TECHNICAL REPORT

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Telecontrol equipment and systems –

Part 6-505: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 User guide

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TELECONTROL EQUIPMENT AND SYSTEMS –

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FOREWORD

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Technical reports do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful by the maintenance team.

IEC 60870-6-505, which is a technical report, has been prepared by IEC technical committee 57: Power system control and associated communications.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
57/548/CDV	57/580/RVC

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

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

This document, which is purely informative, is not to be regarded as an International Standard.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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- withdrawn;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

INTRODUCTION

A large number of utilities use the Telecontrol Application Service Element.2 (TASE.2), an international standard protocol for communication of real-time data. TASE.2 provides a common means for all utilities to exchange data between not only control centers, but power plants and substations as well. The adoption of TASE.2 has lead to the availability of competitively priced data communication products based on TASE.2 from multiple vendors at a fraction of the cost of a proprietary system. This report provides guidance for utility users who are evaluating, procuring, and configuring TASE.2, as well as aid to vendors implementing TASE.2 in their products. The individual server and data objects comprising TASE.2 are described, with cross references to the specification. This provides the reader the basic understanding needed to use the TASE.2 specifications in an informed manner. The guide then addresses practical issues that arise in connection with TASE.2 use.

TELECONTROL EQUIPMENT AND SYSTEMS –

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1 Scope

This technical report provides a set of guidelines on the use of the following TASE.2 international standards:

IEC 60870-6-503

IEC 60870-6-702

IEC 60870-6-802

These standards specify a method of exchanging time-critical control center data through wide- and local-area networks using a full ISO compliant protocol stack. They contain provisions for supporting both centralized and distributed architectures. These standards include the exchange of real-time indications, control operations, time series data, scheduling and accounting information, unstructured ASCII or binary files, remote program control, and event notification.

However, the style of the TASE.2 standards may make them somewhat difficult to read for someone either not familiar with the precise syntax of the language used to describe the protocol or with all the background leading up to the development of these specifications. Furthermore, certain types of information that may be very useful to a user of TASE.2 but not necessary for specifying the protocol or services provided by TASE.2 have been omitted. Thus the need for this User Guide.

1.1 Intended users

This User Guide is intended for a broad audience of readers from an end user trying to decide if TASE.2 is appropriate for their data transfer needs to a vendor planning to implement TASE.2, with the goal of offering a TASE.2 product. In particular, this guide should be helpful to the following:

- An end user, such as an electric utility, with the need to transfer real-time data to another utility or utilities or to another internal control center, who is trying to evaluate which protocol is the most appropriate.
- An end user who has already decided to use TASE.2 and now needs guidance in how to procure TASE.2.
- An end user who has procured TASE.2 and is now concerned about how to map their actual data into TASE.2 data objects exactly.
- An end user who is looking for conventions and answers to practical questions regarding configuring TASE.2 software and networks.
- A vendor with a project to implement the TASE.2 specification either as a special project or to offer a standard product.

1.2 Organization

This guide first introduces the background and concepts of TASE.2 to provide a framework for understanding the TASE.2 specification. Then the individual server and data objects comprising TASE.2 are described with cross references into the specification. At this point, (i.e., Clauses 1-8) the reader should have all the necessary basic understanding to use the TASE.2 specifications intelligently. The remainder of the guide (Clauses 9-20) address practical issues that arise in connection with the use of TASE.2.

1.3 TASE.2 Version

This edition of the TASE.2 User Guide was prepared using the Second Edition of the TASE.2 standards, which at the time of the preparation of this report was the 2000 edition.

2 Reference documents

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 60870-5-101:1995, *Telecontrol equipment and systems – Part 5: Transmission protocols - Section 101: Companion standard for basic telecontrol tasks*

IEC 60870-6-503:2002, *Telecontrol equipment and systems – Part 6-503: Telecontrol protocols compatible with ISO standards and ITU-T recommendations – TASE.2 Services and protocol*

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

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

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

ISO/IEC 9506 (all parts), *Industrial automation systems – Manufacturing message specification*

3 Definitions

For the purposes of this technical report, the following definitions apply.

3.1
action
activity performed by the TASE.2 server triggered by some local predefined stimulus or set of 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 centers which identifies the data elements and objects that can be accessed and the level of access permitted

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

3.5
client
TASE.2 user who requests services or objects owned by another TASE.2 user acting as a server. The client is a 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
object which provides services to group data values for singular operations by a TASE.2 client

3.7
data value
object which represents some alphanumeric quantity that is part of the Virtual Control Center (VCC) which is visible to a TASE.2 user. Data Values exist as part of the implementation of the control center and represent either real entities within the utility such as current, or derived values calculated in the control center. Data Value objects include services for accessing and managing them

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
abstract entity used to implement the TASE.2 protocol and to represent data and optionally provide services for accessing that data within a VCC

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

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

3.13
server
TASE.2 user that is the source of data and provides services for accessing that data. A TASE.2 server 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 tagged 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

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

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

3.21
Virtual Control Center (VCC)
abstract representation of a real control center which describes a set of behaviour with regards to communication and data management functionality and limitations. VCC is a concept taken from the underlying MMS services

4 Abbreviations

For the purpose of this standard, the following abbreviations apply.

ACSE	Association Control Service Element
API	Application Program Interface
BCD	Binary Coded Decimal
COV	Change Of Value
DIS	Draft International Standard
EPRI	Electric Power Research Institute
HLO	Hot line order
ICC	Inter-Control Center
ICCP	Inter-Control Center Communications Protocol
IDEC	Inter-utility Data Exchange Consortium
IP	Internet Protocol

KQH Kilovar hour readings
KWH Kilowatt hour readings
LFC Load Following
MMS Manufacturing Messaging Specification
MOD Motor operated disconnect
PDU Protocol Data Unit
QOS Quality of Service
RBE Report by Exception
ROSE Remote Operations Service Element
TAL Time Allowed to Live
TASE Tele-control Application Service Element, (IEC's designation of an international standard protocol for utility data exchange)
TASE.1 TASE based on the ELCOM-90 protocol
TASE.2 TASE based on the ICCP protocol
TCP Transmission Control Protocol
TLE Time Limit for Execution
TOD Time of Day
UCA Utility Communications Architecture
UCS Utility Communications Standards working group
UDP User Datagram Protocol
VCC Virtual Control Center
VMD Virtual Manufacturing Device
WSCC Western System Coordinating Council
WEICG WSCC Energy Management Systems Inter-utility Communications Guidelines

5 TASE.2 background

Inter-utility real-time data exchange has become critical to the operation of inter-connected systems within the electric power utility industry. The ability to exchange power system data with boundary control areas and beyond provides visibility for disturbance detection and reconstruction, improved modelling capability and enhanced operation through future security control centers or independent system operators.

Historically, utilities have relied on in-house or proprietary, non-IS standard protocols such as those developed by the Western Systems Coordinating Council (WSCC), ELCOM, and the Inter-utility Data Exchange Consortium (IDEC) to exchange real-time data. TASE.2 began as an effort by power utilities, several major data exchange protocol support groups for the protocols mentioned above, EPRI, consultants and a number of SCADA/EMS and protocol vendors to develop a comprehensive, international standard for real-time data exchange within the electric power utilities industry.

By giving all interested parties an opportunity to provide requirements input and to participate in the protocol definition process, it was expected that the final product would both meet the needs of and be accepted by the electric power utility industry. To accomplish this goal, the Utility Communications Specification (UCS) Working Group was formed in September 1991 to:

1) develop the protocol specification;
2) develop a prototype implementation to test the specification;
3) submit the specification for standardization;
4) perform inter-operability tests among the developing vendors.

UCS submitted TASE.2 to the IEC Technical Committee (TC) 57 Working Group (WG) 07 as a proposed protocol standard. Another proposed standard based on ELCOM-90 over ROSE was also being considered by WG 07. TC 57 decided on a multi-standard approach to allow (1) a quick implementation to meet European Common Market requirements by 1992 and (2) also allow long term development of a more comprehensive protocol. The first protocol was designated TASE.1 (Telecontrol Application Service Element-1). The second protocol, based on TASE.2 over MMS, was designated TASE.2.

Successful first implementations of TASE.2 between SCADA/EMS control centers led to further expansion to allow communications between control centers and power plants. This expansion did not impact the basic services, but did lead to the development of specific power plant objects. These objects were incorporated into TASE.2. Similarly, protection event data objects were also added to support substation communications. The second edition of the TASE.2 standards also includes one new object for the exchange of general data reports and another new object for sending acknowledgements of complex data objects.

6 TASE.2 Overview

6.1 TASE.2 Concepts

6.1.1 Protocol Architecture

TASE.2 maximizes the use of existing standard protocols in all layers up to and including the lower layers of layer 7 in the OSI reference model. This has the benefit of requiring new protocol development for TASE.2 only in the upper sublayer of layer 7.

The protocol stack used by TASE.2 is shown in Figure 1. The upper three layers conform to the standard 7-layer OSI protocol stack with control center applications at the top. TASE.2 specifies the use of the Manufacturing Messaging Specification (MMS) for the messaging services needed by TASE.2 in layer 7. MMS specifies the mechanics of naming, listing, and addressing variables, and of message control and interpretation, while TASE.2 specifies such things as the control center object formats and methods for data requests and reporting. Applications at different control centers, possibly written by different vendors, but both conforming to these mechanics, formats, and methods, may interoperate to share data, control utility devices, output information messages, or define and execute remote programs.

Application	ICCP IEC 60870-6-503/802 MMS ACSE	
Presentation	ISO Presentation	
Session	ISO Session	
Transport	ISO Transport Class 4	TCP
Network	ISO CLNP	IP
Data Link	ISO 8802-2 LLC, FDDI, FR, ISDN, etc.	
Physical	Ethernet LAN, WAN, Point-to-Point Circuit, ATM, SDH, etc.	

Figure 1 – TASE.2 Protocol Architecture

TASE.2 also utilizes the services of the Application Control Service Element (ACSE) in layer 7 to establish and manage logical associations or connections between sites. TASE.2 relies on the ISO Presentation Layer 6 and Session Layer 5 as well.

Because of the protocol architecture, TASE.2 is independent of the lower layers, so that as new protocols evolve in the lower layers, TASE.2 will be able to operate over them with only configuration changes. Thus TASE.2 is able to operate over either an ISO-compliant transport layer or a TCP/IP transport service, as long as ISO layers 5-7 are maintained.

IEC 60870-6-702, which is a Protocol Conformance Protocol Specification (PICS), provides details on the requirements of each of the protocols in Layers 5-7. This information is especially important to protocol stack providers.

6.1.2 Application Program Interface (API)

An Application Program Interface (API) is not specified in the TASE.2 specification – only the protocol and service definitions are specified and are the subject of standardization. Each vendor implementing TASE.2 is free to choose the API most suitable for their product or for their intended customers. Figure 2 illustrates this concept.

For example, an Energy Management System/Supervisory Control And Data Acquisition (EMS/SCADA) vendor may choose to provide an API optimized for interfacing with several different types of applications, such as:

– A proprietary real-time SCADA database for the storing and retrieving of real-time power system data, such as analogs, status, and accumulator values, on a periodic basis or when a value changes

– A Relational Data Base Management System (RDBMS) for the storing and retrieving of historical or other non-real time data, or of Block 8 transfer account or device outage data objects.

– Scheduling and accounting applications to send, for example (1) interchange schedules once an hour or once a day and (2) binary files containing accounting data spreadsheet files.

– Dispatcher console operator message application and/or alarm processor application to send ASCII text messages to be displayed on a dispatcher's console display at another control center

These are just a few examples of the types of APIs an EMS/SCADA vendor may provide for its TASE.2 product. How they are implemented is considered a "local implementation issue" in the TASE.2 specification. As long as the protocol services are implemented according to the specification, interoperability is assured between different TASE.2 vendor's products.

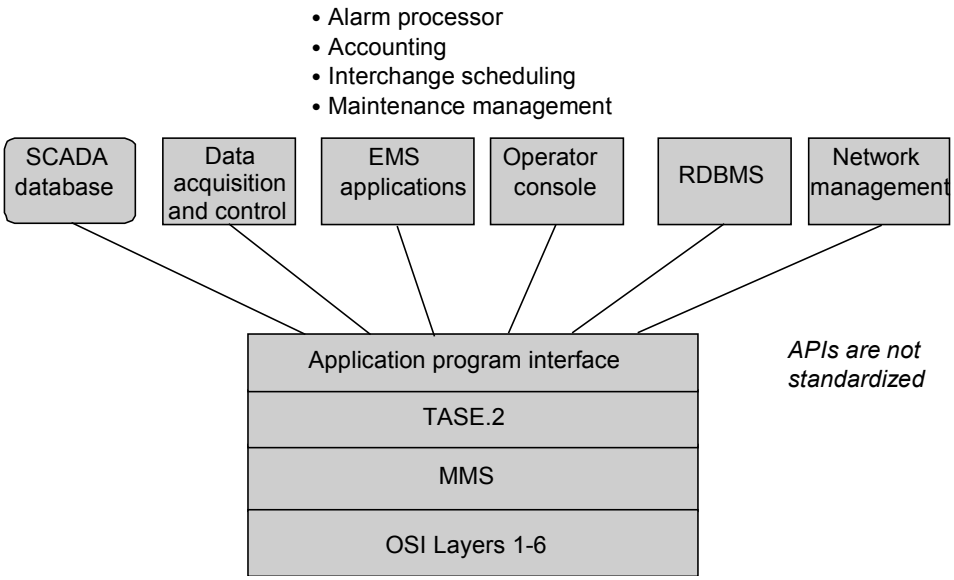

Figure 2 – Application Program Interface (API)