

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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National foreword

This British Standard is the official English language version of EN 61850-8-1:2004. It is identical with IEC 61850-8-1:2004.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power system control and associated communications, which has the responsibility to:

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**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
(IEC 61850-8-1:2004)**

Réseaux et systèmes de communication
dans les postes
Partie 8-1: Implémentation spécifique
des services de communication (SCSM) -
Cartographie avec MMS (ISO 9506-1
et ISO 9506-2) et l'ISO/CEI 8802-3
(CEI 61850-8-1:2004)

Kommunikationsnetze und -systeme
in Stationen
Teil 8-1: Spezifische Abbildung
von Kommunikationsdiensten (SCSM) -
Abbildungen auf MMS (nach ISO 9506-1
und ISO 9506-2) und ISO/IEC 8802-3
(IEC 61850-8-1:2004)

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European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

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Endorsement notice

The text of the International Standard IEC 61850-8-1:2004 was approved by CENELEC as a European Standard without any modification.

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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 routing 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 – Connectionless Session protocol: Protocol specification*

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

ISO/IEC 10035-1:1995, *Information technology – Open Systems Interconnection – Connectionless 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 Identifier
VLAN	Virtual LAN
VMD	Virtual Manufacturing Device
V-PUT	Virtual Put Function. Defined in ISO 9506-1
w	writable

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.

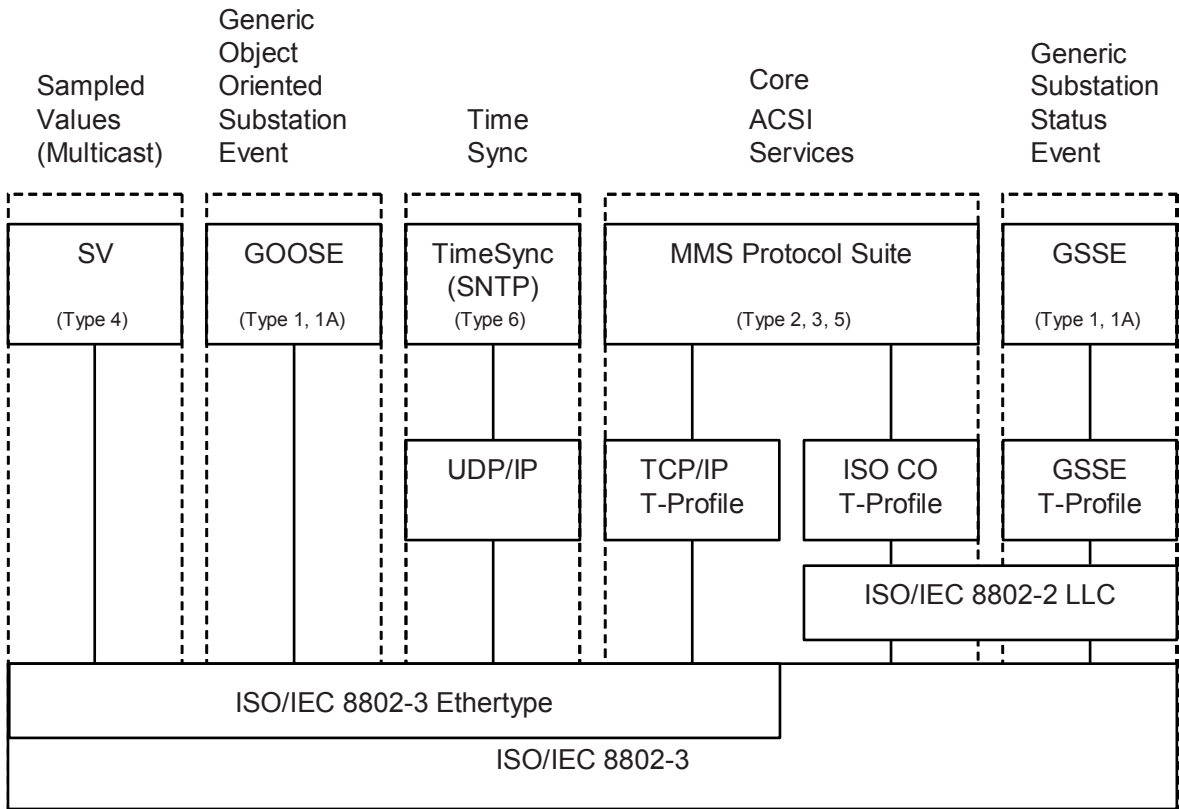
The communication requirements for substations (listed in IEC 61850-5) are met by the profiles shown in Figure 1.

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

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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.

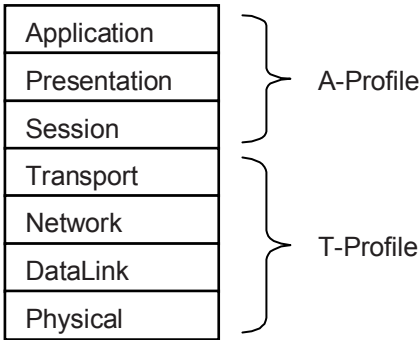
Table 1 – MMS objects and services in use within this SCSM

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.



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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
	DataSetValues
	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 11188-1 and 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 11188-1 and 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 3²

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.

MX
ST
CO
CF
DC
SP
SG
RP
LG
BR
GO
GS
SV
SE
MS
SC (SCL)
US
EX

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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. XCBR\$ST\$Pos).

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. XCBR\$ST\$Pos\$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.

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

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

8.1.3.7 EntryTime

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).

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:

8.1.3.9 UNICODE-STRING

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

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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.