



BSI Standards Publication

Application integration at electric utilities — System interfaces for distribution management

Part 1: Interface architecture and general requirements

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This British Standard is the UK implementation of EN 61968-1:2013. It is identical to IEC 61968-1:2012. It supersedes BS EN 61968-1:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power systems management and associated information exchange.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English version

**Application integration at electric utilities -
System interfaces for distribution management -
Part 1: Interface architecture and general recommendations
(IEC 61968-1:2012)**

Intégration d'applications pour les services
électriques -
Interfaces système pour la gestion de
distribution -
Partie 1: Architecture des interfaces et
recommandations générales
(CEI 61968-1:2012)

Integration von Anwendungen in Anlagen
der Elektrizitätsversorgung -
Systemschnittstellen für Netzfürung -
Teil 1: Schnittstellenarchitektur und
allgemeine Anforderungen
(IEC 61968-1:2012)

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Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 57/1272/FDIS, future edition 2 of IEC 61968-1, prepared by IEC TC 57 "Power systems management and associated information exchange" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61968-1:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-09-04
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-12-04

This document supersedes EN 61968-1:2004.

EN 61968-1:2013 includes the following significant technical changes with respect to EN 61968-1:2004:

- a) update of IRM table which has been out of date since the 1st edition;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 EN 61968-100;
- e) update of annexes.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61968-1:2012 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

- | | | |
|---------------|------|-----------------------------|
| IEC 61968-4 | NOTE | Harmonized as EN 61968-4. |
| IEC 61970-501 | NOTE | Harmonized as EN 61970-501. |

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61968-3	-	Application integration at electric utilities - System interfaces for distribution management - Part 3: Interface for network operations	EN 61968-3	-
IEC 61968-9	-	Application integration at electric utilities - System interfaces for distribution management - Part 9: Interface for meter reading and control	EN 61968-9	-
IEC 61968-11	-	Application integration at electric utilities - System interfaces for distribution management - Part 11: Common Information Model (CIM) extensions for distribution	EN 61968-11	-
IEC 61968-13	-	Application integration at electric utilities - System interfaces for distribution management - Part 13: CIM RDF Model exchange format for distribution	EN 61968-13	-
IEC 61970-301	-	Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base	EN 61970-301	-

CONTENTS

INTRODUCTION	6
1 Scope	11
2 Normative references	11
3 Interface reference model	11
3.1 Domain	11
3.2 Business functions	12
3.3 Interface reference model	13
4 Integration infrastructure recommendations	39
4.1 General	39
4.2 Requirements analysis methodology	39
5 Interface profile	39
5.1 General	39
5.2 Abstract components	40
5.3 Component adapters	41
5.4 Interface specification	41
5.5 Middleware adapter	41
5.6 Middleware services	42
5.7 Communication services	42
5.8 Platform environment	42
6 Information exchange model	42
6.1 General requirements	42
6.2 Message structures	43
6.2.1 General recommendation	43
6.2.2 Message header	44
6.2.3 Message type payload	44
6.2.4 Explanation of associations	46
6.2.5 Compliance philosophy	47
6.2.6 Extension	47
6.2.7 Request message	47
6.2.8 Response message	48
6.2.9 Event message	48
6.2.10 Fault message	48
6.2.11 Signature element	49
7 Component reporting and error handling (informative)	49
7.1 Component reporting	49
7.2 Error message handling	49
8 Security and authentication (informative)	50
9 Maintenance aspects (informative)	50
Annex A (informative) Use of IEC 61968 series of standards	51
Annex B (informative) Inter-application integration performance considerations	61
Annex C (informative) Views of data in a conventional electric utility	62
Bibliography	65

Figure 1 – Distribution management with IEC 61968 compliant interface architecture	7
Figure 2 – Example utility implementation of IEC 61968.....	9
Figure 3 – Typical functions mapped to interface reference model	13
Figure 4 – Overview of the interface profile and corresponding subclause numbers	40
Figure 5 – Logical view of an IEC 61968 message	44
Figure 6 – Example of a message type payload	45
Figure 7 – Example of how message elements are derived from the CIM	46
Figure 8 – Navigating associations in CIM (UML notation)	46
Figure 9 – Navigating associations in message type schemas	47
Figure 10 – Logical view of a request message.....	47
Figure 11 – Logical view of a response message	48
Figure 12 – Logical view of an event message	48
Figure 13 – Logical view of a fault message.....	49
Figure A.1 – Process A: Application of IEC 61968 series by a utility.....	52
Figure A.2 – Process B: application of IEC 61968 series by a utility	53
Figure C.1 – Database views depend on the time and user	63
Table 1 – Document overview for IEC 61968-1	10
Table 2 – The Interface Reference Model (IRM).....	15
Table A.1 – Use case template	55
Table A.2 – Commonly used verbs.....	58
Table B.1 – Typical load scenario	61

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.

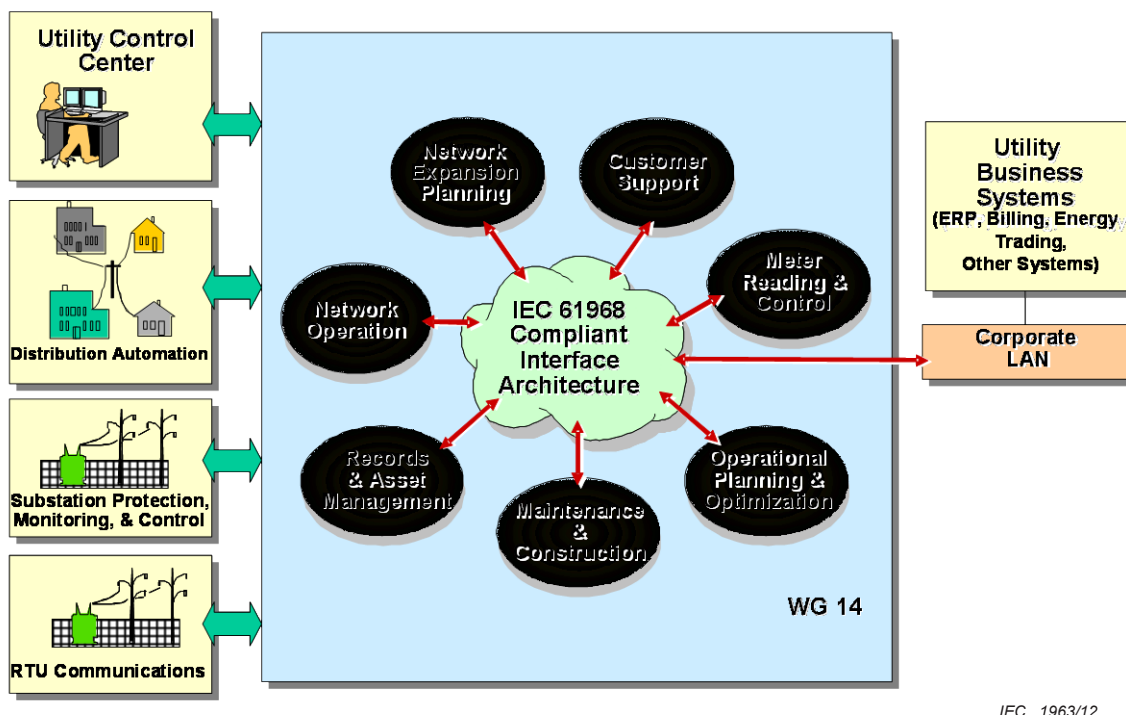
¹ Under consideration.

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.

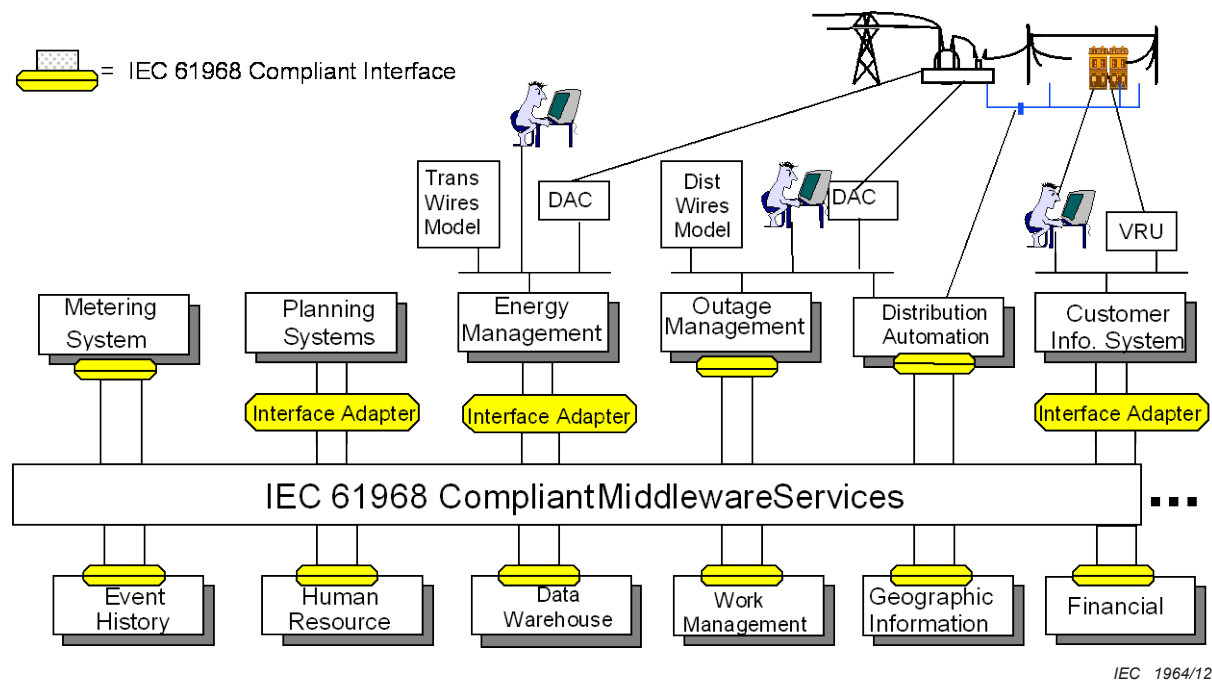


Figure 2 – Example utility implementation of IEC 61968

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.

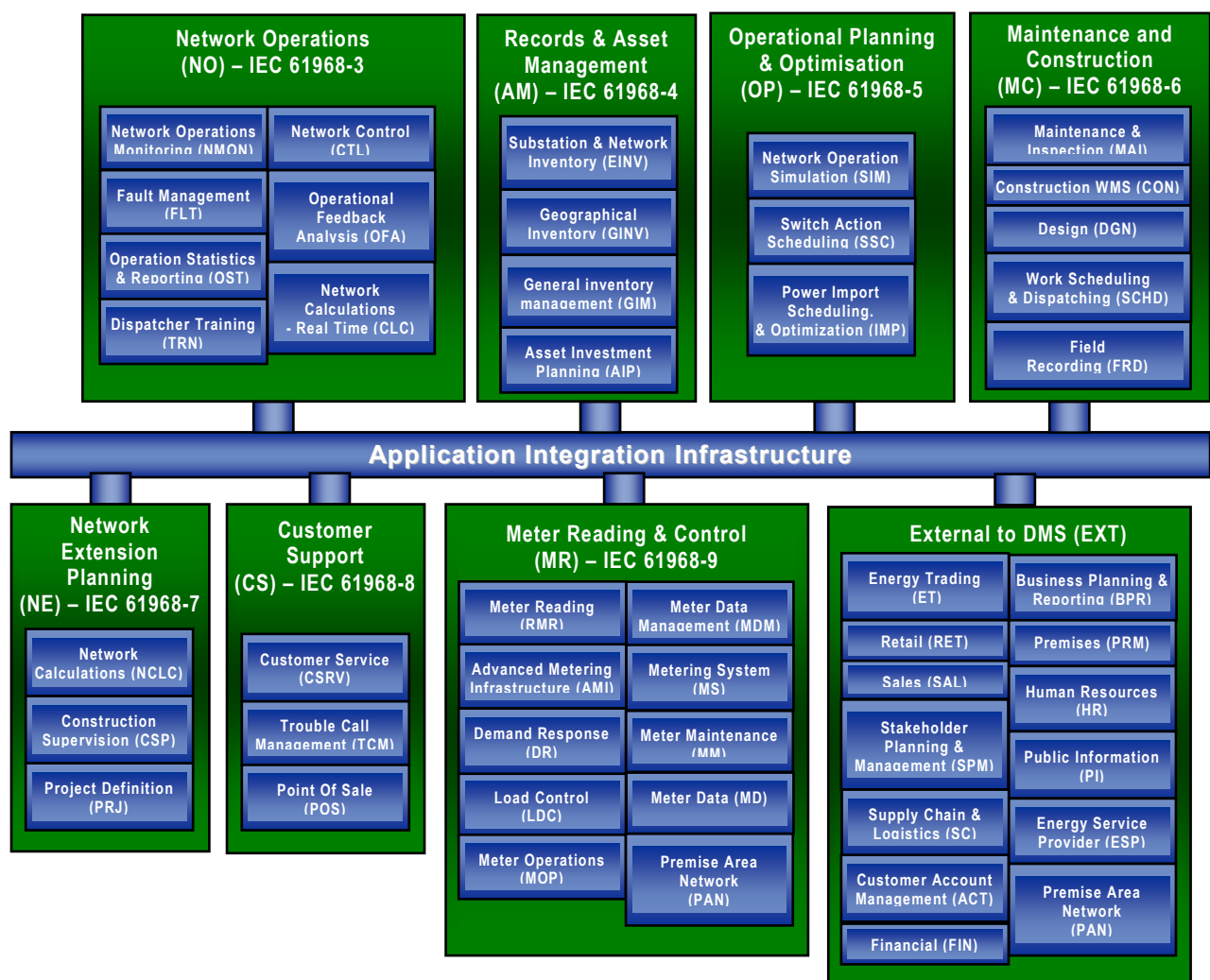
3.2 Business functions

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.

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).

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

IEC 61968-1 describes infrastructure services common to all abstract components whilst IEC 61968-3 to 9 and 13 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 IEC 61968-1 to support at least two applications with interfaces compliant to clauses of IEC 61968-3 to -9 and IEC 61968-13;
- b) an application interface is compliant if it supports the interface standards defined in IEC 61968-3 to 9 and 13 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. It is not required to support interfaces required by other abstract components (Column 3) of the same business sub-function (Column 2) or within the same business function (Column 1). While this standard primarily defines information exchanged among components in different business functions, it may occasionally define information exchanged among components within a single business function when a strong market need for this capability has been realised.

Table 2 – The Interface Reference Model (IRM)

Business Functions	Business Sub-Functions	Abstract Components	Description
<u>Network operation (NO)</u> [Refer to IEC 61968-3 and IEC 61968-13]	Network operation monitoring (NMON)		Provides the means for supervising main substation topology (breaker and switch state) and control equipment status. It also provides the utilities for handling network connectivity and loading conditions. It also makes it possible to locate customer telephone complaints and supervise the location of field crews.
		Substation state supervision	Provides the means for supervising main substation topology (breaker and switch state) and control equipment status. This function is supported by a mimic diagram of substations.
		Network state supervision	Provides the means for handling network connectivity and loading conditions. It also makes it possible to locate customer telephone complaints and supervise the location of field crews.
		Switching action supervision	Provides a view of all incoming work on the systems. Work details are recorded for each set of switching actions (examination of manual and remote controlled operations, work characteristics, and crews involved in the work).
		Switching pinning action supervision	Provides a view of all switching states other than the open or closed of the switch or device. For example, some utilities employ a pinning convention to denote: 1. switch held open (Red Pin) and associated with a clearance safety document, 2. closed fused switch involved in energized line work (Orange Pin) and associated with a Hot Line Work Permit safety document, 3. normally open switch (Green Pin), 4. abnormally open switch (Yellow Pin), 5. abnormally closed switch (Yellow with Green dot Pin), 6. fuse size deviation or information (Blue Pin), 7. Out of Order or defective equipment (Brown Pin), and 8. Transfer of Control (Pink Pin). A normally closed switch is not pinned.
		Process and network data management	Includes the exchange of process related data as well as the sharing of network related data which is needed to perform different functions.
		Operation data management	Management of data acquired through operation (field crews, customers, scheduled and unscheduled outages).
		Regulation step supervision	Provides a view for reporting the regulator tap-position. Substation regulator and pole-mounted distribution line regulator installations will be reporting tap-position via the "Process and network data management" abstract component.
		Alarm supervision	Network monitoring system where thresholds are set to indicate system failure and response required.
		Operator and event logs	Operator logs capture field changes and scheduled work requiring downtimes. Events logs capture outage and other relevant information.
		Weather monitoring (lightning detection)	Allows to predict impacts on the electrical networks, especially where outages are likely to occur due to heavy storm activity. Temperature and wind speed are sometimes used to calculate dynamic load limits on electrical network assets.

Business Functions	Business Sub-Functions	Abstract Components	Description
	Network control (CTL)		Network control is achieved through decentralised control functions which need to be coordinated at an upper level of the control hierarchy
			Local automatic control functions can be performed using only local information and which do not need knowledge of network connectivity. These functions are supported locally by substation control equipment at substation level. Area network control functions coordinate the local functions. These functions are operator-dependent and are provided firstly by the remote control function and secondly through local control which is related to the orders given to field crews through mobile station terminals.
		User access control	All network monitoring applications have user access control.
		Automatic controls	Protection (fault clearance), sectionalising and local voltage/ reactive power control devices which are self-protecting. Some "smarter" devices are programmable and allow control of the threshold indicating how long the device is in fault before it trips, automatic re-closures may automatically close the circuit at a given time.
		Assisted control	Remote switch control, load shedding, voltage reduction broadcast, maintaining voltage profiles and local control through field crews. Protection devices which are network programmable as well as manual network switches.
		Safety document management	Management of safety documents, which are used during the course of work on the electrical system for safety purposes. There are many types of safety documents that could be defined based upon organisational practices.
		Safety checking and interlocks	Following procedures to ensure safety of people and equipment when working with energized electrical networks.
		Major incident coordination	Coordination for major outage response.
	Fault Management (FLT)		Fault management functions which are intended to enhance the speed at which fault localisation and service restoration can be achieved. The fault management function supports the utilities required to identify disruptions in the system, to carry out restoration switching actions and to provide customers with notification of disruptions detected (in terms of duration and cause of breakdown). Fault management makes it possible: – to improve customer complaint response system, providing a prompt reply and a good interface between the Utility and the Customer (better image), – to provide field information to the dispatch operator, helping to restore supply during disruptions, – to compile all information about Quality of Service and make it available outside the Utility (Customers and official entities).
		Trouble call handling and coherency analysis for LV networks	A trouble ticket is a document which is generated when a customer calls to report electrical trouble. The trouble may either be an outage or non-outage problem, such as power quality.

Business Functions	Business Sub-Functions	Abstract Components	Description
		Protective relays analysis	Coordination of protective schemes is accomplished through analysis of protective relays. Protective relay is an electro-mechanical device used to initiate a protection scheme such as opening a breaker after a high current is detected.
		Fault location by analysis of fault detectors and/or trouble call localisation	Connectivity analysis is used to determine the location of the fault. Eventually a special tester is sent to the field to locate the fault.
		Supply restoration assessment	Estimated restoration time provided to customer before and during restoration activities.
		Customer incident information usage	Data including service address, customer number, customer name, premise number, meter number, and etc. Customer call centre usually receives these calls.
		Distribution circuit energization supervision	The energization state of the geographical distribution circuit is to be presented in as well as the connected equipment, e.g. switches, transformers, regulators, capacitors, substation, and etc. The energization state presentation will include predictive state information from an outage management system. A prediction outage state will frequently become a confirmed state, perhaps illustrated by the open state of a switch, when verified by field personnel. Switches, devices, equipment and circuits in the distribution network model can also have a predicted out-of-service state, which will be different from a service interruption state.
	Operation feedback analysis (OFA)		Information can be retrieved from substation and customer records and compared with records taken from real-time operation related to information on network incidents, connectivity and loading. This information analysis provides indicators for optimising periodic maintenance according to fault rates in the network. This requires identification of concurrent values at multiple locations and time tagging of events and values.
		Mal-operation analysis	The review of records for equipment to ascertain the cause of its incorrect operation.
		Network fault analysis	The review of fault records, sequence of events records, and other documentation produced upon a fault to determine the cause of the fault; its total impact, steps taken by the system to recover from the fault, and the possible avoidance of a future occurrence. This data includes pre-fault information as well as post fault information for a specified period.
		Quality index analysis	Quality analysis includes frequency of outages, outage duration, voltage level, voltage fluctuations (drops, peaks, rapid and slow changes) and other factors to measure the quality of power supplied.
		Device operation history	Data concerning the operation of electrical devices. It is often used in condition-based maintenance schemes.
Operation statistics and reporting (OST)		Post-disturbance review	The review of historical records to understand the sequence of events leading up to a disturbance to determine the root cause of the problem.
			Operating statistics and reporting functions makes it possible to archive on-line data and to perform feedback analysis of system efficiency and reliability.

Business Functions	Business Sub-Functions	Abstract Components	Description
		Maintenance information	Planned and unplanned maintenance data including root cause and repair/replace details.
		Information for planning	Service history data used for operational planning
		Information for management control	Service history data used for management control.
	Network calculations – real-time (CLC)		Network calculations provide system operators with the ability to assess the reliability and security of the power system.
		Load estimation	The estimation of load values, calculated on a more granular basis than load forecasts, based on specified conditions, weather and other events.
		Energy trading analysis	Performing network calculations to assess energy trading options and scenarios.
		Load flow/voltage profile	Perform voltage assessment of the network by analyzing operating conditions and predicting and preventing voltage problems.
		Fault current analysis	The review of fault records, sequence of events records, and other documentation produced upon a fault to determine the cause of the fault, its total impact, steps taken by the system to recover from the fault, and the possible avoidance of a future occurrence. This data includes pre-fault information as well as post fault information for a specified period.
		Adaptive relay settings	Protective relay setting that can be adjusted based on conditions such as weather and operational conditions.
	Dispatcher training (TRN)		Training facilities for dispatchers that simulate the actual system they will be using to perform the dispatch function. Various scenarios can be tested to prepare dispatchers for being able to handle atypical events.
		SCADA simulation	Simulating network faults to train dispatchers.
Records and asset management (AM) [Refer to IEC 61968-4]	Substation and network inventory (EINV)		The electrical substation and network assets that a utility owns, or for which has legal responsibility, and will maintain an accurate asset register developed around an asset hierarchy that supports advanced asset management functions.
		Equipment characteristics	Data concerning the nature and operational parameters of physical devices designed to perform particular functions. A characteristic can be viewed as a relationship between two or more variable quantities which describes the performance of a device under given condition.
		Connectivity model	A model of all networked electrical equipment. It is the physical definition of how equipment is connected together. In addition it models topology which is the logical definition of how equipment is electrically connected via closed switches. The topology definition is independent of the other electrical characteristics.

Business Functions	Business Sub-Functions	Abstract Components	Description
		Substation display	Schematic display of substations with references to relevant network data displays and geographic maps. Schematic display includes substation control equipment status and power equipment status.
		Telecontrol database	Telecommunication relationships for remote control and dynamic data acquisition, and other functions requiring electronic communications.
	Geographical inventory (GINV)		Management of geospatial data, typically by utilizing computer graphics technology to enter, store, and update graphic and non-graphic information. Geographic depictions and related non-graphic data elements for each entity are typically stored in some form of a data store. The graphic representations are referenced using a coordinate system that relates to locations on the surface of the earth. Information in the data store can be queried and displayed based upon either the graphic or non-graphic attributes of the entities.
		Network displays	Circuit diagrams of the physical distribution network
	General inventory management (GIM)	Geographic maps	A map, which displays planimetric, electrical, physical asset and/or topographic features and which may be used as a base for a thematic layer. Features which may be included on a base map are roads, rivers, major structures (buildings), contours, etc. Feature presentation will, however, be map scale dependent. A geographic feature is a term applied to the natural or cultural objects shown on a map or chart.
			The non-electrical assets (e.g., tools, concrete, poles, cross-arms, etc.) that a utility owns, or for which has legal responsibility, and will maintain an accurate asset register that supports advanced asset management functions.
		Non-electrical asset inventory	The inventory and condition of installed and non-installed assets other than those covered in EINV Substation and network inventory.
		Materials inventory	The inventory and condition of materials available for use at various locations in the utility.
		Vehicle inventory	The inventory and condition of all utility owned and leased vehicles.
	Asset investment planning (AIP)		Asset investment planning involves strategy definition and prioritisation, maintenance strategy planning, risk management, programme management and decision-making. It drives the condition, configuration, performance, operating costs, and flexibility of the asset base, with the aim of maximising value.
		Maintenance strategy	Maintenance strategy that balances risk, cost, and schedule while applying schedule-based maintenance, reliability-centered maintenance, condition-based maintenance as appropriate.
		Life-cycle planning	Planning the use of an asset throughout its life-span, from the time a decision is made to purchase it until the time it is properly discarded.