



BSI Standards Publication

Power systems management and associated information exchange

Part 1: Reference architecture

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National foreword

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TECHNICAL REPORT



Power systems management and associated information exchange – Part 1: Reference architecture

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE –

Part 1: Reference architecture

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62357-1, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This first edition cancels and replaces the first edition of IEC 62357 published in 2003 and constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- a) update of the description of the various standards activities within TC 57 and the way they individually and collectively contribute to meeting the objectives of TC 57;

- b) update of the areas where harmonization of existing standards within TC 57 is needed and provision of detailed recommendations regarding harmonization of the CIM IEC 61968/61970 and IEC 61850 standards;
- c) definition of a new layered architecture to help direct longer term goals and activities to ensure compatibility of all new standards developed in TC 57;
- d) alignment of the architecture on other internationally recognized architecture standards, such as the UN/CEFACT Core Components Technical Specification;
- e) incorporation of lessons learned during development of the current standards and their application on actual utility projects;
- f) provision of new guidance on the role of TC 57 standards in the Smart Grid.

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

Enquiry draft	Report on voting
57/1184/DTR	57/1255/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.

A list of all parts in the IEC 62357 series, published under the general title *Power systems management and associated information exchange*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

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

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INTRODUCTION

0.1 General

The objectives of IEC/TR 62357-1 are to

- provide a framework to show how the various standardisation activities within IEC Technical Committee 57 relate to each other and how they individually and collectively contribute to meeting the objectives of IEC Technical Committee 57, and
- develop a strategy to combine and harmonize the work of these various activities to help facilitate a single, comprehensive plan for deployment of these standards in product development and system implementations.

IEC/TR 62357-1 provides updates and defines a layered reference architecture to help direct longer term goals and activities, specifically to ensure compatibility of all new standards developed in TC 57 by benefitting from lessons learned during development of the current standards and their application on actual utility projects as well as through application of other internationally recognized architecture standards, such as the UN/CEFACT Core Components Technical Specification.

The second edition of IEC 62357-1 currently being prepared will reflect the progress recently achieved from the international Smart Grid (SG) initiatives and the CIGRE D2.24 large system architecture vision. This second edition will also reflect the most recent editions of the TC 57 standards including IEC 61850 series and IEC 61968 series, IEC 61970 series, and IEC 62325 series.

0.2 Objectives and overview of this technical report

0.2.1 Overview

IEC TC 57 is chartered with developing standards for electric power system management and associated information exchange in the areas of generation, transmission and distribution real-time operations and planning as well as information exchange to support wholesale energy market operations. This technical report has three objectives with respect to TC 57's current and future work. It also has a fourth objective regarding the role of TC 57 standards in development and implementation of the Smart Grid.

0.2.2 Existing TC 57 standards and architecture

The first objective of this technical report is to provide a reference architecture to show how the various existing standards activities within IEC TC 57 relate to each other today and how they individually and collectively contribute to meeting the objectives of TC 57. Clause 3 describes each of the working groups and their current scope of work, while Clause 4 shows how all the standards developed to date fit into an overall architecture

0.2.3 Areas for harmonization

The second objective is to identify areas where harmonization between TC 57 standards is needed and to suggest possible approaches to achieve it in order to facilitate a single, comprehensive, optimal plan for deployment of these standards in product development and system implementations. Clause 5 describes the data modelling and service definition approaches currently used in TC 57. Clause 6 describes way these modelling standards and services are mapped to concrete technologies, while Clause 7 discusses the harmonization needed to ensure that these existing modelling and technology mapping standards are compatible, if not totally integrated.

0.2.4 Future vision for TC 57 standards architecture

The third objective is to define a vision for the future reference architecture that will help direct longer term goals and activities. More specifically the goal is to ensure compatibility of all new standards developed in TC 57 by benefitting from lessons learned during development of the current standards and their application on actual utility projects as well as through application of other internationally recognized architecture standards, such as the UN/CEFACT Core Components Technical Specification.

Clause 8 defines the fundamental architecture principles established to guide the structure of new standards work, specifically proposing a layered architecture that recognizes internationally accepted concepts for a layered architecture including an abstract information model, a business context layer, message assembly layer, and an implementation or technology mapping layer. Clause 9 discusses the conclusions.

0.2.5 Role of TC 57 standards in the smart grid

The fourth objective is to provide an overview of the TC 57 standards and their role in the Smart Grid. Now that the TC 57 standards, such as the IEC 61968 series, IEC 61970 series and IEC 61850 series, have been recognized as pillars for realization of the Smart Grid objectives of interoperability and device management, it is imperative that a correct understanding of these standards and their application be made available to the key stakeholders and all other interested parties involved in implementing the Smart Grid.

0.3 Rationale

The need for this technical report was motivated by three major factors:

- a) there are multiple independent standards initiatives that need to be coordinated and harmonized to facilitate information exchange between systems using these various standards;
- b) there is a need to have a comprehensive vision of how to deploy these standards for actual system implementations and integration efforts;
- c) there needs to be a vision of the future so that additional work can take into account the evolving communications and modelling technologies, and can be incorporated within a clearly defined architectural framework.

There are several different initiatives within TC 57, each dealing with a selected part of real-time operations and planning. Each has a specific objective and may have sufficient breadth of scope to provide the bulk of the relevant standards needed for product vendors to develop products based on those standards.

0.4 Trend toward model driven architectures and integration

In today's utility enterprise, where information exchange between the various generation, distributed resource, transmission, and distribution management systems, as well as customer systems and other IT systems is not only desirable but necessary, each system plays the role of either the supplier or consumer of information, or more typically both. That means that both data semantics and syntax need to be preserved across system boundaries, where system boundaries in this context are interfaces where data is made publicly accessible to other systems or where requests for data residing in other systems are initiated. In other words, the "*what*" of the information exchange is actually much more important for system integration purposes than "*how*" the data is transported between systems.

Most previous efforts to define system architectures have dealt primarily with the *how* (i.e., definition of protocols for transporting the data), with a focus on utilizing as many existing ISO or TCP/IP standards as possible to provide the various layers in the ISO OSI seven-layer

reference model for protocol profiles.¹ However, the increasing use of object modelling techniques to define the data for information exchange within the different standards initiatives has properly shifted the focus away from the *how* to the *what*. Of even more importance, this trend has resulted in the separation of the data from the protocol standards, creating a new layer of abstraction for the data model as well as the data exchange methods that is independent of the underlying infrastructure. The consequence of this is that a common data model and a few generic data-driven interface patterns can be used for all information exchange independent of the underlying protocols selected for a given system implementation. This new architecture is known as a Model-Driven Architecture (MDA), or when applied to integration of systems and applications, as Model-Driven Integration (MDI). Actual implementations can then take advantage of the current industry architectural trends, such as Service Oriented Architectures (SOA) and the use of Web services.

Standardization efforts within TC 57 began several years prior to development of the MDA/MDI architectural concepts. As a result, there was little or no collaboration between working groups. Each working group chose its own modelling language/notation and more importantly generated their own object and service model definitions. This was not done intentionally, and in fact each initiative had perfectly good reasons for their choices given the limited scope of their domain of application. But the consequence is that instead of one object model for each physical entity in the generation, transmission and distribution operations domains being standardized, at least two or more object models exist in most cases with different definitions for classes, attributes, data types, and relationships between classes. Furthermore, in most cases different modelling languages have been used as well.

0.5 Purpose of the reference architecture

To achieve the first objective of this technical report, a reference architecture for power system information exchange is defined to describe all the existing object models, services, and protocols within TC 57 and how they relate to each other. Then, to meet the second objective, a strategy is developed to show where harmonization is needed, and if possible, to recommend how to achieve a common model. Where changes cannot be made due to maturity of standards, then recommendations for adapters to make the necessary transformations between models are made. The third objective of this technical report is achieved by defining a new future reference architecture that recognizes the importance of a single, internally consistent semantic layer to avoid unnecessary seams (i.e., the concept of a seamless architecture), while facilitating information exchange over a variety of industry-standard transport infrastructures. This new reference architecture provides a framework for growth and incorporation of new, evolving technologies without invalidating the existing standards developed by TC 57.

0.6 Scope of reference architecture

0.6.1 General

Originally the charter and title of TC 57 was "Power system control and associated telecommunications". The focus was on developing different protocol standards to address the data communications requirements of different parts of power system control, such as data communications over low-speed serial lines, distribution line carrier protocols, and inter-control center communications protocols.

Later as the scope of the TC 57 work broadened to include data exchange between applications within an energy management system as well as inter-computer system data exchange between distribution management systems and deregulated energy market communications, the charter was changed to "Power system management and associated information exchange", so that the focus shifted from lower lever protocol development to

¹ The original EPRI UCA project, for example, had the focus of settling on the use of MMS and a few standard profiles for transporting data rather than on the semantics of information transfer between systems.

development of more abstract data models and generic interfaces at higher levels in the architecture. This shift resulted in the creation of new working groups to address the new business functions embraced by the new TC 57 charter, which includes:

- energy management,
- SCADA and network operation,
- substation protection, monitoring, and control,
- distribution automation,
- distributed energy resources (DER),
- demand response and load control,
- meter reading and control,
- customers,
- work,
- network expansion planning,
- operational planning and optimization,
- maintenance and construction,
- records and asset management,
- market operations,
- reservations,
- financial,
- energy scheduling.

0.6.2 IEC standards included in reference architecture

The scope of the reference architecture for power system information exchange embraces all these areas from both the abstract information modelling perspective (i.e., platform independent models) as well as the technology mappings for implementation (i.e., platform specific models).

Figure 1 shows where some of these standards are used in the utility operations environment. Not all standards listed above are shown and not all end field devices/systems are shown. More detailed descriptions and illustrations are provided in Clause 3.

The reference architecture for power system information exchange includes the following IEC TC 57 standards (responsible working groups are shown in parentheses):

IEC 60495, *Single sideband power-line carrier terminals* (WG20)

IEC 60663, *Planning of (single-sideband) power line carrier systems* (WG20)

IEC 60870-5 (all parts), *Telecontrol equipment and systems – Part 5: Transmission protocols* (WG3)

NOTE 1 IEC 60870-5 series covers reliable data acquisition and control on narrow-band serial data links or over TCP/IP networks between SCADA masters and substations.

IEC 60870-6 (all parts), *Telecontrol equipment and systems – Part 6: Telecontrol protocols compatible with ISO standards and ITU-T recommendations* (WG7)

NOTE 2 IEC 60870-6 series covers the exchange of real-time operational data between control centres over Wide Area Networks (WANs). This series is known officially as TASE-2 and unofficially as ICCP.

IEC 61334 (all parts), *Distribution automation using distribution line carrier systems* (WG3)

NOTE 3 IEC 61334 series covers data communications over distribution line carrier systems.

IEC 61400-25 (all parts), *Wind turbines – Part 25-1: Communications for monitoring and control of wind power plants*

NOTE 4 IEC 61400-25 series covers monitoring and control of wind power plants and associated communication. The standards developed by JWG 25 are based on IEC 61850 series.

IEC 61850 (all parts), *Communication networks and systems for power utility automation (WG10, WG17, WG18)*

NOTE 5 IEC 61850 series covers communication networks and systems in substations. These standards are known unofficially as the UCA2 protocol standards. They also include standards for hydroelectric power plant communication, monitoring, and control of distributed energy resources and hydroelectric power plants.

IEC 61968 (all parts), *Application integration at electric utilities – System interfaces for distribution management (WG14)*

NOTE 6 IEC 61968 series covers Distribution Management System (DMS) interfaces for information exchange with other IT systems. These include the distribution management parts of the CIM and extensible Markup Language (XML) message standards for information exchange between a variety of business systems, such as meter data management, asset management, work order management, Geographical Information Systems (GIS), etc.

IEC 61970 (all parts), *Energy management system application program interface (EMS-API) (WG13)*

NOTE 7 IEC 61970 series facilitate integration of applications within a control centre, exchange of network power system models with other control centres, and interactions with external operations in distribution as well as other external sources/sinks of information needed for real-time operations. These standards include the generation and transmission parts of the Common Information Model (CIM), profiles for power system model exchange and other information exchanges, and XML file format standards for information exchange.

IEC 62325 (all parts), *Power systems management and associated information exchange – Data and communications security (WG16)*

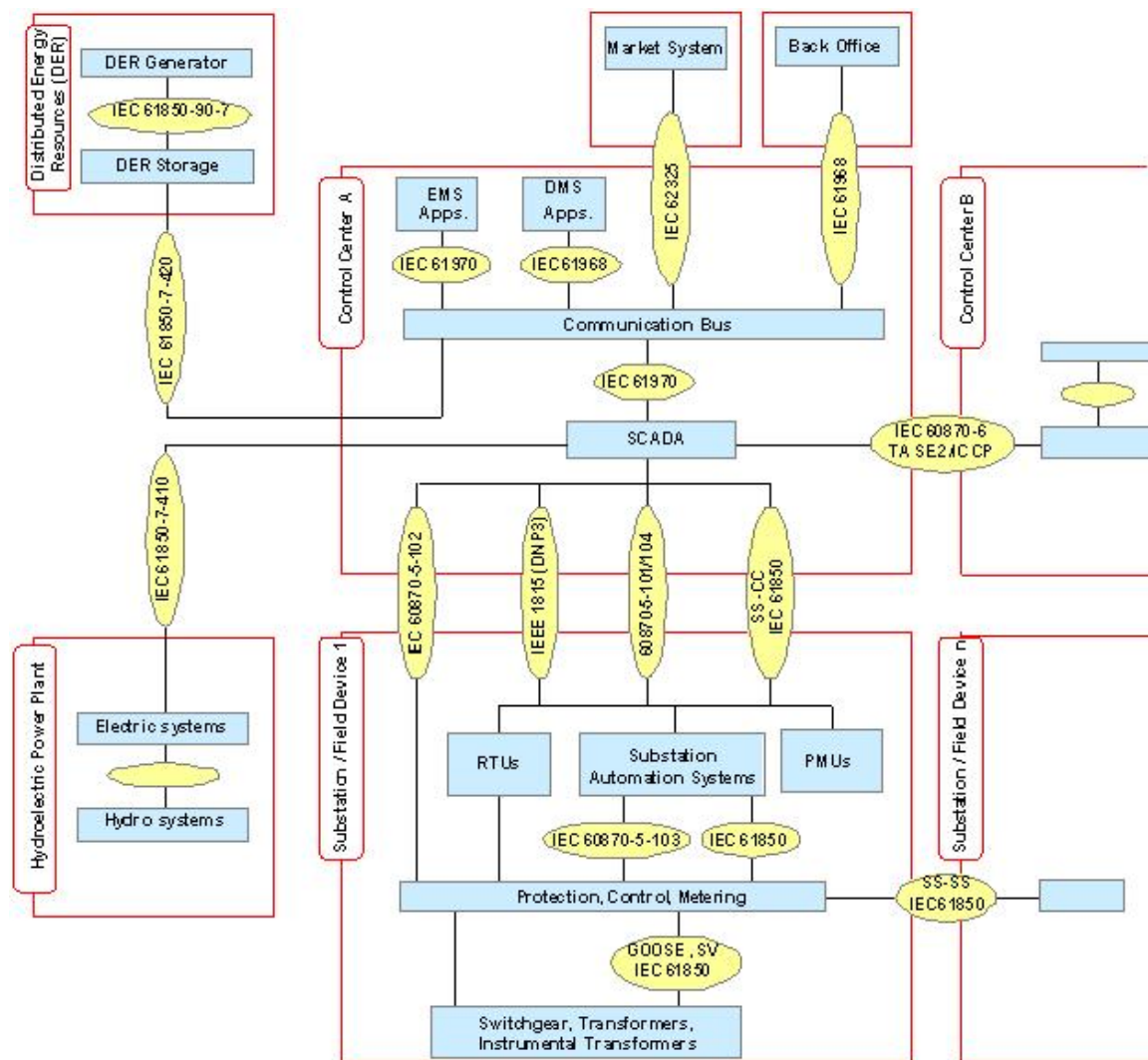
NOTE 8 IEC 62325 series covers deregulated energy market communications.

IEC 62351 (all parts), *Power systems management and associated information exchange – Data and communications security (WG15)*

NOTE 9 IEC 62351 series covers data and communication security.

IEC 62488 (all parts), *Power line communication systems for power utility applications (WG20)*

NOTE 10 IEC 62488 series covers data power line communication systems for power utility applications.



IEC 2049/12

Figure 1 – Application of TC 57 standards to a power system

0.6.3 TC 57 organization and formal liaisons

Figure 2 shows the organization of the IEC TC 57 working groups that are responsible for producing these standards. The formal TC 57 liaisons with external organizations and industry consortiums are also shown and listed below with additional detail:

- **CIGRE**: Category A
 - SC D2-24 Information systems and telecommunications – EMS architectures for the 21st century
 - SC B5-38: Protection and automation
- **ITU-T** (International Telecommunication Union) – Telecommunications sector which is responsible the efficient and timely production of standards covering all fields of telecommunications on a worldwide basis, as well as defining tariff and accounting principles for international telecommunication services. Category A with TC57.
- **UCAIug** (UCA International User Groups), including CIM, OpenSG, and 61850: Category D with WG10, WG13 and WG14
- **ebIX** (European forum for energy business information exchange): Category D with WG16
- **ENTSO-E** (European Network of Transmission System Operators for Electricity), responsible for Europe-wide planning and operations for all cross-border exchanges of electricity: Category D with WG13 and WG16

- **IEEE** (Institute of Electrical and Electronic Engineers) **PES** (Power Engineering Society) **PSCC** (Power Systems Communications Committee) **Security Subcommittee**: Category D with WG15
- **UN/CEFACT** (United Nations/Center for Trade Facilitations and Electronic Business), a United Nations body that is in charge of trade facilitations and have launched an initiative for e-commerce known as ebXML, a suite of specifications to enable enterprises to conduct business over the Internet. Included is a mechanism for enterprises to register core components in XML meta-language, so that other enterprises can determine what information is available, and can then establish dynamic interactions automatically: MoU (Memo of Understanding) between IEC and UN/CEFACT

Later in the introduction the activities of each of the IEC TC 57 working groups is described. As shown the activities are coordinated by the Convener's Advisory Group (CAG) and WG19, which functions as an architecture board to ensure standards developed fit a common architectural framework and are compatible with existing standards.

TC 57 Organization and Formal Liaisons

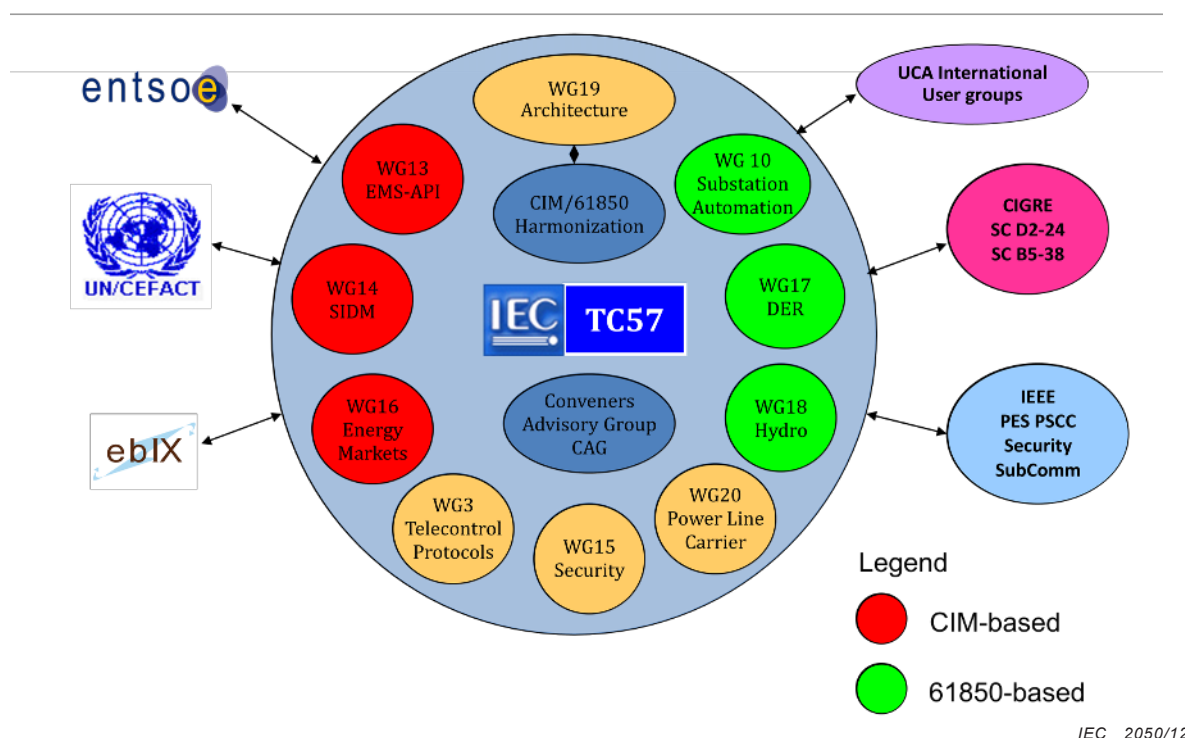


Figure 2 – TC 57 organization and formal liaisons

0.6.4 IEC internal liaisons

Current IEC internal liaisons include:

- IEC TC 4 Hydraulic turbines
- IEC TC 8 Systems aspects for electrical energy supply
- IEC TC 13 Electrical energy measurement, tariff- and load control
- IEC SC 17C High-voltage switchgear and controlgear assemblies
- IEC TC 38 Instrument transformers
- IEC TC 65 Industrial-process measurement, control and automation
- IEC TC 88 Wind turbines (IEC 61400-25-1 to -6)

- IEC TC 95 Measuring relays and protection equipment

0.6.5 Related standards activities

In addition to the formal liaisons, there are other standards-related activities that are relevant to TC 57 and are the source of either existing or planned standards that can be adopted (perhaps with some tailoring to meet utility-specific needs) for use within TC 57. Figure 2 graphically depicts these activities and domains of application. Of particular interest are the following:

National Institute of Standards and Technology (NIST), the non-regulatory federal agency within the U.S. Department of Commerce responsible for generating the Smart Grid Roadmap and defining standards for the Smart Grid.

North American Energy Standards Board – Electricity (NAESBE), an industry forum for the development and promotion of standards which will lead to a seamless marketplace for wholesale and retail electricity, as recognized by its customers, business community, participants, and regulatory entities.

IEEE, in particular the IEEE PES committees, including the power system relaying Committee, and the substations committee, as well as the IEEE Communications Society, IEEE SCC36, and IEEE SCC21.

OPC, an industry consortium responsible for standards related to the integration of near real time applications – primarily in the process control, manufacturing, and utility sectors. WG13 is working closely with OPC to leverage their unified architecture set of interface services for exchanging CIM-based data.

Open Application Group (OAG), an industry consortium responsible for Enterprise Application Integration (EAI) solutions. WG14 is working closely with the OAG to develop standard XML messages for information exchange between distribution management systems and other IT systems.

MultiSpeak, a collaboration of the National Rural Electric Cooperative Association (NRECA) in the USA. The MutiSpeak Initiative has developed and continues to expand a specification that defines standardized interfaces among software applications commonly used by electric utilities.

European Transmission System Operator (ETSO), a consortium of European TSOs that define standards for information exchange. They rely on the UN-CEFACT standardisation process.

European Federation of Energy Traders (EFET), an organization that federates the traders in Europe.

World-Wide Web Consortium (W3C), a consortium that develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential, among these technologies are XML, RDF, OWL, Web services.

Internet Engineering Task Force (IETF) Internet Services

International Standards Organization (ISO) Security and Metadata Repository Standards

Electric Power Research Institute (EPRI), although not a standards organization as such, was a source for a number of the drafts which became standards within TC 57 via the Control Center Applications Program Interface (CCAPI) project.

0.7 Purpose of the future reference architecture for power system information exchange

The future reference architecture is built upon the current TC 57 reference architecture and the many utility requirements that went into defining that architecture. However, it also takes into account new concepts and evolving technologies in the information industry at large. In some cases these are incorporated into the future reference architecture, not necessarily because they are better than what has been developed to-date, but because the electric industry must and will follow technology trends from other industries where these are proven to be cost-beneficial. In other cases, the electric power industry is just now getting into new areas, such as market operations, where some of the needed technologies are being defined elsewhere.

POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE –

Part 1: Reference architecture

1 Overview

1.1 Scope

This part of IEC 62357, which is a Technical Report, specifies a reference architecture and framework for the development and application of IEC standards for the exchange of power system information.

This technical report provides an overview of these standards as well as guidelines and general principles for their application in distribution, transmission, and generation systems involved in electric utility operations and planning.

The future multi-layer reference architecture described in this technical report takes into account new concepts and evolving technologies, such as semantic modelling and canonical data models, in order to build on technology trends of other industries and standards activities to achieve the interoperability goals of the Smart Grid.

1.2 Normative references

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

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

IEC 61968 (all parts), *Application integration at electric utilities – System interfaces for distribution management*

IEC 61970 (all parts), *Energy management system application program interface (EMS-API)*

2 Abbreviations

For the purposes of this document, the following abbreviations apply.

ACSI	Abstract Communication Service Interface
AHWG	Ad Hoc Working Group
API	Application Program Interface
ASCII	American Standard Code for Information Interchange
ASN	Abstract Syntax Notation
CASE	Computer Aided Software Engineering
CASM	Common Access Service Methods
CC	Control Centre
CCAPI	Control Centre Application Program Interface
CCTS	Core Component Technical Specification
CDA	Common Data Access
CES	Component Execution System
CIM	Common Information Model

CIS	Common Interface Specification
CMIP	Communication Management Information Protocol
COM	Common Object Model
CPSM	Common Power System Model
CS	Common Services
DA	Data Access
DAF	Data Access Facility
DAIS	Data Acquisition from Industrial Systems
DBMS	Database Management System
DCOM	Distributed Common Object Modelling
DER	Distributed Energy Resource
DLC	Distribution Line Carrier
DLMS	Distribution Line Messaging System
DMS	Distribution Management System
DOM	Document Object Model
DTD	Document Type Definition
DTF	Domain Task Force
EAI	Enterprise Architecture Integration
ebXML	e business XML
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
EII	Enterprise Information Integration
EJB	Enterprise Java Beans
EMS	Energy Management System
EPRI	Electric Power Research Institute
ERP	Enterprise Resource Planning
ETL	Extract, Transform, and Load
EV	Electric Vehicle
FTP	File Transfer Protocol
GDA	Generic Data Access
GES	Generic Eventing and Subscription
GIS	Geographic Information System
GOOSE	Generic Object Oriented System Event
GSSE	Generic Substation Status Event
GUI	Graphic User Interface
GUID	Globally Unique Identifier
HDAIS	Historical Data Access from Industrial Systems
HIS	Historical Information System
HMI	Human Machine Interface
HSDA	High Speed Data Access
HTML	Hypertext Markup Language
ICCP	Inter-Control Centre Protocol
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IEEE	Institute of Electrical and Electronics Engineers
IEM	Information Exchange Model
IP	Internet Protocol
IRM	Interface Reference Model
ISO	International Standards Organization or Independent System Operator
IS	International Standard
IT	Information Technology
J2EE	Java 2 Enterprise Edition
LAN	Local Area Network

LD	Logical Devices
LV	Low Voltage
MAC	Media Access Control
MDA	Model Driven Architecture
MDI	Model Driven Integration
MDR	Metadata Repository
MIB	Management Information Base
MMS	Manufacturing Messaging Specification
MRID	Master Record Identification Number
MV	Medium Voltage
NDR	Naming and Design Rules
NERC	North American Electric Reliability Corporation
NWIP	New Work in Progress
OAG	Open Application Group
OLE	Object Linking and Embedding
OMG	Object Management Group
OPC	OLE for Process Control
ORB	Object Request Broker
OSI	Open System Interconnect
OWL	Ontology Web Language
PC	Personal Computer
PIM	Platform Independent Model
PLC	Programmable Logic Controller
PSM	Platform Specific Model
PV	PhotoVoltaic
RDBMS	Relational Data Base Management System
RDF	Resource Description Framework
RDFS	RDF Schema
RFP	Request for Proposal
RTO	Regional Transmission Operator
RTU	Remote Terminal Unit
RWO	Real World Objects
SAS	Substation Automation System
SCADA	Supervisory Control and Data Acquisition
SCD	System Configuration Description
SCL	Substation Configuration Language
SCSM	Specific Communication Service Mapping
SGML	Standard Generalized Markup Language
SIDMS	System Interfaces for Distribution Management Systems
SMV	Sample Measured Value
SNMP	Simple Network Management Protocol
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SPAG	Strategic Policy Advisory Group
SQL	Structured Query Language
SSD	Substation System Description
TASE	Telecontrol Application Service Element
TC	Technical Committee or Time Constant
TCP/IP	Transport Control Protocol/Internet Protocol
TLS	Transport Layer Security
TSDA	Time Series Data Access
UCA	Utility Communication Architecture
UDDI	Universal Description and Discovery Information
UML	Unified Modelling Language

UMM	UN/CEFACT Modelling Methodology
UMP	UML Profile
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
URI	Uniform Resource Identifier
URL	Universal Resource Locator
URN	Universal Resource Name
VLPGO	Very Large Power Generation Operators
VPN	Virtual Private Network
WAN	Wide Area Network
WG	Working Group
W3C	World Wide Web Consortium
WSDL	Web Services Definition Language
XMI	Extensible Mark-Up Language Metadata Interchange
XML	Extensible Mark-up Language
XSD	XML Schema Definition
XSL	Extensible Style Sheet Language
XSLT	Extensible Style Sheet Language Template

3 IEC TC 57 standards

3.1 General

As in most standards activities, the working documents that eventually become standards from TC 57 have their genesis within the individual working groups of TC 57. These working groups were formed from the bottom up rather than from an initial vision embodied in an umbrella framework or reference architecture handed down by TC 57. That is, within the original charter of TC 57, which was “power systems control and associated telecommunications”, working groups were formed whenever a member country took the initiative to propose a new work item.

The first working groups focused on protocols and services for data links from control centres to substations and distribution feeders, and to other control centres (WG3, WG7, and WG9). This work primarily provided standards for exchanging SCADA data and controlling substation/field devices.

As new working groups were subsequently formed, the emphasis shifted more to modelling and semantics of data (i.e., the *of* information exchange rather than the *how*, as previously mentioned) with transport mechanisms provided by world-wide, industry-independent standards provided by ISO, W3C, and others. WG10 applied these modelling techniques to substation automation and control, while WG13 and 14 focused on information exchange between transmission and distribution applications and systems, with the focus on message payload definitions and service definitions independent of the underlying transport mechanisms. WG16 extended this approach to market operations. WGs 17 and 18 further extended the application domain to DER and hydroelectric plants, respectively. WGs15 and 19 deal with security and harmonization issues, respectively, to ensure a common approach and internal consistency across all TC 57 working groups.

In parallel with this and in recognition of this shift in the subject of TC 57 standards, the charter of TC 57 was changed to “power system management and associated information exchange.”

The following subclauses describe the standards developed within each of these working groups.

3.2 IEC 60870-5 telecontrol protocol standards from WG3

WG3 initially focused on providing standards for reliable communications on narrow-band serial data links traditionally used for communications between a SCADA master in a control centre and RTUs located in transmission substations in the field. The first WG3 standard, IEC 60870-5-101, resulted in a three-layer protocol stack custom designed for high reliability and high transmission efficiency for use on wires capable of only low bit rates. Later the scope of WG3 was broadened to include telecontrol protocols mapped onto data networks, such as router-based WANs. This resulted in IEC 60870-5-104, which provides network access for 60870-5-101 using standard transport profiles, primarily TCP/IP.

These standards implicitly assume an “anonymous point-oriented model” to identify the values received and devices controlled. This means that the source of a data value, such as analog measurement, status, or accumulator (i.e., counter) value, is an RTU point number or name. This is in contrast to the “device-oriented models” being developed in WG10 in the IEC 61850 series, where real world substation and field devices are represented by object models and the value of the object is identified by a structured name identifying the device that supplies it and the object it contains. In fact, the entire device is modelled to include other information, such as nameplate data.

3.3 IEC 60870-6 standards from WG7

WG7, which is no longer active, focused on providing protocols that could run over a WAN to interconnect control centres² with heterogeneous databases and EMS applications. The goal was to develop protocols and services compliant with the OSI 7-layer reference model using existing ISO standards to the maximum extent possible.³

The first standard published was TASE.1, comprising IEC 60870-6-501, -502, -504, and -701, which is based on the ELCOM-90 protocol from Norway over an OSI protocol stack. While TASE.1 includes enhanced functionality, the primary objective of TASE.1 is to provide for operation of an existing ELCOM-90 protocol over an OSI protocol stack. The application program interface for TASE.1 was maintained exactly as defined in the ELCOM-90 protocol documents to facilitate replacement of ELCOM-90 with TASE.1.

The second standard published was TASE.2, comprising IEC 60870-6-503, -505, -702, and -802. The major objectives of TASE.2 are to provide (1) increased functionality and to (2) maximize the use of existing OSI-compatible protocols, specifically the Manufacturing Messaging Standard (MMS) protocol stack. TASE.2 provides a utility-specific layer over MMS.

In addition to SCADA data and device control functionality as provided in TASE.1, the TASE.2 standards also provide for exchange of information messages (i.e., unstructured ASCII text or short binary files) and structured data objects, such as transmission schedules, transfer accounts, and periodic generation reports. This standard is also known unofficially as ICCP, from the name given by the EPRI project that sponsored the development of the draft specifications for this standard.

The TASE.2 standards make use of a client/server model, in which the client initiates transactions that are processed by the server. Object models were used to define the transactions and services for transferring this data, such as Association, Data Value, Data Set, Transfer Sets, Device Control, etc. The actual data to be transferred was separated from these services and defined as static data objects, such as Indication Points, Control Points, Transfer Account, Device Outage, etc. Thus an attempt was made to separate the data objects to be transferred from the underlying services used to transfer the data.

² The term control centre here also includes power plants and automated substations that contain a host computer acting as a SCADA master located within the substation itself.

³ The scope of TC 57 and WG7 was later modified to embrace the use of TCP/IP for the transport layer as well.

However, since the primary objective of TASE.2 was to support the exchange of real-time SCADA data or schedules and accounting information, the information needed was largely independent of the source of the information. That is, the knowledge of the physical device supplying measurands or status data was immaterial, as long as a power system model within the control centre could make the association of the received point data with its location in the network topology. For that reason, point-oriented models were used to represent the data values received and control commands sent to another control centre or substation host computer acting as a SCADA master for the substation. In other words, while an object model approach is used to define the data objects and services, an anonymous point-oriented model is used to identify the values received and devices controlled, as was done in WG3.

IEC 60870-6-503 defines the services and protocols, including a mapping of the abstract services and data types defined in the server objects onto MMS services and data types. IEC 60870-6-802 defines the data objects and their mapping onto MMS data types. IEC 60870-6-702 defines an application profile for the TASE.2 protocol stack in the upper 3 layers. IEC 60870-6-505 is a user guide for TASE.2.

3.4 IEC 61334 standards from WG9

3.4.1 General

These standards developed by WG9 (inactive) support distribution automation using distribution line carrier systems. These standards address protocols for accessing distribution devices in the field from distribution operations management systems over existing distribution power lines.

The scope of these standards covers communications using distribution line carrier technology on both, medium voltage (MV) and low voltage (LV) distribution networks. The distribution line communication system provides two-way communications which can be used for a large number of devices with various functions (e.g., station control units, remotely controlled feeder switches, meters, transformer station concentrators, portable input unit, light control, load management, and traffic lights).

IEC 61334-4-1 defines the reference architecture based on the client-server model. In IEC 61334-4-41, known as the Distribution Line Messaging System (DLMS), an abstract, object-oriented server model is provided. This model considers the limited resources of distribution devices. The protocol data units of the application protocol supporting the model are described in Abstract Syntax Notation.1 (ASN.1). In addition, efficient encoding-rules are provided (IEC 61334-6).

The standard series IEC 61334-5-1 to IEC 61334-5-5 define several physical and Media Access Control (MAC) layers using different modulation technologies suited for LV and MV communication. IEC 61334-4-511 and -512 specify the management framework and the management procedures, respectively, for the IEC 61334-5-1 profile. IEC 61334-3-21 and -22 define the requirements for coupling the Distribution Line Carrier (DLC) signals into the MV line considering the necessary safety requirements.

3.4.2 Relation to "external" standards

The DLMS standard IEC 61334-4-41 forms the basis for a series of standards developed by IEC TC13 WG14 for metering applications. In particular, IEC 62056 series provides a complete communication stack – including the meter device models –, which is compatible with IEC 61334-4-41.

3.5 IEC 61850 standards for power system IEC communication and associated data models from WG10

3.5.1 General

As the need for standards to address substation automation was identified, new working groups were formed (WG10-12) to develop standards for architectures and interfaces within substations and on distribution feeders. Because of similar and closely related objectives, these three working groups eventually merged into a single working group – working group 10 which produces standards for power system IED communication and associated data models. Work is underway to extend the scope of IEC 61850 to include substation-to-substation communications and substation to control centre communications

As the application use cases for IEC 61850 expanded, two new working groups were created to address these new areas:

- WG17 – Communications systems for Distributed Energy Resources (DER)
- WG18 – Hydroelectric power plants – Communication for monitoring and control

The standards produced by WG17 and WG18 which are also part of the IEC 61850 series of standards are discussed later in 3.10 and 3.11 respectively.

Unlike some other TC 57 protocols which have a flat or tag oriented data hierarchy, IEC 61850 data models are hierarchical in nature. The general IEC 61850 philosophy is to represent substation functions (e.g., metering or protection) by the use of non-distributable function atoms working together to define standardized naming, attributes, data, and methods of such function atoms, called logical nodes. A client then interacts with the resulting data object model *directly* in order to access it for purposes of reading attribute values, such as nameplate data or measured values, or to control the device, rather than indirectly through an RTU.

The common services needed by all substation devices, especially field devices, are modelled as services on objects, which are defined in IEC 61850-7-2 Abstract Communication Service Interface (ACSI). Field devices incorporate these services by specifying which objects within their models inherit the class objects defined in the ACSI. For example, if a model of a utility field device contains a measured value which needs to be read by a substation host, the object inherits the attributes and methods associated with the measurand object Basic Data Class defined in IEC 61850-7-3.

The IEC 61850 standards are based largely on object models for substation devices that originated with the EPRI-sponsored UCA2 project (now IEEE Technical Report 1550). Their general structure can be reused for other application areas by just providing the function atoms (logical nodes) with appropriate data for the new application area, thus allowing the reuse of all service definitions and configuration in the related parts of IEC 61850.

3.5.2 Substation architecture and interface specifications

The IEC 61850 standards specify three kinds of communication services:

- client/server based services, which are intended for vertical communication between system levels, typically from field level to station level to network level,
- a publish/subscribe service for exchanging real time data in the millisecond range between IEDs typically within the same LAN,
- a publish/subscribe based service to exchange analog sample values, typically used to send information from voltage and current sensors to bay level IEDs.

Figure 3 illustrates the logical data flows and interfaces between substation system levels. As may be seen, several types of communication interfaces and requirements are specified in the IEC 61850 standards. Interfaces 1, 3, 6, 8, and 9 comprise what is typically called a station

bus. Specifications for these interfaces define the requirements for peer-to-peer information exchange of physical substation devices (e.g., bay controllers, protection relays, and meters). Interfaces 4 and 5 comprise what is typically called the process bus. Specifications for these interfaces define the requirements for sensor-to-device information exchange. Interface 7 enables remote engineers to communicate directly with devices on the station bus for the purposes of monitoring, configuration, and diagnostics. Interface 10 supports SCADA data exchange with a remote SCADA master. It is shown “greyed out” because, although it has similar requirements to Interface 7, it is up to now not within the scope of the IEC 61850 standards. Interface 2 is for protection-data exchange between bay level and remote protection, and Interface 11 is for control-data exchange between different substations.

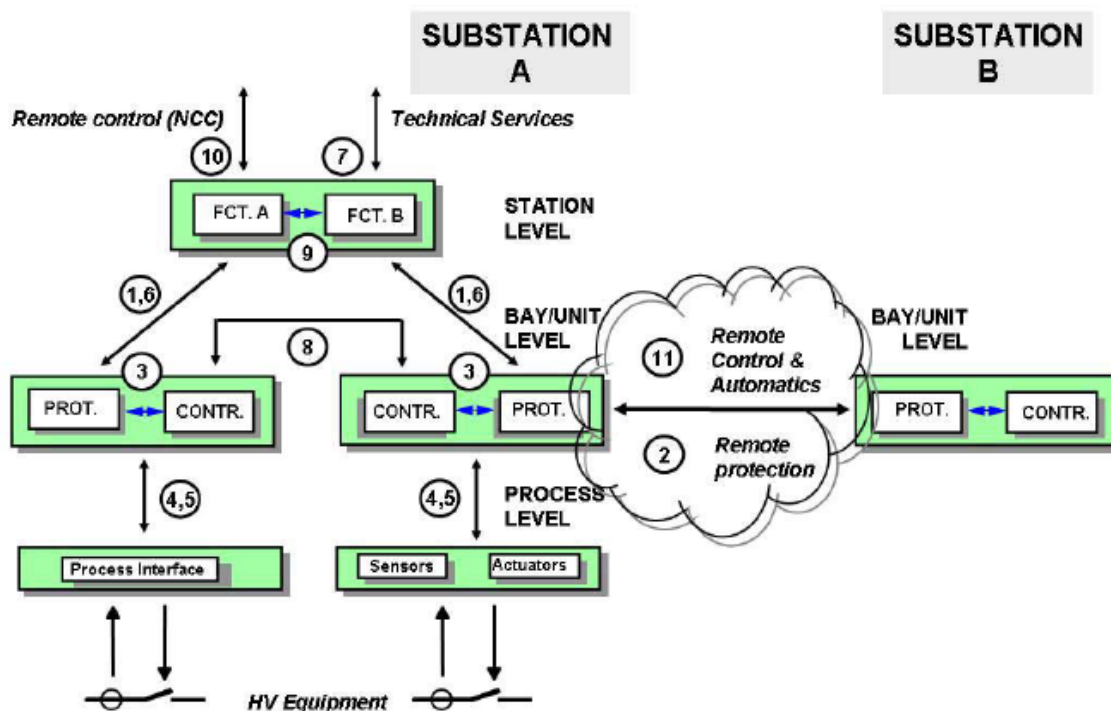


Figure 3 – Communication interface architecture for IEC 61850

IEC 2051/12

Standardized mappings of these abstract services to different application layer communication protocol profiles are defined in IEC 61850-8-x (client server communication and real time communication) / IEC 61850-9-x (raw analog sample values), so that common utility functions will be performed consistently across all field devices independent of the underlying communication stacks.

As described earlier, the architecture of the “IEC 61850 bus” and its communication services enables bay/unit level devices to interact in a peer-to-peer fashion. It also supports the remote monitoring of these devices either directly (e.g., peer-to-peer) or through some type of information aggregator (e.g., sub-Scada master, RTU, or bay controller) at the station level. However, the use of aggregation coupled with protocol conversion (e.g., a sub-Scada master that attaches to the “station bus” with IEC 61850, but transfers information to the Scada master through TASE.2 or IEC 60870) will typically cause some IEC 61850 services to become un-available to the Scada master. Annex A shows which parts of IEC 61850 currently contain the mappings of the abstract services and if those services could be mapped through a TASE.2 aggregator.

3.5.3 Substation configuration description language

Another standard in the IEC 61850 series is the configuration description language for communication in electrical substations related to IEDs, known as the Substation Configuration description Language (SCL), IEC 61850-6, an XML-based configuration language for the binding of logical nodes (i.e., functional atoms within physical devices) to

primary equipment, and specifying configuration and parameter data, and the structure and addressing of the communication network. The intended use is to provide an interoperable way to exchange IED and SA system configuration information between the engineering tools of different (IED) manufacturers.

3.6 IEC 61970 energy management system application program interface standards from WG13

3.6.1 General

WG13 was formed to develop EMS API standards to facilitate the integration of EMS applications developed independently by different vendors, between entire EMS systems developed independently, or between an EMS and other systems concerned with different aspects of power system operations, such as generation or distribution management. This is accomplished by defining standard interfaces to enable these applications or systems to access public data and exchange information independent of how such information is represented internally.

There are three major categories of the IEC 61970 standards:

- a) Part 3XX: The Common Information Model (CIM), which provides an abstract model for a complete power system using Unified Modelling Language (UML) notation. The CIM is part of the overall EMS-API framework. The CIM specifies the semantics for system interfaces (i.e., the meaning of information passed over the interface).
- b) Part 4XX: The Component Interface Specifications (CIS), which specify profiles for interfaces needed in specific business contexts as identified by use cases. The profiles define a restricted subset of the CIM information model needed to support the information content exchanged over the interface. The services needed for the information exchange are provided by existing standards, such as the IEC 62541 OPC Unified Architecture series of standards.
- c) Part 5XX: Message/file assembly and implementation technologies for serialization of the data passed over an interface. These standards provide the syntax for information exchanges (i.e., "how" information is passed to/from an application independent of the underlying communications infrastructure) to ensure interoperability between different vendor products.

3.6.2 Common information model (CIM)

The CIM is an abstract model that represents all the major objects in an electric utility enterprise. This model includes public classes and attributes for these objects, as well as the relationships between them.

Many aspects of the power system of concern to TC 57 are modelled only in the CIM, such as generation equipment, generation dynamics, schedules, energy schedules, financial objects, reservations, and the topology for electrically connecting equipment. Other parts of the power system are modelled in both the CIM and in the IEC 61850 standards produced by WG10, such as substation equipment including transformers, switches, breakers, etc.

The comprehensive CIM is partitioned into several packages for convenience. IEC 61970-301 defines a base set of packages which provide a logical view of the physical aspects of EMS information, including the core, topology, wires, outage, protection, SCADA, measurements, load model, generation, and domain. The IEC 61968 series of standards from WG14 (described later) extend the CIM to include many additional packages modelling different aspects of utility operations, such as assets, consumers, documentation, and distribution systems. The IEC 62325 series of standards from WG16 further extends the CIM to include market operations, reservations, financial, and energy scheduling for deregulated energy market communications.

3.6.3 Component interface specifications (CIS) for information exchange

The CIS series of standards specifies the profiles that a component (or application) should implement to exchange information with other components (or applications) and/or to access publicly available data in a standard way. The profiles describe the specific properties (i.e., a restricted subset of the CIM) that are to be included in information exchanges between applications and/or systems.

The purpose of the CIS is to specify the interfaces that an application or system is to use to facilitate integration with other independently developed applications or systems. For message-based exchanges, the CIS specifies the profile (i.e., information content of the messages exchanged between two (or more) applications). This permits new applications to be developed with knowledge beforehand as to what and how information is available for processing and expected by receiving applications. For the integration of existing systems, the CIS enables a single adapter to be built for a given infrastructure technology independent of who developed the other systems.

For a specific type of application, it is necessary to define what object classes and attributes are exchanged as well as what interface is used. These object classes and attributes typically consist of subsets or views of the CIM object classes. In other words the CIM is used as the basis for “what” information is exchanged between applications and the CIS is used to define “how” data is exchanged between applications as well as defining specific data content for each message (i.e., the message payload).

The CIS (or profiles) in use today are primarily used to define the data content for interactions between systems, such as network model exchange between Transmission System Operators (TSOs) or between Independent System Operators/Regional Transmission Operators (ISO/RTOs) and distribution utilities. A series of profiles are planned for additional information exchanges, such as a SCADA database or planning applications and a historical archive. Since the intent of the EMS-API standards is to define *interface standards* rather than to define *standard applications*, the scope of these CIS can best be understood by considering the list of typical application categories that will be supported by the EMS-API standards. The application categories include, but are not limited to, the following:

- SCADA,
- alarm processing,
- topology processing,
- network applications (e.g., state estimator, optimal power flow, etc.),
- load management,
- generation control,
- unit commitment,
- load forecast,
- energy/transmission scheduling,
- accounting settlements,
- maintenance scheduling,
- historical information system,
- external systems (e.g., distribution management systems (DMS), weather, wholesale power marketing, etc.),
- asset management.

3.6.4 IEC 61970 standards as an integration framework

Figure 4 illustrates the concept of an integration framework within a control centre based on the use of EMS-API standards. Application data is integrated via the component interfaces as

specified in the EMS-API CIS standards. The CIS can be used to solve not only application integration, but also the data integration required for data warehousing and content management. The actual middleware technology (referred to as a Component Execution System (CES) in Figure 4) used to interconnect the applications can be chosen by the system implementer from among the best of breed and is not the subject of the EMS-API standards. As long as the public appearance of the data at the component interface to the CES conforms to the CIM and CIS standards, any application that also conforms will be able to receive and interpret the data. The CIM thus provides the “common language” for information exchange and understanding between applications possibly developed independently by different vendors, creating a model-driven approach to integration for utilities as described earlier.

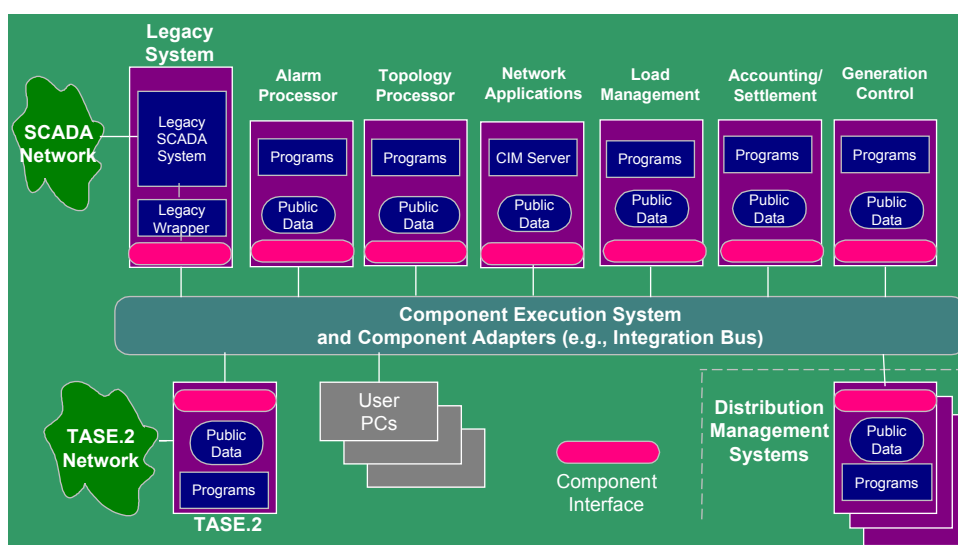


Figure 4 – EMS-API standards as an integration framework

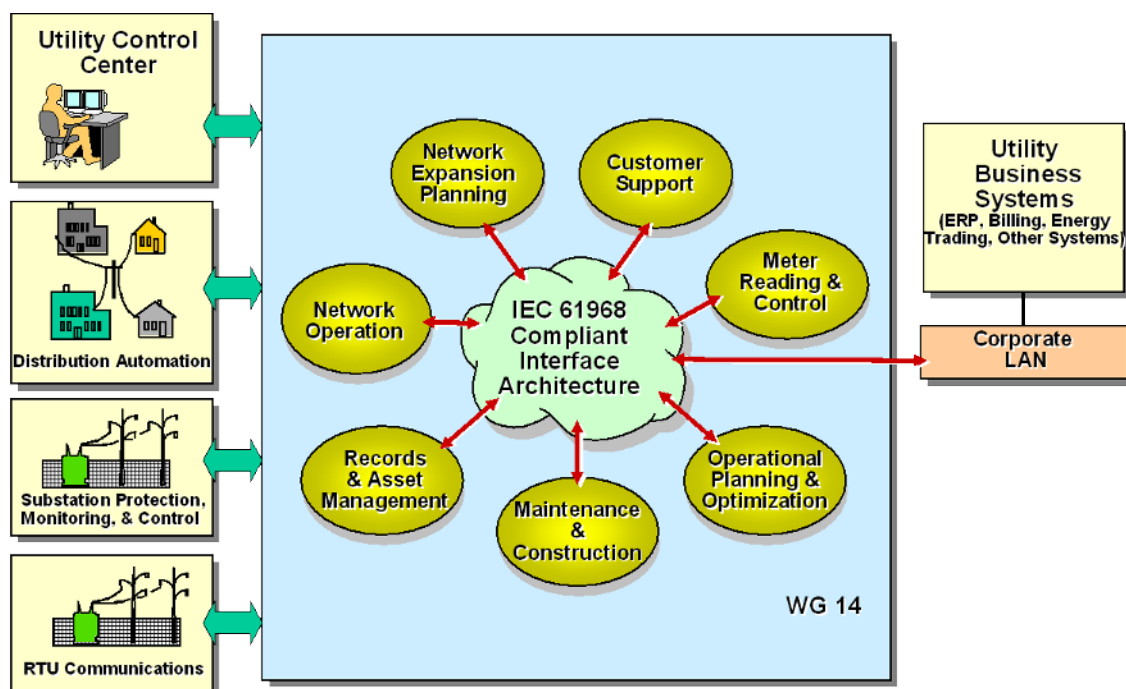
IEC 2052/12

The EMS-API standard requires that any data presented at the interface comply with the standard regarding semantics and syntax, so that any application that wants to receive data from another application should conform to the CIM standards. For SCADA data, for example, this means that a transformation shall be made from the data representation of the protocol used to acquire the data to the CIM representation and the SCADA CIS, which employs an HSDA service interface, should be used for data exchange with other applications.

3.7 IEC 61968 system interfaces for distribution management standards from WG14

WG14 was formed shortly after WG13 to address the need for standards for System Interfaces for Distribution Management Systems (SIDMS). The IEC 61968 series is intended to facilitate inter-application integration of the various distributed software application systems supporting the management of utility electrical distribution networks. These standards define requirements, integration architecture, and interfaces for the major elements of a utility's Distribution Management System (DMS) and other associated external IT systems. Examples of DMS include asset management systems, work order management systems, geographic information systems, customer information systems, while customer resource management is an example of an external IT system interface. The message-based technology used to mesh these applications together into one consistent framework is commonly referred to as

Enterprise Application Integration (EAI); IEC 61968 series guides the utility's use of EAI. Figure 5 clarifies the scope of IEC 61968-1 graphically in terms of business functions.



IEC 2053/12

Figure 5 – Distribution management system with IEC 61968 compliant interface architecture

Standard interfaces are being defined for each class of applications identified in the IEC 61968-1 Interface Reference Model (IRM), as shown in Figure 6 below. A series of normative CIM-based XML message payloads have been and are being defined for each Part identified in the yellow boxes to ensure interoperability between the systems that provide the functionality shown in the green and magenta boxes. In addition to these Parts, the IEC 61968 CIM is also being actively deployed for achieving the Smart Grid vision of interoperability from DMS systems to edge networks and networks. For example, message payloads based on the CIM are being defined for demand response applications as well as Zigbee Smart Energy (SE) profiles for home and building automation.

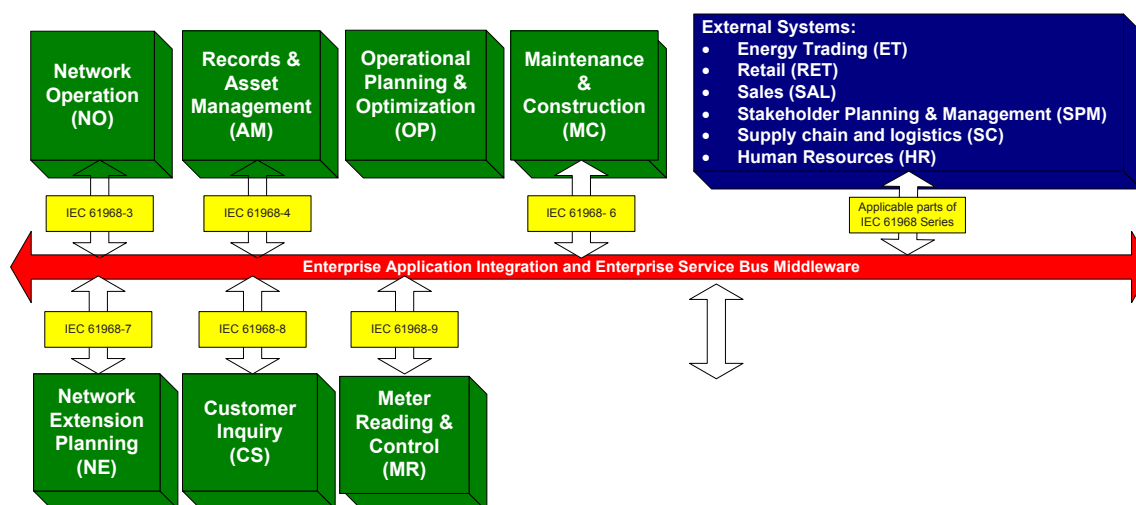


Figure 6 – IEC 61968 Interface Reference Model (IRM)

WG14 is using the Unified Modelling Language (UML) to define additional Real World Objects (RWO) classes in the CIM that are relevant to inter-application information exchange in the distribution domain. The resulting CIM classes (specified in both IEC 61970-301 and IEC 61968-11) govern the semantics used in message types being defined for the Information Exchange Model (IEM), which is to be included in IEC 61968-3 to IEC 61968-9.

XML is a data format for structured document interchange particularly on the Internet. One of its primary uses is information exchange between different and potentially incompatible computer systems. XML is thus well-suited to the domain of system interfaces for distribution management. Therefore, where applicable, IEC 61968-3 to IEC 61968-9 will define document structures in XML. In addition to close cooperation with WG13, WG14 is also working collaboratively with the OAG to improve utilities' ability to integrate between T&D applications (IEC TC 57 domain) & Enterprise Resource Planning (ERP) applications (OAG domain). OAG message exchange is defined using XML.

As described above, WG14 is basing their standards on the same CIM as WG13, with extensions specifically needed for the distribution systems addressed in WG14. Thus WG14 and WG13 are both using the CIM for inter-application information exchange and building an IEM as needed to define the specific semantics and syntax for these exchanges.

Note that the use of object modelling techniques internal to each of the applications/systems integrated with either WG13 or WG14 standards is not a requirement or an issue here. It is only relevant for describing data at the interface that is to be shared. Thus the CIM is the canonical language for semantics and syntax on the network interconnecting applications/systems.

3.8 IEC 62351 standards for data and communications security from WG15

3.8.1 General

WG15 is chartered with undertaking the development of standards for security of the communication protocols defined by IEC TC 57, specifically the IEC 60870-5 series, the IEC 60870-6 series, the IEC 61850 series, the IEC 61970 series, and the IEC 61968 series, as well as undertaking the development of standards and/or technical reports on end-to-end security issues.

The interrelationship of these security standards and the protocols are illustrated in Figure 7.

IEC 62351 Security Standards

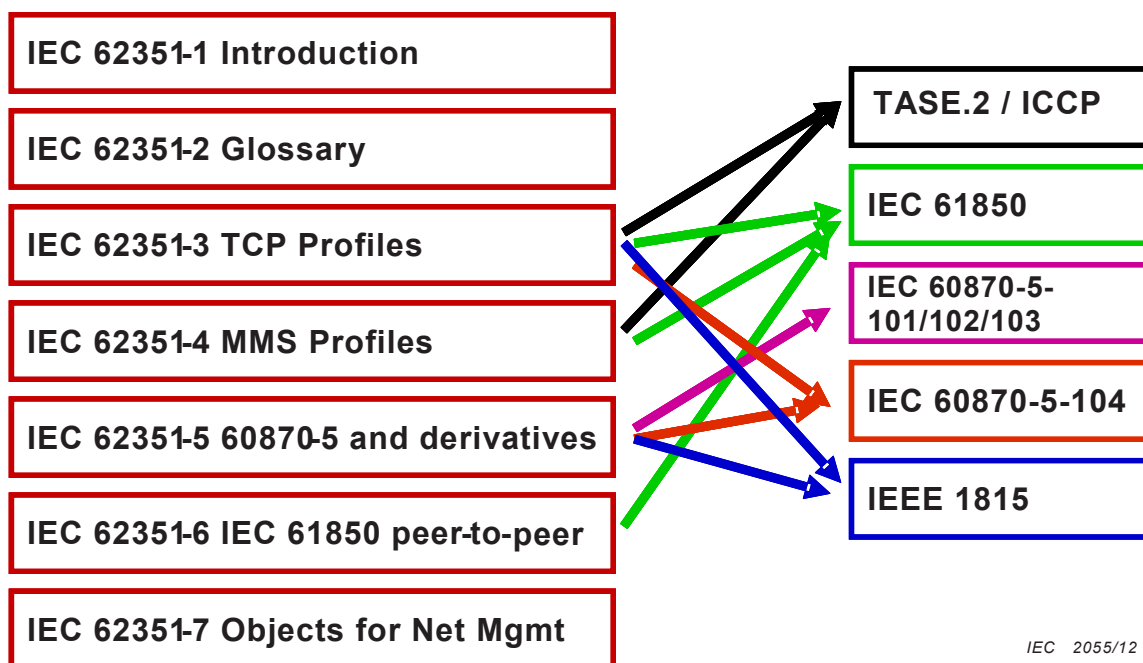


Figure 7 – Interrelationship of IEC 62351 security standards and the TC 57 protocols

3.8.2 Security for TCP/IP-based profiles

IEC 62351-3 provides security for any profile that includes TCP/IP. Rather than re-inventing the wheel, it specifies the use of TLS which is commonly used over the Internet for secure interactions, covering authentication, confidentiality, and integrity. This part describes the parameters and settings for TLS that should be used for utility operations.

Specifically, IEC 62351-3 protects against eavesdropping through TLS encryption, man-in-the-middle security risk through message authentication, spoofing through security certificates (node authentication), and replay, again through TLS encryption. However, TLS does not protect against denial of service. This security attack should be guarded against through implementation-specific measures.

3.8.3 Security for MMS ISO 9506

IEC 62351-4 provides security for profiles that include MMS, including IEC 60870-6 (TASE.2) and IEC 61850. It primarily works with TLS to configure and make use of its security measures, in particular, authentication (i.e., the two entities interacting with each other are who they say they are).

It also allows both secure and non-secure profiles to be used simultaneously, so that not all systems need to be upgraded with the security measures at the same time.

3.8.4 Security for IEC 60870-5 and derivatives

IEC 62351-5 provides different solutions for the serial version of IEC 60870-5 (i.e., IEC 60870-5-101) and for the networked versions (IEC 60870-5-104 and IEEE 1815).

Specifically, the networked versions that run over TCP/IP can utilize the security measures described in IEC 62351-3, which includes confidentiality and integrity provided by TLS encryption. Therefore, the only additional requirement is authentication.

The serial version is usually used with communications media that can only support low bit rates or with field equipment that is compute-constrained. Therefore, TLS would be too compute-intense and/or communications-intense to use in these environments. Therefore, the only security measures provided for the serial version include some authentication mechanisms which address spoofing, replay, modification, and some denial of service attacks, but do not attempt to address eavesdropping, traffic analysis, or repudiation that require encryption. These encryption-based security measures could be provided by alternate methods, such as Virtual Private Networks (VPNs) or “bump-in-the-wire” technologies, depending upon the capabilities of the communications and equipment involved.

3.8.5 Security for IEC 61850 peer-to-peer profiles

IEC 61850 contains three protocols that are peer-to-peer multicast datagrams on a substation LAN and are not routable. The messages need to be transmitted within 4 ms, so encryption or other security measures which affect transmission rates are not acceptable. Therefore, authentication is the only security measure included, so IEC 62351-6 provides a mechanism that involves minimal compute requirements for these profiles to digitally sign the messages.

The different communication profiles of IEC 61850 require security enhancements to ensure that they can be implemented and used in non-secure environments:

- a) client/server, which will specify security primarily through TLS and MMS, but may include additional security measures such as VPNs,
- b) GOOSE – analogue and digital multicast,
- c) GSSE – digital only multicast, MMS involved,
- d) GSE management,
- e) SMV.

3.8.6 Management Information Base (MIB) requirements for end-to-end network management

In addition to security standards for SCADA protocols, standards are also being developed to provide end-to-end security, which involves security policies, access control mechanisms, key management, audit logs, and other critical infrastructure protection issues. To this end, the plan is to develop Management Information Base (MIBs) for the power system operational environment. These MIBs would reflect what information is needed to manage the information infrastructure as reliably as the power system infrastructure is managed. Figure 8 and Figure 9 illustrate this concept.

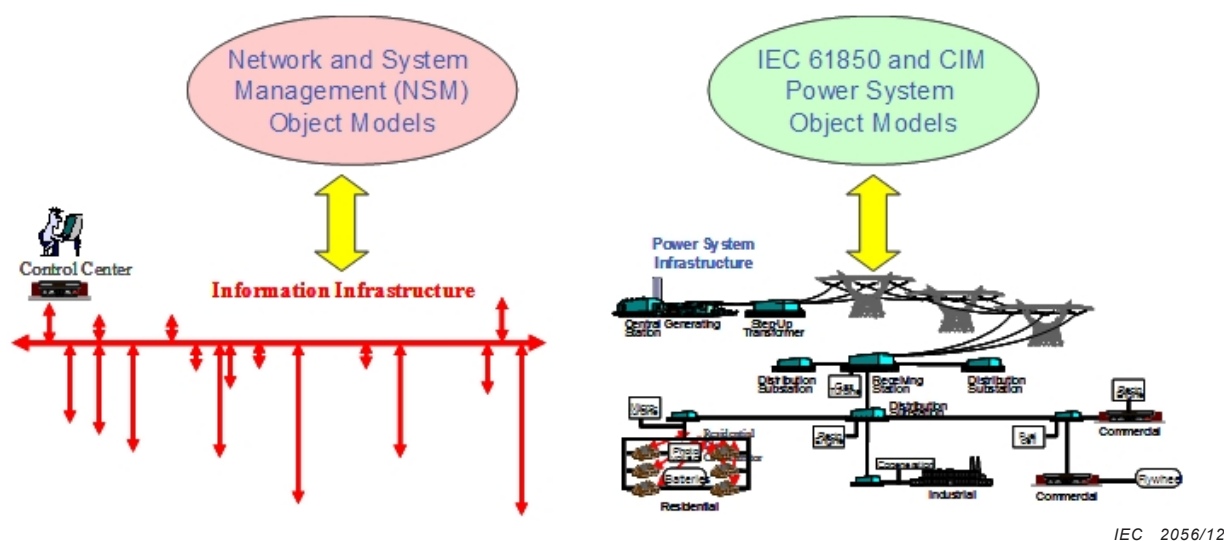


Figure 8 – Management of two infrastructures

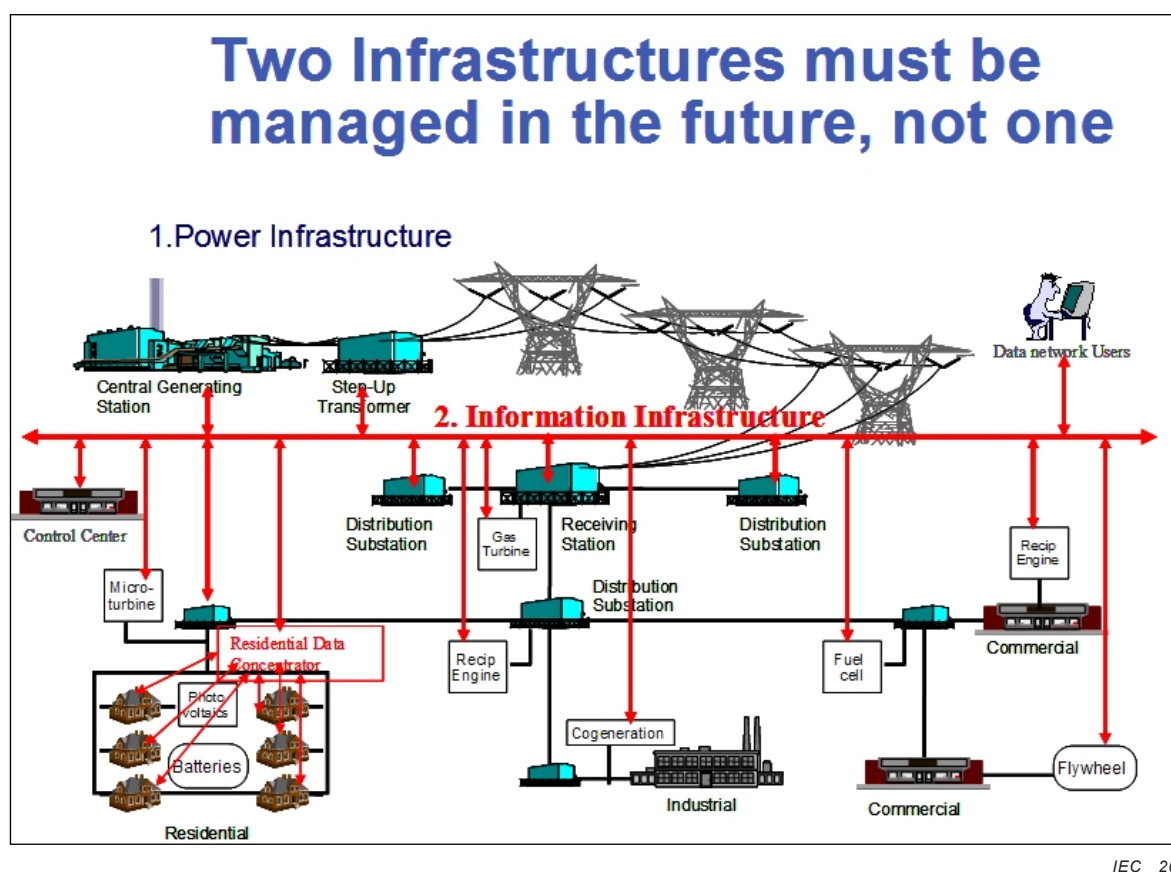


Figure 9 – Information infrastructure underlying power infrastructure

Once the information management requirements are defined, they can be structured as abstract objects, and formatted as standardized Management Information Base (MIBs) to be compliant with information industry (i.e. IETF's Simple Network Management Protocol (SNMP)) standards. The ISO CMIP and the IETF SNMP standards for network management rely on Management Information Base (MIB) data to monitor the health of networks. MIB data, which can be mapped to IEC 61850, IEC 60870-5, or IEC 60870-6 for power system

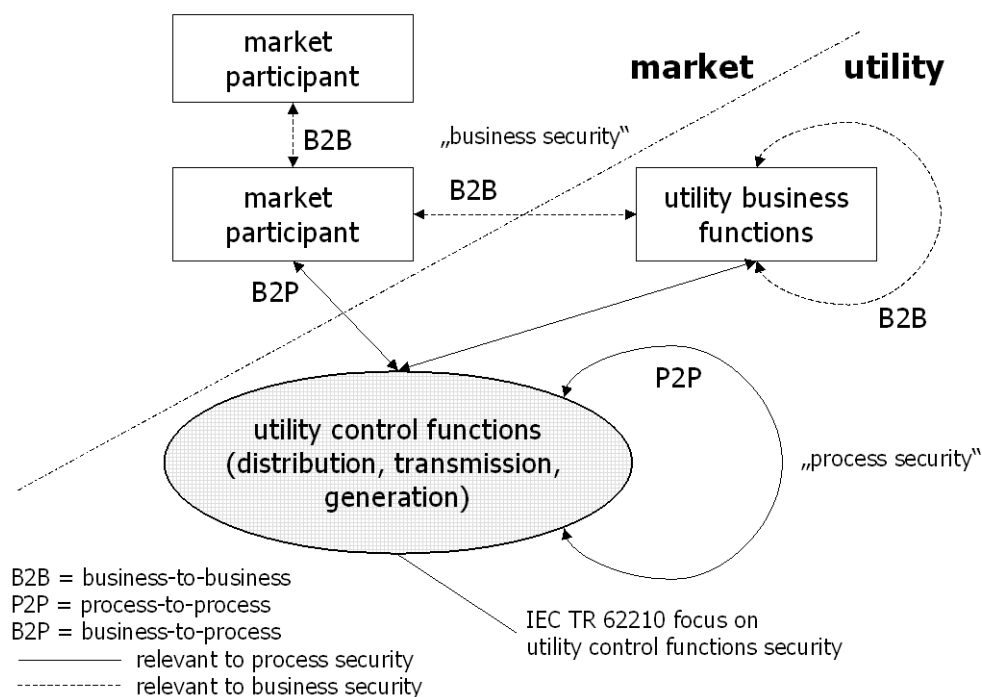
operations, should be developed to support utility networks. This uses a broader definition of security, with the concept that network management is a key component of end-to-end security.

The primary purpose of the WG15 MIB development effort is to define what information is needed to manage the power industry operations information infrastructure as reliably as the power system infrastructure is managed, and to develop standardized MIBs for power industry operations. Two types of MIBs are planned:

- MIBs for network management focused on the detection of security violations and/or intrusions in communications networks used for power system operations,
- MIBs for end devices or systems used in power system operations. These include information on the status of the systems, applications within the systems, devices, etc.

3.9 IEC 62325 standards for a framework for deregulated energy market communications from WG16

This working group is chartered with developing a framework for deregulated energy market communications with a focus on the interface between utilities and the energy market (see Figure 10).



IEC 2058/12

Figure 10 – Framework for deregulated energy market communications

With the transition of monopoly energy supply structures to deregulated energy markets the function of the markets depends heavily on seamless e-business communication between market participants. Compared with global e-business, e-business in the energy market is only a small niche. Today EDIFACT or X12 messages, or propriety HyperText Markup Language (HTML) and XML solutions based on Internet technologies are being used. With the advent of new e-business technologies such as ebXML by UN/CEFACT (United Nations / Centre for trade and electronic business) together with OASIS (Organization for the advancement of structured information standards), and Web services by W3C, an energy market specific profile of these standards can be used for regional energy markets. This profile allows the re-use of proven core components and communication platforms across markets, thus saving cost and implementation time. Because some of these technologies are still developing, other technologies or converged technologies are not excluded for the future.