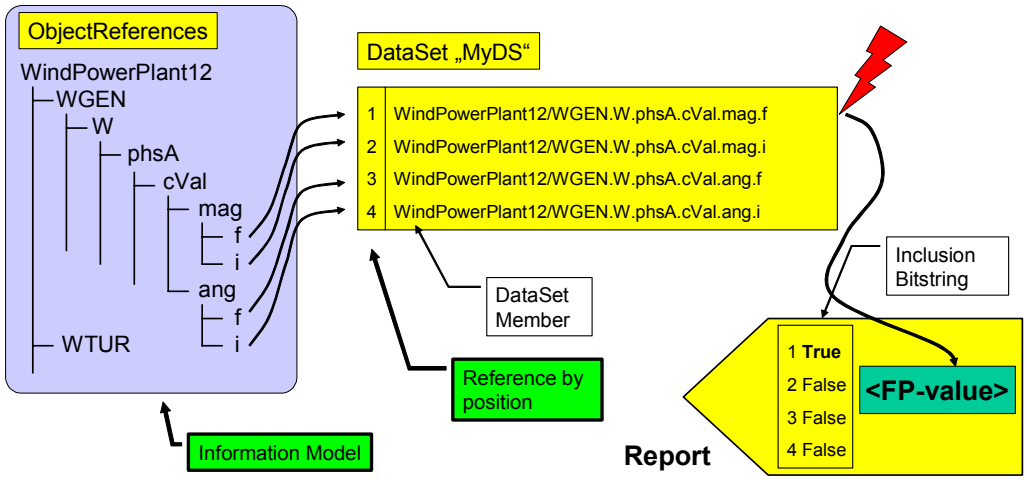

Figure A.1 – Mapping of Information Models to Data Sets for reporting (example)

The report may optionally contain also parameters such as:

– Report identifier (RpdID) – handle given by the client,
– Sequence number – for detection of lost segments,
– SubSequence number – if values do not fit into one report,
– Data Set reference – “MyDS”,
– Cause for reporting (reason code) – data change, quality change, etc.

A.2 Logging example

An example of logging is shown in Figure A.2.

The log entries are obtained from instances referenced by a Data Set (the same source of information used for reporting may be used for logging). A change in one of these values will trigger a log entry to be stored into the log. The log entry is composed of: (1) timestamp of entry, (2) object reference of the data and (3) current value (floating point value in the example).

The log has additional attributes:

– OldEntryTime (timestamp of the oldest entry),
– NewEntryTime (timestamp of the newest entry),
– OldEntry (identifier of the oldest entry),
– NewEntry (identifier of the newest entry).

These attributes can be read.

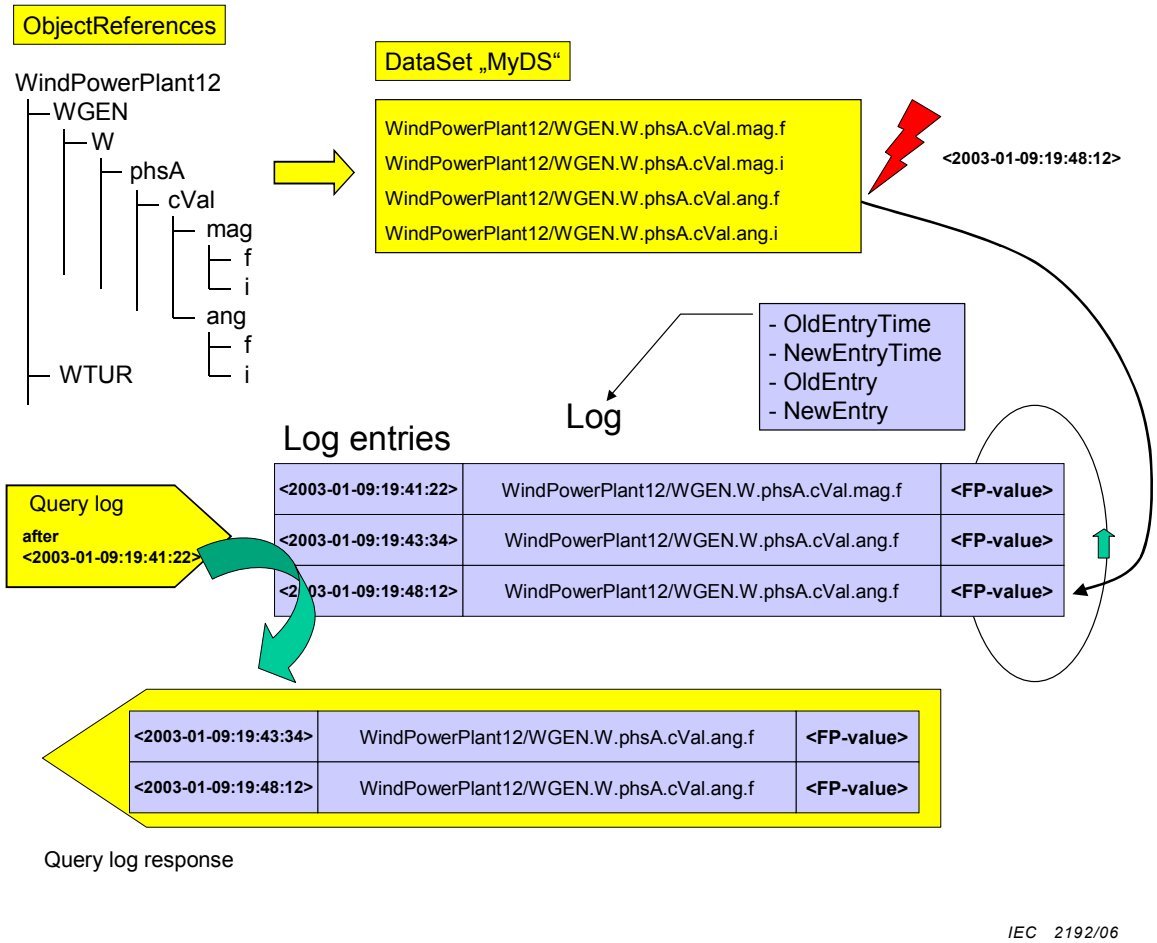

Figure A.2 – Logging basics (example)

The Query Log service allows retrieval of log entries identified by a time range (between time 1 to time 2) or by a timestamp and entry id after which entries should be returned (entry id is required because multiple entries for the same timestamp may be contained in the log).

The query log response delivers the entries requested.

Annex B
(normative)

Relationship between ACSI Services and Functional Constraints

The Functional Constraint (FC) serves two purposes:

– to define the services that are applicable for a specific DataAttribute (see Table B.1),

– to reduce (or filter) the amount of data values carried with some services, for example, the GetDataValues service response of a specific Data or all Data of Logical Node would return all DataAttributes. The FC parameter in the service request, for example, MX, requests only the DataAttributes with FC=MX.

Table B.1 – Relationship between ACSI Services and Functional Constraints

Services	M/O	Service applies to FC
Associate	M	-
Release	O	-
Abort	O	-
GetServerDirectory	O	-
GetLogicalDeviceDirectory	O	-
GetLogicalNodeDirectory	O	-
GetDataValues	M	CF, DC, ST, MX, SP, EX
SetDataValues	M	CF, SP
GetDataDirectory	O	CF, DC, ST, MX, SP, CO, EX
GetDataDefinition	O	CF, DC, ST, MX, SP, CO, EX
GetDataSetValues	M	-
SetDataSetValues	O	-
CreateDataSet	O	The DataSetReference has no FC associated but the elements that build it can be of any FC.
DeleteDataSet	O	-
GetDataSetDirectory	O	-
Report	O	A Report can include elements of any FC. See Note 1.
GetBRCBValues	O	BR
SetBRCBValues	O	BR
GetURCBValues	O	RP
SetURCBValues	O	RP
AddSubscription [a]	O	RP, BR
RemoveSubscription [a]	O	RP, BR
GetLCBValues	O	LG
SetLCBValues	O	LG
GetLogStatusValues	O	LG
QueryLogByTime [a]	O	A LogEntry can include elements of any FC. See Note 2.
QueryLogAfter [a]	O	A LogEntry can include elements of any FC. See Note 2.
Select	O	CO
SelectWithValue	O	CO
Cancel	O	CO
Operate	M	CO
CommandTermination	O	CO
TimeActivatedOperate	O	CO

NOTE 1 Only the changes in the value of the elements defined in IEC 61400-25-2 with the TrgOp “dchg”, “qchg”, “dupd” will generate events to send in the reports.

NOTE 2 Only the changes in the value of the elements defined in IEC 61400-25-2 with the TrgOp “dchg”, “qchg”, “dupd” will generate events to be stored in the LOG.

Annex C
(informative)

Relationship between ACSI defined in IEC 61850-7-2 and IEC 61400-25-3

In the Wind Power Plant automation the requirements are similar but not exactly equal to the ones defined in the Substation Automation System. The consequences of these differences are that some of the ACSI classes defined in IEC 61850-7-2, to provide very specific functionality, are not needed in the IEC 61400-25 series.

The Classes that will not appear in the Wind Power Plant are:

– Substitution.

– Files: the IEC 61400-25 series will not specify how the file interchange, if needed, will be performed.

The Control Blocks that will not be used in IEC 61400-25-3 are:

– SGCB: Setting Group Control Block. All the settings of the system will use the functional constraint FC. That means that there will not be different setting groups preconfigured inside the server.

– GoCB: GOOSE Control Block. Control Block of events of high priority between protection device inside the substation.

– GsCB: GSSE Control Block. Control Block of events of high priority between protection device inside the substation.

– MSVCB: Multicast Sampled Values Control Block.

– USVCB: Unicast Sampled Values Control Block

IEC 61850-7-2 allows the existence of only one LOG in every Logical Device. This restriction has been changed and in IEC 61400-25-3 the LOGs will be linked to the Logical Nodes so that more than one instance could be created and attached to its corresponding Logical Node.

The ACSI defined in the Figure 3 of IEC 61850-7-2 describes the relationship between the different elements that build the ACSI in the substation automation area. Figure C.1 describes the relationship in IEC 61400-25-3.

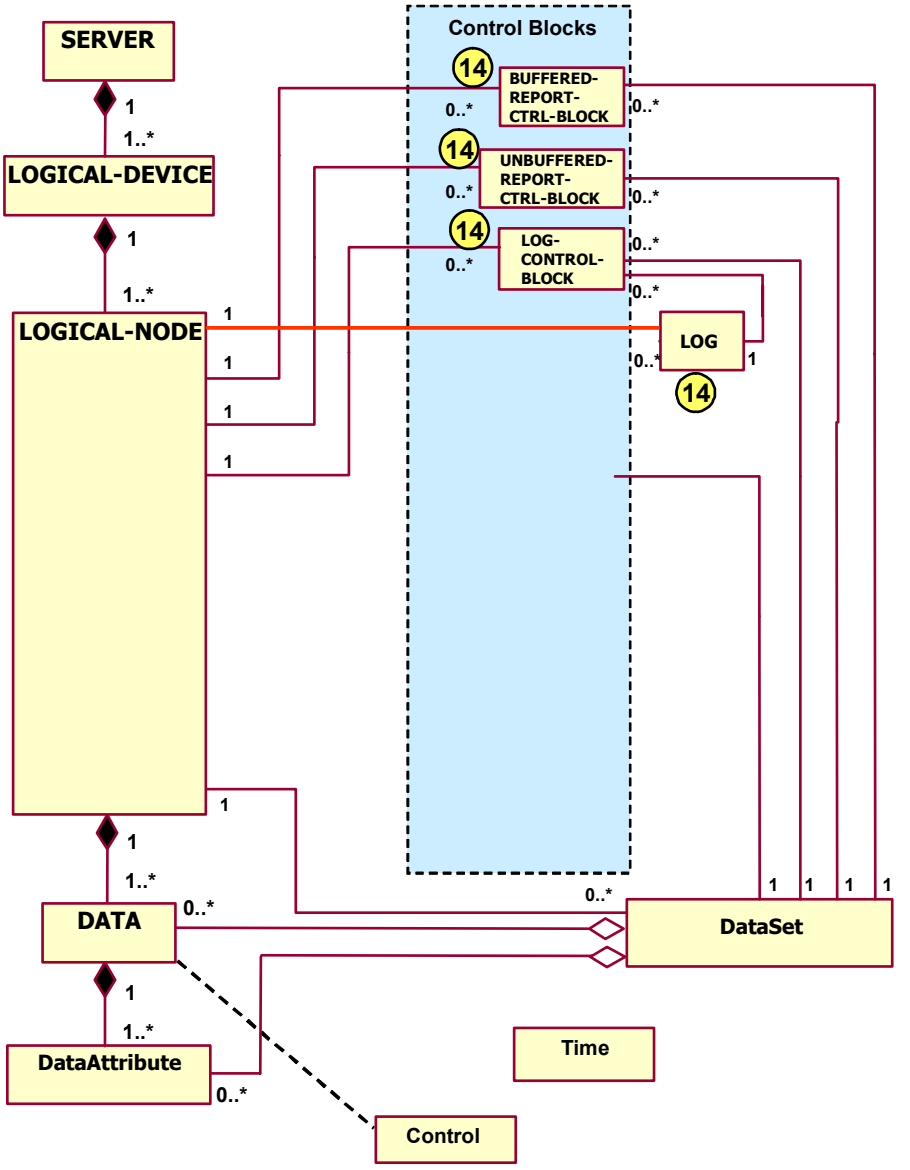

Figure C.1 – Conceptual service model of the ACSI

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other.....

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nearly ❑
fairly well ❑
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standard is incomplete ❑
standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
other .....

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ISBN 2-8318-8911-1

ICS 27.180

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND