# INTERNATIONAL STANDARD

# IEC 61968-1

First edition
2003-10



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

## Part 1: Interface architecture and general requirements



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# CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

## Part 1: Interface architecture and general requirements

## FOREWORD

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International Standard IEC 61968-1 has been prepared by IEC technical committee 57: Power system control and associated communications.

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

| FDIS | Report on voting |
|---|---|
| 57/650/FDIS | 57/668/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.

IEC 61968 consists of the following parts under the general title *Application integration at electric utilities – System interfaces for distribution management*:

Part 1: Interface architecture and general requirements

Part 2: Glossary[1]

Part 3: Interface standard for network operations[1]

Part 4: Interface standard for records and asset management[1]

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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- withdrawn;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



[1] Under consideration.

# INTRODUCTION

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, and tends to be optimized for close, real-time, synchronous connections and interactive request/reply or conversation communication models. IEC 61968, 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 is relevant to loosely coupled applications with more heterogeneity in languages, operating systems, protocols and management tools. IEC 61968 is intended to support applications that need to exchange data on an event driven basis. IEC 61968 is intended to be implemented with middleware services that broker messages among applications, and will complement, but not replace utility data warehouses, database gateways, and operational stores.

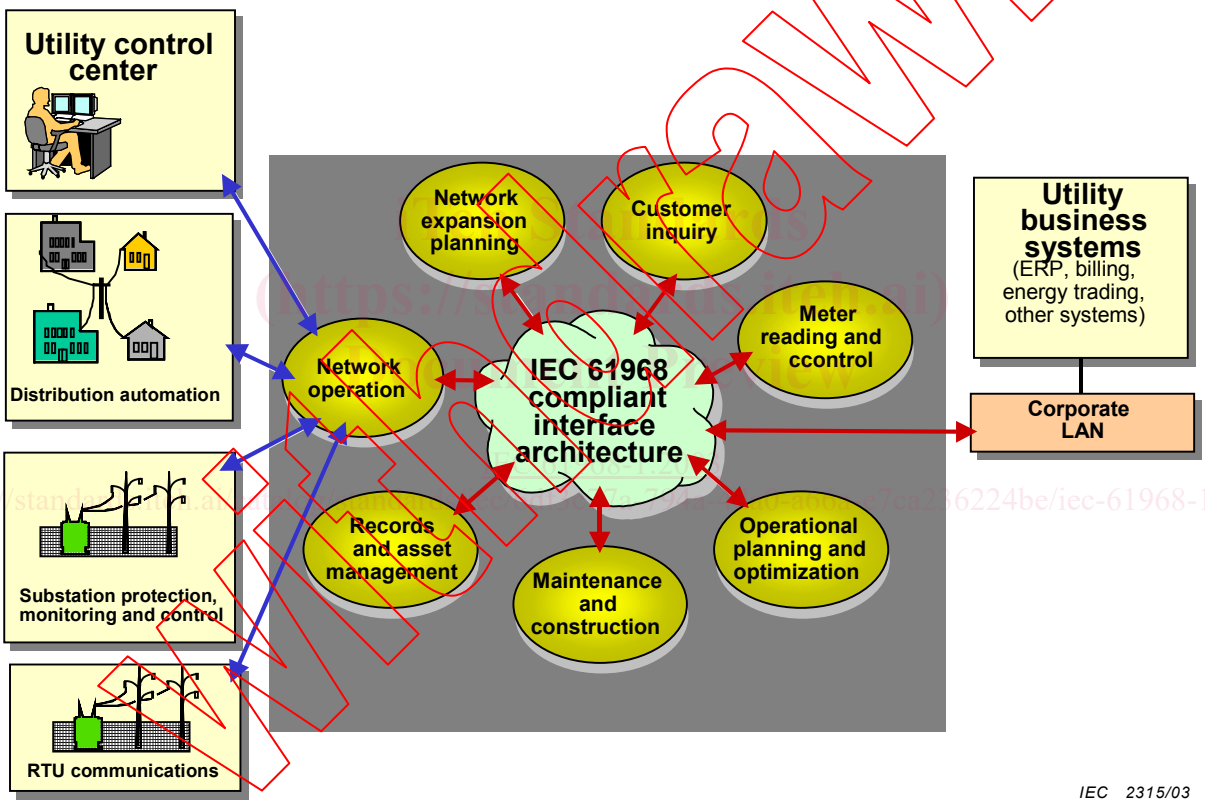


**Figure 1 – Distribution management system with IEC 61968 compliant interface architecture**

Figure 1 clarifies the scope of IEC 61968-1 graphically in terms of business functions and shows a Distribution Management System with IEC 61968 compliant interface architecture.

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

## Part 1: Interface architecture and general requirements

## 1 Scope

This part of IEC 61968 is the first in a series that, taken as a whole, defines interfaces for the major elements of an interface architecture for Distribution Management Systems (DMS). This part of IEC 61968 identifies and establishes requirements for standard interfaces based on an Interface Reference Model (IRM). Subsequent parts of this standard are based on each interface identified in the IRM. This set of standards is limited to the definition of interfaces and is implementation independent. They provide for interoperability among different computer systems, platforms, and languages. Methods and technologies used to implement functionality conforming to these interfaces are considered outside of the scope of these standards; only the interface itself is specified in the IEC 61968 series.

As used in the IEC 61968 series, a DMS 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 IRM is specified in Clause 4.

## 2 General

### 2.1 Overview of the IEC 61968 series

As used in IEC 61968, a DMS (Distribution Management System) 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. Standards interfaces are to be defined for each class of applications identified in the Interface Reference Model (IRM), which is described in Clause 4.

IEC 61968 recommends that 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 well-suited to the domain of system interfaces for distribution management.

Where applicable, future parts of the IEC 61968 series will define the information required for ‘message payloads’. Message Payloads will be formatted using XML with the intent that these payloads can be loaded on to messages of various messaging transports, for example OAG, SOAP (Simple Object Access Protocol), etc. The XML encoding rules will be covered in a future part of the IEC 61968 series.

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

- Message formats and protocols.
- Message contents must be mutually understood, including application-level issues of message layout and semantics.

Clause 5 defines abstract middleware services required 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 middleware such as message brokers, Message Oriented Middleware (MOM), Message-Queuing Middleware (MQM), and Object Request Brokers (ORBs). This clause is organized as follows:

- Subclause 5.1 identifies general requirements of the applications identified in the IRM.
- Subclause 5.2 describes how standard information exchange services may either be invoked directly from an application (native mode) or that software may be used to map (adapt) an application to the information exchange services.
- Subclause 5.3 identifies standard services required for applications to exchange information with other applications.
- Subclause 5.4 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 5.5 to 5.7 describe environmental requirements for information exchange.

### 2.2 An example using the IEC 61968 series

An example of a typical utility's implementation of the IEC 61968 series is provided in Figure 2. In this example, the utility has used interface adapters as a means of integrating many of its legacy systems with other application systems that are IEC 61968 compliant. Note those legacy systems and IEC 61968 series 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 series middleware services.

For the purposes of this example, the utility's Outage Management System (OMS) is assumed to already have the capability of issuing controls to and gathering device states from the Distribution Automation System (DAS). 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 DAS 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.

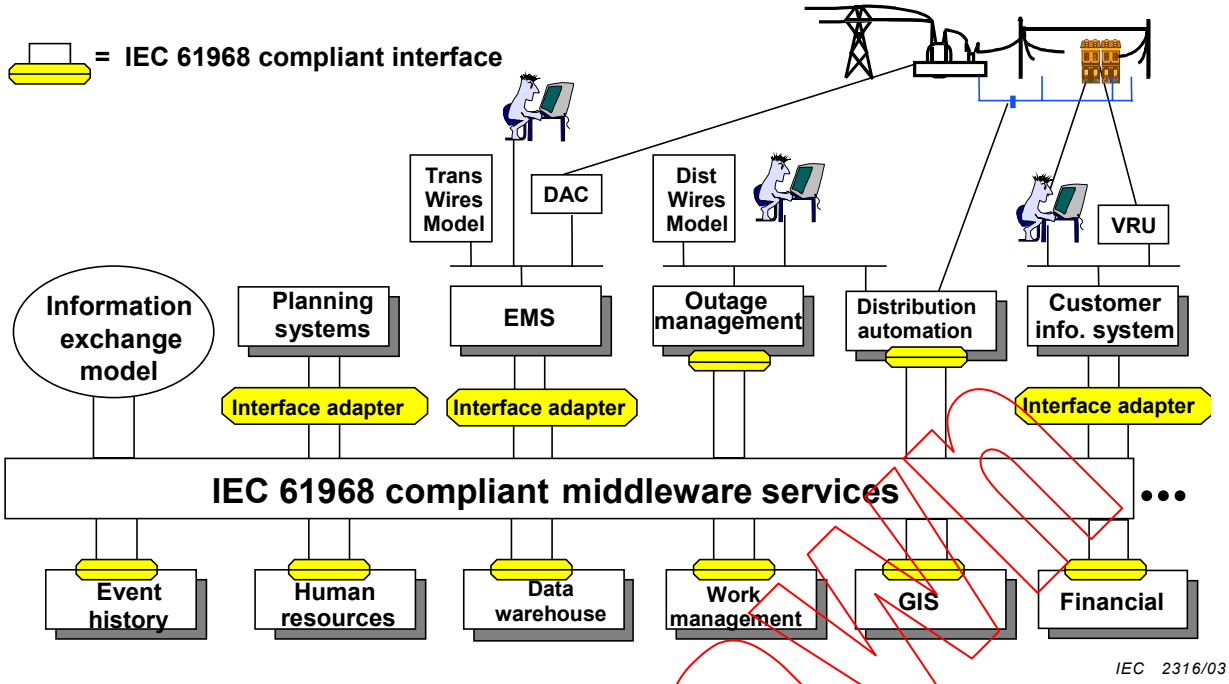


**Figure 2 – Example utility implementation of the IEC 61968 series**

## 2.3 Overview of IEC 61968-1

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, Part 1. |
| 2 | General | Overview and examples. |
| 3 | Interface reference model | The domain relevant to the 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. future parts of the IEC 61968 series will define interfaces for these abstract components. |
| 4 | Interface architecture | The interface reference model for utility inter-application integration is provided along with the rationale for its structure. |
| 5 | Interface profile | Utility inter-application integration environmental requirements are described. Abstract message passing services are defined that must be available for applications to communicate information to other applications, including publish and subscribe services. |
| 6 | Information exchange model | Metadata is used to describe event types that are published by applications. Applications subscribing to receive all messages for a certain event type recognize the fields of a particular event message once they have looked up the metadata for the event type in the information exchange model. While many event types are described in the IEC 61968 series, metadata is the means by which vendors and utilities can add new event types without violating this standard. |
| 7 | Component reporting and error handling | Requirements for audit trails and error message handling authentication necessary to support utility inter-application integration are described. |
| 8 | Security and authentication | Requirements for security and authentication necessary to support utility inter-application integration are described. |
| 9 | Maintenance aspects | General maintenance requirements are specified. |
| Annex A | Distribution management domain | An overview of business functions required for electric utility distribution management is described. |

| | | |
|---|---|---|
| Annex B | IEC 61968 series<br>Development process | The methodology used to determine interface architecture requirements for utility inter-application integration is described. |
| Annex C | Inter-application integration performance considerations | Some typical performance requirements necessary to support utility inter-application integration are described. These requirements are of a general nature as specific implementation requirements will vary by utility. |
| Annex D | Views of data in a conventional electric utility | This annex describes some of the underlying principles of defining the reference data dictionary of a future part of the IEC 61968 series. |
| Annex E | Business functions | This annex describes the typical data producer and consumer subsystems for each DMS business function. |

## 3 Interface reference model

### 3.1 Domain

Within this part of IEC 61968, 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 and facilities management.

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 IEC 61968 series 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 to be extended 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 function[2] 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, which provide the top level categories of the IRM, are shown in Figure 3 below.

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2 The work of the CIRED working group on distribution automation, published in 1996, is fully acknowledged in the segmentation.

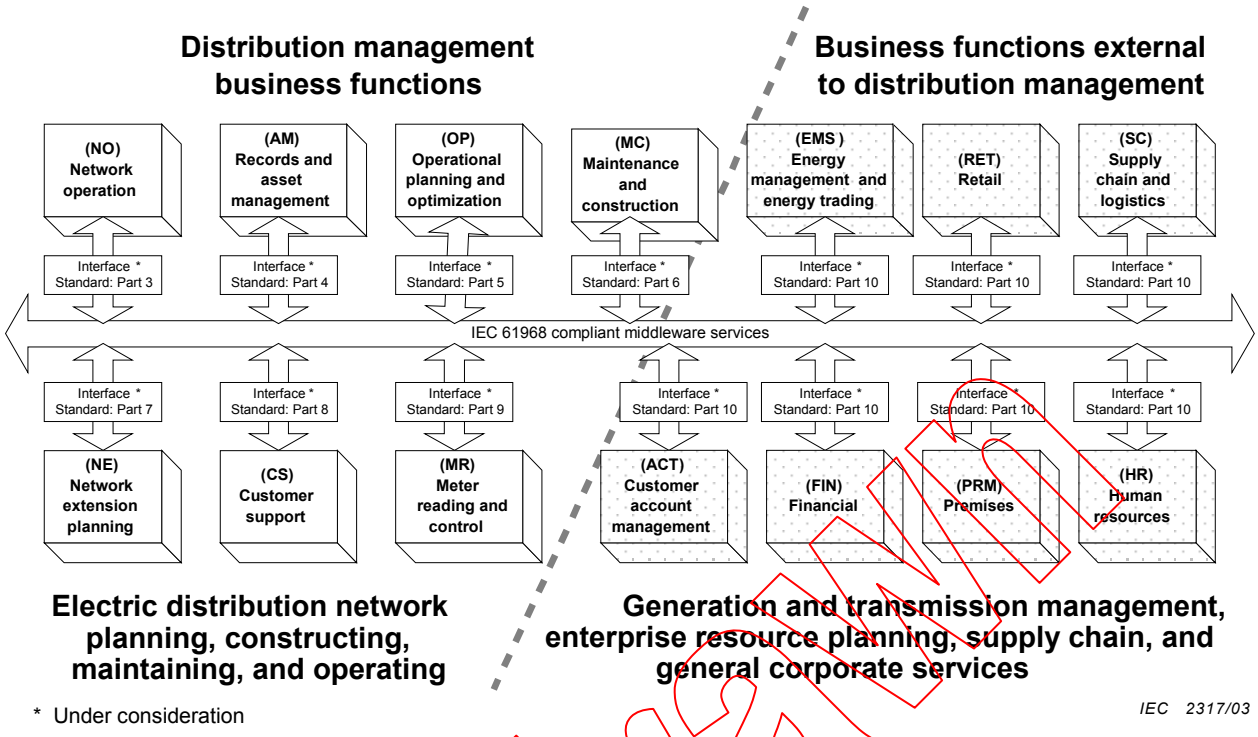


**Figure 3 – Typical applications mapped to interface reference model**



### 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 interface reference model.

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 future parts of the IEC 61968 series. It does not necessarily mean that compliant software is delivered as separate modules.

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

- Sub-business functions (second column of Table 2).
- Abstract components (third column of Table 2).

NOTE 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 (see Clause 5).

Applications from different vendors package the functionality of these abstract components in different ways. To use the IEC 61968 services, each application must support one or more of the interfaces for the abstract components.

This part of IEC 61968 describes infrastructure services common to all abstract components whilst future parts of the IEC 61968 series will define the details of the information exchanged for specific types of abstract component.

IEC 61968 series defines that:

a) An inter-application infrastructure is compliant if it supplies services defined in this part of IEC 61968 to support at least two applications with interfaces compliant to sections of future parts of the IEC 61968 series.

b) An application interface is compliant if it supports the interface standards defined in future parts of the IEC 61968 series for the relevant abstract components defined in the interface reference model.

c) An application is only required to support interface standards of the applicable components listed in column 3 of Table 2. It is not required to support interfaces required by other abstract components (column 3 of Table 2) of the same business sub-function (column 2 of Table 2) or within the same business function (column 1 of Table 2). While this standard primarily defines information exchanged among components in different business functions, it will occasionally also defines information exchanged among components within a single business function when a strong market need for this capability has been realised.

**Table 2 – Interface reference model**

| Business functions | Business sub-functions | Abstract components |
|---|---|---|
| **Network operation (NO)**<br>(Refer to future IEC 61968-3) | Network operation monitoring (NMON) | Substation state supervision |
| | | Network state supervision |
| | | Switching action supervision |
| | | Management of data acquired from SCADA and metering systems |
| | | Management of data acquired through operation (field crews, customers, scheduled and unscheduled outages) |
| | | Alarm supervision |
| | | Operator and event logs |
| | | Weather monitoring (lightning detection) |
| | Network control (CTL) | User access control |
| | | Automatic controls:<br>Protection (fault clearance)<br>Sectionalising<br>Local voltage/reactive power control |
| | | Assisted control:<br>Remote switch control<br>Load shedding<br>Voltage reduction broadcast<br>Local control through field crews |
| | | Safety document management |
| | | Safety checking and interlocks |
| | | Major incident co-ordination |