INTERNATIONAL STANDARD

IEC 60870-6-503

Second edition
2002-04

Telecontrol equipment and systems –

Part 6-503:
Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Services and protocol

Matériels et systèmes de téléconduite –

Partie 6-503:
Protocoles de téléconduite compatibles avec les normes ISO et les recommandations de l'UIT-T – Services et protocole TASE.2

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CONTENTS

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TELECONTROL EQUIPMENT AND SYSTEMS –

Part 6-503: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Services and protocol

FOREWORD

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International Standard IEC 60870-6-503 has been prepared by IEC technical committee 57: Power system control and associated communications.

This second edition cancels and replaces the first edition published in 1997 and constitutes a technical revision.

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

FDIS	Report on voting
57/574/FDIS	57/582/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.

Annexes A and B form an integral part of this standard.

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

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- withdrawn;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

INTRODUCTION

The Telecontrol Application Service Element (TASE.2) protocol (also known as Inter-Control Centre Communications Protocol, ICCP) allows for data exchange over Wide Area Networks (WANs) between a utility control centre and other control centres, other utilities, power pools, regional control centres, and Non-Utility Generators. Data exchange information consists of real-time and historical power system monitoring and control data, including measured values, scheduling data, energy accounting data, and operator messages. This data exchange occurs between one control centre's Supervisory Control And Data Acquisition/Energy Management System/Distribution Management System (SCADA/EMS/DMS) host and another centre's host, often through one or more intervening communications processors.

This part of IEC 60870 defines a mechanism for exchanging time-critical data between control centres. In addition, it provides support for device control, general messaging and control of programs at a remote control centre. It defines a standardized method of using the ISO 9506 Manufacturing Message Specification (MMS) services to implement the exchange of data. The definition of TASE.2 consists of three documents. This part of IEC 60870 defines the TASE.2 application modelling and service definitions. IEC 60870-6-702 defines the application profile for use with TASE.2. IEC 60870-6-802 defines a set of standardized object definitions to be supported.

The TASE.2 describes real control centres with respect to their external visible data and behaviour using an object oriented approach. The objects are abstract in nature and may be used in a wide variety of applications. The use of TASE.2 goes far beyond the application in the control centre to control centre communications. This standard must be understood as a tool box for any application domain with comparable requirements. i.e. the TASE.2 may be applied in areas like substation automation, power plants, factory automation, chemical plants, or others which have comparable requirements. It provides a generic solution for advanced Information and Communication Technology.

The TASE.2 version number for this standard is 2001-08. See 8.2.3 for more details.

TELECONTROL EQUIPMENT AND SYSTEMS –

Part 6-503: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Services and protocol

1 Scope

This part of IEC 60870 specifies a method of exchanging time-critical control centre data through wide-area and local-area networks using a full ISO compliant protocol stack. It contains provisions for supporting both centralized and distributed architectures. This standard includes the exchange of real-time data indications, control operations, time-series data, scheduling and accounting information, remote program control and event notification.

Though the primary objective of TASE.2 is to provide control centre (telecontrol) data exchange, its use is not restricted to control centre data exchange. It may be applied in any other domain having comparable requirements. Examples of such domains are power plants, factory automation, process control automation, and others.

This standard does not specify individual implementations or products, nor does it constrain the implementation of entities and interfaces within a computer system. This standard specifies the externally visible functionality of implementations together with conformance requirements for such functionalities.

1.1 Control centre

The model of a control centre includes four primary classes of host processors: SCADA/EMS, Demand Side Management (DSM)/ Load Management, Distributed Applications, and Display Processors. The SCADA/EMS host is the primary processor, utilizing analogue and digital monitoring data collected at power plants, Non-Utility Generators, and transmission and distribution substations via Data Acquisition Units (DAUs) and Remote Terminal Units (RTUs). The control centre typically contains redundant SCADA/EMS/DMS hosts in a "hot standby" configuration. The DSM/Load Management host(s) are used by either an operator or EMS application to initiate load management activities. The Distributed Application host(s) perform miscellaneous analysis, scheduling, or forecasting functions. Display Processors allow for local operator and dispatcher display and control. Typically, the control centre will contain one or more Local Area Networks (LANs) to connect these various hosts. The control centre will also access several WANs, often through intermediate communications processors. These WAN connections may include the company-wide area network for communications with the corporate host and a distinct real-time SCADA network. Each control centre will also have one or more TASE.2 instances to handle data exchange with remote control centres.

Other classes of host processors like archive systems, engineering stations, or quality control systems (e.g. for data recording according to ISO 9000) may also be included. The application of the TASE.2 control centre model is in principle unlimited. This model provides a common and abstract definition applicable for any real systems which have comparable requirements.

1.2 Architecture

The TASE.2 protocol relies on the use of MMS services (and hence the underlying MMS protocol) to implement the control centre data exchange. Figure 1 shows the relationship of TASE.2, the MMS provider, and the rest of the protocol stack. In most cases, the values of objects being transferred are translated from/to the local machine representation automatically by the local MMS provider. Some TASE.2 objects require a common syntax (representation) and meaning (interpretation) by both communicating TASE.2 systems. This common representation and interpretation constitutes a form of protocol. The control centre applications are not part of this standard. It is assumed that these applications request TASE.2 operations and supply control centre data and functions to the TASE.2 implementation as needed. The specific interface between TASE.2 and the control centre applications is a local issue and not part of this standard.

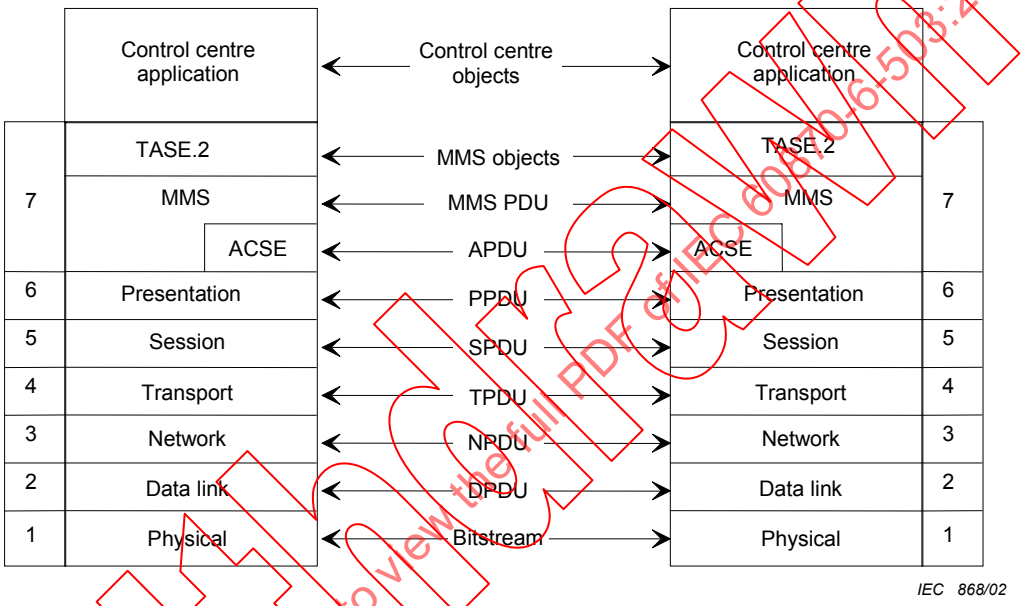

Figure 1 – Protocol relationships

The protocol architecture for TASE.2 requires the use of ISO protocols in layers 5-7 of the OSI reference model. The Transport Profiles (layers 1-4) may use virtually any standard or de-facto standard (including TCP/IP) connection-mode transport layer and connectionless-mode network layer services over any type of transmission media.

1.3 Network Model

The TASE.2 Data Exchange network may be either a private or public packet-switched or mesh network connecting communications processors which provide adequate routing functionality to allow for redundant paths and reliable service.

Figure 2 shows a typical network topology using a router-based Wide Area Network (WAN). The WAN provides routing and reliable service between control centres (which may include internal networks and routing capabilities).

The mesh network shown in figure 3 demonstrates the concept of redundant paths for a mesh network. Each control centre maintains its own series of direct circuits, and also provides a mechanism for routing between those direct circuits. Control Centre C provides an alternate routing path for network traffic going from Control Centre A to B. This network configuration requires key control centres to provide significant routing capabilities.

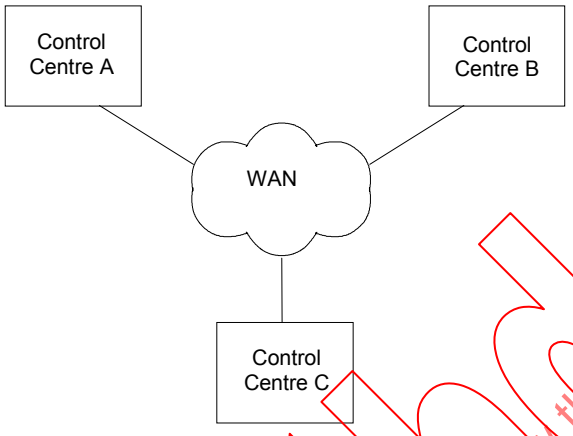

Figure 2 – Router-based WAN

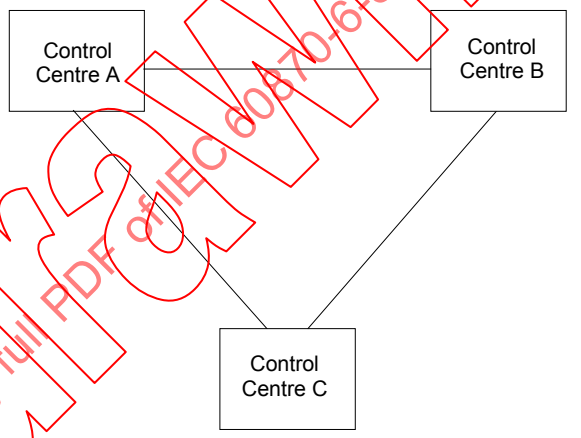

Figure 3 – Mesh network

1.4 Relation between TASE.2 and MMS

The TASE.2 resides on top of MMS. It describes a standardized application of MMS using the MMS services and protocol. TASE.2 enhances the functionality of MMS by specifying structured data mapped to MMS objects and assigning specific semantics to it. As an example of pure MMS services, MMS allows reading data from a remote system. The data will be responded without any specific condition. If these data are read depending on very specific conditions (e.g. on change only) then TASE.2 provides appropriate services which are not provided by MMS.

Though the specific requirements agreed upon within IEC TC 57 have led to the definition of TASE.2 there are several other application domains (outside the control centres) with less, very limited or mixed requirements which may use the TASE.2 services. These other areas are outside the scope of this standard but the use of TASE.2 goes far beyond the specific scope of this standard.

TASE.2 provides an independent and scaleable set of services to allow efficient implementations optimized for the respective requirements of a control centre. It does this by defining several conformance building blocks. MMS offers also a scaleability of its services specifying MMS Conformance Building Blocks (CBBs). A simple TASE.2 implementation requires only a simple MMS implementation.

TASE.2 and MMS provide their services to their respective users. MMS provides its services to TASE.2 and TASE.2 provides its services to the control centre application. MMS is an independent standard that can provide its services also to users other than TASE.2 – it may serve directly to specific control centre applications and to any other application. This means that the use of MMS is not restricted to TASE.2.

For requirements outside the scope of this standard or for future requirements, for example journaling of data, downloading and uploading of mass data like programs, additional MMS models and services, i.e. Journaling and Domain Loading respective can be applied by an real system in addition to TASE.2. This is possible because the additional application of MMS objects and services is independent of the use of TASE.2 and the use of MMS by TASE.2.

2 Normative references

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

IEC 60870-6-702:1998, *Telecontrol equipment and systems – Part 6-702: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – Functional profile for providing the TASE.2 application service in end systems*

IEC 60870-6-802:2002, *Telecontrol equipment and systems – Part 6-802: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Object models*

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

ISO/IEC 8208:2000, *Information technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment*

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

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 9506-1:2000, *Industrial automation systems – Manufacturing Message Specification – Part 1: Service definition*

ISO 9506-2:2000, *Industrial automation systems – Manufacturing Message Specification – Part 2: Protocol specification*

ISO/IEC 9542, *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 10589:1992, *Information technology – Telecommunications and information exchange between systems – Intermediate system to intermediate system intra-domain-routing exchange protocol for use in conjunction with the protocol for providing the connectionless-mode network Service (ISO 8473)*

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-independant 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 10608-5:1992, *Information technology – International Standardized Profile TAnnnn – Connection-mode Transport Service over Connectionless-mode Network Service – Part 5: TA1111/TA1121 profiles including subnetwork-dependent requirements for X.25 packet-switched data networks using virtual calls*

ISO/IEC ISP 10613-1:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 1: Subnetwork-independent requirements*

ISO/IEC ISP 10613-2:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 2: LAN Subnetwork-dependent, media-independent requirements*

ISO/IEC ISP 10613-3:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 3: CSMA/CD LAN subnetwork-dependent,media-dependent requirements*

ISO/IEC ISP 10613-5:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 5: Definition of profile RA51.51, relaying the Connectionless-mode Network Service between CSMA/CD LAN subnetworks*

ISO/IEC ISP 10613-7:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 7: PSDN subnetwork-dependent, media-dependent requirements for virtual calls over a permanent access*

ISO/IEC ISP 10613-8:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 8: Definition of profile RA51.1111, relaying the Connectionless-mode Network Service between CSMA/CD LAN subnetworks and PSDNs using virtual calls over a PSTN leased line permanent access*

ISO/IEC ISP 10613-9:1994, *Information technology – International Standardized Profile RA – Relaying the Connectionless-mode Network Service – Part 9: Definition of profile RA51.1121, relaying the Connectionless-mode Network Service between CSMA/CD LAN subnetworks and PSDNs using virtual calls over a digital data circuit/CSDN leased line permanent access*

ISO 8649, *Information processing systems – Open Systems Interconnection – Service definition for the Association Control Service Element*

3 Definitions

For the purposes of this part of IEC 60870, the following definitions apply. Much of the terminology used with this standard is derived directly from ISO 9506-1 and ISO 9506-2 (MMS). Refer to those standards for further definitions.

3.1
action
activity performed by the TASE.2 server under some defined circumstances

3.2
accounting information
set of information which describes an account for a utility. See IEC 60870-6-802 for more details

3.3
bilateral agreement
agreement between two control centres which includes the data elements to be accessed and the means to access them

3.4
bilateral table
computer representation of the bilateral agreement. The representation used is a local matter

3.5
client
communicating entity which makes use of the VCC for the lifetime of an association via one or more TASE.2 service requests

3.6
data set
data set represents a grouping of data values for singular operations by a TASE.2 user. Data sets allow for convenience in access by the TASE.2 user

3.7
data value
A data value represents some alphanumeric quantity that is part of the Virtual Control Centre (VCC) which is visible to a TASE.2 user. Data values exist as part of the implementation of the control centre and represent either real entities within the utility such as current, or derived values calculated in the control centre

3.8
instance
implementation of TASE.2 executed in either the client or the server role

3.9
interchange schedule
set of information that specifies how energy is transferred from one system to another. See IEC 60870-6-802 for more details

3.10
object
instance of a TASE.2 object model

3.11
object model
definition of an abstract representation that is used for real data, devices, operator stations, programs, event conditions, and event enrollments

3.12
operation
activity which shall be performed by the TASE.2 server at the request of the TASE.2 client

3.13
server
communicating entity which behaves as a VCC over the lifetime of an association

3.14
service
activity which is either a TASE.2 action or operation

3.15
tagged
the term is derived from the practice of putting a physical tag on a device as it is turned off for servicing or locked out from network access as a safety measure. The TASE.2 term is used to signal such a condition to the TASE.2 user

3.16
time series
set of values of a given element that is taken at different times as specified by a single time interval. A time series is implemented through the transfer set mechanism as defined within this specification

3.17
transfer account
set of information that associates interchange scheduling information with either hourly or profile data. See IEC 60870-6-802 for more details

3.18
transfer conditions
events or circumstances under which a TASE.2 server reports the values of a data set, values in a time series, or all transfer account information

3.19
transfer set
object used to control data exchange by associating data values with transmission parameters such as time intervals, for example there are four types of Transfer Sets: Data Set Transfer Sets, Time Series Transfer Sets, Transfer Account Transfer Sets, and Information Message Transfer Sets. A Data Set Transfer Set contains one or more data values which are each mapped to unique physical elements. A Time Series Transfer Set contains one or more data values which are all mapped to the same physical element, but represent its values at different times specified by a single time interval. A Transfer Account Transfer Set contains all of the values of all of the Transfer Accounts. An Information Message is used to manage the exchange of arbitrary binary or text messages or files

3.20
user
implementation of TASE.2 executed in either the client or the server role

3.21
virtual control centre (VCC)
abstract representation of a real control centre which describes a set of behaviour with regards to communication and data management functionality and limitations

4 Abbreviations

BCD	Binary Coded Decimal
CBB	Conformance Building Block
DMS	Distribution Management System
DSM	Demand Side Management
EMS	Energy Management System
ICC	Inter-Control Centre
MMS	Manufacturing Message Specification
QOS	Quality of Service
RBE	Report By Exception
SCADA	Supervisory Control And Data Acquisition
TAL	Time Allowed to Live
TASE.2	Telecontrol Application Service Element 2, also known as Inter-Control Centre Communications Protocol (ICCP)
TLE	Time Limit for Execution
TOD	Time Of Day
UCA	Utility Communications Architecture
VCC	Virtual Control Centre
VMD	Virtual Manufacturing Device

5 TASE.2 Model

The purpose of the TASE.2 model description is to provide a clear understanding of the TASE.2 protocol and its context within the utility control centre environment. This model identifies the basic components, object models and the operation of the protocol. This clause describes both an informal and formal model. In the informal model, different data types are described within the context of the utility control centre environment. In the formal model, the object models together with their specific operations and actions are described in detail. Clause 6 explains the mapping of the formal object models onto the MMS object models. Clause 7 explains the mapping of the operations and actions onto MMS services. Clause 8 summarizes specialized objects used internally by TASE.2.

5.1 Informal TASE.2 Model Description

The model of a control centre includes several different classes of applications, some or all of which may be present, such as SCADA/EMS, DSM/Load Management, Distributed Applications, and Man/Machine Interface. In interactions with other computing elements, a control centre may act as a client, server, or both. As a server, a control centre appears as a singular entity to the clients. The actual implementation may contain several processes and several host processors that are reflected in that logical entity. As a server, a control centre may interact with a number of clients. Control centres which exchange data do so within the rules and restrictions defined in a Bilateral Agreement. Typically, Bilateral Agreements restrict the client's view on a control centre to a subset of data that exists in the server.

TASE.2 is modelled as one or more processes operating as a logical entity which perform certain communications that allow the control centres to acquire or change data, and control devices. This specification defines the services and protocol for performing the communications between these processes. It also uses object models to define the data types and devices on which the TASE.2 services perform. TASE.2 is defined in terms of the client-server model of ISO 9506 (MMS).

The TASE.2 specification defines a number of operations and actions. TASE.2 operations are associated with a TASE.2 client. TASE.2 actions are associated with a TASE.2 server. There are two TASE.2 services that are considered to be both an operation and an action because either a TASE.2 client or a TASE.2 server may invoke them. These services are Conclude and Abort.

Each TASE.2 operation begins with a local TASE.2 instance, acting as a TASE.2 client, invoking a MMS service. This invocation causes the local MMS provider to make use of the MMS protocol to communicate with the remote MMS server associated with the TASE.2 server. The remote MMS server may deliver indications to the remote TASE.2 server, which in turn responds appropriately, invoking one or more MMS responses and/or services as defined in this standard.

A TASE.2 action begins with a local TASE.2 instance, acting as a TASE.2 server, invoking an MMS unconfirmed service. This invocation causes the local MMS provider to make use of the MMS protocol to communicate with the remote MMS client associated with the TASE.2 client. There are no corresponding MMS communications back from the client associated with this invocation. However, in some circumstances such as the acknowledgement of critical data, TASE.2 defines operations necessary for the client to perform when receiving an MMS indication from an unconfirmed MMS service. Thus, TASE.2 defines algorithms for both the client and server for each TASE.2 operation and action, respectively, in terms of:

– the relevant access control mechanisms;
– the mapping between TASE.2 objects and MMS objects;
– the MMS services and indications used;
– the relationship to real control centre functions.

The TASE.2 instances shall have the ability to interface with the local applications to store and retrieve current data, send/deliver operator messages, perform device control and access remote programs as agreed upon between the participating control centres. The specific mechanism for providing this functionality is outside the scope of this standard, and is a local implementation issue.

Figure 4 shows the logical relationships of TASE.2 to the control centre applications. The local TASE.2 instance uses the services of the local MMS provider to communicate with the remote TASE.2 instance. It should be noted that the actual relationships, structure, location, connectivity and interfaces between TASE.2 and the rest of the control centre is local to the control centre and outside the scope of this standard.

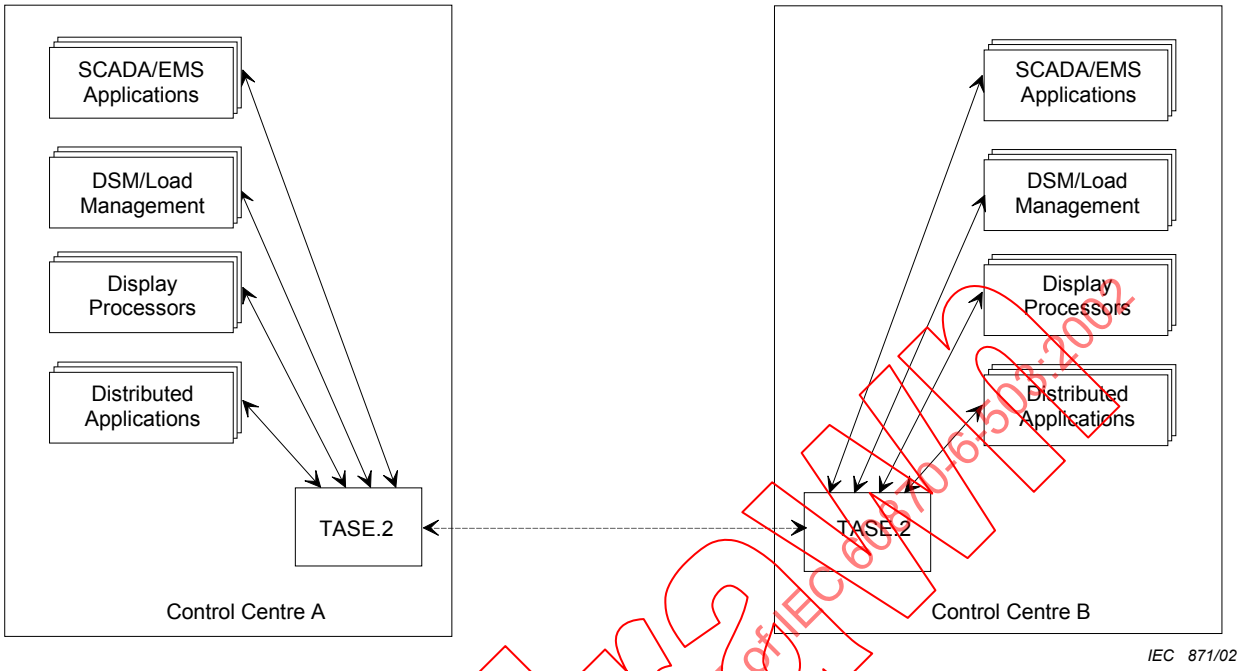

Figure 4 – Informal TASE.2 Model

5.1.1 Associations

TASE.2 association is based on the MMS model of an association. Associations occur between two TASE.2 instances. They are typically long running in that an association is established when two instances start, and remain in place as long as the instances are running and the underlying communications connections are maintained. TASE.2 instances are expected to remain running until an exception condition occurs (for example, an error, operator restart for reconfiguration, or maintenance downtime).

TASE.2 associations include an attribute for network Quality of Service (QOS). The QOS attribute includes such aspects as throughput, residual error rate, priority, transit delay, and protection. Different values for QOS for TASE.2 associations are either defined within this standard in a different clause or by another standard. They are not defined by the control centres or implementations.

The QOS attribute of an association is used within the Network layer Quality of Service parameter. When QOS is used, it is implemented by establishing at least one association between the two TASE.2 instances for each QOS value required. The TASE.2 client shall use an association which is appropriate to the QOS of the operation to be performed. The level of QOS for a TASE.2 association is determined by prior agreement between the control centres. Refer to IEC 60870-6-702 for more details regarding the mapping to the Network layer Quality of Service parameter.

Three TASE.2 operations are defined for use in managing associations: Associate, Conclude, and Abort. The Associate operation is used by a TASE.2 client (initiator) to establish an association with a TASE.2 server. The Conclude operation is used to terminate an association between two TASE.2 instances. Either TASE.2 client or server may terminate the association. The Abort operation is also used by either a TASE.2 client or server to terminate an association when there are failures in the underlying communications mechanisms. See 5.2.2 and 7.1.1 for more details. There are no TASE.2 actions for associations.

5.1.2 Bilateral Agreements, Bilateral Tables and Access Control

Access control is fundamentally the responsibility of the TASE.2 server in that all incoming requests from a TASE.2 client shall be validated before being satisfied. There is no protocol or messaging defined within TASE.2 for exchanging access control information except information used to signal access control violations. Implementors are therefore free to use any method of implementing access control, and may choose to implement only a subset of the access control as described in this standard without affecting interoperability.

When access control is implemented (i.e. when validation occurs and parameters are checked for each TASE.2 operation), the method of signalling violations impacts interoperability, and therefore shall be performed as defined in this standard. Access control of elements between control centres is implemented organizationally through Bilateral Agreements. A Bilateral Agreement is a document signed by two control centres which includes the elements (i.e. data and control elements) which each is willing to transmit to the other. These lists include, among other things, descriptions of data objects (e.g. all State Estimated MW, Mvar, and kV for substations X, Y and Z). The list of data objects to which Centre A is willing to let Centre B have access is distinct from the list of data objects to which Centre B is willing to let Centre A have access.

In order for the Bilateral Agreement to be used by a control centre application using TASE.2, the names of each of the data objects, devices, programs, etc. in the agreement should be maintained in physical data structures within the TASE.2 server. The computer representation of these physical data structures is called the Bilateral Table. While the actual format of the Bilateral Table is outside the scope of this standard, the information that shall be available to the TASE.2 server wishing to implement the full TASE.2 access control is described in this standard. A Bilateral Table is required if a control centre is going to serve any data values to any other control centre. It shall have a conceptual entry for each data object included in the Bilateral Agreement. Upon initiation of an association, the TASE.2 server checks the client control centre identifier provided in the association request to ensure that a Bilateral Agreement exists with that remote control centre.

The TASE.2 formal model defines the general access control requirements for TASE.2. See 5.2.1 for details.

5.1.2.1 General Validity Check

For any operations used by the TASE.2 client on any data objects or data sets after the association has been established, if the TASE.2 server is using an access control mechanism, it shall check to ensure that all identifiers referenced in the operation are valid and covered under the Bilateral Agreement. This is called the general validity check and it applies to all TASE.2 object types.

5.1.2.2 Data Value Object Access Control

In addition to the general access control requirements, the Bilateral Table shall contain for each Data Value object:

a) a method for retrieving the data values which correspond to the data identifier;

b) the parameters which define the maximum exchange rate and security of the object.

In addition to the general validity check, any operation used by the TASE.2 client to access Data Value objects shall be checked by the TASE.2 server to ensure that the parameters of the operations (e.g. time intervals, etc.) conform to the agreed to performance parameters for all referenced data identifiers.

5.1.2.3 Data Set Object Access Control

There are no additional access control requirements for Data Set objects.

5.1.2.4 Account Object Access Control

There are no additional access control requirements for Account objects.

5.1.2.5 Information Message Access Control

There are no additional access control requirements for Information Message objects.

5.1.2.6 Transfer Set Object Access Control

There are no additional access control requirements for Transfer Set objects.

5.1.2.7 Device Object Access Control

Every Device object that is visible via TASE.2 shall be included in the Bilateral Table along with its access control specification. In addition to the general access control requirements, the Bilateral Table shall contain for each Device object:

a) a mapping, if required, between the identifier of the device and the actual device;

b) a value to use for the CheckBackID attribute in response to the Select operation;

c) a value for the Timeout attribute.

In addition to the general validity check, any operation used by the TASE.2 client to access Device objects shall be checked by the TASE.2 server to ensure that the Device operation is performed within the Timeout attribute of the Device object.

5.1.2.8 Program Object Access Control

In addition to the general access control requirements, the Bilateral Table shall contain for each Program object:

a) a mapping, if required, between the program identifier and the internal identifier and system location of the program;

b) the list of Program operations allowed on the program.

In addition to the general validity check, any operation used by the TASE.2 client to access Program objects shall be checked by the TASE.2 server to ensure that the Program operation requested is allowed as specified in the Bilateral Table.

5.1.2.9 Event Enrollment Object Access Control

There are no additional access control requirements for Event Enrollment objects.

5.1.2.10 Event Condition Object Access Control

There are no access control requirements for Event Condition objects.

5.1.3 Data Value Objects and Services

Data Value objects are used to represent the values of control centre data objects. Data Value objects may be any control elements including, but not restricted to: points (analogue, digital, control), or data structures. These real elements are invisible to the TASE.2 user, and only accessible to remote control centres through the Data Value objects in the VCC. Data Value objects exist as part of the implementation of the control centre. They may also represent a value present in another VCC.

There are four TASE.2 operations defined for use with Data Value objects: Get Data Value, Set Data Value, Get Data Value Names, and Get Data Value Type. There are no TASE.2 actions for Data Value objects. All operations on Data Value objects shall be checked for access control permissions by the TASE.2 server. See 5.2.5 and 7.1.2 for more details.

5.1.4 Data Set Objects and Services

Data Set objects are ordered lists of Data Value object identifiers maintained by a TASE.2 server. These objects may be created by a TASE.2 server with or without a request to do so by a TASE.2 client. The Data Set object allows a simple, consistent view of the data by the client control centre, independent of the local storage mechanisms, locations and formats used within the server control centre.

Six TASE.2 operations are defined for manipulating Data Sets objects: Create Data Set, Delete Data Set, Get Data Set Element Values, Set Data Set Element Values, Get Data Set Names, and Get Data Set Element Names. There are no TASE.2 actions for Data Set objects. Data Set objects may be referenced within Transfer Set objects to allow for more complex data transfer mechanisms. See 5.2.6 and 7.1.2 for more details.

5.1.5 Account Objects and Services

Account objects are used to represent information on interchange scheduling and general accounting information. A schedule is a term that is generally used to refer to an amount of energy transferred from one system to another on a periodic basis. In this standard, exchanging schedules has been expanded to include the exchange of any periodic or profile data for control centre energy management. Thus, exchanging schedules also means exchanging generation, actual interchange, loads, price information, memo accounts, and stream flow data. The Transfer Account object models to meet these requirements are defined in detail in IEC 60870-6-802. There are no TASE.2 operations for these objects. For Transfer Account objects, TASE.2 uses Transfer Set objects and services for exchanging data by reporting schedules and accounts under conditions set by the client control centre. In addition, the Query service may be used to retrieve a particular set of schedule or account data.

5.1.6 Information Message Object and Services

The TASE.2 protocol includes an Information Message object for sending text or other data to an application at a remote control centre. An Information Message object consists of a header portion (identifying the source and purpose of the message) and an InfoStream portion, which contains the body of the message. The InfoStream is not limited to printable characters. The remote TASE.2 instance is responsible for checking the access control permissions to verify that the named Information Message object is defined in the Bilateral Table, and if it is, then delivering the message to the appropriate real destination. The mapping required to do this is an implementation issue local to the receiving implementation.

There are no TASE.2 actions for Information Message objects. For Information Message objects, TASE.2 uses Transfer Set objects and services for exchanging data by reporting messages (text or binary) based on conditions at the server.

5.1.7 Transfer Set Objects and Services

Some TASE.2 objects, such as Data Sets, a time series of a single Data Value, and Transfer Accounts, may be transferred in a more complex scheme in which these objects are set up to be reported periodically, on change of object states, or in response to particular server events. Even further, a critical data report mechanism has been defined which requires a confirmation to be sent by the TASE.2 client back to the TASE.2 server when the data has been successfully processed, including delivery to some other final destination in the client's control centre. The TASE.2 Transfer Set objects were designed to allow for the implementation of these more complex data transfers.

There are four different types of Transfer Sets: Data Set Transfer Sets, Time Series Transfer Sets, Transfer Account Transfer Sets and Information Message Transfer Sets. Data Set Transfer Sets include the data values of a single Data Set. Time Series Transfer Sets include the data values of a single Data Value object at different times as specified by a single time interval. Transfer Account Transfer Sets include all of the data in all of the Transfer Account objects. Information Message Transfer Sets are used to transfer arbitrary text strings and binary encoded data.

Each Transfer Set object contains a set of transmission parameters which define under what conditions the data values shall be transmitted from the TASE.2 server to the TASE.2 client. These transmission parameters and transfer conditions vary, and depend upon what kind of data is being transferred. For example, Data Set objects have transfer conditions which include interval timeout, value change, an integrity time out, or at operator request. The Data Set transmission parameters include start time, a report interval, an integrity check, a critical report indication, and a report by exception condition which informs the server to only include changed values in the report, and whether or not the data requires confirmation.

An event condition buffering timer is also included which informs the server to wait for some time interval after an initial event condition occurs, combining subsequent occurrences of event conditions for that Data Set Transfer Set object during the time interval into a single report. Time Series Transfer Sets and Transfer Account Transfer Sets have different transmission parameters and transfer conditions than do Data Set Transfer Sets. Information Message Transfer Sets do not contain either transmission parameters or transfer conditions, as these are application specific. See the formal model for Transfer Set objects for a more complete description of these Transfer Sets.

Also associated with each Transfer Set object is a corresponding set of reception parameters which define what type of processing shall be done whenever the data is received by the TASE.2 client. Reception parameters are created and used only by the TASE.2 client, and do not need to be transmitted, since they affect only the client control centre. The implementation of reception parameters and reception processing is a local issue and outside the scope of this standard [1)].

The Transfer Set object operations defined within TASE.2 are Start Transfer, Stop Transfer, Get Next DSTransfer Set Value, Get Next TSTransfer Set Value. The TASE.2 client sends a Start Transfer indication to the TASE.2 server with the transfer conditions, and the TASE.2 server then enables the appropriate Transfer Set object. A Stop Transfer indication is sent by the TASE.2 client to disable a Transfer Set object. The last two operations provides the TASE.2 client with the name of an available Transfer Set object for Data Set Transfer Set objects and Time Series Transfer Set objects, respectively.

[1)] Some examples of reception processing are:

- storage of the received data into the control centre data base;
- initiation of alarm processing for those data points whose received state warrants it;
- general messaging to the operator for logging purposes;
- local action to handle error condition of expected data values not received;
- delivery of the data to some other local application;
- invocation of some local program to process the incoming data values;
- update some local device.

In addition to the TASE.2 operations, there are two TASE.2 actions defined: Condition Monitoring and Transfer Report. The Condition Monitoring action is performed by the TASE.2 server whenever one or more Transfer Set objects have been enabled by the TASE.2 client, and one or more conditions have occurred which satisfy conditions in one or more of these Transfer Sets. The TASE.2 server shall monitor each of the conditions specified in the transmission parameters of all of the enabled Transfer Sets. When any of the conditions occur, the server initiates a Transfer Report action, described next, for all Transfer Set objects specifying that condition.

The Transfer Report action is used by a TASE.2 server to report back to the client the values for a Data Set object, a time series of a single Data Value object, a Transfer Account object referenced by a Transfer Set object whose conditions for transfer have occurred, or an Information Message. Attributes of the Transfer Set object set by the client inform the server of the appropriate mechanism to use in formatting the report. Based on the transmission parameters of the Transfer Set object, the server may be required to block the report (i.e. use a special encoding for the values).

Figure 5 summarizes the relationships between the objects to transfer and Transfer Reports. The Transfer Reports are created by the TASE.2 server and sent to the TASE.2 client when a pre-defined condition occurs involving an object identified by a Transfer Set object. The TASE.2 server monitors the conditions for all enabled Transfer Set objects. Transfer Reports have the new data values for the associated Data Value objects. See 5.2.9 and 7.1.4 for more details.

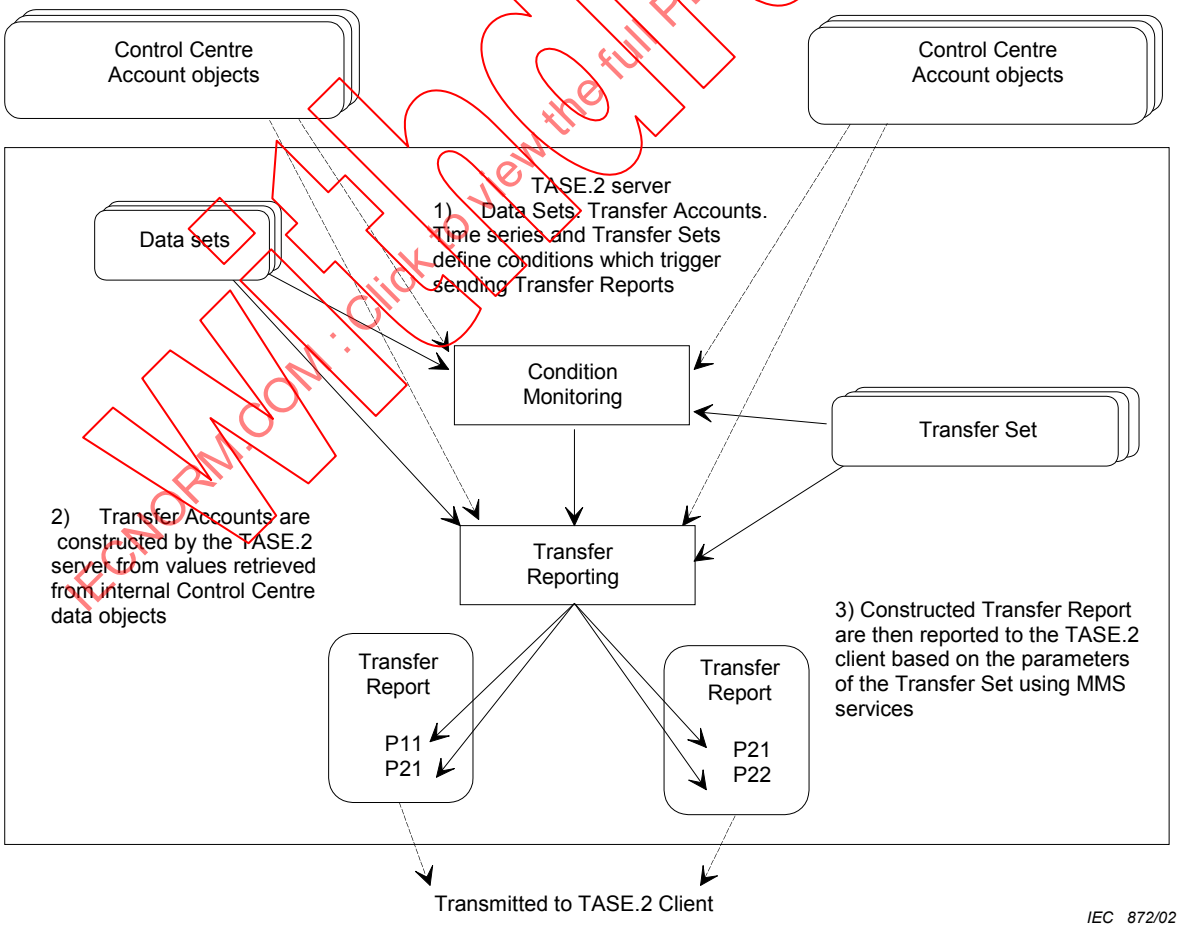

Figure 5 – Transfer Reporting Mechanism

The TASE.2 server keeps track of which Transfer Set objects are available, i.e. not yet enabled, and which are not available. For Data Set and Time Series Transfer Set objects, the VCC maintains a pool of names. When a TASE.2 client wishes to use a Transfer Set object for a Data Set or Time Series, it requests a name from the TASE.2 server. The TASE.2 server returns a name from the pool of names if there is one available. There are two TASE.2 operations used to do this: Get Next DSTransfer Set Value and Get Next TSTransfer Set Value. They shall retrieve the identifier of the next unused (not enabled) Transfer Set object for a Data Set or a Time Series, respectively. When a TASE.2 client disables a Transfer Set object by issuing a Stop Transfer, the name of the Transfer Set object gets put back into the pool of available names by the TASE.2 server. The data associated with any Transfer Set object that has its name in the available pool of names shall be considered invalid by the TASE.2 client.

5.1.8 Common Data Transfer Mechanisms

The following mechanisms are commonly used to exchange data between control centres:

a) One Shot Data

b) Periodic Data

c) Event Data

d) Exception Data

These mechanisms are performed using one or more of the TASE.2 operations.

5.1.8.1 One Shot Data

One Shot Data mechanisms are used to transfer data immediately, typically on behalf of a control centre application such as a State Estimator. The TASE.2 client requests the server to send the current value of one or more objects by using an appropriate "Get" operation associated with the particular object type. The TASE.2 server simply responds with the data values.

5.1.8.2 Periodic Data

Periodic Data mechanism is used to transfer a set of control centre object values within a strict time interval. For Data Sets, the TASE.2 client implements this mechanism by first invoking the Create Data Set operation and specifying a new Data Set object identifier and the list of Data Value objects whose values are to be transferred. This first step may not be necessary if the Data Set object has already been created by the TASE.2 server (i.e. by being predefined). For Data Sets, a time series of a single Data Value and Transfer Accounts, the client then chooses a Transfer Set object to control the exchange and invokes the Start Transfer operation, specifying the object identifier and the Transfer Set object to use, together with the proper transmission parameters. The TASE.2 server reports the values of the objects as requested until the Periodic Data operation is disabled by the TASE.2 client (Stop Transfer operation), or until the TASE.2 server terminates (for example, on reconfiguration or system maintenance).

5.1.8.3 Event Data

The Event Data mechanism is the same as Periodic Data mechanism except that the data values are transferred from the server to the client every time any one of a set of event conditions occurs at the server control centre. The TASE.2 client sets up Event Data mechanism using the same operations as in Periodic Data, but specifies any combination of event conditions within the transmission parameters. Some examples of event conditions are:

a) change in any of the status points in the Data Set object;

b) analogue limit or deadband violation for any of the analogue points in the Data Set object;

c) status or analogue data quality change for any of the points in the Data Set object (e.g. from normal quality to out-of-service);

d) change in a tag value in the Data Set object;

e) operator request at the TASE.2 server control centre;

f) other agreed-upon external events.

If requested by the client, these event conditions may be buffered over a specified time interval so that a quickly occurring sequence of event conditions (for example a series of related data points which change together but not quite simultaneously) can be made to cause only a single transfer.

5.1.8.4 Exception Data

The Exception Data mechanism is the same as that of the Periodic Data except that only the data values which have changed since the last report are included in a report. A change implies a status change, an analogue value changing by more than its deadband, or a quality state change. The transmission parameters for a Data Set object used in the Exception Data exchange mechanism may include an integrity check time interval. This interval specifies a reporting interval at which the TASE.2 server shall report all values in the Data Set object regardless of their changed status. It is the client's responsibility to retrieve the initial values (as One Shot Data) if no integrity scan is used.

5.1.9 Special Transfer Objects and Services

Four object models are defined for use with Transfer Reports to convey information about the Transfer Report generation process. They are:

a) Transfer Set Name – The name of the Transfer Set object which caused the Transfer Report.

b) Transfer Set Conditions – A bitstring indicating which Transfer Condition(s) triggered the transfer.

c) Transfer Set Time Stamp – The time of generation of the Transfer Report.

d) Transfer Set Event Code – If OtherExternalEvent condition, this integer indicates the external event which caused the transmission.

If these objects are included in a Data Set object, they cause all Data Set Transfer Reports generated for that Data Set object to automatically include the information. These objects are optional for Time Series Transfer Reports. Transfer Set Conditions and Transfer Set Time Stamp are required for Transfer Account Transfer Reports. See subsequent clauses on Transfer Sets for more information on Transfer Report generation and the use of these objects.

5.1.10 Device Objects and Services

Within the TASE.2 model, there are two distinct classes of controllable devices: Direct-Control (NonSBO) and Select-Before-Operate. The TASE.2 Device object is used to represent both. Direct Control Device objects may be operated on by the TASE.2 client at any time, subject to access control rights. Any device locking, tag checking, or integrity checking is performed invisibly by the TASE.2 server or other applications within the server control centre. The TASE.2 server notifies the TASE.2 client on device failure or success. Select-Before-Operate Device objects require the TASE.2 client to select the Device object before attempting to operate on it. The server shall check if the Device object is available and operable, and return success or failure of the client's select required depending upon the Device object's state.

Each instance of either Device type may have a Tag associated with it. Tags are usually used to prevent operation of a device.

The TASE.2 operations for Device objects are: Select, Operate, Get Tag Value, and Set Tag Value. The Select operation is used to request the selection of an SBO Device object only. It is not used for non-SBO Device objects. Operate is used to send a command to a Device Object in order to execute a function. The Get and Set Tag Value operations are used to read and write the current Tag value for a device.

NOTE Tag values can also be reported as Data Values in a Data Set or with Data Value operations.

Together with the success or failure indication, the response to a Select operation also includes an arbitrary value set by prior agreement between the control centres which may be used by the client to assure the identity of the device selected. Availability is checked both in terms of access control and in terms of not being selected by any other application. Device objects have two states: ARMED and IDLE. A Device object is IDLE if it has not been selected. When it is selected, it changes to the ARMED state. It remains in the ARMED state until either the TASE.2 client issues an Operate request, a timeout occurs (i.e. the TASE.2 client fails to issue an Operate request within a previously agreed upon time period), or until the Select is pre-empted by some local action[1)] such as tagging.

The Operate request includes a command for the Device object. The operation of the device is verified by the TASE.2 server to the TASE.2 client by a positive or negative response. A positive response to the Operate request indicates that the device received the command, but does not indicate if the command executed successfully. A TASE.2 action, explained in the next paragraph, provides this information. A negative response to the Operate request indicates that the device did not receive or accept the command.

The TASE.2 actions for Device objects are: Timeout, Local Reset, Success, and Failure. The Timeout action is used by the TASE.2 server to signal that the Device object has timed out of the ARMED State and is changing back into the IDLE State. If a timeout occurs (or any other action), the Device object is deselected and the TASE.2 client is notified through this action. Local Reset is used by the TASE.2 server to signal that the Device object state has been moved from the ARMED State to the IDLE State as a result of some local action. The Success action is used by the TASE.2 server to signal that an Operate operation has been successfully completed. The Failure action is used by the TASE.2 server to signal that an Operate operation has failed.

Within the TASE.2 model, the physical device need not, and typically will not, reside on the same system as the TASE.2 server. The TASE.2 server implementation of Operate will typically involve interaction with other control centre functions to actually select and operate the real device.

5.1.11 Program Objects and Services

TASE.2 allows a client to manipulate a program invocation at the server control centre. A Program object is used to represent a program invocation as defined by MMS. For all Program object operations, the program invocation name and the specific operation requested shall be in the Bilateral Agreement between the control centres. The TASE.2 Program object operations manipulate the state of the program invocation at the server control centre. The state descriptions included below are informative and are included to give the reader a high-level understanding of the MMS model. Refer to ISO 9506-1 for the definitive description of the Program Invocation Model.

There are six TASE.2 operations for Program objects: Start, Stop, Resume, Reset, Kill, and Get Program Attributes. Except for Get Program Attributes, each of these operations causes a Program object to change from one state to another. Program objects have the following states: IDLE, RUNNING, STOPPED, and UNRUNNABLE. Start changes the Program object state from IDLE to RUNNING. Stop changes the Program object state from RUNNING to STOPPED. Resume changes the Program object state from STOPPED to RUNNING.

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1) An example of communications to interlocked device control mechanisms is found in draft No. 3 of PC37.107 IEEE Standard for Digital Protective Relay Interfaces. That document provides a framework for distributed processing systems intended for protection and control of substations used in transmission and distribution. These stations utilize protective relaying equipment that detect power system faults reliably within a fraction of a power frequency cycle and respond by opening the appropriate power circuit-breakers to isolate the faulted circuit or piece of equipment. The control system for such stations must provide a secure environment for operators and maintenance personnel and to avoid undesired power outages. The TASE.2 interlocked device control mechanism allows devices within a substation to be controlled by a remote control centre, via the control centre that models the interlocked device and has direct access to either the substation computer or device. Pre-emptive rights are retained at the owning Control Centre's substation.

Reset changes the Program object state from the STOPPED state to the IDLE state or the UNRUNNABLE state depending upon the value of the Reusable attribute of that Program object. If the Reusable attribute is TRUE, then the Program object state shall change to IDLE. If the Reusable attribute is FALSE, then the Program object state shall change to UNRUNNABLE. Kill changes the Program object state to UNRUNNABLE.

There are no TASE.2 actions for Program objects.

Other program invocation states are included in the MMS model, and are used to model intermediate states that a real program invocation may traverse. They are STARTING, STOPPING, RESUMING and RESETTING.

Within the TASE.2 model, the remote program invocation need not reside on the same system as the TASE.2 server. The TASE.2 server of the remote program invocation may have to interact with other control centre functions to actually perform operations on the program invocation. This is a local matter. From the point of view of the TASE.2 client, the actual physical location of the remote program invocation may not be known.

5.1.12 Event Enrollment Objects and Services

TASE.2 uses event conditions at the server control centre to indicate when a particular data error has occurred, or when a device state has changed. When one of these situations happens, the TASE.2 server notifies the TASE.2 client. For a TASE.2 client to indicate to a TASE.2 server that it wants to be notified of a particular event condition, it needs to first enroll in the event. There is one object model associated with TASE.2 event enrollments: Event Enrollment. An Event Enrollment object designates the name of a TASE.2 client who requires a notification when event conditions have occurred, and includes the name of an Event Condition.

The TASE.2 operations for Event Enrollment objects are: Create Event Enrollment, Delete Event Enrollment, and Get Event Enrollment Attributes. There are no TASE.2 actions for Event Enrollment objects.

5.1.13 Event Condition Objects and Services

TASE.2 uses event conditions at the server control centre to indicate when a particular data error has occurred, or when a device state has changed. When one of these situations happens, the TASE.2 server notifies the TASE.2 client. Event Condition objects are predefined. There are no TASE.2 operations for Event Condition objects. There is one TASE.2 action for Event Condition objects: Event Notification.

5.2 Formal TASE.2 Model Description

The interaction between applications in different utility control centres takes place between communicating peers in support of the exchange of control information, monitoring information, or both. During the lifetime of any instance of a communications link or application association, a real system may adopt the client role, the server role, or both. This specification places no restrictions on the behaviour of a client, other than the implied requirement that the system acting in the client role be capable of issuing appropriate requests and receiving responses.

This clause specifies the model of a Virtual Control Centre, VCC. The model is an abstract description of those elements and resources in a control centre that are involved in communications between control centres, (i.e. inter-control centre communication) and the behaviour associated with managing the elements and resources. Since real control centres are also involved in intra-control centre communications, there are additional elements that exist for this. The model for these elements is not included in this standard.

A control centre exists at a supervisory level of control. As such, it contains objects that are its representation of other objects in the utility, such as the values of breakers. While some of the objects in the control centre are linked to other objects in the utility, they have different object classes. In addition, there are other objects that are unique to the control centre itself, such as schedules.

A typical control centre has a variety of software applications running on one or more processors, such as SCADA/EMS, DSM/Load Management, and Operator Stations. The VCC represents the entire collection of these real objects as a virtual model that can perform services for another control centre. There are many different implementation architectures that can perform the functions specified for control centre objects. The mapping from the real data elements to the abstract services is a function that shall be provided in any real implementation. However, the details of the mapping is a local issue and beyond the scope of this standard. Figure 6 shows the relationship between real control centres, the TASE.2 client and server, and the VCC.

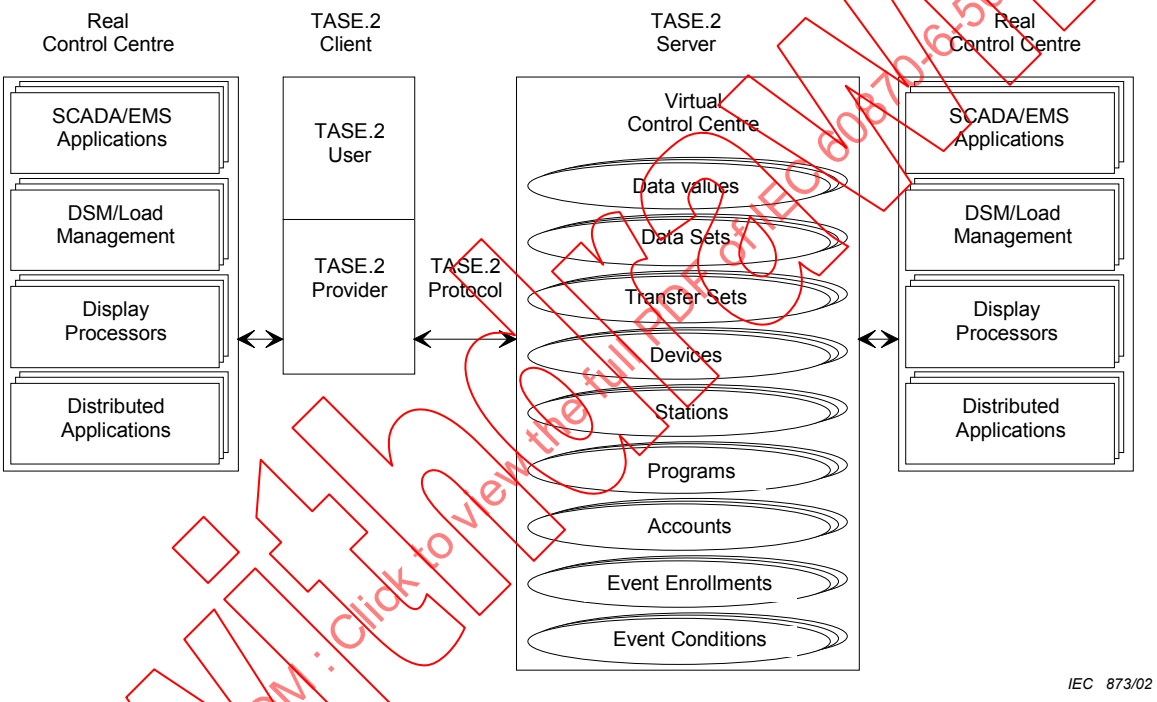

Figure 6 – Relationship between TASE.2 and Real Control Centres

The VCC model consists of the following:

Association object model and services

Bilateral Table object model (no services defined)

Data Value object model and services

Data Set object model and services

Transfer Account object models

Information Message object models

Transfer Set object models (DSTransfer Set, TSTransfer Set, TATransfer Set, and IMTransfer Set) and services

Special Transfer object models (no services defined)

Device object model and services

Program object model and services

Event Enrollment object model and services

Event Condition object model and services

Depending upon its purpose, function, and connectivity, a control centre may communicate with more than one client control centre. These communications are governed by a Bilateral Agreement that exists between two control centres. Whatever restrictions exist in the Bilateral Agreement shall affect the way TASE.2 objects are managed within the VCC. As seen from figure 6, the VCC may contain instances of any of the TASE.2 object models. Some object models are required to have one instance, such as the Next Transfer Set object model.

Some object models are defined to permit their instances to have a global scope, in that their instances may and could contain information that is relevant to more than just one other control centre. This global scope is defined as VCC-specific scope, e.g. a TASE.2 object instance shall have a VCC-specific scope if more than one client control centre needs to access it.

Other object models describe data and resources that have relevance to only one client control centre. Therefore, instances of these object models have a more limited scope. This scope, with relevance to only one client control centre, is called ICC-specific scope.

Some object models are defined to have either scope, i.e. their instances may have either VCC-specific or ICC-specific scope. In this case, the scope of a particular instance of the object model is determined by the applications used by the two control centres. The scope of an object only implies its relevance to one or more control centres. Scope has no implication regarding access control on the object instances.

A TASE.2 client is required to handle object models that have either a VCC-specific or ICC-specific scope. In all cases, the object model names are the network names of server data elements.

Table 1 indicates the scope of the object models in the VCC.

Table 1 – Scope of the object models in the VCC

Object model	VCC-specific	ICC-specific
Data Value	x	x
Data Set	x	x
Account		x
Information Message		x
Transfer Set		x
Device	x	x
Program	x	x
Special Transfer objects		x
Event Enrollment		x
Event Condition	x	

Regarding the Data Value and the Account object models, there exist object model descriptions in this standard not listed in the table above that are described in IEC 60870-6-802. Essentially, the Data Value and Account object models are placeholders for object model definitions of more specific real elements such as a data point, a control point, an interchange schedule, accounting information or a transfer account. Whenever a Data Value or Account object is referenced within this standard, it is meant to represent one of the more specific object models defined in IEC 60870-6-802.

Instances of Data Set object models with a VCC-specific scope cannot be created or deleted by a TASE.2 client. They may be made available by the server for use by clients with the other TASE.2 services.

5.2.1 General Access Control Requirements

A Bilateral Table is required if a control centre is going to serve any data values to any other control centre. A control centre shall have a Bilateral Table for each remote control centre it serves. The Bilateral Table has a conceptual entry for each data object and data set included in the Bilateral Agreement. The Bilateral Table object model is defined in 5.2.3. Each attribute in the object model is required to exist in some locally defined representation. Each data object specified in the Bilateral Table shall have an identifier which uniquely identifies the object.

The Client Control Centre Designation identifies the TASE.2 client control centre which is requesting an association with the TASE.2 server control centre. Upon the initiation of the association, the TASE.2 server shall check the Client Control Centre Designation that is provided in the association request to ensure that a Bilateral Agreement exists with this particular control centre. If one exists, the TASE.2 server shall continue with further checks in the association establishment process as explained in 7.1.1. If it does not exist, then the TASE.2 server shall refuse the association request.

The List of Application References in the Bilateral Table are the Application References that are identified with the control centre designated in the Client Control Centre Designation. For TASE.2, each Application Reference maps to a unique AE-title. See 6.2.3 for more details.

Upon the initiation of the association, after the TASE.2 server has checked the validity of the Client Control Centre Designation, it shall check the List of Application References in that particular client control centre Bilateral Table to ensure that the Application Reference provided in the association request is on the list. If it is on the list, the TASE.2 server shall continue with further checks in the association establishment process as explained in 7.1.1. If it is not on the list, then the TASE.2 server shall refuse the association request.

5.2.2 Association Management

Communication between a TASE.2 client and server takes place in a connection oriented manner over a reliable transport. There are three operations utilized for maintenance of this connection: Associate, Conclude, and Abort. This standard makes no restrictions on the number of associations that can exist between a TASE.2 client and a TASE.2 server. A TASE.2 server may limit these based on its capabilities.

5.2.2.1 Association Object Model

Model: Association
Key Attribute: Association Identifier
Attribute: Application Reference
Attribute: QOS
Attribute: Supported Features

Association Identifier
This attribute uniquely identifies the association with the TASE.2 server.

Application Reference
This attribute uniquely identifies the TASE.2 client Application Process (AP) and Application Entity (AE) with which the TASE.2 server has an association.

QOS
This attribute identifies the various aspects of Quality of Service used in the network layer. This attribute is specific to this association only.

Supported Features
The Supported Features attribute identifies the Building Blocks (see clause 9) supported in the TASE.2 server.

5.2.2.2 Associate Operation

This operation shall establish the connection between a TASE.2 client and TASE.2 server. Only TASE.2 clients are permitted to initiate this operation. When two TASE.2 users are capable of being both a client and a server, the side to initiate the associate operations shall be designated by prior agreement. The TASE.2 user defined to initiate associations shall attempt to initiate each association on start up and after any loss of connection. The TASE.2 client, following an Abort, may try to establish the associations at an alternate address. Implementations may have more than one association between two TASE.2 users to keep the information flowing from one to the other separate.

Additionally, with multiple associations, implementations may have a TASE.2 user act only as a TASE.2 client or TASE.2 server, or act as both. All TASE.2 implementations shall be able to act as either a TASE.2 client or a TASE.2 server over a single association, and may optionally act as both. If a site that can utilize one association for both client-server directions (i.e. dual use) attempts to establish an association with a site that does not support dual use, it is the responsibility of the dual use site to fall back to single use associations.

If an access control mechanism is being used, the TASE.2 server shall perform the actions described in the general access control requirements defined in this standard for establishing as association.

Once the association is established, and prior to issuing any other TASE.2 operations, the TASE.2 client (or both, if both act as a client during the association) shall read the Bilateral Table Version attribute and the TASE.2 Version attribute of the Bilateral Table at the TASE.2 server, and the Supported Features attribute of the Association object at the TASE.2 server. The order in which these attribute values are read, and whether or not they are interspersed with the following checks are outside of the scope of this standard.

The TASE.2 client shall compare the returned value of the Bilateral Table Version attribute with the value of its version identifier established in the Bilateral Agreement between the two corresponding control centres. If these values are not identical, the TASE.2 client shall issue a Conclude operation and perform no further Associate operations until the conflict is resolved. If these values are identical, then the TASE.2 client shall compare the value of the TASE.2 Version attribute returned by the TASE.2 server with the TASE.2 Version identifier established in their Bilateral Agreement. If the TASE.2 Version Number values do not match, the TASE.2 client shall issue a Conclude operation and perform no further Associate operations until the conflict is resolved. The TASE.2 client shall not, during the lifetime of this association, attempt to use any TASE.2 operation which is not included in the returned value of the TASE.2 server's Supported Features attribute.

For any operations used by the TASE.2 client on any data objects after the association has been established, if the TASE.2 server is using an access control mechanism, it shall perform the general validity check to ensure that all identifiers referenced in the operation are valid and covered in the Bilateral Table.

If a request for an association is received by a TASE.2 implementation from a peer control centre where the receiving implementation was designated as the TASE.2 association initiator with the peer, then the TASE.2 implementation shall refuse the connection.

5.2.2.3 Conclude Operation and Action

This operation shall bring about a graceful close to the connection. Either the client or the server may terminate an association using Conclude, making it both an operation and an action. Conclude is only used when one of the TASE.2 instances is being shut down or reconfigured. Conclude shall cause the underlying ACSE connection to be closed, and the TASE.2 client shall attempt to re-establish an association.

5.2.2.4 Abort Operation and Action

This operation shall bring about an abrupt termination of the connection. It shall be used when attempts to bring a graceful close fail and it is necessary to terminate the connection. Associations shall be aborted in response to failures in the underlying communications mechanism. Associations may also be aborted due to violations of the MMS protocols. Either the client or the server may terminate an association using Abort, making it both an operation and an action. Aborted connections are reported to associated applications or applications management functions in the control centres. The TASE.2 client shall attempt to re-establish an association.

5.2.3 Bilateral Tables

A Bilateral Table object is the representation of a Bilateral Agreement between two control centres. It contains information on which objects in the VCC can be accessed and which operations shall be permitted on those objects. The Bilateral Table has an object model but does not have any operations or actions defined for it within this specification.

5.2.3.1 Bilateral Table Object Model

Model: Bilateral Table

Key Attribute: Client Control Centre Designation
Attribute: Version
Attribute: TASE.2 Version
Attribute: Domain Name
Attribute: List of Application References
Attribute: List of Association Objects
Attribute: List of Data Value Objects and Access Control Specifications
Attribute: List of Data Set Objects and Access Control Specifications
Attribute: List of Information Message Objects and Access Control Specifications
Attribute: List of Transfer Account Objects and Access Control Specifications
Attribute: List of Transfer Set Objects and Access Control Specifications
Attribute: List of Device Objects and Access Control Specifications
Attribute: List of Program Objects and Access Control Specifications
Attribute: List of Event Enrollment Objects and Access Control Specifications

Client Control Centre Designation
The Client Control Centre Designation attribute identifies the TASE.2 client control centre for which the Bilateral Table is defined with this TASE.2 server.

Version
The Version attribute identifies a unique version of the Bilateral Table. If any changes are made to a Bilateral Table, then a new unique value for this attribute shall be generated.

TASE.2 Version
The TASE.2 Version attribute identifies a unique version of TASE.2. See 8.2.3 for the value of this attribute corresponding to this version of the TASE.2 specification.

Domain Name
The Domain Name attribute is the name of the TASE.2 Domain.

List of Application References
The List of Application References attribute indicates those TASE.2 client Application Processes and Application Entities which are permitted to establish associations with the TASE.2 server for which the Bilateral Table is defined. All Application References shall indicate the same client control centre, and it shall be the one indicated in the Client Control Centre Designation attribute.

List of Association Objects
This attribute indicates those Association objects that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Data Value Objects and Access Control Specifications
This attribute indicates those Data Value objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Data Set Objects and Access Control Specifications
This attribute indicates those Data Set objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Information Message Objects and Access Control Specifications
This attribute indicates those Information Message objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Transfer Account Objects and Access Control Specifications
This attribute indicates those Transfer Account objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Transfer Set Objects and Access Control Specifications
This attribute indicates those Transfer Set objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Device Objects and Access Control Specifications
This attribute indicates those Device objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute. Associated with each device is a value to be returned when that device is selected.

List of Program Objects and Access Control Specifications
This attribute indicates those Program objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

List of Event Enrollment and Access Control Specifications
This attribute indicates those Event Enrollment objects and access permissions that are defined for the remote control centre identified by the Client Control Centre Designation attribute.

See the clauses for the corresponding object model definitions. The VCC shall contain an Event Condition object named "Access_violation" which can be optionally signalled whenever there is an access violation on any of the VCC objects.

5.2.4 List of Access Control Specification

Many of the object models have a List of Access Control Specification attribute. This attribute is a list of Access Control Specification, i.e. access control information, which specifies the operations permitted on an instance of the object by the remote TASE.2 users. There shall be an Access Control Specification for each TASE.2 client that has (or intends to have) one or more associations with the TASE.2 server. There shall not be more than one Access Control Specification for any TASE.2 user. Access Control Specification is modelled as follows:

Model: Access Control Specification
Key Attribute: TASE.2 Client Name
Attribute: List of Permitted Access

For every TASE.2 client, there is a List of Permitted Access for every TASE.2 object in the TASE.2 server VCC. It indicates whether or not the object is visible to the TASE.2 client, and which services may be performed on the object by the TASE.2 client. This attribute is further defined in the clause for the object models that have a List of Access Control Specification attribute.

The List of Access Control Specification, Access Control Specification, and the List of Permitted Access are not mapped to any MMS Named Variables or MMS Named Types. Their implementation is a local matter.

5.2.5 Data Values

A generic object model for data values is described below. It is used only for descriptive purposes for this standard. However, a set of standardized TASE.2 object model definitions for data values is included in IEC 60870-6-802. Data Value objects are instances of an IndicationPoint, ProtectionEquipmentEvent, or Tag_Value object as described in that section.

The operations for Data Values objects are Get Data Value, Set Data Value, Get Data Value Names, and Get Data Value Type. There are no actions for Data Value objects.

5.2.5.1 Data Value Object Model

Model: Data Value
Key Attribute: Data Value Name
Attribute: List of Access Control Specification

Data Value Name
The Data Value Name attribute uniquely identifies the Data Value with either VCC-specific or ICC-specific scope.

List of Access Control Specification
The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Data Value objects is Visibility, Get Data Value, Set Data Value, and Get Data Value Type.

The Data Value object will either be an IndicationPoint, ProtectionEquipmentEvent, or Tag_Value as described in IEC 60870-6-802. The specific attributes associated with those objects are described there. In addition, vendor specific data types (including arbitrary text or binary coded data) may be included by external agreement.

5.2.5.2 Get Data Value Operation

The Get Data Value operation allows a TASE.2 user to obtain the Value attribute of a Data Value object from the VCC.

5.2.5.3 Set Data Value Operation

The Set Data Value operation allows a TASE.2 user to set the Value attribute of a Data Value object in the VCC.

5.2.5.4 Get Data Value Names Operation

The Get Data Value Names operation allows a TASE.2 user to obtain the list of names of all the Data Value objects in the VCC.

5.2.5.5 Get Data Value Type Operation

The Get Data Value Type operation allows a TASE.2 user to obtain the Type attribute for a Data Value object in the VCC.

5.2.6 Data Sets

A Data Set represents a grouping of Data Values for singular operations by a TASE.2 user. Data Sets allow for convenience in access by a TASE.2 user. With one operation, a TASE.2 user may perform an operation on one or more Data Value objects. While this capability is also provided by Data Value operations, a Data Set permits this to be specified by a singular name.

The Data Set object operations are: Create Data Set, Delete Data Set, Get Data Set Element Values, Set Data Set Element Values, Get Data Set Names, and Get Data Set Element Names. There are no Data Set object actions.

5.2.6.1 Data Set Object Model

Model: Data Set
Key Attribute: Data Set Name
Attribute: Data Set Scope (VCC-specific, ICC-specific)
Attribute: Transfer Set Name OPTIONAL
Attribute: DSConditions Detected OPTIONAL
Attribute: Event Code Detected OPTIONAL
Attribute: Transfer Set Time Stamp OPTIONAL
Attribute: List Of Data Value Objects
Attribute: List of Access Control Specification

Data Set objects may have either a VCC-specific or ICC-specific scope. Data Set objects may contain the Transfer Set Name, DSConditions Detected, Event Code Detected, and the Transfer Set Time Stamp attributes, as well as the List Of Data Value Objects, and List Of Access Control Specification Attributes.

Data Set Name
This attribute uniquely identifies the Data Set.

Data Set Scope
This attribute specifies either VCC-specific or ICC-specific scope.

Transfer Set Name
At the time of reporting, this attribute uniquely identifies the Transfer Set with which the Data Set is associated.

DSConditions Detected
At the time of reporting, this attribute uniquely identifies the conditions that caused the generation of the report. See 5.2.6.1.1 for a description of this attribute.

Event Code Detected
At the time of reporting, this attribute uniquely identifies the event code that caused the generation of the report. This attribute shall only be considered valid if the OtherExternalEvent condition is set in the DSConditions Detected object.

Transfer Set Time Stamp
At the time of reporting, this attribute specifies the time the Transfer Report was generated at the TASE.2 server.

List of Data Value Objects
The List of Data Value objects attribute is an ordered list of names of Data Value objects.

List of Access Control Specification

The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Data Set objects is Visibility, Delete Data Set, Get Data Set Element Values, Set Data Set Element Values, and Get Data Set Element Names.

5.2.6.1.1 DSConditions Detected Object Model

This object model defines the conditions that have been detected which caused a Transfer Report to be sent for a Data Set object.

Model: DSConditions Detected
Attribute: IntervalTimeOut
Attribute: ObjectChange
Attribute: OperatorRequest
Attribute: IntegrityTimeOut
Attribute: OtherExternalEvent

IntervalTimeOut
At the time of reporting, this attribute indicates whether or not the TASE.2 server sent the report because the Interval time arrived.

ObjectChange
At the time of reporting, this attribute indicates whether or not the TASE.2 server sent the report because one or more of the objects in the Data Set changed. Possible changes include a change of value, status, or the quality flag.

OperatorRequest
At the time of reporting, this attribute indicates whether or not the TASE.2 server sent the report because an operator at the TASE.2 server control centre requested it.

IntegrityTimeOut
At the time of reporting, this attribute indicates whether or not the TASE.2 server sent the report of the entire Data Set because the Integrity Check time interval expired. This only happens when RBE is true.

OtherExternalEvent
At the time of reporting, this attribute indicates whether or not the TASE.2 server sent the report because some other external event condition that is not described in the other conditions became true.

5.2.6.2 Create Data Set Operation

The Create Data Set operation allows a TASE.2 user to create a Data Set object in the VCC. This operation shall only be performed on Data Set objects of ICC-specific scope.

5.2.6.3 Delete Data Set Operation

The Delete Data Set operation allows a TASE.2 user to delete a Data Set object in the VCC. This operation shall only be performed on Data Set objects of ICC-specific scope.

5.2.6.4 Get Data Set Element Values Operation

The Get Data Set Element Values operation allows a TASE.2 user to obtain the Value attribute of each of the Data Value objects identified in the List of Data Value attribute.

5.2.6.5 Set Data Set Element Values Operation

The Set Data Set Element Values operation allows a TASE.2 user to set the Value attribute of each of the Data Value objects identified in the List of Data Value attribute.

5.2.6.6 Get Data Set Names Operation

The Get Data Set Names operation allows a TASE.2 user to obtain the list of names for all of the Data Set objects in the VCC.

5.2.6.7 Get Data Set Element Names Operation

The Get Data Set Element Names operation allows a TASE.2 user to obtain the name of each of the Data Value objects identified in the List of Data Value attribute.

5.2.7 Accounts

There are several types of objects for Accounts as defined in IEC 60870-6-802, including Transfer Account, Device Outage, Power Plant, General Data Report, and General Data Response. There are no TASE.2 operations defined for these objects. Transfer Set objects are used to report the values based on conditions established by the client. In addition, the Query operation may be used to request particular information about a schedule or account.

5.2.7.1 Accounts Models

The models for these objects are defined in IEC 60870-6-802.

5.2.7.2 Query Operation

The Query operation allows the TASE.2 user to request an account based on the account reference number, start time, and duration.

5.2.8 Information Messages

The Information Message provides a mechanism which may be used by either a client or server at any time to send either text or binary data. The Information Message may be used in a variety of ways, possible examples include sending a text message to an application supporting an operator station or historical log. Parameters in the Information Message are intended for use in mapping the Information Message to a particular application at the receiving site; details of this mapping are a local issue. The TASE.2 Information Message uses the MMS Named Variable List object and the Information Report service.

5.2.8.1 Information Message Object Model

The Information Message Object Model is defined as follows:

Model: Information Message
Key Attribute: Info Reference
Attribute: LocalReference
Attribute: MessageId
Attribute: Size
Attribute: Info Stream

Info Reference
The Info Reference attribute uniquely identifies the object with either VCC-specific or ICC-specific scope. It is used to identify and/or trigger the processing of the Information Message by applications at the receiving system.

Local Reference
The Local Reference attribute specifies a value agreed upon between sender and receiver of the Information Message. It further identifies the Information Message.

MessageId
The MessageId attribute is used to identify different instances of an Information Message object.

Size
This is the number of octets of the Info Stream that are valid.

Info Stream

This attribute contains an octet stream of the information being sent. The format and interpretation of the contents are locally determined.

5.2.9 Transfer Sets

There are four Transfer Set object models: one for a Data Set, one for a time series for a single Data Value (i.e. Time Series), one for the entire set of Transfer Accounts, and one for Information Messages. There are four operations for Transfer Set objects: Start Transfer, Stop Transfer, Get Next DSTransfer Set Value, and Get Next TSTransfer Set Value. There are two actions for Transfer Sets: Condition Monitoring and Transfer Report.

Each type of Transfer Set object has an attribute called Status which has two values: ENABLED and DISABLED. When the TASE.2 client enables a Transfer Set object, it shall assign values to all of the components in the Transfer Set object's type.

When a Transfer Set object Status is DISABLED, all of the data in the Transfer Set object shall be considered to be in an indeterminate state. Furthermore, if the name of the Transfer Set was dynamically allocated using either the Get Next DSTransfer Set Value or the Get Next TSTransfer Set Value operation, its name shall go back into the pool of available Transfer Set names.

If the name of the Transfer Set was dynamically allocated using either the Get Next DSTransfer Set Value or the Get Next TSTransfer Set Value operation, a TASE.2 client shall not issue a Start Transfer operation on a Transfer Set object after issuing a Stop Transfer operation.

5.2.9.1 Data Set Transfer Set Object Model

Model: Data Set Transfer Set
Key Attribute: Transfer Set Name
Attribute: Data Set Name
Attribute: DSTransmissionPars
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: Event Code Requested
Attribute: List of Access Control Specification

Transfer Set Name
The Transfer Set Name uniquely identifies the Data Set Transfer Set object with an AA-specific scope.

Data Set Name
The Data Set Name identifies a particular Data Set object whose values are being requested by the client.

DSTransmissionPars
This attribute includes all values required to fully specify when and how the TASE.2 server is to send the values of the Data Set object. Its object model definition is described in 5.2.9.1.1 and 6.9.1.1.

Association Identifier
The Association Identifier attribute uniquely identifies the association over which the Transfer Report is to be sent.

Status
The Status attribute may be either ENABLED (to request that Condition Monitoring action be executed) or DISABLED (to cease Condition Monitoring by the VCC).

Event Code Requested
The Event Code Requested attribute indicates which other external event shall trigger the condition. This attribute shall be considered valid only when the OtherExternalEvent condition flag is set in the DSConditions Requested attribute of the Data Set Transfer Set object.

List of Access Control Specification

The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Transfer Set objects is Visibility, Start Transfer, Stop Transfer, and Get Next DSTransfer Set Name.

5.2.9.1.1 DSTransmissionPars Object Model

This object model defines the transmission parameters for Data Set Transfer Sets.

Model: DSTransmissionPars
Attribute: Start Time
Attribute: Interval
Attribute: TLE
Attribute: Buffer Time
Attribute: Integrity Check
Attribute: DSConditions Requested
Attribute: Block Data
Attribute: Critical
Attribute: RBE
Attribute: All Changes Reported OPTIONAL

Start Time
Time value for the TASE.2 server to begin the Condition Monitoring. If Start Time is zero, then the TASE.2 server shall assume it to be its current time and shall begin Condition Monitoring immediately.

Interval
Time interval between TASE.2 server reports. The Interval starts when the Start Time occurs. If RBE is false, then the current state of all objects in the Data Set are reported when the Interval expires. If RBE is true, then the current state of only the changed objects in the Data Set are reported when the Interval expires. If multiple changes occur to the same object during the Interval and All Changes Reported is false, then only the final value is reported. However, if All Changes Reported is true, than all changes that occurred to the same object during the interval are reported.

TLE[1)]
Time value for Time Limit for Execution. This is a time that is primarily relevant to the TASE.2 server. It is the time interval during which the TASE.2 server has to send the Data Set Transfer Report to the TASE.2 client. If the TASE.2 server anticipates that it cannot send the Data Set Transfer Report to the TASE.2 client within the TLE time, then it shall not generate the report, and shall discard the data.

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1) The TASE.2 client may wish to keep track of the time over which a Data Set Transfer Set is considered valid. This has been referred to as Time Allowed to Live, or TAL. There are no requirements in the TASE.2 specification for TAL. However, implementations may choose to use TAL.

Buffer Time
Time interval for buffering the ObjectChange condition before reporting to the TASE.2 client. The Buffer Time starts when the first ObjectChange condition occurs. If RBE is false, then the current state of all objects in the Data Set are reported when the Buffer Time expires. If RBE is true, then the current state of only the changed objects in the Data Set are reported when the Buffer Time expires. If the Buffer Time is zero, then a report is generated for each change. If multiple changes occur to the same object during the Buffer Time and Report All Changes is false, then only the final value is reported. If Report All Changes is true, then all changes to the same object during the Buffer Time are reported.

Integrity Check
Time value for integrity check when IntegrityTimeOut condition is used.

DSConditions Requested
This attribute specifies which conditions shall be monitored by the TASE.2 server. See 5.2.9.1.2 for a description of this attribute.

Block Data
A Boolean flag controlling type of Transfer reporting mechanism to be used. True means block the Transfer Report.

Critical
A Boolean flag controlling type of Transfer Report acknowledgement. True means that the Transfer Report is critical and an acknowledgement from the TASE.2 client back to the TASE.2 server is expected.

RBE

A Boolean flag controlling Report By Exception mechanism. True implies that the changed objects are reported. The report may occur via two mechanisms: (1) List of only changed object values as a List Of Variables; (2) If (1) is anticipated to exceed the negotiated maximum MMS PDU size, then the entire Transfer Set may be transferred as a Named Variable List. See 7.1.4.4.2 for more details.

All Changes Reported
A Boolean flag indicating the number of changes of a given Data Value that may be reported in a single Transfer Report when RBE is true and Buffer Time is non-zero. True means all value changes within the stated buffer period are reported. False means only the last change (assuming there is more than one change of value in the buffer period) is reported in the Transfer Set.

It is the client's responsibility to retrieve the initial values of the Data Set. If the current time is less than the Start Time, then the TASE.2 server shall wait until the Start Time occurs to begin condition monitoring. If the current time is past the Start Time, then the TASE.2 server shall begin condition monitoring immediately.

5.2.9.1.2 DSConditions Requested Object Model

Model: DSConditions Requested
Attribute: IntervalTimeOut
Attribute: IntegrityTimeOut
Attribute: ObjectChange
Attribute: OperatorRequest
Attribute: OtherExternalEvent

IntervalTimeOut
This attribute indicates whether or not the TASE.2 server shall send a report when the Interval time arrives.

IntegrityTimeOut
This attribute indicates whether or not the TASE.2 server shall send a report of the entire Data Set when the Integrity Check time interval expires. This only applies when RBE is TRUE. When RBE is FALSE, the IntervalTimeOut can be used to send periodic reports.

ObjectChange
This attribute indicates whether or not the TASE.2 server shall send a report when any object in the Data Set changes. Possible changes include a change of value, status, or the quality flag.

OperatorRequest
This attribute indicates whether or not the TASE.2 server shall send a report when an operator at the TASE.2 server control centre requests it.

OtherExternalEvent

This attribute indicates whether or not the TASE.2 server shall send a report when any other external event condition that is not described in the other conditions becomes true.

5.2.9.2 Time Series Transfer Set Object Model

Model: Time Series Transfer Set
Key Attribute: Transfer Set Name
Attribute: Data Value Name
Attribute: Begin Time
Attribute: End Time
Attribute: Sampling Interval
Attribute: Reporting Interval
Attribute: TSTransmissionPars
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: List of Access Control Specification

Transfer Set Name
The Transfer Set Name uniquely identifies the Time Series Transfer Set object with AA-specific scope.

Data Value Name
The Data Value Name identifies a particular Data Value object whose time series is being requested by the client.

Begin Time
This attribute specifies the time to start collecting data values in the time series for a Data Value object. Begin Time may specify past time, current time, and future time. If Begin Time is zero, then the TASE.2 server shall assume it to be its current time and shall begin collecting data values immediately.

End Time
This attribute specifies the time to stop collecting data values in the time series for a Data Value object. End Time may specify past time, current time, and future time. When End Time occurs, the TASE.2 server shall stop collecting values, generate the Transfer Report, and send it to the TASE.2 client. If End Time is zero, then the TASE.2 server shall assume it to be its current time and shall stop collecting data values which have time stamps after this time (which can occur if Begin Time specifies a past time), generate the Transfer Report and send it to the TASE.2 client.

Sampling Interval
This attribute specifies the time interval between collecting data values in the time series for a Data Value object.

Reporting Interval
This attribute specifies the time interval between information report generation in the time series for a Data Value object.

TSTransmissionPars
This attribute includes all values required to fully specify when and how the TASE.2 server is to send the time series data of the Data Value object. See 5.2.9.2.1 for a description of this attribute.

Association Identifier
The Association Identifier attribute uniquely identifies the association over which the Transfer Report is to be sent.

Status
The Status attribute may be either ENABLED (to request that Condition Monitoring action be executed) or DISABLED (to cease Condition Monitoring by the VCC).

List of Access Control Specification

The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Transfer Set objects is Visibility, Start Transfer, Stop Transfer, and Get Next TSTransferSet Name.

5.2.9.2.1 TSTransmissionPars Object Model

This object model defines the transmission parameters for Time Series Transfer Sets.

Model: TSTransmissionPars
Attribute: TSConditions Requested
Attribute: Block Data

TSConditions Requested
This specification defines the conditions for monitoring time series data. See 5.2.9.2.2 for details.

Block Data
A Boolean flag controlling type of Transfer reporting mechanism to be used. True means block the Transfer Report.

5.2.9.2.2 TSConditions Requested Object Model

This object model defines the conditions that shall be monitored for Time Series Transfer Sets.

Model: TSConditions Requested
Attribute: EndTimeArrived
Attribute: ReportIntervalTimeOut
Attribute: OperatorRequest

EndTimeArrived
This attribute indicates whether or not the TASE.2 server shall send a report for the time series data at the time specified by the End Time attribute.

ReportIntervalTimeOut
This attribute indicates whether or not the TASE.2 server shall send a report for the time series data upon the initial enabling of the TSTransferSet, and at the periodic interval specified by the Reporting Interval attribute thereafter.

OperatorRequest

This attribute indicates whether or not the TASE.2 server shall send a report when an operator at the TASE.2 server control centre requests it.

The conditions EndTimeArrived and ReportIntervalTimeOut are mutually exclusive. The OperatorRequest may be specified with either the EndTimeArrived or IntervalTimeOut conditions. The EndTimeArrived condition provides a way for a one shot read of a Time Series.

The ReportIntervalTimeOut condition provides a periodic reporting of the Time Series. Upon the enabling of the Time Series Transfer Set, if Begin Time specifies past time, an information report shall be generated containing all of the past values available from Begin Time to the current time. If no past values are available, then no report will be generated. Subsequent reports shall be sent according to the Reporting Interval, and shall contain only the values collected since the last information report generation. For historical data, if the historical values are not time stamped with the same sampling period, extrapolation shall be performed.

The OperatorRequest condition shall cause the server to report the values collected since the last report was sent. If the OperatorRequest condition and the EndTimeArrived condition was specified in the TSConditions Requested attribute of the TSTransmissionPars, and the OperatorRequest condition is detected, a report shall be generated containing the values from the Begin Time to the current time. When the EndTimeArrived condition becomes true, all values collected since the last report shall be included in the information report.

5.2.9.3 Transfer Account Transfer Set Object Model

Model: Transfer Account Transfer Set
Key Attribute: Transfer Set Name
Attribute: TATransmissionPars
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: List of Access Control Specification

Transfer Set Name
The Transfer Set Name uniquely identifies the Transfer Account Transfer Set object with AA-specific scope.

TATransmissionPars
This attribute includes all values required to fully specify when and how the TASE.2 server is to send all of the data in all of the Transfer Accounts. See 5.2.9.3.1 for a description of this attribute.

Association Identifier
The Association Identifier attribute uniquely identifies the association over which the Transfer Report is to be sent.

Status
The Status attribute may be either ENABLED (to request that Condition Monitoring action be executed) or DISABLED (to cease Condition Monitoring by the VCC).

List of Access Control Specification

The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Transfer Set objects is Visibility, Start Transfer, and Stop Transfer.

5.2.9.3.1 TATransmissionPars Object Model

This object model defines the transmission parameters for Transfer Account Transfer Sets.

Model: TATransmissionPars
Attribute: TAConditions Requested
Attribute: Block Data

TAConditions Requested
This specification defines the conditions for monitoring Transfer Accounts. The actual times that the conditions represent are defined in the Bilateral Agreement. See 5.2.9.3.2 for details.

Block Data
A Boolean flag controlling type of Transfer reporting mechanism is to be used. True means block the Transfer Report.

5.2.9.3.2 TAConditions Requested Object Model

Model: TAConditions Requested
Attribute: BeforeTheHour
Attribute: DispatchUpdate
Attribute: DuringTheHour
Attribute: AfterTheHour
Attribute: ActualDataUpdate
Attribute: PastHours
Attribute: ObjectChange
Attribute: OperatorRequest

BeforeTheHour
This attribute indicates whether or not the TASE.2 server shall send a report before the hour. Typically referred to as “pre-schedules”.

DispatchUpdate
This attribute indicates whether or not the TASE.2 server shall send a report for a dispatch update. Typically referred to as “next hour schedules”.

DuringTheHour
This attribute indicates whether or not the TASE.2 server shall send a report during the hour. Typically referred to as “mid hour schedule changes”.

AfterTheHour
This attribute indicates whether or not the TASE.2 server shall send a report after the hour. Typically referred to as “after the hour actuals”.

ActualDataUpdate
This attribute indicates whether or not the TASE.2 server shall send a report for an actual data update, occurring after the hour. Typically referred to as “corrections to previous schedules”.

PastHours
This attribute indicates whether or not the TASE.2 server shall send a report for data in past hours.

ObjectChange
This attribute indicates whether or not the TASE.2 server shall send a report when any object in the Transfer Account changes.

OperatorRequest

This attribute indicates whether or not the TASE.2 server shall send a report when an operator at the TASE.2 server control centre requests it.

5.2.9.4 Information Message Transfer Set Object Model

Model: Information Message Transfer Set
Key Attribute: Transfer Set Name
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: List of Access Control Specification

Transfer Set Name
The Transfer Set Name of the Information Message Transfer Set object shall be IM_Transfer_Set.

Association Identifier
The Association Identifier attribute uniquely identifies the association over which the Transfer Report is to be sent.

Status
The Status attribute may be either ENABLED (to request that Condition Monitoring action be executed) or DISABLED (to cease Condition Monitoring by the VCC).

List of Access Control Specification

The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Information Message Transfer Set objects is Visibility, Start Transfer, and Stop Transfer.

5.2.9.5 Start Transfer Operation

With the Start Transfer operation, the TASE.2 client shall assign values to all of the components in the Transfer Set object type. For Data Set Transfer Sets, if the RBE attribute of DSTransmissionPars is false, the TASE.2 server shall check if all of the data designated by the Data Set Transfer Set object can fit into the maximum MMS PDU size for the Data Set Transfer Report. If the TASE.2 server determines that it cannot fit, it shall respond with an error, and shall return the name of the Transfer Set object back into the pool of available names for Transfer Set objects. The TASE.2 client shall consider all data identified by that Transfer Set object to be invalid. For Time Series and Transfer Account Transfer Sets, if the server determines that the data cannot fit into the maximum MMS PDU size for the Transfer Report, it may use multiple MMS PDUs to send all of the data. See 7.1.4.4.2, 7.1.4.4.3, and 7.1.4.4.4, 7.1.4.4.5 for more details.

5.2.9.6 Stop Transfer Operation

The Stop Transfer operation is used by the TASE.2 client to set the Transfer Set Status attribute to DISABLED. When this occurs, the TASE.2 server shall put the name of the Transfer Set object back into the pool of available names of Transfer Set objects. The TASE.2 client shall consider all data identified by that Transfer Set object name to be invalid.

5.2.9.7 Get Next DSTransfer Set Value Operation

The Get Next DSTransfer Set Value operation allows a TASE.2 client to retrieve the identifier of the next available Data Set Transfer Set object from the pool of available names at the TASE.2 server. The Data Set Transfer Set is allocated to the client upon successful completion of the operation. The Data Set Transfer Set will remain allocated to the client until a) the Transfer Set status is set to DISABLED, b) the association is terminated either through an abort or a conclude, or c) a Start Transfer Set operation fails for that Data Set Transfer Set.

5.2.9.8 Get Next TSTransfer Set Value Operation

The Get Next TSTransfer Set Value operation allows a TASE.2 client to retrieve the identifier of the next available Time Series Transfer Set object from the pool of available names at the TASE.2 server. The Time Series Transfer Set is allocated to the client upon successful completion of the operation. The Time Series Transfer Set will remain allocated to the client until a) the Transfer Set status is set to DISABLED, b) the association is terminated either through an abort or a conclude, or c) a Start Transfer Set operation fails for that Time Series Transfer Set.

5.2.9.9 Condition Monitoring Action

The Condition Monitoring action is performed by the TASE.2 server when one or more Transfer Set objects have the Status attribute set to ENABLED. For Data Set Transfer Set objects that are ENABLED, the TASE.2 server shall begin condition monitoring as soon as the Start Time attribute of the DSTransmissionPars object has arrived. For Time Series Transfer Set objects, Information Message Transfer Set objects, and Transfer Account Transfer Set object that are ENABLED, the TASE.2 server shall begin condition monitoring immediately upon receiving the Start Transfer request from the TASE.2 client.

The TASE.2 server shall check for an occurrence of the entire set or a subset of conditions that correlate to the type of Transfer Set objects that are ENABLED. A subset of conditions may only be checked if the server has not implemented all of the conformance building blocks.

For Data Set Transfer Set objects, the TASE.2 shall check the entire set or a subset of conditions that are defined in the DSConditions Requested object as specified in 5.2.9.1.2.

For Time Series Transfer Set objects, the TASE.2 shall check the entire set or a subset of conditions that are defined in the TSConditions Requested object as specified in 5.2.9.2.2.

For Transfer Account Transfer Set objects, the TASE.2 shall check the entire set or a subset of conditions that are defined in the TAConditions Requested object as specified in 5.2.9.3.2.

For Information Message Transfer Set objects, the conditions used are locally defined and outside the scope of this standard.

When one or more of the specified conditions occur for an ENABLED Transfer Set, the TASE.2 server shall execute the Transfer Report action. See 7.1.4.3 for more details on this action.

5.2.9.10 Transfer Report Action

The Transfer Report action consists of formatting and sending a report which contains the appropriate data for the type of Transfer Set. A Transfer Report is generated when a condition has occurred for an enabled Transfer Set. For Data Set Transfer Reports that are defined to be critical (i.e. have the Critical attribute in the DSTransmissionPars set to TRUE), the TASE.2 client is required to send a confirmation for the receipt of the Transfer Report back to the TASE.2 server that sent it. See 7.1.4.4 for more details on this action.

5.2.10 Special Transfer Objects

Several object models are defined for referencing within Data Sets and Transfer Sets. These objects are used to retrieve information regarding the transfer reporting process. The object models are: Transfer Set Name, Next Transfer Set, Event Code, DSConditions, TSConditions, TAConditions, and Transfer Set Time Stamp. There are no operations or actions defined in this standard for these objects.

5.2.10.1 Transfer Set Name Object Model

Model: Transfer Set Name
Key Attribute: Name

Name
The Name attribute shall uniquely identify a Transfer Set object. The Name may identify either a Data Set Transfer Set or a Time Series Transfer Set. This attribute will take on the name of the Transfer Set which has triggered a condition causing a Transfer Report action.

5.2.10.2 Next Transfer Set

Model: Next Transfer Set
Key Attribute: Next Transfer Set Name

Next Transfer Set Name
This attribute shall uniquely identify a Transfer Set object. The Name may identify either a Data Set Transfer Set or a Time Series Transfer Set.

5.2.10.3 Event Code Object Model

Model: Event Code
Key Attribute: Event Code

Event Code
This attribute shall uniquely identify an Event Code Detected or Event Code Requested object. This attribute will take on the value of an event code which has triggered a condition causing a Transfer Report action.

5.2.10.4 DSConditions Object Model

Model: DSConditions
Key Attribute: DSConditions

DSConditions
The DSConditions attribute shall take on the value of the condition which has triggered a Transfer Report action.

5.2.10.5 TSConditions Object Model

Model: TSConditions
Key Attribute: TSConditions

TSConditions
The TSConditions attribute shall take on the value of the condition which has triggered a Transfer Report action.

5.2.10.6 TAConditions Object Model

Model: TAConditions
Key Attribute: TAConditions

TAConditions
The TAConditions attribute shall take on the value of the condition which has triggered a Transfer Report action.

5.2.10.7 Transfer Set Time Stamp Object Model

Model: Transfer Set Time Stamp
Key Attribute: Transfer Set Time Stamp Name

Transfer Set Time Stamp Name
The Transfer Set Time Stamp Name attribute shall take on the value of the time when a Transfer Report action has been triggered.

5.2.11 Devices

A device represents a real world control object in the VCC. Two classes of devices are included in the TASE.2 model: Select-Before-Operate (SBO) and Direct-Control (Non-SBO). SBO devices have two states: IDLE and ARMED. They support the Select operation. Both classes of device support the Operate operation. Devices also have four actions: Timeout, Local Reset, Success, and Failure. Either class of device may include a model of tagging, in which case the operations Set Tag Value and Get Tag Value may be used to manipulate the device tag.

5.2.11.1 Device Object Model

Model: Device
Key Attribute: Device Name
Attribute: ControlPoint
Attribute: List of Access Control Specification

Device Name
The Device Name attribute uniquely identifies the Device with either VCC-specific or ICC-specific scope.

ControlPoint
The ControlPoint attribute specifies the data type of the value associated with a Device object. See IEC 60870-6-802 for a description of the ControlPoint object model and its mapping.

List of Access Control Specification
The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Device objects is Visibility, Select, Operate and Set Tag.

5.2.11.2 Select Operation

The Select operation takes a device from the IDLE state to ARMED. It takes as an argument the identifier for the Device Name. A Select operation shall fail if the device is a non-SBO device or if it is an SBO device in the ARMED state. The Select operation shall also fail if the value of Tag attribute is OPEN-AND-CLOSE-INHIBIT. The TASE.2 server responds to the TASE.2 client's successful Select request by returning a value for the CheckBackID attribute associated with that device as designated in the Bilateral Table.

5.2.11.3 Operate Operation

In the Operate operation, the TASE.2 client provides a value for the Command attribute of the Device object, and also the CheckBackID. When the device has completed executing the Command function, it transitions from the ARMED state to the IDLE state. The Operate operation takes as arguments the identifier for the Device Name and a value for the Command Attribute. Operate for a device shall fail if the value of Tag attribute conflicts with the requested command. A value of NO-TAG never prevents operation. A value of OPEN-AND-CLOSE-INHIBIT always prevents operation. A value of CLOSE-ONLY-INHIBIT only prevents Close or Raise commands.

5.2.11.4 Set Tag Value Operation

The Set Tag Value operation allows the TASE.2 client the ability to set the Tag attribute of a device. If the new value of the Tag attribute is NO-TAG, then Select and Operate operations are allowed on the device. If the Tag value is OPEN-AND-CLOSE-INHIBIT, no operation is allowed on the device. If the Tag attribute is CLOSE-ONLY-INHIBIT, then operation of the device is partially restricted. If the Tag attribute of a VCC-Specific device is anything but NO-TAG, then only that client that set the tag value may modify the tag value.

5.2.11.5 Get Tag Value Operation

The Get Tag Value operation allows the TASE.2 client to retrieve the current state of the Tag attribute of a device. Note that the current state of the Tag attribute can also be obtained by including a Tag_Value object in a Data Set.

5.2.11.6 Timeout Action

The Timeout action is used by a device to signal that the device has timed out in the ARMED state and is transitioning back to the IDLE state.

5.2.11.7 Local Reset Action

The Local Reset action is used by the TASE.2 server to signal that the device state has moved from the ARMED state to the IDLE state by a local action. The Tag attribute of the device may also be set to a different value as a result of the Local Reset action.

5.2.11.8 Success Action

The Success action is used by the TASE.2 server to signal that an Operate operation has successfully been completed, and that the device is now in the IDLE state.

5.2.11.9 Failure Action

The Failure action is used by the TASE.2 server to signal that an Operate operation has failed. The device state is moved to the IDLE state.

5.2.12 Programs

Program objects in TASE.2 follow the MMS Program Invocation object model exactly, with the addition of access control. There are six operations for Program objects: Start, Stop, Resume, Kill, Reset, and Get Program Attributes. There are no actions defined for Program objects.

5.2.12.1 Program Object Model

Model: Program
Key Attribute: Program Name
Attribute: State (IDLE, RUNNING, STOPPED, UNRUNNABLE)
Attribute: List of Domain Reference
Attribute: MMS Deletable (TRUE, FALSE)
Attribute: Reusable (TRUE, FALSE)
Attribute: Monitor (TRUE, FALSE)
Constraint: Monitor = TRUE
Attribute: Event Condition Reference
Attribute: Event Enrollment Reference
Attribute: Execution Argument
Attribute: List of Access Control Specification

Program Name
The Program Name attribute uniquely identifies a Program object with VCC-specific scope.

List of Access Control Specification

The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Program objects is Visibility, Start, Stop, Resume, Reset, Kill, and Get Program Attributes.

See the MMS standard for a description of the other attributes.

5.2.12.2 Start Operation

Start changes the Program object state from IDLE to RUNNING.

5.2.12.3 Stop Operation

Stop changes the Program object state from RUNNING to STOPPED.

5.2.12.4 Resume Operation

Resume changes the Program object state from STOPPED to RUNNING.

5.2.12.5 Reset Operation

Reset changes the Program object state from STOPPED to IDLE.

5.2.12.6 Kill Operation

Kill changes the Program object state to UNRUNNABLE.

5.2.12.7 Get Program Attributes Operation

The Get Program Attributes operation retrieves the attributes of a Program object.

5.2.13 Event Enrollments

Event Enrollment objects in TASE.2 follow the MMS Event Enrollment object model with some restrictions and the addition of List Of Access Control Specification. There are three operations for Event Enrollment objects: Create Event Enrollment, Delete Event Enrollment, and Get Event Enrollment Attributes. There are no TASE.2 actions for Event Enrollments.

5.2.13.1 Event Enrollment Object Model

Model: Event Enrollment
Key Attribute: Event Enrollment Name
Attribute: MMS Deletable (TRUE, FALSE)
Attribute: Enrollment Class (NOTIFICATION only)
Attribute: Event Condition Reference
Attribute: Event Condition Transitions (IDLE-TO-ACTIVE only)
Attribute: Application Association Local Tag
Attribute: Notification Lost (TRUE, FALSE)
Attribute: Duration (CURRENT, PERMANENT)
Attribute: Client Application
Attribute: Alarm Acknowledgement (NONE only)
Attribute: State (DISABLED, IDLE, ACTIVE only)
Attribute: List of Access Control Specification

List of Access Control Specification
The List of Access Control Specification attribute is a list of access control information which specifies the operations permitted on this object by TASE.2 users. See 5.2.4 for a definition of this attribute. The List of Permitted Access for Event Enrollment objects is Visibility, Delete Event Enrollment, and Get Event Enrollment Attributes.

See the MMS standard for a description of the other attributes.

5.2.13.2 Create Event Enrollment Operation

The Create Event Enrollment creates an Event Enrollment object.

5.2.13.3 Delete Event Enrollment Operation

The Delete Event Enrollment deletes an Event Enrollment object.

5.2.13.4 Get Event Enrollment Attributes Operation

The Get Event Enrollment Attributes retrieves the attributes of an Event Enrollment object.

5.2.14 Event Conditions

Event Condition objects in TASE.2 follow the MMS Event Condition object model exactly. There are no TASE.2 operations for Event Condition objects. Event Conditions are predefined within a VCC. There is one TASE.2 action for Event Conditions: Event Notification.

5.2.14.1 Event Condition Object Model

Model: Event Condition Object
Key Attribute: Event Condition Name
Attribute: MMS Deletable (FALSE only)
Attribute: Event Condition Class (MONITORED only)
Attribute: State (DISABLED, IDLE, ACTIVE)
Attribute: Priority
Attribute: Severity
Attribute: List of Event Enrollment Reference
Attribute: Alarm Summary Reports (FALSE only)
Attribute: Enabled (TRUE, FALSE)

See the MMS standard for a description of the other attributes.

5.2.14.2 Event Notification Action

An Event Notification Action occurs when a particular event condition becomes ACTIVE.

6 Mapping of TASE.2 Object Models onto MMS Object Models

This clause relates the general model of the VCC, developed in clause 5, to the abstract model of the Virtual Manufacturing Device (VMD) described in the MMS standard, ISO 9506-1.

6.1 Object Modelling Notation (informative)

The TASE.2 documents (this standard and IEC 60870-6-802) make use of a technique of abstract object modelling in order to fully describe the TASE.2 device model and the TASE.2 service procedures. In this modelling technique, abstract objects, the characteristics of such objects, and operations on those objects are described. The objects defined are abstract and aid in the understanding of the intent of TASE.2 service procedures and their effects. In implementing TASE.2, a real system maps the concepts described in the model to the real device. Hence, as viewed externally, a device that conforms to this standard exhibits the characteristics described in the object modelling technique, but the mechanisms for realization of this view are not defined by this standard.

TASE.2 defines a number of classes of objects. Each object is an instance of a class, and constitutes an abstract entity which exhibits certain characteristics and may be affected by certain TASE.2 services and operations. Each class is given a name, by which it may be referenced.

Each class is characterized by a number of attribute types, which serve to describe some externally visible feature(s) of all objects of this class. Each instance of a class (object) has the same set of attribute types, but has its own set of attribute values.

Each object must be uniquely identified among all instances of the same class. For this purpose, one or more of the object attribute values, as a combination, must be unique. (For example, many objects have an attribute type called "object name", which is different for each object of the same class). In TASE.2, each attribute which is a part of this combination of attributes which make the object unique is identified as a "key attribute".

Finally, some objects contain attributes which are conditional, in the sense that they are relevant to the object if and only if certain conditions hold true. TASE.2 expresses such attributes through the use of a "constraint", which specifies a condition. Attributes that are subject to a constraint are considered to be object attributes for an object if and only if the corresponding constraint is satisfied for that object.

In TASE.2, classes are syntactically defined as a set of objects as follows:

Object: (name of class)
Key Attribute: (name of attribute type (values))
Attribute: (name of attribute type (values))
.
.
.
Attribute: (name of attribute type (values))
Constraint: (constraint expression)
Attribute: (name of attribute type (values))
Attribute: (name of attribute type (values))
Attribute: (name of attribute type (values))

By convention, each object definition begins with an object declaration and the name of the object. Immediately following, and indented, one Key Attribute is named. Next, zero or more Attributes are named. Note that constraints may be expressed anywhere within the attributes, with the convention that all attributes subject to the constraint are indented underneath it. The first attribute definition that is not indented ends the list of attributes that are subject to the constraint. For convenience, attributes may also be indented under other attributes in order to show a hierarchy of nesting of such attributes.

This standard makes use of several MMS object classes. Their definition can be found in the respective parts of ISO 9506-1.

6.2 The Virtual Control Centre (VCC)

A control centre is modelled with one or more Virtual Control Centres (VCC). A VCC is mapped onto an MMS Virtual Manufacturing Device (VMD). It therefore has the same definition and behaviour as an MMS VMD. An MMS VMD exists within the MMS server application process. It constitutes that portion of an information processing task which makes available a set of resources and functionality associated with a real device. By mapping a TASE.2 VCC to an MMS VMD, the TASE.2 VCC performs the same function for a control centre that a MMS VMD does for a real device: it represents that portion of an information processing task which makes available a set of resources and functionality associated with a control centre. There is no abstract model for the TASE.2 VCC. Much of the information represented in the MMS VMD for the device that maps onto similar information used for control centres is represented in the Bilateral Table object model.

In MMS, a server is a communicating entity which behaves as a VMD for a particular service request instance, and a client is a communicating entity which makes use of the VMD for some particular purpose via a service request instance. For TASE.2, the definitions of a client and a server are much the same. A TASE.2 server is a communicating entity which behaves as a VCC for a particular service request instance. Similarly, a TASE.2 client is a communicating entity which makes use of the VCC via one or more TASE.2 service requests for a particular service request instance. A TASE.2 server shall represent only one VCC within an association.

6.2.1 TASE.2 Domain Mapping

Just like an MMS VMD, a TASE.2 VCC shall contain zero or more Domains. In MMS, a Domain is used to represent a specific instance of use of a set of capabilities of the MMS VMD. It includes those aspects of an MMS VMD that are associated with a specific element of a co-ordinated control or monitoring strategy. In TASE.2, the use of Domains is slightly different. A TASE.2 Domain represents a specific instance of a set of resources and capabilities associated with a unique, remote control centre. Therefore, a TASE.2 VCC may have a Domain for each control centre with which it may have a TASE.2 association, or with which it currently has a TASE.2 association. There is one and only one TASE.2 Domain within a VCC that serves another control centre. It may not have any Domains if all of the objects within the VCC are relevant to more than one control centre. When an object has an ICC-specific scope, it is associated with the Domain representing the control centre for which this object is relevant.

A TASE.2 Domain contains objects associated with a single Bilateral Agreement. Each TASE.2 Domain is mapped onto an MMS Domain.

At a TASE.2 server, there may be real data and devices that are relevant to more than one control centre. With the TASE.2 model, there may be real data and devices represented by different TASE.2 identifiers. Depending upon the implementation, there could be one TASE.2 object in one TASE.2 Domain representing device A, for example, and a different TASE.2 object in a different TASE.2 Domain representing the same device A. These TASE.2 objects would each have an ICC-specific scope, map to the same real device, but be associated with different control centres. Another way to handle this would be to have a single TASE.2 object representing the device, but give it a VCC-specific scope. This TASE.2 object would not be associated with any particular control centre then, because its scope is not ICC-specific.

6.2.2 TASE.2 Control Centre Mapping

Within TASE.2, an Application Process (AP) shall be identified with only one TASE.2 control centre. Therefore, an Application Process title (AP-title) can be used to uniquely identify a TASE.2 control centre. An AP shall contain the capabilities to act as either a TASE.2 client, a TASE.2 server, or both. An AP with either TASE.2 client or TASE.2 server capabilities is called a TASE.2 AP. A VCC exists within a TASE.2 AP that has the capabilities of acting as a TASE.2 server. A TASE.2 AP with server capabilities may contain one or more VCCs.

6.2.3 OSI Application Processes, Application Entities and Presentation Addresses

In OSI, an Application Process (AP) has one or more Application Entities (AEs) which represent a set of communication capabilities. AEs, in turn, are represented by a set of Application Service Elements (ASEs). MMS is an ASE, and TASE.2 uses the MMS ASE for all of its communications. An AE within a TASE.2 AP that uses MMS to implement the TASE.2 client or server capabilities as defined in this standard is called a TASE.2 AE.

In OSI, AEs are identified by one or more Application Entity titles (AE-titles). An AE-title identifies an AP and one of its AEs through the combination of an Application Process title (AP-title) and an Application Entity qualifier (AE-qualifier)[1]. In TASE.2, an AE-title can therefore uniquely identify a TASE.2 AP and one of its TASE.2 AEs. Furthermore, because TASE.2 maps an AP to a single TASE.2 control centre, an AE-title can also be used to uniquely identify a TASE.2 control centre.

In OSI, an AE-title is bound to a single Presentation Address (which contains a set of Presentation Address Access Points called PSAPs). So, with either a single Presentation Address or an AE-title, a TASE.2 client can uniquely address a TASE.2 server in an OSI communications environment to establish an association. Once this association is established, an Association identifier, which is determined at the time the association is established, can be used to address the communications channel between the two entities.

6.3 Association Object Model Mapping

The TASE.2 Association object model is defined as:

Model: Association
Key Attribute: Association Identifier
Attribute: Application Reference
Attribute: QOS
Attribute: Supported Features

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[1] An AE-title is defined in ISO 8649 to be:
AE-title ::=SEQUENCE
{AP-title,
AE-qualifier
}

The attributes of the Association object shall be mapped as follows:

Association Identifier
This attribute uniquely identifies the association with the TASE.2 server. It shall be represented as an MMS Association Identifier.

Application Reference
This attribute uniquely identifies the TASE.2 client Application Process (AP) and Application Entity (AE) with which the TASE.2 server has an association. It shall be represented as an AE-title.

QOS
This attribute identifies the various aspects of Quality of Service used on the association. It is specific to this association only. The representation of QOS shall be a local matter, except that it shall be used in the network layer to establish the Quality of Service. Refer to IEC 60870-6-702.

Supported Features

This attribute identifies the Building Blocks supported in the TASE.2 server. It shall be represented as an MMS Named Variable called "Supported_Features" as defined in clause 8.

6.4 Bilateral Table Object Model Mapping

The TASE.2 Bilateral Table object model is defined as:

Model: Bilateral Table
Key Attribute: Client Control Centre Designation
Attribute: Version
Attribute: TASE.2 Version
Attribute: Domain Name
Attribute: List of Application References
Attribute: List of Association Objects
Attribute: List of Data Value Objects and Access Control Specifications
Attribute: List of Data Set Objects and Access Control Specifications
Attribute: List of Information Message Objects and Access Control Specifications
Attribute: List of Transfer Account Objects and Access Control Specifications
Attribute: List of Transfer Set Objects and Access Control Specifications
Attribute: List of Device Objects and Access Control Specifications
Attribute: List of Program Objects and Access Control Specifications
Attribute: List of Event Enrollment Objects and Access Control Specifications

Each Bilateral Table is associated with an MMS Domain. This MMS Domain has a name that identifies the TASE.2 client that corresponds to its Client Control Centre Designation attribute. The attributes of the Bilateral Table object shall be mapped as follows:

Client Control Centre Designation
This attribute identifies the TASE.2 client control centre for which the Bilateral Table is defined with this TASE.2 server. It shall be represented as an AP-title.

Version
This attribute uniquely identifies a unique version of the Bilateral Table. If any changes are made to the Bilateral Table, then a new unique value for this attribute shall be generated. This attribute shall be represented as an MMS Named Variable called "Bilateral_Table_ID" as defined in clause 8.

TASE.2 Version
This attribute identifies a unique version of TASE.2. This attribute shall be represented as an MMS Named Variable called "TASE.2_Version" as defined in 8.2.3.

Domain Name
The Domain Name attribute is the name of the TASE.2 Domain. It is not mapped.

List of Application References
This attribute identifies those TASE.2 client Application Processes and Application Entities which are permitted to establish associations with the TASE.2 server for which the Bilateral Table is defined. It shall be represented as a list of AE-titles.

List of Association Objects
This attribute identifies those Association objects that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Association Objects shall be represented as a list of MMS Named Variable objects.

List of Data Value Objects and Access Control Specifications
This attribute identifies those Data Value objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Data Value Objects shall be represented as a list of MMS Named Variable objects.

List of Data Set Objects and Access Control Specifications
This attribute identifies those Data Set objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Data Set Objects shall be represented as a list of MMS Named Variable List objects.

List of Information Message Objects and Access Control Specifications
This attribute identifies those Information Message objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Information Message Objects shall be represented as a list of MMS Named Variable List objects.

List of Transfer Account Objects and Access Control Specifications
This attribute identifies those Transfer Account objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Transfer Account Objects shall be represented as a list of MMS Named Variable objects.

List of Transfer Set Objects and Access Control Specifications
This attribute identifies those Transfer Set objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Transfer Set Objects shall be represented as a list of MMS Named Variable objects.

List of Device Objects and Access Control Specifications
This attribute identifies those Device objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Device Objects shall be represented as a list of MMS Named Variable objects.

List of Program Objects and Access Control Specifications
This attribute identifies those Program objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Program Objects shall be represented as a list of MMS Program Invocation objects.

List of Event Enrollment Objects and Access Control Specifications
This attribute identifies those Event Enrollment objects and their corresponding Access Control Specifications that can be accessed by the remote control centre identified by the Client Control Centre Designation attribute. The List of Event Enrollment Objects shall be represented as a list of MMS Event Enrollment objects.

The List of Access Control Specification for all of the objects is not defined in this standard. Its implementation is a local matter. This specification does not require the MMS Conditioned Service mechanism for implementing access control.

6.5 Data Value Object Model Mapping

The Data Value object model is defined as follows:

Model: Data Value
Key Attribute: Data Value Name
Attribute: List of Access Control Specification

Data Value objects shall be represented as MMS Named Variables. Data Value objects shall have either a VMD-specific or Domain-specific scope. If the scope is Domain-specific, then it shall correspond to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table. The scope of the variable does not have any implications regarding access control. Access control is specified in the List of Access Control Specification attribute.

Each Data Value object maps to an MMS Named Variable with a Type Description that has one of the types defined for the Indication Point, Protection Equipment Event, or Tag_Value object models defined in IEC 60870-6-802. See that section of IEC 60870-6 for more details on these type definitions. See clause 8 for more details on the MMS Named Variable mapping.

Data Value Name
This attribute uniquely identifies the MMS Named Variable for this Data Value object. Data Value objects may be identified using any legal MMS Variable Name, with the following exceptions:

Data Value objects may not use the same name as any TASE.2 controllable devices (which are also represented by MMS Named Variables) defined for this client control centre.

Data Value objects may not use the names of Transfer Set objects, which are also represented as MMS Named Variables but have unique semantics.

The names may be arbitrarily assigned by agreement between control centres.

This attribute shall be represented by the type MMS ObjectName.

List of Access Control Specification

The representation of List of Access Control Specification is a local matter.

6.6 Data Set Object Model Mapping

The Data Set object model is defined as follows:

Model: Data Set
Key Attribute: Data Set Name
Attribute: Data Set Scope (VCC-specific, ICC-specific)
Attribute: Transfer Set Name OPTIONAL
Attribute: DSConditions Detected OPTIONAL
Attribute: Event Code Detected OPTIONAL
Attribute: Transfer Set Time Stamp OPTIONAL
Attribute: List Of Data Value Objects
Attribute: List of Access Control Specification

Data Set objects shall be represented as MMS Named Variable Lists. Data Set objects may have either a VMD-specific (i.e. VCC-specific) or Domain-specific (i.e. ICC-specific) scope. The Data Set may contain the Transfer Set Name, DSConditions Detected, Event Code Detected, and/or the Transfer Set Time Stamp attributes in addition to the List Of Data value Objects. See clause 8 for the mapping of a Data Set object onto an MMS Named Variable List.

Data Set Name
This attribute shall be represented as the MMS Variable List Name attribute. Data Set objects may be identified using any legal MMS Variable List Name, with the following exceptions:

The names shall be unique (within their scope) for all time, i.e. a name shall never be used for more than one Data Set object at any one time.

The names may be arbitrarily assigned by agreement between control centres.

Data Set Scope
This attribute specifies the scope of the Data Set object. It shall be represented in the MMS ObjectName for the Data Set object.

Transfer Set Name
This attribute uniquely identifies the MMS Named Variable for the Transfer Set object for this Data Set. The MMS Named Variable identified by this attribute must be of type DSTransferSet, defined in clause 8. It shall be represented as an MMS Named Variable with type MMS ObjectName.

DSConditions Detected
This attribute identifies the conditions that generated the most recent Transfer Set report. It shall be represented as an MMS Named Variable with type DSConditions. See 5.2.6.1.1 for the definition of these conditions.

Event Code Detected
This attribute identifies the external event condition that generated the most recent Transfer Set report. It shall be represented as an MMS Named Variable with type Integer16. It shall only be present if the OtherExternalEvent attribute is set in the DSConditions Detected object.

Transfer Set Time Stamp
This attribute identifies the time at which the most recent Transfer Set report was generated. It shall be represented as an MMS Named Variable with type GMTBasedS.

List of Data Value Objects
This attribute shall be represented as the MMS List of Variable attribute. It is a list of Data Value Names. See 6.5 for the mapping of a Data Value Name attribute.

List of Access Control Specification
The representation of List of Access Control Specification is a local matter.

6.7 Account Object Model Mapping

For Transfer Account, Account Request, Device Outage, Power Plant, General Data Report, and General Data Response object model mapping, see IEC 60870-6-802.

6.8 Information Message Object Model Mapping

Information Messages shall be represented as Domain or VMD-specific MMS Named Variables. Information Messages may not be read or written, but are only reported by the server. At the time of reporting, the Info Reference, LocalReference, MessageId, and Size attributes of an Information Message is mapped to an MMS variable named "Info_Mess_ Header", of type InfoMessHeader. The InfoStream of the Information Message object is mapped to an MMS Variable named Info_Buf_XX, of type InfoBufXX, where XX is the smallest of the InfoBuf type sizes which can completely contain the message. See IEC 60870-6-802 for details of the Information Message type definitions.

6.9 Transfer Set Object Model Mapping

Transfer Set objects shall be represented as MMS Named Variables. There are four MMS Named Types resulting from this object model definition defined for use for the Transfer Set MMS Named Variables: DSTransferSet, TSTransferSet, TATransferSet, and IMTransferSet. They are described in clause 8. The MMS Named Variables shall have Domain-specific scope, and shall correspond to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table.

6.9.1 Data Set Transfer Set Object Model Mapping

The Data Set Transfer Set object model is defined as follows:

Model: Data Set Transfer Set
Key Attribute: Transfer Set Name
Attribute: Data Set Name
Attribute: DSTransmissionPars
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: Event Code Requested
Attribute: List of Access Control Specification

Transfer Set Name
This attribute uniquely identifies the MMS Named Variable for this Transfer Set object. The MMS Named Variable identified by this attribute must be of type DSTransferSet, as defined in clause 8.

Data Set Name
This attribute identifies a Data Set object whose values are being requested by the client. It shall be represented by the DataSetName component of the MMS Named Variable. It has the type MMS ObjectName.

DSTransmissionPars
This attribute defines all values required to fully specify when and how the TASE.2 server is to send the values of the Data Set object. It shall be represented by several components of the MMS Named Variable. These components are described in 5.2.9.1.1 and 6.9.1.1, which also provide the definition of this attribute.

Association Identifier
This attribute identifies the association between the TASE.2 client and TASE.2 server. It shall be represented as an MMS Association Identifier. It is not mapped onto any component in the MMS Named Variable.

Status
This attribute shall be either ENABLED to request that Condition Monitoring action be executed, or DISABLED to cease Condition Monitoring by the VCC. It is represented by the Status component of the MMS Named Variable. It has the type Boolean, defined as follows: non-zero value means ENABLED, and is mapped to true; zero value means DISABLED, and is mapped to false.

Event Code Requested
This attribute indicates which external event shall trigger the condition. It shall only be considered valid if the OtherExternalEvent condition flag is set in the DSConditions Requested attribute within the TransmissionPars attribute of the Transfer Set object. It shall be represented by the EventCodeRequested component of the MMS Named Variable. It has the type Integer16.

List of Access Control Specification
The representation of List of Access Control Specification is a local matter.

6.9.1.1 DSTransmissionPars Object Model Mapping

The DSTransmissionPars object model is defined as follows:

Model: DSTransmissionPars
Attribute: Start Time
Attribute: Interval
Attribute: TLE
Attribute: Buffer Time
Attribute: Integrity Check
Attribute: DSConditions Requested
Attribute: Block Data
Attribute: Critical
Attribute: RBE
Attribute: All Changes Reported OPTIONAL

The DSTransmissionPars object model is mapped to the appropriate components of the MMS Named Variable representing the DSTransferSet as defined in clause 8.

Start Time
This attribute is the time value for the TASE.2 server to begin the Condition Monitoring. It has the type GMTBasedS.

Interval
This attribute is the time interval between TASE.2 server reports. The Interval starts when the Start Time occurs. If RBE is false, then the current state of all objects in the Data Set are reported when the Interval expires. If RBE is true, then the current state of only the changed objects in the Data Set are reported when the Interval expires. If multiple changes occur to the same object during the Interval and All Changes Reported is false, then only the final value is reported. However, if All Changes Reported is true, than all changes that occurred to the same object during the interval are reported. It has the type TimeInterval32.

TLE[1)]
Time value for Time Limit for Execution. This is a time that is primarily relevant to the TASE.2 server. It is the time over which the TASE.2 server has to send the Data Set Transfer Report to the TASE.2 client. If the TASE.2 server anticipates that it cannot send the Data Set Transfer Report to the TASE.2 client within the TLE time, then it shall not generate the report, and shall discard the data. It has the type TimeIntervalS.

Buffer Time
This attribute is the time interval for buffering the ObjectChange condition before reporting to the TASE.2 client. The Buffer Time starts when the first ObjectChange condition occurs. If RBE is false, then the current state of all objects in the Data Set are reported when the Buffer Time expires. If RBE is true, then the current state of only the changed objects in the Data Set are reported when the Buffer Time expires. If multiple changes occur to the same object during the Buffer Time and Report All Changes is false, then only the final value is reported. If Report All Changes is true, then all changes to the same object during the Buffer Time are reported. It has the type TimeIntervalS.

Integrity Check
This attribute is the time value for integrity check when IntegrityTimeOut condition is used. It has the type TimeInterval32.

DSConditions Requested
This attribute gives the conditions under which the Transfer Report shall be made. See 5.2.9.1.2 for the definition of the conditions. This attribute has the type DSConditions.

[1)] The TASE.2 client may wish to keep track of the time over which a Data Set Transfer Set is considered valid. This has been referred to as Time Allowed to Live, or TAL. There are no requirements in the TASE.2 specification for TAL. However, implementations may choose to use TAL.

Block Data
This attribute indicates the type of Transfer reporting mechanism to be used. It has the type Boolean, which is defined as follows: non-zero value means true, and indicates blocking Transfer Report; zero value means false, and indicates not blocking the Transfer Report.

Critical
This attribute indicates whether or not the Transfer Report requires acknowledgement. It has the type Boolean, which is defined as follows: non-zero value means true, and indicates that an acknowledgement is required; zero value means false, and indicates that no acknowledgement is required.

RBE
This attribute indicates how much of the data is reported in the Transfer Set as defined by the Report By Exception mechanism. It has the type Boolean, which is defined as follows: non-zero value means true, and indicates that only changed object values shall be included in the Transfer Report; zero value means false, and indicates that all of the object values shall be included in the Transfer Report.

All Changes Reported
This attribute indicates how many value changes may be reported in a Transfer Report when RBE is true and Buffer Time is non-zero. It has the type Boolean, which is defined as follows: non-zero value means true, and indicates that all changes in an object value shall be included in the Transfer Report; zero value means false, and indicates that only the last object value change shall be included in the Transfer Report.

6.9.2 Time Series Transfer Set Object Model Mapping

The Time Series Transfer Set object model is defined as follows:

Model: Time Series Transfer Set
Key Attribute: Transfer Set Name
Attribute: Data Value Name
Attribute: Begin Time
Attribute: End Time
Attribute: Sampling Interval
Attribute: Reporting Interval
Attribute: TSTransmissionPars
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: List of Access Control Specification

See 6.9.1 for the mapping of the Association Identifier, Status, and List of Access Control Specification attributes.

Transfer Set Name
This attribute uniquely identifies the MMS Named Variable for the Transfer Set object for this Time Series. The MMS Named Variable identified by this attribute must be of type TSTransferSet, defined in clause 8.

Data Value Name
This attribute identifies a Data Value object whose time series values are being requested by the client. It shall be represented by the DataValueName component of the MMS Named Variable. It has the type MMS ObjectName.

Begin Time
This attribute specifies the time to start collecting data values in the time series for a Data Value object. It shall be represented by the BeginTime component of the MMS Named Variable. It has the type GMTBasedS.

End Time
This attribute specifies the time to stop collecting data values in the time series for a Data Value object. When this time occurs, the TASE.2 server shall generate the Transfer Report and send it to the TASE.2 client. It shall be represented by the EndTime component of the MMS Named Variable. It has the type GMTBasedS.

Sampling Interval
This attribute specifies the time interval between collecting data values in the time series for a Data Value object. It shall be represented by the SamplingInterval component of the MMS Named Variable. It has the type TimeIntervalL32.

Reporting Interval
This attribute specifies the time interval between information report generation. It shall be represented by the ReportingInterval component of the MMS Named Variable. It has the type TimeIntervalL32.

TSTransmissionPars

This attribute includes all values required to fully specify when and how the TASE.2 server is to send the time series data of the Data Value object. It shall be represented by several components of the MMS Named Variable. These components are described in 6.9.2.1. See 5.2.9.2.1 for the definition of this attribute.

6.9.2.1 TSTransmissionPars Object Model Mapping

The TSTransmissionPars object model is defined as follows:

Model: TSTransmissionPars
Attribute: TSConditions Requested
Attribute: Block Data

The TSTransmissionPars object model is mapped to the appropriate components of the MMS Named Variable representing the TSTransferSet as defined in clause 8.

TSConditions Requested
This attribute gives the conditions under which the Transfer Report shall be made. See 5.2.9.2.2 for the definition of the conditions. This attribute has the type TSConditions.

Block Data
See 5.2.9.1.1, 6.9.1.1 for the mapping of this attribute.

6.9.3 Transfer Account Transfer Set Object Model Mapping

The Transfer Account Transfer Set object model is defined as follows:

Model: Transfer Account Transfer Set
Key Attribute: Transfer Set Name
Attribute: TATransmissionPars
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: List of Access Control Specification

See 6.9.1 for the mapping of the Association Identifier, Status, and List of Access Control Specification attributes.

Transfer Set Name
This attribute uniquely identifies the MMS Named Variable for the Transfer Set object for this Transfer Account. The MMS Named Variable identified by this attribute must be of type TATransferSet, defined in clause 8.

TATransmissionPars

This attribute includes all values required to fully specify when and how the TASE.2 server is to send all of the data in all of the Transfer Accounts. See 6.9.3.1 for the mapping of this attribute.

6.9.3.1 TATransmissionPars Object Model Mapping

The TATransmissionPars object model is defined as follows:

Model: TATransmissionPars
Attribute: TAConditions Requested
Attribute: Block Data

The TATransmissionPars object model is mapped to the appropriate components of the MMS Named Variable representing the TATransferSet as defined in clause 8.

TAConditions Requested
This attribute gives the conditions under which the Transfer Report shall be made. See 5.2.9.3.2 for the definition of the conditions. This attribute has the type TAConditions.

Block Data
See 5.2.9.1.1 and 6.9.1.1 for the mapping of this attribute.

6.9.4 Information Message Transfer Set Object Model Mapping

The Information Message Transfer Set object model is defined as follows:

Model: Information Message Transfer Set
Key Attribute: Transfer Set Name
Attribute: Association Identifier
Attribute: Status (ENABLED, DISABLED)
Attribute: List of Access Control Specification

See 6.9.1 for the mapping of the Association Identifier and List of Access Control Specification attributes.

Transfer Set Name
This attribute uniquely identifies the MMS Named Variable for the Transfer Set object for this Information Message. The MMS Named Variable identified by this attribute must be of type Boolean.

Status
This attribute shall be either ENABLED to request that Condition Monitoring action be executed, or DISABLED to cease Condition Monitoring by the VCC. It is represented by the MMS Variable having the Transfer Set Name of type Boolean, defined as follows: A non-zero value means ENABLED, and is mapped to true; a zero value means DISABLED, and is mapped to false.

6.10 Next Transfer Set Object Model Mapping

The Next Transfer Set object model is defined as follows:

Model: Next Transfer Set
Key Attribute: Next Transfer Set Name

There are two Next Transfer Set objects for every TASE.2 Domain. They use "Next_DSTransfer_Set" and "Next_TSTransfer_Set" for the MMS Item Identifiers in their MMS Object Names. These objects shall be represented as MMS Named Variables with the type of MMS ObjectName. They shall have a Domain-specific scope that corresponds to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table. The Next Transfer Set Name attribute shall be represented by the MMS Variable Name attribute. See clause 8 for more details.

6.11 Transfer Set Name Object Model Mapping

The Transfer Set Name object model is defined as follows:

Model: Transfer Set Name
Key Attribute: Name

These objects shall be represented as MMS Named Variables with the type of MMS ObjectName. They shall have a Domain-specific scope that corresponds to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table. These objects are undefined except when the TASE.2 server is constructing a Transfer Report. The Name attribute shall be represented by the MMS Variable Name attribute and shall be the one associated with the Transfer Set indicated in the Transfer Report. See clause 8 for more details.

6.12 Conditions Object Model Mapping

There are three Conditions object models:

Model: DSConditions
Key Attribute: DSConditions

Model: TSConditions
Key Attribute: TSConditions

Model: TAConditions
Key Attribute: TAConditions

These objects shall be represented as MMS Named Variables. They shall have a Domain-specific scope that corresponds to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table. The name in the Key Attribute shall be represented by the MMS Variable Name attribute.

The DSConditions object shall be represented as an MMS Named Variable with the type DSConditions. The TSConditions object shall be represented as an MMS Named Variable with the type TSConditions. The TAConditions object shall be represented as an MMS Named Variable with the type TAConditions.

6.13 Event Code Object Model Mapping

The Event Code object model is defined as follows:

Model: Event Code
Key Attribute: Event Code

This object shall be represented as an MMS Named Variable with the type of Integer16. It shall have a Domain-specific scope that corresponds to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table.

6.14 Transfer Set Time Stamp Object Model Mapping

The Transfer Set Time Stamp object model is defined as follows:

Model: Transfer Set Time Stamp
Key Attribute: Transfer Set Time Stamp

This object shall be represented as an MMS Named Variable with the Type Description of GMTBasedS. It shall have a Domain-specific scope that corresponds to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table. The value of these objects is undefined except when the TASE.2 server is constructing a Transfer Report.

6.15 Device Object Model Mapping

The Device object model is defined as follows:

Model: Device
Key Attribute: Device Name
Attribute: ControlPoint
Attribute: List of Access Control Specification

These objects shall be represented as MMS Named Variables with a Type Description of one of the types defined for ControlPoint objects found in IEC 60870-6-802, and optionally the CheckBackID and Tag_Value types. They shall have either a Domain-specific or VMD-specific scope. If the scope is Domain-specific, then it shall correspond to the MMS Domain defined for the TASE.2 client control centre that has been identified in the Bilateral Table. Each Device object maps as follows:

Device Name
The Device Name attribute shall be represented as the MMS Variable Name attribute, either VMD-Specific or Domain-Specific.

ControlPoint
The ControlPoint attribute is mapped to one of the ControlPoint types described in IEC 60870-6-802 (Control_Command, Control_Setpoint_Real or Control Setpoint Discrete), and optionally the CheckBackID and Tag_Value types. The CheckBackID variable associated with an SBO device is named <Device_Name>_SBO. The Tag_Variable variable associated with a taggable device is named <Device_Name>_TAG.

List of Access Control Specification
The representation of List of Access Control Specification is a local matter.

Devices shall have a state model associated with the Named Variable which shall interact with the V-Get and V-Put functions.

6.16 Program Object Model Mapping

The Program object model is defined as follows:

Model: Program
Key Attribute: Program Name
Attribute: State (IDLE, RUNNING, STOPPED, UNRUNNABLE)
Attribute: List of Domain Reference
Attribute: MMS Deletable (TRUE, FALSE)
Attribute: Reusable (TRUE, FALSE)
Attribute: Monitor (TRUE, FALSE)
Constraint: Monitor = TRUE
Attribute: Event Condition Reference
Attribute: Event Enrollment Reference
Attribute: Execution Argument
Attribute: List of Access Control Specification

Program objects shall be represented as MMS Program Invocations. They shall have a VMD-specific scope. Each Program object attribute maps to a MMS Program Invocation with the identical name, with the exception of the List of Access Control Specification.

List of Access Control Specification
The representation of List of Access Control Specification is a local matter.

6.17 Event Enrollment Object Model Mapping

The Event Enrollment object model is defined as follows:

Model: Event Enrollment
Key Attribute: Event Enrollment Name
Attribute: MMS Deletable (TRUE, FALSE)
Attribute: Enrollment Class (NOTIFICATION)
Attribute: Event Condition Reference
Attribute: Event Condition Transitions (IDLE-TO-ACTIVE only)
Attribute: Application Association Local Tag
Attribute: Notification Lost (TRUE, FALSE)
Attribute: Duration (CURRENT, PERMANENT)
Attribute: Client Application
Attribute: Alarm Acknowledgement (NONE only)
Attribute: State (DISABLED, IDLE, ACTIVE only)
Attribute: List of Access Control Specification

Event Enrollment objects shall be mapped onto MMS Event Enrollment objects of VMD-specific or Domain-specific scope. The MMS Event Enrollment object attributes shall have the following types and/or restrictions:

Event Enrollment Name	=	locally determined
MMS Deletable	=	TRUE or FALSE
Enrollment Class	=	NOTIFICATION only
Event Condition Reference	=	one of the predefined names in 8.5
Event Condition Transitions	=	IDLE-TO-ACTIVE only
Application Association Local Tag	=	the Association Identifier for the Association object
Notification Lost	=	TRUE or FALSE
Event Action Reference	=	not supported
Acknowledgement Event Condition Reference	=	not supported
Duration	=	CURRENT or PERMANENT
Client Application	=	Application Reference in the Association object
Additional Detail	=	not supported
Alarm Acknowledgement Rule	=	NONE only
Time Active Acknowledged	=	not supported
Time Idle Acknowledged	=	not supported
State	=	DISABLED, IDLE, ACTIVE only

List of Access Control Specification
The representation of List of Access Control Specification is a local matter.

6.18 Event Condition Object Model Mapping

The Event Condition object model is defined as follows:

Model: Event Condition Object
Key Attribute: Event Condition Name
Attribute: MMS Deletable (FALSE only)
Attribute: Event Condition Class (MONITORED only)
Attribute: State (DISABLED, IDLE, ACTIVE)
Attribute: Priority
Attribute: Severity
Attribute: List of Event Enrollment Reference
Attribute: Alarm Summary Reports (FALSE only)
Attribute: Enabled (TRUE, FALSE)

Event Condition objects shall be mapped onto MMS Event Condition objects of scope VMD-specific. Each MMS Event Condition object shall have the following attribute settings:

Event Condition Name	=	one of the predefined names in 8.5
MMS Deletable	=	FALSE
Event Condition Class	=	MONITORED
State	=	DISABLED, IDLE, or ACTIVE
Priority	=	0
Severity	=	0
Additional Detail	=	not supported
List Of Event Enrollment Reference	=	List of Association Identifiers
Enabled	=	TRUE or FALSE
Alarm Summary Reports	=	FALSE only
Monitored Variable Reference	=	not supported
Evaluation Interval	=	not supported
Time Of Last Transition To ACTIVE	=	not supported
Time Of Last Transition To IDLE	=	not supported

Clients wishing to receive Event Notifications for changes in Event Conditions need to create an Event Enrollment object for those Event Conditions.

The following predefined MMS Event Condition objects exist for general VMD use:

a) "Access_violation": used when an access control violation occurs on any TASE.2 object; the use of this event condition is OPTIONAL.

The following predefined MMS Event Condition objects exist for Device objects:

a) "<device_name>_time": associated with the Timeout condition;

b) "<device_name>_fail": associated with the Failure condition;

c) "<device_name>_reset": associated with the Local Reset action;

d) "<device_name>_success": associated with the Success condition.

7 Mapping of TASE.2 Operations and Actions onto MMS Services

This clause describes all algorithms required to implement the TASE.2 services (operations and actions) of the TASE.2 protocol. These algorithms include the manipulation of TASE.2 objects, the use of MMS services, and what the contents of the MMS service parameters shall be in order to implement the VCC. TASE.2 requires no additional parameters or other changes to the base MMS services or objects.

Figure 7 shows the relationship of the TASE.2 server and its environment. This diagram and the others within this clause follow a common convention for describing the TASE.2 components. Objects are represented by ovals; TASE.2 internal logical components are enclosed within the major rectangle. Elements above the rectangle are control centre objects, which might possibly be on other systems within the control centre. Labels or elements below the rectangle represent MMS services offered by the MMS service provider. Solid lines represent data or control flow, while dashed lines represent flows taken only under exceptional conditions. For example, each of the TASE.2 server components implementing operations on particular object classes interact with the local MMS by issuing MMS service requests and receiving MMS service indications. These components access control centre objects after first verifying the access control permissions agreed to between the control centres.

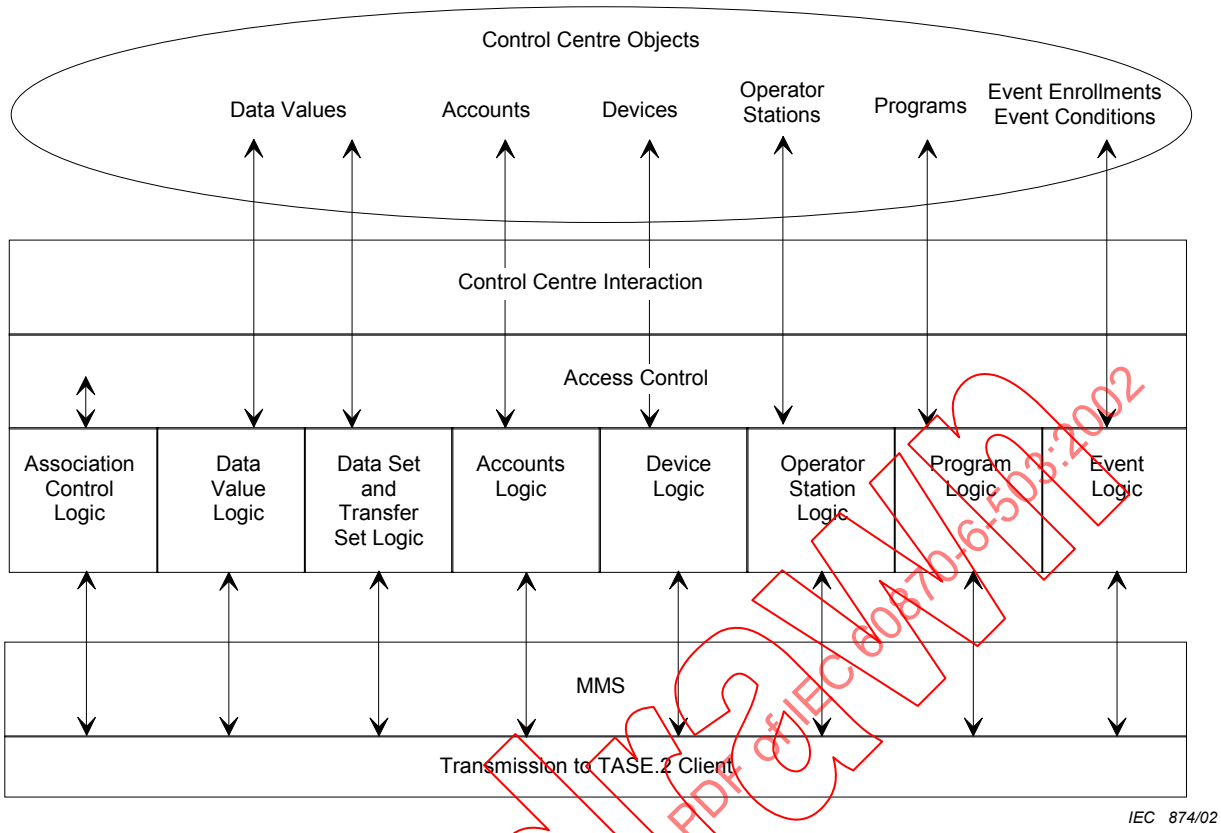

Figure 7 – TASE.2 server components

The TASE.2 server components labelled Control Centre Interaction and Access Control support all of the other TASE.2 components, and so are not called out separately in the following clauses. The support actions of these components are described within the operation definitions of each of the other components.

7.1 Use of MMS Services

Each of the TASE.2 operations and actions are described in detail below, first from the point of view of the TASE.2 client role, then from the point of view of the TASE.2 server role. The relationships of the TASE.2 server components and both MMS Services and control centre objects are shown in figures throughout this subclause.

Each of the TASE.2 service definitions includes server requirements for checking access control. These checks are used to verify that each TASE.2 operation is consistent with the Bilateral Agreement which is in effect between the TASE.2 client and TASE.2 server. In addition to the access control error handling and reporting described for each service, the TASE.2 server may signal each access control violation by invoking a MMS Event Notification service request with the event condition name "Access_violation". This is optional.

Many of the TASE.2 operations use the MMS Read and Write services. These services have the ability to read or write, respectively, to one or more MMS variables at a time. A positive MMS Read or Write service response is sent back to the client from the server if the MMS service request was acceptable to the VMD, and additionally:

a) if it is an MMS Read service request, the VMD attempted to determine the value of each of the MMS variables in the request; or

b) if it is an MMS Write service request, the VMD attempted to replace the value of each of the specified MMS variables with the value supplied in the request.

Because of this, a positive MMS service response could be sent back from the server but indicate a failure on reading or writing to any or all of the MMS variables. This is true even when only one MMS variable is indicated in the MMS Read or Write service request.

7.1.1 Association Management Mapping to MMS

TASE.2 association management includes three operations: Associate, Conclude, and Abort. The Associate operation maps onto the MMS Initiate service. The Conclude operation and action maps onto the MMS Conclude service. The Abort operation and action is mapped onto the MMS Abort service. Figure 8 shows the relationships between the TASE.2 server components and the MMS services used to implement association management. The Validate Association, Terminate Association, and Abort Association actions may not always be performed by MMS.

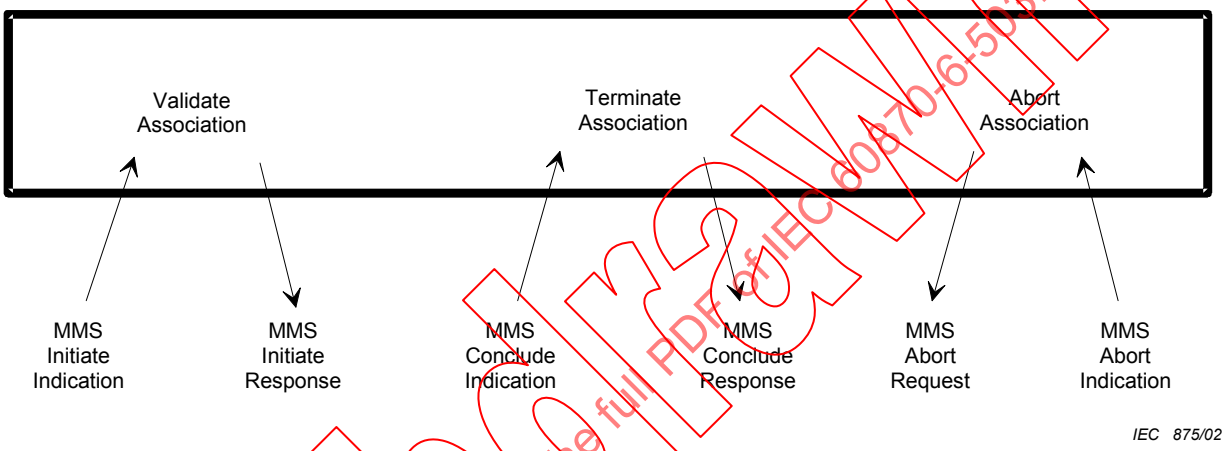

Figure 8 – TASE.2 Server Association Control Components

7.1.1.1 Associate Operation and Action Mapping

The Associate operation and action is used to establish MMS associations between TASE.2 instances. Each association has a specific QOS attribute, defining such aspects as network priority and protection. When both TASE.2 instances perform both the client and server role, one of the instances shall be designated the initiator of the association by prior agreement between the control centres.

If a request for an association is received by a TASE.2 implementation from a peer control centre where the receiving implementation was designated as the TASE.2 association initiator with the peer, then the TASE.2 implementation shall refuse the association request. An MMS Initiate-ErrorPDU shall be sent with an error class of INITIATE and an error code of OTHER.

7.1.1.1.1 Client Role

The TASE.2 client shall request establishment of associations for each of the QOS values required to implement the QOS as agreed to in the Bilateral Agreement. When a TASE.2 client requests any TASE.2 service other than association management services, the client shall choose an association with QOS yielding priority and security attributes matching the highest priority and highest security control centre object referenced in the request.

The TASE.2 client shall attempt to initiate all required associations (one for each QOS to be used) as soon as it is fully operational. In the event of any failure to associate, the client shall try to re-establish the association.

The TASE.2 client requests an association using the MMS Initiate service. It shall specify the following MMS arguments to the service:

Local Detail Calling	–	Max. message size (see text below)
Proposed Max. Serv Outstanding Calling	–	Local issue
Proposed Max. Serv Outstanding Called	–	Local issue
Proposed Data Structure Nesting level	–	Local issue, > 1
Init Request Detail	–	See text below

The Local Detail Calling argument shall conform to the maximum message size stated in the NIST specification. The arguments Init Request Detail and Init Response Detail are used to negotiate:

a) the version number of MMS to use;

b) the MMS Conformance Building Blocks;

c) the MMS services supported for use within the association.

The values used for the Init Request Detail and Init Response Detail shall conform, at a minimum, with the values specified in the PICS statement within IEC 60870-6-702. The client may not perform any other TASE.2 services on this association until a response indication is received for the requested association.

If the response Indication is positive, the response shall include the MMS arguments specified in the positive service response of the server described in the next subclause. The TASE.2 client shall then use the MMS Read service request to retrieve the values of three MMS Named Variables "Bilateral_Table_ID", "TASE.2_Version", and "Supported_Features". The order in which these variables are read, and whether or not they are interspersed with the following checks are outside the scope of this standard.

The TASE.2 client shall compare the returned value of the "Bilateral_Table_Version" variable with the value of its version identifier established in the Bilateral Agreement between the two corresponding control centres. If these values do not match, the TASE.2 client shall issue a MMS Conclude service indication and perform no further MMS Initiate service requests until the conflict is resolved. If these values do match, then the TASE.2 client shall compare the value of the "TASE.2_Version" variable returned by the TASE.2 server with its TASE.2 Version identifier established in their Bilateral Agreement. If the value does not match with the value of its TASE.2 Version Number, the TASE.2 client shall issue a MMS Conclude service indication and perform no further MMS Initiate service requests until the conflict is resolved. The TASE.2 client shall not, during the lifetime of this association, attempt to use any TASE.2 operation which is not included in the returned value of the TASE.2 server's "Supported_Features" variable.

If the response indication is negative, the TASE.2 client shall attempt to establish another association after some period of time.

7.1.1.1.2 Server Role

Upon receiving a MMS Initiate service indication, the TASE.2 server shall validate the association by checking that a Bilateral Agreement exists between its calling and called control centre. If data exchange is to occur, then the server shall execute the general access control mechanism as defined previously in this standard. If the Initiate service indication is valid, the server shall accept the association by issuing a positive MMS Initiate service response with the following MMS arguments:

Local Detail Calling	– Max. message size (see client text above)
Negotiated Max. Serv Outstanding Calling	– Local issue
Negotiated Max. Serv Outstanding Called	– Local issue
Negotiated Data Structure Nesting level	– Local issue, > 1
Init Response Detail	– See client text above

If the Initiate service indication is not valid, the server shall decline the association by issuing a negative MMS Initiate response.

The server shall also support a number of MMS Event Condition objects which are associated with TASE.2 events. These objects are defined in 8.5.

7.1.1.2 Conclude Operation and Action Mapping

When a TASE.2 instance (in the client or server role) is shutting down or reconfiguring, the TASE.2 instance may terminate its associations with remote TASE.2 instances. It does this by issuing a MMS Conclude service request. Termination is considered an abnormal action, and so the state of any outstanding requests or actions shall be considered indeterminate.

7.1.1.2.1 Client Role

Upon receiving an MMS Conclude service indication, the TASE.2 client shall respond by issuing a positive MMS Conclude service response. The client shall attempt to re-establish the association.

7.1.1.2.2 Server Role

Upon receiving a MMS Conclude service indication, the TASE.2 server shall respond by issuing a positive MMS Conclude service response. All outstanding TASE.2 operations being performed for this association shall be terminated. This includes:

a) Transfer Set objects: the server shall cease monitoring all transfer conditions. All active Transfer Set objects for that association are considered DISABLED. Their names shall be returned to the pool of names for available Transfer Set objects.

b) Device objects: all devices that have been selected by the client shall be deselected.

c) Messages: all outstanding messages designated for Information Message objects may or may not be completed at the discretion of the server.

d) Program objects: no specific actions are required for program invocations started on behalf of the concluding client. Program objects may or may not be stopped at the discretion of the server.

7.1.1.3 Abort Operation and Action Mapping

Either the TASE.2 client or TASE.2 server may generate an Abort by issuing an MMS Abort service request. Upon receiving an MMS Abort service indication, the MMS association is considered terminated.

7.1.1.3.1 Client Role

Upon receiving an MMS Abort service indication, the TASE.2 client shall consider all outstanding requests to be in an indeterminate state. The TASE.2 client shall attempt to re-establish the association.

7.1.1.3.2 Server Role

Upon receiving an MMS Abort service indication, the TASE.2 server shall terminate all outstanding TASE.2 operations on behalf of the aborting client. It shall perform all of the functions described for the Conclude operation as well. See 7.1.1.2.2 for details.

7.1.2 Data Value Operations Mapping to MMS

The operations specified for the Data Value object model shall be mapped onto services for MMS Named Variables as specified below. The service definitions of ISO 9506-1 are not modified except where specified below. For each of the service definitions, the Visibility access permission shall apply. Enforcement of this access permission is a local matter. If an implementation checks the Visibility access permission and the service fails as a consequence, then the error code OBJECT-NON-EXISTENT with error class ACCESS shall be returned.

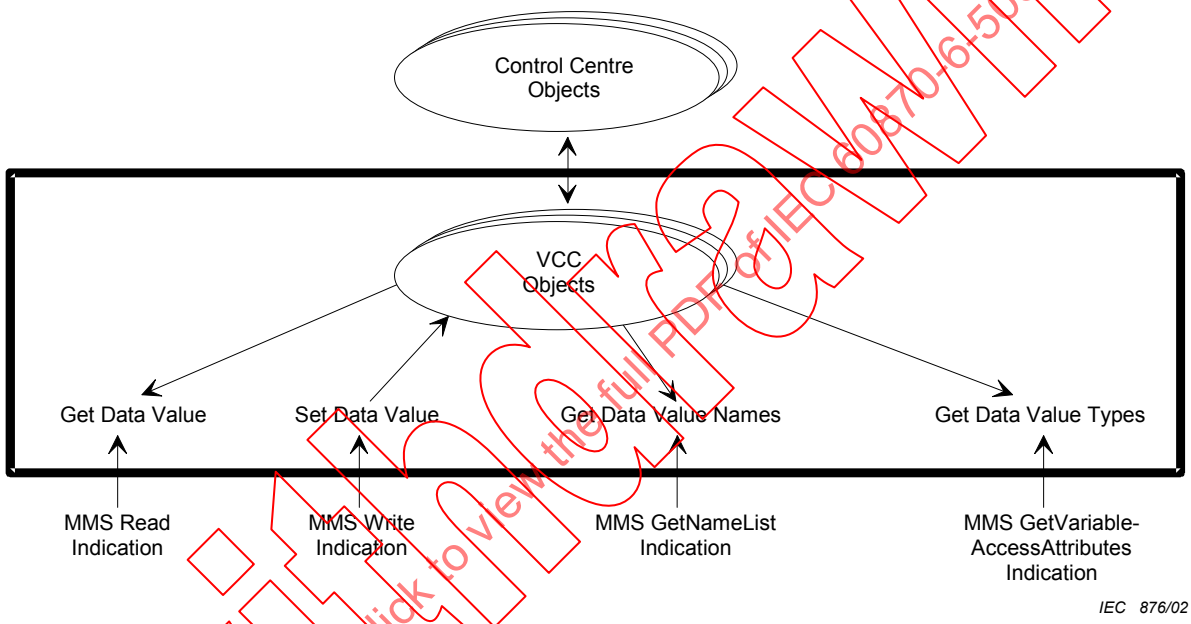

Figure 9 – Data Value operations

Figure 9 shows the relationships between the TASE.2 server components and the MMS services used to implement the Data Value operations.

7.1.2.1 Get Data Value Operation Mapping

The Get Data Value operation shall be mapped onto the MMS Read Service for a Named Variable. The service procedure shall be modified to utilize the Access Control Specification. If the Get Data Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the failure is signalled in the response.

7.1.2.1.1 Client Role

The TASE.2 client may issue a MMS Read service request at any time subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Specification With Result – Boolean flag

Variable Access Specification – enumerated list of Variable Specification[1)]

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1) The single Variable List Name parameter is used in the operations for Data Set objects.

The Specification With Result argument is a Boolean flag used to inform the server whether or not to include the identifier(s) of the requested object(s) in the result.

The Variable Access Specification shall include the MMS Kind of Access parameter. It specifies whether the access shall be an enumerated list of Variable Specification (i.e. a List of Variable), or a single Variable List Name. For the Get Data Value operation, this parameter shall be an enumerated list of Variable Specification and not a single Variable List Name. It shall only specify objects within the VCC that permit read access according to the Bilateral Table.

7.1.2.1.2 Server Role

Upon receiving a valid MMS Read service indication for a Data Value object, the server shall check for the existence of the Data Value object and check the Access Control Specification according to the Bilateral Table. If the server detects an error in either of these checks, the server shall respond with a positive MMS Read service response with the corresponding access result parameter of FAILURE with the error code as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED.

If no error exists, the server shall respond with a positive MMS Read service response including the data requested.

Figure 10 shows the sequence of the TASE.2 Get Data Value operation, together with the associated MMS requests, indications, responses and confirms.

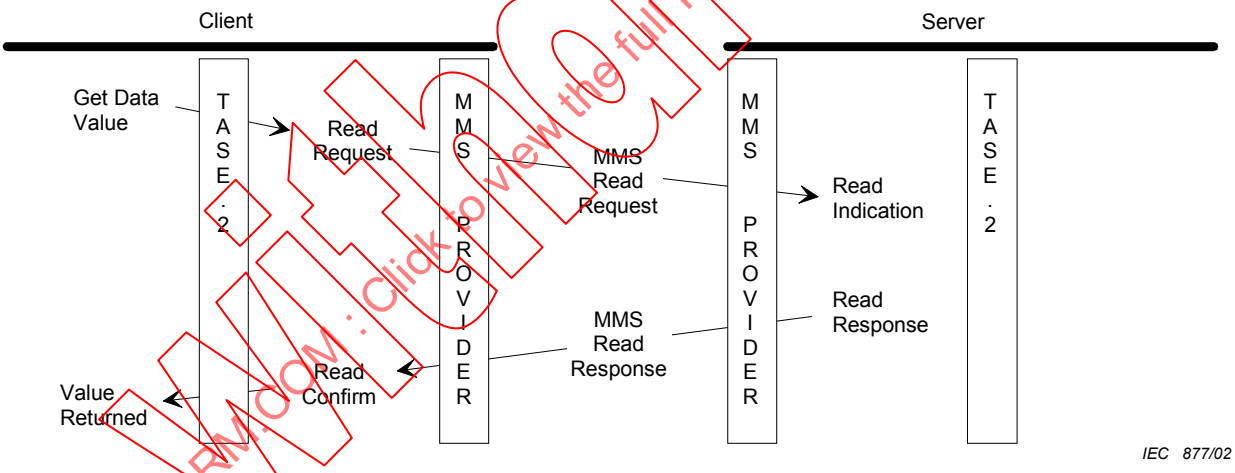

Figure 10 – Sequence of Get Data Value

7.1.2.2 Set Data Value Operation Mapping

The Set Data Value operation shall be mapped onto the MMS Write Service for a Named Variable. The service procedure shall be modified to utilize the Access Control Specification. If the Set Data Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the failure is signalled in the response.

7.1.2.2.1 Client Role

The TASE.2 client may issue a MMS Write service request at any time subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Variable Access Specification – enumerated list of Variable Specification

List of Data

The Variable Access Specification shall include the MMS Kind of Access parameter. It specifies whether the access shall be an enumerated list of Variable Specification (i.e. a List of Variable), or a single Variable List Name. For the Set Data Value operation, this parameter shall be an enumerated list of Variable Specification and not a single Variable List Name. It shall only specify objects within the VCC that permit write access according to the Bilateral Table.

The List of Data shall specify the values to be written to the variables specified in the Variable Access Specification, and shall be placed in this list in the order of the variables specified in the Variable Access Specification.

7.1.2.2.2 Server Role

Upon receiving a valid MMS Write service indication referencing MMS Named Variables representing Data Value objects, the server shall check for the existence of each Data Value object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on either of these checks, the server shall respond with a positive MMS Write service response with the corresponding DataAccess error code as follows: if the object does not exist, the DataAccess code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the DataAccess code shall be OBJECT-ACCESS-DENIED. For either case, the error class shall be access.

If no error exists, the server shall attempt to write the values of each of the specified objects and respond with a positive MMS Write service response with the corresponding access code SUCCESS. If it is not successful, it shall respond with a positive MMS Write service response with the corresponding DataAccess error code appropriate to the failure (HARDWARE-FAULT, TYPE-INCONSISTENT, OBJECT-ATTRIBUTE-UNSUPPORTED).

7.1.2.3 Get Data Value Names Operation Mapping

The Get Data Value Names operation shall be mapped onto the MMS GetNameList Service of the appropriate scope for Data Value objects mapped onto MMS Named Variables.

7.1.2.3.1 Client Role

The TASE.2 client may at any time issue a MMS GetNameList service request subject to the Access Control Specification defined in the Bilateral Table with the following arguments:

Extended Object Class – Named Variables

Object Scope – scope of variables of interest

Continue After – optional character string

The client uses this service to retrieve the names of all of the objects of the Extended Class within the specified Object Scope. If the Continue After argument is used, only the names occurring alphabetically following the character string shall be returned.

7.1.2.3.2 Server Role

Upon receiving a valid MMS GetNameList service indication, the server shall issue a positive MMS GetNameList response with the following arguments:

List Of Identifier – List of Named Variables in the specified scope

More Follows – Boolean, true implies that the list was too long

If the More Follows argument is true, the client shall perform subsequent MMS GetNameList service requests, each using the last item in the previously returned List Of Identifiers as the Continue After character string until a response is received with the More Follows argument set to false.

7.1.2.4 Get Data Value Type Operation Mapping

The Get Date Value Type operation shall be mapped onto the MMS GetVariableAccess Attributes service.

7.1.2.4.1 Client Role

The TASE.2 client may at any time issue an MMS GetVariableAccessAttributes service request subject to the Access Control Specification as defined in the Bilateral Agreement with the following arguments:

Kind of Variable	– NAMED (no Data Value objects are UNNAMED)
Name	– the name of the Data Value object

The client uses this service to retrieve the access information of Data Value objects.

7.1.2.4.2 Server Role

Upon receiving an MMS GetVariableAccessAttributes service indication, the server shall check for the existence of the Data Value object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on either of these checks, the server shall respond with a negative MMS GetVariableAccessAttributes service response with an error code as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED. For either case, the error class shall be ACCESS.

If no error exists, the server shall issue a positive MMS GetVariableAccessAttributes response with the following arguments:

MMS Deletable	– Boolean indicating whether or not the Data Value object specified is deletable using the MMS DeleteNamedVariableList service
Type Specification	– the Type Description attribute of the Data Value object

7.1.3 Data Set Operations Mapping to MMS

The operations specified for the Data Set model shall be mapped onto the MMS services for Named Variable Lists. The service definitions of ISO 9506-1 are not modified except where specified below. For each of the service definitions, the Visibility access permission shall apply. Enforcement of this permission is a local matter. If an implementation checks the Visibility access permission and the service fails as a consequence, then the error code OBJECT-NON-EXISTENT with error class ACCESS shall be returned.

Figure 11 shows the relationships between the TASE.2 server components and the MMS services used to implement the Data Set operations.

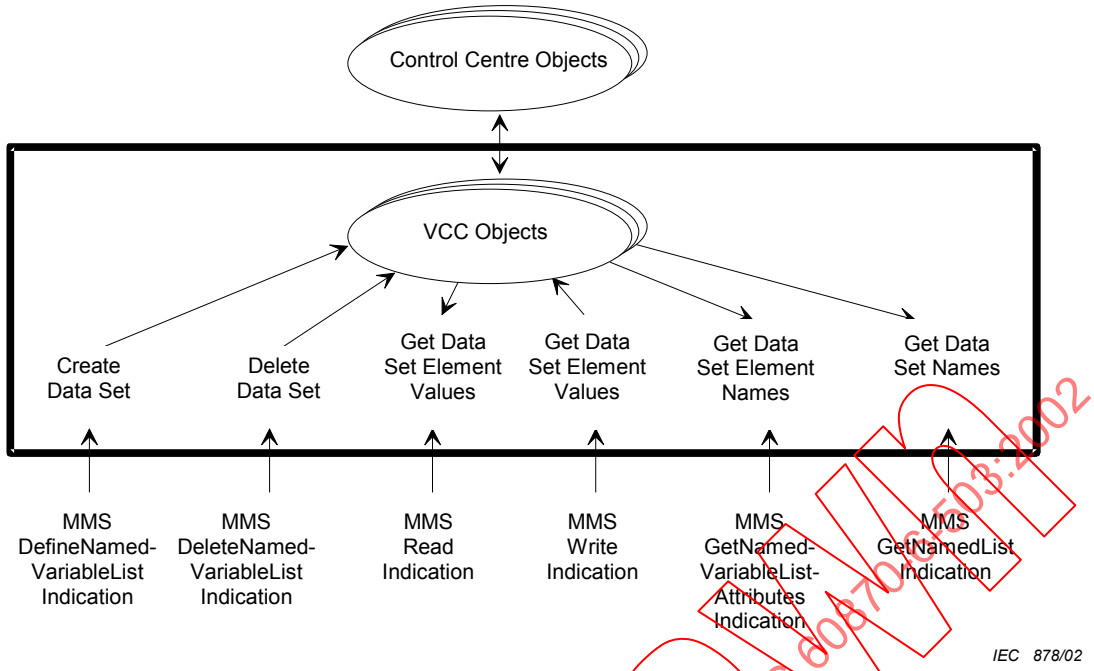

Figure 11 – Data Set operations

7.1.3.1 Create Data Set Operation Mapping

The Create Data Set operation shall be mapped to the MMS DefineNamedVariableList service. The service procedure shall be modified to utilize the Access Control Specification. If the Create Data Set access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail for error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.3.1.1 Client Role

The TASE.2 client requests that a Data Set be created within the TASE.2 server by issuing a MMS DefineNamedVariableList service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Variable List Name – the Domain-specific Variable List Name, of type ObjectName (from ISO 9506), that will identify the Data Set object which the client requests to be created.

List of Variables – a list of MMS Variable Specifications which represent and specify all of the attributes for a specific Data Set object. This includes the Variable Specifications of the Data Value objects, as well as (optionally) any of the following: "Transfer_Set_Name", "DSConditions_Detected", "Event_Code_Detected", and "Transfer_Set_Time_Stamp".

The Variable List Name of the Data Set shall be unique. It is recommended that it include a version number to guarantee uniqueness.

7.1.3.1.2 Server Role

Upon receiving an MMS DefineNamedVariableList service indication, the server shall:

a) check the Access Control Specification according to the Bilateral Table, including that the Client has at least Read access to all of the objects in the List of Variables;

b) check the uniqueness of the Variable List Name argument;

c) check for the existence of all of the objects in the List of Variables;

d) check to ensure that the scope of the Variable List Name is ICC-specific;

e) check to ensure that there are adequate resources to support creation of the Data Set.

If the server detects an error, the server shall respond with a negative MMS DefineNamed VariableList service response. The response shall include the following values, corresponding to the checks above:

a) errorClass ACCESS, a code of OBJECT-ACCESS-DENIED;

b) errorClass DEFINITION, code OBJECT-EXISTS;

c) errorClass DEFINITION, code OBJECT-UNDEFINED;

d) errorClass DEFINITION, code OBJECT-ATTRIBUTE-INCONSISTENT;

e) errorClass RESOURCE, code MEMORY-UNAVAILABLE.

Otherwise, the server shall respond with a positive MMS DefineNamedVariableList service response.

The following reserved identifiers may be referenced within a Data Set object. When these identifiers are used, they require the TASE.2 server to return information about the Transfer Report action together with the rest of the Data Set:

"Transfer_Set_Name" – Used to specify the MMS Named Variable in the Information Report that will contain the name of the Transfer Set object that generated the Transfer Report.

"DSConditions_Detected" – Used to specify the MMS Named Variable in the Information Report that will contain the DSConditions Detected object specifying conditions that became true, triggering the generation of the Transfer Report.

"Event_Code_Detected" – Used to specify the MMS Named Variable in the Information Report that will contain the Event Code Detected object specifying other external event condition that became true, triggering the generation of the Transfer Report.

"Transfer_Set_Time_Stamp – Used to specify the MMS Named Variable in the Information Report that will contain the Transfer Set Time Stamp object value that contains the time the Transfer Report was generated.

Figure 12 shows the sequence of the Create Data Set operation, together with the MMS services and their associated requests, indications, responses and confirmations for this operation.

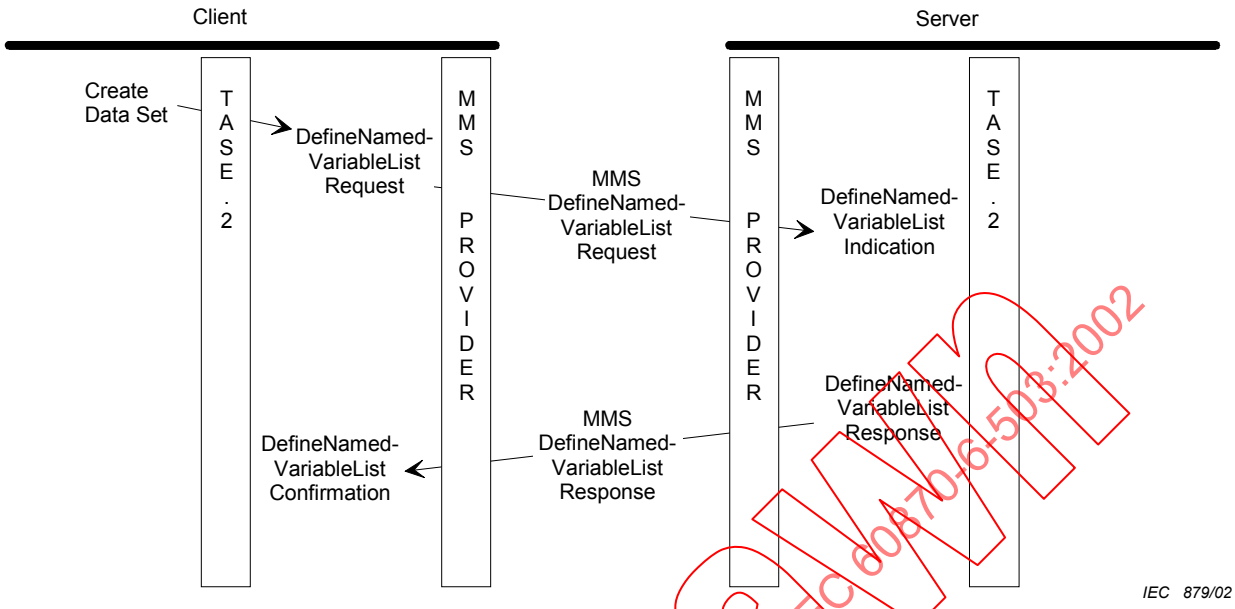

Figure 12 – Sequence of Create Data Set

7.1.3.2 Delete Data Set Operations Mapping

The Delete Data Set operation shall be mapped onto the MMS DeleteNamedVariableList service. The service procedure shall be modified to utilize the Access Control Specification. If the Delete Data Set access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.3.2.1 Client Role

The TASE.2 client requests that a Data Set object be deleted within the TASE.2 server by issuing a MMS DeleteNamedVariableList service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Scope of Delete	– SPECIFIC
List of Variable List Name	– list of one or more Variable List Names specifying the Data Set objects to be deleted
Domain Name	– not used

7.1.3.2.2 Server Role

Upon receiving a MMS DeleteNamedVariableList service indication, the server shall perform the following checks for each Variable List Name in the request:

a) check the existence of the Data Set object;

b) check the Access Control Specification according to the Bilateral Table for the Data Set object;

c) check for an active Data Set Transfer Set which references the Data Set object in its Data Set Name attribute;

d) check to ensure that the scope of the Data Set object is ICC-specific.

If the server detects an error on any of these checks, the server shall not delete the failing Data Set object and shall respond with a negative MMS DeleteNamedVariableList service response. The response shall include a code from the following list, corresponding to the checks above:

a) errorClass DEFINITION, code OBJECT-UNDEFINED

b) errorClass ACCESS, code OBJECT-ACCESS-DENIED

c) errorClass ACCESS, code OBJECT-ACCESS_UNSUPPORTED

d) errorClass DEFINITION, code OBJECT-ATTRIBUTE-INCONSISTENT

If no error exists, the server shall respond with a positive MMS DeleteNamedVariableList service response after deleting each of the Data Set objects.

Figure 13 shows the sequence of the TASE.2 and MMS services and their associated requests, indications, responses and confirmations for the Delete Data Set operation.

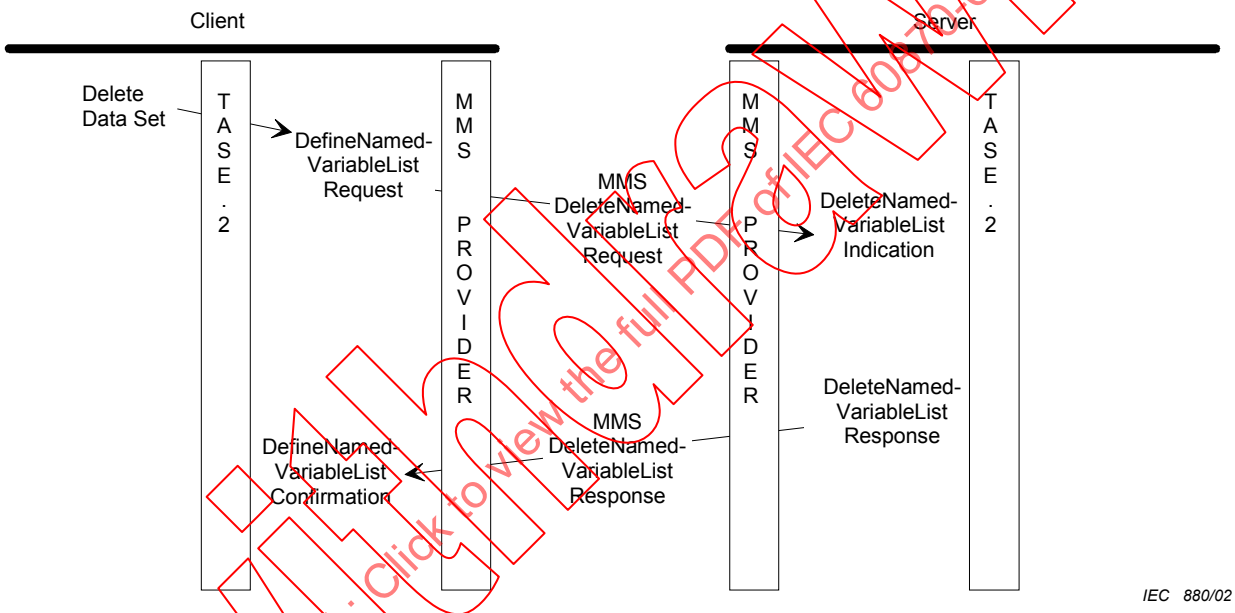

Figure 13 – Sequence of Delete Data Set

7.1.3.3 Get Data Set Element Values Operation Mapping

The Get Data Set Element Values operation shall be mapped onto the MMS Read Service for a Named Variable List. The service procedure shall be modified to utilize the Access Control Specification. If the Get Data Set Element Values access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with the error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.3.3.1 Client Role

The TASE.2 client may issue a MMS Read service request at any time subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Specification With Result

Variable Access Specification – Variable List Name[1)]

[1)] The enumerated list of Variable Specification parameter is used in operations for Data Value objects.

The Specification With Result argument is a Boolean flag used to inform the server whether or not to include the identifier(s) of the requested object(s) in the result.

The Variable Access Specification shall include the MMS Kind of Access parameter. It specifies whether the access shall be an enumerated list of Variable Specification (i.e. a List of Variable), or a single Variable List Name. For the Get Data Set Element Values operation, this parameter shall be a Variable List Name and not an enumerated list of Variable Specification. It shall only specify objects within the VCC that permit read access according to the Bilateral Table.

7.1.3.3.2 Server Role

Upon receiving an MMS Read service indication for an MMS Named Variable List representing a Data Set, the server shall check for the existence of the Data Set object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on either of these checks, the server shall respond with a positive MMS Read service response with the error code as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED. For either case, the error class shall be ACCESS.

If no error exists, the server shall respond with a positive MMS Read service response. The positive MMS Read service response shall contain an access result for each member of the Data Set. The following checks are performed for each member of the Data Set when constructing the access result:

a) if the Access Control Specification according to the Bilateral Table does not include Read access to the Data Value object, then return access result FAILURE, DataAccessError OBJECT-ACCESS-DENIED;

b) if the member is one of the Special Transfer Set Objects (Transfer_Set_Name, DSConditions_Detected, Event_Code_Detected, and Transfer_Set_Time_Stamp), then return access result FAILURE, DataAccessError OBJECT-ACCESS-DENIED.

In all other cases, the access result shall contain SUCCESS and the value of the corresponding Data Value object.

7.1.3.4 Set Data Set Element Values Operation Mapping

The Set Data Set Element Values operation shall be mapped onto the MMS Write Service for a Named Variable List. The service procedure shall be modified to utilize the Access Control Specification. If the Set Data Set Element Values access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.3.4.1 Client Role

The TASE.2 client may issue a MMS Write service request at any time subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Variable Access Specification – Variable List Name

List of Data

The Variable Access Specification shall include the MMS Kind of Access parameter. It specifies whether the access shall be an enumerated list of Variable Specification (i.e. a List of Variable), or a single Variable List Name. For the Set Data Set Element Values operation, this parameter shall be a Variable List Name and not an enumerated list of Variable Specification. It shall only specify objects within the VCC that permit write access according to the Bilateral Table.

The List of Data shall specify the values to be written to the variables specified in the Variable Access Specification, and shall be placed in this list in the order of the variables specified in the Variable Access Specification.

7.1.3.4.2 Server Role

Upon receiving a MMS Write service indication for an MMS Named Variable List representing a Data Set object, the server shall check for the existence of the Data Set object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on either of these checks, the server shall respond with a positive MMS Write service response with the error code as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED. For either case, the error class shall be ACCESS.

If no error exists, the server shall respond with a positive MMS Write service response. The positive MMS Write service response shall contain a response code for each member of the Data Set. The following checks are performed for each member of the Data Set when constructing the response codes:

a) if the Access Control Specification according to the Bilateral Table does not include Write access to the Data Value object, then return response code FAILURE, DataAccessError OBJECT-ACCESS-DENIED;

b) if the member is one of the Special Transfer Set Objects (Transfer_Set_Name, DSConditions_Detected, Event_Code_Detected, and Transfer_Set_Time_Stamp), then return response code FAILURE, DataAccessError OBJECT-ACCESS-DENIED.

In all other cases, the response code shall contain SUCCESS and the value from the List of Data shall be written to the corresponding Data Value object.

7.1.3.5 Get Data Set Names Operation Mapping

The Get Data Set Names operation shall be mapped to the MMS GetNameList Service for MMS Named Variable Lists of the appropriate scope. The service procedure shall be modified to utilize the Access Control Specification. If the Get Data Set Names access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.3.5.1 Client Role

The TASE.2 client may at any time issue a MMS GetNameList service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Extended Object Class	– Named Variable Lists
Object Scope	– VCC-specific (VMD-specific) or ICC-specific (Domain-specific)
Continue After	– optional character string

The client uses this service to retrieve the names of all of the objects of the Extended Class within the specified Object Scope. If the Continue After argument is used, only the names occurring alphabetically following the character string shall be returned.

7.1.3.5.2 Server Role

Upon receiving a valid MMS GetNameList service indication, the server shall issue a positive MMS GetNameList response with the following arguments:

List Of Identifier	– List of Named Variable Lists in the requested scope
More Follows	– Boolean, true implies that the list was too long

If the More Follows argument is true, the client shall perform subsequent MMS GetNameList service requests, each using the last item in the previously returned List Of Identifiers as the Continue After character string, until a response is received with the More Follows argument set to false.

7.1.3.6 Get Data Set Element Names Operation Mapping

The Get Data Set Element Names operation shall be mapped onto the MMS GetNamedVariableListAttributes service. The service procedure shall be modified to utilize the Access Control Specification. If the Get Data Set Element Names access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.3.6.1 Client Role

The TASE.2 client may at any time issue a MMS GetNamedVariableListAttributes service request subject to the Access Control Specification defined in the Bilateral Table with the following arguments:

Variable List Name – Variable List Name attribute of the Named Variable List object whose attributes are desired

The client shall use this service to retrieve the names of all of the Data Value objects referenced in the Data Set object specified by the MMS Named Variable List.

7.1.3.6.2 Server Role

Upon receiving an MMS GetNamedVariableListAttributes service indication, the server shall check for the existence of the Data Set object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on either of these checks, the server shall respond with a negative MMS GetNamedVariableListAttributes service response with the error code as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED. For either case, the error class is ACCESS.

If no error exists, the server shall respond with a positive MMS GetNamedVariableListAttributes service response including:

MMS Deletable – Boolean indicating whether or not the Named Variable List specified is deletable using the DeleteNamedVariableList service

List of Variable – List Of Variable attribute of the referenced Named Variable List

7.1.4 Transfer Set Operations and Actions Mapping to MMS

Four operations, Start Transfer, Stop Transfer, Get Next DSTransfer Set Value, and Get Next TSTransfer Set Value, and two server actions, Condition Monitoring and Transfer Report, are defined for Transfer Sets. The operations are mapped onto the MMS services for Named Variable Lists. The Transfer Report is mapped onto the MMS service for Information Reports. Condition monitoring is not mapped to any MMS service. The service definitions of ISO 9506-1 are not modified except where specified below. For each of the service definitions, the Visibility access permission shall apply. Enforcement of this permission is a local matter. If an implementation checks the Visibility access permission and the service fails as a consequence, then the error code OBJECT-NON-EXISTENT with error class ACCESS shall be returned.

Figure 14 shows the relationships between the TASE.2 server components and the MMS services used to implement the Transfer Set operations and actions.

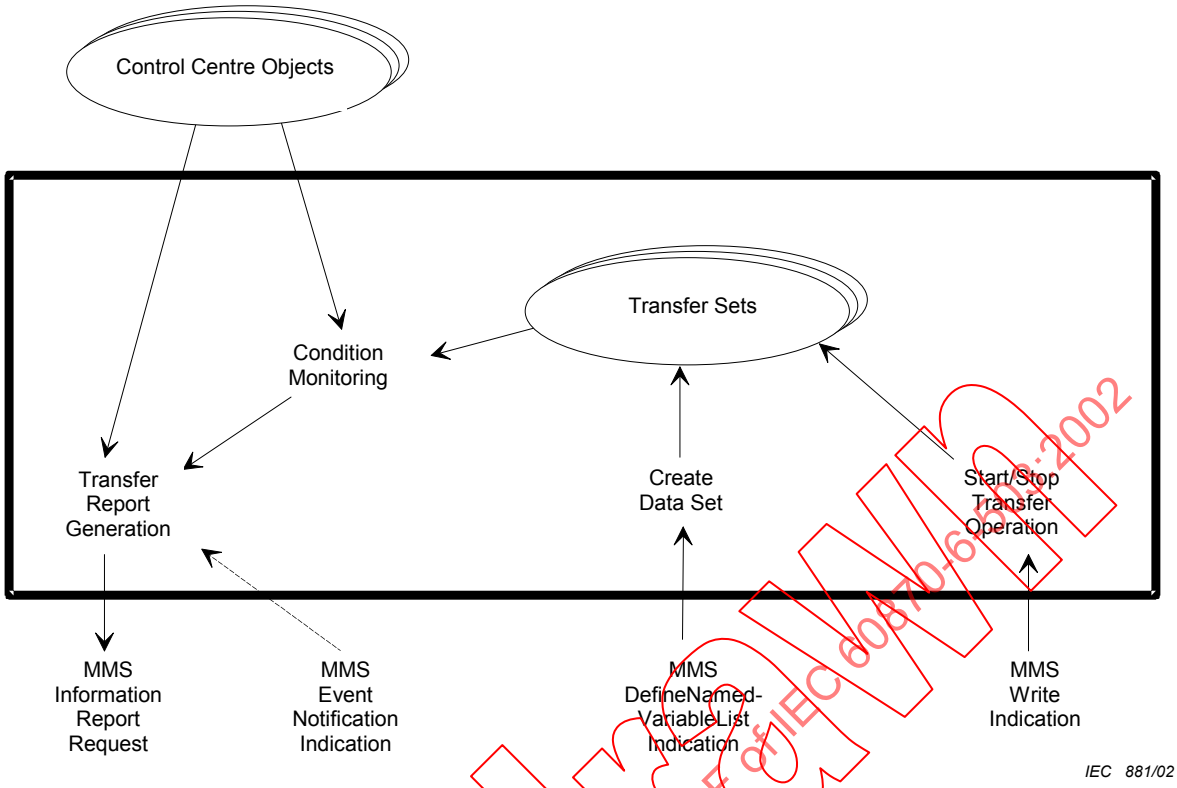

Figure 14 – Transfer Set services

7.1.4.1 Start Transfer Operation Mapping

The Start Transfer operation shall be mapped onto the MMS Write service for a Named Variable. The service procedure shall be modified to utilize the Access Control Specification. If the Start Transfer permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail for error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.4.1.1 Client Role

The TASE.2 client shall invoke the Start Transfer operation in an association with an appropriate QOS. The client may issue an MMS Write service request subject to the Access Control Specification as defined in the Bilateral Table only if it has received the name of the MMS Named Variable representing the Transfer Set object via a Get Next DSTransfer Set Value operation for Data Sets or Get Next TSTransfer Set Value operation for Time Series, and has not previously issued a Start Transfer operation for that same MMS Named Variable. The client shall write to an MMS Named Variable which has one of the four TransferSet types defined in clause 8. The identifier of the Transfer Set variable shall be one of the Transfer Set objects included in the Bilateral Table. The MMS client shall perform the write by issuing an MMS Write service request with the following arguments:

Variable Access Specification – enumerated list of Variable Specification

List Of Data – attributes of the Transfer Set objects to be written

The Variable Access Specification shall include the MMS Kind of Access parameter. It specifies whether the access shall be an enumerated list of Variable Specification (i.e. a List of Variable), or a single Variable List Name. For the Start Transfer operation, this parameter shall be an enumerated list of Variable Specification and not a single Variable List Name. It shall only specify objects within the VCC that permit write access according to the Bilateral Table. This list shall be identifiers of Transfer Set objects.

The List of Data shall specify the values to be written to the variables specified in the Variable Access Specification, and shall be placed in this list in the order of the variables specified in the Variable Access Specification. The attributes are written using the MMS Named Type of either DSTransferSet, TSTransferSet, TATransferSet or IMTransferSet, depending upon the type of Transfer Set being used. The attributes contain one of the following sets of values.

For MMS Named Variables of DSTransferSet type:

Data Set Name	– MMS Object Name of the Data Set to be reported
Transmission Parameters	– structure of DSTransmissionPars object
Status	– ENABLED (1)

For MMS Named Variables of TSTransferSet type:

Data Value	– MMS Object Name of the Data Value to be reported
Transmission Parameters	– structure of TSTransmissionPars object
Begin Time	– time to begin collecting values
End Time	– time to stop collecting values
Sampling Interval	– time between collecting values
Reporting Interval	– time between reporting values
Status	– ENABLED (1)

The client shall not specify any negative values for Begin Time, End Time, Sampling Interval and Reporting Interval. End Time shall be greater than or equal to Begin Time.

For MMS Named Variables of TATransferSet type:

Transmission Parameters	– structure of TATransmissionPars object
Status	– ENABLED (1)

For MMS Named Variables representing Information Message Transfer Set:

Status	– ENABLED (1)

The MMS Named Variable List referenced by the Data Set Name attribute for the DSTransferSet type shall exist in the TASE.2 server (created through the use of the Create Data Set operation or predefined).

The MMS Named Variable referenced by the Data Value attribute for the TSTransferSet type shall exist in the TASE.2 server.

7.1.4.1.2 Server Role

On receiving a valid MMS Write service indication referencing an MMS Named Variable representing a Transfer Set object, the server shall:

a) For MMS Named Variables of type DSTransferSet:

   1) check for the existence of the Data Set object, and if it exists, check the Access Control Specification as defined in the Bilateral Table for the Data Set object;

   2) check the Access Control Specification as defined in the Bilateral Table for all of its Data Value object elements. If the IntervalTimeOut DSCondition is included, the check shall include the comparing of the allowed access frequency of each Data Value object against the Interval attribute of the DSTransferSet;

   3) if RBE is false, check if all of the data can fit into a single MMS PDU of the negotiated maximum size.

b) For MMS Named Variables of type TSTransferSet:

   1) check for the existence of the Data Value object, and if it exists, check the Access Control Specification as defined in the Bilateral Table for the Data Value object;

   2) check the allowed access frequency in the Bilateral Table of each Data Value object against the Sampling Interval attribute of the TSTransferSet;

   3) check if the values for Begin Time, End Time, Sampling Interval and Reporting Interval are greater than or equal to zero. An error condition shall occur if any of these values are negative;

   4) check if End Time is greater than or equal to Begin Time. An error condition shall occur if this is not true.

c) For MMS Named Variables of type TATransferSet, check the Access Control Specification as defined in the Bilateral Table for all of the Transfer Account objects.

d) For MMS Named Variables representing Information Message Transfer Sets:

   1) check for the existence of the Information Transfer Set object, and if it exists, check the Access Control Specification as defined in the Bilateral Table for the IMTransfer Set object.

If the server detects an error on any of these checks, the server shall respond with a positive MMS Write service response with a negative Write Result parameter as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED; if there is an error in the check for exceeding the negotiated maximum MMS PDU size, the error code shall be OBJECT-ATTRIBUTE-INCONSISTENT; if there is an error in the checks for the values of Begin Time, End Time, Sampling Interval and Reporting Interval, the error code shall be OBJECT-ATTRIBUTE-INCONSISTENT. When a server receives an MMS Write service request that enables a Transfer Set object that is already enabled, it shall respond with a positive Write service response with a negative Write Result parameter and an error code of ATTRIBUTE-INCONSISTENT. The Transfer Set object shall remain enabled and unchanged.

If no error exists, the server shall respond with a positive MMS Write service response.

If the Start Time attribute in the Transmission Parameters is past the current time, is the current time, or is zero, the server shall start monitoring the transfer conditions as soon as possible as specified in the DSTransmissionPars attribute, depending upon the type of Transfer Set object specified in the Start Transfer operation.

The MMS Named Variable List referenced by the Data Set Name attribute for the DSTransferSet type in the client's request shall exist in the TASE.2 server (created through the use of the Create Data Set operation or predefined).

The MMS Named Variable referenced by the Data Value attribute for the TSTransferSet type in the client's request shall exist in the TASE.2 server.

7.1.4.2 Stop Transfer Operation Mapping

The Stop Transfer operation shall be mapped onto the MMS Write service for a Named Variable. The service procedure shall be modified to utilize the Access Control Specification. If the Stop Transfer permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall signal the failure in the response.

7.1.4.2.1 Client Role

The client writes value of DISABLED to the Status attribute of a Transfer Set object using an MMS Write service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Variable Access Specification	– enumerated list of Variable Specification
List Of Data	– DISABLED (0)

The Variable Access Specification shall include the MMS Kind of Access parameter. It specifies whether the access shall be an enumerated list of Variable Specification (i.e. a List of Variable), or a single Variable List Name. For the Stop Transfer operation, this parameter shall be an enumerated list of Variable Specification and not a single Variable List Name. It shall only specify objects within the VCC that permit write access according to the Bilateral Table. This list shall be identifiers of Transfer Set objects.

The List of Data shall specify the values to be written to the variables specified in the Variable Access Specification, and shall be placed in this list in the order of the variables specified in the Variable Access Specification. The attributes are written using the MMS Named Type of either DSTransferSet, TSTransferSet or TATransferSet, or Boolean (Information Message Transfer Set) depending upon the type of Transfer Set being used. The Status attribute shall be set to DISABLED (0).

The TASE.2 client shall be prepared to accept at least one more Transfer Report from the server after the MMS Write service request is issued.

7.1.4.2.2 Server Role

On receiving the MMS Write service indication referencing an MMS Named Variable which represents a Transfer Set object, the server shall check for the existence of the Transfer Set object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on either of these checks, the server shall respond with a positive MMS Write service response with a negative Write Result and error code as follows: if the object does not exist, the error code shall be OBJECT-NON-EXISTENT; if there is an error in the access control permissions, the error code shall be OBJECT-ACCESS-DENIED.

If no error exists, the server shall terminate transfer condition monitoring for the specified Transfer Set object. If the Transfer Set was allocated via a Get Next DSTransfer Set Value or Get Next TSTransfer Set Value, it shall also return the name of the Transfer Set object to the pool of available names for Transfer Set objects.

7.1.4.3 Condition Monitoring Action Mapping

A Transfer Set is considered to be enabled if its Status attribute is set to ENABLED. The Condition Monitoring action is performed by the TASE.2 server when there are one or more enabled Transfer Set objects. For enabled Data Set Transfer Set objects, the TASE.2 server shall begin condition monitoring as soon as the Start Time attribute of the DSTransmissionPars object has passed. If the Start Time is zero, then the TASE.2 server shall begin condition monitoring immediately. For enabled Time Series Transfer Set, Transfer Account Transfer Set and Information Message Transfer Set objects, the TASE.2 server shall begin condition monitoring immediately upon receiving the Start Transfer request from the TASE.2 client.

The TASE.2 server shall check for an occurrence of the entire set or a subset of conditions that correlate to the type of enabled Transfer Set objects: a subset of conditions may only be checked if the server has not implemented all of the conformance building blocks.

For Data Set Transfer Set objects, the TASE.2 server shall check the entire set or a subset of conditions that are defined in the DSConditions Requested attribute of the DSTransmissionPars object.

For Time Series Transfer Set objects, the TASE.2 server shall check the entire set or a subset of conditions that are defined in the TSConditions Requested attribute of the TSTransmissionPars object.

For Transfer Account Transfer Set objects, the TASE.2 shall check the entire set or a subset of conditions that are defined in the TAConditions Requested attribute of the TATransmissionPars object.

For Information Message Transfer Set objects, the TASE.2 server shall monitor local conditions, subject to Bilateral Agreements.

When one or more of the specified conditions occur for an enabled Transfer Set, the TASE.2 server shall execute the Transfer Report action. The mechanism for performing condition monitoring is a local matter.

7.1.4.3.1 Data Set Transfer Set Condition Monitoring

If the Buffer Time attribute of the DSTransmissionPars attribute of the Data Set Transfer Set object is non-zero, it specifies the number of seconds to wait after a transfer condition is detected before sending a Transfer Report. This delay allows for a sequence of transfer conditions which may typically occur together (for example, a group of control centre data objects which change together but not quite simultaneously) to be buffered into a single Transfer Report.

It is the client's responsibility to retrieve the initial values of the Data Set. If the current time is less than the Start Time, then the TASE.2 server shall wait until the Start Time occurs to begin condition monitoring. If the current time is past the Start Time, or if Start Time is zero, then the TASE.2 server shall begin condition monitoring immediately after receiving the Start Transfer indication.

7.1.4.3.2 Time Series Transfer Set Condition Monitoring

The TASE.2 server shall start condition monitoring on Time Series Transfer Set objects immediately upon receiving a Start Transfer operation request from the TASE.2 client.

When the Begin Time attribute of the Time Series Transfer Set object specifies past time, the TASE.2 server shall immediately generate a report containing all of the values of the Data Value object from the Begin Time to the current time. It shall then begin collecting values of the Data Value object specified by the Transfer Set object at time intervals specified by the Sampling Interval attribute. For the past time, if the Sampling Interval is different from the interval in which the data was sampled, the TASE.2 server shall extrapolate.

When the Begin Time attribute of the Time Series Transfer Set object specifies future time, when this time has arrived, the TASE.2 server shall begin collecting values of the Data Value object specified by the Transfer Set object at time intervals specified by the Sampling Interval attribute. The first data value in the time series shall be obtained by the TASE.2 server at the Begin Time. Each subsequent data value in the time series shall be obtained by the TASE.2 server when the time interval specified in the Sampling Interval attribute of the Time Series Transfer Set object has arrived.

A value of zero for Begin Time or End Time implies the current time. When Begin Time is zero, the TASE.2 server shall treat it as time arrived (explained in the above paragraph). End Time shall always be greater than or equal to Begin Time.

The TASE.2 server shall generate a report when one of the conditions occurs. When the Reporting Interval of the Time Series Transfer Set object has arrived, as indicated by the condition ReportIntervalTimeOut occurring, the TASE.2 server shall generate a report, and continue to collect data values until the End Time has arrived. When the End Time of the Time Series Transfer Set object has arrived, as indicated by the condition EndTimeArrived occurring, the TASE.2 server shall stop collecting data values and generate a report with the values that have not been previously reported.

The TASE.2 server shall also generate a Transfer Report containing all of the existing collected data values if the OperatorRequest condition occurs. Once it does this, it shall continue to collect new values for the Data Value object at the specified time intervals until the EndTimeArrived condition has occurred. The generation and sending of a Transfer Report for the OperatorRequest condition shall not affect the time intervals for collecting data values in any way.

The TASE.2 server shall not report any values in any Transfer Report that have been included in a previous Transfer Report for any condition. It is a local matter as to how the TASE.2 server maintains the data values collected for the time series Transfer Report.

7.1.4.3.3 Transfer Account Transfer Set Condition Monitoring

The TASE.2 server shall start condition monitoring on Transfer Account Transfer Set objects immediately upon receiving a Start Transfer operation request from the TASE.2 client. When any one or more of the conditions specified in the TAConditions Requested attribute of the TATransmissionPars attribute of the Transfer Account Transfer Set occurs, the TASE.2 server shall generate a Transfer Report for each of the Transfer Account objects and send it to the TASE.2 client. It shall generate as many Transfer Reports as necessary in order to report all of the Transfer Account objects.

The TAConditions Requested imply a set of times that the TASE.2 server uses to perform condition monitoring on Transfer Account Transfer Set objects. These sets of times are defined in the Bilateral Table.

7.1.4.3.4 Information Message Transfer Set Condition Monitoring

The TASE.2 server shall start condition monitoring on Information Message Transfer Set objects immediately upon receiving a Start Transfer operation request from the TASE.2 client. When locally defined condition occurs, the TASE.2 server shall generate a Transfer Report for each of the Information Message objects and send it to the TASE.2 client.

7.1.4.4 Transfer Report Action Mapping

The TASE.2 Transfer Report action for any of the four types of Transfer Sets shall be mapped to the MMS Information Report service. The Information Report shall contain one or more data values depending upon type of Transfer Set and the processing results of the transfer reporting.

7.1.4.4.1 Client Role

When a TASE.2 client receives an MMS InformationReport service indication for a Data Set Transfer Report, the client shall check that the Data Set Name is correct for the Transfer Report. If it is not, it shall discard the data and send a negative acknowledgement back to the TASE.2 server. This negative acknowledgement shall be mapped onto an MMS InformationReport service. The information report shall contain the MMS Named Variable called "Transfer_Report_NACK". It shall use the same Data Set Transfer Set Name that was contained in the Information Report it received from the TASE.2 server. The value of the Domain identifier portion of the object name for Transfer_Report_NACK shall be equal to the value of the Domain identifier of the Transfer Set Name contained in the Information Report received by the server.

For Data Set Transfer Sets, if the Data Set name is correct for the Transfer Report, the TASE.2 client shall process the data according to the Reception Parameters as specified in the Bilateral Agreement.

For Data Set Transfer Sets, if the TASE.2 client had set the Critical attribute of the DSTransmissionPars in the Transfer Set object to true when invoking the Start Transfer operation, an acknowledgement by the TASE.2 client to the TASE.2 server of the Transfer Report is required. The TASE.2 client shall map this acknowledgement onto a MMS Information Report, and shall use the MMS InformationReport service. The Information Report shall contain the MMS Named Variable called "Transfer_Report_ACK". It shall use the same Transfer Set Name that was contained in the Information Report received by the TASE.2 client from the TASE.2 server. The value of the Domain identifier portion of the object name for Transfer_Report_ACK shall be equal to the value of the Domain identifier of the Transfer Set Name contained in the Information Report received by the TASE.2 client from the TASE.2 server. The Information Report shall also contain the MMS Named Variable called "Transfer_Set_Time_Stamp" with the value equal to the value contained in the Information Report received by the TASE.2 client from the TASE.2 server. The TASE.2 client knows which Transfer Reports need acknowledgement because it defined the DSTransmissionPars.

7.1.4.4.2 Server Role – Data Set Transfer Reports

Whenever a TASE.2 server performing condition monitoring detects a true condition for an enabled Transfer Set object, the server shall generate a Transfer Report unless the TLE has been exceeded. If the TLE has been exceeded for a previous Transfer Report, the server shall generate a Transfer Report regardless of whether or not it will exceed the TLE.

Data Set Transfer Reports for Transfer Set objects are required to fit into a single MMS PDU. For Transfer Sets that have the RBE attribute of the DSTransmissionPars set to false, the MMS Information Report shall contain the MMS Named Variable List that represents the entire Data Set object.

For Transfer Sets that have the RBE attribute of the DSTransmissionPars set to true, the MMS Information Report shall contain a List of Named Variables representing the appropriate members of the Data Set to be reported. Note that if any of the Special Transfer Objects (Transfer_Set_Name, DSConditions_Detected, Event_Code_Detected, and Transfer_Set_Time_Stamp) were included in the Data Set, then they will be included in the RBE report. If the MMS server anticipates the Transfer Report will exceed the negotiated maximum MMS PDU size, then the entire Data Set may be transferred as if RBE were false, if this results in a smaller encoding. In the event that this occurs, the TASE.2 server shall still be considered as conforming to RBE.

The TLE field indicates the time limit for execution for a Data Set Transfer Report. It is the time within which the server should generate a Transfer Report. Its purpose is to indicate to the server the maximum time a Data Set Transfer Report is considered valid by the TASE.2 client. If the TASE.2 server anticipates that it will take longer to generate the Data Set Transfer Report than the time indicated in the TLE, it shall discard the Data Set Transfer Report, or not generate one at all. If the TLE attribute of the DSTransmissionPars attribute is zero, it is ignored by the server.

The server shall generate the Transfer Report by issuing a MMS InformationReport service request with the following arguments:

If the Block Data attribute of the Transfer Set object is false:

Variable Access Specification	– If the Transfer Set attribute RBE is true, then it is the list of MMS Named Variables from the Data Set object that have changed. Otherwise, it is the name of the MMS Named Variable List that represents the Data Set object.
List Of Data	– If the RBE is false, it is the values of all of the MMS Named Variables in the Data Set object. Otherwise, it is the values of the MMS Named Variables from the Data Set object that have changed.

If the Block Data attribute of the Data Set Transfer Set object is true:

Variable Access Specification	– A list of MMS Named Variables consisting of any of the Special Transfer Object identifiers that appear in the MMS Named Variable List that represents the Data Set object, as well as the MMS Named Variable representing the blocked data (see below).
List Of Data	– A list containing the values of each of the Special Transfer Objects that appear in the MMS Named Variable List, plus the value of the octet-string constructed according to the rules below.

If the Block Data attribute is true, the data values shall be transferred as a single MMS octet-string with the following header appearing first:

Field	Length (number of octets)
RBE Blocking Rule	1

RBE Blocking Rule is the rule number used in formatting the rest of the octet-string, defined by:

Rule 0: no RBE (RBE false in the DSTransmissionPars attribute of Transfer Set object)

For each variable in the MMS Named Variable List representing the Data Set object, append the variable value to the end of the octet-string based on its storage type (see IEC 60870-6-802). Values are stored octet aligned.

Rule 1: Offset1 (RBE true in the DSTransmissionPars attribute of Transfer Set object)

Following the header, for each variable in the MMS Named Variable List representing the Data Set object that is to be included in the report, append the relative position (1 octet, unsigned integer) of the identifier in the MMS Named Variable List (for the nth identifier, add n to the octet-string) followed by the value. Both the offsets and the values shall be octet aligned. The offset starts with 0.

Rule 2: Offset2 (RBE true in the DSTransmissionPars attribute of Transfer Set object)

Following the header, for each variable in the MMS Named Variable List representing the Data Set object that is to be included in the report, append the relative position (2 octets, unsigned integer) of the identifier in the MMS Named Variable List (for the nth identifier, add n to the octet-string) followed by the value. Both the offsets and the values shall be octet aligned. The offset starts with 0.

If RBE was true in the DSTransmissionPars attribute of the Transfer Set object, the TASE.2 server may choose to apply any one of rules 1 or 2. It is recommended that the server apply the rule that yields the most compact octet-string for transmission.

If the Critical attribute of the DSTransmissionPars attribute in the Transfer Set object is true, the server shall expect an MMS Information Report indication as an acknowledgement from the client. This report shall contain the Data Set Transfer Set Name and Transfer Set Time Stamp that were sent in the MMS Information Report sent to the TASE.2 client.

If a correct acknowledgement has not been received by the TASE.2 server, or if the TASE.2 server received an Information Report from a TASE.2 client indicating a Transfer_Report_NACK as a consequence of sending that same TASE.2 client a Transfer Report, and if Event Conditions are implemented by the TASE.2 server, the TASE.2 server shall trigger the MMS Event Condition named "Data_failure". Additional TASE.2 server actions, such as notifying the operator, are local issues and outside the scope of this standard. If Event Conditions are not supported by the TASE.2 server, the action taken when correct acknowledgement is not received is a local matter.

7.1.4.4.3 Server Role – Time Series Transfer Reports

Whenever a TASE.2 server performing condition monitoring detects a true condition for an enabled Transfer Set object, the server shall generate a Transfer Report.

For Time Series Transfer Sets, the server is permitted to send an Information Report when it anticipates the set of collected data values to be close to generating a maximum MMS PDU. When this occurs, the server shall set the "MaxMMSPDU" condition to be true in the TSConditions Detected object. Once it sends this report with this condition, it shall not report these same values again in subsequent Information Reports: it shall only report new data values in subsequent Information Reports until the EndTimeArrived condition occurs.

The Information Report shall contain all of the following items for Time Series Transfer Reports:

a) the MMS Named Variable representing the Transfer Set Name;

b) the MMS Named Variable representing the TSConditions detected for the Transfer Set;

c) a sequence of MMS Named Variables representing the Data Value object for each time interval in the Time Series.

The TASE.2 server shall use the MMS Named Variables "Transfer_Set_Name" and "TSConditions_Detected" defined in 8.2 to represent their corresponding data.

7.1.4.4.4 Server Role – Transfer Account Transfer Reports

Whenever a TASE.2 server, performing condition monitoring, detects a true condition for an enabled Transfer Set object, the server shall generate a Transfer Report.

The Information Report which represents a Transfer Report shall contain:

a) the MMS Named Variable "TAConditions_Detected", representing the TAConditions detected which caused the Transfer Report;

b) all of the MMS Named Variables used to represent the Account, as defined in IEC 60870-6-802.

Figure 15 shows the sequence of the TASE.2 operations and MMS services, together with their associated requests, indications, responses and confirmations for the Start Transfer and Stop Transfer operations, together with the Transfer Reporting mechanism for all three types of Transfer Set objects.

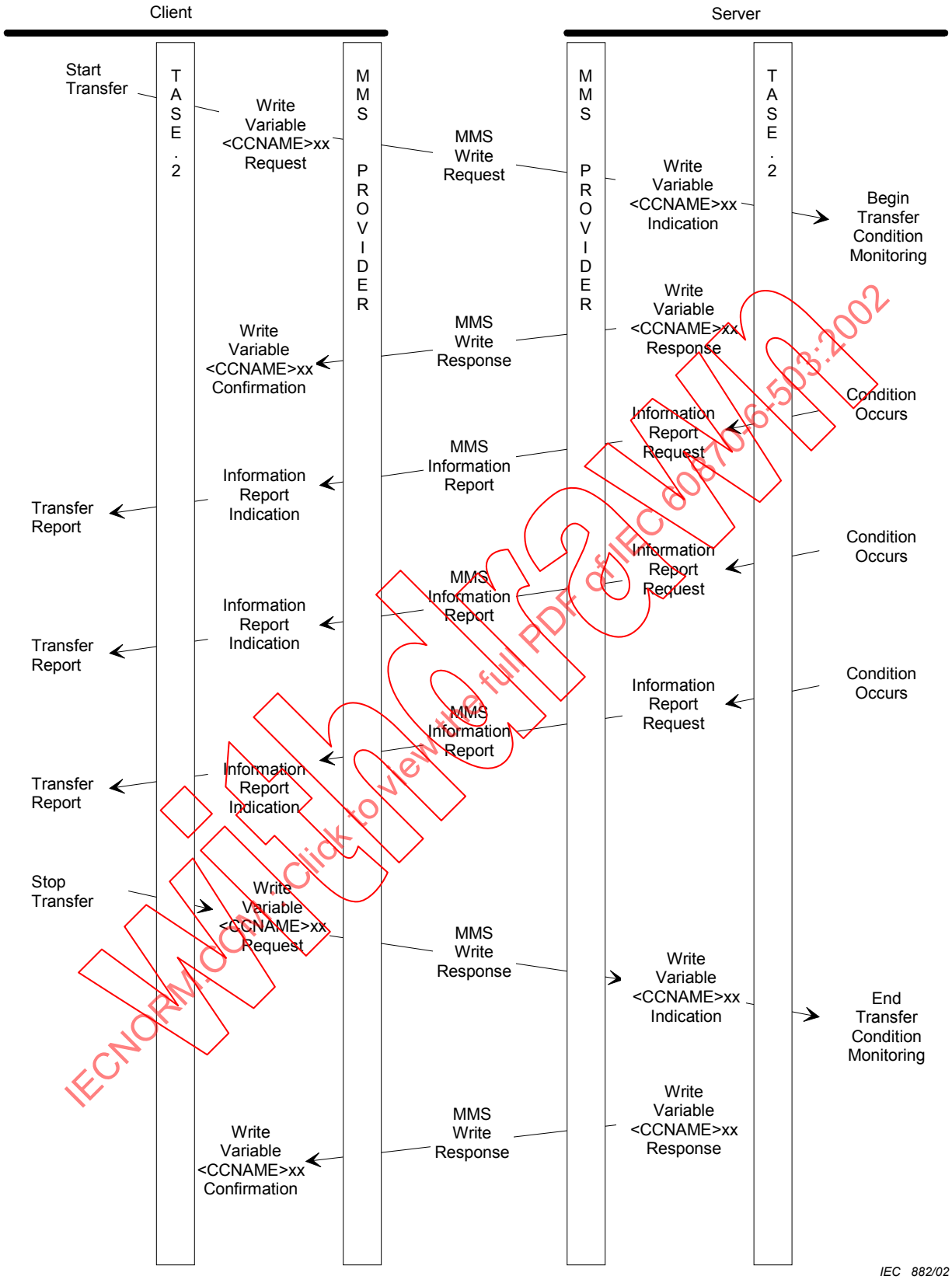

Figure 15 – Sequence of Transfer Set operations and actions

7.1.4.4.5 Server Role – Information Message Transfer Reports

Whenever a TASE.2 server, performing condition monitoring, detects a true condition for an enabled Information Message Transfer Set object, the server shall generate a Transfer Report.

The MMS Information Report which represents the Information Message Transfer Report shall contain all of the following objects, in the following order:

a) the MMS Named Variable representing the Info Reference, LocalReference, MessageId, and Size;

b) the MMS Named Variable representing the InfoStream attribute.

7.1.4.5 Get Next DSTransfer Set Value Operation Mapping

The Get Next DSTransfer Set Value operation shall be mapped onto the MMS Read Service for a Named Variable. The service procedure shall be modified to utilize the Access Control Specification. If the Get Next DSTransfer Set Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail and the condition be signalled in the response.

7.1.4.5.1 Client Role

The TASE.2 client may issue an MMS Read service request at any time subject to the Access Control Specification as defined in the Bilateral Table using the following argument:

Specification With Result

Variable Access Specification – the MMS Named Variable "Next_DSTransfer_Set"

The Specification With Result argument is a Boolean Flag used to inform the server whether or not to include the identifier of the requested object in the result.

The Variable Access Specification specifies the pool of available Transfer Set object names at the server that are used for Data Set objects.

7.1.4.5.2 Server Role

Upon receiving an MMS Read service indication for the MMS Named Variable "Next_ DSTransfer_Set", if the Get Next DSTransfer Set Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the server shall respond with a positive MMS Read response with accessResult OBJECT-ACCESS-DENIED. Otherwise, the server shall check the pool of available names for an available Data Set Transfer Set name. If there is no available name, the server shall respond with a positive MMS Read service response, but with the access result TEMPORARILY-UNAVAILABLE. If there is an available name, then the server shall respond with a positive MMS Read service response with access result SUCCESS and the name of a Transfer Set allocated to the client. The Data Set Transfer Set will remain allocated to the client until a) the Transfer Set status is set to DISABLED, b) the association is terminated either through an abort or a conclude, or c) a Start Transfer Set operation fails for that Data Set Transfer Set.

7.1.4.6 Get Next TSTransfer Set Value Operation Mapping

The Get Next TSTransfer Set Value operation shall be mapped onto the MMS Read Service for a Named Variable. The service procedure shall be modified to utilize the Access Control Specification. If the Get Next TSTransfer Set Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with the condition signalled in the response.

7.1.4.6.1 Client Role

The TASE.2 client may issue an MMS Read service request at any time subject to the Access Control Specification as defined in the Bilateral Table using the following argument:

Specification With Result

Variable Access Specification – the MMS Named Variable "Next_TSTransfer_Set"

The Specification With Result argument is a Boolean Flag used to inform the server whether or not to include the identifier of the requested object in the result.

The Variable Access Specification specifies the pool of available Transfer Set object names at the server that are used for Data Set objects.

7.1.4.6.2 Server Role

Upon receiving an MMS Read service indication for the MMS Named Variable "Next_TSTransfer_Set", if the Get Next TSTransfer Set Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the server shall respond with a positive MMS Read response with the Access Result FAILURE and Data Access error code of OBJECT-ACCESS-DENIED. Otherwise, the server shall check the pool of available names for an available Time Series Transfer Set name. If there is no available name, the server shall respond with a positive MMS Read service response, but with the Access Result FAILURE and Data Access TEMPORARILY-UNAVAILABLE. If there is an available name, then the server shall respond with a positive MMS Read service response with access result SUCCESS and the name of a Transfer Set allocated to the client. The Time Series Transfer Set will remain allocated to the client until a) the Transfer Set status is set to DISABLED, b) the association is terminated either through an abort or a conclude, or c) a Start Transfer Set operation fails for that Data Set Transfer Set.

7.1.5 Account Operations and Actions Mapping

The only operation defined for Accounts is the Query operation, which is mapped onto an MMS Write Operation, and which also employs an MMS InformationReport service from the server to the client. The service definitions of ISO 9506-1 are not modified except where specified below. For each of the service definitions, the Visibility access permission shall apply. Enforcement of this permission is a local matter. If an implementation checks the Visibility access permission and the service fails as a consequence, then the error code OBJECT-NON-EXISTENT and error class ACCESS shall be returned.

7.1.5.1 Query Mapping

The TASE.2 client issues a Query operation by invoking an MMS Write operation of an AccountRequest variable. The server will respond to the MMS Write request, then issue an MMS InformationReport of the requested data.

7.1.5.1.1 Client Role

The client may issue an MMS Write service request at any time subject to Access Control Specification as defined in the Bilateral Table with the following arguments:

Variable Access Specification – List of MMS Named Variables representing the AccountRequest object

List Of Data – the values of the MMS Named Variables which specify the Query operation

The model and mapping of the AccountRequest object is defined in IEC 60870-6-802.

7.1.5.1.2 Server Role

Upon receiving a valid MMS Write service indication referencing MMS Named Variables which represent an AccountRequest object, the server shall check for the existence of the AccountRequest object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on the existence of the AccountRequest, it shall return a positive MMS Write response with Access Result FAILURE and error code OBJECT-NON-EXISTENT for each of the variables representing the AccountRequest object. If the server detects an error on the Access Control Specification or determines that the AccountRequest object is not in the Bilateral Table, it shall return a positive MMS Write response with Access Result FAILURE and an error code of OBJECT-ACCESS-DENIED for each of the variables representing the AccountRequest object. The server shall also verify that the values being written to the AccountRequest object by the requesting TASE.2 client are reasonable, and will result in an InformationReport which will fit within the maximum negotiated MMS PDU size. If the values are not appropriate, the server shall respond with a positive MMS Write service response with Access Result FAILURE and error code OBJECT-ACCESS-DENIED for each of the variables representing the AccountRequest object.

If no error is found in processing the MMS Write service request, the server shall respond with a positive MMS Write service response with Access Result SUCCESS. The server shall then construct a Transfer Report of the selected account or schedule data according to the rules as specified in 7.1.4.4, where:

a) the TAConditions, which define the type of data returned;

b) the MMS Named Variable Request_Id of type RequestId, which shall be equal to the MessageId received in the AccountRequest;

c) the MMS Named Variables representing the Account information requested, as defined in IEC 60870-6-802.

Note that if all of the requested data is not available to the server, the server shall adjust the requested time periods, etc. to reflect the actual amount of data returned.

7.1.6 Device Operations and Actions Mapping to MMS

The operations for Device objects are: Select, Operate, Set Tag, and Get Tag. There are four actions: Timeout, Success, Failure and Local Reset. The Select and Operate operations shall be mapped on to the MMS Read and Write services, respectively. Likewise, the Set Tag and Get Tag operations shall be mapped on to the MMS Read and Write services, respectively (although for different variables). The service definitions of ISO 9506-1 are not modified except where specified below. For each of the service definitions, the Visibility access permission shall apply. Enforcement of this permission is a local matter. If an implementation checks the Visibility access permission and the service fails as a consequence, then the condition is signalled in the response.

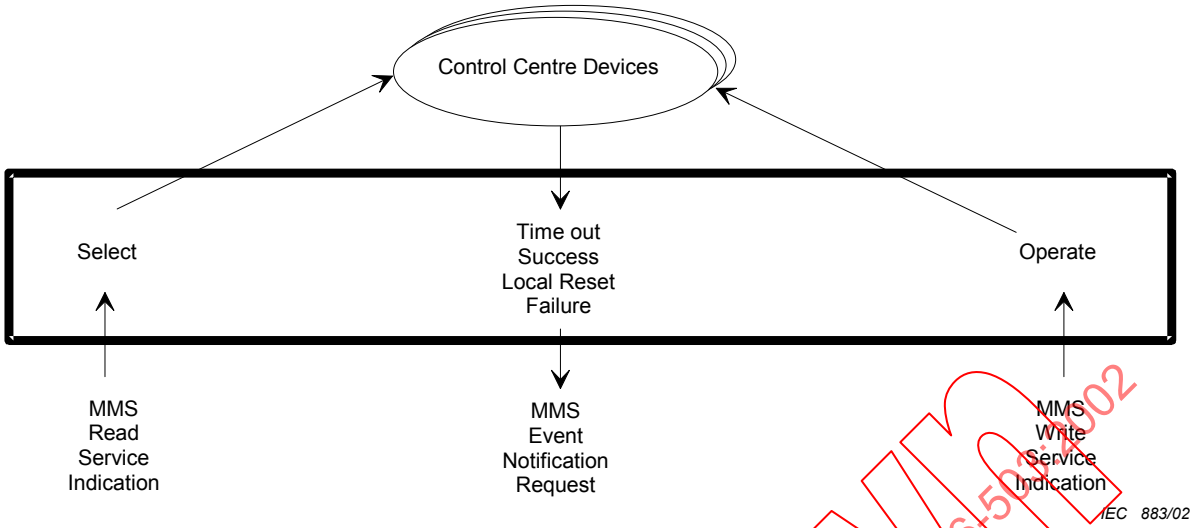

Figure 16 – Device operations

Figure 16 shows the elements of the TASE.2 server for Device objects. Figure 17 shows the sequence of the TASE.2 and MMS services and their associated requests, indications, responses and confirmations for the Device Control operations in the simplest case.

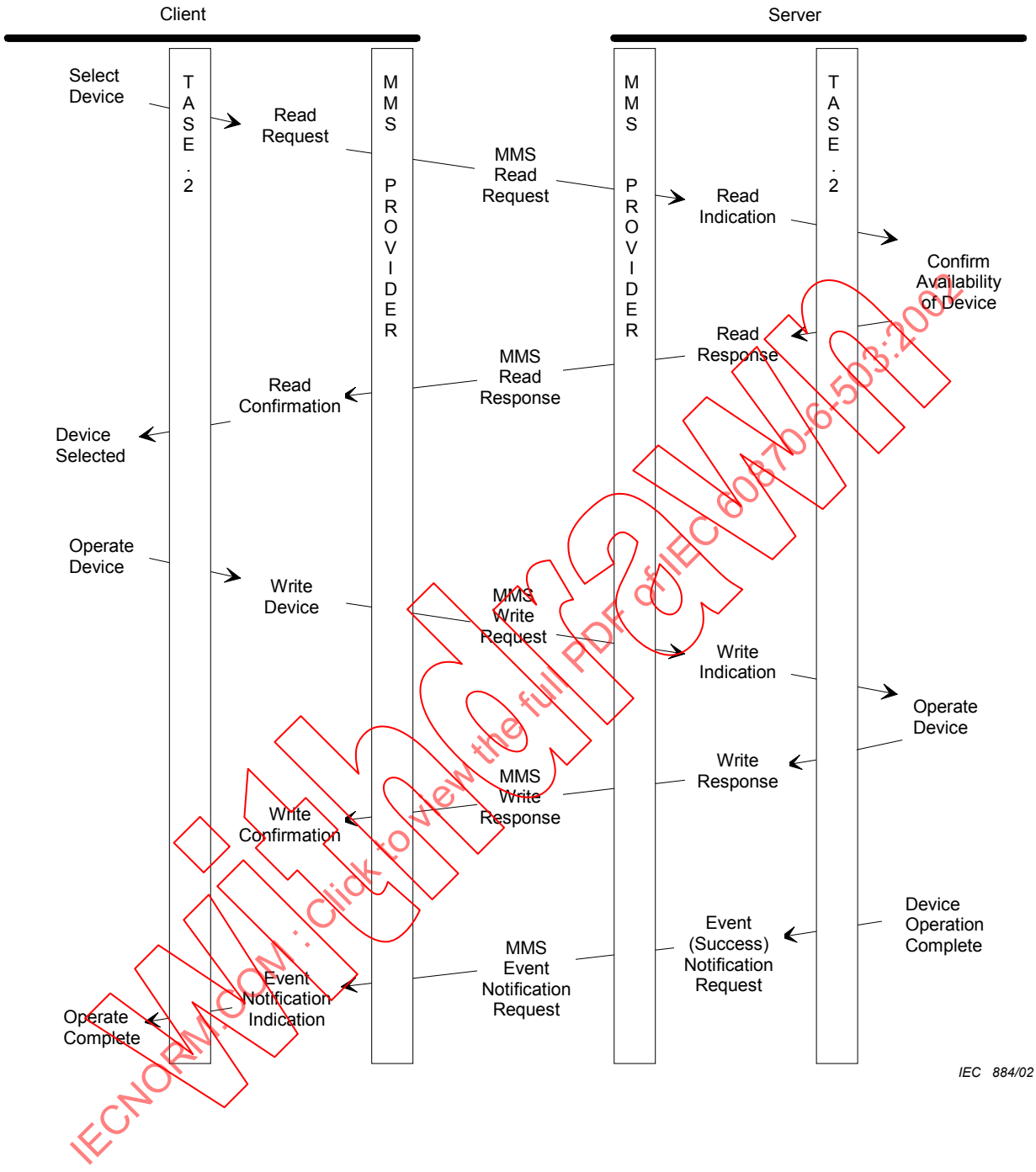

Figure 17 – Sequence of Device Control

7.1.6.1 Select Operation Mapping

The Select operation shall be mapped onto the MMS Read service. The MMS object to be read is the CheckBackID variable named <Device_Name>_SBO. The service procedure shall be modified to utilize the Access Control Specification. If the Select access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail and the condition shall be signalled in the response.

The V-Get function shall modify the internal state to ARMED and initialize the associated timer with the value of the Timeout Attribute. The timer shall begin operating. If the timer is not cleared prior to accumulating time equal to the timeout period, then the internal state shall transition to the IDLE state and the Timeout event shall be signalled. If the device cannot transition to the ARMED state, then an error condition shall be returned.

7.1.6.1.1 Client Role

The TASE.2 client may issue an MMS Read service request at any time subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Specification With Result	– optional
Variable Access Specification	– MMS Object Name (<Device_Name>_SBO) of the CheckBackID object

If the MMS Read is successful, the TASE.2 client shall receive the CheckBackID object as defined in the Bilateral Table from the TASE.2 server. The use of the CheckBackID by the TASE.2 client is a local matter.

7.1.6.1.2 Server Role

Upon receiving an MMS Read service indication referencing an MMS Named Variable representing a CheckBackID of a device object, the TASE.2 server shall check for the existence of the Device object, check the Access Control Specification according to the Bilateral Table, then check the actual availability of the device. The availability check may require the server to access some other local system, such as an RTU, for the device availability. If the server detects an error on the existence of the device, it shall return a positive MMS Read response with Access Result FAILURE and error code OBJECT-NON-EXISTENT. If the server detects an error on the Access Control Specification it shall return a positive MMS Read response with Access Result FAILURE and error code of OBJECT-ACCESS-DENIED. If the server detects that the device is unavailable or inoperable, the server shall respond with a positive MMS Read response with Access Result FAILURE and error code HARDWARE-FAULT. If the server detects that the device state is ARMED, is busy with another select or operation, or is tagged OPEN-AND-CLOSE-INHIBIT, it shall return a positive MMS Read response with Access Result FAILURE and error code TEMPORARILY-UNAVAILABLE.

If no error exists, the server shall respond with a positive MMS Read response with the value for the CheckBackID in the Bilateral Table for the associated Device object.

If at any time during the Select/Operate cycle, either the TASE.2 server or any intermediate system between the TASE.2 server and the physical device requires emergency pre-emption of device control, the TASE.2 server shall perform the Local Reset action. If, at any time in the Select/Operate cycle, the server detects a timeout (failure to operate within the agreed time) the server shall perform the Timeout action.

7.1.6.2 Operate Operation Mapping

The Operate operation shall be mapped to the MMS Write service. The service procedure shall be modified to utilize the Access Control Specification. If the Select access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail and the condition shall be signalled in the response. The V-Put function shall cancel the associated timer.

7.1.6.2.1 Client Role

The TASE.2 client may issue an MMS Write service request at any time for a non-SBO device, and only after the Select operation for SBO devices. In both circumstances, the MMS Write service request is subject to the Access Control Specification as defined in the Bilateral Table. It shall include the following arguments:

Variable Access Specification	– MMS Object Name of the device object to which the Command is to be written
List Of Data	– the value of the Command

7.1.6.2.2 Server Role

Upon receiving an MMS Write service indication of an MMS Named Variable representing a Device object, the server shall check for the existence of the Device object and check the Access Control Specification according to the Bilateral Table. If the server detects an error on the existence of the device, it shall return a positive MMS Write response with Access Result FAILURE and error code OBJECT-NON-EXISTENT. If the server detects an error on the Access Control Specification it shall return a positive MMS Write response with Access Result FAILURE and error code of OBJECT-ACCESS-DENIED. The server shall also verify that, for SBO devices, the Device object is selected by the requesting TASE.2 client. If the server detects that the device state is not ARMED, the device state is ARMED but it was selected by the action of a different control centre, the device is busy with another select or operate operation, or the device is tagged, the server shall respond with a positive MMS Write service response with Access Result FAILURE and error code TEMPORARILY-UNAVAILABLE.

If no error exists, the TASE.2 server shall forward the Command value to the appropriate destination which actually controls the real device, then wait for a response from the real device indicating the completion and outcome of executing the Command. Then the TASE.2 server shall respond with an MMS Write service response. Note that the MMS Write service response does not indicate whether the real device successfully executed the Command; it only indicates that the device received the Command.

The TASE.2 server shall respond with a positive MMS Write service response if the device received the Command. If the device operation completes and is successful, the TASE.2 server shall perform the Success action.

If the device did not execute the Command to completion for some reason, the TASE.2 server shall respond with a positive MMS Write service response with Access Result FAILURE and error code HARDWARE-FAULT. In addition to generating the response, the TASE.2 server shall perform the Failure action.

If, at any time during the Select/Operate cycle, either the TASE.2 server or any intermediate system between the TASE.2 server and the physical device requires emergency pre-emption of device control, the TASE.2 server shall perform the Local Reset action.

If, at any time in the Select/Operate cycle, the server detects a timeout (failure to operate within the agreed time) the server shall perform the Timeout action.

7.1.6.3 Timeout Action Mapping

The Timeout action shall be mapped to a transition of the MMS Event Condition having the name <device_name>_time. The server shall trigger the MMS Event Condition named <device_name>_time and cause a state transition from IDLE to ARMED, perform any associated Event Notifications as specified by Event Enrollments for this Event Condition and cause a transition from ARMED to IDLE.

7.1.6.4 Local Reset Action Mapping

The Local Reset action shall be mapped to a transition of the MMS Event Condition having the name <device_name>_reset. The server shall trigger the MMS Event Condition named <device_name>_reset and cause a state transition from IDLE to ARMED, perform any associated Event Notifications as specified by Event Enrollments for this Event Condition, and cause a transition from ARMED to IDLE.

7.1.6.5 Success Action Mapping

The Success action shall be mapped to a transition of the MMS event condition Event Condition having the name <device_name>_success. The server shall trigger the MMS Event Condition named <device_name>_success and cause a state transition from IDLE to ARMED, perform any associated Event Notifications as specified by Event Enrollments for this Event Condition, and cause a transition from ARMED to IDLE.

7.1.6.6 Failure Action Mapping

The Failure action shall be mapped to a transition of the MMS event condition, Event Condition having the name <device_name>_fail. The server shall trigger the MMS Event Condition named <device_name>_fail and cause a state transition from IDLE to ARMED, perform any associated Event Notifications as specified by Event Enrollments for this Event Condition, and cause a transition from ARMED to IDLE.

7.1.6.7 Set Tag Operation Mapping

The Set Tag Operation shall be mapped to an MMS Write service request. The service procedure shall be modified to utilize the Access Control Specification. If the Set Tag Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, the service shall fail with error code OBJECT-ACCESS-DENIED. If the Tag attribute is not present for the device, the service shall fail with error code OBJECT-NON-EXISTENT. If the device state is ARMED, or if the device is busy with a select or an operate operation, the server shall return a positive MMS Write response with the Access Result FAILURE and an error code of TEMPORARILY-UNAVAILABLE.

7.1.6.7.1 Client Role

The TASE.2 client may issue an MMS Write service request at any time for the MMS Named Variable representing the Tag attribute of a device. The service request shall contain the following arguments:

Variable Access Specification – MMS Object Name (<Device_Name>_TAG) of the Tag_Value variable representing the tag of the device

List Of Data – a structure containing the Tag values and the reason for tagging, as specified in IEC 60870-6-802.

7.1.6.7.2 Server Role

Upon receiving an MMS Write service indication of an MMS Named Variable representing the Tag attribute of a Device object, the server shall check for the existence of the Device object, the existence of a Tag attribute for the device, and check the Access Control Specification according to the Bilateral Table. If the server detects an error on the existence of the device or a Tag attribute for the device, it shall return a positive MMS Write response with Access Result FAILURE and error code OBJECT-NON-EXISTENT. If the server detects an error on the Access Control Specification, it shall return a positive MMS Write response with Access Result FAILURE and error code of OBJECT-ACCESS-DENIED. If the device state is ARMED, or if the device is busy with a select or an operate operation, the server shall return a positive MMS Write response with the Access Result FAILURE and an error code of TEMPORARILY-UNAVAILABLE.

If the device is VCC-Specific and the current Tag Value is not NO_TAG the server shall check that the requesting Client was the previous writer of the Tag. If not, then the server shall return a positive MMS Write response with Access Result FAILURE and an error code of TEMPORARILY-UNAVAILABLE.

If no error exists, the TASE.2 server shall set the value and reason of the Tag attribute of the device, and shall respond with a positive MMS Write service response.

7.1.6.8 Get Tag Value Operation Mapping

The Get Tag Operation shall be mapped to an MMS Read service request. The service procedure shall be modified to utilize the Access Control Specification. If the Get Tag Value access permission is not defined for the TASE.2 user in the List of Access Control Specification, the service shall fail with error code OBJECT-ACCESS-DENIED. If the Tag attribute is not present for the Device object, the service shall fail with error code OBJECT-NON-EXISTENT.

7.1.6.8.1 Client Role

The TASE.2 client may issue an MMS Read service request of the Tag attribute of a device at any time subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Specification With Result – optional

Variable Access Specification – MMS Object Name (<Device_Name>_TAG) of the Tag attribute of the Device object

If the MMS Read is successful, the TASE.2 client shall receive the current tag value and reason of the Device object as defined in the Bilateral Table from the TASE.2 server.

7.1.6.8.2 Server Role

Upon receiving an MMS Read service indication of an MMS Named Variable representing the Tag attribute of a Device object, the server shall check for the existence of the Device object, the existence of a Tag attribute for the device, and check the Access Control Specification according to the Bilateral Table. If the server detects an error on the existence of the device or a Tag attribute for the device, it shall return a positive MMS Read response with Access Result FAILURE and error code OBJECT-NON-EXISTENT. If the server detects an error on the Access Control Specification it shall return a positive MMS Read response with Access Result FAILURE and error code of OBJECT-ACCESS-DENIED.

If no error exists, the TASE.2 server shall respond with a positive MMS Read service response containing the value and reason of the Tag attribute of the device.

7.1.7 Program Operations Mapping to MMS

The operations specified for the Program object model shall be mapped onto the MMS services for Program Invocations. The service definitions of ISO 9506-1 are not modified except where specified below. For each of the service definitions, the Visibility access permission shall apply. Enforcement of this permission is a local matter. If an implementation checks the Visibility access permission and the service fails as a consequence, then the error code OBJECT-NON-EXISTENT and error code ACCESS shall be returned.

There are six Program operations: Start, Stop, Resume, Reset, Kill and Get Program Attributes. Each of these operations allows a TASE.2 client to control a Program object within a TASE.2 server. The model for Program objects is the MMS Program Invocation model as defined in the MMS Service Specification.

Figure 18 shows the TASE.2 server components for implementing Program operations.

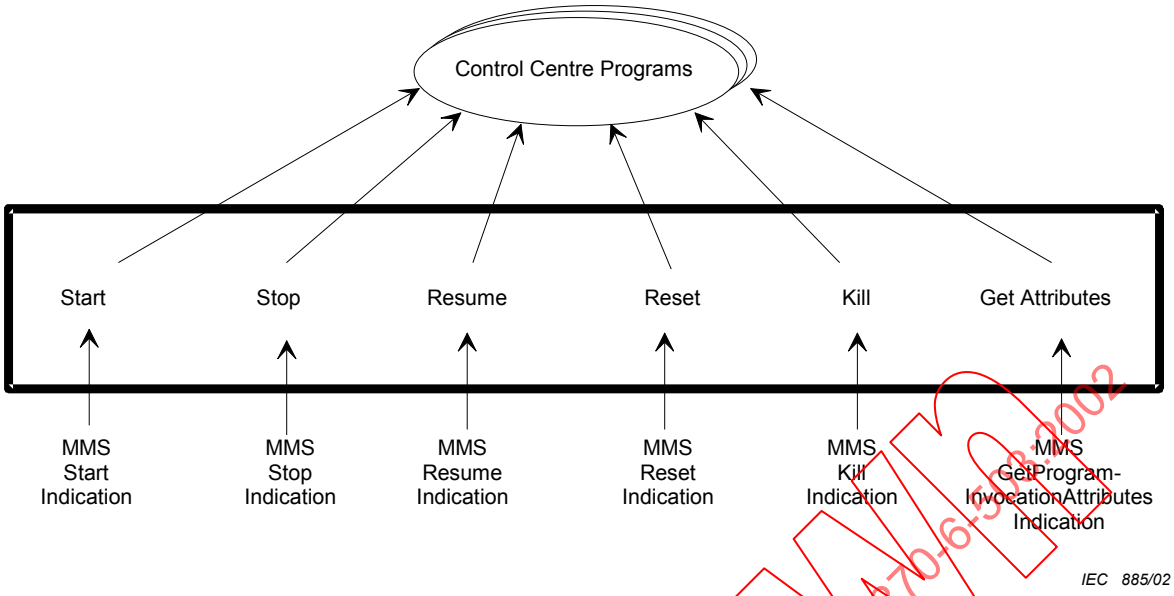

Figure 18 – Server Program Components

Within the MMS model, program invocation objects may exist in a variety of states. The TASE.2 use of MMS Program Invocation services is restricted to a subset of services, and so need only be concerned with the states IDLE, RUNNING, STOPPED and UNRUNNABLE.

7.1.7.1 Start Operation Mapping

The Start operation is mapped onto the MMS Start service. The service procedure shall be modified to utilize the Access Control Specification. If the Start access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.7.1.1 Client Role

A TASE.2 client may request a remote TASE.2 server to run a program invocation by issuing a MMS Start service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Program Invocation Name – MMS Object Name of the Program object

Execution Argument – character string to be passed to the program

The program invocation shall be in the IDLE state at the time of the request.

7.1.7.1.2 Server Role

Upon receiving an MMS Start service indication, the server shall check if the identifier of the Program object is available via the Access Control Specification as defined in the Bilateral Table. If the server detects an error on this check, it shall respond with a negative MMS Start service response with error code OBJECT-ACCESS-DENIED and error class ACCESS. If the Program object is not in the IDLE state, the server shall respond with a negative MMS Start service response with error code OBJECT-STATE-CONFLICT and error class SERVICE.

If no error is detected, the server shall put the Program object in the RUNNING state using the Execution Argument as an argument to the Program object, and shall respond with a positive MMS Start service response. The Program object shall remain in the RUNNING state until it terminates by itself or is terminated by the client using the Stop service. If it terminates by itself, it is then considered in the IDLE state.

7.1.7.2 Stop Operation Mapping

The Stop operation shall be mapped onto the MMS Stop service. The service procedure shall be modified to utilize the Access Control Specification. If the Stop access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.7.2.1 Client Role

A TASE.2 client may request a remote TASE.2 server to terminate the running of a Program object by issuing a MMS Stop service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Program Invocation Name – MMS Object Name of the Program object

The Program object shall be in the RUNNING state at the time of the request.

7.1.7.2.2 Server Role

Upon receiving an MMS Stop service indication, the server shall check if the identifier of the Program object is available via the Access Control Specification as defined in the Bilateral Table. If the server detects an error on this check, it shall respond with a negative MMS Stop service response with error code OBJECT-ACCESS-DENIED and error class ACCESS. If the Program object is not in the RUNNING state, the server shall respond with a negative MMS Stop service response with error code OBJECT-STATE-CONFLICT and error class SERVICE.

If no error is detected, the server shall put the Program object in the STOPPED state, and shall respond with a positive MMS Stop service response.

7.1.7.3 Resume Operation Mapping

The Resume operation shall be mapped onto the MMS Resume service. The service procedure shall be modified to utilize the Access Control Specification. If the Resume access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.7.3.1 Client Role

A TASE.2 client may request a remote TASE.2 server to resume the running of a Program object by issuing a MMS Resume service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Program Invocation Name – MMS Object Name of the Program object

Execution Argument – optional character string in which to pass data to the resuming program

The Program object shall be in the STOPPED state at the time of the request.

7.1.7.3.2 Server Role

Upon receiving an MMS Resume service indication, the server shall check if the identifier of the Program object is available via the Access Control Specification as defined in the Bilateral Table. If the server detects an error on this check, it shall respond with a negative MMS Resume service response with error code OBJECT-ACCESS-DENIED and error class ACCESS. If the Program object is not in the STOPPED state, the server shall respond with a negative MMS Resume service response with error code OBJECT-STATE-CONFLICT and error class SERVICE.

If no error is detected, the server shall put in the Program Invocation in the RUNNING state, and shall respond with a positive MMS Resume service response.

7.1.7.4 Reset Operation Mapping

The Reset operation shall be mapped onto the MMS Reset service. The service procedure shall be modified to utilize the Access Control Specification. If the Reset access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.7.4.1 Client Role

A TASE.2 client may request a remote TASE.2 server to reset a Program object by issuing an MMS Reset service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Program Invocation Name – MMS Object Name of the Program object

The Program object shall be in the STOPPED state at the time of the request.

7.1.7.4.2 Server Role

Upon receiving an MMS Reset service indication, the server shall check if the identifier of the Program object is available via the Access Control Specification as defined in the Bilateral Table. If the server detects an error on this check, it shall respond with a negative MMS Reset service response with error code OBJECT-ACCESS-DENIED and error class ACCESS. If the Program object is not in the STOPPED state, the server shall respond with a negative MMS Reset service response with error code OBJECT-STATE-CONFLICT and error class SERVICE.

If no error is detected, the server shall put the Program Invocation in the IDLE state, and shall respond with a positive MMS Reset service response.

7.1.7.5 Kill Operation Mapping

The Kill operation shall be mapped onto the MMS Kill service. The service procedure shall be modified to utilize the Access Control Specification. If the Kill access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.7.5.1 Client Role

A TASE.2 client may request a remote TASE.2 server to kill a Program object by issuing a MMS Kill service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Program Invocation Name – MMS Object Name of the Program object

7.1.7.5.2 Server Role

Upon receiving an MMS Kill service indication, the server shall check if the identifier of the Program object is available via the Access Control Specification as defined in the Bilateral Table. If the server detects an error on this check, it shall respond with a negative MMS Kill service response with error code OBJECT-ACCESS-DENIED and error class ACCESS. If the Program object is not in the STOPPED state, the server shall respond with a negative MMS Kill service response with error code OBJECT-STATE-CONFLICT and error class SERVICE.

If no error is detected, the server shall put the Program Invocation in the UNRUNNABLE state, and shall respond with a positive MMS Kill service response.

7.1.7.6 Get Program Attributes Operation Mapping

The Get Program Attributes operation shall be mapped onto the MMS GetProgramInvocation Attributes service. The service procedure shall be modified to utilize the Access Control Specification. If the GetProgramInvocationAttributes access permission is not defined for the TASE.2 user in the List of Access Control Specification, then the service shall fail with error code OBJECT-ACCESS-DENIED and error class ACCESS.

7.1.7.6.1 Client Role

A TASE.2 client may request information about a Program Invocation object by issuing a MMS GetProgramInvocationAttributes service request subject to the Access Control Specification as defined in the Bilateral Table with the following arguments:

Program Invocation Name – MMS Object Name of the Program object

7.1.7.6.2 Server Role

Upon receiving an MMS GetProgramInvocationAttributes service indication, the server shall check if the identifier of the Program object is available via the Access Control Specification as defined in the Bilateral Table. If the server detects an error on this check, it shall respond with a negative MMS GetProgramInvocationAttributes service response with error code OBJECT-ACCESS-DENIED and error class ACCESS.

If no error is detected, the server shall not modify the Program Invocation state, and shall respond with a positive MMS GetProgramInvocationAttributes service response with the following arguments:

State – state of the Program object

List of Domain Names – not restricted by TASE.2

MMS Deletable – not restricted by TASE.2

Reusable – not restricted by TASE.2

Monitor – not restricted by TASE.2

Execution Argument – value of the execution argument of the Program object.

Figure 19 shows the sequence of the TASE.2 and MMS services and their associated requests, indications, responses and confirmations for some simple cases of the Program object operations.