INTERNATIONAL STANDARD

IEC 61850-8-1

First edition
2004-05

Communication networks and systems in substations –

Part 8-1:
Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

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International Standard IEC 61850-8-1 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

FDIS	Report on voting
57/692/FDIS	57/712/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.

IEC 61850 consists of the following parts, under the general title *Communication networks and systems in substations:*

Part 1: Introduction and overview

Part 2: Glossary

Part 3: General requirements

Part 4: System and project management

Part 5: Communication requirements for functions and device models

Part 6: Configuration description language for communication in electrical substations related to IEDs

Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models

Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI)

Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes

Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes

Part 8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

Part 9-1: Specific Communication Service Mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link

Part 9-2: Specific Communication Service Mapping (SCSM) – Sampled values over ISO/IEC 8802-3

Part 10: Conformance testing [1]

This document specifies in Annex E specialized CDCs (Common Data Classes) based on CDCs defined in IEC 61850-7-3:2003.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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- withdrawn;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

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

[1] Under consideration.

INTRODUCTION

This document is part of a set of specifications which details layered substation communication architecture.

This part of IEC 61850 is intended to provide inter-device operation of a variety of substation and feeder devices to achieve interoperability providing detailed information on how to create and exchange concrete communication messages that implement abstract services and models specified in IEC 61850-7-4, IEC 61850-7-3, and IEC 61850-7-2.

The mapping allows for data exchange over ISO/IEC 8802-3 Local Area Networks between all kinds of substation devices. Some of the protocol stacks used within this document are routable. Therefore the actual communications path may not be restricted to the LAN. Data exchange consists of real-time monitoring and control data, including measured values, to name just a few.

NOTE This part of IEC 61850 does not provide tutorial material. It is recommended that IEC 61850-5 and IEC 61850-7-1 be read in conjunction with IEC 61850-7-2.

COMMUNICATION NETWORKS AND SYSTEMS IN SUBSTATIONS –

Part 8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

1 Scope

This part of IEC 61850 specifies a method of exchanging time-critical and non-time-critical data through local-area networks by mapping ACSI to MMS and ISO/IEC 8802-3 frames.

MMS services and protocol are specified to operate over full OSI and TCP compliant communications profiles. The use of MMS allows provisions for supporting both centralized and distributed architectures. This standard includes the exchange of real-time data indications, control operations, report notification.

This part of IEC 61850 specifies the mapping of the objects and services of the ACSI (Abstract Communication Service Interface, IEC 61850-7-2) to MMS (Manufacturing Message Specification, ISO 9506) and ISO/IEC 8802-3 frames.

This standard also specifies the mapping of time-critical information exchanges to non-MMS protocol. The protocol semantics are defined in IEC 61850-7-2. This standard contains the protocol syntax, definition, mapping to ISO/IEC 8802-3 frame formats, and any relevant procedures specific to the use of ISO/IEC 8802-3.

This mapping of ACSI to MMS defines how the concepts, objects, and services of the ACSI are to be implemented using MMS concepts, objects, and services. This mapping allows interoperability across functions implemented by different manufacturers.

This part of the standard defines a standardized method of using the ISO 9506 services to implement the exchange of data. For those ACSI services, defined in IEC 61850-7-2 that are not mapped to MMS, this part defines additional protocols. This standard describes real substation devices with respect to their external visible data and behaviour using an object oriented approach. The objects are abstract in nature and may be used to a wide variety of applications. The use of this mapping goes far beyond the application in the substation communications.

This part of IEC 61850 provides mappings for the services and objects specified within IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4.

2 Normative references

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

IEC 60874-10-1:1997, *Connectors for optical fibres and cables – Part 10-1: Detail specification for fibre optic connector type BFOC/2,5 terminated to multimode fibre type A1*

IEC 60874-10-2:1997, *Connectors for optical fibres and cables – Part 10-2: Detail specification for fibre optic connector type BFOC/2,5 terminated to single-mode fibre type B1*

IEC 60874-10-3:1997, *Connectors for optical fibres and cables – Part 10-3: Detail specification for fibre optic connector type BFOC/2,5 for single and multimode fibre*

IEC 61850-2, *Communication networks and systems in substations – Part 2: Glossary*

IEC 61850-5, *Communication networks and systems in substations – Part 5: Communication requirements for functions and device models*

IEC 61850-7-1, *Communication networks and systems in substations – Part 7-1: Basic communication structure for substation and feeder equipment – Part 7-1: Principles and models*

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

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

IEC 61850-7-4, *Communication networks and systems in substations – Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes*

IEC 61850-9-1, *Communication networks and systems in substations – Part 9-1: Specific Communication Service Mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link*

IEC 61850-9-2, *Communication networks and systems in substations – Part 9-2: Specific Communication Service Mapping (SCSM) – Sampled values over ISO/IEC 8802-3*

ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 7498-3:1997, *Information technology – Open Systems Interconnection – Basic Reference Model: Naming and addressing*

ISO/IEC 8072:1996, *Information technology – Open systems interconnection – Transport service*

ISO/IEC 8073:1997, *Information technology – Open Systems Interconnection – Protocol for providing the connection-mode transport service definition*

ISO/IEC 8326:1996, *Information processing system – Open Systems Interconnection – Session service definition*

ISO/IEC 8327-1:1997, *Information technology – Open Systems Interconnection – Connection-oriented session protocols: Protocol specification*

ISO/IEC 8348:2002, *Information technology – Open Systems Interconnection – Network service definition*

ISO/IEC 8473-1:1998, *Information technology – Protocol for providing the connectionless-mode network service: Protocol specification*

ISO/IEC 8473-2:1996, *Information technology – Protocol for providing the connectionless-mode network service – Part 2: Provision of the underlying service by an ISO/IEC 8802 subnetwork*

ISO/IEC 8602:1995, *Information technology – Protocol for providing the OSI connectionless-mode transport service*

ISO/IEC 8649:1996, *Information technology – Open Systems Interconnection – Service definition for the Associated Control Service Element*

ISO/IEC 8650-1:1996, *Information technology – Open Systems Interconnection – Connection-oriented protocol for the Association Control Service Element: Protocol specification*

ISO/IEC 8802-2:1998, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control*

ISO/IEC 8802-3:2001, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 8822:1994, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 8823-1:1994, *Information technology – Open Systems Interconnection – Connection-oriented presentation protocol: Protocol specification*

ISO/IEC 8824-1:1999, Information technology – Abstract Syntax Notation One (ASN. 1): Specification of basic notation
Amendment 1 (2000)
Amendment 2 (2000)

ISO/IEC 8825-1:2000, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO/IEC 8877:1992, *Information technology – Telecommunications and information exchange between systems – Interface connector and contact assignments for ISDN Basic Access Interface located at reference points S and T*

ISO/IEC 9542:1988, *Information processing systems – Telecommunications and information exchange between systems – End system to Intermediate system routeing exchange protocol for use in conjunction with the Protocol for providing the connectionless-mode network service (ISO 8473)*

ISO/IEC 9548-1:1996, *Information technology – Open Systems Interconnection – Connection-less Session protocol: Protocol specification*

ISO/IEC 9576-1:1995, *Information technology – Open Systems Interconnection – Connection-less Presentation protocol: Protocol specification*

ISO/IEC 10035-1:1995, *Information technology – Open Systems Interconnection – Connection-less protocol for the Association Control Service Element: Protocol specification*
Amendment 1 (1998)

ISO/IEC ISP 10608-1:1992, *Information technology – International Standardized Profile TAnnnn – Connection-mode Transport Service over Connectionless-mode Network Service – Part 1: General overview and subnetwork-independent requirements*

ISO/IEC ISP 10608-2:1992, *Information technology – International Standardized Profile TAnnnn – Connection-mode Transport Service over Connectionless-mode Network Service – Part 2: TA51 profile including subnetwork-dependent requirements for CSMA/CD Local Area Networks (LANs)*

ISO/IEC ISP 11188-1:1995, *Information technology – International Standardized Profile – Common upper layer requirements – Part 1: Basic connection oriented requirements*

ISO/IEC ISP 11188-3:1996, *Information technology – International Standardized Profile – Common upper layer requirements – Part 3: Minimal OSI upper layer facilities*

ISO 9506-1:2003, *Industrial automation systems – Manufacturing Message Specification – Part 1: Service definition*

ISO 9506-2:2003, *Industrial automation systems – Manufacturing Message Specification – Part 2: Protocol specification*

ISO/ISP 14226-1:1996, *Industrial automation systems – International Standardized Profile AMM11: MMS General Applications Base Profile – Part 1: Specification of ACSE, Presentation and Session protocols for use by MMS*

ISO/ISP 14226-2:1996, *Industrial automation systems – International Standardized Profile AMM11: MMS General Applications Base Profile – Part 2: Common MMS requirements*

ISO/ISP 14226-3:1996, *Industrial automation systems – International Standardized Profile AMM11: MMS General Applications Base Profile – Part 3: Specific MMS requirements*

IEEE C37.111:1999, *IEEE Standard for Common Format for Transient Data Exchange (COMTRADE) for Power Systems*

IEEE 754:1985, *IEEE Standard for Binary Floating-Point Arithmetic*

IEEE 802.1Q:1998, *IEEE Standards for Local and Metropolitan Networks: Virtual Bridged Local Area Networks*

RFC 542, *File Transfer Protocol for the ARPA Network, IETF, available at <http://www.ietf.org>*

RFC 768, *User Datagram Protocol, IETF, available at <http://www.ietf.org>*

RFC 791, *Internet Protocol – DARPA Internet Program Protocol Specification, IETF, available at <http://www.ietf.org>*

RFC 792, *Internet Control Message Protocol – DARPA Internet Program Protocol Specification, IETF, available at <http://www.ietf.org>*

RFC 793, *Transmission Control Procedure – DARPA Internet Program Protocol Specification, IETF, available at <http://www.ietf.org>*

RFC 826, *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware, IETF, available at <http://www.ietf.org>*

RFC 894, *A Standard for the Transmission of IP datagrams over Ethernet Networks, IETF, available at <http://www.ietf.org>*

RFC 919, *Broadcasting Internet Datagrams, IETF, available at <http://www.ietf.org>*

RFC 922 *Broadcasting Internet Datagrams in the presence of subnets, IETF, available at <http://www.ietf.org>*

RFC 950, *Internet Standard Subnetting Procedure, IETF, available at* <http://www.ietf.org>

RFC 959, *File Transfer Protocol (FTP), IETF, available at* <http://www.ietf.org>

RFC 1006 *ISO transport services on top of TCP: Version 3, IETF, available at <http://www.ietf.org>*

RFC 1112, *Host Extensions for IP Multicasting, IETF, available at <http://www.ietf.org>*

RFC 1122, *Requirements for Internet Hosts – Communication Layers, IETF, available at <http://www.ietf.org>*

RFC 1123, *Requirements for Internet Hosts – Application and Support, IETF, available at <http://www.ietf.org>*

RFC 2030, *Simple Network Time Protocol (SNTP) Version 4, IETF, available at <http://www.ietf.org>*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61850-2 as well as the following apply.

3.1
(*n*)-layer
any specific layer

[ISO/IEC 7498-1, 3.1]

3.2
(*n*)-protocol data unit
unit of data specified in an (n)-protocol and consisting of (n)-protocol-control-information and possibly (n)-user-data

[ISO/IEC 7498-1, 5.6.1.3]

3.3
(*n*)-protocol
set of rules and formats (semantic and syntactic) which determines the communication behavior of (N)-entities in the performance of (n)-functions

[ISO/IEC 7498-1, 5.2.1.9]

3.4
class
description of a set of objects that share the same attributes, services, relationships, and semantics

[IEC 61850-7-2, 3.1]

3.5
client
entity that requests a service from a server and that receives unsolicited messages from a server

[IEC 61850-7-2, 3.2]

3.6
device
entity that performs control, actuating and/or sensing functions and interfaces to other such entities within an automation system

[IEC 61850-7-2, 3.3]

NOTE Devices alone do not perform energy transport functions.

3.7
logical device
entity that represents a set of typical substation functions

[IEC 61850-7-2, 3.6]

3.8
logical node
entity that represents a typical substation function

[IEC 61850-7-2, 3.7]

3.9
physical device
entity that represents the physical parts of a device (hardware and operating system, etc.)

[IEC 61850-7-2, 3.8]

NOTE Physical devices host logical devices.

3.10
Application and Transport Profiles (A-Profile and T-Profile)
set of protocols for a specific purpose

3.11
attribute
named element of data which has a specific type

3.12
data
meaningful structured information of applications located in an automation device which can be read or written.

NOTE This definition is in accordance with the Data definition of IEC 61850-7-2. The MMS use of Data refers to data types and potential instantiations of MMS variables. The reader of this part of IEC 61850 shall be careful of the context in which “data” is being used.

3.13
ISO/IEC 8802-3
communication technology according to ISO/IEC 8802-3

3.14
server
entity that provides services to clients or issues unsolicited messages

4 Abbreviations

A	Application
ACSE	Association Control Service Element
ACSI	Abstract Communication Service Interface
APPID or AppID	Application Identification
BRBC	Buffered Report Control Block
CBB	Conformance Building Block
CDC	Common Data class
CL	Connectionless
Client-CR	Client Conformance Requirement
CO	Connection Oriented
DNA	Dynamic Namespace Attribute
F/S	Functional Standard.
FC	Functional Constraint
FCD	Functionally Constrained Data
GPS	Global Positioning System
GOOSE	Generic Object Oriented Substation Event
GSE	Generic Substation Event
GSSE	Generic Substation Status Event
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISO	International Standardization Organization
LAN	Local Area Network
LCB	Log Control Block
LD	Logical Device
LLC	Logical Link Control
LN	Logical Node
LPDU	Link Protocol Data Unit
M or m	Mandatory. Indicates that the service, parameter, or attribute shall be supported within an implementation
M= or m=	Mandatory information that shall be equal the original information supplied in the request
MAC	Media Access Control
MJD	Modified Julian Day
MMS	Manufacturing Message Specification (ISO 9506)
o	Optional: Indicates that the service, parameter, or attribute may be supported within an implementation
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement

PIXIT	Protocol Implementation Extra Information
r	readable
RFC	Request for Comments
S	Server specified parameter
SAP	Service Access Point. The Service Access Point represents a logical construct through which a peer selects a communication protocol or access to an applications. The selection of the entire seven layers of SAPs represents a communication profile
SBO	Select Before Operate
SCL	substation automation System Configuration Language (IEC 61850-6)
SNTP	Simple Network Time Protocol
SCSM	Specific Communication Service Mapping
Server-CR	Server Conformance Requirement
SG	Setting Group
SNTP	Simple Network Time Protocol
SV	Sampled Values
Sync	Synchronization
T	Transport or Timestamp
TAI	Temps Atomique International
TCP	Transmission Control Protocol
TPID	Priority Tagging Identification (for IEEE 802.1Q networks) = 0x8100
UCA	Utility Communication Architecture
u or U	User-specific: Indicates that the service, parameter, or attribute can be defined by an implementation
u= or U=	User-specific information that shall be equal the original information supplied in the request
UTC	coordinated universal time
VARSPEC	Variable Specification
V-GET	Virtual Get Function. Defined in ISO 9506-1
VID	VLAN Identificator
VLAN	Virtual LAN
VMD	Virtual Manufacturing Device
V-PUT	Virtual Put Function. Defined in ISO 9506-1
w	writeable

5 Overview

5.1 General

The purpose of IEC 61850-8-1 is to provide detailed instructions/specification as to the mechanisms and rules required to implement the services, objects, and algorithms specified in IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4 while making use of ISO 9506 (all parts) (Manufacturing Message Specification), SNTP, and other application protocols (see Figure 1). This Clause is intended to provide an overview of the methodology to provide the mapping from IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4 into MMS.

The communication requirements for substations (listed in IEC 61850-5) are met by the profiles shown in Figure 1.

The message types and performance classes specified in IEC 61850-5 are mapped as shown in Figure 1:

Type 1 (Fast messages)

Type 1A (Trip)

Type 2 (Medium speed messages)

Type 3 (Low speed messages)

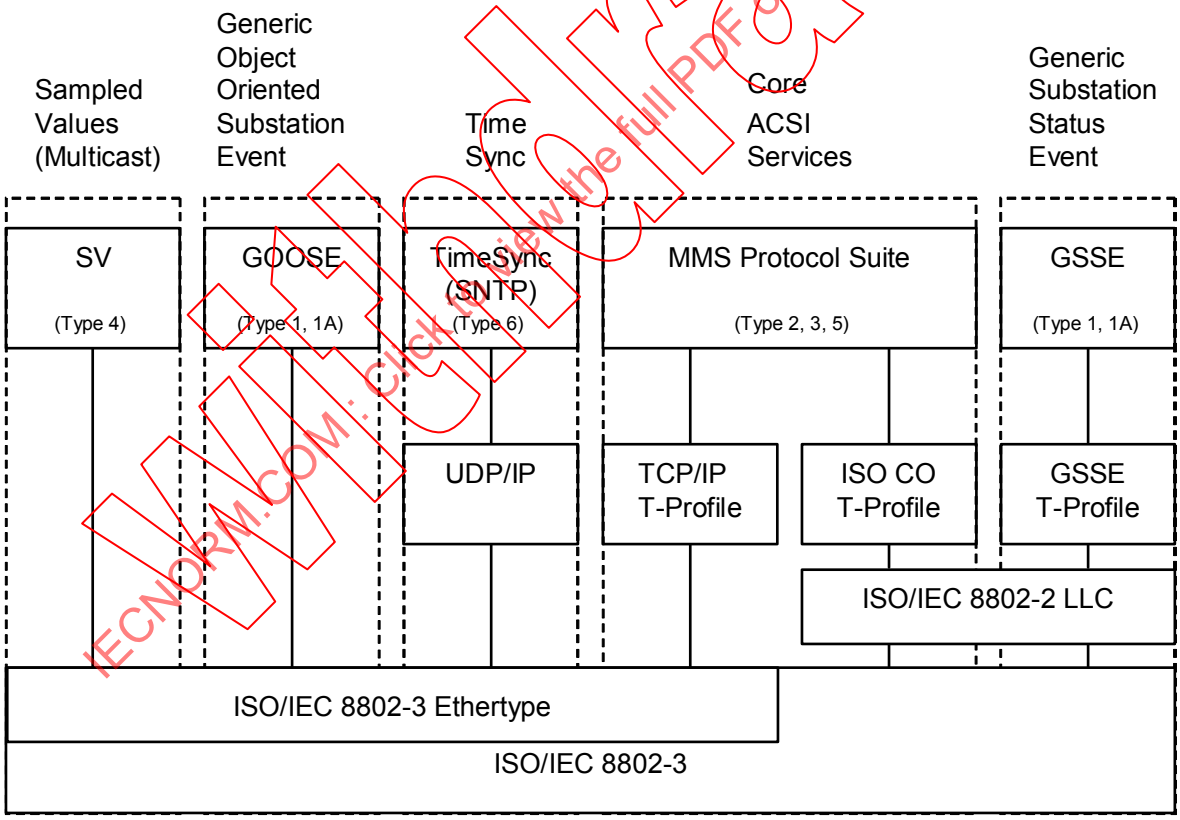
Type 4 (Raw data messages)

Type 5 (File transfer functions)

Type 6 (Time synchronisation messages)

Messages of Type 1 and Type 1A are mapped to distinct Ethertypes to optimise decoding of received messages.

Messages of Type 2, 3, and 5 require message oriented services. The MMS standard provides exactly the information modelling methods and services required by the ACSI.



(Type x) is the Message type and performance class defined in IEC 61850-5

Figure 1 – Overview of functionality and profiles

Further details pertaining to the use and actual specification of each profile may be found in Clause 6.

5.2 IEC 61850 server object

An instance of an IEC 61850-7-2 Server class is mapped one-to-one to an MMS Virtual Manufacturing Device (VMD) object. The MMS VMD is that portion of an application task that makes available (for control, monitoring, or both) a set of resources and functionality associated with one or more devices. Each VMD is assigned one or more communication addresses that create Service Access Points (SAPs) through which MMS services can be exchanged. The format of the address is determined by the communication profile that is being used. It is through MMS services that MMS objects can be manipulated. Within this mapping to MMS, a VMD represents the capabilities provided by an IEC 61850-7-2 server on the network.

The server also is specified to contain other objects. These objects are:

– files

– client associations

5.3 MMS communication profiles

The VMD's service address format is determined through the communication profile being used. However, ISO has recognized the existence of Application Profiles (A-Profiles) and Transport Profiles (T-Profiles). A-Profiles represent the protocols and agreements in regards to the upper 3 layers of the OSI Reference Model (ISO/IEC 7498-1). The T-Profiles represent the protocols and agreements in regards to the lower 4 layers of the OSI reference model.

For the purpose of this document, there are 2 A-Profiles: Connection Oriented OSI and Connectionless OSI. Additionally, there are 3 T-Profiles: Connection Oriented TCP, Connection Oriented OSI, and Connectionless OSI. The ConnectionOriented A-Profile shall only be used over the connection oriented T-Profiles.

5.4 Non-MMS communication profiles

There are several services, specified in IEC 61850-7-2, that have been intentionally mapped to application protocols and communication profiles that do not make use of ISO 9506 as the application layer protocol. Other communication profiles are used to accomplish time synchronization, via IETF Simple Network Time Protocol (SNTP), sampled values, and GOOSE/GSSE messages.

5.5 MMS objects being used

ISO 9506 (MMS) specifies several MMS objects that could be used as part of this SCSM. However, all objects are not required in order to perform the mapping of IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4. Table 1 shows the MMS objects and services that shall be used within this SCSM.

Table 1 – MMS objects and services in use within this SCSM

MMS OBJECT	IEC 61850 OBJECT	MMS SERVICES IN USE
Application Process VMD	Server	Initiate Conclude Abort Reject Cancel Identify[1]
Named Variable Objects	Logical Nodes and Data	Read Write InformationReport GetVariableAccessAttribute GetNameList
Named Variable List Objects	Data Sets	GetNamedVariableListAttributes GetNameList DefineNamedVariableList DeleteNamedVariableList GetNameList Read Write InformationReport
Journal Objects	Logs	ReadJournal InitializeJournal GetNameList
Domain Objects	Logical Devices	GetNameList GetDomainAttributes StoreDomainContents
Files	Files	FileOpen FileRead ObtainFile FileClose FileDirectory FileDelete
[1] Required by ISO 9506 for conformance.		

6 Communication stack

6.1 Overview of the protocol usage

The OSI Reference Model (ISO/IEC 7498-1) details a model based upon the concept of layering of communication functionality. The model details 7 layers and details the functional requirements, for each layer, in order to achieve a robust communication system. The model does not specify the protocols to be used to achieve the functionality, nor does it restrict the solution to be a single set of protocols.

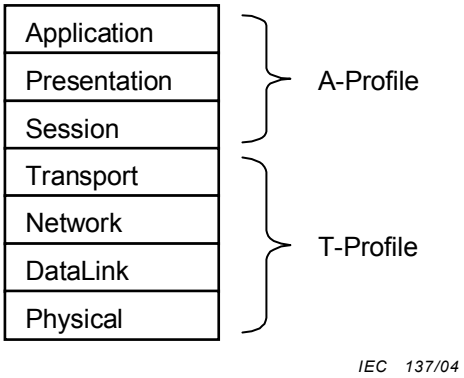


Figure 2 – OSI reference model and profiles

The use of ISO Application (A-Profile) and Transport (T-Profile) Profiles (see Figure 2) describes the various stack profiles. An ISO A-Profile is the set of specifications and agreements relating to the upper 3 layers of the ISO OSI reference model (e.g. the layers of application, presentation, and session). An ISO T-Profile is the set of specifications and agreements relating to the lower 4 layers of the ISO OSI reference model (e.g. the layers of transport, network, DataLink and physical).

Various combinations of A-Profiles and T-Profiles can be combined in order to allow certain types of information/services to be exchanged. The services, as specified in IEC 61850-7-2, are mapped into 4 different combinations of A- and T- profiles. The four different combinations are used for:

– Client/server services (see Figure 1 Core ACSI Services). See 6.2 for further details.
– GOOSE/GSE Management Services. See 6.3 for further details.
– GSSE Services. See 6.4 for further details.
– Time Sync. See 6.5 for further details.

6.2 Client/server services and communication profiles

6.2.1 Client/server services

The client/server communication profile shall be used for any implementation claiming conformance to this standard and declaring support for one of the IEC 61850-7-2 services shown in Table 2.

Table 2 – Services requiring client/server Communication Profile

IEC 61850-7-2 model	IEC 61850-7-2 service
Server	GetServerDirectory
Association	Associate
	Abort
	Release
Logical Device	GetLogicalDeviceDirectory
Logical Node	GetLogicalNodeDirectory
	GetAllDataValues
Data	GetDataValues
	SetDataValues
	GetDataDirectory
	GetDataDefinition
Data Set	GetDataSetValues
	SetDataSetValues
	CreateDataSet
	DeleteDataSet
	GetDataSetDirectory
Substitution	GetDataValues
	SetDataValues
Setting Group Control Block	SelectActiveSG
	SelectEditSG
	SetSGValues
	ConfirmEditSGValues
	GetSGValues
	GetSGCBValues

IEC 61850-7-2 Model	IEC 61850-7-2 Service
Report Control Block	Report
	GetBRCBValues
	SetBRCBValues
	GetURCBValues
	SetURCBValues
LOG Control Block	GetLCBValues
	SetLCBValues
	GetLogStatusValues
	QueryLogByTime
	QueryLogAfter
GOOSE	GetGoCBValues
	SetGoCBValues
GSSE	GetGsCBValues
	SetGsCBValues
Control	Select
	SelectWithValue
	Cancel
	Operate
	CommandTermination
	TimeActivatedOperate
FILE transfer	GetFile
	SetFile
	DeleteFile
	GetFileAttributeValues

6.2.2 A-Profile

Services and protocols of the A-Profile client/server shall be as shown in Table 3.

Table 3 – Service and protocols for client/server communication A-Profile

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
Application	Manufacturing Message Specification	ISO 9506-1:2003	ISO 9506-2:2003	m
	Association Control Service Element	ISO/IEC 8649:1996	ISO/IEC 8650:1996	m
Presentation	Connection Oriented Presentation	ISO/IEC 8822:1994	ISO/IEC 8823-1:1994	m
	Abstract Syntax	ISO/IEC 8824-1:1999	ISO/IEC 8825-1	m
Session	Connection Oriented Session	ISO/IEC 8326:1996	ISO/IEC 8327-1:1997	m

There are 2 T-Profiles that may be used by the client/server A-Profile: TCP/IP or OSI. An implementation that claims conformance to this standard shall implement the TCP/IP profile as a minimum.

Implementation agreements

This A-Profile shall conform to the agreements specified in ISO/ISP 14226-1, ISO/ISP 14226-2, ISO/ISP 14226-3, ISO/IEC ISP 11188-1and ISO/IEC ISP 11188-3.

6.2.3 TCP/IP T-Profile

Table 4 shows services and protocols of the TCP/IP T-Profile client/server.

Table 4 – Service and protocols for client/server TCP/IP T-Profile

OSI Model Layer	Specification			m/o
	Name	Service specification	Protocol specification	
Transport	ISO Transport on top of TCP	RFC 1006		m
	Internet Control Message Protocol (ICMP)	RFC 792		m
	Transmission Control Protocol (TCP)	RFC 793		m
Network	Internet Protocol	RFC 791		m
	An Ethernet Address Resolution Protocol (ARP)	RFC 826		m
DataLink	Standard for the transmission of IP datagrams over Ethernet networks	RFC 894		m
	Carrier Sense Multiple Access with collision detection (CSMA/CD)	ISO/IEC 8802-3:2001		m
Physical (option 1)	10Base-T/100Base-T	ISO/IEC 8802-3:2001		c1
	Interface connector and contact assignments for ISDN Basic Access Interface. [a]	ISO/IEC 8877:1992		
Physical (option 2)	Fibre optic transmission system 100Base-FX	ISO/IEC 8802-3:2001		c1
	Basic Optical Fibre Connector. [b]	IEC 60874-10-1, IEC 60874-10-2 and IEC 60874-10-3		

[a] This is the specification for the 10BaseT connector.

[b] This is the specification for the ST connector.

c1 It is recommended to implement at least one of the two Physical interfaces. Additional or future technologies may be used.

Implementation agreements

TCP_KEEPALIVE

The TCP_KEEPALIVE function according to RFC 793 shall be implemented. The value of the TCP KEEPALIVE shall be configurable. The range of allowed values shall be specified in the PIXIT declaration of the implementation. The value of the TCP shall be specified in seconds.

NOTE It is recommended that the minimum-maximum value of the allowable range should be no greater than 20 s. It is also recommended that the TCP_KEEPALIVE be configurable to a minimum of 1 s. This results in a recommended range of 1 to 20.

Transport selector

The Transport Selector size shall be limited to a maximum of 4 octets.

6.2.4 OSI T-Profile

Table 5 shows services and protocols of the OSI T-Profile client/server.

Table 5 – Service and protocols for client/server OSI T-Profile

OSI Model Layer	Specification			m/o
	Name	Service specification	Protocol specification	
Transport	Connection Oriented Transport	ISO/IEC 8072:1996	ISO/IEC 8073:1997	m
Network	Connectionless Network	ISO/IEC 8348:2002	ISO/IEC 8473-1:1998 ISO/IEC 8473-2:1996	m
	End System to Intermediate System (ES/IS)	ISO/IEC 9542:1988		m
DataLink	Logical Link Control	ISO/IEC 8802-2:1998		m
	Carrier Sense Multiple Access with collision detection (CSMA/CD)	ISO/IEC 8802-3:2001		m
Physical (option 1)	10Base-T/100Base-T	ISO/IEC 8802-3:2001		c1
	Interface connector and contact assignments for ISDN Basic Access Interface. [a]	ISO/IEC 8877:1992		
Physical (option 2)	Fibre optic transmission system 100Base-FX	ISO/IEC 8802-3:2001		c1
	Basic Optical Fibre Connector. [b]	IEC 60874-10-1, IEC 60874-10-2 and IEC 60874-10-3		

[a] This is the specification for the 10BaseT connector.

[b] This is the specification for the ST connector.

c1 It is recommended to implement at least one of the two Physical interfaces. Additional or future technologies may be used.

Implementation agreements

The OSI T-Profile shall conform to the agreements as specified in ISO/IEC ISP 10608-1 and ISO/IEC ISP 10608-2.

Naming and addressing

The naming and addressing, of this profile, shall be as specified in ISO/IEC 7498-3. The addressing shall be further constrained to support, at a minimum, the ISO DCC (39 hexadecimal) and Local (49 hexadecimal) AFI values found in ISO/IEC 7498-3.

Transport selector

The Transport Selector size shall be limited to a maximum of 4 octets.

LLC type

This profile shall use Class 1 LLC as specified in ISO/IEC 8802-2.

6.3 GSE management and GOOSE services communication profiles

6.3.1 GSE mapping overview

The GSE communication profile shall be used for any implementation claiming conformance to this standard and declaring support for one of the IEC 61850-7-2 services shown in Table 6.

Table 6 – Services requiring GSE Management and GOOSE communication profile

Model	IEC 61850-7-2 service
Generic Substation Event	GetReference GetGOOSEElementNumber SendGOOSEMessage

6.3.2 A-Profile

Table 7 shows services and protocols of the A-Profile GSE Management and GOOSE services.

Table 7 – Service and protocols for GSE Management and GOOSE communication A-Profile

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
Application	GSE/GOOSE protocol	See Annex A		m
Presentation	Abstract Syntax	NULL		m
Session				

The presentation layer encoding shall be Basic Encoding Rules as defined in ISO/IEC 8824-1 and ISO/IEC 8825-1 to encode the grammar referenced.

6.3.3 T-Profile

The T-Profile for GSE and GOOSE Services shall be as shown in Table 8.

Table 8 – GOOSE/GSE T-Profile

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
Transport				
Network				
DataLink	Priority Tagging/ VLAN	IEEE 802.1Q		m
	Carrier Sense Multiple Access with collision detection (CSMA/CD).	ISO/IEC 8802-3:2001		m
Physical (option 1)	10Base-T/100Base-T	ISO/IEC 8802-3:2001		c1
	Interface connector and contact assignments for ISDN Basic Access Interface. [a]	ISO/IEC 8877:1992		
Physical (option 2)	Fibre optic transmission system 100Base-FX	ISO/IEC 8802-3:2001		c1
	Basic Optical Fibre Connector. [b]	IEC 60874-10-1, IEC 60874-10-2 and IEC 60874-10-3		

[a] This is the specification for the 10BaseT connector.

[b] This is the specification for the ST connector.

c1 It is recommended to implement at least one of the two physical interfaces. Additional or future technologies may be used.

Implementation agreements

T-DATA service

The T-DATA service shall be mapped directly to the M_UNITDATA service of the DataLink.

Link layer: MAC – sublayer

See Annex C for definitions.

The T-DATA destination address for a GOOSE message shall contain a multicast MAC address. The T-DATA source address for a GOOSE message shall contain a unicast MAC address.

The T-DATA destination address for a GSE management messages shall contain a unicast MAC address. The T-DATA source address for a GSE Management messages shall contain a unicast MAC address.

Link Layer: Priority tagging/Virtual LAN

See Annex C.

6.4 GSSE Service and communication profile

6.4.1 GSSE mapping overview

This communication profile shall be used for any implementation claiming conformance to this standard and declaring support for the IEC 61850-7-2 service (shown in Table 9).

Table 9 – Service requiring GSSE communication profile

Model	IEC 61850-7-2 Service	Comment
Generic substation event model	SendGSSEMessage	See 18.2.2.5

6.4.2 A-Profile

Table 10 shows services and protocols that shall form the A-Profile GSSE.

Table 10 – Service and protocols for GSSE communication A-Profile

OSI Model Layer	Specification			m/o
	Name	Service Specification	Protocol Specification	
Application	Manufacturing message specification	ISO 9506-1:2003	ISO 9506-2:2003	m
	Association control service element	ISO/IEC 8649:1996	ISO/IEC 10035-1:1995	m
Presentation	Connectionless presentation	ISO/IEC 8822:1994	ISO/IEC 9576-1:1995	m
	Abstract syntax	ISO/IEC 8824-1:1999	ISO/IEC 8825-1	m
Session	Connectionless session	ISO/IEC 8326:1996	ISO/IEC 9548-1:1996	m

Implementation agreements

This A-Profile shall conform to the agreements specified in ISO/ISP 14226-1, ISO/ISP 14226-2, ISO/ISP 14226-3, ISO/IEC ISP 11188-1and ISO/IEC ISP 11188-3.

6.4.3 T-Profile

The T-Profile for GSSE Services shall be as shown in Table 11.

Table 11 – GSSE management T-Profile

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
Transport	Connectionless transport	ISO/IEC 8072:1996	ISO/IEC 8602:1995	m
Network	Connectionless network	ISO/IEC 8348:2002	ISO/IEC 8473-1:1998 ISO/IEC 8473-2:1996	m
	End System to Intermediate System (ES/IS)	ISO/IEC 9542:1988		m
DataLink	Logical Link Control	ISO/IEC 8802-2:1998		m
	Carrier Sense Multiple Access with collision detection (CSMA/CD)	ISO/IEC 8802-3:2001		m
Physical (option 1)	10Base-T/100Base-T	ISO/IEC 8802-3:2001		c1
	Interface connector and contact assignments for ISDN Basic Access Interface. [a]	ISO/IEC 8877:1992		
Physical (option 2)	Fibre optic transmission system 100Base-FX	ISO/IEC 8802-3:2001		c1
	Basic Optical Fibre Connector. [b]	IEC 60874-10-1, IEC 60874-10-2 and IEC 60874-10-3		

[a] This is the specification for the 10BaseT connector.

[b] This is the specification for the ST connector.

c1 It is recommended to implement at least one of the two physical interfaces. Additional or future technologies may be used.

The destination T-DATA address for a GSSE message shall contain a multicast MAC address. The source T-DATA address for a GSSE message shall contain a unicast MAC address.

Implementation agreements

The OSI T-Profile shall conform to the agreements as specified in ISO/IEC ISP 10608-1 and ISO/IEC ISP 10608-2.

Naming and addressing

The naming and addressing of this profile shall be as specified in ISO/IEC 7498-3. The addressing shall be further constrained to support, at a minimum, the ISO DCC (39 hexadecimal) and Local (49 hexadecimal) AFI values as defined in ISO/IEC 7498-3.

LLC type

This profile shall use Class 1 LLC as specified in ISO/IEC 8802-2.

6.5 Time sync

This communication profile shall be used for any implementation claiming conformance to this standard and declaring support for objects containing an attribute of type TIMESTAMP.

6.5.1 A-Profile

The A-Profile for Time Sync Services shall be as shown in Table 12.

Table 12 – Time sync A-Profile

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
Application	Simple Network Time Protocol	RFC 2030		m
Presentation				
Session				

Implementation agreements

This A-Profile shall conform to the agreements specified in RFC 1122 and RFC 1123.

Mode 3, 4 of SNTP time synchronization shall be supported.

6.5.2 T-Profile

The T-Profile for Time Sync Services shall be as shown in Table 13.

Table 13 – Time sync T-Profile

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
Transport	Internet Control Message Protocol (ICMP)	RFC 792		m
	User Datagram Protocol (UDP)	RFC 768		m
Network	Internet Protocol	RFC 791		m
	An Ethernet Address Resolution Protocol (ARP)	RFC 826		m
	Broadcasting Internet Datagrams	RFC 922 RFC 950 RFC 919		m
	Host Extensions for IP Multicasting	RFC 1112		m
DataLink	Standard for the transmission of IP datagrams over Ethernet networks	RFC 894		m
	Carrier Sense Multiple Access with collision detection (CSMA/CD)	ISO/IEC 8802-3:2001		m
Physical (option 1)	10Base-T/100Base-T	ISO/IEC 8802-3:2001		c1
	Interface connector and contact assignments for ISDN Basic Access Interface. [a]	ISO/IEC 8877:1992		
Physical (option 2)	Fibre optic transmission system 100Base-FX	ISO/IEC 8802-3:2001		c1
	Basic Optical Fibre Connector. [b]	IEC 60874-10-1, IEC 60874-10-2 and IEC 60874-10-3		

OSI model layer	Specification			m/o
	Name	Service specification	Protocol specification	
[a] This is the specification for the 10BaseT connector.				
[b] This is the specification for the ST connector.				
c1 – It is recommended to implement at least one of the two Physical interfaces.				

7 Objects of IEC 61850

7.1 Server

For details, see 5.2.

7.2 Logical device (LD)

An instance of a IEC 61850-7-2 logical device class shall be represented by an MMS domain object. The IEC 61850-7-2 server object shall contain one or more MMS domain objects. An MMS domain represents a collection of information associated with a specific name. The domain object provides both an unambiguous name space for its subordinate objects (they need only be uniquely named within the scope of the domain). Within this mapping to MMS, the domain is used to represent the collection of objects and services that constitute a logical device.

Each physical device shall have one domain that represents the physical resources of the MMS VMD. This domain shall contain at least a LLN0 and a LPHD logical node.

Example IEC 61850-7-1 shows an example of a physical device that proxies other physical devices. This example can be extended to a single physical device with slotted CPU capability. Each CPU, and its associated Logical Devices, would have their own LPHD information. The entire box needs a set of independent LPHD and LLNO.

7.3 Logical node (LN)

7.3.1 General

The construction of the contents of a logical node, that need mapping, are defined in IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4.

Each instance of a IEC 61850 Logical node maps to a single MMS NamedVariable. The MMS NamedVariable name is a local issue, but shall be named in accordance with the naming conventions set forth in IEC 61850-7-2, IEC 61850-7-3, and IEC 61850-7-4.

The MMS NamedVariable shall have a hierarchical MMS complex MMS type description. The general hierarchy of the MMS TypeDescription consists of multiple levels of components. The algorithm for the creation of the TypeDescription is specified in Equation 1.

For each functional constraint (c) found in Figure 3[2]

    For each DATA (d) in the LN

        If the FCD generated from d,c is not empty, then add a component of ComponentName (d) of the ComponentType determined by the FCD to structure (s).

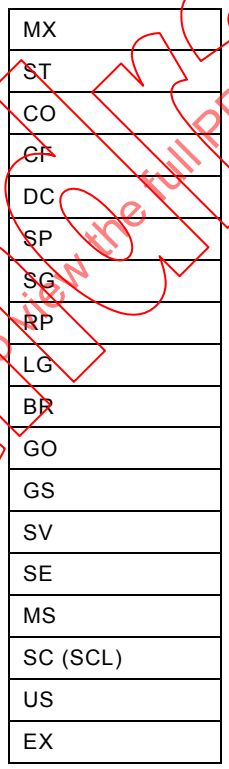
    End For

If the structure (s) is not empty then add a component of ComponentName (c) of the ComponentType (s) to the TypeDescription being generated.

End For

Equation 1: Algorithm for logical node mapping

The order of the resulted components is recommended to be as shown in Figure 3.



IEC 138/04

Figure 3 – Recommended ordered list of functional constraints

NOTE FCs are defined as follows: RP – unbuffered report control blocks; LG – log control blocks; BR – buffered report control blocks; GO – GOOSE control blocks; GS – GSSE control blocks; SV – substituted values; SE- Setting group editing; MS – Multicast Sampled Values control block (from IEC 61850-9-2); US – Unicast Sampled Values control block (from IEC 61850-9-1); and EX – extension.

If there is no DATA (d) that instantiates a specific functional constraint, that functional constraint shall not appear as part of the NamedVariable TypeDescription.

---

2 The recommended ordering provides compatibility with existing UCA 2.0 implementations.

Within a MMS component, representing a functional constraint, the order of the MMS components is determined by the order of the names of the compatible data classes (see IEC 61850-7-4) whose data attributes have the specific functional constraint.

Within a MMS component, representing IEC 61850-7-4 data attributes, the order of the MMS components is determined by the order of the names of the common data classes (specified in IEC 61850-7-3).

Common data classes, which have a single attribute, shall be mapped to a MMS primitive data type, unless otherwise specified. The component name shall be the attribute name from IEC 61850-7-3 unless otherwise specified.

Custom or proprietary extensions to data or data attributes shall be added to the end of the MMS TypeDescription structures. These components shall be named according to the data or data attribute names in the order given by the extended name space document.

This algorithm and mapping produces a MMS NamedVariable whose components are accessible through the use of MMS variable specification of an alternate access type. Additionally, there shall be a mapping to a set of flattened MMS named variables. The names of the flattened MMS named variables shall be created through the concatenation of the MMS named variable component names separated by "$". The nesting of the concatenation shall be constrained by the maximum MMS NamedVariable identifier size.

These two methods of creating a MMS variable specification shall be referred to as a 8-1 VARSPEC.

7.3.2 Mapping of LNReference to VariableAccessSpecifications

An ACSI LNRef may be mapped to a MMS VariableAccessSpecification, when appropriate. The VariableSpecification of such a mapping shall be of type name (e.g. an MMS ObjectName). The scope of the ObjectName is determined by the ACSI LNReference parameter. If a LogicalDevice name is present within the LNReference, the scope of the MMS request shall be Domain-Specific. If an "@" is present, the scope shall be AA-Specific. If neither is present, the scope shall be VMD-Specific.

For a domain-specific scoped request, then the name of the ObjectName's DomainID shall be the name of the LogicalDevice specified within the LNRef.

The ObjectName identifier for the MMS NamedVariable shall be the name of the LogicalNode contained within the LNRef.

An alternate specification shall be supported. This specification references the MMS named variable that has been mapped into a NamedVariable substituting the "$" character for the ASCII "." character.

7.3.3 Data

Logical Nodes, according to IEC 61850-7-2, consist of one or more data. The names of data will be based upon the hierarchically named component of the data found within the MMS named variable. Each level of hierarchy will be delimited through the use of a "$" within the MMS named variable that represents the data.

The data of an instance of LOGICAL-NODE shall be decomposed into multiple MMS NamedComponents

Example <LNVariableName>$<FC>$<LNDataName1> (e.g. XCBRSTPos).

7.3.4 Data Attributes (DataAttr)

The logical node data attributes DataAttr map in a similar manner to the Data. However, the attribute name is also included within the hierarchy.

Example <LNVariableName>$<FC>$<LNDataName1>$<AttributeName1>
(e.g. XCBRSTPos$ctlVal).

8 Mapping of IEC 61850-7-2 and IEC 61850-7-3 data attributes

8.1 Mapping of Attributes specified in IEC 61850-7-2

8.1.1 Basic data attribute types

The mapping of basic types of IEC 61850-7-2 shall be as defined in Table 14.

Table 14 – Mapping of ACSI data types

IEC 61850-7-2 type name	MMS data type	MMS value range	Comment
BOOLEAN	Boolean		
INT8	Integer	–128 to 127	
INT16	Integer	–32 768 to 32 767	
INT32	Integer	–2 147 483 648 to 2 147 483 647	
INT128	Integer	–2**127 to (2**127)–1	
INT8U	Unsigned	0 to 255	
INT16U	Unsigned	0 to 65 535	
INT32U	Unsigned	0 to 4 294 967 295	
FLOAT32	Floating-point	Range of values and precision as specified by IEEE 754 single precision floating point	
FLOAT64	Floating-point	Range of values and precision as specified by IEEE 754 double precision floating point	
ENUMERATED	Integer	Ordered set of values, defined where type is used	See 8.1.2.2
CODED ENUM	Bit-string	Ordered set of values, defined where type is used	See 8.1.2.3
OCTET STRING	Octet-string	Max length shall be defined where type is used	See 8.1.2.4
VISIBLE STRING	Visible-string	Max length shall be defined where type is used	See 8.1.2.5
UNICODE STRING	MMS string	Max length shall be defined where type is used	See 8.1.3.9

8.1.2 Additional definitions of basic data type

8.1.2.1 General

For the purposes of this standard, the reference to bitstring shall indicate the use of an MMS bitstring type. According to this definition, Bit(0) is mapped to the most significant bit of the value.

The amount of bits conveyed by a sent variable length bit-string shall always be equal to the maximum length of the defined variable length bit-string at the sender side.

NOTE The attempt to write in an attribute a value that is not supported by the application will lead to a write negative response with a DataAccessError=object-value-invalid (for instance: writing a not supported Enumerated, writing a longer VisibleString/bitString than defined, etc.).

8.1.2.2 ENUMERATED

The IEC 61850-7-2 ENUMERATED shall map to a value represented by a MMS integer value. Values that are 0 or greater shall be reserved for values standardized within IEC 61850. Values that are less than 0 shall be considered private values. The range of allowed values are specified in IEC 61850-7-2 and IEC 61850-7-3. The size of the MMS data type shall be the minimum size required to contain the maximum standardized value.

Enumerated values outside the standardized range of values but within the MMS integer size, shall be assumed to be value extensions and shall not cause a protocol error.

NOTE For IEC 61850 enumerated values, where the actual numeric values are specified, the integer values within the context of IEC 61850-8-1 shall be the same as the numeric values specified.

8.1.2.3 CODED ENUM

The IEC 61850-7-2 CODED ENUM is represented by a bit-string. The size of the bit-string shall be the number of bits required to represent the maximum enumerate value defined in IEC 61850-7-2 and IEC 61850-7-3. The value of a particular bit-string shall be the unsigned integer encoding of the enumerated values in the order specified in IEC 61850-7-2 and IEC 61850-7-3.

For the purposes of IEC 61850-8-1, CODED ENUMs that appear within a PACKED LIST or an array of other CODED ENUMs are treated as special cases.

8.1.2.4 OCTET-STRING

The IEC 61850-7-2 OCTET-STRING shall map to a value represented by a MMS variable length octet-string. The maximum size of the MMS octet-string shall be the size as specified in IEC 61850-7-2 and IEC 61850-7-3.

8.1.2.5 VISIBLE-STRING

The IEC 61850-7-2 VISIBLE-STRING shall map to a value represented by a MMS variable length MMSString. The maximum size of the MMS visible-string shall be the size as specified in IEC 61850-7-2 and IEC 61850-7-3.

The character set, of MMSString, shall be constrained to ISO646String.

8.1.3 Common data types

8.1.3.1 OBJECTNAME

This type never appears within the context of IEC 61850-8-1. Therefore it is not mapped.

8.1.3.2 OBJECTREFERENCE

The IEC 61850-7-2 ObjectReference maps to a variable length MMS visible-string. The maximum size of the visible-string shall be 65 octets. The value is the fully MMS scope qualified name of the MMS object. The value shall be constructed as:

– AA-specific scope objects: @<MMS Object Name>
– Domain specific: <MMS Domain Name>/<MMS Object Name>
– VMD-specific: /<MMS Object Name>

The construction of MMS object names from IEC 61850 names is defined in 7.3.

The allowed character set is defined as the MMS Identifier and the "/" and "@" characters.

8.1.3.3 ServiceError

The ServiceError encoding is specified in the description of the individual services. Default mapping of a SCSI error is ACSI service error "failed-due-to-communications-constraint".

8.1.3.4 EntryID

The ACSI EntryID type shall be mapped to an 8 octet fixed length MMS OCTETSTRING. The contents of the OCTETSTRING are IEC 61850 server specific. It is suggested that the format of the contents be documented as part of the implementation's PIXIT statement.

8.1.3.5 PACKED LIST

A PACKED LIST type shall be mapped to a variable length MMS Bit-string. The minimum size of the bit-string shall be determined by the number of bits required to encode the members of the PACKED LIST. The order of the bits, in the bit-string, shall be that the first member of the PACKED LIST shall be mapped to Bit(0). The other members shall be mapped in consecutive bits in the order specified by IEC 61850-7-2 and IEC 61850-7-3.

Bitstrings shall support at least the number of bits required to represent the maximum enumerated value defined. Bits that are returned in excess of that number of bits may be ignored.

Bit 0 shall be the leftmost (most significant) bit of the first octet. Bit 7 shall be the rightmost (least significant) bit of the first octet. Bit 8 shall be the leftmost (most significant) bit of the second octet. Bit 15 shall be the rightmost (least significant) bit of the second octet. This shall be continued in that way in further octets.

There are special cases that are individually mapped and do not conform to the general rule. These are the timestamp type and quality type. For detailed mapping information, see 8.2 and 8.1.3.6.

8.1.3.6 TIMESTAMP

Extensions to the Data syntax of ISO 9506-2 are given in Annex G.

The quality flags are located in the eighth octet. These flags are defined in Table 15.

Table 15 – Encoding of IEC 61850-7-2 TimeQuality

Bit	Value	Meaning
0		Leap Second Known
1		ClockFailure
2		Clock not synchronized
3-7		Time accuracy of fractions of second
	00000	0 bit of accuracy
	00001	1 bit of accuracy
	00010	2 bits of accuracy
	00011	3 bits of accuracy
	00100 - 11000	Integer value of number of bits of accuracy
	11000- 11110	Invalid
	11111	unspecified

Bit 0 shall be the most significant bit of octet 7. Bit 7 shall be the least significant bit of octet 7.

The octet format shall be (using ASN.1 bstring notation):

'sssssssssssssssssssssssssssssssfffffffffffffffffffffqqqqqqqq'B

8.1.3.7 EntryTime

EntryTime shall be mapped to the MMS DataType of BINARY-TIME. The size of the BINARY-TIME value shall be six (6) octets.

It should be noted that exceptions to this mapping do occur. One such example is the T attribute of the GOOSE message (see 18.1.2.5).

8.1.3.8 TriggerConditions

The values for TriggerConditions encoded as a PACKED_LIST, however Bit(0) is reserved. Therefore, the mapping of TriggerConditions to MMS is a variable length BITSTRING. The minimum size of the BITSTRING shall be six(6) bits. Additional bits are reserved for future versions of the standard. The bits are assigned as follows:

Bit 0 Reserved (reserved to provide backward compatibility with UCA 2.0)
Bit 1 data-change
Bit 2 quality-change
Bit 3 data-update
Bit 4 integrity
Bit 5 general-interrogation

8.1.3.9 UNICODE-STRING

Extensions to the Data syntax of ISO 9506-2 are given in Annex G.

8.2 Mapping of quality common data attribute type specified in IEC 61850-7-3

The definition, found in IEC 61850-7-3 of the Quality common data attribute, specifies a combination of PACKED LISTs, CODED ENUMs, and BOOLEAN values. The mapping of this data attribute shall be as prescribed in this Clause.

An IEC 61850-7-3 value of the type quality, shall be represented by an MMS DataType of BIT-STRING. The BIT-STRING shall be encoded as variable length bit-string. Bits that are not conveyed shall assume a DEFAULT value as specified in this Subclause.

The bit-string bit values shall be as defined in Table 16.

Future versions of the standard may add additional bits. The maximum allowed bit number shall be 15.

Table 16 – Encoding of IEC 61850-7-3 quality

Bit(s)	IEC 61850-7-3		Bit-String	
	Attribute name	Attribute value	Value	Default
0-1	Validity	Good	0 0	0 0
		Invalid	0 1	
		Reserved	1 0	
		Questionable	1 1	
2	Overflow		TRUE	FALSE
3	OutofRange		TRUE	FALSE
4	BadReference		TRUE	FALSE
5	Oscillatory		TRUE	FALSE
6	Failure		TRUE	FALSE
7	OldData		TRUE	FALSE
8	Inconsistent		TRUE	FALSE
9	Inaccurate		TRUE	FALSE
10	Source	Process	0	0
		Substituted	1	
11	Test		TRUE	FALSE
12	OperatorBlocked		TRUE	FALSE

9 Server class model

9.1 Server mapping

The ACSI Server, specified in IEC 61850-7-2, shall be mapped to at least one MMS VMD.

9.2 Server class attributes

9.2.1 ServiceAccessPoint

There are 5 ServiceAccessPoints (e.g. communication interfaces) that may be supported by an IEC 61850-8-1 implementation. The access points/communication interfaces that shall be supported are determined by the service support declared by the implementation.

1) Client/server profile

   Implementations that use the client/server profile shall support at least one Presentation Address that makes use of the TCP/IP T-Profile. More than one PresentationAddress may be supported.

   Additionally, one or more PresentationAddresses that uses the OSI T-Profile may also be supported.

2) GSE management

   Implementations that support the GSE management profile shall support as least one ServiceAccessPoint for the GSE management services. An access point shall be defined as an L-Address. The L-Address shall be the combination of the physical MAC address, ETHERTYPE, and APPID specified by the profile for GSE management (see 6.3.3).

   The destination ServiceAccessPoint shall be another L-Address specifying the same ETHERTYPE.

3) GOOSE services

   Implementations that support the GOOSE profile shall support as least one ServiceAccessPoint for transmitting GOOSE services. The access point shall be defined as an L-Address. The L-Address shall be the combination of the physical MAC address, ETHERTYPE, and APPID specified by the profile for GOOSE (see 6.3.3).

   The destination ServiceAccessPoint shall be another L-Address specifying the same ETHERTYPE. The destination MAC address shall be an address that has the multicast bit set.

4) GSSE services

   Implementations that support the GSSE profile shall support at least ServiceAccessPoint for transmitting GSSE services. The access point shall be a PresentationAddress.

   The destination ServiceAccessPoint shall be another PresentationAddress, as constrained by the profile. The destination ServiceAccessPoint shall be another L-Address specifying the same LLC. The destination MAC address shall be an address that has the multicast bit set.

5) Transmission of sampled values services

   Shall be as specified in IEC 61850-9-1 and IEC 61850-9-2.

9.2.2 Logical devices

Logical devices are mapped to MMS domain objects. For each logical device instance there shall be a single MMS domain. The domain name shall be the name of the logical device instance.

Further mapping information regarding logical devices is found in Clause 11.

9.2.3 Files

Files are mapped to MMS file objects. Further mapping information regarding files is found in Clause 23.

9.2.4 Client associations

See Clause 10.

9.3 Server class service GetServerDirectory

The GetServerDirectory service shall be mapped based upon the ACSI class being requested within the ServerDirectory service. There are 2 ACSI classes allowed: LOGICAL-DEVICE and FILE.

LOGICAL-DEVICE class

The ACSI request maps to an MMS GetNamedList request. The GetNamedList object class shall have a value of domain. The MMS GetNamedList service, if constrained by the negotiated mmsPDU size limitation, may segment the process by returning a subset of file names and a flag (moreFollows) indicating the need to request the next subset. The client shall then post another request, this time specifying the position in the list at which the server should continue with name retrieval. Due to this constraint, the mapping of the ACSI service is actually a sequence of GetNamedList services (until moreFollows=FALSE).

The ACSI ServiceErrors "failed-due-to-server-constraint" shall map to the Reject Code as detailed in Table 17. The ACSI ServiceErrors are mapped to MMS reject reasons. ACSI ServiceError values that do not appear in the table are not mapped.

Table 17 – ServiceError mapping for GetServerDirectory for non-files

ACSI service error	MMS reject	
	Reject reason	**Reject code**
failed-due-to-server-constraint	confirmed-requestPDU	other, unrecognized-service, max-serv-oustanding-exceeded

FILE class

The ACSI request maps to an MMS FileDirectory request. The MMS FileDirectory service, if constrained by the negotiated mmsPDU size limitation, may segment the process by returning a subset of file names and a flag (moreFollows) indicating the need to request the next subset. The Client shall then post another request, this time specifying the position in the list at which the server should continue with name retrieval. Due to this constraint, the mapping of the ACSI service is actually a sequence of FileDirectory services (until moreFollows=FALSE).

The ACSI ServiceErrors shall map to Error Class/Error Code or Reject Code as detailed in Table 18. The ACSI ServiceErrors are mapped to either MMS ServiceErrors or MMS Reject reasons. ACSI ServiceError values that do not appear in the table are not mapped.

If the Filename (for instance MMS FileSpecification) is not present in the FileDirectory.request, then the responding server shall return the Filenames present in the root directory. For servers that have logical devices, 23.1 specifies the root directory. The names of the files returned shall be the filenames of the files present in the LD directory. For servers that have no logical devices (for instance possibly a file server), the root directory shall be a local issue.

Table 18 – ServiceErrors mapping of ACSI GetServerDirectory for files

ACSI service error	MMS ServiceError	
	Error class	**Error code**
parameter-value-inappropriate	file	filename-syntax-error
parameter-value-inconsistent	file	filename-ambiguous
	MMS reject	
	Reject reason	Reject code
failed-due-to-server-constraint	confirmed-requestPDU	other, unrecognized-service, max-serv-oustanding-exceeded

10 Association model

10.1 Association relation to communication profiles

There are two types of application associations specified in IEC 61850-7-2. These are:

– two-party associations;
– multicast associations.

There are several communication profiles specified in this document. An implementation-claiming conformance to any one of the given profiles shall implement the association model required for that profile, as defined in Table 19.

Table 19 – Association model versus communication profiles

Communication profile	ACSI association model(s) supported
Client/server	Two party
GSE Management	Two party
GOOSE	Multicast
GSSE	Multicast
Time Sync	Two party or multicast

10.2 Two party association model for client/server communication profile

10.2.1 Association mapping

The client/server profile shall map the ACSI two party association model to the MMS environment as specified in ISO 9506-1.

NOTE The MMS environment, as specified in ISO 9506-1, is brought into existence through the establishment of a single application-to-application association that is created and maintained via a connection-oriented communication profile. The addressing and procedures for this may be found in ISO 9506-1. However, the MMS environment consists, additionally, of the negotiation of application capabilities through the exchange of the MMS initiate service.

AssociationID

The AssociationID shall be a local issue. However, there shall be a one-to-one correspondence between an AssociationID and an MMS environment, including negotiated parameters.

NOTE Security, authentication is a future work item and is pending the development of a common IEC Technical Committee 57 security mechanism. This mechanism may restrict the visibility of objects within the MMS Environment. These efforts are underway within IEC Technical Committee 57 Working Groups 7 and 15.

10.2.2 Association services

10.2.2.1 Associate

The ACSI associate request service shall map directly to the MMS initiate request service.

The ACSI associate response service shall map directly to the MMS initiate response service.

The ACSI associate response– service shall map to the MMS initiate service result(–).

The ACSI ServiceErrors shall map to Error Class/Error Code as detailed in Table 20. ACSI ServiceError values that do not appear in the table are not mapped.

Table 20 – Associate service error mappings

ACSI service error	MMS Serviceerror		ACSE AARE
	Error class	Error code	Parameter Values
instance-not-available	application-reference	application-unreachable	
parameter-value-inappropriate	application-reference	application-reference-invalid, context-unsupported	
parameter-value-inconsistent	initiate	max-services-outstanding-calling-insufficient max-services-outstanding-called-insufficient	
failed-due-to-communications-constraint	initiate	parameter-CBB-insufficient nesting-level-insufficient	
failed-due-to-server-constraint	initiate	other	Result::=Failure

Any other MMS ServiceErrors shall be mapped to failed-due-to-server-constraint.

10.2.2.2 Abort

The ACSI abort request service shall map directly to the MMS abort request service.

The ACSI Abort Indication service shall map directly to the MMS abort indication. The reason code values shall be as defined in ISO 9506 (all parts).

10.2.2.3 Release

The ACSI release request service shall map directly to the MMS conclude request service.

The ACSI release response+ shall map directly to the MMS conclude response.

The ACSI release response– shall map directly to the MMS conclude error. The ACSI ServiceErrors shall map to Error Class/Error Code as detailed in Table 21. ACSI ServiceError values that do not appear in the table are not mapped.

Table 21 – Release service error mappings

ACSI service error	MMS ServiceError	
	Error class	Error code
instance-in-use	conclude	further-communication-required
failed-due-to-server-constraint	conclude	other

Any other MMS ServiceErrors shall be mapped to failed-due-to-server-constraint.

10.3 Two party association model for GSE management communication profile

Although the GSE Management communication profile does not make use of multicast, the association model shall be implemented consistent with the multicast association model.

10.4 Two party association model for time sync

Although the SNTP protocol does not make use of MMS, it does behave as if it were a two party association model. Please refer to RFC 2030 for the specifics.

10.5 Multicast association model

The association model is specified as part of the various communication profiles.

11 Logical device model

The ACSI request GetLogicalDeviceDirectory maps to an MMS GetNamedList request. The GetNamedList object class shall have a value of NamedVariable within the scope of a particular domain. The MMS GetNamedList service, if constrained by the negotiated mmsPDU size limitation, may segment the process by returning a subset of object names and a flag (moreFollows) indicating the need to request the next subset. The client shall then post another request, this time specifying the position in the list at which the server should continue with name retrieval. Due to this constraint, the mapping of the ACSI service is actually a sequence of GetNamedList services (until moreFollows=FALSE).

The NamedVariable objects returned may contain more objects than solely logical nodes. Therefore, the MMS ObjectName will need to be filtered based upon the naming standards within this document (e.g. a NamedVariable that has no '$' character).

The ACSI Response– maps onto the MMS ServiceError, as specified in Table 17.

12 Logical node model

12.1 Logical node class

An instance of an ACSI LogicalNode shall be mapped to a single MMS NamedVariable. The mapping algorithm shall be as specified in 7.3.

12.2 Logical node class attributes

Data

The ACSI data, associated with an instance of a logical node, shall appear as MMS named components within the NamedVariable's MMS TypeDescription.

DataSets

The ACSI DataSet shall be mapped to a MMS NamedVariableList object. If the DataSet is within a logical node, then the name of the NamedVariableList object shall be constructed by concatenating logical node name and DataSet name separated by a "$" character. A DataSetRef appearing within an IEC 61850-7-2 data object shall be mapped to a MMS variable length VISIBLE-STRING. The value of the VISIBLE-STRING shall be an OBJECT-REFERENCE as specified in 8.1.3.2.

BufferedReportControlBlocks

See 17.1.1.1.

UnbufferedReportControlBlocks

See 17.1.1.2.

LogControlBlocks

See 17.3.2.

SettingGroupControlBlock

See 16.

Log

The mapping of the IEC 61850-7-2 Log class shall be specified in 17.3.3.

GOOSEControlBlock

See 18.1.1.

GSSEControlBlock

See 18.2.1.

MulticastSampledValueControlBlock

MulticastSampledValueControlBlock shall map as per the data mapping rules.

UnicastSampledValueControlBlock

UnicastSampledValueControlBlock shall map as per the data mapping rules.

12.3 Logical node class cervices

12.3.1 GetLogicalNodeDirectory

The GetLogicalNodeDirectory service shall map directly to the GetNamedList MMS service (see Table 22).

Table 22 – GetNamedList classes for GetLogicalNodeDirectory service

ACSI class being requested in GetLogicalNodeDirectory	GetNamedList service constraints
Data	NamedVariable
DataSet	NamedVariableList
BufferedReportControlBlock	NamedVariable
UnbufferedReportControlBlock	NamedVariable
LogControlBlock	NamedVariable
SettingGroupControlBlock	NamedVariable
Log	Journal
GooseControlBlock	NamedVariable
GSSEControlBlock	NamedVariable
MulticastSampledValueControlBlock	NamedVariable
UnicastSampledValueControlBlock	NamedVariable

The ACSI request maps to an MMS GetNamedList request. The GetNamedList object class shall have a value as specified in Table 22. The scope of the request shall be the scope of the LogicalNode (typically within the scope of a particular domain). The MMS GetNamedList service, if constrained by the negotiated mmsPDU size limitation, may segment the process by returning a subset of object names and a flag (moreFollows) indicating the need to request the next subset. The client shall then post another request, this time specifying the position in the list at which the server should continue with name retrieval. Due to this constraint, the mapping of the ACSI service is actually a sequence of GetNamedList services (until moreFollows=FALSE).

The ACSI Response– maps onto the MMS ServiceError as specified in Table 17.

12.3.2 GetAllDataValues

12.3.2.1 Request

The ACSI request shall map to an MMS read request. The mapping of the ACSI LNReference parameter shall be as per 7.3.2.

If the ACSI request contains a functional constraint parameter, the read request Variable AccessSpecification shall specify alternateAccess. The accessSelection of the alternate access specification shall specify component. The value of the component shall be the value of the functional constraint being specified.

NOTE The access to all values of a particular logical node may also be obtained through the use of a single MMS named variable, with no alternate access. The name of the variable would be <LogicalNodeName>.

12.3.2.2 Response+

The ACSI GetAllDataValues response+ maps to a MMS ReadResponse where the AccessResult returns MMS data.

The ACSI GetAllDataValues response+ parameter of DataAttributeReference is not mapped nor supported within this SCSM.

The DataAttributeValue(s) shall be mapped to the MMS AccessResult of the MMS read response. There shall be only 1 AccessResult returned.

12.3.2.3 Response–

The ACSI GetAllDataValues response– shall map to a MMS read response where AccessResult indicates failure. Table 23 defines the mappings.

Table 23 – MMS AccessResult mapping to ASCI ServiceError

ACSI service error	AccessResult Codes (DataAccessError)
instance-not-available	object-non-existent
access-violation	object-access-denied
parameter-value-inconsistent	invalid-address
instance-locked-by-other-client	temporarily-unavailable
type-conflict	type-inconsistent
failed-due-to-server-constraint	hardware-failure

NOTE An out of range access will result in an MMS DataAccessError “object-value-invalid”.

13 Data class model

13.1 Data class

Instances of IEC 61850-7-2 data shall be mapped to a IEC 61850-8-1 VARSPEC as specified in 7.3.1 data class attributes.

Functionally Constrained Data (FCD)

An ACSI FCD is mapped as specified in 7.3.1.

Functionally Constrained Data Attribute (FCDA)

An ACSI FCDA is a special case of the mapping specified in 7.3.1. The differentiation between an FCD and a FCDA is that a FCDA is specified as nesting one level below the FCD. Once mapped to MMS, the FCDA is identical and has the same IEC 61850-8-1 VARSPEC as a data attribute access.

13.2 Data class services

13.2.1 GetDataValues

The ACSI GetDataValues service shall be mapped to the MMS read service. The mapping of the ACSI service parameters shall be as defined in Table 24.

Table 24 – Mapping of GetDataValues service parameters

GetDataValues parameters	MMS service or parameter	Constraint
Request	Read request service	
Reference	variableAccessSpecification	Maps to a 8-1VARSPEC
Response+	Read response service	
DataAttributeValue[1..n]	listOfAccessResult	
Response–	Read response service	
ServiceError	listOfAccessResult	See Table 23

13.2.2 SetDataValues

The ACSI SetDataValues service shall be mapped to the MMS Write service. The mapping of the ACSI service parameters shall be as defined in Table 25.

Table 25 – Mapping of SetDataValues service parameters

SetDataValues service parameters	MMS service or parameter	Constraint
Request	Write request service	
Reference	variableAccessSpecification	Mapped to 8-1VARSPEC
DataAttributeValue[1..n]	listOfData	
Response+	Write response service	
	success	
Response–	Write response service	
ServiceError	failure	See Table 23

13.2.3 GetDataDirectory

The ACSI GetDataDirectory service shall be mapped to the MMS GetVariableAccessAttributes service. The mapping of the ACSI service parameters shall be as defined in Table 26.

Table 26 – Mapping of GetDataDirectory service parameters

GetDataDirectory service parameters	MMS service or parameter	Constraint
Request	GetVariableAccessAttributes request	
DataReference	Name	The name is created from the reference as per 7.3.2
Response+	GetVariableAccessAttributes Response	
DataAttributeName[1..n]	typeDescription	
Response–		
ServiceError	MMS ServiceError	See Table 27

Table 27 – ServiceError Mappings for GetDataDirectory service

ACSI service error	MMS ServiceError	
	Error class	**Error code**
instance-not-available	access	object-non-existent
access-violation	access	object-access-denied
failed-due-to-communications-constraint	Any class	Any error code not mapped by this table
failed-due-to-server-constraint	resource	capability-unknown

13.2.4 GetDataDefinition

This service shall be the same as GetDataDirectory (see 13.2.3).

14 Data set class model

14.1 Data set class

An IEC 61850-7-2 data set shall be mapped to a MMS NamedVariableList.

14.2 Data set attributes

DSName

The IEC 61850-7-2 DataSetName attribute shall be mapped to the MMS variable list name attribute of a named variable list object.

DSRef

The IEC 61850-7-2 DSRef attribute shall be mapped to the ObjectName of an MMS NameVariableList.

DSMemberRef

The list of DSMemberRef shall be a list of ACSI Functionally Constrained Data (FCD) or a Functionally Constrained Data Attribute (FCDA). See 13.2 for the mapping of FCD.

14.3 Data set services

14.3.1 GetDataSetValues

The ACSI GetDataSetValues service shall be mapped to the MMS read service. The mapping of the ACSI service parameters shall be as defined in Table 28.

Table 28 – Mapping of GetDataSetValues service parameters

GetDataSetValues service parameters	MMS service or parameter	Constraint
Request	Read request service	
	specificationWithResult	Shall be TRUE
DataSetReference	variableAccessSpecification	Shall be constrained to variableListName
Response+	Read response service	
DataSetReference		Is not mapped
DataAttributeValue[1..n]	listOfAccessResult	
Response–	Read response service	
ServiceError	listOfAccessResult	See Table 23

14.3.2 SetDataSetValues

The ACSI SetDataSetValues shall be mapped to the MMS Write Service. The mapping of the ACSI service parameters shall be as defined in Table 29.

Table 29 – Mapping of SetDataSetValues service parameters

SetDataSetValues parameters	MMS service or parameter	Constraint
Request	Write request service	
DataSetReference	variableAccessSpecification	Shall be constrained to variableListName
DataAttributeValue[1..n]	listOfData	
Response+	Write response service	
Result	success	
Response–	Write response service	
ServiceError	failure	See Table 23

14.3.3 CreateDataSet

The ACSI CreateDataSet service shall be mapped to the MMS DefineNamedVariableList Service. The mapping of the ACSI service parameters shall be as defined in Table 30 and Table 31.

There are two types of DataSets specified in IEC 61850-7-2. These are persistent and non-persistent. The persistent DataSet shall be mapped to a MMS NamedVariableList whose scope is either VMD-SCOPE or DOMAIN-SPECIFIC SCOPE. The non-persistent DataSet shall be mapped to an ASSOCIATION-SPECIFIC MMS NamedVariableList.

Table 30 – Mapping of CreateDataSet service parameters

CreateDataSet parameters	MMS service or parameter	Constraint
Request	DefineNamedVariableList request service	
DataSetReference	variableListName	
DSMemberRef[1..n]	listOfVariable	
Response+	DefineNamedVariableList response service	
Result		
Response–		
ServiceError	MMS ServiceError	See Table 31

Table 31 – ServiceError mapping for CreateDataSet

ACSI service error	MMS ServiceError	
	Error class	**Error code**
instance-in-use	definition	object-exists
access-violation	access	object-access-unsupported
parameter-value-inconsistent	definition	invalid-address
type-conflict	definition	
failed-due-to-communications-constraint	All classes	any unmapped error codes

14.3.4 DeleteDataSet

The ACSI DeleteDataSet service shall be mapped to the MMS DeleteNamedVariableList service. The mapping of the ACSI service parameters shall be as defined in Table 32 and Table 33.

Table 32 – Mapping of DeleteDataSet service parameters

DeleteDataSet parameters	MMS service or parameter	Constraint
Request	DeleteNamedVariableList request service	
DataSetReference	listOfVariableListName	
Response+	DeleteNamedVariableList response service	
	numberDeleted	
Response–		
ServiceError	MMS ServiceError	See Table 33

Table 33 – ServiceError mapping for DeleteDataSet

ACSI service error	MMS ServiceError	
	Error class	**Error code**
instance-not-available	definition	object-undefined
access-violation	access	object-access-denied
failed-due-to-communications-constraint	Any class	Any unmapped error codes
failed-due-to-server-constraint	access	object-access-unsupported
instance-in-use	service	object-state-conflict
		DeleteVariableList-Error PDU
parameter-value-inappropriate		DeleteVariableList-Error

14.3.5 GetDataSetDirectory

The ACSI GetDataSetDirectory service shall be mapped to the MMS GetNamedVariableList Attributes service. The mapping of the ACSI service parameters shall be as defined in Table 34 and Table 35.

Table 34 – Mapping of GetDataSetDirectory service parameters

GetDataSetDirectory parameter	MMS service or parameter	Constraint
Request	GetNamedVariableListAttributes request service	
DataSetReference	variableListName	variableAccessSpecification shall be constrained to a variableListName. variableListName ObjectName shall specify the scope and name of the named variable list.
Response+	GetNamedVariableListAttributes response service	
DSMemberRef[1..n]	listOfVariable	
Response–		
ServiceError	MMS ServiceError	See Table 35

Table 35 – ServiceError mapping for GetDataSetDirectory

ACSI service error	MMS ServiceError	
	Error class	**Error code**
instance-not-available	definition	object-undefined
access-violation	access	object-access-denied
failed-due-to-communications-constraint	Any class	Any unmapped error codes
failed-due-to-server-constraint	access	object-access-unsupported

15 Substitution model

The substitution model maps directly to a specialization of data. No additional mapping is required.

16 Setting group control class model

16.1 Setting group control class definition

An implementation claiming support for this model shall declare, in its PIXIT, the number of setting groups supported by each logical device. This declaration indicates that the PIXIT specified numbered of setting group value sets shall be maintained in a non-volatile fashion (e.g. persistent between power-cycles).

The value of EditSG, upon power-up, shall be 0.

There shall be one Setting Group Control Block (SGCB) within a LogicalDevice.

16.2 Setting group control class services

16.2.1 SelectActiveSG

This service is a specialization of the SetDataValues service (see 13.2.2). The value of ActSG shall be set. The ACSI ServiceError shall map as defined in Table 36.

Table 36 – Mapping of ACSI ServiceError for SelectActiveSG

ACSI service error	AccessResult codes (DataAccessError)
instance-not-available	object-non-existent
access-violation	object-access-denied
parameter-value-inconsistent	invalid-address
instance-locked-by-other-client	temporarily-unavailable
type-conflict	type-inconsistent
failed-due-to-server-constraint	hardware-failure
instance-in-use	temporarily-unavailable

16.2.2 SelectEditSG

This service is a specialization of the SetDataValues service (see 13.2.2). The value of EditSG shall be set. The ACSI ServiceError shall map as defined in Table 36.

16.2.3 SetSGValues

This ACSI service is mapped to a MMS Write of the desired values. Prior to execution of this service, the appropriate edit group needs to be selected through the use of SelectEditSG service.

A value that has been successfully written shall be non-volatile as part of the setting group set.

16.2.4 ConfirmEditSGValues

This service is a specialization of the SetDataValues service (see 13.2.2). The value of CnfEdit shall be set TRUE. The ACSI ServiceError shall map as defined in Table 36.

The effect of when and how the non-volatile storage is updated is a local issue. The methodology should be documented. The value of CnfEdit shall return to FALSE once the storage is completed.

16.2.5 GetSGValues

This ACSI service is mapped to a MMS read of the desired values. Prior to execution of this service, the appropriate edit group and/or active group need to be selected through the use of SelectEditSG or SelectActiveSG service.

16.2.6 GetSGCBValues

This service is a specialization of the GetDataValues service (see 13.2.1).

17 Reporting and logging class model

17.1 Report model

17.1.1 Report control blocks

Instances of the buffered report control block shall be of the FC “BR”. Instances of the unbuffered report control block shall be of the FC “RP”.

17.1.1.1 Buffered report control block

The mapping of the BRCB class definition shall be as a MMS named component within an instance of a logical node. The MMS structure type representing the BRCB shall be of the type defined in Table 37.

Table 37 – Mapping of BRCB to MMS type definition

ACSI component name	MMS named component name	MMS type	Comment
RptID	RptID	See 8.1.2.5	May not be written when RptEna=TRUE
RptEna	RptEna		
DatSet	DatSet	See 8.1.3.2	May not be written when RptEna=TRUE
ConfRev	ConfRev		May not be written
OptFlds	OptFlds	See Table 38	May not be written when RptEna=TRUE
BufTm	BufTm		May not be written when RptEna=TRUE
SqNum	SqNum		May not be written
TrgOps	TrgOps	See 8.1.3.8	May not be written when RptEna=TRUE
IntgPd	IntgPd		May not be written when RptEna=TRUE
GI	GI		
PurgeBuf	PurgeBuf		May not be written when RptEna=TRUE
EntryID	EntryID	See 8.1.3.4	May not be written when RptEna=TRUE
TimeofEntry	TimeofEntry		May not be written

A write of a change of value to DatSet, OptFlds, TrgOps, IntgPd, or PurgeBuf shall execute the PurgeBuf procedure described in IEC 61850-7-2.

NOTE The recommended naming of instances of a BRCB should be a MMS component name of brcb<yy><xx>. "xx" should be omitted for the first instance of a BRCB within a logical node. "xx" shall take on the values of 01 to 99 for any additional instances within a logical node. The MMS type definition of the BR MMS component should be ordered in the ascending value of "xx". Other component names may be used as a local option. If there are pre-defined BRCB's that reference a dataset that have members of only FCD's of a single FC, then "yy" shall be assigned the value of the FC. Otherwise, "yy" shall be omitted.

RptEna
A V-Put of RptEna shall fail if the value of DatSet is NULL.

DatSet
A V-Put of a DataSet that does not exist shall fail unless the value is NULL. The value of NULL shall indicate that there is no DataSet.

OptFlds

OptFlds shall be mapped to an MMS BITSTRING according to Table 38.

Table 38 – Mapping of OptFlds within Bitstring

ACSI value of BRCState	MMS bit position
reserved	0
sequence-number	1
report-time-stamp	2
reason-for-inclusion	3
data-set-name	4
data-reference	5
buffer-overflow	6
entryID	7
conf-revision	8
segmentation	9

The segmentation bit is reserved in order to keep OptFlds and ReportedOptFlds in alignment.

17.1.1.2 Unbuffered report control block

The mapping of the URCB class definition shall be as a MMS named component within an instance of a logical node. The MMS structure type representing the URCB shall be of the type defined in Table 39:

Table 39 – Mapping of URCB to MMS type definition

ACSI component name	MMS named component name	MMS type	Comment
RptID	RptID	See 8.1.2.5	May not be written when RptEna=TRUE
RptEna	RptEna		
Resv	Resv		May not be written when RptEna=TRUE
DatSet	DatSet	See 8.1.3.2	May not be written when RptEna=TRUE
ConfRev	ConfRev		May not be written
OptFlds	OptFlds	See Table 38	May not be written when RptEna=TRUE The values of buffer-overflow and entryID shall be ignored
BufTm	BufTm		May not be written when RptEna=TRUE
SqNum	SqNum		May not be written
TrgOps	TrgOps	See 8.1.3.8	May not be written when RptEna=TRUE
IntgPd	IntgPd		May not be written when RptEna=TRUE
GI	GI		

A transition of RptEna from FALSE to TRUE shall cause the value of SqNum to be set to zero (0).

NOTE The recommended naming of instances of a URCB shall be a MMS Component Name of urcb<yy><xx>. "xx" should be omitted for the first instance of a URCB within a logical node. "xx" should take on the values of 01 to 99 for any additional instances within a logical node. The MMS type definition of the RP MMS component should be ordered in the ascending value of "xx". ". Other component names may be used as a local option. If there are pre-defined URCB's that reference a dataset that have members of only FCD's of a single FC, then "yy" shall be assigned the value of the FC. Otherwise, "yy" shall be omitted.

RptEna
A V-Put of RptEna shall fail if the value of DatSet is NULL.

DatSet
A V-Put of a DataSet that does not exist shall fail unless the value is NULL. The value of NULL shall indicate that there is no DataSet.

17.2 Reporting services

17.2.1 Report service

A report shall be conveyed in an MMS information report that has its variableAccess specification set to indicate a variableListName. This MMS named variable list is instantaneously created, reported, and then deleted.

The variableListName ObjectName shall contain the VMD-SPECIFIC value "RPT". In addition to the variableAccessSpecification, the InformationReport shall consist of a SEQUENCE of AccessResult. The AccessResult values shall occur as described in Table 40.

Table 40 – Order of AccessResults for variableListName report

IEC 61850-7-2 report format parameter name	Condition
RptID	Shall always be present
Reported OptFlds	Shall always be present
SeqNum	Shall be present if OptFlds.sequence-number is TRUE
TimeofEntry	Shall be present if OptFlds.report-time-stamp is TRUE
DatSet	Shall be present if OptFlds.data-set-name is TRUE
BufOvfl	Shall be present if OptFlds.buffer-overflow is TRUE
EntryID	Shall be present if OptFlds.entryID is TRUE
ConfRev	Shall be present if OptFlds.conf-rev is TRUE
SubSeqNum	Shall be present if OptFlds.segmentation is TRUE
MoreSegmentsFollow	Shall be present if OptFlds.segmentation is TRUE
Inclusion-bitstring	Shall be present
data-reference(s)	Shall be present if OptFlds.data-reference is TRUE
value(s)	See value(s)
ReasonCode(s)	Shall be present if OptFlds.reason-for-inclusion is TRUE

AccessResult for RptID

The AccessResult, containing the value of RptID, shall be the same MMS TypeDescription as that of the RptID component of the control block.

If the control block RptID value is NULL, then the MMS data shall contain the object reference specifying the control block which caused the report to be generated.

AccessResult for Reported OptFlds

The AccessResult, containing the value of OptFlds, shall be the same MMS TypeDescription as that of the OptFlds component of the control block. The values for this result are defined in Table 38.

The segmentation bit shall be used when included in a reported. This bit shall be used to indicate the presence or absence of the SubSeqNum and the MoreSegmentsFollow access-result.

If the segmentation bit is TRUE, then the SubSeqNum and MoreSegmentsFollow AccessResults shall be present. If the segmentation bit is FALSE, the SubSeqNum and MoreSegmentsFollow AccessResults shall not be present.

AccessResult for SeqNum

The AccessResult, containing the value of SeqNum, shall be the same MMS TypeDescription as that of the SeqNum component of the control block.

AccessResult for TimeofEntry

The AccessResult, containing the value of TimeofEntry, shall have a MMS TypeDescription of MMS binary-time. The format shall be 6 octets.

AccessResult for DatSet

The AccessResult, containing the value of DatSet, shall have the same MMS TypeDescription as the DatSet component of the control block.

AccessResult for bufOvfl

The AccessResult, containing the value of bufOvfl shall be a MMS Type of BOOLEAN. The value of FALSE indicates that there is no buffer overflow.

AccessResult for EntryID

The AccessResult, containing the value of EntryID, shall be the same MMS TypeDescription as that of the EntryID component of the control block.

AccessResult for ConfRev

The AccessResult, containing the value of ConfRev, shall be the same MMS TypeDescription as that of the ConfRev component of the control block.

AccessResult for SubSeqNum

The value conveyed in the MMS InformationReport listOfAccessResult shall be an MMS Unsigned Integer. The range of values shall be consistent with a 16 bit unsigned integer value.

AccessResult for MoreSegmentsFollow

The AccessResult, containing the value of MoreSegmentsFollow shall be a MMS type of BOOLEAN. The value of TRUE indicates that there are more report sub-sequences required to complete the entire report.

AccessResult for inclusion-bitstring

The AccessResult, containing the value of the inclusion bitstring shall be a MMS type of bitstring. The number of used bits, within the bitstring, shall be equal to the number of members of the NamedVariableList designated as the DataSet. If a bit value is TRUE, then a value for the corresponding NamedVariableList member will be present. If OptFld.data-reference and/or OptFlds.reason-for-inclusion are TRUE, then those AccessResults shall also be present. The order of the bits, in the bitstring, shall be the order of the members of the NamedVariableList.

AccessResult for data-reference(s)

The AccessResult, containing the value of the data-reference shall be a MMS type of VISIBLESTRING. The value of the AccessResult shall be the ObjectReference for the NamedVariableList member whose value is being included. The order of the AccessResult(s) shall be the order of the members of the NamedVariableList.

AccessResult for value(s)

This set of AccessResult shall contain the MMS data corresponding to the members of the DatSet that are being reported. The order of the AccessResult(s) shall be the order of the members of the NamedVariableList.

AccessResult for ReasonCode(s)

The Reason-for-inclusion shall be encoded as multiple AccessResults. Each AccessResult shall be a MMS bit-string data type. The size of the AccessResult shall be the same size as the TrgOps component of the control block. The general-interrogation bit (Bit 5) shall be used to indicate that the reason is due to a general interrogation. This number of AccessResults shall be the same as the number of AccessResults of the value(s) attribute, within the InformationReport. The order of the AccessResult(s) shall be the order of the members of the NamedVariableList.

17.2.2 GetBRCBValues

This service shall be mapped to a MMS read service.

The ACSI FunctionalConstraint value shall be ignored. The MMS read response shall return all values of the BRCB specified by the ACSI BRCBReference. The mapping of the BRCBReference shall be as defined in 7.3.2.

The Response– service error shall be mapped as specified in Table 23.

17.2.3 SetBRCBValues

This service shall be mapped to a MMS write service.

The ACSI FunctionalConstraint value shall be ignored. The MMS write response shall return AccessResult of the BRCB elements specified by the ACSI request. The mapping of the BRCBReference shall be as defined in 7.3.2.

The Response– service error shall be mapped as specified in Table 23.

17.2.4 GetURCBValues

Shall be mapped as per 17.2.2.

17.2.5 SetURCBValues

Shall be mapped as per 17.2.3.

17.3 Log model

17.3.1 General

IEC 61850-7-2 specifies two major components to the Log Model: a control class and the log class itself.

17.3.2 Mapping of log control class

The log control class, as specified in IEC 61850-7-2, maps to structure components defined as part of the log control block (see 17.3.3). Instances of this class shall be of the FC “LG”.

17.3.3 Mapping of log class

The mapping of the log class maps onto two different MMS objects: a Log Control Block (LCB); and an MMS journal.

17.3.3.1 Log control block

The Log Control Block (LCB) is represented as an MMS data definition that combines the attributes from the IEC 61850-7-2 log control class and other attributes from the log class (see Figure 4).

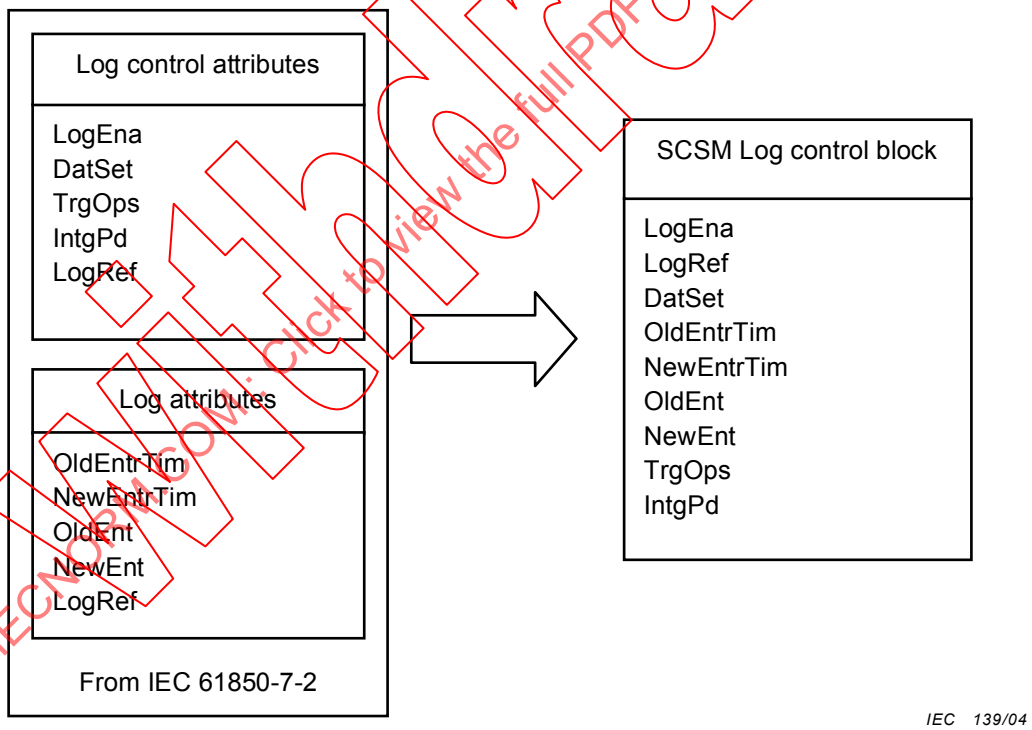


Figure 4 – Relationship of LCB attributes to IEC 61850-7-2 log definitions

The IEC 61850-8-1 MMS TypeDescription of an LCB is a structure with the MMS named components described in Table 41.

Table 41 – Definition of an MMS log control block

IEC 61850-7-2 attribute name	IEC 61850-8-1 component name	MMS TypeDescription	r/w	m/o	Comments
LogEna	LogEna	See 8.1.1	r/w	m	
LogRef	LogRef	See 8.1.2.5	r/w	m o	May not be written if LogEna=TRUE
DatSet	DatSet	See 8.1.2.5	r/w	m o	May not be written if LogEna=TRUE
OldEntrTm	OldEntrTm	See 8.1.3.7	r	m	See [a)]
NewEntrTm	NewEntrTm	See 8.1.3.7	r	m	See [a)]
OldEnt	OldEnt	See 8.1.3.4	r	m	See [a)]
NewEnt	NewEnt	See 8.1.3.4	r	m	See [a)]
OptFlds					Not mapped. This Clause forces the reasonCodes to always appear in the Log.
TrgOps	TrgOps	See 8.1.3.8	r/w	m	May not be written if LogEna=TRUE
IntgPd	IntgPd	See 8.1.1	r/w	o	May not be written if LogEna=TRUE

[a)] These attributes are defined as part of the Log Object in IEC 61850-7-2, but are mapped to additional attributes in the LCB within the context of this standard. The values of these attributes shall reflect the appropriate values for the Log specified by the value of LogRef.

17.3.3.2 MMS TypeDescription definition for LCB MMS structure

17.3.3.2.1 LogEna

The values of LogEna shall be mapped as defined in Table 42.

Table 42 – Mapping of values for LogEna

ACSI value	MMS value of LogEna component
enabled	TRUE
disabled	FALSE

The default value of LogEna is a local issue, however it is suggested that the default value should be FALSE.

The value of LogEna shall be non-volatile.

17.3.3.2.2 LogRef

The maximum size, of a value contained within LogRef, shall be 65 octets. The form of the value shall be that of an ObjectReference. The DEFAULT value shall be an ObjectReference specifying the logical device (e.g. MMS domain) and the actual name of the journal. The name of the default journal shall be “GeneralLog”. Thus the default value of LogRef shall be of the form: <MMS Domain Name>/GeneralLog.

Example For a LogRef within a Logical Device “LD1”, the value of LogRef would be “LD1/GeneralLog”.

A V-Put of a LogRef value that specifies a non-existent MMS journal shall fail.

A NULL value is reserved to indicate that no log/journal has been selected.

NOTE 1 Multiple log controls may reference the same log through having the same value of LogRef.

NOTE 2 It is recommended that implementations claiming conformance to the log model implement at least one LCB as part of LLN0.

17.3.3.2.3 DatSet

The maximum size of a value contained within DatSet shall be 65 octets. The form of the value shall be that of an ObjectReference. The ObjectReference shall specify an existing MMS NamedVariableList. The default value of DatSet shall be determined through its usage within LNData.

A V-Put of a DataSet value that specifies a non-existent MMS NamedVariableList shall fail.

A NULL value is reserved to indicate that no DataSet has been selected.

17.3.3.2.4 OldEntrTim and NewEntrTim

The values, contained within the components of OldEntrTim and NewEntrTim, shall specify the Entry-Time.

If there are no journal entries within the journal, specified by LogRef, the value of these components shall be equal and the binary-time values shall be 0.

17.3.3.2.5 OldEnt and NewEnt

The values, contained within the components of OldEnt and NewEnt, shall be of type EntryID (see 8.1.3.4). These values shall represent the Journal entryIdentifier (see 17.3.3.3.1) values for the oldest and newest entries.

If there are no journal entries within the journal, specified by LogRef, the value of these components shall be equal, and NULL.

17.3.3.3 Mapping of LogEntries

The log class definition, found in IEC 61850-7-2, specifies a sequence of attributes named LogEntries. A LogEntry shall be mapped directly to ISO 9506 (all parts) journal EntryContent. The mapping shall be as defined in Table 43.

Table 43 – Mapping of ACSI LogEntries

IEC 61850-7-2 LogEntry attribute	ISO 9506-1	Type definition	Comment
TimeOfLog	EntryTime	See 8.1.3.7	
EntryID	Entry Identifier	See 8.1.3.4	
EntryData	Information Type Constrained to be EVENT-DATA		
DataRef, value	Journal variable		
ReasonCode	Journal variable		

LogEntries shall be non-volatile.

17.3.3.3.1 ISO 9506 (all parts) entry identifier

The entry identifier shall be as specified in 8.1.3.4. The contents of the value are a local issue.

An entry identifier whose octets all have a value of 0 shall not be allowed. This value is reserved to indicate that the log is empty.

17.3.3.3.2 ISO 9506 information type constraints

ISO 9506 allows the information type to be constrained to ANNOTATION, EVENT-DATA, DATA.

ANNOTATION

The use of the ANNOTATION constraint is a local issue.

EVENT-DATA

The EVENT-DATA information type shall be used to indicate information entered into the MMS Journal due to log control block control/processing. The use of this constraint is not restricted solely to indicating LCB control, but other uses are considered to be a local issue.

The EVENT-DATA Information Type Event Transition Record shall be used for journalling transitions of the LCD LogEna value as prescribed:

– The event condition name value shall be the MMS NamedVariable ObjectName representing the log control block that caused the journal entry to be created.

– The event condition state shall be the state of the LogEna component of the log control block that caused the journal entry to be created.

The value mapping between LogEna values and event condition state values shall be:

– A value of LogEna being FALSE shall be mapped to the event condition state of DISABLED. The transition of the LogEna value from TRUE to FALSE shall cause a journal entry to be created.

– A value of LogEna being TRUE shall be mapped to either the event condition state of IDLE or ACTIVE. The IDLE state is reserved to indicate a transition of the value of LogEna from FALSE to TRUE. Only a journal entry with an event condition state value of ACTIVE shall have a list of journal variables.

For efficiency reasons, a sequence of entryDat(s) may be entered within a single MMS journal entry.

On a power-up or reset the status of the LCB's LogEna should be journaled with a value IDLE.

DATA

DATA shall be used for logging of values from DataSets specified by an LCB.

17.3.3.3.3 ISO 9506 (all parts) information journal variables

MMS journal variables are represented as a sequence of a journal variable tag and data. This document maps both the LogEntry datRef/value and reasonCode to individual journal variables. These journal variables shall appear within a single information type entry and shall be in the order of: the journal variable representing the datRef/value followed by the journal variable representing the reasonCode.

Each individual journal variable is reflected as member of the listofVariables within the journal entry content (see 16.8.1 of ISO 9506-2 (2003)). Each member of the listofVariables consists of a variableTag and a valueSpecification.

The variableTag shall have a minimum-maximum size of 65 octets.

Journal variableTag for DatRef

A journal variable representing journal data relating to DatRef shall have a value of the form ObjectReference.

Journal variableTag for ReasonCode

A journal variable tag representing journal data relating to reasonCode shall have the value of "ReasonCode". The valueSpecification shall have a MMS TypeDescription of bitstring. The minimum size of the bitstring shall be 6 bits.

Example The value of a journal variableTag for a reasonCode relating to a datRef, whose ObjectReference is LD1/MMXU.MX.V, would be: "LD1/MMXU.MX.V|reasonCode".

17.3.4 Mapping of log and log control services

17.3.4.1 Overview

The ACSI log model services shall be mapped to the MMS services as described in Table 44.

Table 44 – General mappings of ACSI log model services

ACSI service	MMS service
GetLCBValues	Read
SetLCBValues	Write
GetLogStatusValues	Read
QueryLogbyTime	ReadJournal
QueryLogAfter	ReadJournal

17.3.4.1.1 GetLCBValues

This ACSI service shall be mapped to the MMS read service. The read service shall execute a V-Get on any of the log control class attributes (see Figure 4).

The Response– shall be mapped as per the ServiceError mapping specified in Table 23.

17.3.4.1.2 SetLCBValues

This ACSI service shall be mapped to the MMS write service. The write service shall execute a V-Put on any of the log control class attributes (see Figure 4). A V-Put, while the component LogEna has a value of TRUE, shall fail for the components of LogRef, DatSet, TrgOps, and IntgPd.

The Response– shall be mapped as per the ServiceError mapping specified in Table 23.

17.3.4.1.3 GetLogStatusValues

This ACSI service shall be mapped to the MMS read service. The read service shall execute a V-Get on any of the log control class attributes (see Figure 4).

The Response– shall be mapped per the ServiceError mapping specified in Table 23.

17.3.4.1.4 QueryLogByTime

17.3.4.1.4.1 Request

The ACSI QueryLogByTime service shall be mapped to the MMS ReadJournal service. The ReadJournal-Request shall contain parameters as described in Table 45.

Table 45 – Mapping of QueryLogByTime request parameters

ACSI QueryLogByTime request		MMS ReadJournal-Request	
Parameter	**Type**	**Parameter**	**MMS definition**
LogReference	ObjectReference	journalName	ObjectName
RangeStartTime	EntryTime	startingTime	TimeOfDay
RangeStopTime	EntryTime	endingTime	TimeOfDay

17.3.4.1.4.2 Response (QueryLogByTime and QueryLogAfter)

The ACSI QueryLogByTime-response service shall be mapped to the MMS ReadJournal-response service. The ReadJournal-response shall contain parameters as described in Table 46.

Table 46 – Mapping of response parameters

ACSI QueryLogByTime response ACSI QueryLogAfter response		MMS ReadJournal-Response	
Parameter	**Type**	**Parameter**	**MMS definition**
ListOfLogEntries	LogEntry	listOfJournalEntry	JournalEntry

The conformance statement for JournalEntry is found in Table 103.

17.3.4.1.4.3 Response– (QueryLogByTime and QueryLogAfter)

The ACSI ServiceErrors shall map to Error Class/Error Code as detailed in Table 47.

Table 47 – ServiceError mappings for Log services

ACSI Service Error	MMS ServiceError	
	Error class	**Error code**
instance-not-available	access	object-non-existent
access-violation	access	object-access-denied
failed-due-to-server-constraint	all others	all others

17.3.4.1.5 QueryLogAfter

17.3.4.1.5.1 Request

The ACSI QueryLogAfter service shall be mapped to the MMS ReadJournal service. The ReadJournal-Request shall contain parameters as described in Table 48.

Table 48 – Mapping of QueryLogAfter request parameters

ACSI QueryLogAfter Request		MMS ReadJournal-Request	
Parameter	**Type**	**Parameter**	**MMS definition**
LogReference	ObjectReference	journalName	ObjectName
entryToStartAfter	EntryTime	timeSpecification	TimeOfDay
Entry	EntryID	entrySpecification	OCTET STRING

17.3.4.1.5.2 Response

The ACSI QueryLogAfter-response service shall be mapped to the MMS ReadJournal-response service. The ReadJournal-response shall be as specified in 17.3.4.1.4.2.

17.3.4.1.6 GetLogStatus

Shall be mapped onto the MMS read service of the log control block.

17.3.5 Conformance

An implementation that claims conformance to the ACSI log model shall support the services as described in Table 49.

Table 49 – Log conformance requirements

ACSI Service	Client-CR		Server-CR	
	Request	Response	Request	Response
GetLCBValue	m	m	m	m
SetLCBValue	o	c1	m	m
QueryLogByTime	c2	c3	m	m
QueryLogAfter	c2	c4	m	m
GetLogStatusValues	o	o	m	m
c1 – Shall be 'm' if GetLCBValue-request is supported. c2 – One of either QueryLogByTime or QueryLogAfter shall be supported. c3 – Shall be 'm' if QueryLogByTime-request is supported. c4 – Shall be 'm' if QueryLogAfter-request is supported.				

18 Mapping of the generic substation event model (GSE)

18.1 Generic object oriented substation event (GOOSE)

18.1.1 GOOSE control definition

The GOOSE Control, as defined in IEC 61850-7-2, shall be mapped to an MMS GOOSE Control Block (GCB) as defined in Table 50. All GCB's shall be of the functional constraint "GO".

Table 50 – MMS TypeDescription definition for GCB MMS structure

Component Name	MMS TypeDescription	r/w	m/o	Condition	Comments
GoEna	boolean	rw	m		
GoID	visible-string	r	m		Formerly IEC 61850-7-2 APPID
DatSet	visible-string	r	m		The value of this component shall be of the format of ObjectReference and shall be limited to VMD or domain scoped NamedVariableLists
ConfRev	int32u	r	m		
NdsCom	boolean	r	m		
DstAddress	See Table 51	r	m		

GoEna

Shall be as defined in IEC 61850-7-2.

GoID

Shall be as defined in IEC 61850-7-2. The default value of this attribute shall be the GOOSE Control Block reference.

DatSet

Shall be of the data type specified in 8.1.3.2. The value shall be constrained to the set of existing MMS NamedVariableLists. A V-Put of a value indicating a non-existent NamedVariableList shall fail.

ConfRev

This MMS component represents the IEC 61850-7-2 attribute of ConfRev.

NdsCom

This MMS component represents the IEC 61850-7-2 attribute of NdsCom.

DstAddress

This shall be a MMS structured type whose components are defined as described in Table 51.

Table 51 – DstAddress structure

Component Name	Data Type	m/o	Comments
Addr	OCTET-STRING	m	Length is 6 Octets and contains the value of the destination Media Access Control (MAC) address to which the GOOSE message is to be sent. The address shall be an Ethernet address that has the multicast bit set TRUE.
PRIORITY	Unsigned8	m	Range of values shall be limited from 0 to 7.
VID	Unsigned16	m	Range of values shall be limited from 0 to 4 095.
APPID	Unsigned16	m	As defined in Annex C

18.1.2 GOOSE services

18.1.2.1 GetGoReference

The GetGoReference service, as specified in IEC 61850-7-2, allows a client to request the resolution of one or more element offsets. The response returns the set of requested ElementOffsets and the actual reference values. The service primitives are shown in Figure 5.

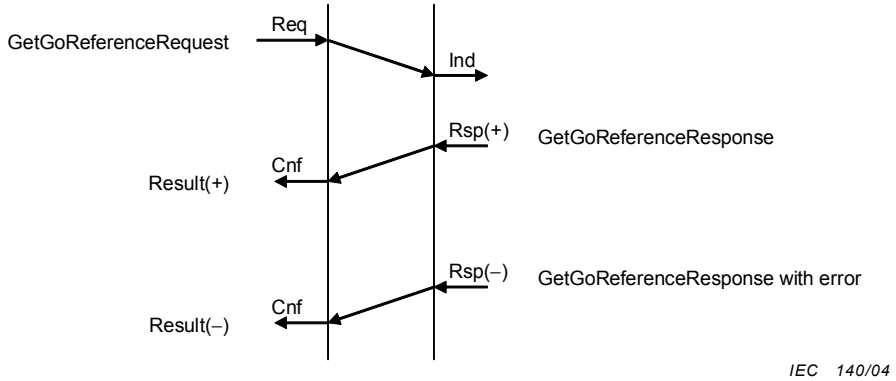


Figure 5 – GetGoReference service primitives

The client assigns a reference for every request and includes this reference as the StateID parameter within the request. A client that receives a GetGoReferenceResponse containing a unknown StateID shall ignore the PDU.

The application protocol specification in Annex A (with ASN.1 basic encoding rules) shall be used as the transfer syntax for the GetReference service. The GetGoReference service shall be mapped onto a GSEMngtPdu according to Table 52, and transferred using the T-DATA service as defined in 6.3.3.

Table 52 – Mapping of GetGoReference service

Parameter name	Transfer syntax mapping
Request	
GoCBReference	ident
MemberOffset [1..n]	offset
Response+	
GoCBReference	ident
ConfigurationRevision	confRev
DatSet	responsePositive
MemberReference [1..n]	
Response–	
ServiceError	responseNegative

Table 53 shows the parameters of the GetGoReference service primitives.

Table 53 – GetGoReference

Parameter Name	Req	Ind	Rsp	Cnf
Request	M	M(=)		
Destination Address	M	M(=)		
StateID	M	M(=)		
GoCBReference	U	U(=)		
MemberOffset References	M	M(=)		
Result(+)			S	S(=)
StateID			M	M(=)
ConfRev			M	M(=)
DatSet			M	M(=)
List Of Results			M	M(=)
MemberOffset Reference			M	M(=)
Result(–)			S	S(=)
StateID			M	M(=)
ErrorReason			M	M(=)

Destination address

The destination address shall be used to specify the address required by the T-Profile.

StateID

This is a client assigned value used to reference the client's state machine. The range of this value shall be –32 767 to 32 767.

GoCBReference

This value shall be a VISIBLE_STRING and shall be capable of containing a value whose size is 65 octets. The value shall correspond to the GOOSE control block for whom the lookup is being requested.

MemberOffsets

This is the list of elements for which the client is requesting to obtain the reference. The range of this value shall be 0 or greater. The value shall be less than 512.

Reference

This shall be one of the requested reference offsets requested by the client.

ConfRev

This parameter shall contain the configuration revision number of the GCB at the time the request was resolved.

DatSet

Shall contain the value of the DataSetReference at the time the request was resolved.

ListOfResults

This shall be the list of elements for which the server shall return the references. The range of this value shall be 0 or greater. The value shall be between 0 and 512.

Reference

These values shall contain the string reference of the offset being requested or an appropriate error code as specified in Annex A.

ErrorReason

This parameter indicates an error condition that prohibits the completion of the client's request.

T-DATA mapping

All GSE Management PDU's shall be sent and received using the T-DATA service.

18.1.2.2 GetGOOSEElementNumber

The GetGOOSEElementNumber service, as specified in IEC 61850-7-2, allows a client to request the resolution of one or more reference strings to element offsets. The response returns the set of requested ElementOffsets and the actual reference values. The sequence of service primitives shall be as in Figure 6.

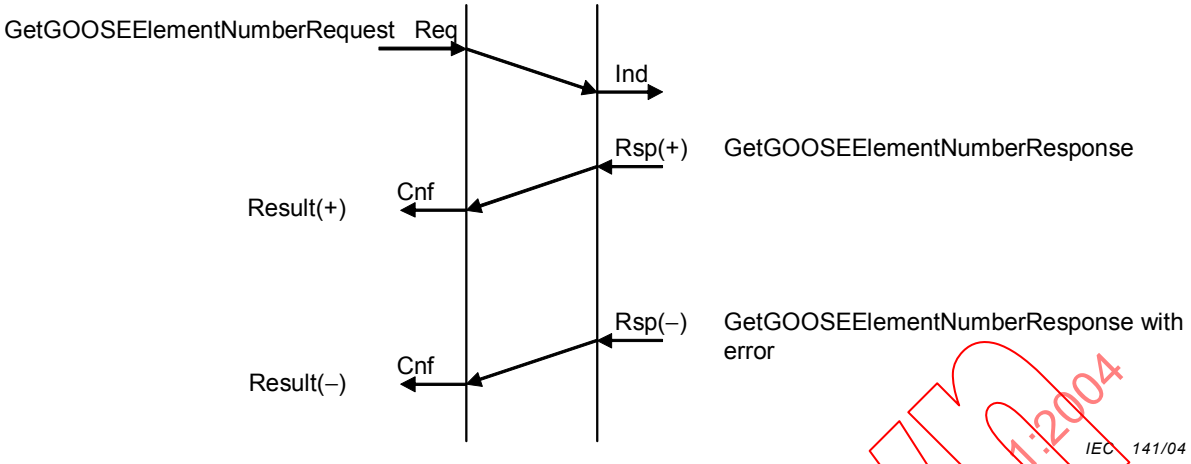


Figure 6 – GetGOOSEElementNumber service primitives

The client assigns a reference for every request and includes this reference as the StateID parameter within the request. A client that receives a GetGOOSEElementNumberResponse containing an unknown StateID shall ignore the PDU.

A server that declares support for GOOSE, and not the GetGOOSEElementNumber service, shall return a gseNotSupportedPDU if it receives a GetGOOSEElementNumberRequest.

The application protocol specification in Annex A (with ASN.1 basic encoding rules) shall be used as the transfer syntax for the GetGOOSEElementNumber service. The GetGOOSE ElementNumber service shall be mapped onto a GSEMngtPdu according to Table 54.

Table 54 – Mapping of GetGOOSEElementNumber service

Parameter name	Transfer syntax mapping
Request	
GoCBReference	ident
MemberReference [1..n]	references
Response+	
GoCBReference	ident
ConfigurationRevision	confRev
DatSet	responsePositive
MemberOffset [1..n]	
Response–	
ServiceError	responseNegative

Table 55 shows the parameter of the GetGOOSEElementNumber service primitives.

Table 55 – GetGOOSEElementNumber

Parameter Name	Req	Ind	Rsp	Cnf
Request	M	M(=)		
Destination Address	M	M(=)		
StateID	M	M(=)		
GoCBReference	U	U(=)		
MemberReference ReferenceString	M	M(=)		
Result(+)			S	S(=)
StateID			M	M(=)
ConfRev			M	M(=)
DatSet			M	M(=)
MemberOffset ElementNumber			M	M(=)
Result(–)			S	S(=)
StateID			M	M(=)
ErrorReason			M	M(=)

See 18.1.2.1 for parameter definitions not defined in this Subclause.

MemberReference

This is the list of references for which the client is requesting to obtain the element offset. NULL values shall not be allowed.

ReferenceString

This shall be the string value for the Reference whose offset is being requested by the client. The value shall not be NULL.

ElementNumber

This parameter value contains the offset value for the corresponding requested ReferenceString or an error reason.

T-DATA Mapping

All GSE Management PDU's shall be sent and received using the T-Profile T-DATA service.

18.1.2.3 GetGoCBValues

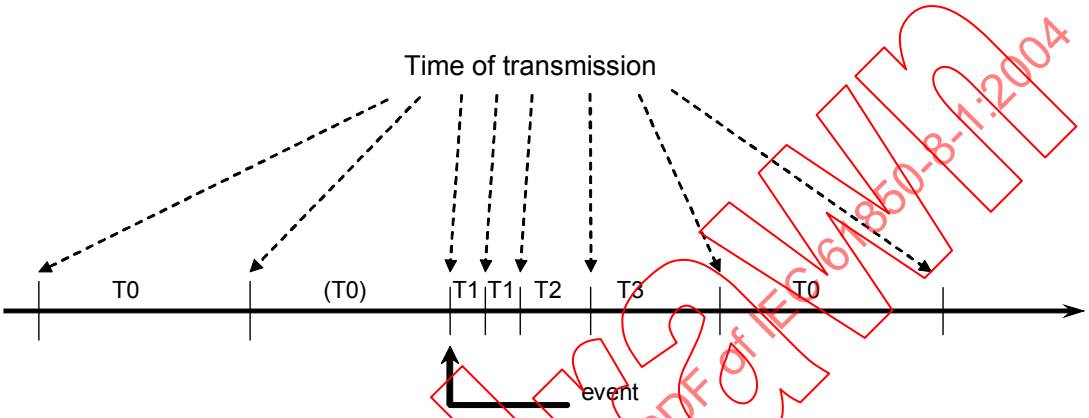
This service shall be mapped to the MMS read service.

18.1.2.4 SetGoCBValues

This service shall be mapped to the MMS write service.

18.1.2.5 SendGOOSEMessage

The GOOSE service model of 61850-7-2 ".. provides the possibility for a fast and reliable system-wide distribution of input and output data values." This SCSM uses a specific scheme of re-transmission to achieve the appropriate level of reliability. When a GOOSE server generates a SendGOOSEMessage request, the current data set values are encoded in a GOOSE message and transmitted as T-DATA on the multicast association. The event that causes the server to invoke a SendGoose service is a local application issue as defined in IEC 61850-7-2. Additional reliability is achieved by re-transmitting the same data (with gradually increasing SqNum and retransmission time). How this will be done is shown in Figure 7.



T0	retransmission in stable conditions (no event for a long time).
(T0)	retransmission in stable conditions may be shortened by an event.
T1	shortest retransmission time after the event.
T2, T3	retransmission times until achieving the stable conditions time.

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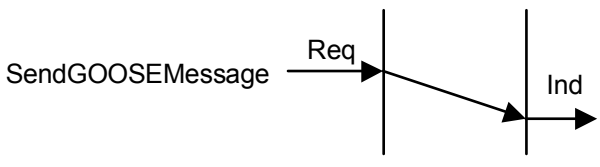
Figure 7 – Transmission time for events

NOTE Applications may choose to publish both transitions of transient or pulsed data attribute values. Other applications could choose to publish only on a significant event.

Each message in the retransmission sequence carries a timeAllowedToLive parameter that informs the receiver of the maximum time to wait for the next re-transmission. If a new message is not received within that time interval, the receiver shall assume that the association is lost.

The specific intervals used by any GOOSE publisher are a local issue. The timeAllowedtoLive parameter informs subscribers of how long to wait.

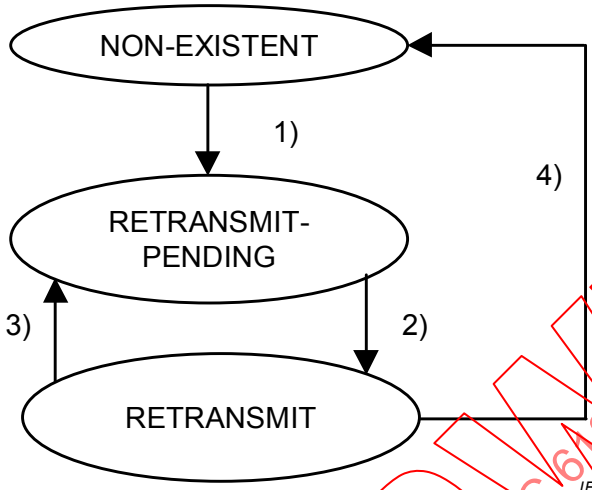
The SendGOOSEMessage service, as specified in IEC 61850-7-2, allows a client to send variable information in an unsolicited and unconfirmed manner (see Figure 8).



IEC 143/04

Figure 8 – SendGooseMessage message service primitives

The client creates and maintains a state machine (according to Figure 9) for each enabled GCB. The client state machine has three states (NON-EXISTENT, RETRANSMIT-PENDING, and RETRANSMIT).



1) Client issues GOOSE.request. A retransmission timer is started based upon client's timeAllowedtoLive parameter value. SqNum is set to 0. It is suggested that the retransmission timer be less than (actually half) of the timeAllowedtoLive parameter.

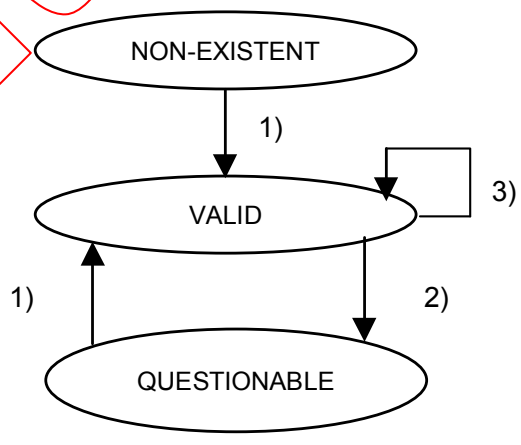
2) retransmission expiration timer indicates time for retransmission. SqNum is incremented skipping 0 on overflow.

3) Upon retransmission, a GOOSE.request is issued and the next retransmission interval is used. A retransmission timer is started. The selection method of retransmission intervals is a local issue. The maximum time allowed between retransmissions is a local issue. This time shall be less than 60 s.

4) All GOOSE messages and re-transmissions when the GoEna is set to FALSE.

Figure 9 – Client state machine for GOOSE service

The server shall create a state machine (according to Figure 10) consisting of three states (NON-EXISTENT, VALID, and QUESTIONABLE).



1) Server receives GOOSE.indication. Starts timeAllowedtoLive expiration timer.

2) timeAllowedtoLive expiration timer expires.

3) Receives a valid GOOSE indication or valid retransmission.

Figure 10 – Server state machine for GOOSE service

Table 56 shows the mapping of the parameters of the GOOSE service primitive.

Table 56 – GOOSE service parameter mapping

IEC 61850-7-2 parameter	Parameter name	Req	Ind
Argument	Argument	M	M(=)
	Destination address	U	U(=)
DatSet	datSet	U	U(=)
GoID[a)]	goID	U	U(=)
GoCBRef	gocbRef		
T	t	U	U(=)
StNum	stNum	U	U(=)
SqNum	sqNum	M	M(=)
timeAllowedtoLive	timeAllowedtoLive	U	U(=)
Test	test	U	U(=)
ConfRev	confRev	U	U(=)
NdsCom	ndsCom	U	U(=)
GOOSEData	numDatSetEnries	U	U(=)
	allData	U	U(=)
	timeAllowedToLive	U	U(=)

[a)] Formerly AppID as defined in IEC 61850-7-2.

Destination address

The destination address shall be used to specify the address of the physical node to which the query is to be issued based upon the T-Profile being used.

DatSet

This VisibleString shall have a maximum size of 65 octets. The value shall be the same as found in the GOOSE control block specified by GoCRef.

GoID

This VisibleString shall have a maximum size of 65 octets. The value shall be the same as found in the GOOSE control block specified by GoCRef.

GoCBRef

This VisibleString shall have a maximum size of 65 octets. The value shall be the reference to the GOOSE control block that is controlling the GOOSE message.

T

This attribute's type has been mapped from a ENTRYTIME to TIMESTAMP in order to allow additional timestamp precision. This TIMESTAMP has a size of 8 octets. It shall have the format as specified in 8.1.3.6.

StNum

This INTEGER value shall have a range of 1 to 4 294 967 295.

SqNum

This INTEGER value shall have a range of 0 to 4 294 967 295. The value of 0 is reserved for the first transmission of a StNum change. SqNum will increment for each transmission, but will rollover to a value of 1.

Test

This BOOLEAN shall have a range of TRUE, FALSE.

ConfRev

This INTEGER value shall have a range of 0 to 4 294 967 295.

NdsCom

This BOOLEAN shall have a range of TRUE, FALSE.

numDatSetEntries

This parameter specifies the number of members of the MMS NamedVariableList that is specified in the GOOSE control block (see 18.1.1) that controls the actual GOOSE service.

allData

This parameter contains a list of user defined information of the MMS NamedVariableList that is specified in the GOOSE control block (see 18.1.1).

timeAllowedtoLive

This INTEGER value shall have a range of 1 to 4 294 967 295. The units of the value shall be ms.

mapping

The GOOSE PDU shall be as defined in Annex A.

DatSet

The value of the DatSet parameter shall be the value of the DatSet component of the associated GCB.

NdsCom

The value NdsCom parameter shall be the value of the NdsCom component of the associated GCB.

T-DATA mapping

All GSE Management PDU's shall be sent and received using T-Profile T-DATA service.

18.2 Generic Substation State Event (GSSE)

18.2.1 GSSE control definition

The GSSE control, as defined in IEC 61850-7-2, shall be mapped to an MMS GSSE control block (SCB) as defined in Table 57. The functional constraint for an SCB shall be 'GS'.

Table 57 – MMS TypeDescription Definition for GSSE control block MMS structure

IEC 61850-7-2 control block	Component name	MMS TypeDescription	r/w	m/o	FC
GsEna	GsEna	BOOLEAN	r	m	GS
GsID[a]	GsID	VISIBLE-STRING	r[b]	m	GS
Data Label	DNALabels	ARRAY OF VISIBLE-STRING	r[b]	m	GS
	UserSTLabels	ARRAY OF VISIBLE-STRING	r[b]	m	GS
LSentData	LsentData	STRUCTURE	r[b]	m	GS

[a] Formerly APPID as defined in IEC 61850-7-2.

[b] A V-Put to these attributes shall FAIL.

NOTE The IEC 61850-7-2 DataLabel(s) is mapped into DNALabels and UserSTLabels.

GsID

Shall be as defined in IEC 61850-7-2. The default value of this attribute shall be the GOOSE control block reference.

The value contained shall be unique within the substation.

DNALabels

This is an array of the type VISIBLE-STRING. The array size shall be 32. The maximum allowed VISIBLE-STRING value shall be 65 octets.

The values contained by the VISIBLE-STRING shall represent the first 32 DataLabels as defined in IEC 61850-7-2 and correspond to the data labels assigned to the GOOSE DNA bits.

The first array entry (e.g. zero) is reserved and the value shall be “test”.

The second array entry (e.g. one) is reserved and the value shall be “ConfRev”.

UserSTLabels

This is an array of the type VISIBLE-STRING. The maximum array size shall be 128 entries. There shall be at least 1 entry in the array. The maximum allowed VISIBLE-STRING value shall be 65 octets.

The values contained by the VISIBLE-STRING shall represent the DataLabels as defined in IEC 61850-7-2 and correspond to the data labels assigned to the GOOSE UserST bits.

LSentData

This component represents the data last sent in the GSSE Message. The LSentData shall be mapped to an MMS structured TypeDescription. The component names shall be as specified Table 58.

Table 58 – Mapping of LSentData

IEC 61850-7-3 Name	IEC 61850-8-1 Data type/range	IEC 61850-8-1 type specified in Subclause
GsID	VISIBLE-STRING	8.1.2.5
t	ENTRY-TIME	
SqNum	INT32U	8.1.1
StNum	INT32U	8.1.1
TAL	INT32U	8.1.1
usec	INT32U	8.1.1
PhsID	INT16U	8.1.1
DNA	BIT-STRING	8.1.1
UserSt	BIT-STRING	8.1.1

GsID

This value shall reflect the value of the SCBGsID sent in the last GSSE message. The format and data type is defined in 8.1.2.5.

t

The ‘t’ component shall be of the type MMS BinaryTime. The value shall contain 6 octets and shall contain the time at which the last state change was detected for the data being issued by the GSSE message.

TAL

This INTEGER value shall have a range of 1 to 4 294 967 295. It represents the timeAllowedtoLive of the last sent message. The unit of the value shall be ms. The maximum is a local issue. This time shall be less than or equal to 60 seconds.

usec

The component usec shall be used to convey the microsecond component of the state change timestamp.

PhsID

The integer values of PhsID shall be as defined in Table 59.

Table 59 – Definition of integer values of PhsID

Value	Name
(0)	None
(1)	Phase A
(2)	Phase B
(3)	Phase C
(4)	Neutral
(5)	A to neutral
(6)	B to neutral
(7)	C to neutral
(8)	AB
(9)	BC
(10)	CA
(11)	AB to neutral
(12)	BC to neutral
(13)	CA to neutral
(14)	ABC
(15)	ABC to neutral

DNA

This BIT-STRING shall be 64 bits. The BIT-STRING represents an array of double-bit pair values whose meaning corresponds to the DNALabels within the SCB. The double-bit values shall be defined in Table 60.

Table 60 – Definition of double-bit GSSE values

Bit pair values		Meaning
MSB	LSB	
FALSE	FALSE	Reserved
FALSE	TRUE	FALSE
TRUE	FALSE	TRUE
TRUE	TRUE	Invalid value

The first two bit-pairs are reserved as defined by the DNALabels.

UserST

This BIT-STRING shall be at least 2 bits and a maximum of 256 bits. The BIT-STRING represents an array of double-bit pair values whose meaning corresponds to the UserST within the SCB. The double-bit values shall be as defined in Table 60.

18.2.2 GSSE services

18.2.2.1 GetGsReference

The GetGsReference service, as specified in IEC 61850-7-2, allows a client to request the resolution of one or more element offsets. The response returns the set of requested ElementOffsets and the actual reference values. The service primitives are shown in Figure 11.

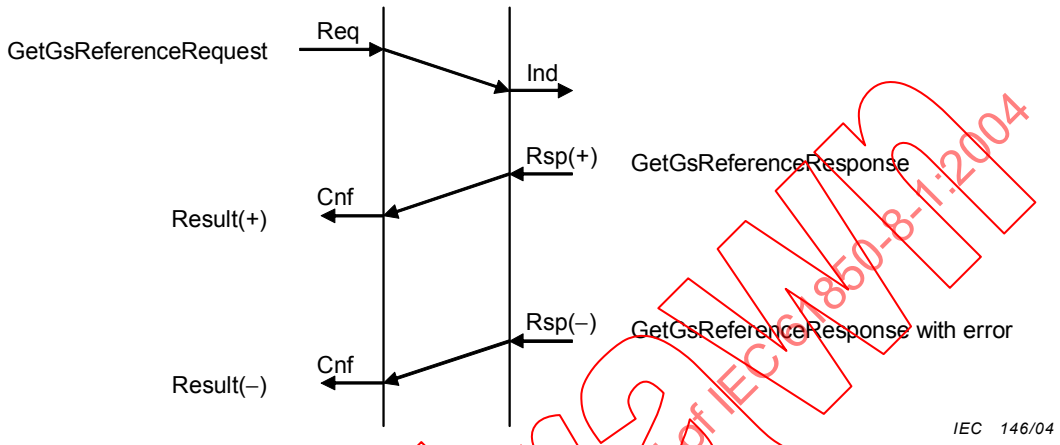


Figure 11 – GetGsReference service primitives

The client assigns a reference for every request and includes this reference as the StateID parameter within the request. A client that receives a GetGsReferenceResponse containing an unknown StateID shall ignore the PDU.

The Application protocol specification in Annex A (with ASN.1 basic encoding rules) shall be used as the transfer syntax for the GetReference service. The GetGsReference service shall be mapped onto a GSEMngtPdu according to Table 61.

Table 61 – Mapping of GetGsReference service

Parameter name	Transfer syntax mapping
Request	
GsCBReference	ident
DataOffset [1..n]	offset
Response+	
GsCBReference	ident
DataLabel [1..n]	responsePositive
Response–	
ServiceError	responseNegative

Table 62 shows the parameters of the GetGsReference service primitives.

Table 62 – GetGsReference

Parameter name	Req	Ind	Rsp	Cnf
Request	M	M(=)		
Destination address	M	M(=)		
StateID	M	M(=)		
GsID	U	U(=)		
DataOffset OffsetNumber	M	M(=)		
Result(+)			S	S(=)
StateID			M	M(=)
GsID			M	M(=)
List of results			M	M(=)
DataLabel label			M	M(=)
Result(–)			S	S(=)
StateID			M	M(=)
ErrorReason			M	M(=)

Destination address

The destination address shall be used to specify the address required by the T-Profile

StateID

This is a client assigned value used to reference the client's state machine. The range of this value shall be –32 767 to 32 767.

GsID

This value shall be a VISIBLE_STRING and shall be capable of containing a value whose size is 65 octets. The value shall correspond to the GsID for whom the lookup is being requested.

DataOffset

This is the list of elements for which the client is requesting to obtain the reference. The range of this value shall be 0 or greater. The value shall be less than 512.

OffsetNumber

This shall be one of the requested Reference offsets requested by the client.

ListOfResults

This is the list of elements for which the server is responding the reference. The range of this value shall be 0 or greater. The value shall be less than 512.

Label

These values shall contain the string reference of the offset being requested or an appropriate error code as specified in Annex A.

ErrorReason

This parameter indicates an error condition that prohibits the completion of the client's request.

T-DATA mapping

All GSE Management PDU's shall be sent and received using the T-DATA service.

18.2.2.2 GetGSSEDataOffset

The GetGSSEDataOffset service, as specified in IEC 61850-7-2, allows a client to request the resolution of one or more reference strings to element offsets. The response returns the set of requested ElementOffsets and the actual reference values. The sequence of service primitives shall be as in Figure 12.

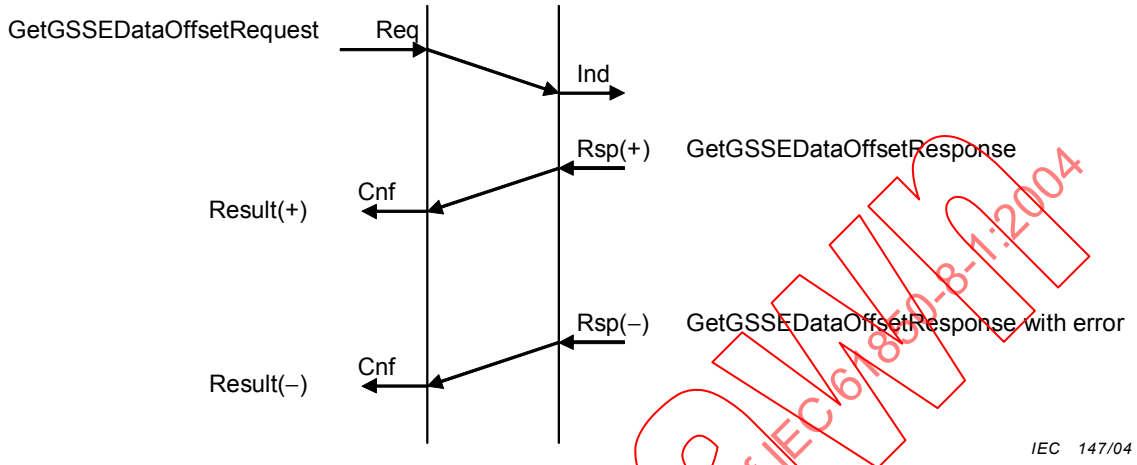


Figure 12 – GetGSSEDataOffset service primitives

The client assigns a reference for every request and includes this reference as the StateID parameter within the request. A client that receives a GetGSSEDataOffset containing an unknown StateID shall ignore the PDU.

A server that declares support for GOOSE, and not the GetGSSEDataOffset service, shall return a gseNotSupportedPDU if it receives a GetGSSEDataOffsetRequest.

The application protocol specification in Annex A (with ASN.1 basic Encoding Rules) shall be used as the transfer syntax for the GetGOOSEElementNumber service. The GetGSEEDataOffset service shall be mapped onto a GSEMngtPdu according to Table 63.

Table 63 – Mapping of GetGOOSEElementNumber service

Parameter name	Transfer syntax mapping
Request	getGSSEDataOffset
GsCBReference	gsID
DataLabel [1..n]	label
Response+	getGSSEDataOffset
GoCBReference	gsID
DataOffset [1..n]	dataOffset
Response–	getGSEEDataOffset
ServiceError	error

Table 64 shows the parameter of the GetGSSEDataOffset service primitives.

Table 64 – GetGSSEDataOffset

Parameter Name	Req	Ind	Rsp	Cnf
Request	M	M(=)		
Destination Address	M	M(=)		
StateID	M	M(=)		
GsID	U	U(=)		
MemberReference ReferenceString	M	M(=)		
Result(+)			S	S(=)
StateID			M	M(=)
GsID			M	M(=)
MemberOffset ElementNumber			M	M(=)
Result(–)			S	S(=)
StateID			M	M(=)
ErrorReason			M	M(=)

See 18.1.2.1 for parameter definitions not defined in this Subclause.

DataLabel

This is the list of offset for which the client is requesting to obtain the label. NULL values shall not be allowed.

Label

This shall be the string value for the reference whose offset is being requested by the client. The value shall not be NULL.

dataOffset

This parameter value contains the offset value for the corresponding requested ReferenceString or an error reason.

T-DATA mapping

All GSE management PDU's shall be sent and received using the T-Profile T-DATA service.

18.2.2.3 GetGsCBValues

This service shall be mapped to the MMS read service.

18.2.2.4 SetGsCBValues

This service shall be mapped to the MMS write service.

18.2.2.5 SendGSSEMessage

The GSSE service model of 61850-7-2 "provides the possibility for a fast and reliable system-wide distribution of input and output data values." This SCSM uses a specific scheme of re-transmission to achieve the appropriate level of reliability. When a GSSE server generates a SendGSSEMessage request, the current data set values are encoded in a GSSE message and transmitted as LDATA on the multicast association. The event that causes the server to invoke a SendGSSEMessage service is a local application issue as defined in IEC 61850-7-2. Additional reliability is achieved by re-transmitting the same data (with gradually increasing SqNum and retransmission time). Figure 7 shows how this will be done.

NOTE Applications may choose to publish both transitions of transient or pulsed data attribute values (e.g. a trip). Other applications could choose to publish only on a significant event (e.g. start).

Each message in the retransmission sequence carries a timeAllowedToLive parameter that informs the receiver of the maximum time to wait for the next re-transmission. If a new message is not received within that time interval, the receiver shall assume that the association is lost.

The SendGSSEMessage service, as specified in IEC 61850-7-2, allows a client to send variable information in an unsolicited and unconfirmed manner (see Figure 13).

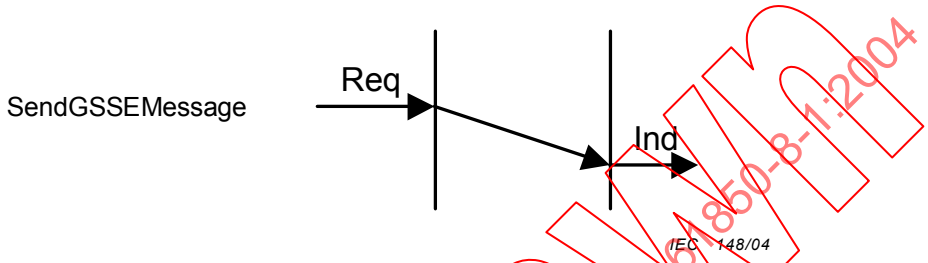
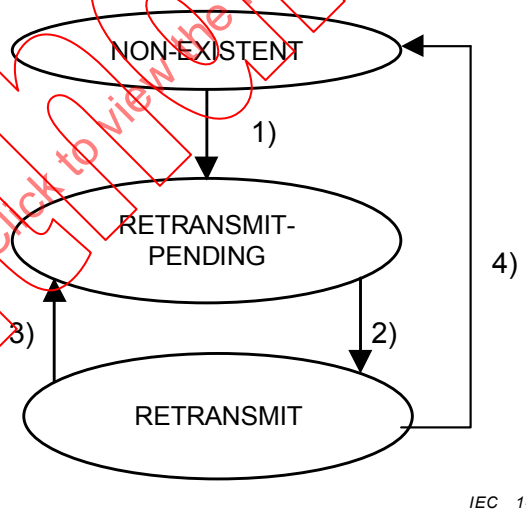


Figure 13 – GSSE service primitives

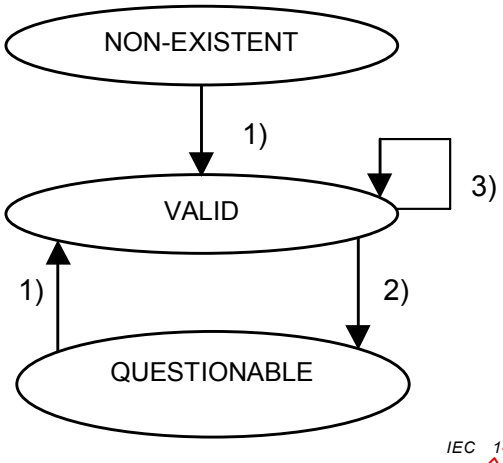
The client creates a state machine prior to issuing the GSSE request. The client assigns a reference for this state machine (according to Figure 14) and includes this reference. The value of this reference is a local issue. The client state machine has three states (NON-EXISTENT, RETRANSMIT-PENDING, and RETRANSMIT).



1) Client Issues GSSE.request. A retransmission timer is started based upon client's HoldTim parameter value. SqNum is set to 0. It is suggested that the retransmission timer be less than (actually half) of the HoldTim.
2) Retransmission expiration timer indicates time for retransmission. SqNum is incremented skipping 0 on overflow.
3) Upon retransmission, a GSSE.request is issued and the next retransmission interval is used. A retransmission timer is started. The selection method of retransmission intervals is a local issue. The maximum time allowed between retransmissions is a local issue. This time shall be less than 60 s.
4) All GOOSE messages and re-transmissions when the GsEna is set to FALSE.

Figure 14 – Client state machine for GSSE service

The server shall create a state machine (according Figure 15) consisting of three states (NON-EXISTENT, VALID, and QUESTIONABLE).



1) Server receives GSSE.indication. Starts HoldTim expiration timer.
2) HoldTim expiration timer expires.
3) Server receives a valid GSSE indication or retransmission.

Figure 15 – Server state machine for GSSE service

Table 65 shows the parameter of the GSSE service primitives.

Table 65 – GSSE service

IEC 61850-7-2 parameter name	Parameter name	Req	Ind
Argument	Argument	M	M(=)
	Destination address	U	U(=)
GsID	AppID	M	M(=)
T	T	M	M(=)
StNum	StNum	M	M(=)
SqNum	SqNum	M	M(=)
	usec	U	U(=)
	TAL	M	M(=)
PhsID	PhsID	M	M(=)
GSSEData		M	M(=)
test	DNA	U	U(=)
	Test (bit pair 0)	U	U(=)
	ConfRev (bit pair 1) bit pairs 2-31 are user assigned		
	UserST (user assigned)		

Destination address

The destination address shall be used to specify the presentation address of the physical node to which the query is to be issued.

GsID

This VisibleString shall have a maximum size of 65 octets. The value shall be globally unique within the substation.

This value shall be mapped into the SendingIED component of the GSSE control block structure.

t

The 't' component shall be of the type MMS BinaryTime. The value shall contain 6 octets and shall contain the time at which the last state change was detected for the data being issued by the GSSE message.

usec

As defined in LsentData structure.

StNum

This INTEGER value shall have a range of 1 to 4 294 967 295. This value shall be mapped to the StNum component of the LSentData structure.

SqNum

This INTEGER value shall have a range of 0 to 4 294 967 295. This value shall be mapped to the SqNum component of the LSentData structure. The value of 0 shall be reserved and used to indicate the first transmission due to a change in StNum. A rollover from the value of 4 294 967 295 shall be to a value of 1.

PhsID

See 18.2.1.

TAL

TimeAllowed to live as defined as part of the LsentData structure.

Test

The value shall be mapped to the first DNA bit-pair in the LSentData. The value of the bit-pair shall be as defined in Table 66.

Table 66 – Mapping of test values to bit-pair values

Bit pair values		ACSI value
MSB	LSB	
FALSE	TRUE	no-test
TRUE	FALSE	test

ConfRev

This BOOLEAN value shall indicate if a configuration change has occurred to either the AppID, DNALabels, or UserSTLabels of the GCB. A value of TRUE indicates that a configuration change has been detected. Upon detection, the value shall remain TRUE for no-longer than 60 s and no less than 30 s.

The value is mapped to the second DNA bit-pair according to the bit-pair value specification in Table 60.

ListofData

The ListofData shall be a set of double-bit pair values. The list shall contain a minimum of 33 such pairs, with the values as specified in Table 60. The first 32 values shall be mapped to the DNA BIT-STRING of the PACT structure. The remaining values shall be mapped into the UserSt BIT-STRING accordingly.

If the 'test' parameter has a value of 'test' then any non-test data values shall be set to the INVALID value.

GSSE message

The information in the LSentData structure shall be transmitted according to the procedures specified within this Subclause. The information shall be sent in an MMS information report containing a variableAccessSpecification indicating a variableSpecification. The variable Specification choice shall be name, the ObjectName choice shall be vmd-specific, and the identifier shall have the value “GOOSE”.

NOTE This mapping maintains backward compatibility and interoperability with the UCA 2.0 GOOSE message definition.

19 Transmission of sampled values class model

Shall be as specified in IEC 61850-9-2.

20 Control class model

The IEC 61850 control models are accessed via the MMS read and write named variable services. The common data classes (defined in IEC 61850-7-3 and specialized in Annex E of this part of IEC 61850) that allow control operations contain elements with the FC of “CO” and “SP”. The control models defined within IEC 61850-7-2 contain additional service parameters which are conveyed when executing the control. The mapping of control models and services is accomplished by combining the service parameters and the control elements into MMS structure type definitions and inserting them as components of the MMS named variable representing the common data class instance in a logical node. The services are then mapped to MMS read and write service requests of these inserted components.

20.1 Control service parameters

Table 67 lists the service parameters, as defined within IEC 61850-7-2.

Table 67 – Control service parameters

IEC 61850-7-2 parameter	Semantic	IEC 61850-7-2 Subclause
Value	Attributes with FC of ‘CO’ or ‘SP’ from CDC	17.5.2.2
T	Control time stamp	17.5.2.3
Test	Test status	17.5.2.4
Check	Check condition	17.5.2.5
AddCause	Additional cause diagnostic	17.5.2.6
TimOperRsp	Time activated operate response	17.5.2.7

The type definitions for each of these parameters are constructed according to the rules defined in 8.1 and 7.3.2.

20.2 Mapping of control objects

The data objects with controllable DataAttributes (derived from CDCs with attributes FC=CO and FC=SP) shall be mapped according to the rules defined in 7.3.1: the MMS named variable components representing the attributes with FC=CO and FC=SP of a data object have the following general reference:

<LDname>/<LNname>CO<DOname>

<LDname>/<LNname>SP<DOname>

where the MMS type specification of the <DOname> component includes each of the attributes with FC=CO and FC=SP. The structures of the <DOname> component for each of the service choices shall be as defined in Table 68.

Table 68 – Mapping of IEC 61850-7-2 control model to MMS control components

Service choice	DataAttributes	
	With TimeActivatedOperate	Without TimeActivatedOperate
Direct with normal security		
	Oper	Oper
SBO with normal security		
	SBO	SBO
	Oper	Oper
	Cancel [a]	Cancel [a]
SBO with enhanced security		
	SBOw	SBOw
	Oper	Oper
	Cancel [a c]	Cancel [a]
Direct with enhanced security		
	Oper	Oper
	Cancel [b]	

[a] The cancel service cancels the object selection.

[b] The cancel service cancels the time activation.

[c] The cancel service cancels both the select and the time activation.

20.3 Mapping of control services

Table 69 gives an overview of the mapping of the control services.

Table 69 – Mapping of control services

ASCI service		MMS service	Variable specification	Access result
Select	Request	Read request	SBO	
	Response +	Read response	SBO	Success
	Response –	Read response	SBO = NULL	Success
SelectWithValue	Request	Write request	SBOw	
	Response +	Write response		Success
	Response –	Write response		Failure
		InformationReport (ListOfVariable)	LastApplError	
Cancel	Request	Write request	Cancel	
	Response +	Write response		Success
	Response –	Write response		Failure
		InformationReport (ListOfVariable)	LastApplError	
Operate	Request	Write request	Oper [3]	
	Response +	Write response		Success
	Response –	Write response		Failure
		InformationReport (ListOfVariable)	LastApplError	
TimeActivatedOperate	Request	Write request	Oper [4]	
	Response + [1]	Write response		Success
	Response – [1]	Write response		Failure
		InformationReport (ListOfVariable)	LastApplError	
	Response + [2]	InformationReport (ListOfVariable)	Oper	
	Response – [2]	InformationReport (ListOfVariable)	LastApplError	
CommandTermination	Request +	InformationReport (ListOfVariable)	Oper	
	Request –	InformationReport (ListOfVariable)	LastApplError Oper	

[1] Maps the first TimOper_rsp as defined in IEC 61850-7-2.

[2] Maps the second TimOper_rsp as defined in IEC 61850-7-2.

[3] The attribute operTm shall not be written during the operate service, otherwise it is a TimeActivatedOperate.

[4] The attribute operTm shall be written during the TimeActivatedOperate Service, otherwise it is an operate.

20.4 Select

The select service shall be performed through the use of an MMS read of the SBO attribute. The mapping of parameters is as specified in Table 70.

Table 70 – Select service parameter mapping

IEC 61850-7-2 parameter	Parameter name
ControlObjectReference	SBO

20.4.1 Select request

The IEC 61850-7-2 select request shall be performed through the use of an MMS Read.request of the SBO attribute.

20.4.2 Select response+

The IEC 61850-7-2 select response+ shall be performed through the use of an MMS Read.response that contains a non-NULL value for the SBO attribute.

20.4.3 Select response–

The IEC 61850-7-2 select response– shall be performed through the use of an MMS Read.response+ that contains a NULL value for the SBO attribute.

20.5 SelectwithValue

The select with value service shall be performed through the use of an MMS write to the SBOw attribute. The mapping of parameters is as specified in Table 71.

Table 71 – SelectwithValue service parameter mapping

IEC 61850-7-2 parameter	Parameter name
ControlObjectReference	SBOw
Value	SBOw$ctlVal
T	SBOw$T
Test	SBOw$Test
Check	SBOw$Check
NOTE The definition of SBOw is given in Table E.8.	

20.5.1 SelectwithValue request

The IEC 61850-7-2 select request shall be performed through the use of an MMS Write.request of the SBOw structure.

20.5.2 SelectwithValue response+

The IEC 61850-7-2 SelectwithValue response+ shall be performed through the use of an MMS Write.response+ that contains a MMS AccessResult indicating success.

20.5.3 SelectwithValue response–

The IEC 61850-7-2 SelectwithValue response– maps onto two MMS PDUs. The order of the PDUs shall be an InformationReport.request with AdditionalCauseDiagnostic (see 20.8) and a MMS Write.response+ that contains an AccessResult indicating failure as defined in Table 72.

Table 72 – Select, Oper and Cancel AccessResult specification

	Conveyed By MMS AccessResult		
Error	**Data**	**DataAccessError**	**Error condition**
TEMPORARILY-UNAVAILABLE	NULL String		Control is already selected or being operated
HARDWARE-FAULT		HARDWARE-FAULT	Control may not be operated due to hardware fault
OBJECT-ACCESS-DENIED		OBJECT-ACCESS-DENIED	Access control failure
OBJECT-UNDEFINED		OBJECT-UNDEFINED	Control does not exist in this security view

20.6 Cancel

The cancel service shall be performed through the use of an MMS write to the cancel attribute. The mapping of parameters is as specified in Table 73.

Table 73 – Cancel service parameter mapping

IEC 61850-7-2 Parameter	Parameter name
ControlObjectReference	Cancel
T	Cancel$T
Test	Cancel$Test
NOTE The definition of Cancel is given in Table E.10.	

20.6.1 Cancel request

The IEC 61850-7-2 cancel request shall be performed through the use of an MMS Write.request of the Cancel structure.

20.6.2 Cancel response+

The IEC 61850-7-2 cancel response+ shall be performed through the use of an MMS Write.response+ that contains a MMS AccessResult indicating Success.

20.6.3 Cancel response–

The IEC 61850-7-2 cancel response– maps onto two MMS PDUs. The order of the PDUs shall be an InformationReport.request with AdditionalCauseDiagnostic (see 20.8) and a MMS Write.response+ that contains an AccessResult indicating failure.

20.7 Operate

The operate service shall be performed through the use of an MMS Write to the oper attribute. The mapping of parameters is as specified in Table 74.

Table 74 – Operate service parameter mapping

IEC 61850-7-2 parameter	Parameter name
ControlObjectReference	Oper
Value	Oper$ctlVal
T	Oper$T
Test	Oper$Test
Check	Oper$Check
NOTE The definition of Oper is given in Table E.9.	

20.7.1 Operate request

20.7.1.1 Control with normal security

The IEC 61850-7-2 operate request shall be performed through the use of an MMS Write.request of the appropriate Oper structure.

20.7.1.2 Control with enhanced security

The IEC 61850-7-2 operate request shall be performed through the use of an MMS Write.request of the appropriate Oper structure.

20.7.1.3 Control with TimeActivation

The IEC 61850-7-2 operate request shall be performed through the use of an MMS Write.request of the appropriate Oper structure.

The operate with TimeActivation service shall be performed through the use of an MMS write to the oper attribute with the parameter OperTm present containing a valid timestamp. The value OperTm = 0 is equivalent to control with enhanced security (i.e. without time activation). The mapping of parameters is as specified in Table 75.

Table 75 – Control with TimeActivation service parameter mapping

IEC 61850-7-2 parameter	Parameter name
Argument	Argument
	Oper$operTm
ControlObjectReference	Oper
Value	Oper$ctlVal
T	Oper$T
Test	Oper$Test
Check	Oper$Check
NOTE The definition of Oper is given in Table E.9.	

20.7.2 Operate response+

The IEC 61850-7-2 operate response+ shall be performed through the use of an MMS Write.response+ that contains a MMS AccessResult indicating success. The second operate response+ of a time activated control maps to an information report of the oper structure.

20.7.3 Operate response–

20.7.3.1 Control with normal security

The IEC 61850-7-2 operate response– shall be performed through the use of an MMS Write.response AccessResult indicating failure,

20.7.3.2 Control with enhanced security

The IEC 61850-7-2 operate response– maps onto two MMS PDUs, an AdditionalCause Diagnostic (see 20.8) and a MMS Write.response+ that contains an AccessResult indicating failure.

20.7.3.3 Control with TimeActivation

The IEC 61850-7-2 operate response– maps onto two MMS PDUs, an AdditionalCause diagnostic (see 20.8) and a MMS Write.response+ that contains an AccessResult indicating failure. A second operate response– differs from the first (see Table 69).

20.8 AdditionalCauseDiagnosis in negative control service responses

Some abstract control services supply additional application specific information in their negative responses. This information is defined by the AdditionalCauseDiagnosis (AddCause) service parameter defined in IEC 61850-7-2. The transmission of this information shall map to an MMS InformationReport service of an VMD-SPECIFIC MMS named variable "LastApplError" of the structure defined in Table 76. This MMS named variable shall be instantaneously created, reported, and then deleted.

Table 76 – Definition of LastApplError variable structure

Component name	ACSI TypeDescription	r/w	m/o	Comments
CntrlObj	VISIBLESTRING	r	m	
Error	ENUMERATED	r	m	
Origin	Originator	r	m	See IEC 61850-7-3
ctlNum	INT8U	r	m	See IEC 61850-7-3
AddCause	ENUMERATED	r	m	

The value of the named variable shall represent the last detect control service application error that required additional diagnostics. The value of LastApplError shall be reported as a single MMS named variable (e.g. the structured variable shall be reported). The value of this variable shall be volatile and shall assume the specified default values upon two-party (see 10.2) association establishment.

CntrlObj

CntrlObj shall be a named component that shall have VISIBLESTRING data type of the structure

<LDeviceName>/<LNVariableName>$<FC>$<LNDataName1>$<AttributeName1>
(see 8.1.3.2)

and shall have a maximum size of 65 octets. The value shall represent the control object that was operated upon that caused the additional cause to be generated.

The default value shall be NULL.

Error

Error is a named component that is an ENUMERATED data type as defined in 8.1.2.2. The enumerated values for error shall be as defined as:

```
Error ::= INTEGER {
                    (0) No Error
                    (1) Unknown
                    (2) Timeout Test Not OK
                    (3) Operator Test Not OK
}
```

The default value shall be 0.

origin

Used to designate the client who initiated the control action.

ctlNum

The control sequence number as specified by the client initiating the service.

NOTE Negative control responses mostly consist of an MMS write response+ and an additional MMS InformationReport request defined above. The transmission of the origin and ctlNum in the InformationReport request enables the client to allocate this InformationReport request to the corresponding MMS write service.

The default value shall be 0.

AddCause

AddCause shall be a named component that is a ENUM8 data type as defined in 8.1.2.2. Table 77 defines the actual MMS values assigned to AddCause.

Table 77 – Mapping of ACSI AddCause values

ACSI value	MMS value
Unknown	0
Not-supported	1
Blocked-by-switching-hierarchy	2
Select-failed	3
Invalid-position	4
Position-reached	5
Parameter-change-in-execution	6
Step-limit	7
Blocked-by-Mode	8
Blocked-by-process	9
Blocked-by-interlocking	10
Blocked-by-synchrocheck	11
Command-already-in-execution	12
Blocked-by-health	13
1-of-n-control	14
Abortion-by-cancel	15
Time-limit-over	16
Abortion-by-trip	17
Object-not-selected	18

20.9 CommandTermination

The CommandTermination service request positive shall map to the MMS InformationReport Service of the Oper component of the MMS named variable representing the control.

The CommandTermination service request negative shall map to the MMS InformationReport Service with a listOfVariable containing two MMS variables. The first variable is the MMS named variable named “LastApplError”. The second variable is the MMS variable that represents the Oper component of the MMS named variable representing the control.

21 Time and time synchronization model

Time synchronization, accomplished via LAN communication, shall be accomplished through the use of SNTP (see 6.5).

Hardware synchronization mechanisms (e.g. GPS or other) are beyond the scope of this standard.

22 Naming conventions

See Clause 7.

23 File transfer

23.1 File transfer model

The IEC 61850-7-2 file class shall be mapped to the MMS file object. If a implementation declares support for file transfer, MMS file services shall be implemented according to this Clause. In addition, it is a local issue if the IETF File Transfer Protocol (FTP – see RFC 542) is also implemented. The conformance to the FTP RFC is out-of-scope of this standard.

The mapping is specified in Table 78.

Table 78 – Mapping of ACSI file class to MMS file object

IEC 61850-7-2 file class attribute name	MMS file object attribute	m/o
FileName	FileName	m
FileSize	Size	m
LastModified	LastModified	m

FileName

The IEC 61850-7-2 FileName attribute shall be mapped to the MMS FileName attribute. The MMS FileName shall consist of a sequence of file paths and a name-of-a-file. IEC 61850-7-2 FileNames shall be constrained to be no larger than 255 octets.

The file path specification is optional. If present, the file path specification shall consist of a sequence of file directory names. File directory names shall be constrained to be no larger than 32 octets. Directory names shall be separated by the PIXIT determined character (typically a “\” or “/”).

A server, that contains logical devices, shall have as one of its root directories a directory whose name is “LD”. Below the LD root shall be a set of directory names that represent the logical devices within the server. These file directory names shall be the same value as the

logical device names (e.g. The names of the domains). Files that are specific to a logical device shall be located within the directory that represents the logical device.

NOTE Not all files may be able to be associated with a particular LD. As an example, the image file of the server itself may not be directly associated with an LD. Therefore, for files not associated with a LD, it is a local issue in regards to the directory in which such files are stored.

The minimum-maximum name-of-a-file size shall be 12 octets. It is recommended that the file specification be a maximum size of 64 octets. The maximum file specification size shall be specified in the implementation's PIXIT statement.

FileName suffixes should be used to differentiate the content format of files. The suffix should be a maximum of 3 octets. The suffixes in Table 79 are reserved.

Table 79 – Reserved file suffixes

Suffix	Contents
Bin	Shall indicate binary format
Dtd	eXtensible Markup Language Document Type Description file of format dtd:XML
Gif	Shall indicate graphics interchange format contents
Htm	Shall indicate HTML contents
Pqd	Power Quality Data Interchange Format – PQDIF
txt	Shall indicate ASCII contents
Xml	eXtensible Markup Language file of format table-xml:XML
Xsd	eXtensible Markup Language Schema Definition file of format xsd:XML
Zip	Shall indicate zip compressed file format

FileName case sensitivity shall be declared in the implementation's PIXIT statement.

COMTRADE FILES

IEEE C37.111(1999) (COMTRADE) files shall be contained within a file directory whose name is "COMTRADE". The file specifications shall be consistent with the naming conventions and suffixes specified in IEEE C37.111(1999).

The IEEE COMTRADE specification IEEE C37.111(1999) specifies the use of three different suffixes (e.g. hdr, cfg, and dat). In normal information/computational usage these suffixes may represent files other than COMTRADE.

If the directory contains a file with a suffix of "zip", that file shall convey the compressed contents of the COMTRADE hdr, cfg, and dat files of the files of the same name.

The COMTRADE directories shall be located in the appropriate directory path (e.g. within the LD directory or at the root level).

FileSize

The IEC 61850-7-2 FileSize attribute shall be mapped to the MMS file size attribute. A value of 0 may be used to indicate that the file has an unknown size or that the file contains 0 octets.

The size value shall be interpreted as an estimated file size and shall not be used to determine absolute size.

NOTE Transfers from one file system to another may increase or decrease the actual size of the file.

LastModified

The IEC 61850-7-2 LastModified attribute shall be mapped to the MMS file LastModified attribute.

23.2 File services

23.2.1 GetFile

The ACSI GetFile service shall be mapped to a sequence of MMS FileOpen, FileRead, and FileClose services as specified by ISO 9506-1 and ISO 9506-2.

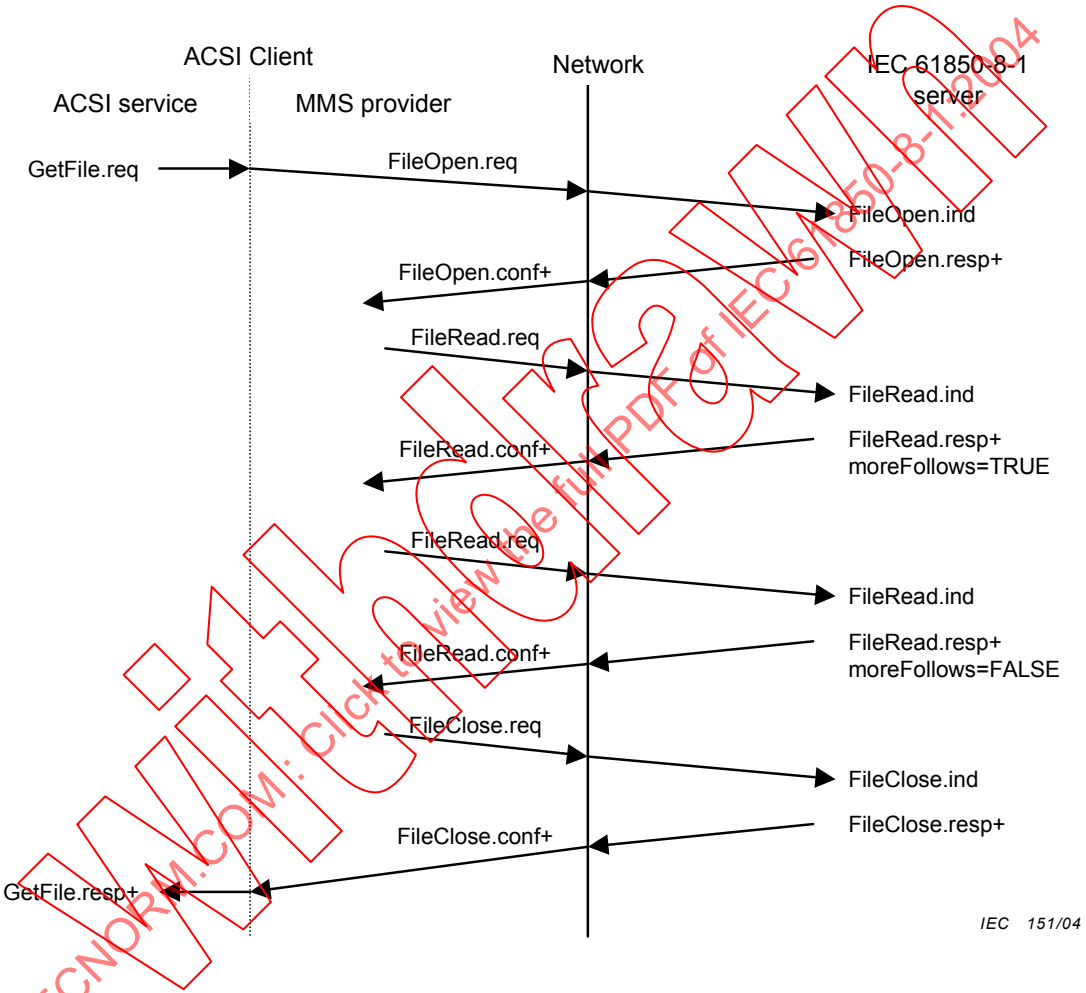


Figure 16 – Mapping of ACSI GetFile to MMS FileOpen, FileRead, FileClose

Figure 16 shows the sequence of MMS services that result from an ACSI GetFile request. An ACSI GetFile request causes an MMS FileOpen request to be generated. The initialPosition shall be 0. A FileOpen positive confirmation shall cause the first in a possible sequence of MMS FileRead requests to be generated. A FileRead positive confirmation with moreFollows=FALSE shall cause an MMS FileClose request to be issued. A FileRead positive confirmation with moreFollows=TRUE shall cause another in the sequence of FileRead requests to be issued. Upon receipt of a FileClose positive confirmation, a GetFile positive response indication shall be given.

If any MMS services return a negative confirmation, then a GetFile negative response indication shall be given.

Table 80 specifies the mapping of the ACSI GetFile service parameters.

Table 80 – Mapping of ACSI GetFile service parameters

ACSI parameter	MMS service and parameter	Constraint
FileName	FileOpen.request FileName	Shall be present and shall have a non-NULL value.
FileData	FileRead response FileData	

FileName

The ACSI filename parameter shall be mapped as specified in 23.1. This is a mandatory parameter that shall be present and shall have a non-NULL value.

FileData

The ACSI FileData shall be mapped to the sequence of FileRead response FileData returned.

23.2.2 SetFile

Figure 17 shows that an ACSI SetFile request shall be mapped to an MMS ObtainFile.request.

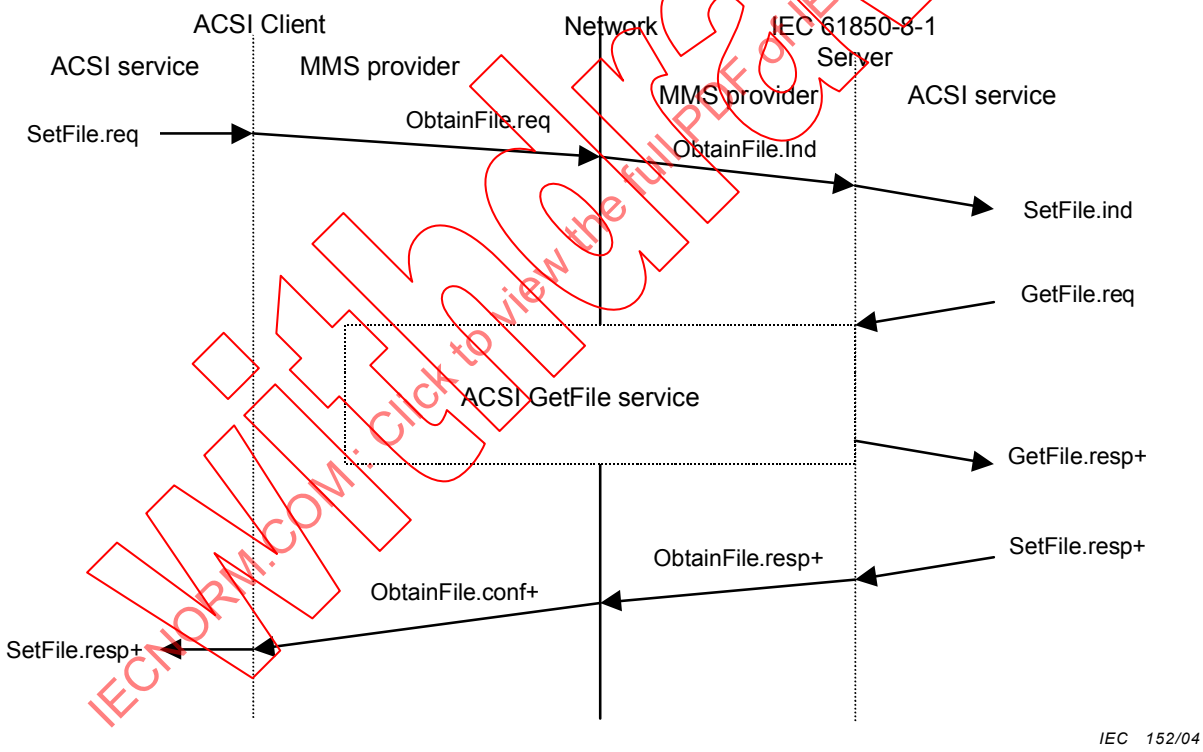


Figure 17 – Mapping of ACSI SetFile service

The sourceFilename parameter shall be supplied, therefore this SCSM requires a source filename parameter. Upon reception of the ObtainFile indication, the ObtainFile file transfer procedure shall be executed through the invocation of the ACSI GetFile service. Upon a GetFile response positive, an ObtainFile positive response shall be issued. Upon reception of the ObtainFile positive confirmation, a SetFile positive response shall be indicated. The mapping of the file parameters is specified in Table 81.

Table 81 – Mapping of ACSI SetFile parameters

ACSI parameter	MMS service and parameter	Constraint
FileName	ObtainFile request destinationFile	Shall be present and shall have a non-NULL value.
FileData	FileRead response FileData[1)]	
SourceFileName[2)]	ObtainFile request sourceFile	
[1)] This mapping occurs as part of the execution of the ACSI GetFile service. [2)] Parameter added by this SCSM.		

FileName

The ACSI filename parameter shall be mapped as specified in 23.1. This is a mandatory parameter that shall be present and shall have a non-NULL value.

FileData

The ACSI FileData shall be mapped to the sequence of FileRead response FileData returned.

SourceFileName (added by SCSM)

This parameter shall represent the name of the file from which FileData is to be obtained through the ACSI GetFile service. The SourceFilename parameter shall be mapped as specified in 23.1.

23.2.3 DeleteFile

The ACSI DeleteFile service shall map to the MMS FileDelete service as detailed in Table 82.

Table 82 – Mapping of ACSI DeleteFile service

ACSI service or parameter	MMS service or parameter	Constraint
FileDelete request	DeleteFile request	Shall be present and shall have a non-NULL value.
FileName	FileName	
FileDelete response+	DeleteFile response+	

FileName

The ACSI filename parameter shall be mapped as specified in 23.1. This is a mandatory parameter that shall be present and shall have a non-NULL value.

23.2.4 GetFileAttributeValues

The ACSI GetFileAttributeValues service shall be mapped to a sequence of MMS FileDirectory services. An ACSI GetFileAttributeValues request shall cause an MMS FileDirectory request to be issued. If a FileDirectory positive confirmation with moreFollows=TRUE is received, another MMS FileDirectory request shall be issued. If an MMS FileDirectory positive confirmation is received with moreFollows=FALSE, then the MMS DirectoryEntries from all MMS FileDirectory confirmations shall be indicated as part of the ACSI GetFileAttributeValues response+.

If a MMS FileDirectory negative confirmation is received, then a ACSI GetFileAttributeValues negative response shall be indicated.

The parameters of the ACSI GetFileAttributeValues service shall be mapped as detailed in Table 83.

Table 83 – Mapping of ACSI GetFileAttributeValues parameters

ACSI service or parameter	MMS service or parameter	Constraint
GetFileAttributeValues request	FileDirectory request	
FileName	FileName	
GetFileAttributeValues response+	FileDirectory response+	
FileName		
File Attributes	listOfDirectoryEntry	
GetFileAttributeValues response–	FileDirectory response–	
ServiceError	listOfDirectoryEntry	

FileName

The ACSI Filename parameter shall be mapped as specified in 23.1.

ListOfDirectoryEntry

The ListOfDirectoryEntry parameter shall be mapped to the MMS FileDirectory service listOfDirectoryEntry. The mappings of the parameters shall be as specified in Table 84.

Table 84 – Mapping of ACSI ListOfDirectoryEntry

ACSI ListofDirectoryEntry parameter	MMS DirectoryEntry parameter	Constraint
FileName	FileName	
FileAttributes	FileAttributes	

The ACSI FileAttributes parameter shall be mapped as specified in 23.1.

24 Conformance

24.1 Notation

For the following Clause, the following definitions apply:

- m: mandatory support. The item shall be implemented.
- c: conditional support. The item shall be implemented if the stated condition exists.
- o: optional support. The implementation may decide to implement the item.
- x: excluded. The implementation shall not implement this item.
- i: out-of-scope. The implementation of the item is not within the scope of this standard.
- F/S: Functional Standard. Should be applied.
- Base: Shall be applied in any application claiming conformance to this standard.

24.2 PICS

24.2.1 Profile conformance

Table 85 and Table 86 define the basic conformance statement.

Table 85 – PICS for A-Profile support

A-Profile shortcut	Profile Description	Client		Server		Value/comment
		F/S		F/S		
A1	Client/server A-Profile	c1		c1		Refer to 6.2
A2	GOOSE/GSE management A-Profile	c2		c2		Refer to 6.3
A3	GSSE A-Profile	c3		c3		Refer to 6.4
A4	TimeSync A-Profile	c4		c4		Refer to 6.5
c1 Shall be 'm' if support for any service specified in Table 2 are declared within the ACSI basic conformance statement. c2 Shall be 'm' if support for any service specified in Table 6 are declared within the ACSI basic conformance statement. c3 Shall be 'm' if support for any service specified in Table 9 are declared within the ACSI basic conformance statement. c4 Support for at least one other A-Profile shall be declared (e.g. in A1-A3) in order to claim conformance to IEC 61850-8-1.						

Table 86 – PICS for T-Profile support

T-Profile	Profile Description	Client		Server		Value/Comment
		F/S		F/S		
T1	TCP/IP T-Profile	c1		c1		Refer to 6.2
T2	OSI T-Profile	c2		c2		Refer to 6.2
T3	GOOSE/GSE T-Profile	c3		c3		Refer to 6.3
T4	GSSE T-Profile	c4		c4		Refer to 6.4
T5	TimeSync T-Profile	o		o		Refer to 6.5
c1 Shall be 'm' if support for A1 is declared. Otherwise, shall be 'i'. c2 Shall be 'o' if support for A1 is declared. Otherwise, shall be 'i'. c3 Shall be 'm' if support for A2 is declared. Otherwise, shall be 'i'. c4 Shall be 'm' if support for A3 is declared. Otherwise, shall be 'i'.						

24.2.2 MMS conformance

The following conformance statements are conditional upon the support of the client/server A-Profile (e.g. A1 see profile description in Clause 6) being declared.

Except where present, MMS conformance shall be in accordance with ISO/ISP 14226-2.

24.2.2.1 Character sets

24.2.2.1.1 MMS identifier

The MMS Identifier shall be constrained to BasicIdentifier.

The use of ExtendedIdentifier is deprecated.

24.2.2.1.2 MMSString

The MMSString shall be constrained to use the ISO646String character set. All other character sets are deprecated.

24.2.2.1.3 ObjectName

The MMS ObjectName shall be constrained to use BasicIdentifier. All other character sets are deprecated.

24.2.2.2 Environmental services

24.2.2.2.1 Initiate conformance

Table 87 and Table 88 specify the conformance of the initiate service.

Table 87 – MMS InitiateRequest general parameters

InitiateRequest	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
InitiateRequest						
localDetailCalling	m	m		m	m	
proposedMaxServOutstandingCalling	m	m	1 or greater	m	m	1 or greater
proposedMaxServOustandingCalled	m	m	1 or greater	m	m	1 or greater
initRequestDetail	m	m		m	m	
InitiateRequestDetail						
proposedVersionNumber	m	m	Shall be 2.1	m	m	Shall be 2.1
proposedParameterCBB	m	m	See 24.2.2.2.1.1	m	m	See 24.2.2.2.1.1
servicesSupportedCalling	m	m		m	m	
additionalSupportedCalling	c1	x		c1	x	
additionalCbbSupportedCalling	c1	x		c1	x	
privilegeClassIdentityCalling	c1	x		c1	x	
c1 Conditional upon Parameter CBB CSPI – see Table 90.						

Table 88 – MMS InitiateResponse general parameters

InitiateResponse	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
InitiateResponse						
localDetailCalled	m	m		m	m	
negotiatedMaxServOutstandingCalling	m	m	1 or greater	m	m	1 or greater
negotiatedMaxServOustandingCalled	m	m	1 or greater	m	m	1 or greater
initResponseDetail	m	m		m	m	
InitiateResponseDetail						
negotiatedVersionNumber	m	m	Shall be 2.1	m	m	Shall be 2.1
negotiatedParameterCBB	m	m	See 24.2.2.2.1.2	m	m	See 24.2.2.2.1.2
servicesSupportedCalled	m	m	See 24.2.2.2.1.1	m	m	See 24.2.2.2.1.1
additionalSupportedCalled	c1	x		c1	x	
additionalCbbSupportedCalled	c1	x		c1	x	
privilegeClassIdentityCalled	c1	x		c1	x	
c1 Conditional upon Parameter CBB CSPI – see Table 90.						

24.2.2.2.1.1 Services supported

Table 89 defines the service support requirement, and restrictions, for this standard. Relationship to ACSI services can be found in Table 1.

Table 89 – MMS service supported conformance table

MMS service supported CBB	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
status	o	o		o	m	
getNameList	o	o		o	c1	
identify	o	o		m	m	
rename	o	o		o	o	
read	o	o		o	c2	
write	o	o		o	c3	
getVariableAccessAttributes	o	o		o	c4	
defineNamedVariable	o	o		o	o	
defineScatteredAccess	o	i		o	i	
getScatteredAccessAttributes	o	i		o	i	
deleteVariableAccess	o	o		o	o	
defineNamedVariableList	o	o		o	o	
getNamedVariableListAttributes	o	o		o	c5	
deleteNamedVariableList	o	o		o	c6	
defineNamedType	o	i		o	i	
getNamedTypeAttributes	o	i		o	i	
deleteNamedType	o	i		o	i	
input	o	i		o	i	
output	o	i		o	i	
takeControl	o	i		o	i	
relinquishControl	o	i		o	i	
defineSemaphore	o	i		o	i	
deleteSemaphore	o	i		o	i	
reportPoolSemaphoreStatus	o	i		o	i	
reportSemaphoreStatus	o	i		o	i	
initiateDownloadSequence	o	i		o	i	
downloadSegment	o	i		o	i	
terminateDownloadSequence	o	i		o	i	
initiateUploadSequence	o	i		o	i	
uploadSegment	o	i		o	i	
terminateUploadSequence	o	i		o	i	
requestDomainDownload	o	i		o	i	
requestDomainUpload	o	i		o	i	
loadDomainContent	o	i		o	i	
storeDomainContent	o	i		o	i	
deleteDomain	o	i		o	i	
getDomainAttributes	o	o		o	c14	
createProgramInvocation	o	i		o	i	

MMS service supported CBB	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
deleteProgramInvocation	o	i		o	i	
start	o	i		o	i	
stop	o	i		o	i	
resume	o	i		o	i	
reset	o	i		o	i	
kill	o	i		o	i	
getProgramInvocationAttributes	o	i		o	i	
obtainFile	o	c9		o	c9	
defineEventCondition	o	i		o	i	
deleteEventCondition	o	i		o	i	
getEventConditionAttributes	o	i		o	i	
reportEventConditionStatus	o	i		o	i	
alterEventConditionMonitoring	o	i		o		
triggerEvent	o	i		o	i	
defineEventAction	o	i		o	i	
deleteEventAction	o	i		o	i	
alterEventEnrollment	o	i		o	i	
reportEventEnrollmentStatus	o	i		o	i	
getEventEnrollmentAttributes	o	i		o	i	
acknowledgeEventNotification	o	i		o	i	
getAlarmSummary	o	i		o	i	
getAlarmEnrollmentSummary	o	i		o	i	
readJournal	o	c13		o	c13	
writeJournal	o	o		o	o	
initializeJournal	o	o		o	c12	
reportJournalStatus	o	i		o	i	
createJournal	o	i		o	i	
deleteJournal	o	i		o	i	
fileOpen	o	c8		o	c8	
fileRead	o	c8		o	c8	
fileClose	o	c8		o	c8	
fileRename	o	i		o	i	
fileDelete	o	c9		o	c9	
fileDirectory	o	c11		o	c11	
unsolicitedStatus	o	i		o	i	
informationReport	o	c7		o	c7	
eventNotification	o	i		o	i	
attachToEventCondition	o	i		o	i	
attachToSemaphore	o	i		o	i	
conclude	m	m		m	m	
cancel	o	o		o	m	
getDataExchangeAttributes	o	c10		o	c10	
exchangeData	o	c10		o	c10	

MMS service supported CBB	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
defineAccessControlList	o	c10		o	c10	
getAccessControlListAttributes	o	c10		o	c10	
reportAccessControlledObjects	o	c10		o	c10	
deleteAccessControlList	o	c10		o	c10	
alterAccessControl	o	c10		o	c10	
reconfigureProgramInvocation	o	c10		o	c10	

c1 Shall be ‘m’ if logical device or logical node model support is declared in ACSI basic conformance statement.

c2 Shall be ‘m’ if logical node model support is declared in ACSI basic conformance statement or if support for the MMS write service is declared.

c3 Shall be ‘m’ if ACSI support for SetDataValues service is declared or implied.

c4 Shall be ‘m’ if logical node model support is declared in ACSI basic conformance statement.

c5 Shall be ‘m’ if data set support is declared in the ACSI basic conformance statement.

c6 Shall be ‘m’ if support for defineNamedVariableList is declared.

c7 Shall be 'm' if support for ACSI Report or ACSI command termination is declared.

c8 Shall be 'm' if support for ACSI GetFile is declared.

c9 Shall be 'm' if support for ACSI SetFile is declared.

c10 Shall not be present since MMS minor version is declared to be 1.

c11 Shall be 'm' if support for ACSI GetFileAttributeValues is declared.

c12 Shall be 'm' if support for the ACSI log model is declared.

c13 Shall be 'm' if support for the ACSI QueryLogByTime or QueryLogAfter is declared.

c14 Shall be 'm' if support for the ACSI logical device model is declared.

24.2.2.2.1.2 Parameter CBB

The specific settings for the MMS parameter CBB is specified in Table 90.

Table 90 – MMS Parameter CBB

MMS parameter CBB	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
STR1	o	o		o	c1	
STR2	o	o		o	o	
NEST	1	1 or greater		1	c2	
VNAM	o	o		o	c1	
VADR	o	o		o	o	
VALT	o	o		o	c1	
bit 5	x	x		x	x	
TPY	o	o		o	o	
VLIS	o	c1		o	c3	
bit 8	x	x		x	x	
bit 9	x	x		x	x	
CEI	o	i		o	i	
ACO	o	c4		o	c4	
SEM	o	c4		o	c4	
CSR	o	c4		o	c4	
CSNC	o	c4		o	c4	
CSPLC	o	c4		o	c4	
CSPI	o	c4		o	c4	
c1 Shall be 'm' if ACSI logical node model support declared. c2 Shall be five(5) or greater if ACSI logical node model support is declared. c3 Shall be 'm' if ACSI data set, reporting, GOOSE, or logging model support is declared. c4 Shall not be present. Receiving implementations shall assume not supported.						

24.2.2.2.2 GetNameList conformance

Table 91 defines the conformance of the GetNameList service.

Table 91 – GetNameList conformance statement

GetNameList	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
ObjectClass	m	m		m	m	
ObjectScope	m	m		m	m	
DomainName	o	o	24.2.2.1.1	m	m	24.2.2.1.1
ContinueAfter	o	m	24.2.2.1.1	m	m	24.2.2.1.1
Response+						
List Of Identifier	m	m	24.2.2.1.1	m	m	24.2.2.1.1
MoreFollows	m	m		m	m	
Response–						
Error Type	m	m		m	m	
NOTE Object class 'vmd' (formerly VMDSpecific in MMS V1.0) shall not appear. If a request contains this ObjectClass, an MMS Reject shall be issued.						

24.2.2.3 Variable access conformance

24.2.2.3.1 Supporting productions

24.2.2.3.1.1 AlternateAccessSelection

Table 92 defines the conformance of the alternate access selection.

Table 92 – AlternateAccessSelection conformance statement

AlternateAccessSelection	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
accessSelection	o	o		o	m	
component	o	o		o	m	
index	o	i		o	i	
indexRange	o	i		o	i	
allElements	o	i		o	x	
alternateAccess	o	o		o	m	
selectAccess	o	o		o	m	
component	o	o		o	m	
index	o	i		o	i	
indexRange	o	i		o	i	
allElements	o	i		o	x	

24.2.2.3.1.2 VariableAccessSpecification

Table 93 defines the conformance of the variable access.

Table 93 – VariableAccessSpecification conformance statement

VariableAccessSpecification	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
listOfVariable	o	o		o	c1	
variableSpecification	o	o		o	c1	
alternateAccess	o	o		o	c1	
variableListName	o	o		o	c2	
c1 Shall be 'm' if ACSI support for Logical Node Model is declared. c2 Shall be 'm' if ACSI support for ACSI DataSets, reporting, or logging is declared.						

24.2.2.3.1.3 VariableSpecification

Table 94 defines the conformance of the variable specification.

Table 94 – VariableSpecification conformance statement

VariableSpecification	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
name	o	o		o	m	
address	o	o		o	i	
variableDescription	o	o		o	i	
scatteredAccessDescription	o	x		o	x	
invalidated	o	x		o	x	

24.2.2.3.2 Read

Table 95 defines the conformance of the read service.

Table 95 – Read conformance statement

Read	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
specificationWithResult	o	o		o	m	
variableAccessSpecification	m	m	See 24.2.2.3.1.2	m	m	See 24.2.2.3.1.2
Response						
variableAccessSpecification	o	o		o	m	
listOfAccessResult	m	m		m	m	

24.2.2.3.3 Write

Table 96 defines the conformance of the write service.

Table 96 – Write conformance statement

Write	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
variableAccessSpecification	m	m	See 24.2.2.3.1.2	m	m	See 24.2.2.3.1.2
listOfData	m	m		m	m	
Response						
failure	m	m		m	m	
success	m	m		m	m	

24.2.2.3.4 InformationReport

Table 97 defines the conformance of the InformationReport service.

Table 97 – InformationReport conformance statement

InformationReport	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
variableAccessSpecification	m	m	See 24.2.2.3.1.2	m	m	See 24.2.2.3.1.2
listOfAccessResult	m	m		m	m	

24.2.2.3.5 GetVariableAccessAttributes

Table 98 defines the conformance of the GetVariableAccessAttributes service.

Table 98 – GetVariableAccessAttributes conformance statement

GetVariableAccessAttributes	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
name	o	o		m	m	
address	o	o		m	x	
Response						
mmsDeletable	m	m		m	m	
address	o	x		o	x	
typeSpecification	m	m		m	m	

24.2.2.3.6 DefineNamedVariableList

Table 99 defines the conformance of the DefineNamedVariableList service.

Table 99 – DefineNamedVariableList conformance statement

DefineNamedVariableList	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
variableListName	m	m		m	m	
listOfVariable	m	m		m	m	
variableSpecification	m	m		m	m	
alternateAccess	o	i		o	m	
Response	m	m		m	m	

24.2.2.3.7 GetNamedVariableListAttributes

Table 100 defines the conformance of the GetNamedVariableListAttributes service.

Table 100 –GetNamedVariableListAttributes conformance statement

GetNamedVariableListAttributes	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
ObjectName	m	m		m	m	
Response						
mmsDeletable	m	m		m	m	
listOfVariable	m	m		m	m	
variableSpecification	m	m		m	m	
alternateAccess	o	m		o	i	

24.2.2.3.8 DeleteNamedVariableList

Table 101 defines the conformance of the DeleteNamedVariableList service.

Table 101 – DeleteNamedVariableList conformance statement

DeleteNamedVariableList	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
Scope	m	m		m	m	
listOFVariableListName	m	m		m	m	
domainName	o	m		o	m	
Response						
numberMatched	m	m		m	m	
numberDeleted	m	m		m	m	
DeleteNamedVariableList-Error	m	m		m	m	

24.2.2.4 Journal management services

24.2.2.4.1 ReadJournal

Table 102 and Table 103 define the conformance of the ReadJournal service.

Table 102 – ReadJournal conformance statement

ReadJournal	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
invokeID	m	m		m	m	
journalName	m	m		m	m	
rangeStartSpecification	o	m		o	m	
startingTime	o	c1		o	m	
EntrytoStartAfter	o	o		o	m	
rangeStopSpecification	o	m		o	m	
endingTime	o	c2		o	m	
numberOfEntries	o	o		o	m	
EntryToStartAfter	o	c2		o	m	
TimeSpecification	m	m		m	m	
EntrySpecification	m	m		m	m	
Response						
invokeID	m	m		m	m	
listOfJournalEntry	m	m		m	m	
entryIdentifier	o	m		m	m	See 17.3.3.3.1
originatingApplication	m	m		m	m	
entryContent	m	m		m	m	
moreFollows	m	m		o	m	
c1 At least one shall be present. c2 At least one shall be present.						

Table 103 – JournalEntry conformance statement

Ref	Parameter	Client-CR			Server-CR		
		Base	F/S	Value/range	Base	F/S	Value/range
1	occurrenceTime	m	m		m	m	
2	additionalDetail	x	x		x	x	
3	entryForm	m	m		m	m	
4	data	o	m		o	c1	
5	event	o	m		o	o	
6	currentState	o	m		o	c2	
7	listofVariable	o	m		o	c3	
8	variableTag	o	m		o	c4	
9	valueSpecification	o	m		o	c4	
10	annotation	o	m		o	c1	
c1 Either data or annotation shall be present. c2 If event is present, then m. c3 If data is present, then m. c4 If listofVariable present, then m.							

24.2.2.4.2 InitializeJournal

Table 104 defines the conformance of the InitializeJournal service.

Table 104 – InitializeJournal conformance statement

InitializeJournal	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
journalName	m	m		m	m	
limitSpecification	m	m		m	m	
limitingTime	m	m		m	m	
limitingEntry	o	o		o	m	
Response+						
entriesDeleted	m	m		m	m	

24.2.2.5 File management services

24.2.2.5.1 FileDirectory

Table 105 defines the conformance of the FileDirectory service.

Table 105 – FileDirectory conformance statement

FileDirectory	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
filespecification	o	o		m	m	
continueAfter	o	o		m	m	
Response+						
listOfDirectoryEntry	m	m		m	m	
MoreFollows	m	m		m	m	

24.2.2.5.2 FileOpen

Table 106 defines the conformance of the FileOpen service.

Table 106 – FileOpen conformance statement

FileOpen	Client-CR			Server-CR		
	Base	F/S	Value/range	Base	F/S	Value/range
Request						
filename	m	m		m	m	
initialPosition	o	o		m	m	
Response+						
frsmID	m	m		m	m	
fileAttributes	m	m		m	m	