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Entwurf

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Fernwirkeinrichtungen und -systeme – Teil 6-503: Fernwirkprotokolle, die mit ISO-Normen und ITU-T-Empfehlungen kompatibel sind – TASE.2-Dienste und -Protokoll (IEC 57/1213/CD:2012), Text in Englisch

Telecontrol equipment and systems –
Part 6-503: Telecontrol protocols compatible with ISO standards and ITU-T recommendations –
TASE.2 Services and protocol
(IEC 57/1213/CD:2012), Text in English

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2013-03-25 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

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- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (Hausanschrift: Stresemannallee 15, 60596 Frankfurt am Main).

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 157 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

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Nationales Vorwort

Das internationale Dokument IEC 57/1213/CD:2012 „Telecontrol equipment and systems – Part 6-503: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Services and protocol“ (CD, en: Committee Draft) ist unverändert in diesen Norm-Entwurf übernommen worden.

Das internationale Dokument wurde vom TC 57 „Power systems management and associated information exchange“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet und den nationalen Komitees zur Stellungnahme vorgelegt.

Die IEC und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Da der Abstimmungszeitraum für einen FDIS bzw. Schluss-Entwurf prEN nur 2 Monate beträgt, und dann keine sachlichen Stellungnahmen mehr abgegeben werden können, sondern nur noch eine „JA/NEIN“-Entscheidung möglich ist, wobei eine „NEIN“-Entscheidung fundiert begründet werden muss, wird bereits der CD als DIN-Norm-Entwurf veröffentlicht, um die Stellungnahmen aus der Öffentlichkeit frühzeitig berücksichtigen zu können.

Für dieses Dokument ist das nationale Arbeitsgremium K 952 „Netzleittechnik“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (www.dke.de) zuständig.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf eine Norm ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils neueste gültige Ausgabe der in Bezug genommenen Norm.

Für den Fall einer datierten Verweisung im normativen Text bezieht sich die Verweisung immer auf die in Bezug genommene Ausgabe der Norm.

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für den vorliegenden Normentwurf erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 60870-6-503 veröffentlicht. Zu deren Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Normentwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Es ist vorgesehen, auch bei der entsprechenden zukünftigen Deutschen Norm auf die deutsche Sprachfassung zu verzichten und diese in der englischsprachigen Fassung zu veröffentlichen.

Änderungen

Gegenüber DIN EN 60870-6-503:2003-02 wurden folgende Änderungen vorgenommen:

a) Pflege der Abwärtskompatibilität,

b) Berücksichtigung der spezifischen Kommentare von IEC/TC 57 WG 19,

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c) Einarbeitung der Empfehlung der Semantik von IEC 60870-6 TASE.2 und IEC 61970 an die TC 57 Referenz Architektur anzugleichen,

d) Aktualisierung der Sicherheitsbezüge,

e) Einarbeitung der vorherigen Verbesserungsvorschläge,

f) Einarbeitung der nationalen Kommentierungen zu 57/980/DC,

g) Entfernung der Objekte und Dienste, die typischerweise nicht innerhalb eines informativen Annex verwendet werden,

h) Verbleibende Normung relevante Sektion beinhalten Objekte und Dienste, die zur Unterstützung der Blogs 1,2,3,4 und 5 benötigt werden,

i) Erhaltung der Konsistenz mit den Revisionen, die als Teil der Revision für IEC 60870-6-802 durchgeführt wurden,

j) Adress-Dienst-Mehrdeutigkeiten, die Interoperabilität verhindern.

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Nationaler Anhang NA
(informativ)

3 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach ISO 9506-1, ISO 9506-2 (Nachrichtenformate für Fertigungszwecke) und die folgenden Begriffe.

3.1
Aktion
(en: action)
Vorgang, der vom TASE.2-Server unter bestimmten definierten Bedingungen ausgeführt wird

3.2
Abrechnungsinformation
(en: accounting information)
Informationsmenge, die die Abrechnung für ein Energieversorgungsunternehmen beschreibt. Weitere Einzelheiten siehe IEC 60870-6-802

3.3
bilaterale Vereinbarung
(en: bilateral agreement)
Vereinbarung zwischen zwei Netzleitstellen, die die Datenelemente, auf die zugegriffen wird, und die Mittel für den Zugriff betrifft

3.4
bilaterale Tabelle
(en: bilateral table)
rechentechnische Darstellung der bilateralen Vereinbarung. Die verwendete Darstellung ist lokal festzulegen

3.5
Client
(en: client)
kommunizierende Einheit, die für die Lebensdauer einer Assoziation über eine oder mehr TASE.2-Dienstanforderungen die virtuelle Netzleitstelle (VCC) nutzt

3.6
Datensatz
(en: data set)
ein Datensatz ist eine Zusammenfassung von Datenwerten für einmalige Operationen durch einen TASE.2-Benutzer. Datensätze vereinfachen den Zugriff durch den TASE.2-Benutzer

3.7
Datenwert
(en: data value)
ein Datenwert gibt eine bestimmte alphanumerische Größe wieder, die Teil der virtuellen Netzleitstelle (VCC) und für einen TASE.2-Benutzer einsehbar ist. Datenwerte existieren als Teil der Implementierung der Netzleitstelle und stellen entweder reale Einheiten innerhalb des Energieversorgungsunternehmens wie einen Strom oder in der Netzleitstelle berechnete abgeleitete Werte dar

3.8
Instanz
(en: instance)
Implementierung von TASE.2, die entweder in der Rolle als Client oder als Server ausgeführt wird

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3.9
Übertragungsfahrplan
(en: interchange schedule)
Informationsmenge, die festlegt, wie Energie von einem Netz in ein anderes übertragen wird. Weitere Einzelheiten siehe IEC 60870-6-802

3.10
Objekt
(en: object)
Instanz eines TASE.2-Objektmodells

3.11
Objektmodell
(en: object model)
Definition einer abstrakten Darstellung, die für reale Daten, Geräte, Bedienstationen, Programme, Ereignisbedingungen und Ereignisbenachrichtigungen benutzt wird

3.12
Operation
(en: operation)
Aktivität, die vom TASE.2-Server auf Anforderung des TASE.2-Clients ausgeführt wird

3.13
Server
(en: server)
Kommunikationseinheit, die sich über die Lebensdauer einer Assoziation wie eine virtuelle Netzleitstelle (VCC) verhält

3.14
Dienst
(en: service)
Aktivität, die entweder eine TASE.2-Aktion oder eine TASE.2-Operation ist

3.15
markiert
(en: tagged)
der Begriff wurde von der Praxis abgeleitet, an ein Gerät eine Markierung anzubringen, wenn es für eine Wartung abgeschaltet oder als Sicherheitsmaßnahme vom Zugang zum Netz ausgeschlossen wird. In TASE.2 wird der Begriff dazu benutzt, um dem TASE.2-Benutzer eine solche Bedingung anzuzeigen

3.16
Zeitfolgen
(en: time series)
Menge von Werten eines gegebenen Elementes, die zu verschiedenen Zeitpunkten, wie durch ein einzelnes Zeitintervall festgelegt, aufgenommen werden. Eine Zeitfolge wird mit dem Mechanismus eines Datensatzes zur Übertragungssteuerung nach den Festlegungen in der vorliegenden Spezifikation implementiert

3.17
Übertragungsbilanz
(en: transfer account)
Informationsmenge, die Informationen des Übertragungsfahrplanes entweder mit Stundendaten oder mit Profildaten verknüpft. Weitere Einzelheiten siehe IEC 60870-6-802

3.18
Übertragungsbedingungen
(en: transfer conditions)
Ereignisse oder Umstände, unter denen ein TASE.2-Server die Werte eines Datensatzes, Werte in einer Zeitfolge oder sämtliche Informationen der Übertragungsbilanz meldet

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3.19
Datensatz zur Übertragungssteuerung
(en: transfer set)
Objekt zur Steuerung des Datenaustausches durch die Verknüpfung von Datenwerten mit Übertragungsparametern wie Zeitintervallen; es z. B. gibt vier Typen von Datensätzen zur Übertragungssteuerung: Data Set Transfer Sets (Datensatz zur Übertragungssteuerung von Datensätzen), Time Series Transfer Sets (Datensatz zur Übertragungssteuerung von Zeitfolgen), Transfer Account Transfer Sets (Datensatz zur Übertragungssteuerung von Übertragungsbilanzen) und Information Message Transfer Sets (Datensatz zur Übertragungssteuerung von Nachrichten). Ein Data Set Transfer Set enthält einen oder mehr Datenwerte, die jeweils auf eindeutige physikalische Elemente abgebildet werden. Ein Time Series Transfer Set enthält einen oder mehr Datenwerte, die alle auf dasselbe physikalische Element abgebildet werden, aber deren Werte zu verschiedenen Zeitpunkten, die durch ein einzelnes Zeitintervall festgelegt sind, darstellen. Ein Transfer Account Transfer Set enthält alle Werte aller Übertragungsbilanzen. Ein Information Message Transfer Set wird benutzt, um den Austausch von beliebigen binären Nachrichten oder Dateien oder Textnachrichten oder -dateien zu verwalten

3.20
Benutzer
(en: user)
Implementierung von TASE.2, die entweder in der Rolle als Client oder als Server ausgeführt wird

3.21
virtuelle Netzleitstelle
(en: virtual control centre, VCC)
abstrakte Darstellung einer realen Netzleitstelle, die eine Verhaltensmenge hinsichtlich der Kommunikations- und Datenverwaltungsfunktionalität und -einschränkungen beschreibt

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

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.

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The committee has decided that the contents of this publication will remain unchanged until 2016. At this date, the publication will be

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

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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 clause 8.2.3 for more details.

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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

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.

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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.

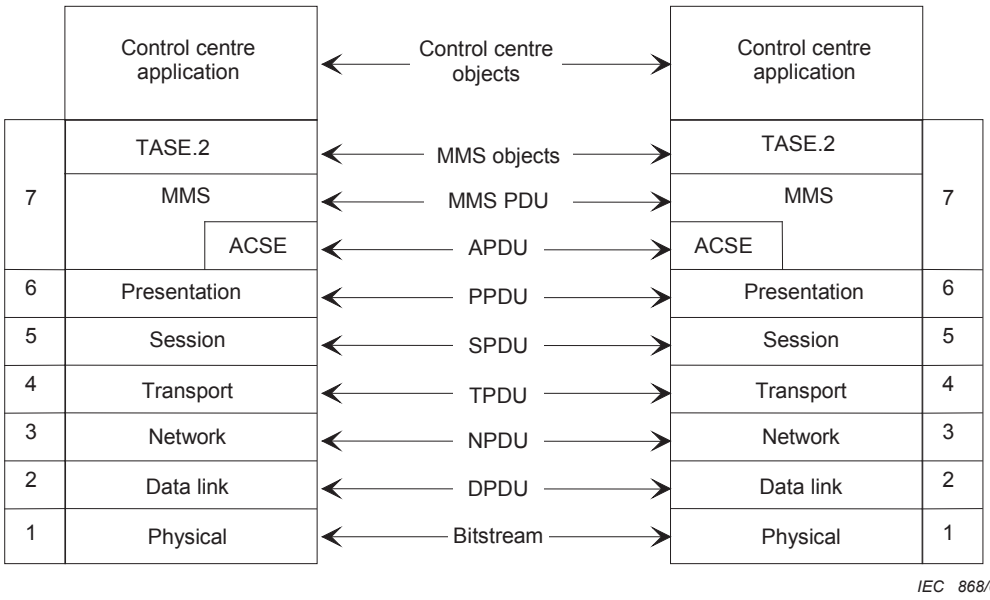

Figure 1 - Protocol relationships

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 (e.g. TCP) connection-mode transport layer and connectionless-mode network layer (e.g. IP) services over any type of transmission media.

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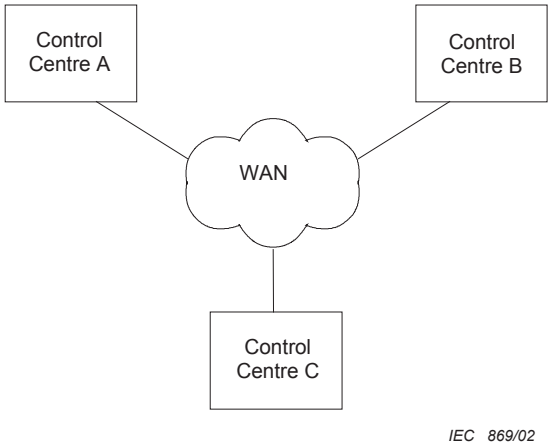
1.3 Network Model

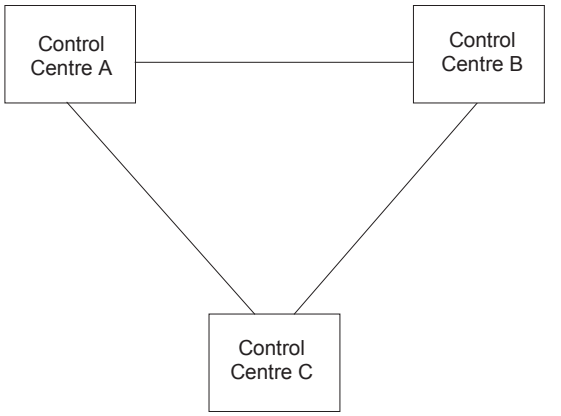
The TASE.2 Data Exchange network may be either a private or public packet-switched or mesh network connecting communications processors which provide adequate routing functionality to allow for redundant paths and reliable service.

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 2 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.



WAN Topology



Mesh Topology

Figure 2 - TASE.2 network topologies

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 scalable 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 scalability of its services specifying MMS Conformance Building Blocks (CBBs). A simple TASE.2 implementation requires only a simple MMS implementation.

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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.

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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 60870-6-702:2011-	*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 60870-6-802:2011-	*Telecontrol equipment and systems – Part 6-802: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Object models*
ISO/IEC 8802-3:2008-	*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 9506-1:2003-	*Industrial automation systems – Manufacturing Message Specification – Part 1: Service definition*
ISO 9506-2:2003-	*Industrial automation systems – Manufacturing Message Specification – Part 2: Protocol specification*
ISO 8649-	*Information processing systems – Open Systems Interconnection – Service definition for the Association Control Service Element*
IEC 62351-4 ed1.0	Power systems management and associated information exchange - Data and communications security - Part 4: Profiles including MMS

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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

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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

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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
IP	Internetworking Protocol
MMS	Manufacturing Message Specification (e.g. ISO/IEC 9506)
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)
TCP	Transmission Control Protocol
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.

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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 and perform device control 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 3 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.

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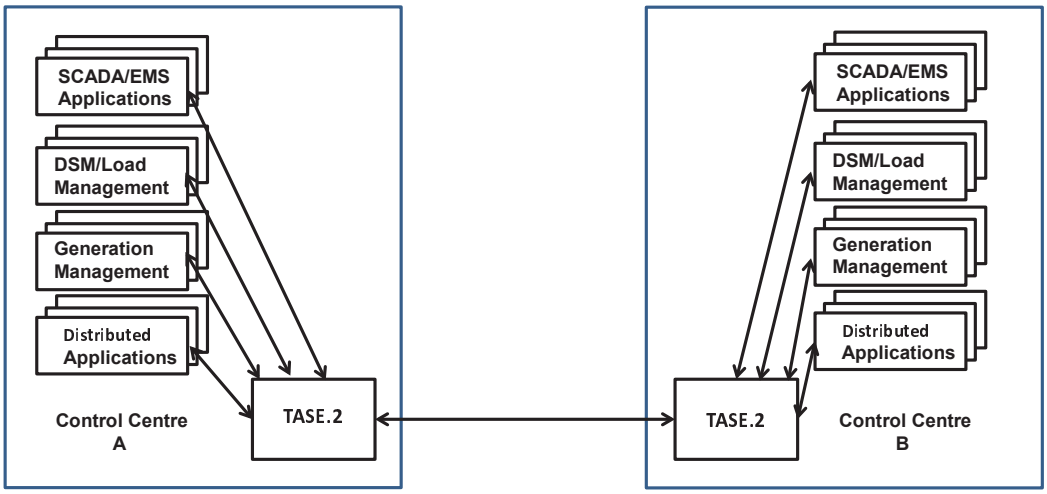

Figure 3 – Informal TASE.2 Model

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 clause 5.2.2 and 7.1.1 for more details. There are no TASE.2 actions for associations.

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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 clause 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:

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

d) 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.

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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 (Informative)

See clause D.2.1.1.

5.1.2.5 Information Message Access Control (Informative)

See clause D.2.1.2.

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:

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

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

g) 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 (Informative)

See clause D.2.1.3.

5.1.2.9 Event Enrollment Object Access Control (Informative)

See clause D.2.1.4.

5.1.2.10 Event Condition Object Access Control (Informative)

See clause D.2.1.5.

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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 clause 5.2.5 and clause 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 clause 5.2.6 and clause 7.1.3 for more details.

5.1.5 Account Objects and Services (Informative)

See clause D.2.2.

5.1.6 Information Message Object and Services (Informative)

See clause D.2.3

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 were previously four different types of Transfer Sets in IEC 60870-6-503:2002. However, in this version there is only one that is supported normatively: Data Set Transfer Set. The other three types are intended to be deprecated and therefore are provided for informational/historical purposes: 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.

Transfer Set objects 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

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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. 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. 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 operation provides the TASE.2 client with the name of an available Transfer Set object for Data Set Transfer Set objects.

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. 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 4 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

———————

[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.

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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 clause 5.2.9 and clause 7.1.4 for more details.

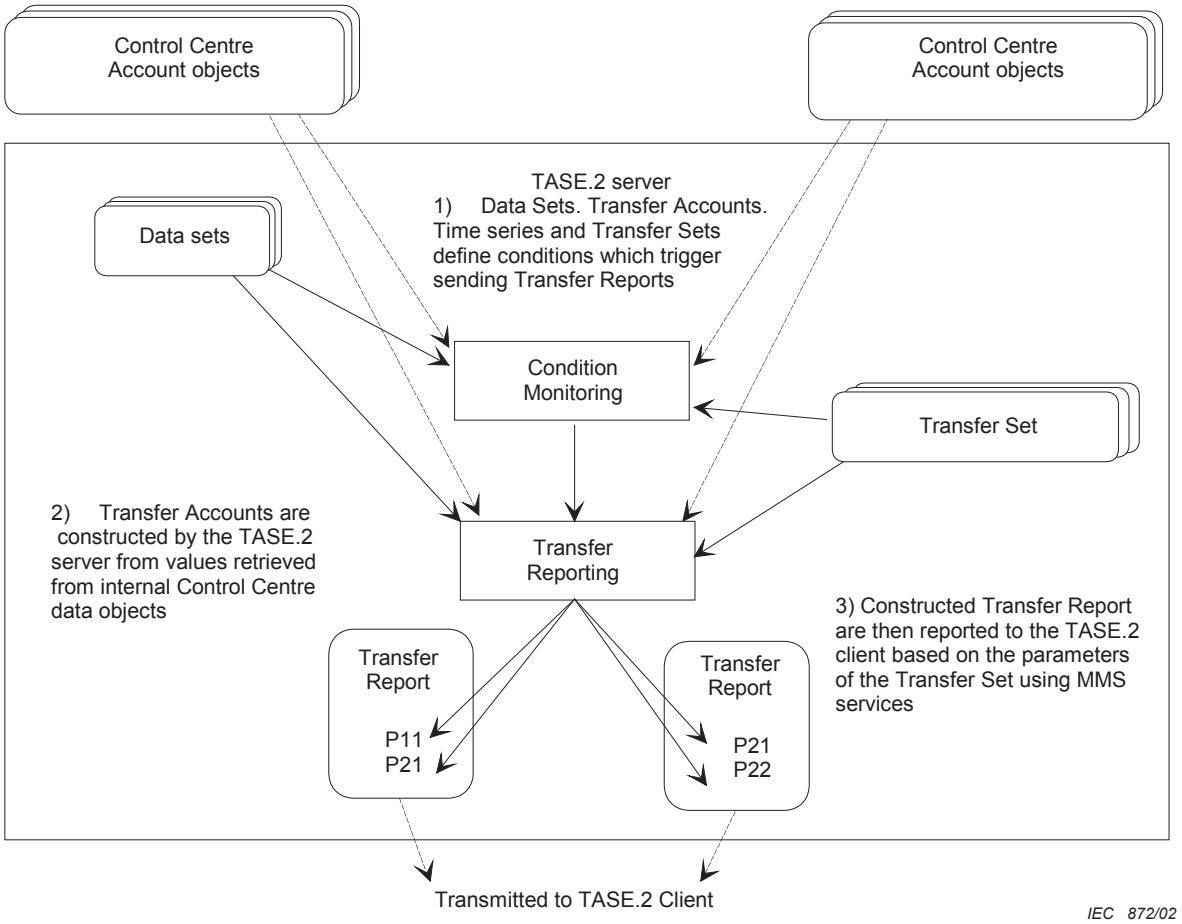

Figure 4 – Transfer Reporting Mechanism

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. They shall retrieve the identifier of the next unused (not enabled) Transfer Set object for a Data Set. 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:

h) a) One Shot Data

i) b) Periodic Data

j) c) Event Data

k) d) Exception Data

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

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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

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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.

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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 (Informative)

See clause D.2.4.

5.1.12 Event Enrollment Objects and Services (Informative)

See clause D.2.5.

5.1.13 Event Condition Objects and Services (Informative)

See clause D.2.6.

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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.

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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 Generation Management. 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 5 shows the relationship between real control centres, the TASE.2 client and server, and the VCC.

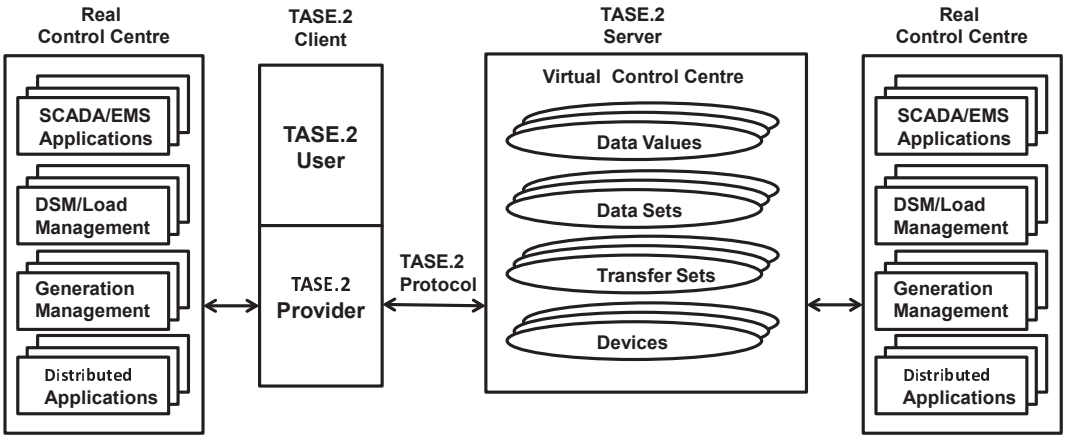

Figure 5– Relationship between TASE.2 and Real Control Centres

The VCC model consists of the following:

l) Association object model and services

m) Bilateral Table object model (no services defined)

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n) Data Value object model and services

o) Data Set object model and services

p) Transfer Set object model (DSTransfer Set) and services

q) Device 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 5, 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		out-of-scope
Transfer Set		x
Device	x	x
Program	out-of-scope	out-of-scope
Special Transfer objects		out-of-scope
Event Enrollment		out-of-scope
Event Condition	out-of-scope	

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

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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 clause 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
Security Credentials (Optional)
Attribute: QOS
Attribute: Supported Features
Attribute:

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

Application Reference

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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.

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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.

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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

r) Key Attribute: Client Control Centre Designation

s) Attribute: Version

t) Attribute: TASE.2 Version

u) Attribute: Domain Name

v) Attribute: List of Application References

w) Attribute: List of Association Objects

x) Attribute: List of Data Value Objects and Access Control Specifications

y) Attribute: List of Data Set Objects and Access Control Specifications

z) Attribute: List of Transfer Set Objects and Access Control Specifications

aa) Attribute: List of Device Objects and Access Control Specifications

bb)

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 clause 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. This list includes the appropriate security credential information.

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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 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.

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.

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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

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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.

5.2.6.2 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.

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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.

5.2.6.3 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.

5.2.6.4 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.

5.2.6.5 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.

5.2.6.6 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.

5.2.6.7 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.

5.2.6.8 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 (Informative)

See clause D.3.1.

5.2.8 Information Messages (Informative)

See clause D.3.3

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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, and Get Next DSTransfer 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 the Get Next DSTransfer 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 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

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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.

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.

———————

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.

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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.

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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 (Informative)

See clause D.3.5.1.

5.2.9.3 Transfer Account Transfer Set Object Model (Informative)

See clause D.3.6.

5.2.9.4 Information Message Transfer Set Object Model (Informative)

See clause D.3.7.

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 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.

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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 clause 5.2.9.1.2.

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 clause 7.1.4.4.2 for more details on this action.

5.2.9.9 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.

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, 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.

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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 (Informative)

See clause D.3.8.1.

5.2.10.6 TAConditions Object Model (Informative)

See clause D.3.8.2.

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.

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