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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

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FOREWORD

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

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

FDIS	Report on voting
88/540/FDIS	88/552/RVD

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

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

This second edition cancels and replaces the first edition published in 2006.

The scope of revision includes:

- Harmonization with service models in Edition 2 of IEC 61850-7-2.
- Reduction of overlap between standards and simplification by increased referencing.

This edition includes the following significant technical changes with respect to the previous edition:

a) Add subscription and remove subscription services have been removed.
b) Tables in Clause 9 indicating expected services have been replaced by tables in a new Annex D including ACSI conformance statements for clients and servers.
c) Technical issues (“Tissues”) for IEC 61850-7-2 edition 2 have been considered and changes have been made accordingly.

Technical issues (“Tissues”), as collected by the IEC 61400-25 users group USE61400-25, have been considered, but no technical issues were registered for edition 1.

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 stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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

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~~ are 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 IEC 61400-25-3;
– mapping to a communication profile, providing a protocol stack to carry the exchanged values from the modelled information (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.

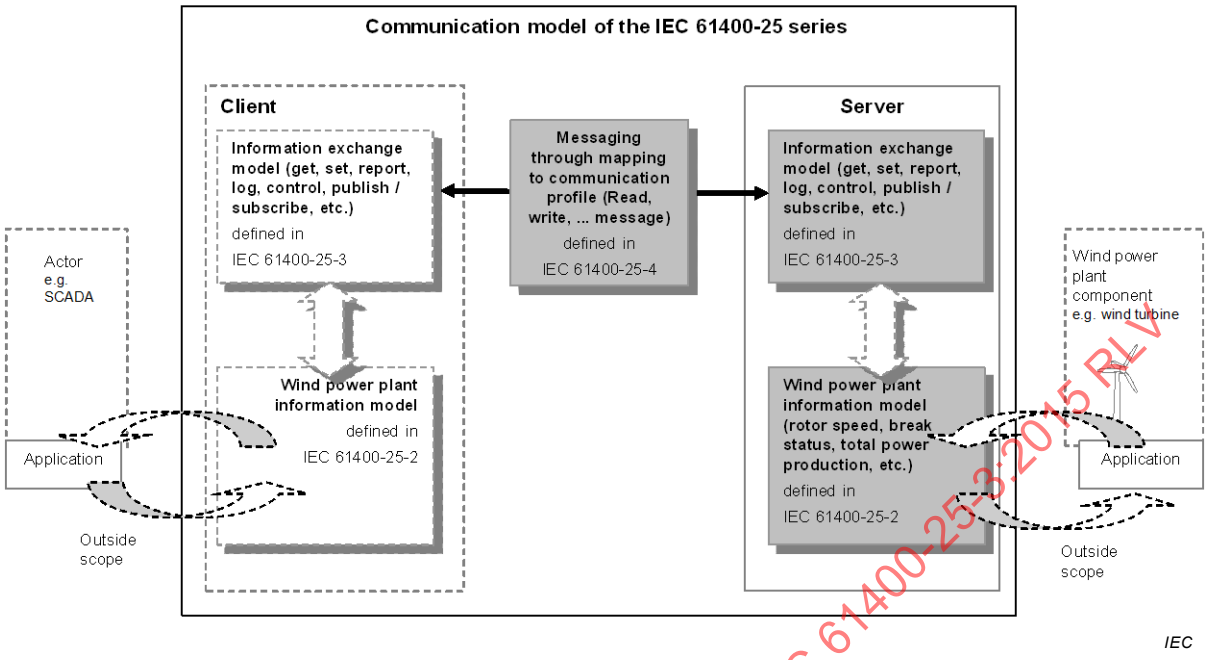

Figure 1 – Conceptual communication model of the IEC 61400-25 series

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 61400-25-1, *Wind turbines – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models*

IEC 61400-25-2:2015, *Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models*

IEC 61400-25-4:2008, *Wind turbines – Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile*

IEC 61850-7-2:~~2003~~ 2010, *Communication networks and systems ~~in substations~~ for power utility automation – Part 7-2: Basic information and 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 given in IEC 61400-25-1 as well as the following apply.

3.1
control object
data object instance of a controllable data object class who's ctlModel DataAttribute is not set to "status-only"

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.

Annex D provides ACSI conformance statements for clients and servers.

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 Clause 7 and 8.

The mandatory services for each information exchange model are indicated in the corresponding service tables in Clause D.4.

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 fourth 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 Parameters	Command transfer Set point transfer Parameters 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 Clause 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 Clause 7 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.

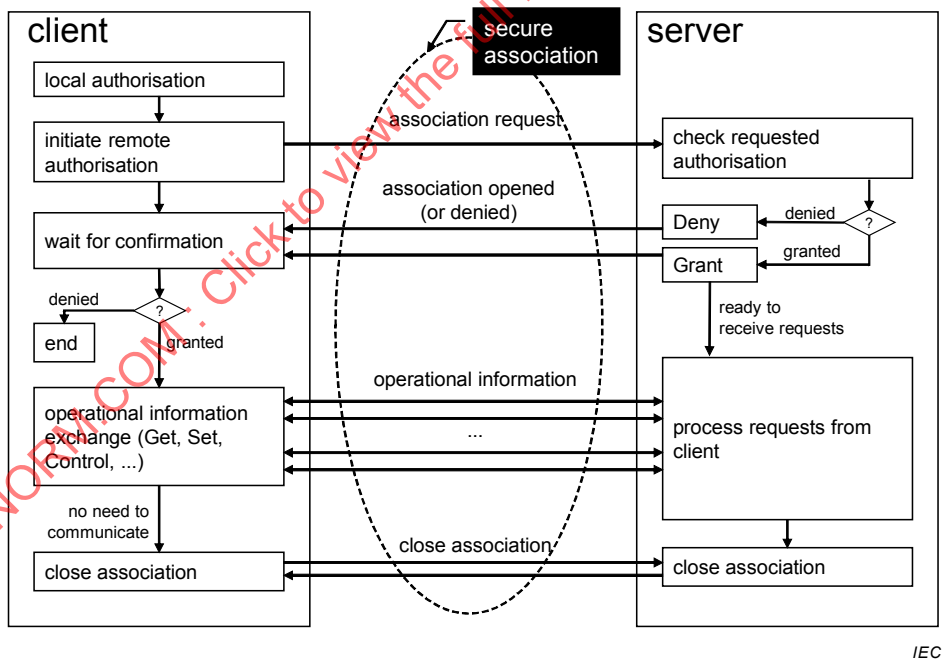

Figure 2 – Association and authorisation model (conceptual)

The requirements to be fulfilled by an association between a client and a 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 are 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

7.3.1 General

The control model defines ~~the Information Exchange models for commands and controlling of a group of set points contained in an operational device~~ the information exchange for operating commands. The control model can only be applied to control objects, i.e. to data object instances of a controllable common data class (e.g. SPC, INC) whose DataAttribute "ctlModel" is not set to "status-only". The control model is mainly used to change the status of a device (e.g. stop/start Turbine) or to change the value of a set point or parameter. The conceptual mechanism of the control model is shown in Figure 3.

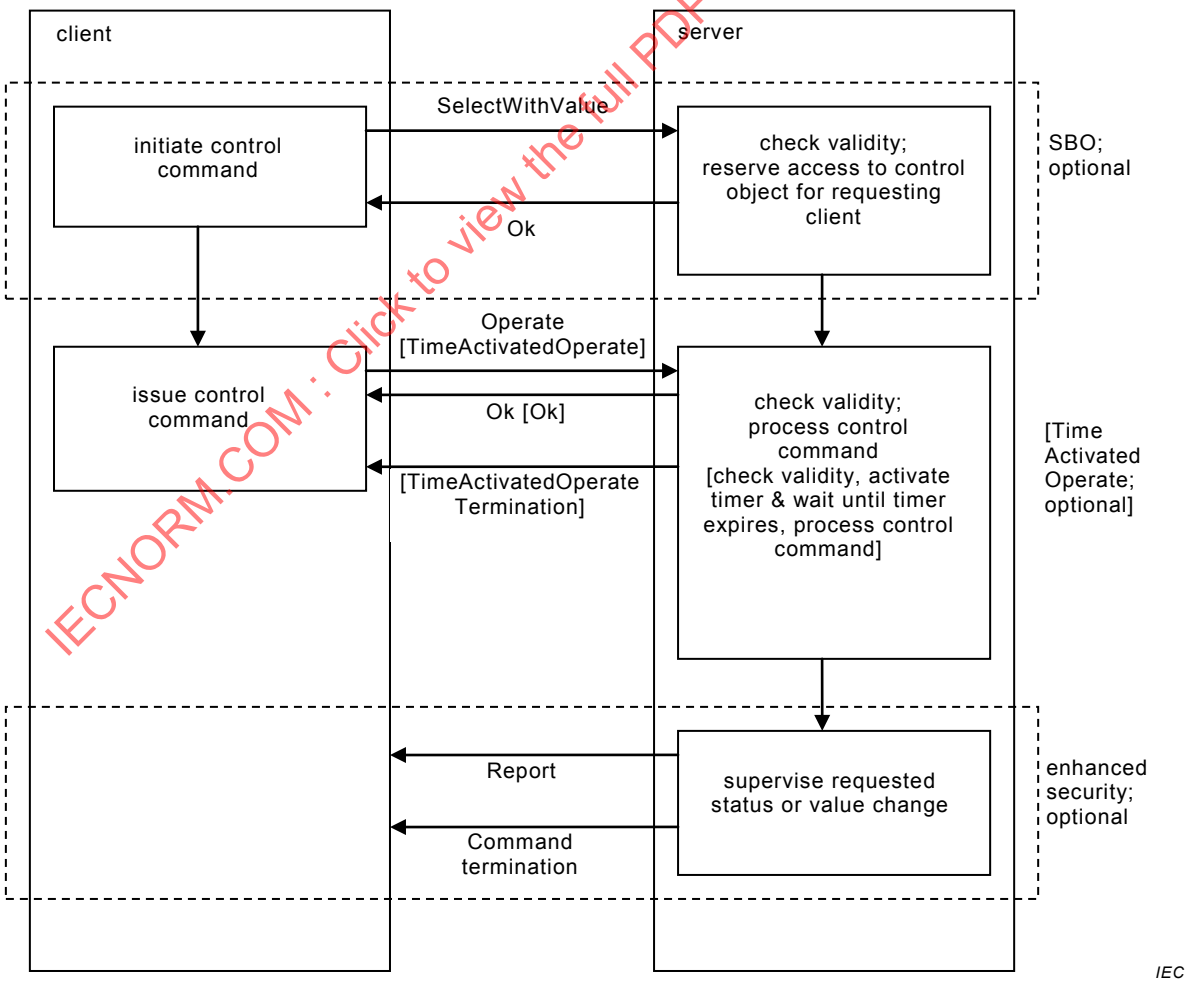

Figure 3 – Control model (conceptual)

NOTE The control model with its state transitions and services is described in more detail in IEC 61850-7-2:2010 (Clause 20).

~~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.~~

IEC 61850-7-2:2010 describes different models for the control object:

– direct control or select before operate (SBO),
– normal security or enhanced security,

and as an extension

– operate or time activated operate.

The value of the control object's dataAttribute "ctlModel" determines which of the supported models can be applied to the control object.

Tracking of the control services is beyond the scope of this standard.

7.3.2 Direct control / Select before operate (SBO)

With direct control, the control object shall not be selected before sending the "Operate" (or "TimeActivatedOperate") command.

With SBO, the control object shall be selected before sending the "Operate" (or "TimeActivatedOperate") command. On receipt of a "SelectWithValue" request, the server checks the validity of the command, issues a positive "SelectWithValue" response and starts a deselect timer. The access to this control object is now restricted to this client and to the requested action. The control object will be deselected for example if the deselect timer expires or if the client sends a "Cancel" command.

7.3.3 Operate / TimeActivatedOperate

Within one control sequence, either Operate OR TimeActivatedOperate shall be used.

On receipt of an "Operate" request, the server checks the validity of the command, issues a positive "Operate" response and starts to process the requested action.

The "TimeActivatedOperate" command contains in addition a parameter "operTm" that holds an absolute time at which the command shall be executed. On receipt of a "TimeActivatedOperate" request, the server checks the validity of the command, activates a timer and issues a positive "TimeActivatedOperate" response. At the specified time, the server will automatically start to process the command and issue a "TimeActivatedOperate" termination.

7.3.4 Normal security / Enhanced security

With normal security the requested status or value change may optionally be reported by the Report service (see 7.4). If enhanced security is supported, the server supervises the

requested change of the status or value. As soon as the status or value has changed, the server uses the Report service to report the new status or value (stVal) to the client and issues a “CommandTermination” request.

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) a 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.

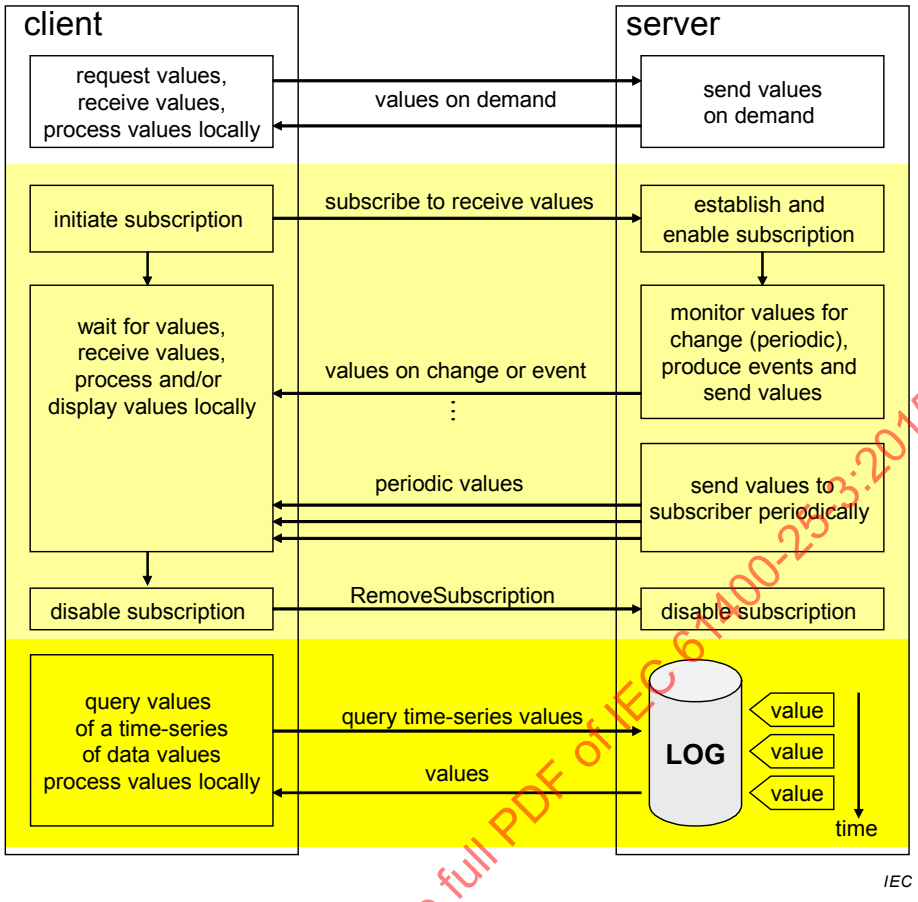

Figure 4 – Monitoring, reporting and logging model (conceptual)

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
	~~**Subscription**~~	~~YES~~	~~YES/NO~~	~~YES~~	~~Server~~	~~Real-time GUI~~
Reporting	**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 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 Clause 8 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 is 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.

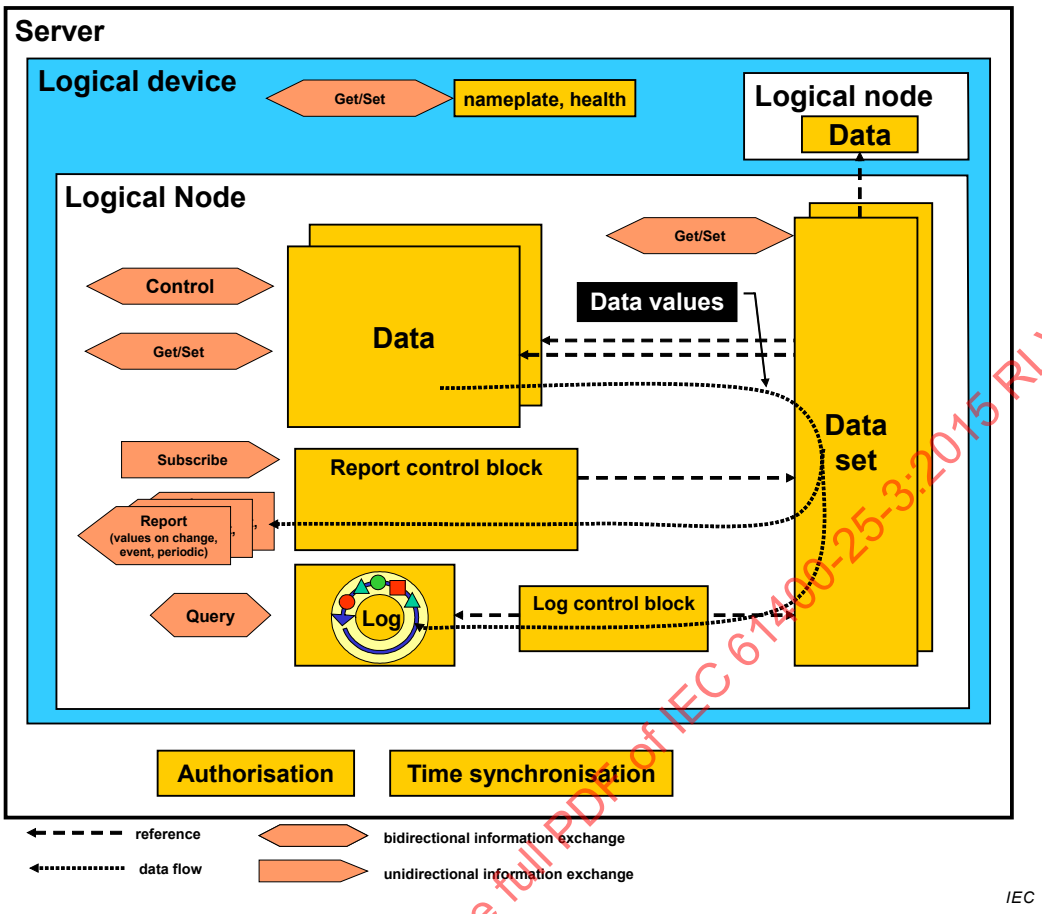

Figure 5 – Conceptual information exchange model for a wind power plant

The specification in Clause 9 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 class are listed in Table D.1.

~~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 services shall be as defined in Clause ~~7~~ 8 of IEC 61850-7-2:2010.

9.3 Services of ~~Server class~~ GenServerClass

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~~ ObjectReferences to all logical devices made visible and thus accessible to the requesting client by the addressed server as shown in ~~Table 4~~ Table D.3.

~~Table 4 – Server~~

~~Services for SERVER~~	~~M/O~~
~~GetServerDirectory~~	~~O~~

The details of the ~~Server class~~ GenServerClass services are defined in Clause ~~6~~ 7 of IEC 61850-7-2:2010. It is to be noted that within this standard "logical-device" is the only valid value for the parameter ObjectClass.

9.4 Services of ~~Logical Device class~~ GenLogicalDeviceClass

A 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~~ ObjectReferences of all logical nodes it contains as shown in ~~Table 5~~ Table D.3.

~~Table 5 – Logical Device~~

~~Services for LOGICAL-DEVICE~~	~~M/O~~
~~GetLogicalDeviceDirectory~~	~~O~~

The details of the ~~Logical Device class~~ GenLogicalDeviceClass services shall be as defined in Clause ~~8~~ 9 of IEC 61850-7-2:2010.

9.5 Services of ~~Logical Node class~~ GenLogicalNodeClass

A logical Node (for example, a transmission) is a collection of data objects (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.~~

Using the service GetLogicalNodeDirectory, 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~~ instances of a

requested ACSIClass. Within the IEC 61400-25 series valid values for the ACSIClass are restricted to data object, DATA-SET, BRCB, URCB, LCB and LOG.

~~**Table 6 – Logical Node**~~

~~Services for LOGICAL-NODE~~	~~M/O~~
~~GetLogicalNodeDirectory~~	~~O~~

A client shall use the GetAllDataValues service to retrieve all data attribute references and their values (having the same FunctionalConstraint) of all data objects made visible and thus accessible to the requesting client by the referenced logical node.

The details of the ~~Logical Node class~~ GenLogicalNodeClass services shall be as defined in Clause ~~9~~ 10 of IEC 61850-7-2:2010.

9.6 Services of ~~Data class~~ GenDataObjectClass

~~DATA~~ A data object (for example, status of a rotor) is a collection of data attributes (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 attribute values of data objects (i.e., its data attributes) can be set or retrieved by using the services GetDataValues or SetDataValues as shown in Table D.3.

A client shall use the GetDataDirectory service to retrieve the list of all data attribute names of the referenced data object.

A client shall use the GetDataDefinition service to retrieve the complete list of all data attribute definitions of the referenced data object.

The details of the ~~Data class~~ GenDataObjectClass services shall be as defined in Clause ~~10~~ 11 of IEC 61850-7-2:2010.

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

9.7 Services of DataSetClass

~~DATA-SET is a group of references to DATA. Instances of DATA-SETs can be accessed directly by the services shown in Table 8.~~ A data set is an ordered set of ObjectReferences to data objects (FCDs) and/or data attributes (FCDAs). All contents of data sets can be set or retrieved by using the services shown in Table D.3. 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 DataSetClass services shall be as defined in Clause ~~11~~ 13 of IEC 61850-7-2:2010.

~~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 ReportControlBlockClass

~~9.8.1 ACSI conformant services~~

~~REPORT-CONTROL~~ A report control block provides the mechanism for spontaneously reporting 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~~ report control block is determined by the values of its attributes (for example, enable/disable reporting, use of sequence number). The ~~REPORT-CONTROL~~ report control block references an instance of a data set. ~~The REPORT-CONTROL provides the spontaneous Report service;~~ The attributes of an instance of a ~~REPORT-CONTROL~~ report control block can be ~~accessed directly~~ set or retrieved by using the services shown in ~~Table 9~~ Table D.3.

In addition to reporting, the BRCB (BUFFERED-REPORT-CONTROL-BLOCK) provides the functionality to ~~ensure that a server sends a sequence-of-events~~ prevent loss of events even if the communication is temporarily interrupted (by using sequence-of-events). With the URCB (UNBUFFERED-REPORT-CONTROL-BLOCK) ~~a server does not need to buffer events~~ events will be lost 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~~ ReportControlBlockClass services shall be as defined in ~~14.2~~ 17.2 of IEC 61850-7-2:2010.

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 6. 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.

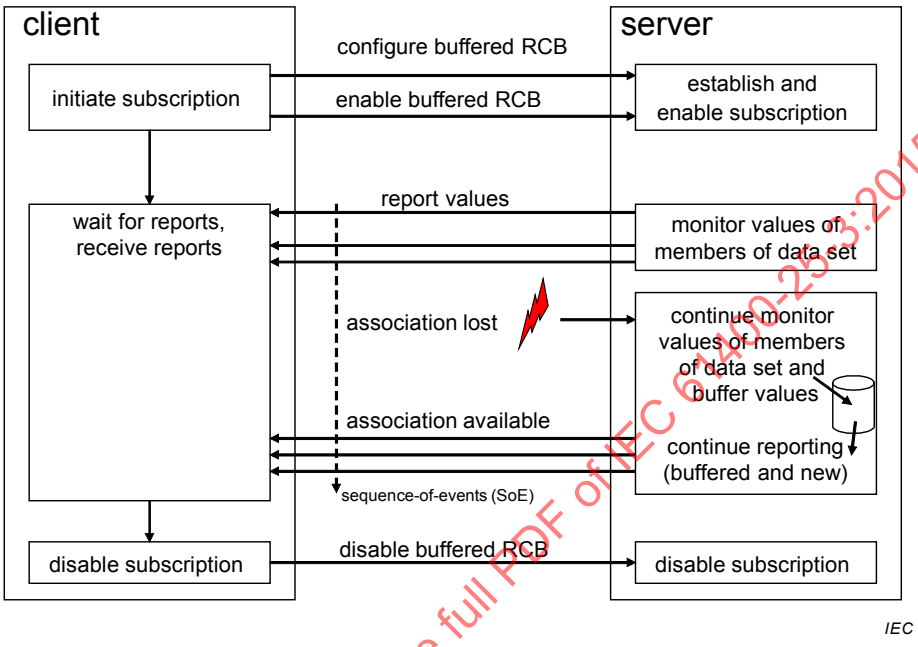

Figure 6 – Buffered report control block – conceptual

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

Parameter name	Description
	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 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 Blockand LogClasses~~ LogControlBlockClass and LogClass

~~LOG-CONTROL~~ A log control block provides the mechanism ~~of spontaneously log~~ for logging data values on specific criteria (e.g., 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~~ log control block is determined by the values of its attributes (e.g., enable/disable logging). The ~~LOG-CONTROL~~ log control block references an instance of a data set. The attributes of an instance of a log control block can be set or retrieved by using the services shown in Table D.3.

The ~~LOG~~ log provides the query services to ~~receive~~ retrieve data values ~~stored between two times given by the query;~~. The attributes of an instance of a ~~LOG~~ log can be ~~accessed directly~~ retrieved by using the services shown in ~~Table 12~~ Table D.3.

~~**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 services QueryLogByTime and QueryLogAfter shall provide – as a specialisation of the log as defined in 17.3 of IEC 61850-7-2:2010 – a filter parameter to select one or more functionally constrained data (FCD) or functionally constrained data attribute (FCDA) of a data object to be queried.

The details of ~~the LOG-CONTROL class and LOG class~~ the LogControlBlockClass and LogClass services shall be as defined in ~~14.3~~ 17.3 of IEC 61850-7-2:2010.

The DataFilter according to ~~Table 13~~ Table 3 shall be added to the QueryLogByTime and QueryLogAfter requests.

Table ~~13~~ 3 – 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.

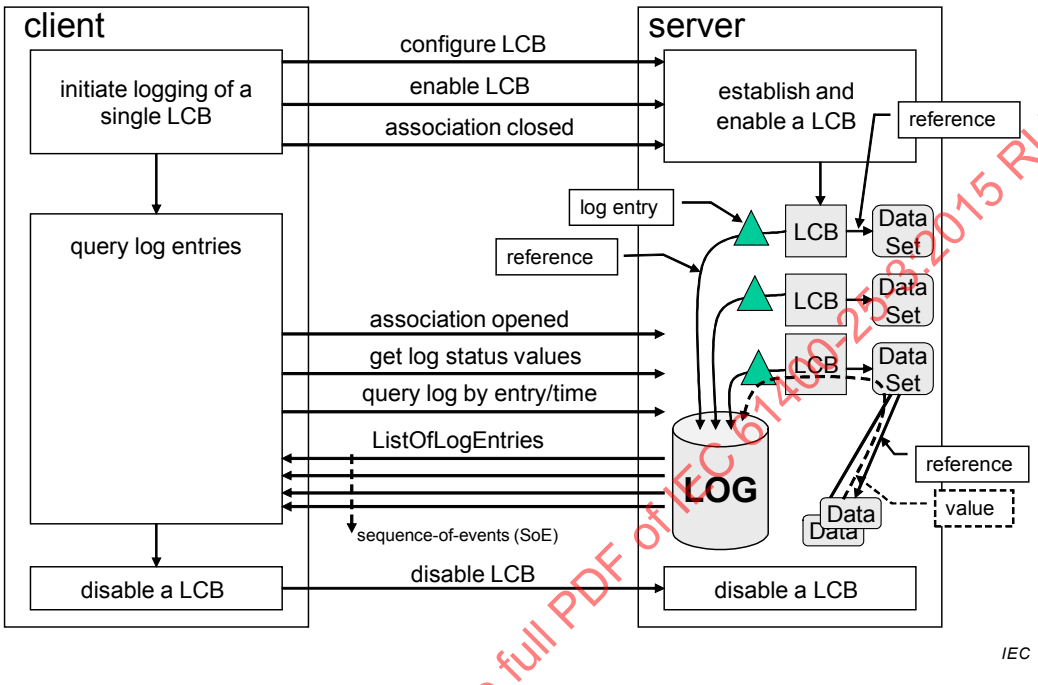

Figure 7 – Log control block – conceptual

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~~ ControlClass

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

The ~~CONTROL~~ control class provides the services shown in ~~Table 14~~ Table D.3.

~~**Table 14 – CONTROL**~~

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

The details of the ~~CONTROL class~~ ControlClass services shall be as defined in Clause ~~17~~ 20.5 of IEC 61850-7-2:2010.

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 DataSet, in this case “MyDS”. The DataSet can contain references to both data attributes and data objects. The position of each member in the DataSet 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 DataSet 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.

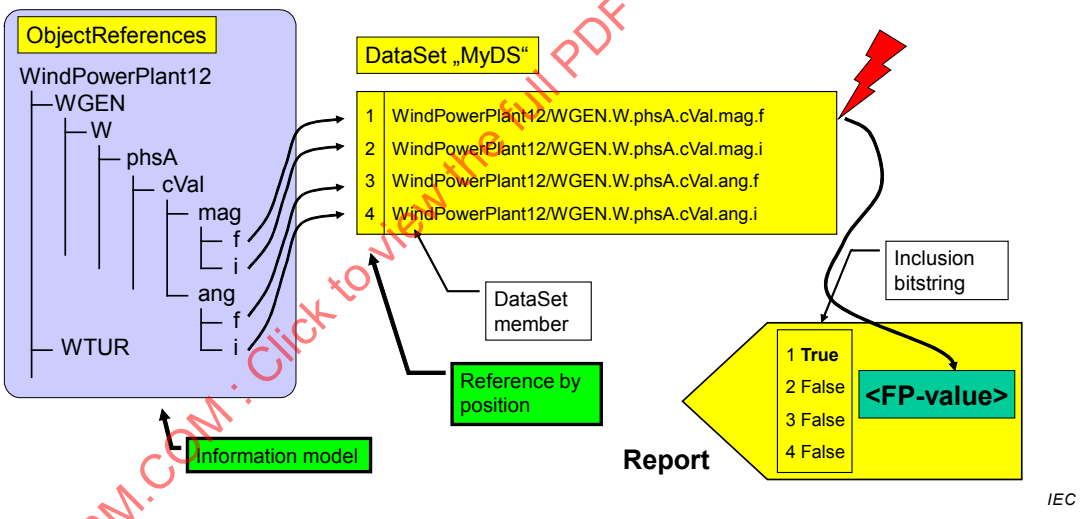

Figure A.1 – Mapping of information models to data sets for reporting (example)

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,
– DataSet reference – “MyDS”,
– Cause for reporting (reason code) – data change, quality change, etc.

Subclause 17.2 of IEC 61850-7-2:2010 contains additional examples on reporting.

A.2 Logging example

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

The log entries are obtained from instances referenced by a DataSet (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 object or data attribute and (3) current value (floating point value in the example).

The log has additional attributes:

– ~~OldEntryTime~~ OldEntrTm (timestamp of the oldest entry),
– ~~NewEntryTime~~ NewEntrTm (timestamp of the newest entry),
– ~~OldEntry~~ OldEntr (identifier of the oldest entry),
– ~~NewEntry~~ NewEntr (identifier of the newest entry).

These attributes can be read.

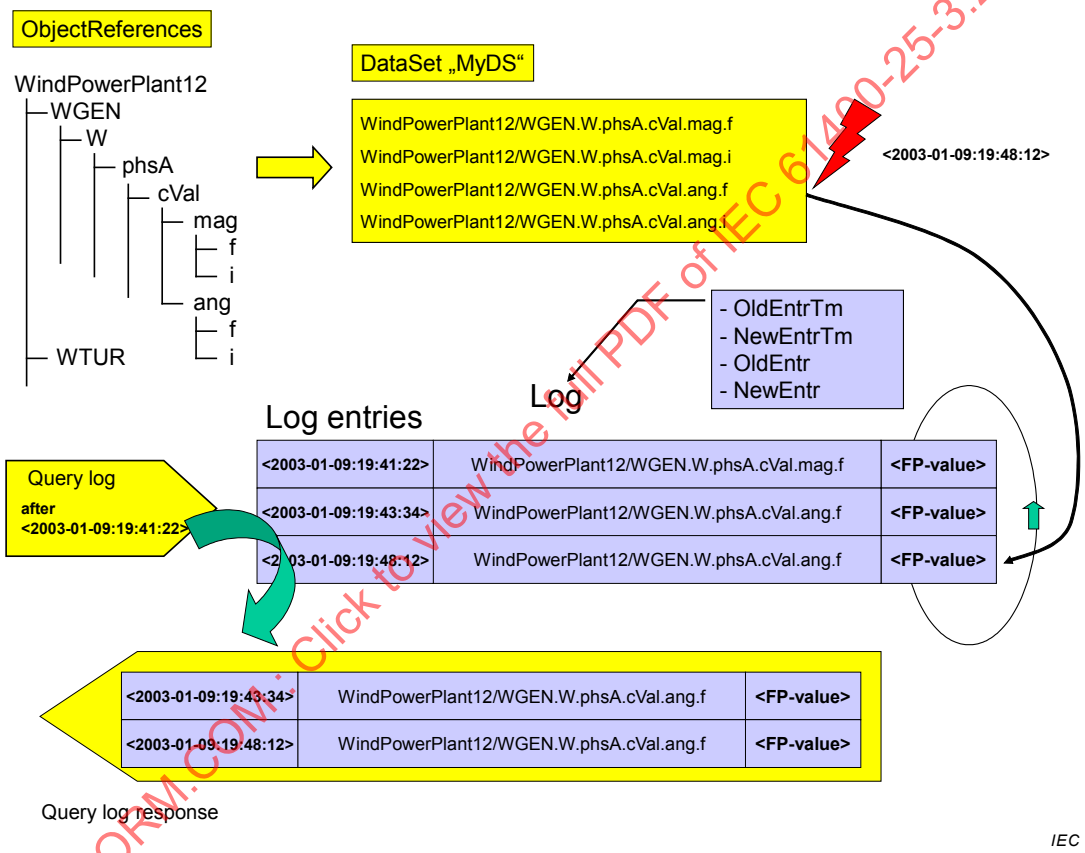

Figure A.2 – Logging basics (example)

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.

Subclause 17.3 of IEC 61850-7-2:2010 contains additional examples on logging.

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. Note that only FC's from IEC 61400-25-2 CDC's and CDC's inherited by IEC 61850-7-3 are considered.

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

Services	M/O	Service applies Relationship to FC
Associate	M	–
Release	O	–
Abort	O	–
GetServerDirectory	O	–
GetLogicalDeviceDirectory	O	–
GetLogicalNodeDirectory	O	–
GetAllDataValues		The service is applicable with optional FC: all except SE
GetDataValues	M	CF, DC, ST, MX, SP, EX The service is applicable with FC: all except SE
SetDataValues	M	The service is applicable with FC: DC, CF, SV, BL, SP
GetDataDirectory	O	CF, DC, ST, MX, SP, CO, EX –
GetDataDefinition	O	CF, DC, ST, MX, SP, CO, EX –
GetDataSetValues	M	- The service should be applied only to those dataset elements with FC: all except SE
SetDataSetValues	O	- The service should be applied only to those datasets elements with FC: DC, CF, SV, BL, SP
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. all except SE, 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: all except SE, See Note 2.
QueryLogAfter ~~a~~	~~O~~	A LogEntry can include elements of any FC: all except SE, 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 following classes do not appear in the wind power plant:

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

The following control blocks are not used in IEC 61400-25-3:

– 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 61850-7-2:2010 describes the relationship between the different elements that build the ACSI in the ~~substation~~ power utility automation area. Figure C.1 describes the relationship in IEC 61400-25-3.

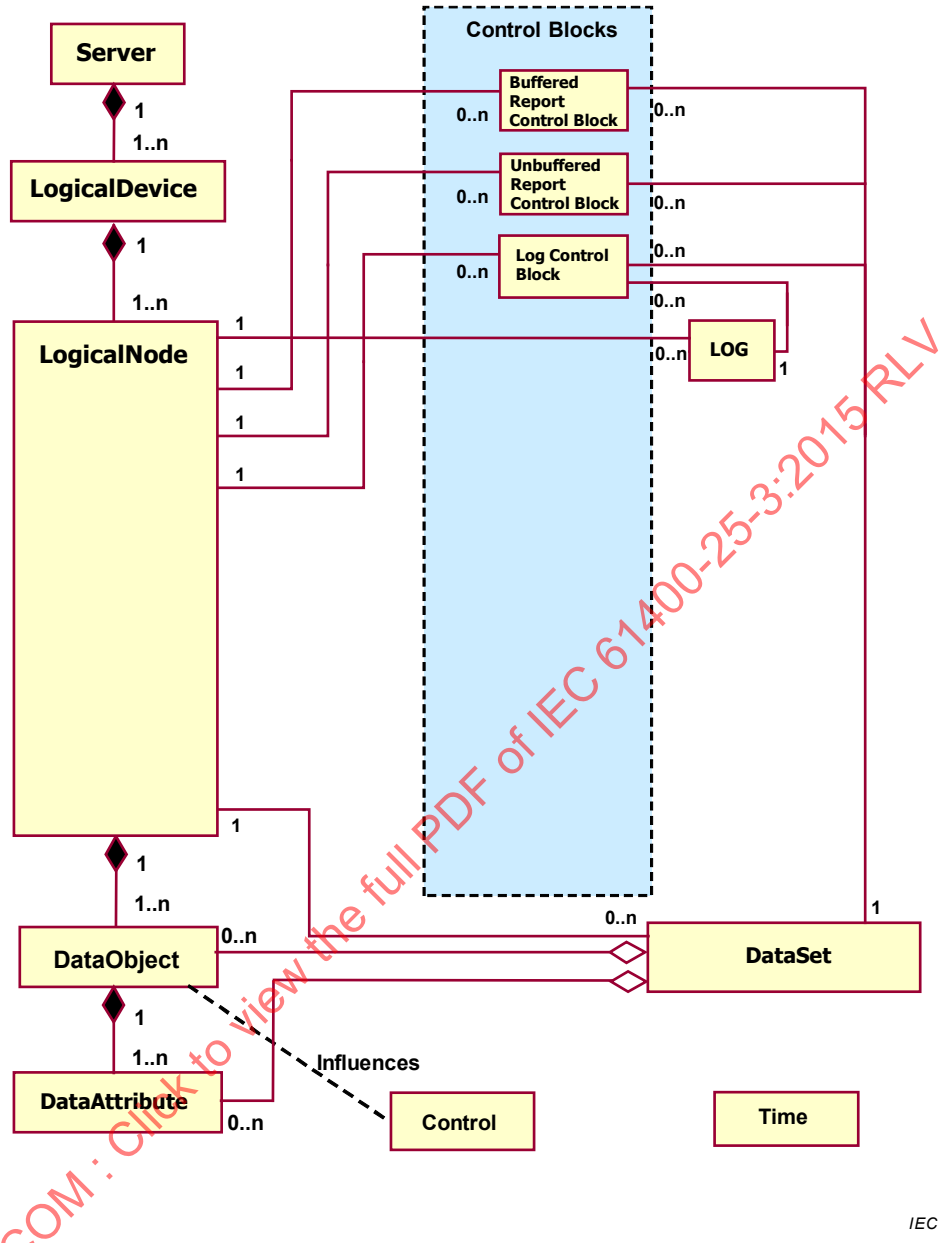

Figure C.1 – Conceptual service model of the ACSI

Annex D
(normative)

ACSI conformance statement

D.1 General

The following ACSI conformance statements shall be used to provide an overview and details about a device claiming conformance with ACSI:

– ACSI basic conformance statement,
– ACSI models conformance statement, and
– ACSI service conformance statement

to specify the communication features mapped to an SCSM.

NOTE 1 The conformance statements of Annex D are abstract in the sense that the ACSI models and their services are mapped to application layer models, services, and protocols. Additional details on the conformance are defined in the SCSM.

NOTE 2 For several features, the conformance requirement is implicitly defined with the common data class contained in IEC 61400-25-2 and IEC 61850-7-3 and the compatible logical-node classes and data object classes contained in IEC 61400-25-2 and IEC 61850-7-4, for example, a TrgOp (trigger option) of the value qchg (quality change) of DataAttribute requires the support of the TrgOps (trigger option) qchg of the BRCB or URCB.

D.2 ACSI basic conformance statement

The basic conformance statement shall be as defined in Table D.1.

Table D.1 – Basic conformance statement

		Client/ subscriber	Server/ publisher	Value/ comments
Client-server roles				
B11	Server side (of TWO-PARTY APPLICATION-ASSOCIATION)	–	c[1]	
B12	Client side (of TWO-PARTY APPLICATION-ASSOCIATION)	c[1]	–	
SCSMs supported				
B25	SCSM: IEC 61400-25-4:2008, Annex A (web services)			
B26	SCSM: IEC 61400-25-4:2008, Annex B (OPC XML-DA)			
B27	SCSM: IEC 61400-25-4:2008, Annex C (ISO 9506 mms)			
B28	SCSM: IEC 61400-25-4:2008, Annex D (IEC 60870-5-104)			
B29	SCSM: IEC 61400-25-4:2008, Annex E (DNP3)			
c[1] shall be 'M' if support for logical-device model has been declared.				

D.3 ACSI models conformance statement

The ACSI models conformance statement shall be as defined in Table D.2.

Table D.2 – ACSI models conformance statement

		Client/ subscriber	Server/ publisher	Value/ comments
If Server side (B11) and /or Client side (B12) supported				
M1	**Logical device**	c^2	c^2	
M2	**Logical node**	c^3	c3	
M3	**Data**	c^4	c^4	
M4	**Data set**	cw^1	cw^1	
M5	**Substitution**	O	O	
	Reporting			
M7	**Buffered report control**	O	O	
M7-1	sequence-number			
M7-2	report-time-stamp			
M7-3	reason-for-inclusion			
M7-4	data-set-name			
M7-5	data-reference			
M7-6	buffer-overflow			
M7-7	entryID			
M7-8	BufTm			
M7-9	IntgPd			
M7-10	GI			
M7-11	conf-revision			
M8	**Unbuffered report control**	O	O	
M8-1	sequence-number			
M8-2	report-time-stamp			
M8-3	reason-for-inclusion			
M8-4	data-set-name			
M8-5	data-reference			
M8-6	BufTm			
M8-7	IntgPd			
M8-8	GI			
M8-9	conf-revision			
	Logging			
M9	**Log control**	O	O	
M9-1	IntgPd			
M10	**Log**	O	O	
	Control			
M11	**Control**	O	cw^2	
For all IEDs				
M16	**Time**	O	M	Time source with required accuracy shall be available

c^2 shall be 'M' if support for logical-node model has been declared.
c^3 shall be 'M' if support for data model has been declared.
c^4 shall be 'M' if support for data-set, Substitution, Report, Log Control, or Time model has been declared.
cw^1 shall be 'M' if support for Report has been declared and if SCSM supports dataset.
cw^2 shall be 'M' if a control object is supported.

M-Mandatory
O-Optional

D.4 ACSI service conformance statement

The ACSI service conformance statement shall be as defined in Table D.3 (depending on the statements in Table D.1 and in Table D.2). The conformance statement for time resolution and accuracy of data shall be as defined in Table D.4.

Table D.3 – ACSI service conformance statement *(1 of 2)*

	Services	Client/ subscriber	Server/ publisher	Comments
Server (see 9.3)				
S1	GetServerDirectory	O	cw[3]	
cw[3] If this service is supported by the SCSM then the service shall be mandatory.				
Application association (see 9.2)				
S2	Associate	M	M	
S3	Abort	cw[4]	cw[3]	
S4	Release	cw[4]	cw[3]	
cw[4] If these services are supported by the SCSM then either the Abort or the Release request shall be supported by the client. Additionally, the client must understand the abort request delivered by the server.				
Logical device (see 9.4)				
S5	GetLogicalDeviceDirectory	O	cw[3]	
Logical node (see 9.5)				
S6	GetLogicalNodeDirectory	O	cw[3]	
S7	GetAllDataValues	O	cw[3]	
Data (see 9.6)				
S8	GetDataValues	O	M	
S9	SetDataValues	O	O	
S10	GetDataDirectory	O	cw[3]	
S11	GetDataDefinition	O	cw[3]	
Data set (see 9.7)				
S12	GetDataSetValues	O	cw[3]	
S13	SetDataSetValues	O	O	
S14	CreateDataSet	O	O	
S15	DeleteDataSet	O	O	
S16	GetDataSetDirectory	O	cw[3]	
Reporting (see 9.8)				
S24	Report	cw[3]	cw[3]	
S24-1	data-change (dchg)			
S24-2	ochg-change (qchg)			
S24-3	data-update (dupd)			
S25	GetBRCBValues	cw[5]	cw[5]	
S26	SetBRCBValues	O	O	
S28	GetURCBValues	cw[5]	cw[5]	
S29	SetURCBValues	O	O	
cw[5] If these services are supported by the SCSM, support shall be declared for at least one (BRCB or URCB).				

Table D.3 *(2 of 2)*

	Services	Client/ subscriber	Server/ publisher	Comments
Logging (see 9.9)				
Log control block				
S30	GetLCBValues	cw[3]	cw[3]	
S31	SetLCBValues	O	O	
Log				
S32	QueryLogByTime	cw[6]	cw[3]	
S33	QueryLogAfter	cw[6]	cw[3]	
S34	GetLogStatusValues	cw[3]	cw[3]	
cw[6] If these services are supported by the SCSM, support shall be declared for at least one (QueryLogByTime or QueryLogAfter).				
Control (see 9.10)				
S51	Select	M	O	
S52	SelectWithValue	M	O	
S53	Cancel	O	O	
S54	Operate	M	M	
S55	Command-Termination	M	O	
S56	TimeActivatedOperate	O	O	
S57	TimeActivatedOperateTermination	O	O	

Table D.4 – Time

	Services	Client/ subscriber	Server/ publisher	Comments
Time (IEC 61850-7-2:2010 6.1.2.9)				
T1	Time resolution of internal clock			Nearest negative power of 2 in seconds
T2	Time accuracy of internal clock			T0 (10 ms)
				T1 (1 ms)
				T2 (100 µs)
				T3 (25 µs)
				T4 (4 µs)
				T5 (1 µs)
T3	Supported Timestamp resolution			Nearest value of 2**(–n) in seconds according to IEC 61850-7-2:2010, 6.1.2.9.3.2
NOTE The time resolution and accuracy of data available in the IED but retrieved from and time stamped in other devices is out of the scope of this table and may be different from what is defined in this table.				

Bibliography

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*

IEC 61850-7-4, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61400-25-3

Edition 2.0 2015-06

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND TURBINES –

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

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61400-25-3 has been prepared by IEC technical committee 88: Wind turbines.

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

FDIS	Report on voting
88/540/FDIS	88/552/RVD

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

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

This second edition cancels and replaces the first edition published in 2006.

The scope of revision includes:

- Harmonization with service models in Edition 2 of IEC 61850-7-2.
- Reduction of overlap between standards and simplification by increased referencing.

This edition includes the following significant technical changes with respect to the previous edition:

a) Add subscription and remove subscription services have been removed.
b) Tables in Clause 9 indicating expected services have been replaced by tables in a new Annex D including ACSI conformance statements for clients and servers.
c) Technical issues (“Tissues”) for IEC 61850-7-2 edition 2 have been considered and changes have been made accordingly.

Technical issues (“Tissues”), as collected by the IEC 61400-25 users group USE61400-25, have been considered, but no technical issues were registered for edition 1.

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 stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

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

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.

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 are 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).

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 IEC 61400-25-3;
– mapping to a communication profile, providing a protocol stack to carry the exchanged values from the modelled information (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,
– self-description of devices (device data dictionary),
– data typing and discovery of data types.

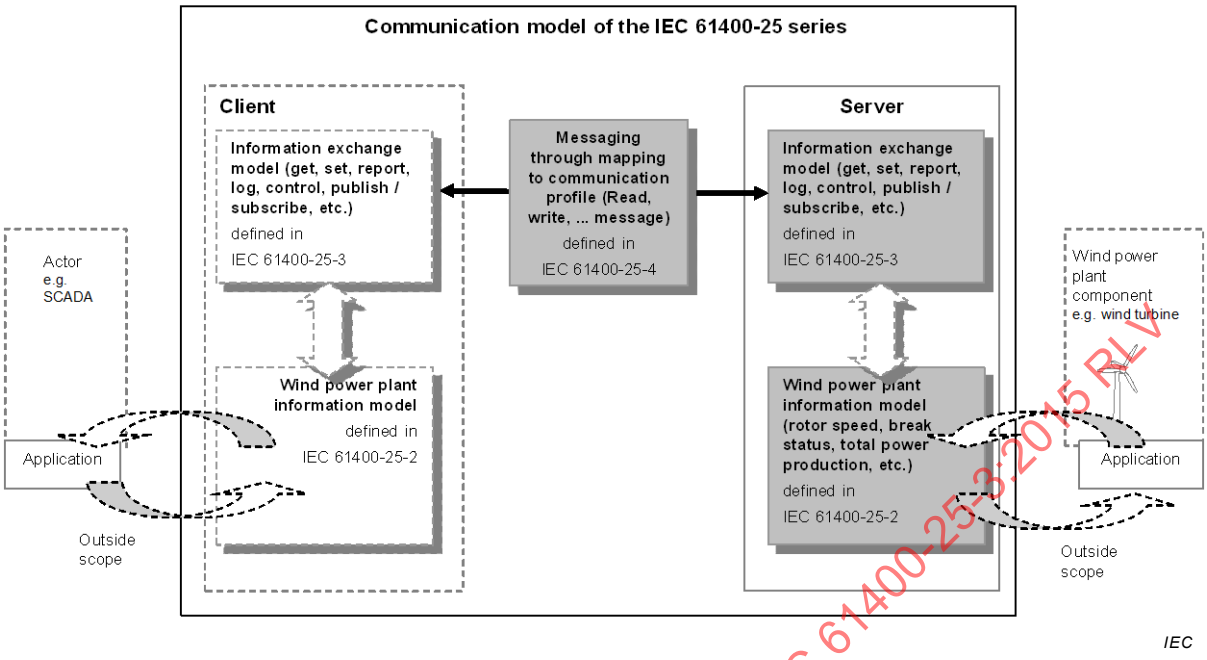

Figure 1 – Conceptual communication model of the IEC 61400-25 series

2 Normative references

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

IEC 61400-25-1, *Wind turbines – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models*

IEC 61400-25-2:2015, *Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models*

IEC 61400-25-4:2008, *Wind turbines – Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile*

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61400-25-1 as well as the following apply.

3.1
control object
data object instance of a controllable data object class who's ctlModel DataAttribute is not set to "status-only"

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.

Annex D provides ACSI conformance statements for clients and servers.

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 Clause 7 and 8.

The mandatory services for each information exchange model are indicated in the corresponding service tables in Clause D.4.

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 fourth 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 Parameters	Command transfer Set point transfer Parameters 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 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 Clause 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 Clause 7 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.

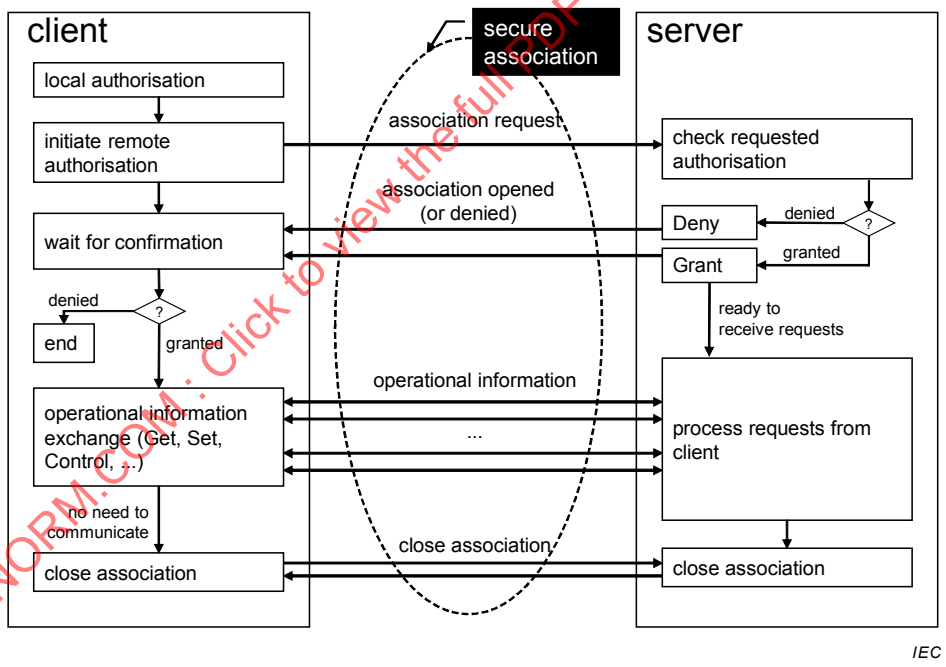

Figure 2 – Association and authorisation model (conceptual)

The requirements to be fulfilled by an association between a client and a 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 are 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

7.3.1 General

The control model defines the information exchange for operating commands. The control model can only be applied to control objects, i.e. to data object instances of a controllable common data class (e.g. SPC, INC) whose DataAttribute “ctlModel” is not set to “status-only”. The control model is mainly used to change the status of a device (e.g. stop/start Turbine) or to change the value of a set point or parameter. The conceptual mechanism of the control model is shown in Figure 3.

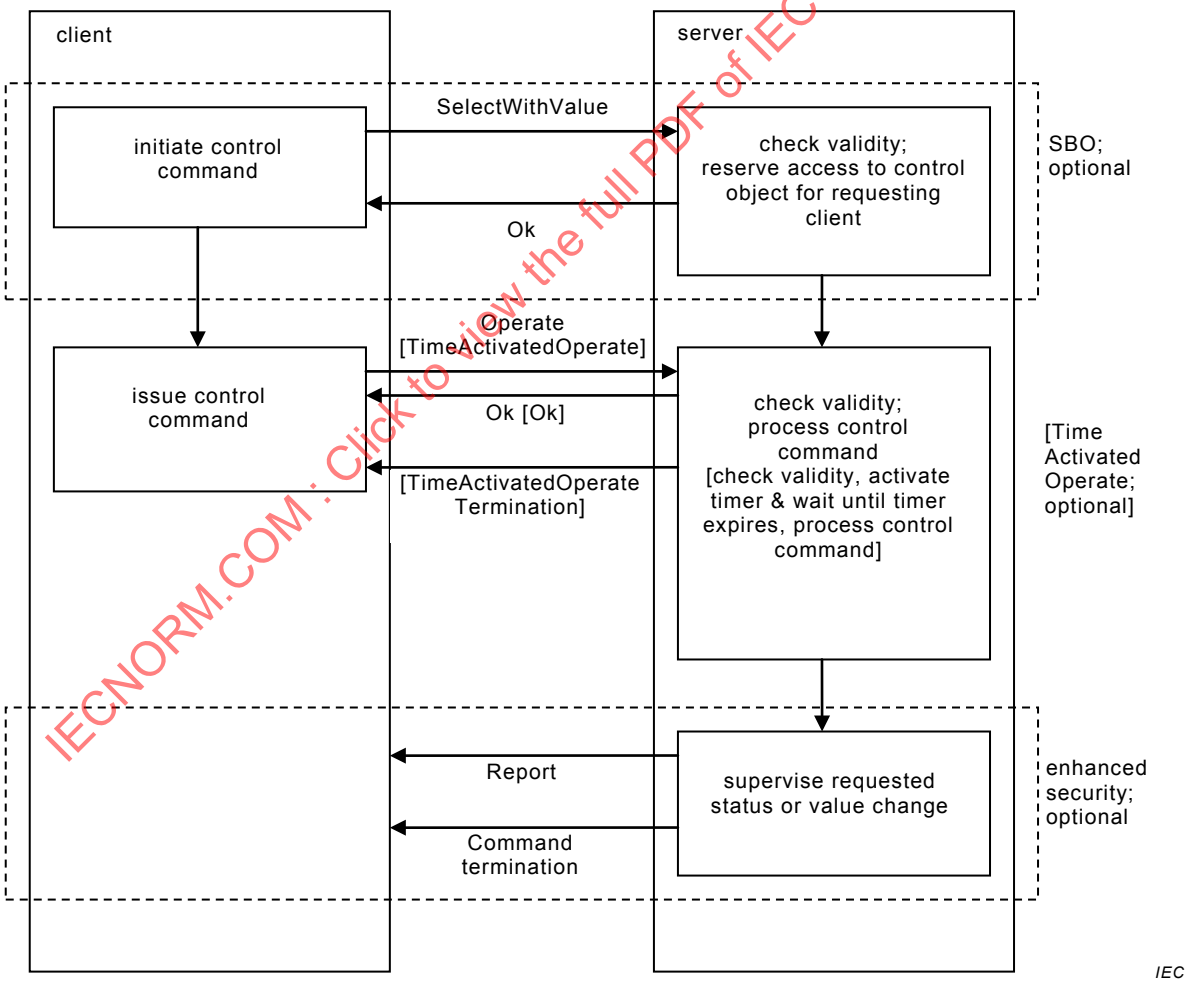

Figure 3 – Control model (conceptual)

NOTE The control model with its state transitions and services is described in more detail in IEC 61850-7-2:2010 (Clause 20).

IEC 61850-7-2:2010 describes different models for the control object:

– direct control or select before operate (SBO),
– normal security or enhanced security,

and as an extension

– operate or time activated operate.

The value of the control object's dataAttribute "ctlModel" determines which of the supported models can be applied to the control object.

Tracking of the control services is beyond the scope of this standard.

7.3.2 Direct control / Select before operate (SBO)

With direct control, the control object shall not be selected before sending the "Operate" (or "TimeActivatedOperate") command.

With SBO, the control object shall be selected before sending the "Operate" (or "TimeActivatedOperate") command. On receipt of a "SelectWithValue" request, the server checks the validity of the command, issues a positive "SelectWithValue" response and starts a deselect timer. The access to this control object is now restricted to this client and to the requested action. The control object will be deselected for example if the deselect timer expires or if the client sends a "Cancel" command.

7.3.3 Operate / TimeActivatedOperate

Within one control sequence, either Operate OR TimeActivatedOperate shall be used.

On receipt of an "Operate" request, the server checks the validity of the command, issues a positive "Operate" response and starts to process the requested action.

The "TimeActivatedOperate" command contains in addition a parameter "operTm" that holds an absolute time at which the command shall be executed. On receipt of a "TimeActivatedOperate" request, the server checks the validity of the command, activates a timer and issues a positive "TimeActivatedOperate" response. At the specified time, the server will automatically start to process the command and issue a "TimeActivatedOperate" termination.

7.3.4 Normal security / Enhanced security

With normal security the requested status or value change may optionally be reported by the Report service (see 7.4). If enhanced security is supported, the server supervises the requested change of the status or value. As soon as the status or value has changed, the server uses the Report service to report the new status or value (stVal) to the client and issues a "CommandTermination" request.

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) a 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.

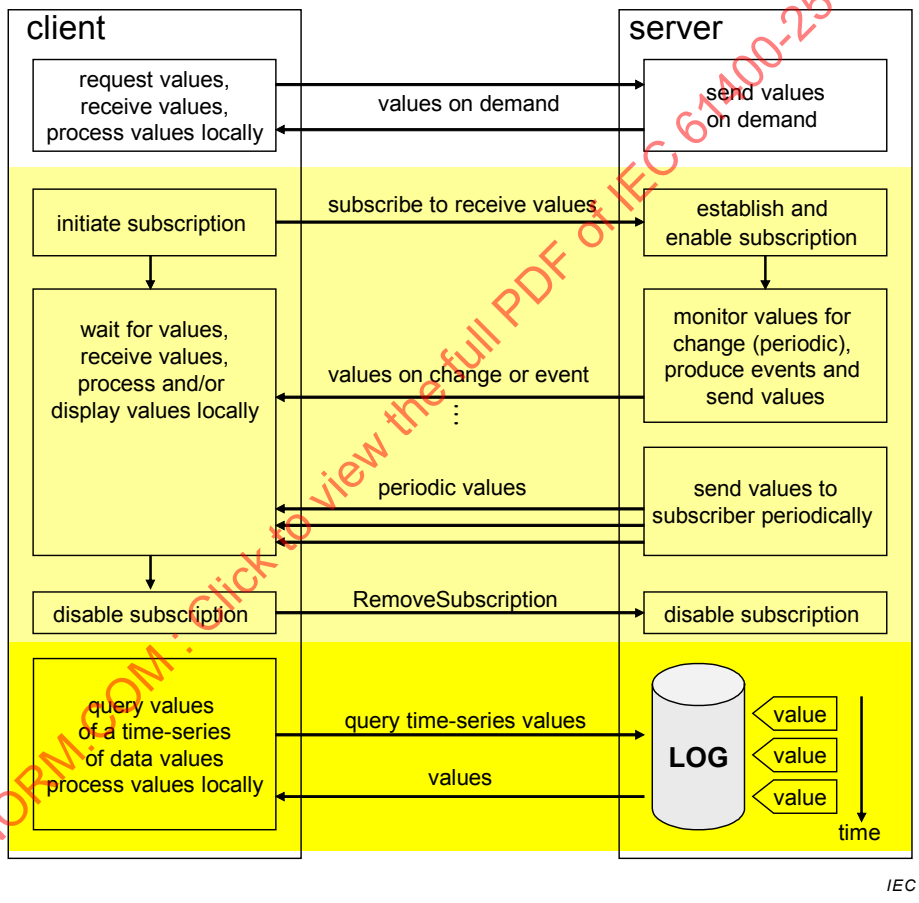

Figure 4 – Monitoring, reporting and logging model (conceptual)

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	**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 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 Clause 8 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 is 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.

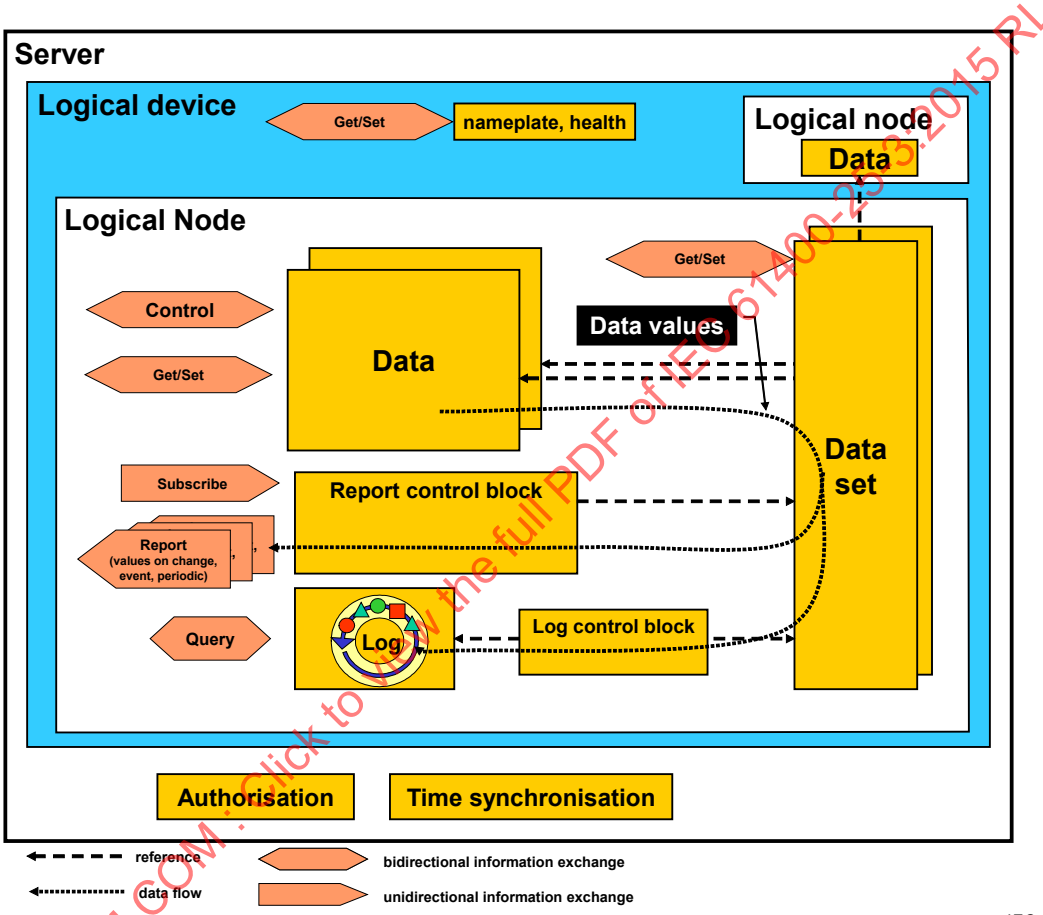

Figure 5 – Conceptual information exchange model for a wind power plant

The specification in Clause 9 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 for two-party-application-association class are listed in Table D.1.

The details of the two-party-application-association class services shall be as defined in Clause 8 of IEC 61850-7-2:2010.

9.3 Services of GenServerClass

A server represents the externally visible behaviour of a device. A client shall use the GetServerDirectory service to retrieve a list of the ObjectReferences to all logical devices made visible and thus accessible to the requesting client by the addressed server as shown in Table D.3.

The details of the GenServerClass services are defined in Clause 7 of IEC 61850-7-2:2010. It is to be noted that within this standard “logical-device” is the only valid value for the parameter ObjectClass.

9.4 Services of GenLogicalDeviceClass

A logical device (for example, a wind turbine controller) is a collection of logical nodes (for example, rotor, transmission and generator). The logical device can be browsed to get the ObjectReferences of all logical nodes it contains as shown in Table D.3.

The details of the GenLogicalDeviceClass services shall be as defined in Clause 9 of IEC 61850-7-2:2010.

9.5 Services of GenLogicalNodeClass

A logical node (for example, a transmission) is a collection of data objects (for example, transmission gear temperature).

Using the service GetLogicalNodeDirectory, the logical node can be browsed to get the names of all instances of a requested ACSIClass. Within the IEC 61400-25 series valid values for the ACSIClass are restricted to data object, DATA-SET, BRCB, URCB, LCB and LOG.

A client shall use the GetAllDataValues service to retrieve all data attribute references and their values (having the same FunctionalConstraint) of all data objects made visible and thus accessible to the requesting client by the referenced logical node.

The details of the GenLogicalNodeClass services shall be as defined in Clause 10 of IEC 61850-7-2:2010.

9.6 Services of GenDataObjectClass

A data object (for example, status of a rotor) is a collection of data attributes (for example, actual status value, quality, timestamp).

The attribute values of data objects (i.e., its data attributes) can be set or retrieved by using the services GetDataValues or SetDataValues as shown in Table D.3.

A client shall use the GetDataDirectory service to retrieve the list of all data attribute names of the referenced data object.

A client shall use the GetDataDefinition service to retrieve the complete list of all data attribute definitions of the referenced data object.

The details of the GenDataObjectClass services shall be as defined in Clause 11 of IEC 61850-7-2:2010.

EXAMPLE GetDataValues "WindPowerPlant12/WGEN.W.phsA.cVal.mag.f[MX]" returns the floating point value of the current value.

9.7 Services of DataSetClass

A data set is an ordered set of ObjectReferences to data objects (FCDs) and/or data attributes (FCDAs). All contents of data sets can be set or retrieved by using the services shown in Table D.3. 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).

The details of the DataSetClass services shall be as defined in Clause 13 of IEC 61850-7-2:2010.

9.8 Services of ReportControlBlockClass

A report control block provides the mechanism for spontaneously reporting 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 block is determined by the values of its attributes (for example, enable/disable reporting, use of sequence number). The report control block references an instance of a data set. The attributes of an instance of a report control block can be set or retrieved by using the services shown in Table D.3.

In addition to reporting, the BRCB (BUFFERED-REPORT-CONTROL-BLOCK) provides the functionality to prevent loss of events even if the communication is temporarily interrupted (by using sequence-of-events). With the URCB (UNBUFFERED-REPORT-CONTROL-BLOCK) events will be lost in case of communication interruption.

The details of the ReportControlBlockClass services shall be as defined in 17.2 of IEC 61850-7-2:2010.

The basic reporting mechanism is shown in Figure 6. 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.

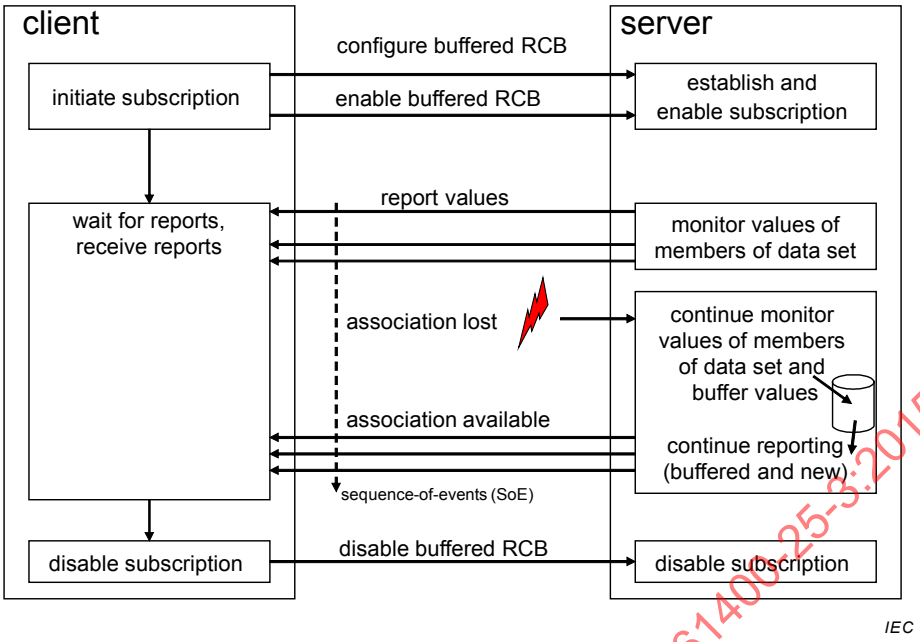

Figure 6 – Buffered report control block – conceptual

9.9 Services of LogControlBlockClass and LogClass

A log control block provides the mechanism for logging data values on specific criteria (e.g. 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 block is determined by the values of its attributes (e.g. enable/disable logging). The log control block references an instance of a data set. The attributes of an instance of a log control block can be set or retrieved by using the services shown in Table D.3.

The log provides the query services to retrieve data values. The attributes of an instance of a log can be retrieved by using the services shown in Table D.3.

The services QueryLogByTime and QueryLogAfter shall provide – as a specialisation of the log as defined in 17.3 of IEC 61850-7-2:2010 – a filter parameter to select one or more functionally constrained data (FCD) or functionally constrained data attribute (FCDA) of a data object to be queried.

The details of the LogControlBlockClass and LogClass services shall be as defined in 17.3 of IEC 61850-7-2:2010.

The DataFilter according to Table 3 shall be added to the QueryLogByTime and QueryLogAfter requests.

Table 3 – 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.

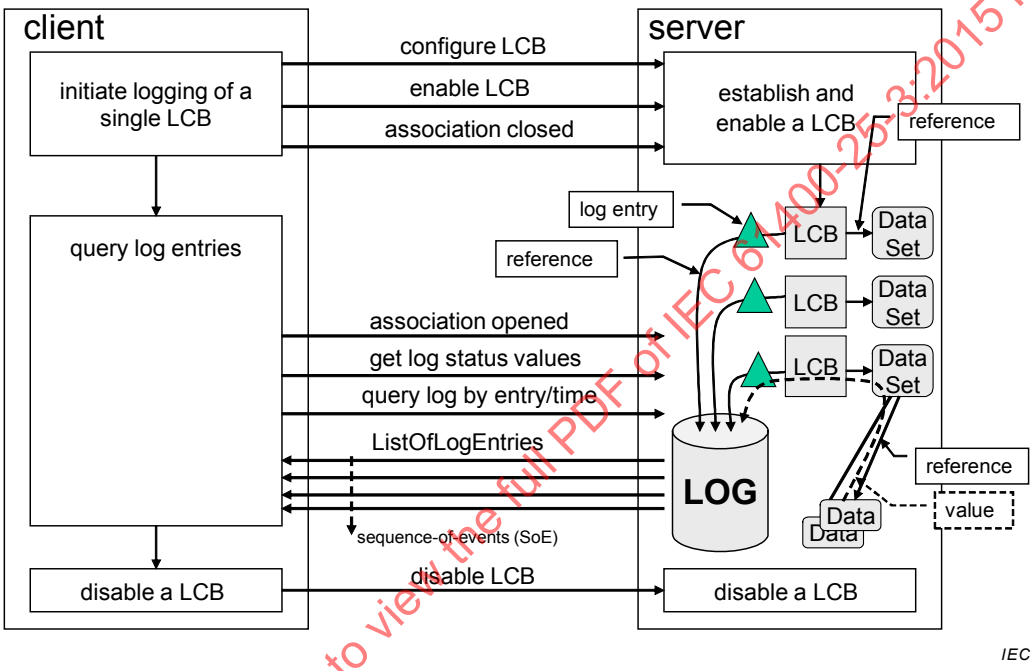

Figure 7 – Log control block – conceptual

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 ControlClass

A control class provides the mechanism to control functions and real devices represented by a server.

The control class provides the services shown in Table D.3.

The details of the ControlClass services shall be as defined in 20.5 of IEC 61850-7-2:2010.

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 DataSet, in this case “MyDS”. The DataSet can contain references to both data attributes and data objects. The position of each member in the DataSet 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 DataSet 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.

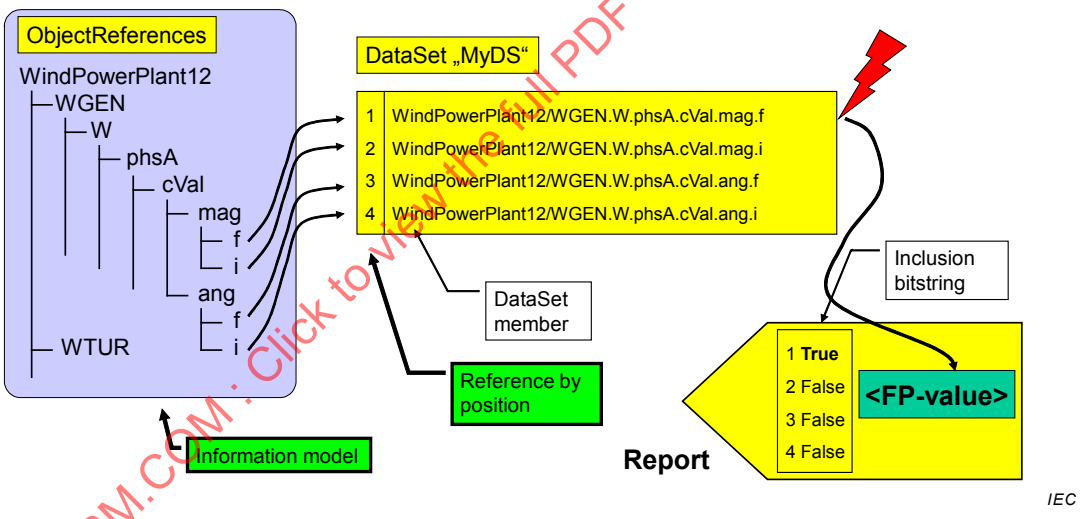

Figure A.1 – Mapping of information models to data sets for reporting (example)

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,
– DataSet reference – “MyDS”,
– Cause for reporting (reason code) – data change, quality change, etc.

Subclause 17.2 of IEC 61850-7-2:2010 contains additional examples on reporting.

A.2 Logging example

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

The log entries are obtained from instances referenced by a DataSet (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 object or data attribute and (3) current value (floating point value in the example).

The log has additional attributes:

– OldEntrTm (timestamp of the oldest entry),
– NewEntrTm (timestamp of the newest entry),
– OldEntr (identifier of the oldest entry),
– NewEntr (identifier of the newest entry).

These attributes can be read.

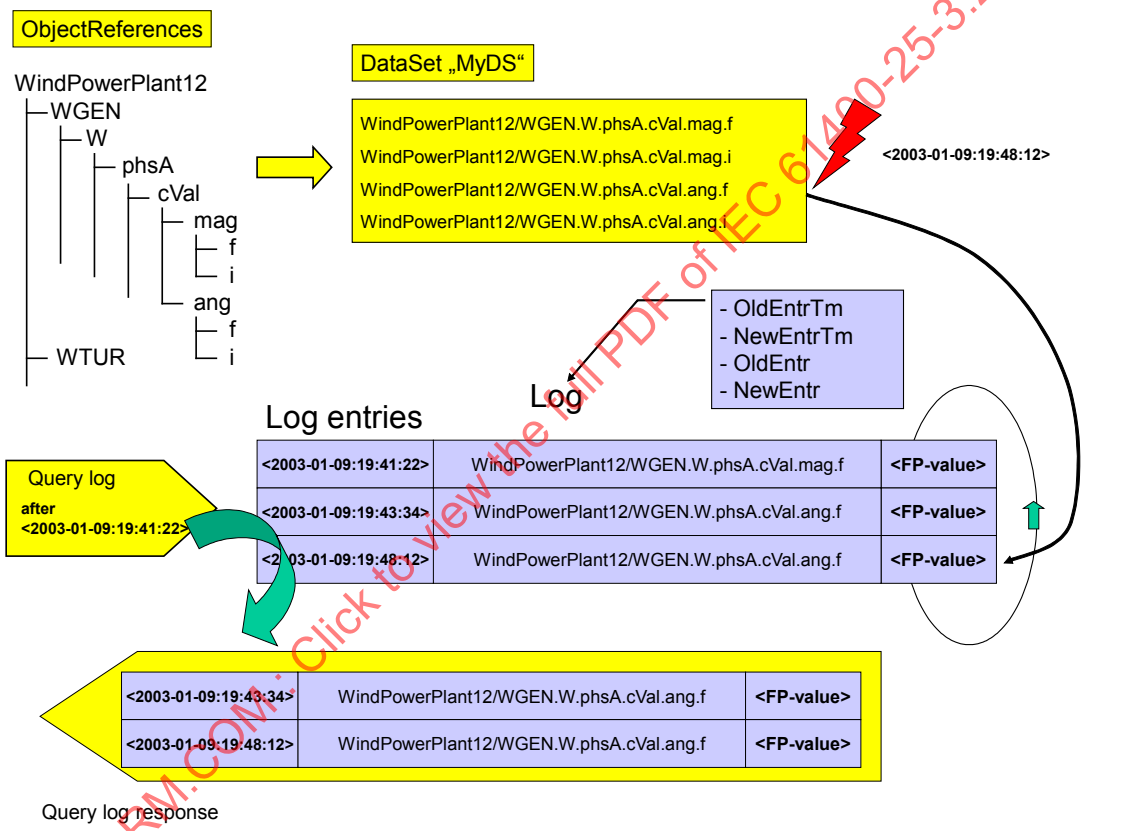

Figure A.2 – Logging basics (example)

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.

Subclause 17.3 of IEC 61850-7-2:2010 contains additional examples on logging.

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. Note that only FC's from IEC 61400-25-2 CDC's and CDC's inherited by IEC 61850-7-3 are considered.

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

Services	Relationship to FC
Associate	–
Release	–
Abort	
GetServerDirectory	–
GetLogicalDeviceDirectory	–
GetLogicalNodeDirectory	–
GetAllDataValues	The service is applicable with optional FC: all except SE
GetDataValues	The service is applicable with FC: all except SE
SetDataValues	The service is applicable with FC: DC, CF, SV, BL, SP
GetDataDirectory	–
GetDataDefinition	–
GetDataSetValues	The service should be applied only to those dataset elements with FC: all except SE
SetDataSetValues	The service should be applied only to those datasets elements with FC: DC, CF, SV, BL, SP
CreateDataSet	The DataSetReference has no FC associated but the elements that build it can be of any FC
DeleteDataSet	–
GetDataSetDirectory	–
Report	A report can include elements of FC: all except SE, see Note 1
GetBRCBValues	–
SetBRCBValues	–
GetURCBValues	–
SetURCBValues	–
GetLCBValues	–
SetLCBValues	–
GetLogStatusValues	–
QueryLogByTime	A LogEntry can include elements of FC: all except SE, see Note 2
QueryLogAfter	A LogEntry can include elements of any FC: all except SE, see Note 2
Select	–
SelectWithValue	–
Cancel	–

Operate	–
CommandTermination	–
TimeActivatedOperate	–
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 following classes do not appear in the wind power plant:

– Tracking.

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

The following control blocks are not used in IEC 61400-25-3:

– 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.

– MSVCB: Multicast sampled values control block.

– USVCB: Unicast sampled values control block.

The ACSI defined in the Figure 3 of IEC 61850-7-2:2010 describes the relationship between the different elements that build the ACSI in the power utility automation area. Figure C.1 describes the relationship in IEC 61400-25-3.

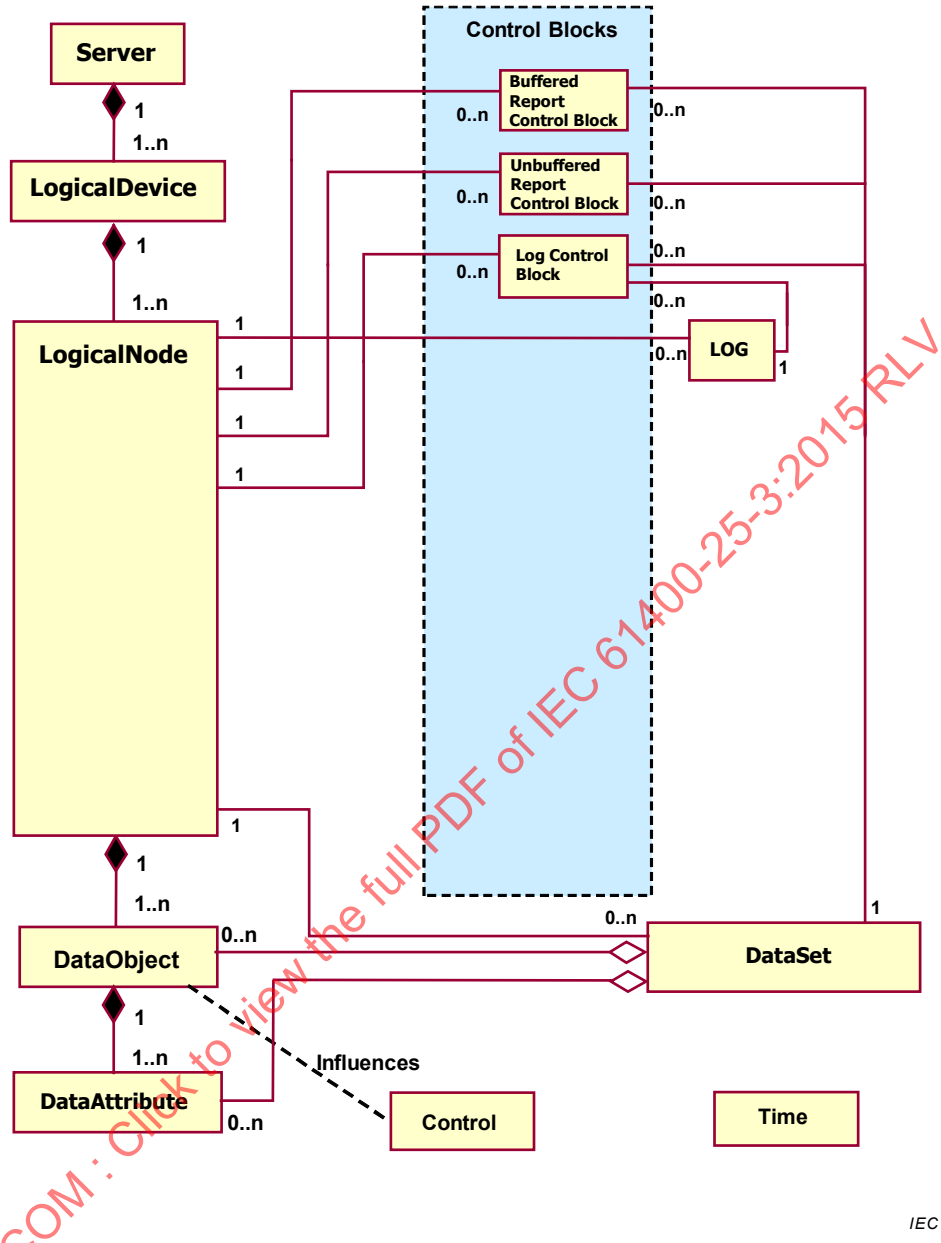

Figure C.1 – Conceptual service model of the ACSI

Annex D
(normative)

ACSI conformance statement

D.1 General

The following ACSI conformance statements shall be used to provide an overview and details about a device claiming conformance with ACSI:

– ACSI basic conformance statement,
– ACSI models conformance statement, and
– ACSI service conformance statement

to specify the communication features mapped to an SCSM.

NOTE 1 The conformance statements of Annex D are abstract in the sense that the ACSI models and their services are mapped to application layer models, services, and protocols. Additional details on the conformance are defined in the SCSM.

NOTE 2 For several features, the conformance requirement is implicitly defined with the common data class contained in IEC 61400-25-2 and IEC 61850-7-3 and the compatible logical-node classes and data object classes contained in IEC 61400-25-2 and IEC 61850-7-4, for example, a TrgOp (trigger option) of the value qchg (quality change) of DataAttribute requires the support of the TrgOps (trigger option) qchg of the BRCB or URCB.

D.2 ACSI basic conformance statement

The basic conformance statement shall be as defined in Table D.1.

Table D.1 – Basic conformance statement

		Client/ subscriber	Server/ publisher	Value/ comments
Client-server roles				
B11	Server side (of TWO-PARTY APPLICATION-ASSOCIATION)	–	c[1]	
B12	Client side (of TWO-PARTY APPLICATION-ASSOCIATION)	c[1]	–	
SCSMs supported				
B25	SCSM: IEC 61400-25-4:2008, Annex A (web services)			
B26	SCSM: IEC 61400-25-4:2008, Annex B (OPC XML-DA)			
B27	SCSM: IEC 61400-25-4:2008, Annex C (ISO 9506 mms)			
B28	SCSM: IEC 61400-25-4:2008, Annex D (IEC 60870-5-104)			
B29	SCSM: IEC 61400-25-4:2008, Annex E (DNP3)			
c[1] shall be 'M' if support for logical-device model has been declared.				

D.3 ACSI models conformance statement

The ACSI models conformance statement shall be as defined in Table D.2.

Table D.2 – ACSI models conformance statement

		Client/ subscriber	Server/ publisher	Value/ comments
If Server side (B11) and /or Client side (B12) supported				
M1	**Logical device**	c[2]	c[2]	
M2	**Logical node**	c[3]	c3	
M3	**Data**	c[4]	c[4]	
M4	**Data set**	cw[1]	cw[1]	
M5	**Substitution**	O	O	
	Reporting			
M7	**Buffered report control**	O	O	
M7-1	sequence-number			
M7-2	report-time-stamp			
M7-3	reason-for-inclusion			
M7-4	data-set-name			
M7-5	data-reference			
M7-6	buffer-overflow			
M7-7	entryID			
M7-8	BufTm			
M7-9	IntgPd			
M7-10	GI			
M7-11	conf-revision			
M8	**Unbuffered report control**	O	O	
M8-1	sequence-number			
M8-2	report-time-stamp			
M8-3	reason-for-inclusion			
M8-4	data-set-name			
M8-5	data-reference			
M8-6	BufTm			
M8-7	IntgPd			
M8-8	GI			
M8-9	conf-revision			
	Logging			
M9	**Log control**	O	O	
M9-1	IntgPd			
M10	**Log**	O	O	
	Control			
M11	**Control**	O	cw[2]	
For all IEDs				
M16	**Time**	O	M	Time source with required accuracy shall be available

c[2] shall be 'M' if support for logical-node model has been declared.
c[3] shall be 'M' if support for data model has been declared.
c[4] shall be 'M' if support for data-set, Substitution, Report, Log Control, or Time model has been declared.
cw[1] shall be 'M' if support for Report has been declared and if SCSM supports dataset.
cw[2] shall be 'M' if a control object is supported.

M-Mandatory
O-Optional

D.4 ACSI service conformance statement

The ACSI service conformance statement shall be as defined in Table D.3 (depending on the statements in Table D.1 and in Table D.2). The conformance statement for time resolution and accuracy of data shall be as defined in Table D.4.

Table D.3 – ACSI service conformance statement *(1 of 2)*

	Services	Client/ subscriber	Server/ publisher	Comments
Server (see 9.3)				
S1	GetServerDirectory	O	cw[3]	
cw[3] If this service is supported by the SCSM then the service shall be mandatory.				
Application association (see 9.2)				
S2	Associate	M	M	
S3	Abort	cw[4]	cw[3]	
S4	Release	cw[4]	cw[3]	
cw[4] If these services are supported by the SCSM then either the Abort or the Release request shall be supported by the client. Additionally, the client must understand the abort request delivered by the server.				
Logical device (see 9.4)				
S5	GetLogicalDeviceDirectory	O	cw[3]	
Logical node (see 9.5)				
S6	GetLogicalNodeDirectory	O	cw[3]	
S7	GetAllDataValues	O	cw[3]	
Data (see 9.6)				
S8	GetDataValues	O	M	
S9	SetDataValues	O	O	
S10	GetDataDirectory	O	cw[3]	
S11	GetDataDefinition	O	cw[3]	
Data set (see 9.7)				
S12	GetDataSetValues	O	cw[3]	
S13	SetDataSetValues	O	O	
S14	CreateDataSet	O	O	
S15	DeleteDataSet	O	O	
S16	GetDataSetDirectory	O	cw[3]	
Reporting (see 9.8)				
S24	Report	cw[3]	cw[3]	
S24-1	data-change (dchg)			
S24-2	ochg-change (qchg)			
S24-3	data-update (dupd)			
S25	GetBRCBValues	cw[5]	cw[5]	
S26	SetBRCBValues	O	O	
S28	GetURCBValues	cw[5]	cw[5]	
S29	SetURCBValues	O	O	
cw[5] If these services are supported by the SCSM, support shall be declared for at least one (BRCB or URCB).				

Table D.3 *(2 of 2)*

	Services	Client/ subscriber	Server/ publisher	Comments
Logging (see 9.9)				
Log control block				
S30	GetLCBValues	cw[3]	cw[3]	
S31	SetLCBValues	O	O	
Log				
S32	QueryLogByTime	cw[6]	cw[3]	
S33	QueryLogAfter	cw[6]	cw[3]	
S34	GetLogStatusValues	cw[3]	cw[3]	
cw[6] If these services are supported by the SCSM, support shall be declared for at least one (QueryLogByTime or QueryLogAfter).				
Control (see 9.10)				
S51	Select	M	O	
S52	SelectWithValue	M	O	
S53	Cancel	O	O	
S54	Operate	M	M	
S55	Command-Termination	M	O	
S56	TimeActivatedOperate	O	O	
S57	TimeActivatedOperateTermination	O	O	

Table D.4 – Time

	Services	Client/ subscriber	Server/ publisher	Comments
Time (IEC 61850-7-2:2010 6.1.2.9)				
T1	Time resolution of internal clock			Nearest negative power of 2 in seconds
T2	Time accuracy of internal clock			T0 (10 ms)
				T1 (1 ms)
				T2 (100 µs)
				T3 (25 µs)
				T4 (4 µs)
				T5 (1 µs)
T3	Supported Timestamp resolution			Nearest value of 2**(–n) in seconds according to IEC 61850-7-2:2010, 6.1.2.9.3.2
NOTE The time resolution and accuracy of data available in the IED but retrieved from and time stamped in other devices is out of the scope of this table and may be different from what is defined in this table.				

Bibliography

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*

IEC 61850-7-4, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ÉOLIENNES –

Partie 25-3: Communications pour la surveillance et la commande des centrales éoliennes – Modèles d'échange d'information

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La Norme internationale IEC 61400-25-3 a été établie par comité d'études 88 de l'IEC: Éoliennes.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
88/540/FDIS	88/552/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Cette deuxième édition annule et remplace la première édition parue en 2006.

L'étendue de la révision comprend:

- L'harmonisation avec les modèles de services de l'édition 2 de l'IEC 61850-7-2.
- La réduction de l'écart entre les normes et la simplification par un référencement amélioré.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) Les services d'ajout et de suppression d'abonnement ont été supprimés.
b) Les tableaux de l'Article 9 indiquant les services attendus ont été remplacés par les tableaux d'une nouvelle Annexe D comprenant les déclarations de conformité ACSI pour les clients et les serveurs.
c) Les problèmes techniques (« Tissues » pour « Technical issues » en anglais) propres à l'IEC 61850-7-2 édition 2 ont été pris en compte et des modifications ont été effectuées en conséquence.

Les problèmes techniques (« Tissues »), recueillis par le groupe d'utilisateurs USE61400-25 de l'IEC 61400-25 ont été pris en compte, mais aucun problème technique n'a été consigné pour l'édition 1.

Une liste de toutes les parties de la série IEC 61400, publiées sous le titre général *Éoliennes*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. À cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

La série IEC 61400-25 définit les communications pour la surveillance et la commande des centrales éoliennes. L'approche de modélisation de la série IEC 61400-25 a été sélectionnée pour fournir des définitions abstraites des classes et des services de telle sorte que les spécifications soient indépendantes des piles de protocoles, des mises en œuvre et des systèmes d'exploitation spécifiques. La mise en correspondance de ces classes et services abstraits avec un profil de communication spécifique ne relève pas du domaine d'application de la présente partie (IEC 61400-25-3), mais de celui de l'IEC 61400-25-4.

La présente partie de l'IEC 61400-25 définit les services du modèle d'échange d'information des dispositifs électroniques intelligents dans les centrales éoliennes. Les services sont désignés comme l'Interface abstraite pour les services de communication (abstract communication service interface en anglais) ou ACSI. L'ACSI a été définie de manière à être indépendante des systèmes de communication sous-jacents.

Le modèle d'échange d'information est défini en termes de

– modèle de classes hiérarchiques de toutes les informations auxquelles on peut avoir accès,
– services d'échange d'information qui fonctionnent avec ces classes,
– paramètres associés à chaque service d'échange d'information.

La technique de description ACSI permet une abstraction par rapport à l'ensemble des différentes approches de mise en œuvre de la collaboration des divers dispositifs.

Ces définitions de services abstraits sont traduites en définitions d'objets concrets à utiliser pour un protocole particulier. La mise en correspondance avec des piles de protocoles spécifiques est spécifiée dans l'IEC 61400-25-4.

NOTE 1 L'abstraction dans l'interface ACSI a une double signification. En premier lieu, seuls les aspects d'un dispositif réel (par exemple, un rotor) ou d'une fonction réelle qui sont visibles et accessibles sur un réseau de communication sont modélisés. Cette abstraction génère les modèles de classes hiérarchiques et leur comportement définis dans l'IEC 61400-25-2. En second lieu, l'ACSI permet une abstraction par rapport à l'aspect des définitions concrètes concernant la manière dont les dispositifs échangent l'information; seule une collaboration conceptuelle est définie. L'échange d'informations concrètes est défini dans l'IEC 61400-25-4.

NOTE 2 Les performances liées à la mise en œuvre de la série IEC 61400-25 sont spécifiques à l'application. La série IEC 61400-25 ne garantit pas un certain niveau de performances. Ce type de garantie s'étend au-delà du domaine d'application de la série IEC 61400-25. Toutefois, il n'y a pas de limitation sous-jacente à la technologie de communication qui interdit des applications à haut débit (réponses de l'ordre de la milliseconde).

ÉOLIENNES –

Partie 25-3: Communications pour la surveillance et la commande des centrales éoliennes – Modèles d'échange d'information

1 Domaine d'application

La série IEC 61400-25 concerne essentiellement les communications entre les composants des centrales éoliennes tels que les éoliennes et des acteurs tels que les systèmes SCADA. La communication interne entre les composants des centrales éoliennes ne relève pas du domaine d'application de la série IEC 61400-25.

La série IEC 61400-25 est conçue pour un environnement de communication fondé sur un modèle client-serveur. Trois domaines sont définis, qui sont modélisés séparément pour assurer l'extensibilité des systèmes mis en œuvre: (1) modèles d'information de centrale éolienne, (2) modèle d'échange d'information et (3) mise en correspondance de ces deux modèles avec un profil de communication normalisé.

Le modèle d'information de centrale éolienne et le modèle d'échange d'information, considérés ensemble, constituent une interface entre le client et le serveur. Dans cette combinaison, le modèle d'information de centrale éolienne sert de trame pour interpréter les données accessibles de la centrale éolienne. Le modèle d'information de centrale éolienne est utilisé par le serveur pour fournir au client une vue uniforme, orientée composant, des données de la centrale éolienne. Le modèle d'échange d'information reflète toutes les fonctions actives du serveur. La série IEC 61400-25 permet de connecter entre eux une combinaison hétérogène de clients et de serveurs issus de différents constructeurs et fournisseurs.

Comme le montre la Figure 1, la série IEC 61400-25 définit un serveur ayant les aspects suivants:

– les informations fournies par un composant de centrale éolienne, par exemple, "vitesse du rotor de l'éolienne" ou "production électrique totale durant un certain laps de temps", sont modélisées et rendues accessibles. Les informations modélisées dans la série IEC 61400-25 sont définies dans l'IEC 61400-25-2;
– les services pour échanger les valeurs des informations modélisées, définies dans l'IEC 61400-25-3;
– la mise en correspondance avec un profil de communication, fournissant une pile de protocoles pour transporter les valeurs échangées provenant des informations modélisées (IEC 61400-25-4).

La série IEC 61400-25 se contente de définir comment modéliser les informations, l'échange d'information et la mise en correspondance avec des protocoles de communication spécifiques. La série IEC 61400-25 s'abstient de définir comment et où mettre en œuvre l'interface de communication, l'interface du programme d'application et les recommandations de mise en œuvre. Toutefois, l'objectif de la série IEC 61400-25 est de permettre l'accès aux informations associées à un composant individuel de la centrale éolienne (tel qu'une éolienne) à travers un dispositif logique correspondant.

La présente partie de l'IEC 61400-25 spécifie une interface abstraite pour les services de communication qui décrit l'échange d'information entre un client et un serveur pour:

– l'accès et la récupération des données,
– la commande des dispositifs,

– les rapports et journalisations d'événements,
– l'autodescription des dispositifs (dictionnaire de données de dispositif),
– l'établissement de types de données et la découverte de types de données.

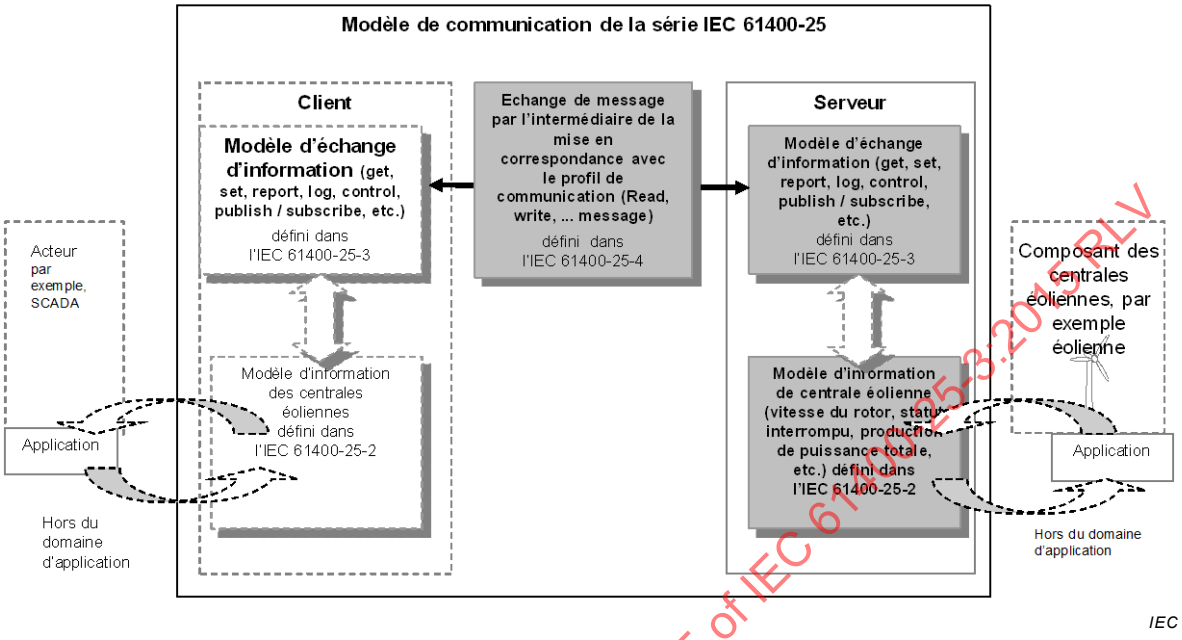

Figure 1 – Modèle de communication conceptuelle de la série IEC 61400-25

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61400-25-1, *Wind turbines – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models* (disponible en anglais seulement)

IEC 61400-25-2:2015, *Eoliennes – Partie 25-2: Communications pour la surveillance et la commande des centrales éoliennes – Modèles d'information*

IEC 61400-25-4:2008, *Wind turbines – Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile* (disponible en anglais seulement)

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)* (disponible en anglais seulement)

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions donnés dans l'IEC 61400-25-1 ainsi que les suivants s'appliquent.

3.1
objet de commande
instance d'objet de données d'une classe d'objets de données contrôlables dont le DataAttribute ctlModel n'est pas réglé sur “status-only” ("statut-uniquement")

4 Abréviations

ACSI	Abstract Communication Service Interface (Interface abstraite pour les services de communication) (définie par exemple dans l'IEC 61850-7-2)
FCD	Functionally Constrained Data (Données fonctionnellement contraintes)
FCDA	Functionally Constrained Data Attribute (Attribut de données fonctionnellement contraintes)
DEI	Dispositif électronique intelligent
IEM	Information Exchange Model (Modèle d'échange d'information)
LCB	Log Control Block (Bloc de commande de journal)
LD	Logical Device (Dispositif logique)
LN	Logical Node (Nœud logique)
LOG	Journal
LPHD	Logical Node Physical Device (Dispositif physique de nœud logique)
RCB	Report Control Block (Bloc de commande de rapport)
SCADA	Supervisory Control and Data Acquisition (Système de supervision, contrôle et acquisition de données)
SCSM	Specific Communication Service Mapping (Mise en correspondance des services de communication spécifiques (définie par exemple dans l'IEC 61850-8-1)
SG	Setting Group (Groupe de réglage)
WPP	Wind Power Plant (Centrale éolienne)
WT	Wind Turbine (Éolienne)
XML	Extensible Mark-up Language (Langage de balisage extensible)
GUI	Graphical User Interface (Interface utilisateur graphique)

5 Généralités

La présente partie de l'IEC 61400-25 fournit les modèles d'échange d'information qui peuvent être appliqués par un client et un serveur pour accéder au contenu et à la structure du modèle d'information de centrale éolienne défini dans l'IEC 61400-25-2.

L'Article 6 donne une vue d'ensemble des modèles d'échange d'information pour les fonctions d'exécution et de gestion.

L'Article 7 présente les modèles d'échange d'information pour les fonctions d'exécution: autorisation, commande, surveillance, rapport et journalisation.

L'Article 8 donne une vue d'ensemble des modèles d'échange d'information pour les fonctions de gestion.

L'Article 9 fournit les détails des services pour les classes de modèles de services suivantes:

- Association d'application,
- Classe de serveurs,
- Classe de dispositifs logiques (récupérer l'autodescription, etc.),
- Classe de nœuds logiques (récupérer l'autodescription, etc.),
- Classe de données (obtenir des valeurs, définir des valeurs, récupérer l'autodescription, etc.),

- Classe DataSet (obtenir des valeurs, définir des valeurs, créer des ensembles de données, récupérer l'autodescription, etc.),
- Classe de blocs de commande de rapport (obtenir des attributs, définir des attributs, consigner dans un rapport, etc.),
- Classes de blocs de commande de journal et classes de journaux (obtenir des attributs, définir des attributs, récupérer des entrées de journaux, etc.),
- Classe de commande (sélectionner, exécuter, etc.).

L'Annexe A donne des exemples des services de rapport et de journalisation exigés.

L'Annexe B spécifie la relation entre les services ACSI et les contraintes fonctionnelles.

L'Annexe C spécifie la relation entre l'interface ACSI définie dans l'IEC 61850-7-2 et celle définie dans l'IEC 61400-25-3.

L'Annexe D fournit des déclarations de conformité ACSI pour les clients et les serveurs.

6 Vue d'ensemble des modèles d'échange d'information

Les modèles d'échange d'information fournissent des services pour les fonctions de communication regroupées comme suit:

- fonctions d'exécution,
- fonctions de gestion.

Ces deux groupes sont présentés et décrits plus en détail dans les Articles 7 et 8.

Les services obligatoires pour chaque modèle d'échange d'information sont indiqués dans les tableaux de services correspondants à l'Article D.4.

Les instances des modèles d'échange d'information énumérés dans le Tableau 1 doivent avoir accès à une instance du modèle d'information d'une centrale éolienne (dispositif logique, nœud logique, données, attributs de données et objets de blocs de commande). Les deux premières colonnes du tableau énumèrent les groupes fonctionnels et leurs modèles d'échange d'information, qui sont décrits de manière synthétisée dans la troisième colonne. Les quatrième et cinquième colonnes identifient les types de données et les principes de transfert qui sont applicables pour chaque modèle d'échange d'information. La dernière colonne indique les modèles de services ACSI utilisés pour les modèles d'échange d'information correspondants.

Tableau 1 – Modèles d'échange d'information

Groupe fonctionnel	Modèle d'échange d'information	Description succincte	Catégories d'information	Principes de transfert	Modèles de services ACSI
Exécution (voir Article 7)	Autorisation (voir 7.2)	Authentification et restriction de l'accès aux fonctions d'exécution et de gestion	Messages textes courts	Transfert de données sur demande Transfert de commandes	ASSOCIATION
	Commande (voir 7.3)	Commande des dispositifs fonctionnels	Points de consigne Commandes Paramètres	Transfert de commandes Transfert de points de consigne Transfert de paramètres	CONTROL
	Surveillance (voir 7.4)	Surveillance des données actuelles et changement des données des dispositifs fonctionnels	Donnée mesurée Donnée traitée (Valeurs moyennes, Min/Max) Statut Alarmes Événements Minuterie Compteur Points de consigne Paramètres Données de séries temporelles (c'est-à-dire Journal Alarme/Événement, Journal de commandes, journal de points de consigne) (Valeurs analogiques, valeurs binaires)	Transfert de données périodique (toutes les données ou uniquement les données modifiées depuis le dernier transfert) Transfert de données sur demande Transfert de données dirigé par les événements (spontané)	LOGICAL-DEVICE LOGICAL-NODE DATA DATA-SET BUFFERED-REPORT-CONTROL UNBUFFERED-REPORT-CONTROL LOG LOG-CONTROL (voir l'Article 9 pour les détails des services ACSI)
	Rapport et journalisation (voir 7.4)	Balayage et enregistrement continus des valeurs et des événements commandés par déclencheur	Historiques (Journaux) Rapports Statistiques Courbes Tendances Événements Messages textes courts		
Gestion (voir Article 8)	Diagnostic (voir 8.5)	Autosurveillance des dispositifs	*Les catégories d'information de surveillance, de rapport et de journalisation s'appliquent*		
	Gestion des utilisateurs et de l'accès (voir 8.2)	Configuration des environnements utilisateurs, droits d'accès et surveillance d'accès	*Spécifiques au système*		
	Configuration (voir 8.3)	Gestion de la configuration des dispositifs	*Spécifiques au système*		
	Synchronisation temporelle (voir 8.4)	Synchronisation des horloges de dispositifs	*Spécifiques à la SCSM*		

Les modèles d'échange d'information doivent être réalisés par les modèles ACSI correspondants et les services associés (comme illustré dans la dernière colonne du Tableau 1). L'objectif du tableau est de donner une vue d'ensemble en appliquant la terminologie courante du domaine des centrales éoliennes.

7 Fonctions d'exécution

7.1 Généralités

Les modèles d'échange d'information applicables aux fonctions d'exécution décrites à l'Article 7 sont les suivants:

- modèle d'association et d'autorisation,
- modèle de commande,
- modèle de surveillance, de rapport et de journalisation.

Les contraintes fonctionnelles des services ACSI sont spécifiées à l'Annexe B.

7.2 Modèle d'association et d'autorisation

L'objet du modèle d'association et d'autorisation est de fournir un échange d'information sécurisé via une association entre un client et un serveur. Le modèle prévoit l'authentification du client et contrôle l'accès aux fonctions du serveur. Le mécanisme conceptuel est présenté à la Figure 2.

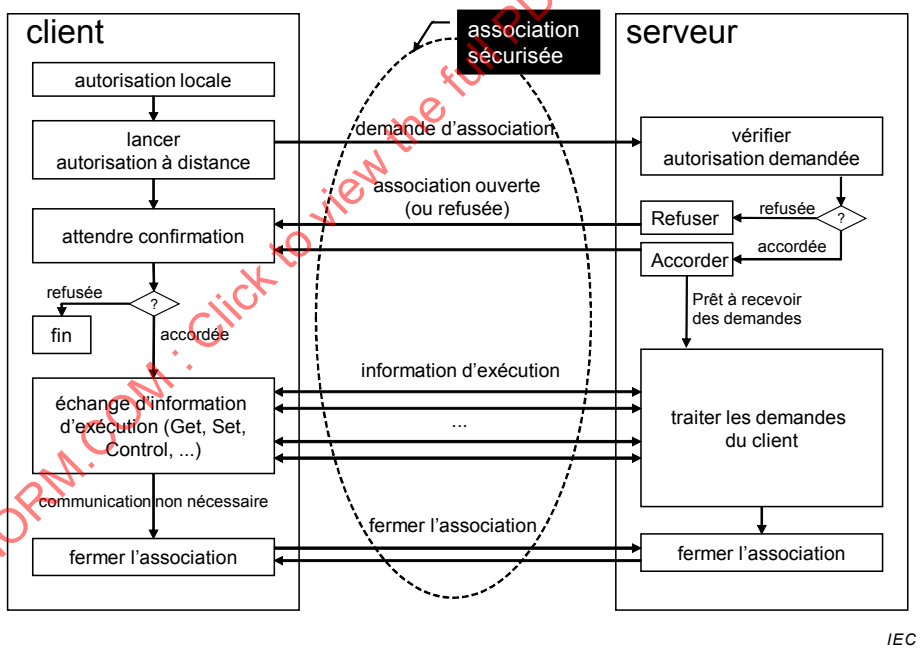

Figure 2 – Modèle d'association et d'autorisation (conceptuel)

Les exigences à satisfaire par une association entre un client et un serveur sont les suivantes:

– **authentification:** détermination de l'identité des utilisateurs/client,

– **autorisation et contrôle d'accès:** assurance du fait que l'entité dispose des droits d'accès appropriés (il faut au minimum fournir un nom d'utilisateur et un mot de passe),

– **intégrité:** les messages et l'infrastructure informatique sont protégés contre toute modification ou destruction non autorisée,