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Application integration at electric utilities – System interfaces for distribution management –

Part 1: Interface architecture and general recommendations

Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution –

Partie 1: Architecture des interfaces et recommandations générales



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APPLICATION INTEGRATION AT ELECTRIC UTILITIES – SYSTEM INTERFACES FOR DISTRIBUTION MANAGEMENT –

Part 1: Interface architecture and general recommendations

FOREWORD

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International Standard IEC 61968-1 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) update of IRM table which has been out of date since the 1st edition;
- b) addition of missing Advanced Metering Infrastructure (AMI) related functions;
- c) alignment with newly released documents from the technical committee;
- d) alignment with IEC 61968-100;
- e) update of annexes.

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

FDIS	Report on voting
57/1272/FDIS	57/1288/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.

A list of all parts in the IEC 61968 series, published under the general title *Application integration at electric utilities – System interfaces for distribution management*, 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- withdrawn,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.

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INTRODUCTION

IEC 61968 is a series of standards:

IEC 61968 part	Title
1	Interface architecture and general recommendations
2	Glossary
3	Interface for network operation
4	Interface for records and asset management
5	Interface standard for operational planning and optimisation ¹
6	Interface for maintenance and construction ²
7	Interface standard for network extension planning ³
8	Interface standard for customer support ⁴
9	Interface for meter reading and control
11	Common information model (CIM) extensions for distribution
13	CIM RDF model exchange format for distribution
100	Implementation profiles ⁵

The IEC 61968 series is intended to facilitate inter-application integration, as opposed to intra-application integration of the various distributed software application systems supporting the management of utility electrical distribution networks. Intra-application integration is aimed at programs in the same application system, usually communicating with each other using middleware that is embedded in their underlying runtime environment. Additionally the intra-application integration tends to be optimized for close, real-time, synchronous connections and interactive request/reply or conversation communication models. IEC 61968 series by contrast, is intended to support the inter-application integration of a utility enterprise that needs to connect disparate applications that are already built or new (legacy or purchased applications) each supported by dissimilar runtime environments. Therefore, IEC 61968 series is relevant to loosely coupled applications with more heterogeneity in languages, operating systems, protocols, and management tools. IEC 61968 series is intended to support applications that need to exchange data on an event driven basis. IEC 61968 series is also intended to be implemented with middleware services that broker messages among applications and complementing, but not replacing, utility data warehouses, database gateways, and operational stores.

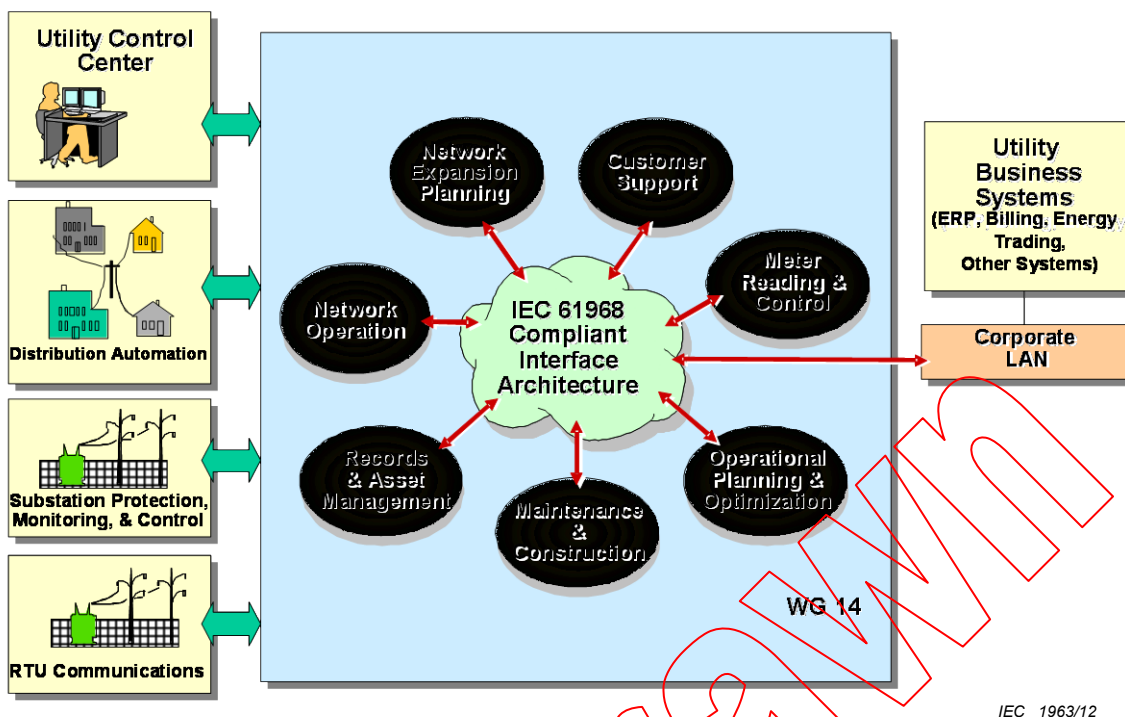
¹ Under consideration.

² Under consideration.

³ Under consideration.

⁴ Under consideration.

⁵ Under consideration.



IEC 1963/12

Figure 1 – Distribution management with IEC 61968 compliant interface architecture

Figure 1 clarifies the scope of IEC 61968-1 graphically in terms of business functions and shows distribution management with IEC 61968 compliant interface architecture.

As used in IEC 61968 series, distribution management consists of various distributed application components for the utility to manage electrical distribution networks. These capabilities include monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping and facilities management. The distribution management system could also be integrated with premise area networks (PAN) through an advanced metering infrastructure (AMI) network. Standard interfaces are to be defined for each class of applications identified in Clause 3, Interface Reference Model (IRM), except for those in the group EXT (External to DMS – distribution management system).

In the distribution management domain it is important to keep in mind the basic meaning of the following terms:

- management: effective regulation and direction;
- automation: working without human participation in accordance with pre-defined rule sets;
- system: a set of organized operations working to support a particular activity (set of applications). Generally, a system in the context of this work is a computer based technology.

In the world of integrated systems, systems can also be a subset of a larger system, a system of systems or a set of federated systems. A system composed of coordinating subsystems may support activities more efficiently than the subsystems operating independently.

As the size of an organisation increases so does the complexity of the tasks and information exchange associated with the tasks. Furthermore, the deeper the data structure is within a system the less transparent it is to the end user. This suggests the need for data stewardship to avoid:

- errors arising from multiple points of data entry;

- lack of consistency with software interfaces;
- expensive changes with new or upgraded software;
- loss of governance of authorised data.

The standardisation of data facilitates the reduction of errors, reduced time for data entry, and improved process control.

IEC 61968 series recommends that the semantics (domain model) of system interfaces of a compliant utility inter-application infrastructure be defined using Unified Modelling Language (UML).

The Extensible Markup Language (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 recommended to define grammar/syntax (profiles) of a compliant utility inter-application infrastructure.

Where applicable, IEC 61968-3 to -9 and -13 of this standard will define the information recommended for 'message payloads'. Message Payloads will be formatted using XML, with structures defined using XML Schema (IEC 61968-3 to -9) or RDF Schema (IEC 61968-13) with the intent that these payloads can be loaded on to messages of various messaging transports, such as SOAP, JMS, RESTful HTTP, or Web Services (WS). It is the intent of IEC 61968 series to be leveraged by Service-Oriented Architectures (SOA) and to encourage the usage of Enterprise Service Buses (ESB). In the future, it is possible that payload formats other than XML could be officially adopted by IEC 61968 series for specific parts or information exchanges.

Communication between application components of the IRM requires compatibility on two levels:

- message formats and protocols;
- message contents are mutually understood, including application-level issues of message layout and semantics.

Clause 5 defines abstract middleware services recommended to support communication between the applications defined in the IRM. These services are intended to be deployed, with little additional software required, by mapping them to commonly available services from various messaging technologies including Web services (WS-*) and middleware such as Message Brokers, Message Oriented Middleware (MOM), Message-Queuing Middleware (MQM), and Enterprise Service Buses (ESB). Clause 5 is organized as follows:

- Subclause 5.1 provides overview of interface profile.
- Subclause 5.2 identifies general recommendations of the applications identified in the IRM.
- Sub-clause 5.3 describes component adapters.
- Subclause 5.4 describes interface specification recommendations.
- Subclause 5.5 describes how information exchange services may either be supported directly by middleware or that software may be required to map (adapt) the utility's middleware services to the standard information exchange services.
- Subclauses 5.6 to 5.8 describe environmental recommendations for information exchange.

An example of a typical utility's implementation of IEC 61968 series is provided in Figure 2. In this example, the utility has used interface adapters as a means to integrate many of its legacy systems with other application systems that are IEC 61968 compliant. Note those legacy systems and IEC 61968 compliant systems both continue to use proprietary integration techniques among their internal applications; only information that needs to be exchanged among applications at the utility enterprise level is expected to use IEC 61968 interface services.

For purposes of this example, it is assumed that the utility's Outage Management System (OMS) already has the capability to issue controls to and gather device states from the Distribution Automation system. As it is working acceptably for the utility, this interface does not need to be changed. However, because other applications need to be notified when distribution devices change state, the Distribution Automation system publishes state changes through middleware services. Another benefit of publishing events is that they can be recorded by an event history application in a data store; this data can then be used in the generation of various types of reports. As much of the information exchanged among these systems is useful for management decision support, a data warehouse application has also been connected to the IEC 61968 middleware services so that it may receive published information.

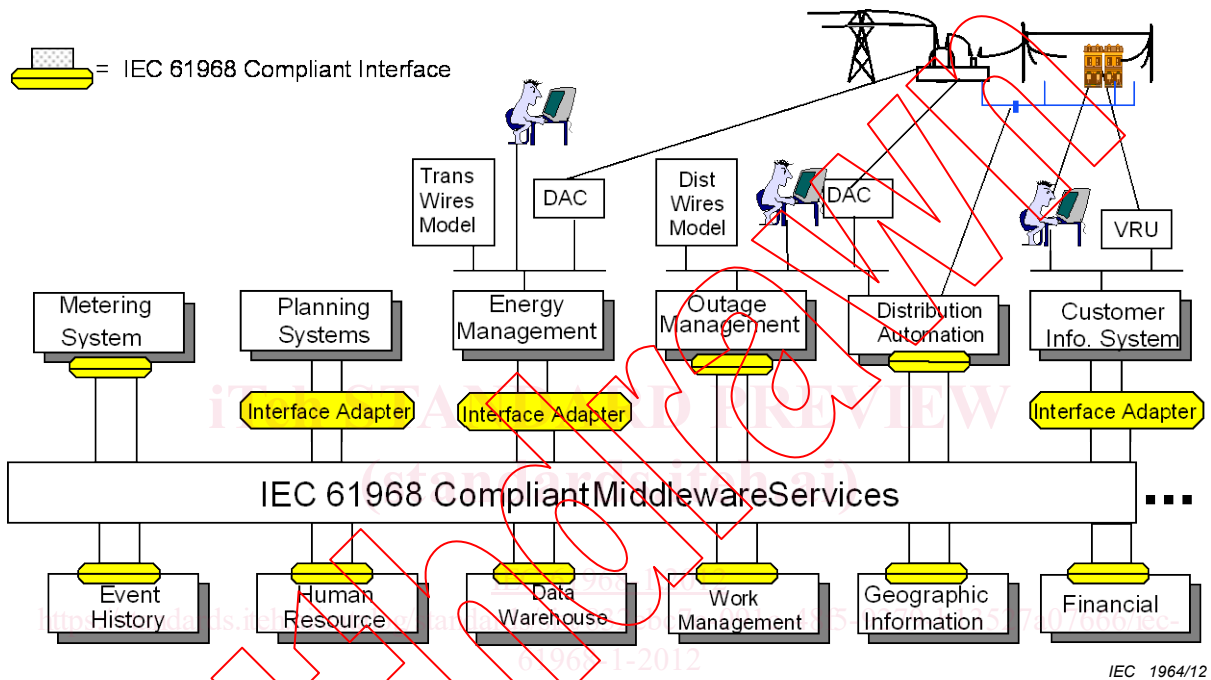


Figure 2 – Example utility implementation of IEC 61968

The organization of IEC 61968-1 is described in Table 1.

Table 1 – Document overview for IEC 61968-1

Clause	Title	Purpose
1.	Scope	Scope of IEC 61968-1.
2.	Normative references	Documents that contain provisions which, through reference in this text, constitute provisions of this International Standard.
3.	Interface reference model	The domain relevant to IEC 61968 series is described. For each relevant business function, a list of abstract components is provided, which is described by the functions performed by the component. Parts IEC 61968-3 to -9 define interfaces for these abstract components.
4.	Integration infrastructure recommendations	Utility inter-application infrastructure recommendations to integrate components distributed throughout the enterprise.
5.	Interface profile	Utility inter-application integration environmental requirements are described. Abstract message passing services are defined and are available for applications to communicate information to other applications, including publish and subscribe services.
6.	Information exchange model	Requirements and recommendations are provided for information exchange between applications/functions listed in the IRM.
7.	Component reporting and error handling	Recommendations for audit trails and error message handling authentication necessary to support utility inter-application integration are described.
8.	Security and authentication	Recommendations for security and authentication necessary to support utility inter-application integration are described.
9.	Maintenance aspects	General maintenance recommendations are specified.
Informative Annex A	Use of IEC 61968 series	The methodology used to determine interface architecture recommendations for utility inter-application integration is described.
Informative Annex B	Inter-application integration performance considerations	Some typical performance recommendations necessary to support utility inter-application integration are described. These recommendations are of a general nature as specific implementation requirements will vary by utility.
Informative Annex C	Views of data in a conventional electric utility	This annex describes some of the underlying principles of defining the reference data dictionary of IEC 61968-11.

APPLICATION INTEGRATION AT ELECTRIC UTILITIES – SYSTEM INTERFACES FOR DISTRIBUTION MANAGEMENT –

Part 1: Interface architecture and general recommendations

1 Scope

This Part of IEC 61968 series, is the first in a series that, taken as a whole, define interfaces for the major elements of an interface architecture for distribution management.

This International Standard identifies and establishes recommendations for standard interfaces based on an Interface Reference Model (IRM). Subsequent clauses of this standard are based on each interface identified in the IRM. This set of standards is limited to the definition of interfaces. They provide for interoperability among different computer systems, platforms, and languages. Methods and technologies used to implement functionality conforming to these interfaces are recommended in IEC 61968-100.

As used in IEC 61968, distribution management consists of various distributed application components for the utility to manage electrical distribution networks. These capabilities include monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping, facilities management, and metering. The IRM is specified in Clause 3.

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 61968-3, *Application integration at electric utilities – System interfaces for distribution management – Part 3: Interface for network operation*

IEC 61968-9, *Application integration at electric utilities – System interfaces for distribution management – Part 9: Interface for meter reading and*

IEC 61968-11, *Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution*

IEC 61968-13, *Application integration at electric utilities – System interfaces for distribution management – Part 13: CIM RDF model exchange format for distribution*

IEC 61970-301, *Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base*

3 Interface reference model

3.1 Domain

Within this standard, the distribution management domain covers all aspects of management of utility electrical distribution networks. A distribution utility will have some or all of the responsibility for monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management,

outage management, work management, automated mapping, facilities management, and metering.

The distribution management domain may be organised as two inter-related types of business, electricity supply and electricity distribution. Electricity supply is concerned with the purchase of electrical energy from bulk producers for sale to individual consumers. Electricity distribution covers the management of the physical distribution network that connects the producers and consumers. In some countries, the responsibility of organisations may be legally restricted and certain sections of the standard will be inapplicable.

A utility domain includes the software systems, equipment, staff and consumers of a single utility organisation, which could be a company or a department. It is expected that within each utility domain, the systems, equipment, staff and consumers can be uniquely identified. When information is exchanged between two utility domains, then identifiers may need extending with the identity of the utility organisation in order to guarantee global uniqueness.

3.2 Business functions

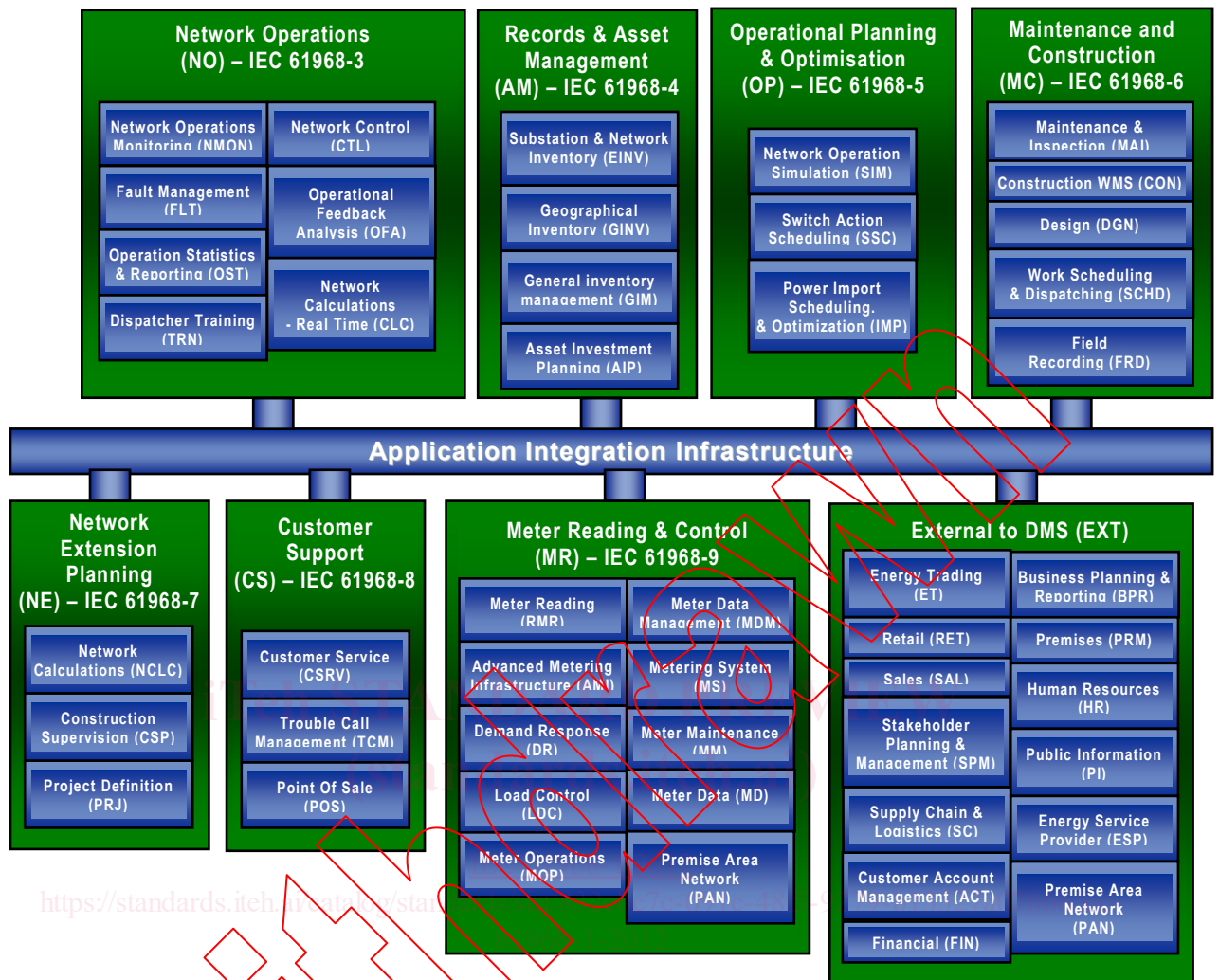
Various departments within a utility co-operate to perform the operation and management of a power distribution network; this activity is termed distribution management. Other departments within the organisation may support the distribution management function without having direct responsibility for the distribution network. This segmentation by business function⁶ is provided in the Interface Reference Model (IRM), which is described in detail in 3.3.

The use of a business-related model should ensure independence from vendor-produced system solutions. It is an important test of the viability of this standard that the IRM be recognisable to utility staff as a description of their own distribution network operation and management.

Major utility business functions and sub-functions of the IRM are shown in Figure 3.

<https://standards.iteh.org/standards/sst/62-90bc7c-091c-48f5-9279-b13527a07666/iec-61968-1-2012>

⁶ The work of the CIRED Working Group on Distribution Automation, published in 1996, is fully acknowledged in the segmentation.



IEC 1965/12

Figure 3 – Typical functions mapped to interface reference model

3.3 Interface reference model

It is not the intention of this standard to define the applications and systems that vendors should produce. It is expected that a concrete (physical) application will provide the functionality of one or more abstract (logical) components as listed in this standard. These abstract components are grouped by the business functions of the IRM.

In this standard, the term abstract component is used to refer to that portion of a software system that supports one or more of the interfaces defined in IEC 61968-3 to 9 and 13. It does not necessarily mean that compliant software is delivered as separate modules.

In this subclause, the definitions of business functions introduced in 3.2 are further extended into:

- sub-business functions (second column);
- abstract components (third column).

Some abstract components may be used by several different business functions. For example, a component like power flow can be used for network operation, short term operational planning and optimisation, and long term network extension planning. Much of the information exchanged for power flow purposes in each of these areas will therefore use many of the same information exchange message types (refer to Clause 6).