

DIN EN IEC 61968-3

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Ersatz für
DIN EN 61968-3:2005-03
Siehe Anwendungsbeginn

**Integration von Anwendungen in Anlagen der Elektrizitätsversorgung –
Systemschnittstellen für Netzführung –
Teil 3: Schnittstelle für Netzbetriebsarten
(IEC 61968-3:2017);
Englische Fassung EN IEC 61968-3:2018**

Application integration at electric utilities –
System interfaces for distribution management –
Part 3: Interface for network operations
(IEC 61968-3:2017);
English version EN IEC 61968-3:2018

Intégration d'applications pour les services électriques –
Interfaces système pour la gestion de la distribution –
Partie 3: Interface pour l'exploitation du réseau
(IEC 61968-3:2017);
Version anglaise EN IEC 61968-3:2018

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Anwendungsbeginn

Anwendungsbeginn für die von CENELEC am 2017-03-03 angenommene Europäische Norm als DIN-Norm ist 2019-08-01.

Für DIN EN 61968-3:2005-03 besteht eine Übergangsfrist bis 2021-05-18.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN IEC 61968-3:2018-08.

Für dieses Dokument ist das nationale Arbeitsgremium K 952 „Netzleittechnik“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (www.dke.de) zuständig.

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Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für die vorliegende Norm erfüllt.

Da sich die Benutzer der vorliegenden Norm der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN IEC 61968-3 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe und Abkürzungen festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA der vorliegenden Norm hinzugefügt. Für die meisten der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Diese Norm steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

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Änderungen

Gegenüber DIN EN 61968-3:2005-03 wurden folgende Änderungen vorgenommen:

- a) Ersetzen der Messwertliste durch Messung und Steuerungen;
- b) ersetzen von „OperationalRestriction“ durch „Tag“;
- c) ersetzen von „OutageRecord“ durch „Outage“;
- d) ersetzen von „SafetyDocument“ durch „ClearanceDocument“;
- e) ersetzen von „SwitchingSchedule“ durch „SwitchingOrder“;
- f) hinzufügen von „SwitchingPlan“;
- g) hinzufügen von „TemporaryNetworkChange“;
- h) hinzufügen von „TroubleTicket“;
- i) hinzufügen von „Incident“;
- j) hinzufügen von „TroubleOrder“;
- k) hinzufügen von Anwendungsfällen und Sequenzdiagrammen.

Frühere Ausgaben

DIN EN 61968-3: 2005-03

Nationaler Anhang NA (informativ)

Auszugsweise Übersetzung

Reihenfolge und Inhalt der folgenden Abschnitte sind identisch mit denen in den jeweiligen Abschnitten der Englischen Fassung.

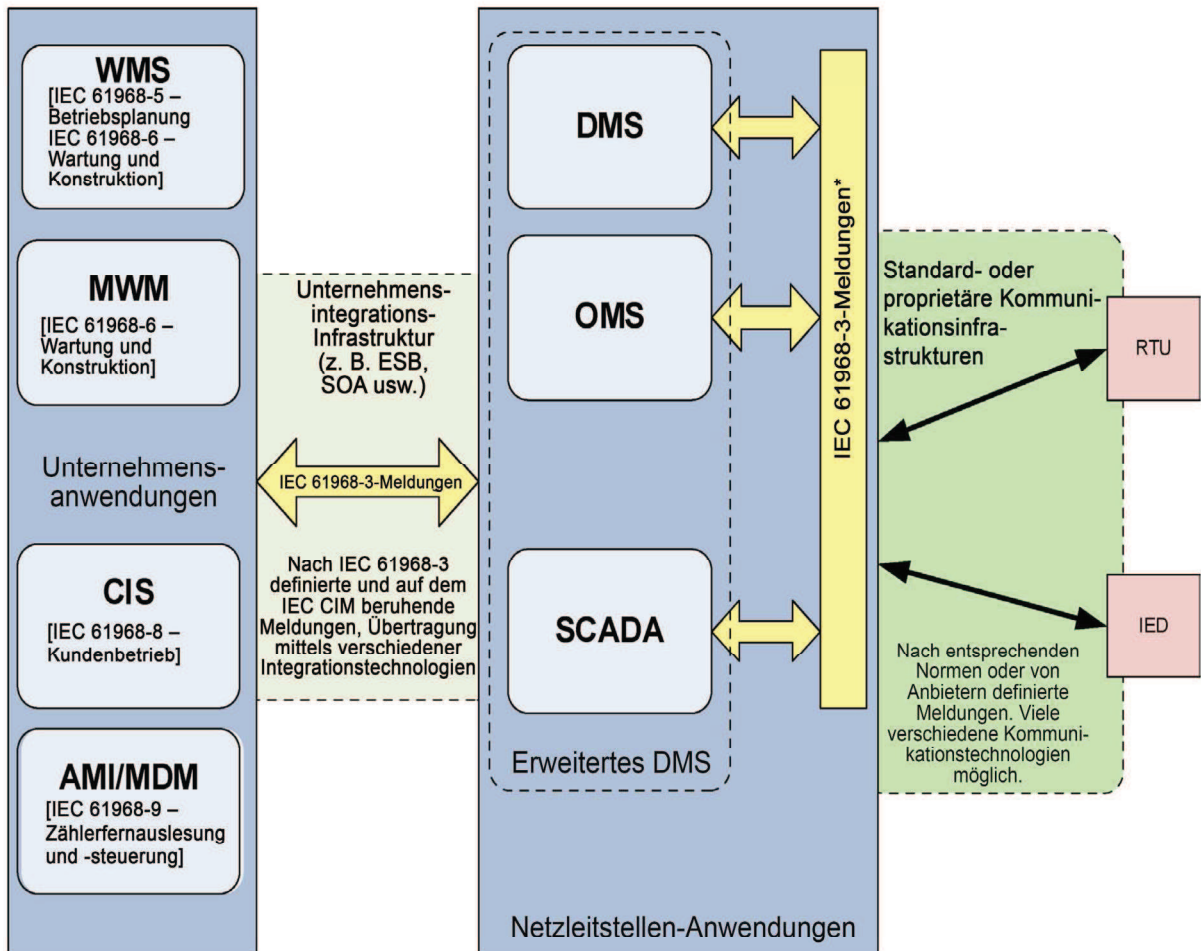
1 Anwendungsbereich

Entsprechend dem Schnittstellen-Referenzmodell aus IEC 61968 statet die in diesem Teil von IEC 61968 definierte Funktion für den Netzbetrieb Energieversorgungsunternehmen mit den Mitteln zur Überwachung der Hauptstationstopologie (Leistungsschalter- und Schaltzustand) und der Steuerung des Status von Betriebsmitteln aus. Darüber hinaus ermöglicht sie die Verwaltung der Netzkonnektivität und der Lastbedingungen. Schließlich bietet sie Energieversorgungsunternehmen die Möglichkeit, telefonisch eingegangene Beschwerden von Kunden zu orten und den Aufenthaltsort von Teams vor Ort zu überwachen.

IEC 61968-3 legt den Informationsinhalt einer Reihe von Meldungsnutzlasten fest, die für die Unterstützung zahlreicher mit dem Netzbetrieb zusammenhängender Geschäftsfunktionen verwendet werden können. Zu den typischen Anwendungen der in IEC 61968-3 definierten Meldungsnutzlasten gehören z. B. die Datenerfassung durch externe Systeme, die Fehlereingrenzung, die Fehlerbehebung, das Problemmanagement und die Wartung und Inbetriebnahme der Anlage.

Das in Bild 1 dargestellte Diagramm des Anwendungsbereichs illustriert die Möglichkeit, Funktionalität nach IEC 61968-3 entweder als ein einzelnes, integriertes erweitertes Verteilnetzmanagementsystem oder als Menge einzelner Funktionen – OMS, DMS und SCADA – zu implementieren. Den Energieversorgungsunternehmen steht es frei, diese Systeme bei unterschiedlichen Anbietern zu erwerben und sie anschließend mithilfe der Meldungen aus IEC 61968-3 zu integrieren. Alternativ könnte ein Anbieter zwei oder alle Komponenten als ein einzelnes, integriertes System anbieten. Wenn mehrere Systeme von ein und demselben Anbieter bereitgestellt werden, darf der Anwender entscheiden, ob er Erweiterungen der Meldungen nach IEC 61968 oder einen proprietären Integrationsmechanismus verwendet, um die Funktionalität über die Anforderungen/Unterstützung der Spezifikation aus IEC 61968-3 hinaus auszubauen.

In einem zusätzlichen Teil von IEC 61968 werden Integrationsszenarien oder Anwendungsfälle dokumentiert werden; welche informative Beispiele sind für die Verwendung von in diesem Dokument definierten Meldungsnutzlasten sowie von in anderen Teilen der Reihe IEC 61968 zu definierenden Meldungsnutzlasten.



* Hinweis: Je nach Systemkonfiguration können dies auch proprietäre Schnittstellen sein (z. B. ein System, das DMS und SCADA in einem einzelnen Produkt abdeckt).

Bild 1 – Anwendungsbereich von IEC 61968-3

3 Begriffe und Abkürzungen

3.1 Begriffe

Es werden keine Begriffe in diesem Dokument angegeben.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>
- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>

3.2 Abkürzungen

Für die Anwendung dieses Dokuments gelten die Abkürzungen nach IEC 61968-2 und die folgenden Abkürzungen.

ANMERKUNG Für allgemeine Glossar-begriffe kann das International Electrotechnical Vocabulary, IEC 60050, herangezogen werden.

FLISR Fehlerortung und -eingrenzung und Dienstwiederherstellung (en: fault location, isolation and service restoration)

WMS Arbeitsplanungssystem (en: work management system)

– Leerseite –

English Version

**Application integration at electric utilities – System interfaces for
distribution management – Part 3: Interface for network
operations
(IEC 61968-3:2017)**

Intégration d'applications pour les services électriques -
Interfaces système pour la gestion de la distribution -
Partie 3: Interface pour l'exploitation du réseau
(IEC 61968-3:2017)

Integration von Anwendungen in Anlagen der
Elektrizitätsversorgung – Systemschnittstellen für
Netzführung – Teil 3: Schnittstelle für Netzbetriebsarten
(IEC 61968-3:2017)

This European Standard was approved by CENELEC on 2017-03-03. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 57/1810/FDIS, future edition 2 of IEC 61968-3, 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 IEC 61968-3:2018.

The following dates are fixed:

- latest date by which the document has to be (dop) 2018-11-18
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2021-05-18
standards conflicting with the
document have to be withdrawn

This document supersedes EN 61968-3:2004.

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

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Endorsement notice

The text of the International Standard IEC 61968-3:2017 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 61968-6	NOTE	Harmonized as EN 61968-6.
IEC 61968-8	NOTE	Harmonized as EN 61968-8.
IEC 61968-9	NOTE	Harmonized as EN 61968-9.
IEC 61968-11	NOTE	Harmonized as EN 61968-11.
IEC 61968-13	NOTE	Harmonized as EN 61968-13.
IEC 62361-100	NOTE	Harmonized as EN 62361-100.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61968-1	–	Application integration at electric utilities – System interfaces for distribution management – Part 1: Interface architecture and general requirements	EN 61968-1	–
IEC/TS 61968-2	–	Application integration at electric utilities – System interfaces for distribution management – Part 2: Glossary	–	–
IEC 61968-100	–	Application integration at electric utilities – System interfaces for distribution management – Part 100: Implementation profiles	EN 61968-100	–
IEC 61970-301	–	Energy Management System Application Program Interface (EMS-API) – Part 301: Common information model (CIM) base	EN 61970-301	–

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INTRODUCTION

The purpose of this part of IEC 61968 is to define a standard for the integration of network operations systems with each other and other systems and business functions within the scope of IEC 61968. The specific details of communication protocols those systems employ are outside the scope of this part of IEC 61968. Instead, this part of IEC 61968 will recognize and model the general capabilities that can be potentially provided by network operations systems. In this way, this part of IEC 61968 will not be impacted by the specification, development and/or deployment of next generation network operations systems, either through the use of standards or proprietary means.

The IEC 61968 series of standards is intended to facilitate inter-application integration as opposed to intra-application integration. 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 optimised for close, real-time, synchronous connections and interactive request/reply or conversation communication models. Therefore, these inter-application interface standards are relevant to loosely coupled applications with more heterogeneity in languages, operating systems, protocols and management tools. This series of standards is intended to support applications that need to exchange data every few seconds, minutes, or hours rather than waiting for a nightly batch run. This series of standards, which are intended to be implemented with middleware services that exchange messages among applications, will complement, not replace utility data warehouses, database gateways, and operational stores.

As used in IEC 61968, a distribution management system (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. Standard interfaces are defined for each class of applications identified in the interface reference model (IRM), which is described in IEC 61968-1.

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

Part 3: Interface for network operations

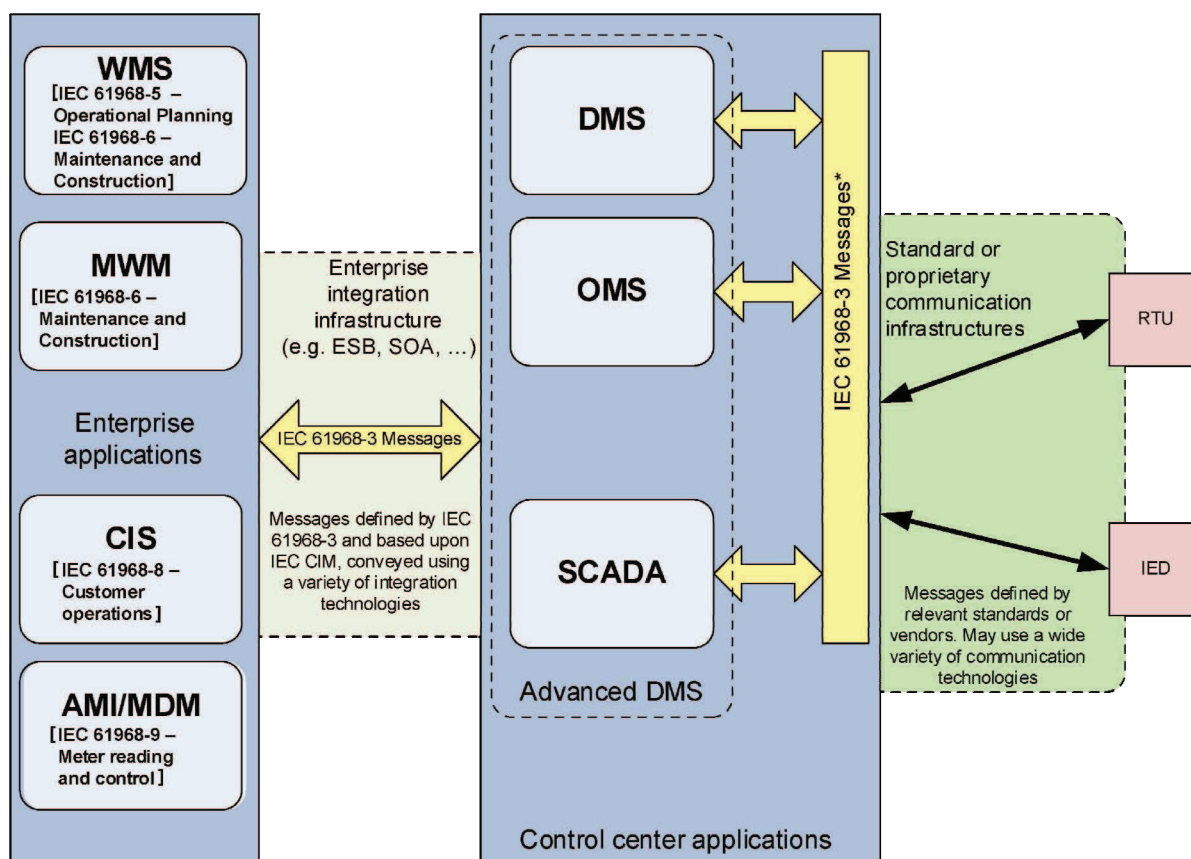
1 Scope

Per the IEC 61968 Interface Reference Model, the Network Operations function defined in this part of IEC 61968 provides utilities the means to supervise main substation topology (breaker and switch state) and control equipment status. It also provides the means for handling network connectivity and loading conditions. Finally, it makes it possible for utilities to locate customer telephone complaints and supervise the location of field crews.

IEC 61968-3 specifies the information content of a set of message payloads that can be used to support many of the business functions related to network operations. Typical uses of the message payloads defined in IEC 61968-3 include data acquisition by external systems, fault isolation, fault restoration, trouble management, maintenance of plant, and the commissioning of plant.

The scope diagram shown in Figure 1 illustrates the possibility of implementing IEC 61968-3 functionality as either a single integrated advanced distribution management system or as a set of separate functions – OMS, DMS and SCADA. Utilities may chose to buy these systems from different vendors and integrate them using the IEC 61968-3 messages. Alternatively, a single vendor could provide two or all of these components as a single integrated system. In the case of more than one system being provided by the same vendor, the vendor may chose to use either extensions of the IEC 61968-messages or a proprietary integration mechanism to provide enhanced functionality over and above what is required/supported by the IEC 61968-3 specification.

An additional part of IEC 61968 will document integration scenarios or use cases, which are informative examples showing typical ways of using the message payloads defined in this document as well as message payloads to be defined in other parts of the IEC 61968 series.



3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.2 Abbreviated terms

For the purposes of this document, the abbreviations given in IEC 61968-2 as well as the following apply.

NOTE Refer to International Electrotechnical Vocabulary, IEC 60050, for general glossary definitions.

FLISR Fault Location, Isolation and Service Restoration

WMS Work Management System

4 Reference and Information Models

4.1 General approach to network operations

Traditionally there have been two types of systems to manage distribution operations: Distribution Management Systems (DMS) and Outage Management Systems (OMS). Often a DMS has been delivered as an extension to a SCADA system, but some DMS can be delivered as a standalone set of distribution applications with no SCADA.

Outage Management Systems are used extensively in many parts of the world (typically with large service territories and a large amount of primary overhead conductor) to manage their distribution systems. Such distribution systems are typically configured radially and cover large distances. For this reason it has been historically expensive to monitor the status of the distribution system, particularly outside of the substation. In more dense populations the cost of telemetry and automation is lower, and can be justified on a cost per customer basis.

Thus often the only way that a distribution utility knows that there is a problem with the system is when a customer calls to report an outage. The utility then collects a set of outage calls, and from the pattern of calls received, determines the likely location and cause of the outage. A crew is then sent to the location of the outage to investigate further and affect repairs.

Distribution management systems have their roots in transmission SCADA systems. As automation has moved downwards and into distribution substations, there has been an increasing need to provide functionality for distribution applications. Distribution management systems originated as either extensions to the existing transmission SCADA, by adding additional points to cover the feeder breakers, or by adding a standalone distribution SCADA system. Both types of system usually have RTUs, communication front-ends, alarm systems and displays.

What characterizes these systems as distribution management systems are the addition of functions such as the ability to add temporary devices, such as line cuts and jumper lines. Such temporary devices are uncommon in transmission systems, but are very common in distribution systems. Since many distribution systems are operated in a radial configuration, it is often necessary to operate feeder tie switches to reconfigure feeders, either to restore outages or to adjust to different loading situations. This dictates a need for the ability to dynamically color lines according to which direction they are being energized from and also for the ability to color lines according to whether they are energized or not. In addition, in certain parts of the world, such systems can be

unbalanced, meaning that each electrical phase is operated independently. Another characteristic of a distribution system is that change is the norm. New residential construction and routine maintenance means that the distribution network model changes frequently. It is not uncommon for 10 000 or even 100 000 changes to occur to a distribution system in a single week.

The thing that both the DMS and OMS have in common is the need for an as operated near real-time network model. Thus this part of IEC 61968 includes the ability to exchange distribution network models between two such systems and to keep them synchronized. Increasingly, vendors are beginning to realize that this integration is non-trivial to implement and maintain, are therefore offering integrated DMS/OMS, and even integrated DMS/OMS/SCADA systems in order to provide reduced total cost of ownership and consistent views of the real-time distribution network. The term ADMS (Advanced Distribution Management System) has been coined to describe such systems.

4.2 Reference Model

Figure 2 serves as reference models and provide examples of the logical components and data flows related to this International Standard. Clause 0 provides references to terms that are defined by the CIM.

The diagram in Figure 2 describes the flows between the components in the reference model.

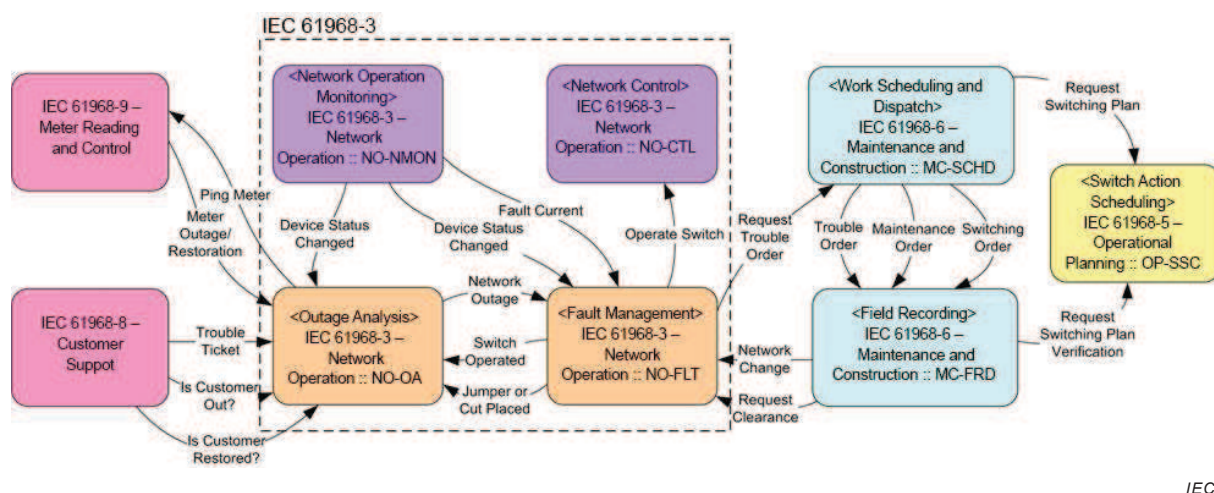


Figure 2 – IEC 61968-3 Reference Model

The reference architecture reflects five main logical components (potentially realized as systems or subsystems) related to network operations:

IEC 61968-9, *Meter Reading & Control*, for associating outage events and meter pings with operations

IEC 61968-8, *Customer Operations* for trouble call management associated with outages

IEC 61968-6, *Maintenance & Construction* for work orders required for trouble and switching

IEC 61968-5, *Operational Planning* for switching plan generation for both planned and unplanned work

4.3 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 this part of IEC 61968 through IEC 61968-9. It does not necessarily mean that compliant software is delivered neither as separate modules nor as a single system.

IEC 61968-1 describes infrastructure services common to all abstract components while IEC 61968-3 through IEC 61968-9 define the details of the information exchanged for specific types of abstract component.

IEC 61968 defines that:

- An inter-application infrastructure is compliant if it supplies services defined in Part 1 to support at least two applications with interfaces compliant to sections of Parts 3 to 9.
- An application interface is compliant if it supports the interface standards defined in Parts 3 to 9 for the relevant abstract components defined in the Interface Reference Model.
- An application is only required to support interface standards of the applicable components listed under abstract components. An application is not required to support interfaces required by other abstract components of the same business sub-function or within the same business function. While this standard primarily defines information exchanged among components in different business functions, it will occasionally also define information exchanged among components within a single business function when a strong market need for this capability has been realised.

4.4 Network operations functions and components

It should be noted that the message payloads defined in this document, IEC 61968-3, *Interfaces for Network Operations*, may be sent or received by any type of component within a distribution management system (DMS) system.

Table 1 shows these functions and typical abstract components that are expected to be producers of information for these message payloads. This is not intended to be an exhaustive list of functions and abstract components, rather they are examples. Typical consumers of the information include, but are not restricted to, the other components as listed in IEC 61968-1.

Table 1 – Business Functions and Abstract Components

Business Functions	Business Sub-Functions	Abstract Components
Network Operations (NO)	Network Operation Monitoring (NMON)	Substation state supervision
		Network state supervision
		Switching action supervision
		Switching pinning action supervision
		Process and network data management
		Operation data management
		Regulation step supervision
		Alarm supervision
		Operation and event logs
		Weather monitoring (lightning detection)
	Network Control (CTL)	User access control
		Automatic controls
		Assisted control
		Safety document management
		Safety checking and interlocks
		Major incident coordination
	Fault Management (FLT)	Trouble call handling
		Protective relays analysis
		Fault location
		Supply restoration assessment
		Customer incident information usage
		Distribution circuit energization supervision
	Operation Feedback Analysis (OFA)	Mal-operation analysis
		Network fault analysis
		Quality index analysis
		Device operation history
		Post-disturbance review
	Operation Statistics and Reporting (OST)	Maintenance information
		Information for planning
		Information for management control
	Network Calculations real-time (CLC)	Load estimation
		Energy trading analysis
		Load flow/voltage profile
		Fault current analysis
		Adaptive relay settings
	Dispatcher training (TRN)	SCADA simulation

The use case sequence diagrams presented in this document assume a simplified interpretation of the business functions listed in Table 1. This allowed for easier mapping of business functions to systems familiar to the participated vendors.

Table 2 shows the interpretation of the business functions defined in Table 1 as it relates to 61968-3 use cases. These interpretations are used to assist the reader understand of the use cases.

Table 2 – Interpretation of Network Operations Business Functions

Business Function	IRM Description	61968-3 Use Case Interpretation
NO-NMON	Network Operation Monitoring	Distribution Management System (DMS) as used in the control room for network operations management
NO-CTL	Network Control	SCADA as used for network monitoring and control
NO-FTL	Fault Management	Outage Management System (OMS)

4.5 Static Information Model

4.5.1 General

The information model relevant to network operations consists of classes that provide a template for the attributes for each message payload.

The classes are defined in detail in IEC 61968-11, Common Information Model (CIM) Extensions for Distribution or in IEC 61970-301, Energy Management System Application Program Interfaces – Common Information Model Core.

4.5.2 Classes related to network operations

Table 3 lists those classes that are associated with network operations classes but only the name of an instance is given within message payloads defined in this standard. The detailed attributes of these classes are used in message payloads defined in other parts of IEC 61968.

Table 3 – Classes related to network operations

Related Class	Reference	Description
TroubleTicket	IEC 61968-8	A type of document that contains the information of one or more customer calls.
Work	IEC 61968-6	A type of document that contains information used to request, initiate, track and record work, particularly construction and maintenance tasks.

NOTE The class definitions provided here are for convenience purposes only. The normative definitions are provided by IEC 61968-11, which describes the distribution extensions to the IEC CIM.

5 Network operations message payloads

5.1 General

The purpose of this clause is to describe the message payloads related to IEC 61968-3. It is important to note that some of these message payloads may also be used by other parts of IEC 61968. The general approach to the realization of message structures and XML schemas for IEC 61968 message payloads is described in IEC 61968-1 and IEC 61968-100.

Although they may be represented in sequence diagrams for context and completeness, this document does not describe message formats that are defined by other parts of IEC 61968. The message payload structures defined by this part of IEC 61968 are described in Clause 0.

The normative XML schemas for message payloads defined by this part are provided in Annex B, providing more detailed, annotated descriptions of the message structures. Message structures are diagrammed within Clause 0. Note that these diagrams are examples and not intended to be exhaustive. The notation convention shows required elements with a solid outline, and optional elements with dashed outlines.

It is also important to note that the use cases and sequence diagrams provided in Annex A are informative in nature, and are intended to provide examples of usage for the normative message payload definitions. There is no intent by this standard to standardize specific business processes.

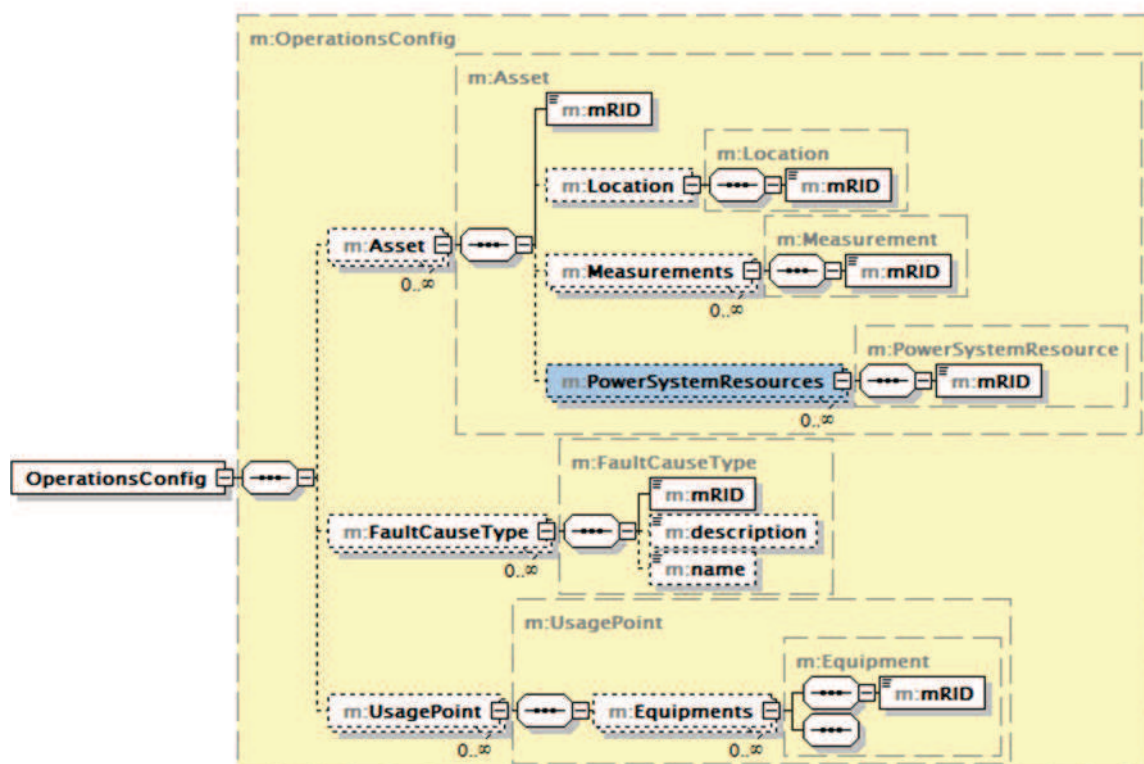
5.2 OperationsConfiguration payload

5.2.1 General

All messages rely on unique identifiers (**mRIDs**) for all objects that are part of the common network model, in this case the common distribution network model which is defined as part of CIM. In order to publish those unique identifiers, the respective system needs either to import that network model or load the necessary identifiers as part of the systems configuration step.

5.2.2 Message payload

This message payload, shown in Figure 3, includes the configuration needed to define **Assets**, **FaultCauseTypes**, and **UsagePoints** consistently among the specific messages and can be used to load the map of **mRIDs** that are necessary to uniquely identify the objects like **equipments**, **asset**, etc. Depending on the use cases a system needs to address and which messages should be supported by that system, the operations configuration has to include different sets of objects. For example to support the message **TagAction**, **PowerSystemResources** need to be configured.



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Figure 3 – OperationsConfiguration message payload

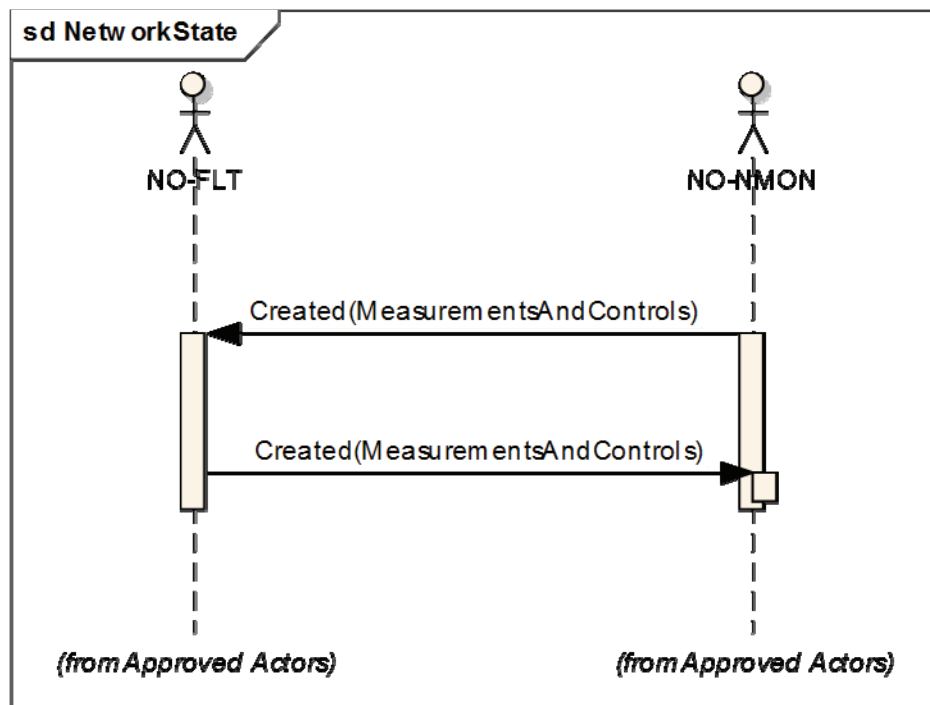
5.3 MeasurementsAndControls payload

5.3.1 General

MeasurementsAndControls message payloads are designed to communicate network state information such as the current switch status, the state of a fault relay, the current tap position or the current value of a voltage measurement as well as requests to change the network state such as open or close a switch, control the position of a transformer tap or set a new set point for a local controller.

Network state is monitored by SCADA and communicated to other systems that need to consider the current network state for further processing and analysis, i.e. an OMS system (for the Fault Management function) or a DMS (for the Network Operations and Monitoring function). Controls are typically sent from a DMS system to a SCADA system.

Typically, the payload contains either measurements or controls, as shown in Figure 4. Note that the arrows are bidirectional because the arrow from NO-NMON to NO-FLT is for a measurement, while the arrow from NO-FLT to NO-NMON is a control.



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Figure 4 – MeasurementsAndControls

5.3.2 Measurement

Measurements communicate the current value of network information. This includes digital network information (**Digital Measurement**) such as switch status, tap position or fault relay status as well as analog network information (**Analog Measurement**) such as current, voltage, active power and reactive power. Use cases include:

- SCADA notifies interested parties of changes in the status of a protective device due to an outage (i.e. trip of a circuit breaker). This notification can be used as a trigger for outage analysis or fault location in Fault Management or Network Operations.
- SCADA notifies interested parties changes in the status of a fault indicator. This notification can be used by fault location for further analysis to narrow down the faulted area.

- SCADA notifies interested parties changes in the status of a switch or a tap changer as result of a switching operation. This information may be used by any system that needs to process network state changes.
- SCADA notifies interested parties of changed fault current or fault reactance at a protective device. These values can be used by fault location to calculate the faulted area.
- SCADA notifies interested parties of changed values like active power, reactive power, current, voltage and frequency. This information may be used by any system that needs to process network state changes.

5.3.3 Control

Controls request remote control to change the status of a switchable device such as open or close a switch, change a transformer tap position or set a new set point for a local controller. Controls may either be requested as single action or as part of a switching plan. Use cases include:

- Fault Management requests to open or close a switch as part of a switching plan for fault isolation and/or service restoration. Such a switch control operation may affect all phases or a single phase.
 - In case of a multi-phase configuration, one control will switch all available phases (i.e. two or three phases)
 - In case of a single-phase configuration, one control will switch all available phases, if the corresponding switch is gang-operated. Otherwise one control will switch one phase. In that case the phase to be switched is identified via the terminal
- Volt/var control proposes to change the tap position of a transformer as part of the calculated switching plan.
- Volt/var control proposes to set a new setpoint for a local controller as part of the calculated switching plan

5.3.4 Message payload

This message payload, shown in Figure 5, can be used for exchanging measurement data including 0 to many measurement value and/or measurement control objects.

Measurement value objects:

- Accumulator value
- Analog value (for example active and reactive power)
- Discrete value (for example status of a breaker)
- String measurement value

Measurement control objects:

- Accumulator reset
- Setpoint (for example setpoint for local voltage control)
- Command (for example open or close a switch)
- RaiseLowerCommand (for example raise or lower a transformers tap position)

The detailed format for analog value is shown in Figure 6 and setpoint control is shown in Figure 7 as an example for the different measurement value and measurement control formats.

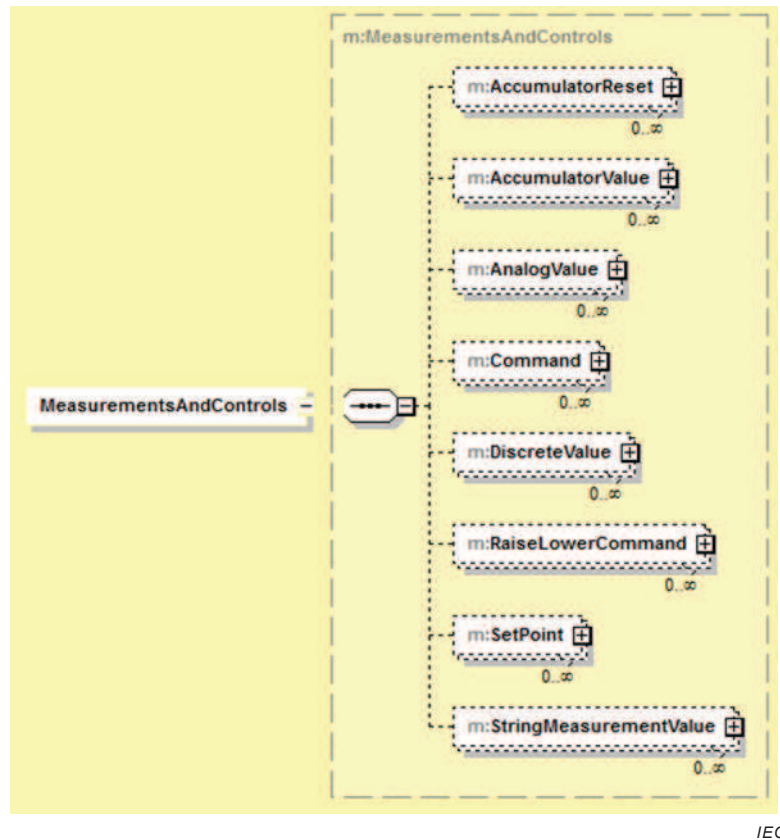
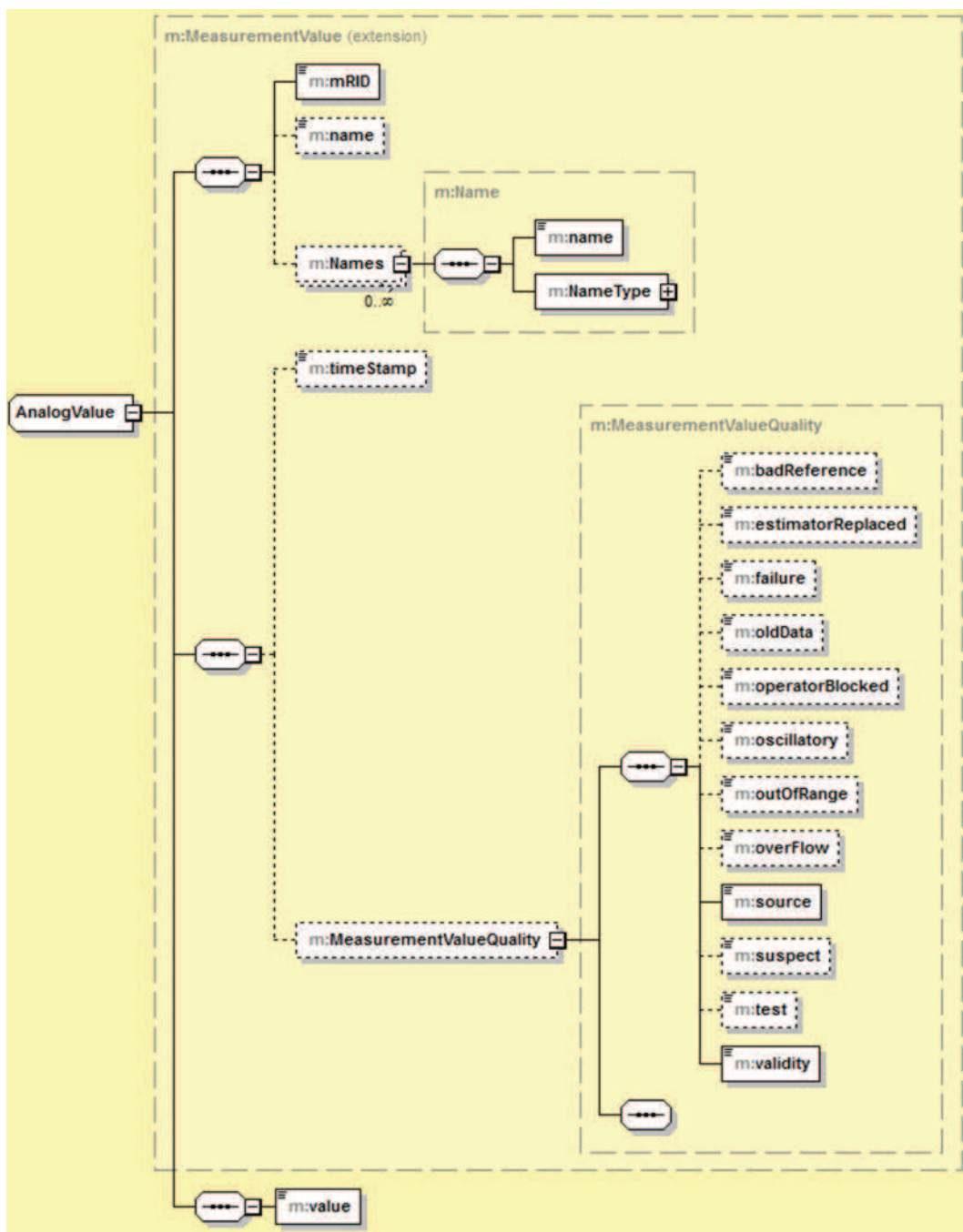
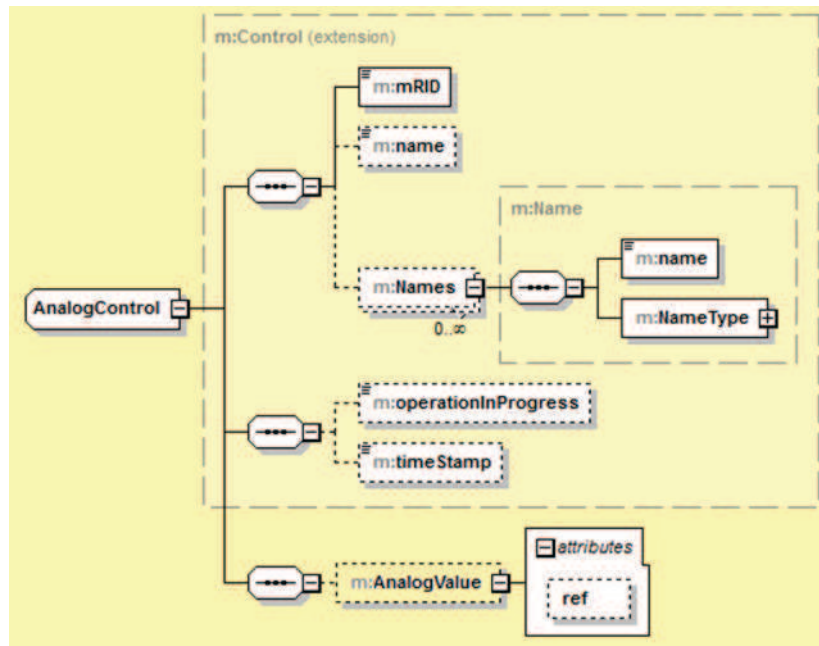


Figure 5 – **MeasurementsAndControls** message payload



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Figure 6 – MeasurementsAndControls message payload, AnalogValue detail



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Figure 7 – MeasurementsAndControls message payload, Setpoint (AnalogControl) detail

5.4 TemporaryNetworkChanges payload

5.4.1 General

Temporary network changes are of special importance in the case of network construction, during outages caused by severe weather or other disaster, or as emergency backup during maintenance of the network or power plants. In those scenarios, the power utilities are forced to still maintain the balance between generation and consumption as well as to re-supply as fast as possible affected customers. Temporary network changes such as jumpers, cuts and grounds, are used to temporarily reconfigure the respective part of the network.

Temporary Network Changes message payloads are designed to communicate creation and deletion of temporary network changes such as jumpers, cuts and grounds typically in the context of switching operations for fault isolation and service restoration. The sequence diagram for creating and deleting temporary network changes is shown in Figure 8.

Depending on the type of the network (balanced / unbalanced), a temporary network change may affect either three phases, two phases or a single phase. In the case of creating a single phase jumper, this jumper may connect two different phases of the respective field resources (cross phase jumper).

The creation and deletion of temporary network changes may be defined as part of a switching plan as **Cut**, **Ground** or **Jumper Action**.

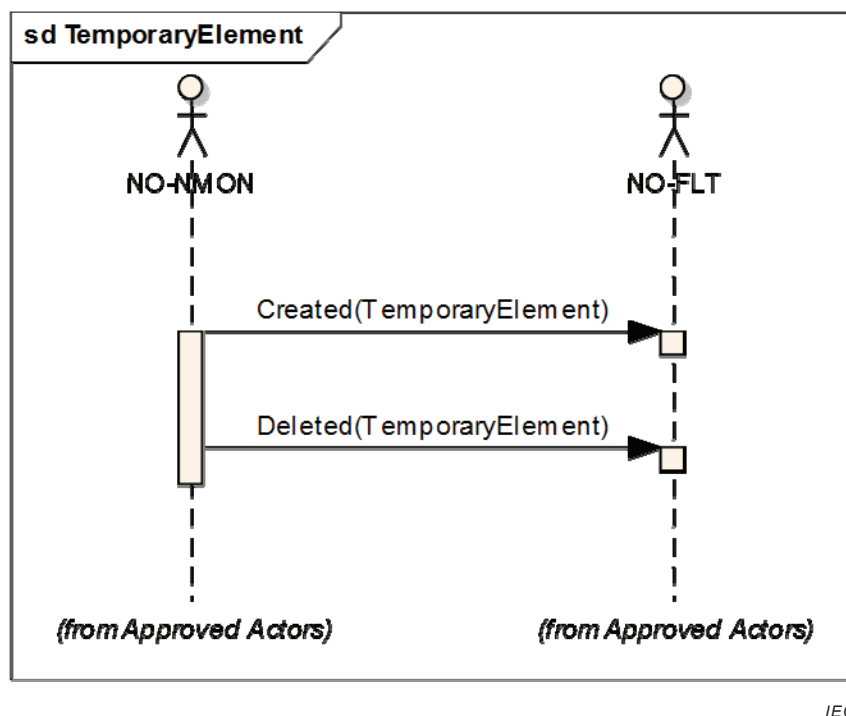


Figure 8 – Temporary Network Changes

5.4.2 Message payloads

These message payloads, shown in Figures 9, 10, 11, 12, 13 and 14 can be used to communicate creation and deletion of temporary network changes.

Figure 9 shows the **TemporaryNetworkChanges** message payload, which is further broken down into payloads for **Clamp**, **Cut**, **EnergySource**, **Ground** and **Jumper**.

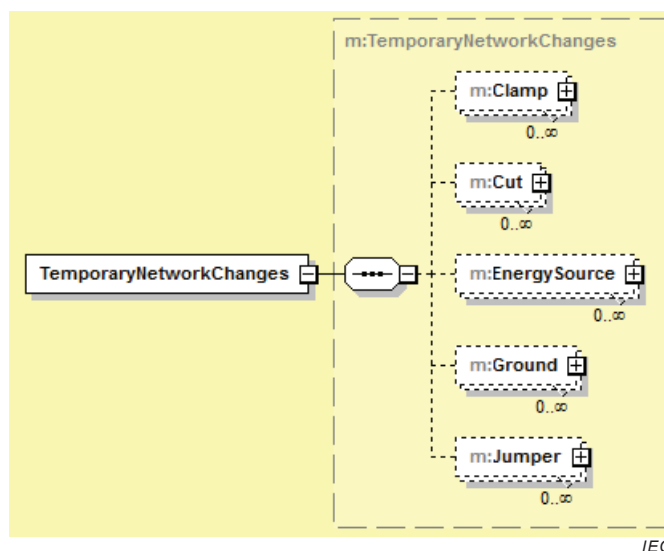
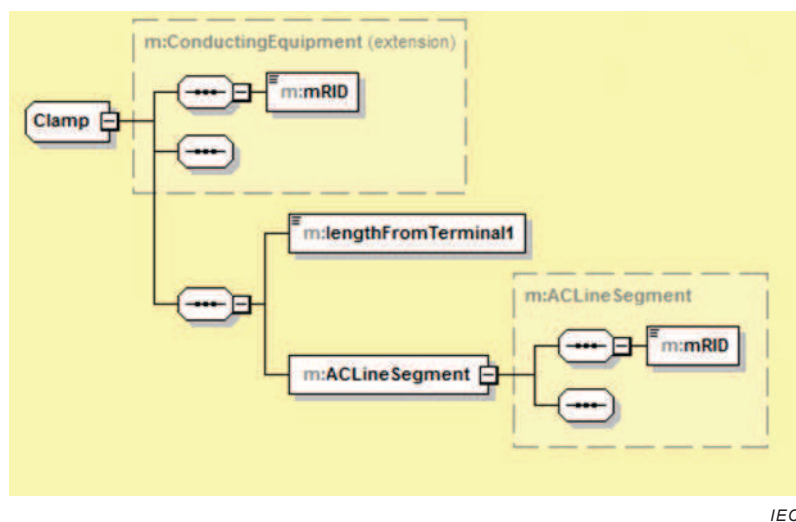


Figure 9 – TemporaryNetworkChanges message payload

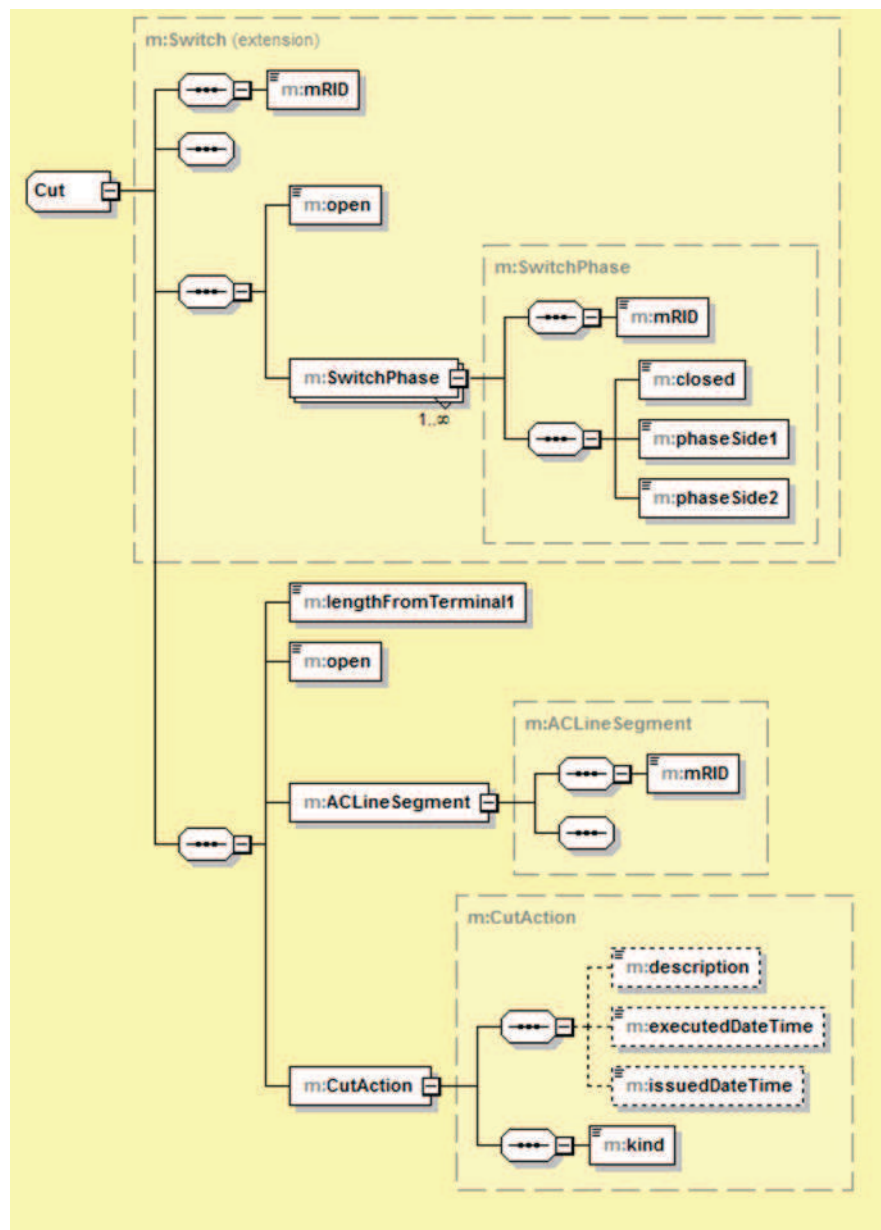
Figure 10 shows the payload for a **Clamp** temporary network change. **Clamps** are used as a connection point for connecting temporary equipment to permanent lines.



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Figure 10 – TemporaryNetworkChanges message payload, Clamp detail

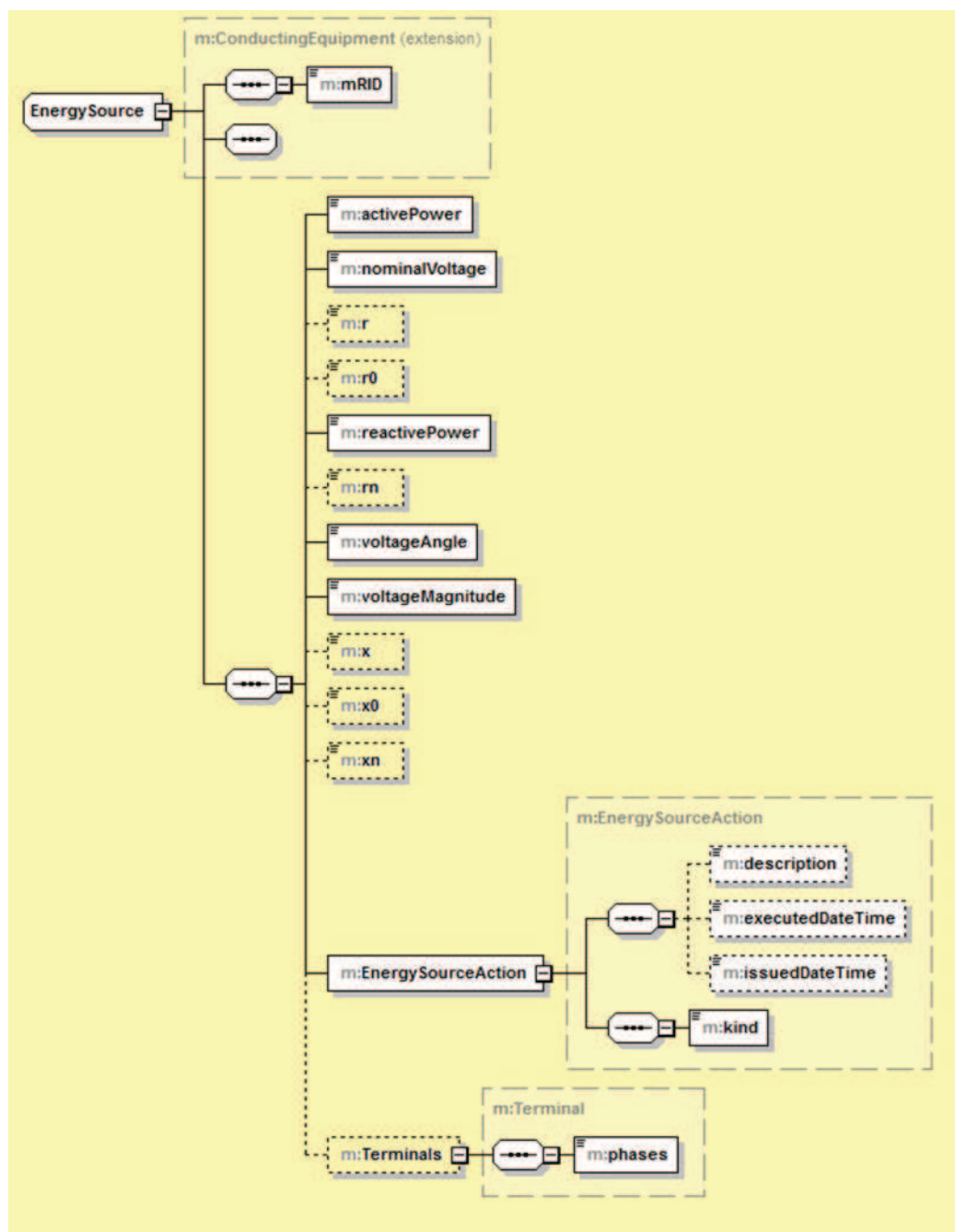
Figure 11 shows the message payload for a **cut** temporary network change. A **cut** is used to model a temporary break in the connectivity of a permanent conductor.



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Figure 11 – TemporaryNetworkChanges message payload, Cut detail

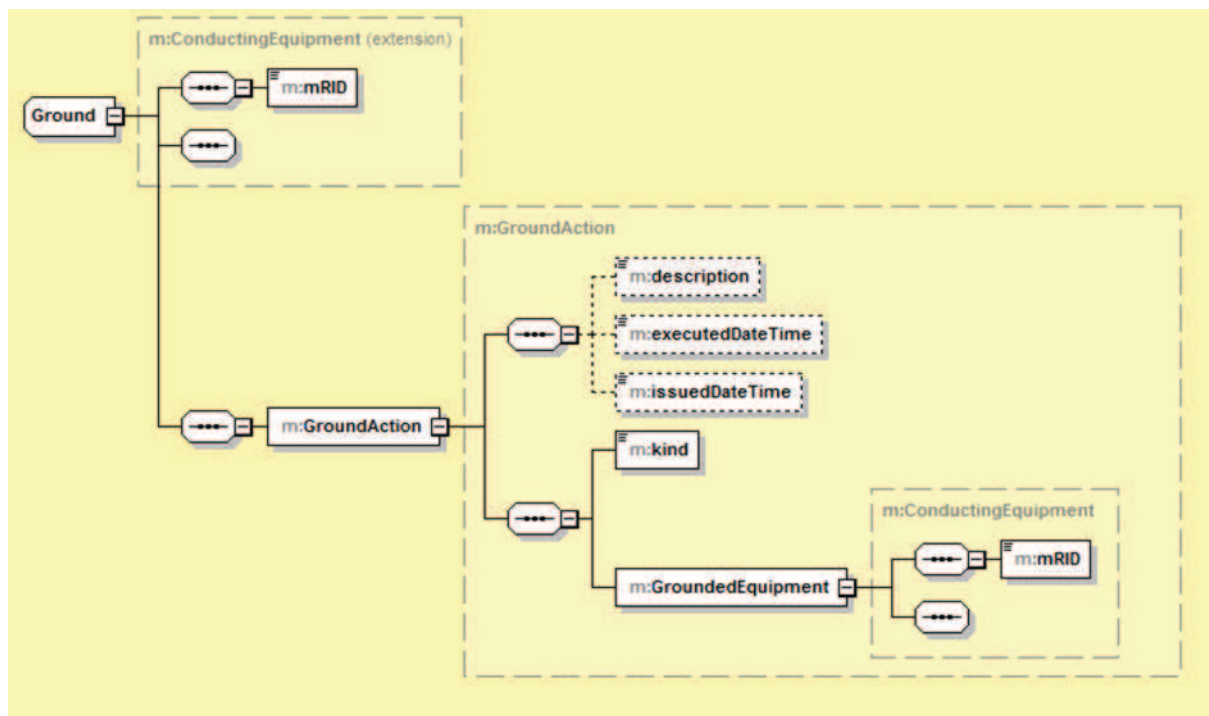
Figure 12 shows the message payload for an **EnergySource** temporary network change. An **EnergySource** is used to model a temporary generator or mobile transformer, for example.



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Figure 12 – TemporaryNetworkChanges message payload, EnergySource Details

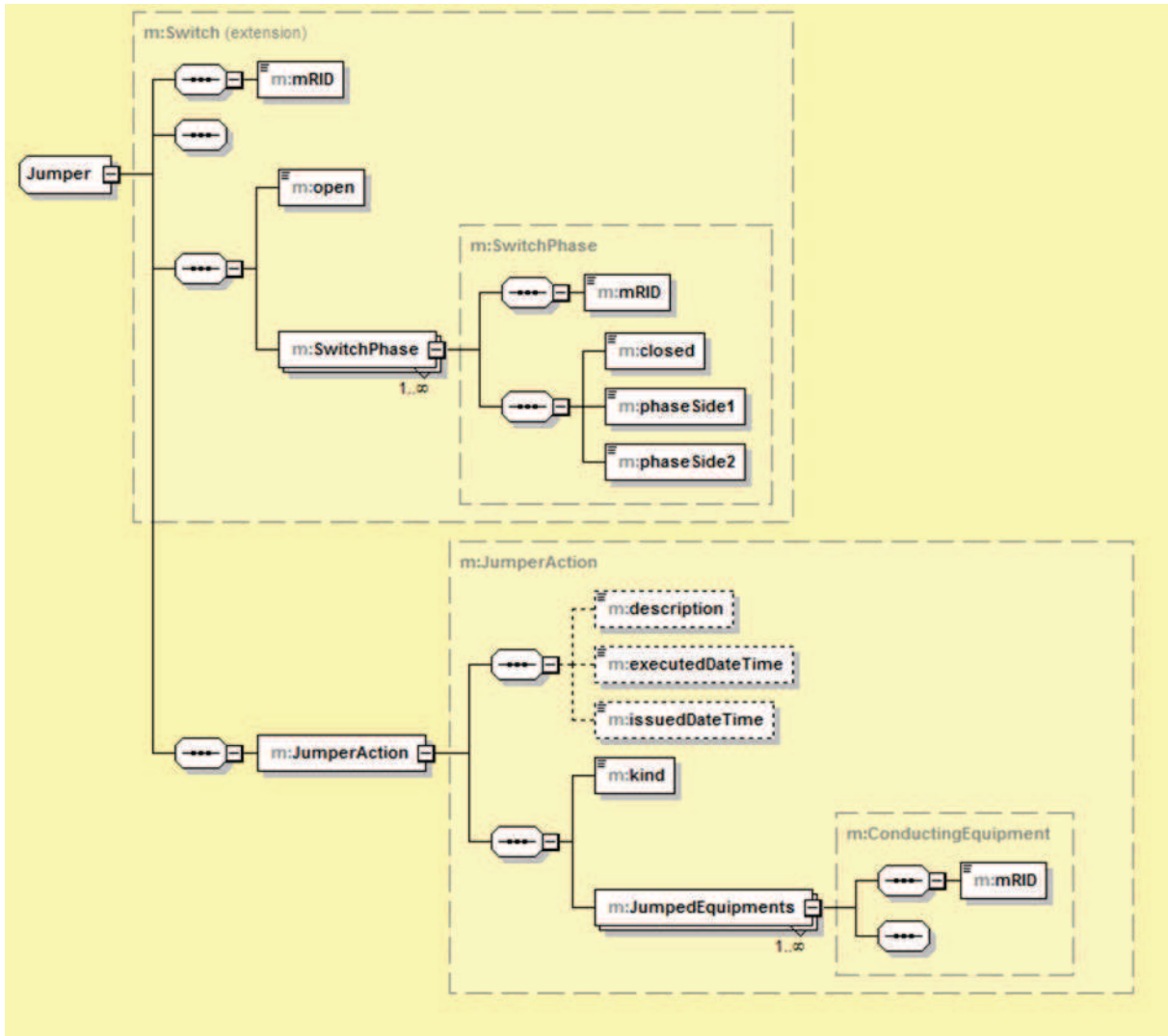
Figure 13 shows the payload for a **ground** temporary network change. **Grounds** are used to model temporary grounds placed on equipment while crews are working in a de-energized area, for safety reasons.



IEC

Figure 13 – TemporaryNetworkChanges message payload, Ground details

Figure 14 shows the payload for a **jumper** temporary network change. A **jumper** is used to model a temporary conductor, used to temporarily energize the network when the permanent equipment is unable to do so, for example when there is a network fault.



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Figure 14 – TemporaryNetworkChanges message payload, Jumper Details

5.5 SwitchingPlan payload

5.5.1 General

SwitchingPlan message payloads are designed to communicate a set of switching actions that form a sequence to manage a complete operational task. Figure 15 shows a sequence diagram that illustrates the creation of a switching plan. Use cases include:

- Fault Management proposes one or more switching plans as alternative solutions for fault or work area isolations and/or service restoration.
- Network optimization applications such as Volt/Var control, optimal feeder reconfiguration, etc. propose one or more switching plans as alternative solutions to optimize the entire distribution grid or selected parts of the distribution grid.
- A request to generate a switching plan may be result of a user interaction or issued from an application as part of a complete workflow like fault location, isolation and restoration.

A switching plan may include non-network actions such as placement or removal of tags, placement or removal of temporary elements, or general instructions to a field crew or operator.

A switching plan may be communicated between different parties during its life cycle

- A switching plan is created
- A switching plan is validated
- A switching plan is approved
- A switching plan is executed

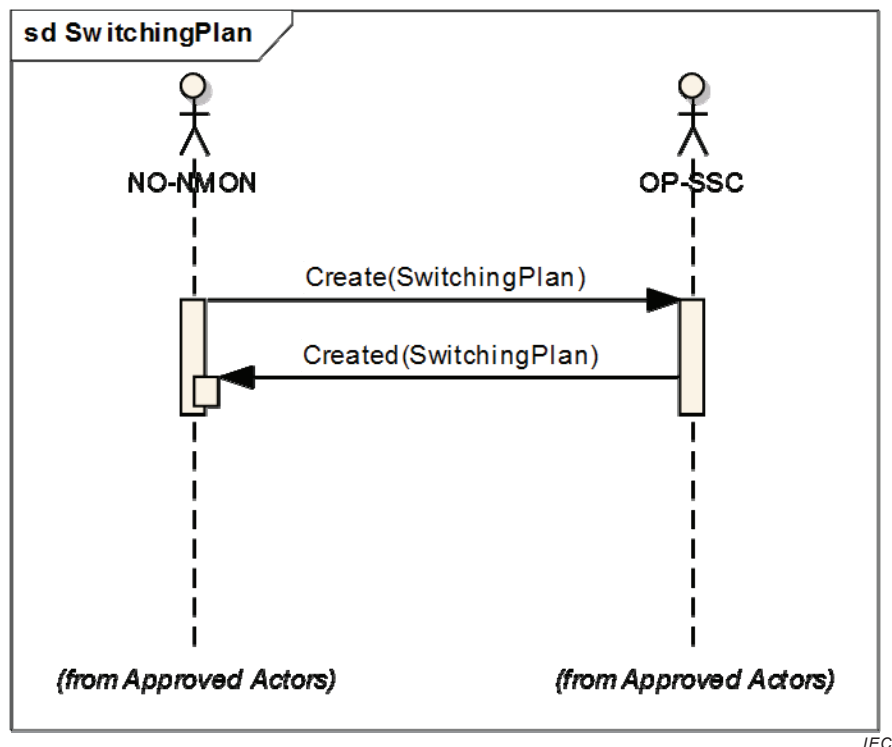
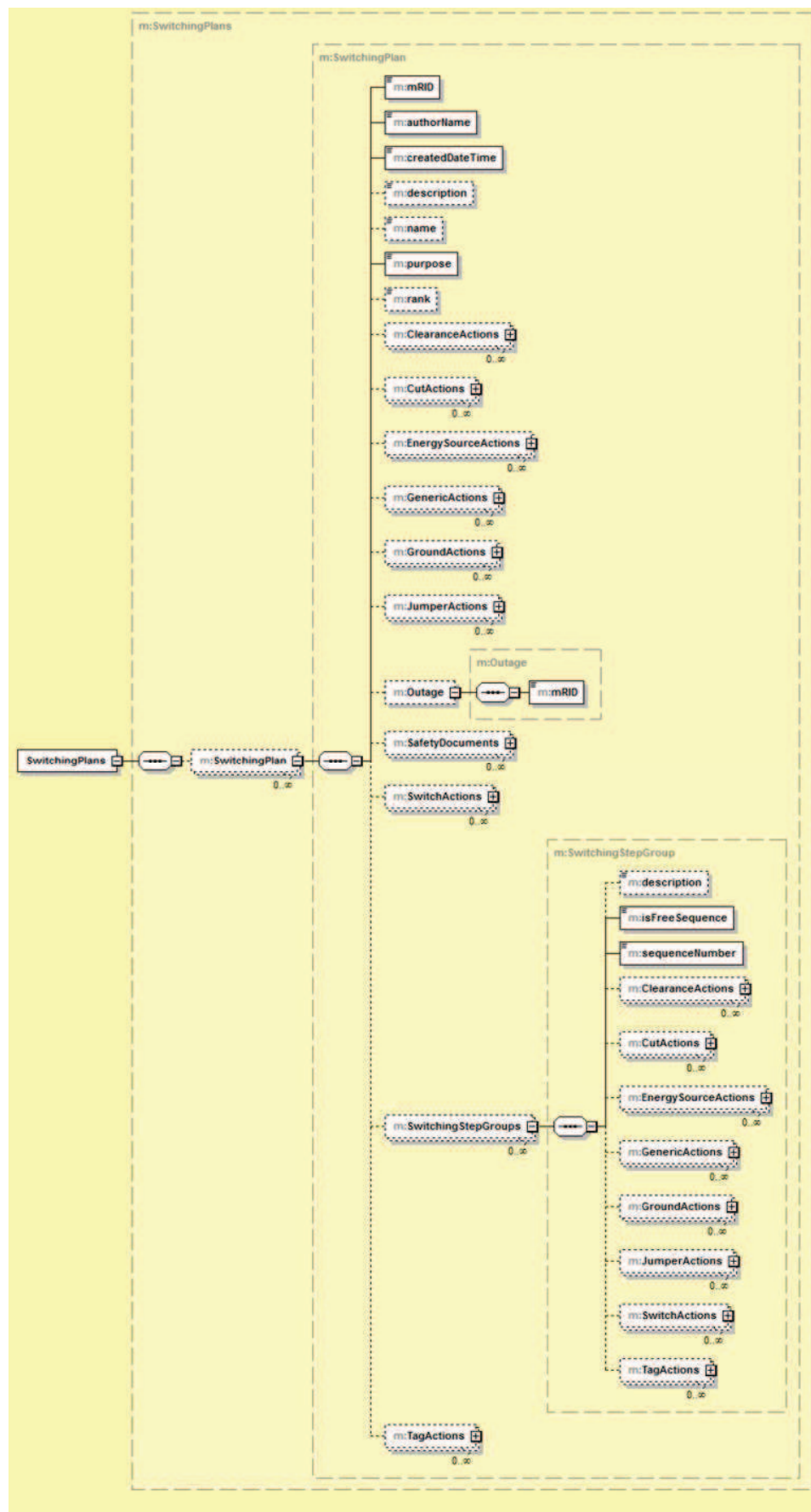


Figure 15 – Switching Plan

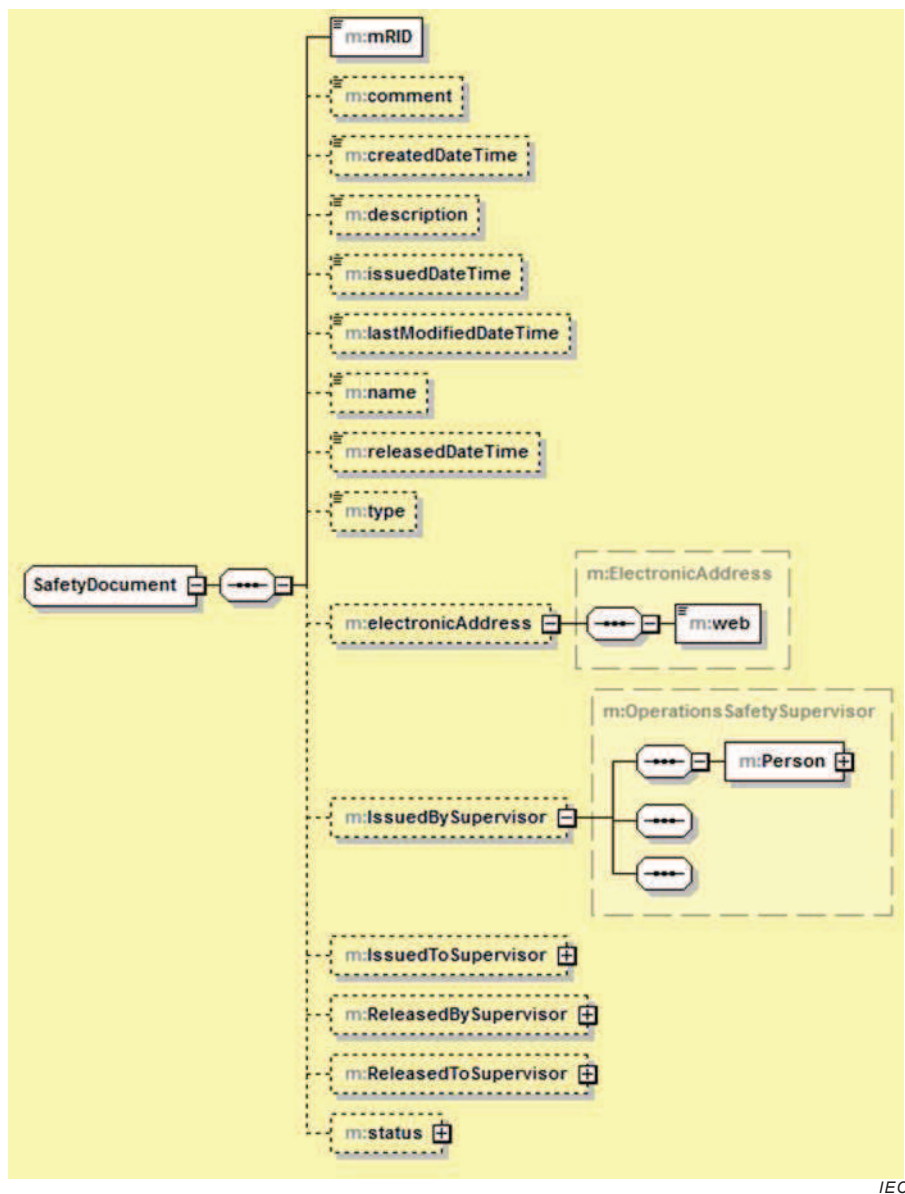
5.5.2 Message payload

This message payload, shown in Figure 16, can be used for exchanging 0 to many switching plans. Each switching plan may include 0 to many switching actions and/or switching step groups. Switching step groups are used to define the sequence (order) for groups of actions. Optionally, each switching plan may include safety documents (shown in Figure 17).



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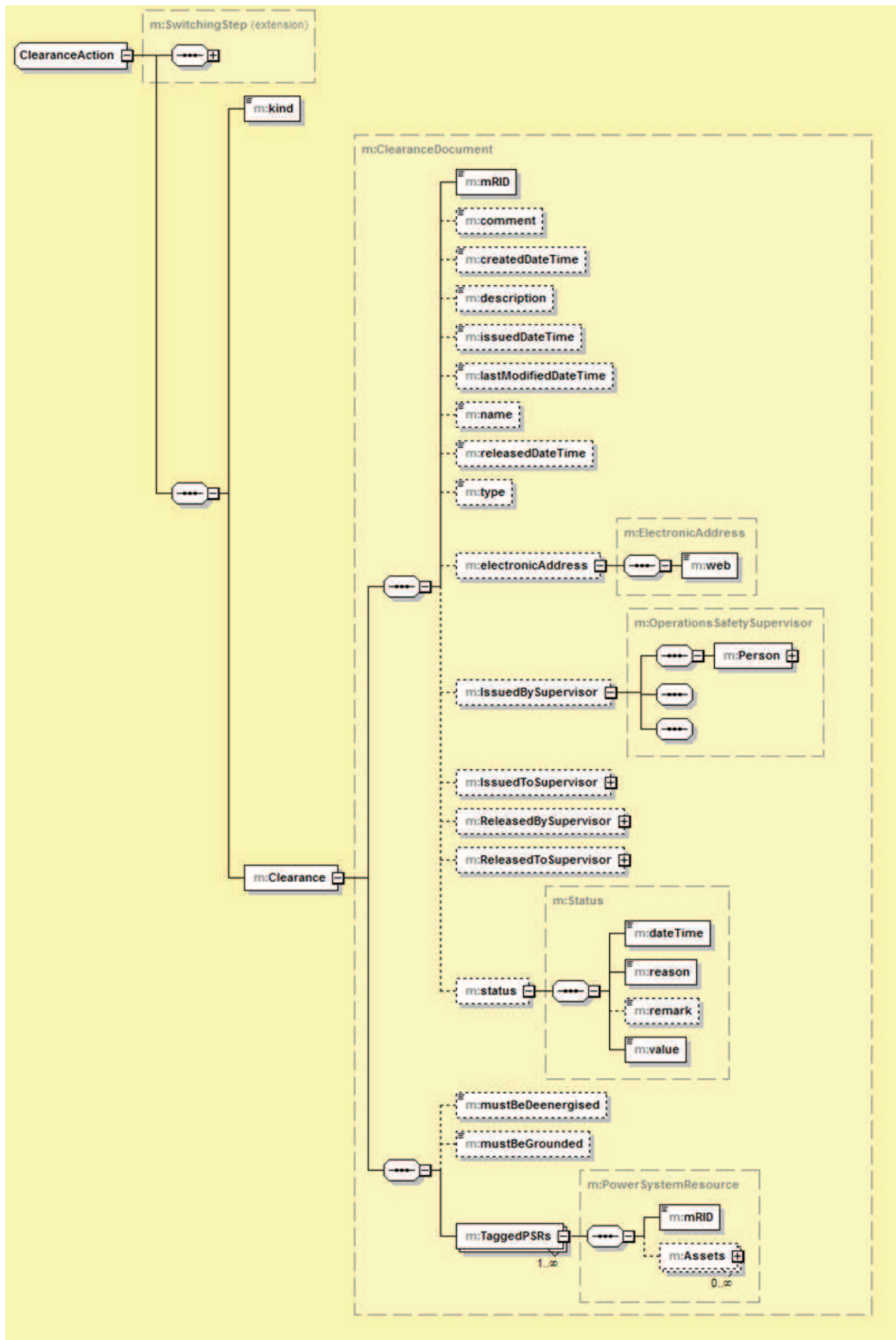
Figure 16 – SwitchingPlans message payload



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Figure 17 – SwitchingPlans message payload, SafetyDocument detail

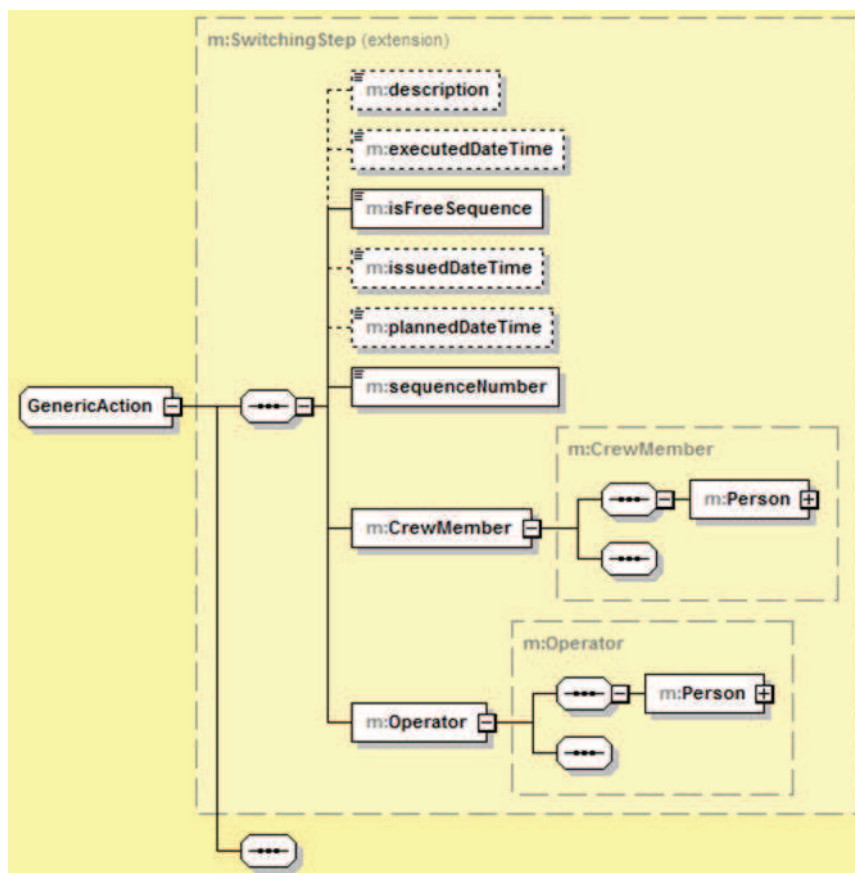
ClearanceActions, shown in Figure 18, covers the steps to clear equipment for maintenance work and document the corresponding switching actions to isolate the respective equipment.



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Figure 18 – SwitchingPlan message payload, ClearanceAction detail

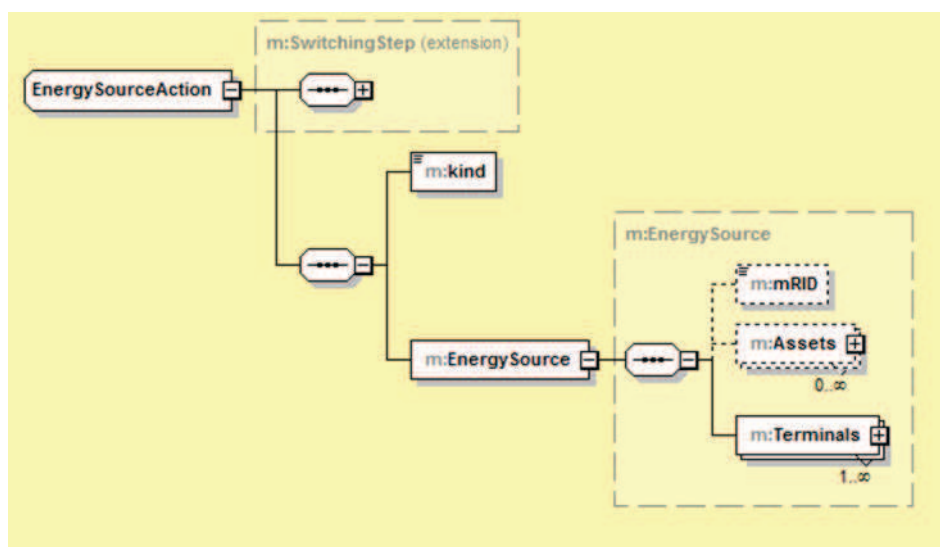
Figure 19 shows the **GenericAction** message payload. Generic actions within a switching plan define the set of actions that are performed as a switching step that do not impact the state of the network or perform an action on the network that is not modelled.



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Figure 19 – SwitchingPlan message payload, GenericAction detail

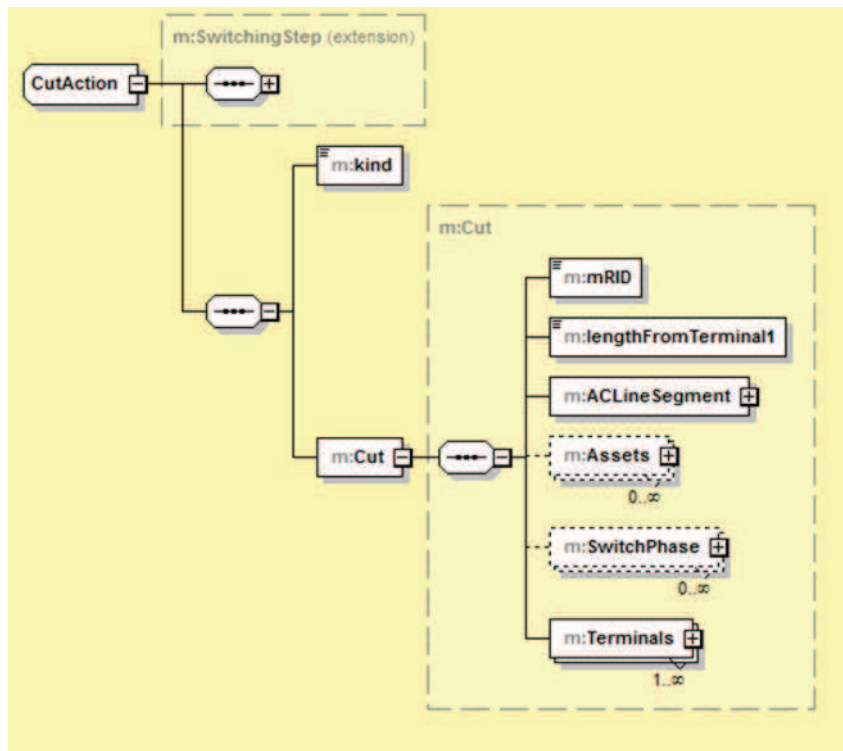
Figure 20 defines the payload for **EnergySourceAction**, which is used to specify a switching step to add or remove a temporary **EnergySource**.



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Figure 20 – SwitchingPlan message payload, EnergySourceAction detail

Figure 21 defines the payload for a **CutAction**, which is used to specify a switching step to add or remove a **Cut** to/from a conductor.



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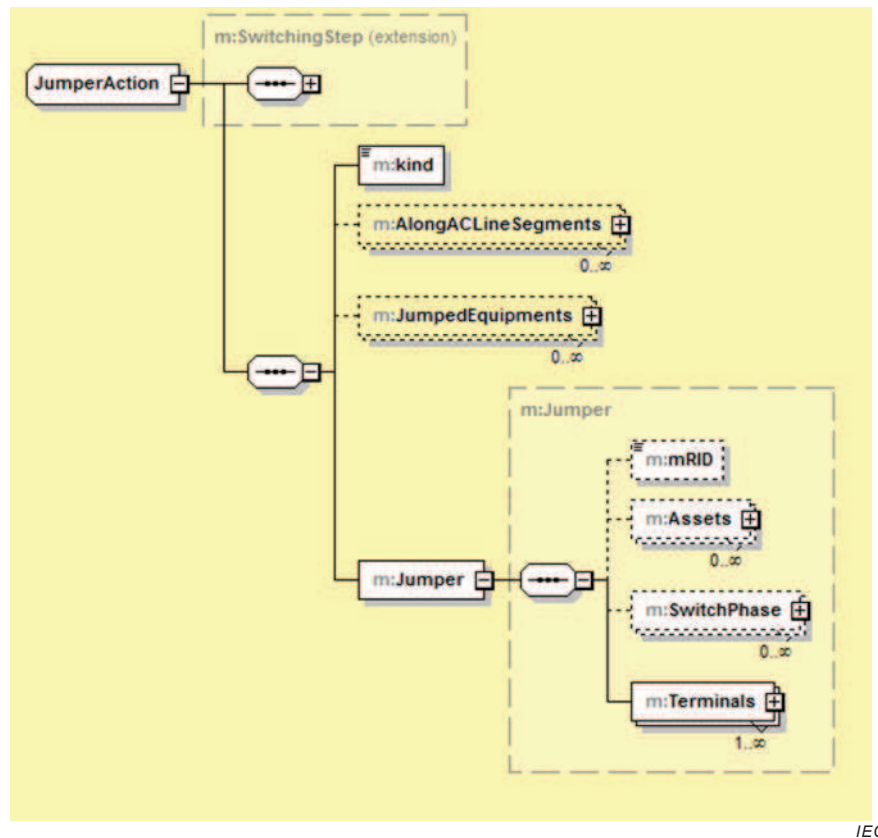
Figure 21 – SwitchingPlan message payload, CutAction detail

Figure 22 defines the payload for a **GroundAction**, which is used to specify a switching step to add or remove a **Ground** to/from a conductor or equipment.



Figure 22 – SwitchingPlan message payload, GroundAction detail

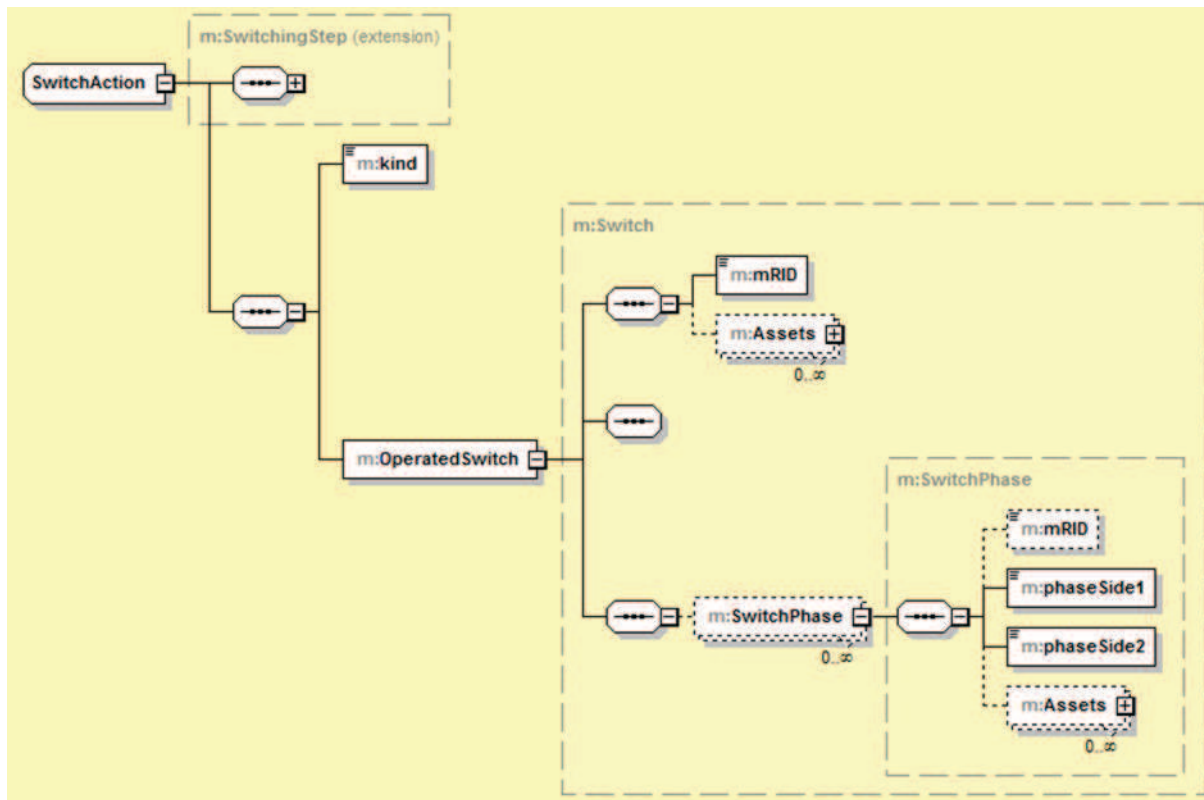
Figure 23 defines the payload for a **JumperAction**, which is used to specify a switching step to add or remove a **Jumper**.



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Figure 23 – **SwitchingPlan** message payload, **JumperAction** detail

Figure 24 defines the payload for **SwitchingAction**, which is used to specify a switching step to open or close one or more phases of an **OperatedSwitch**.



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Figure 24 – SwitchingPlan message payload, SwitchingAction detail

Figure 25 defines the payload for **TagAction**, which is used to specify a switching step to add or remove an **OperationalTag**.

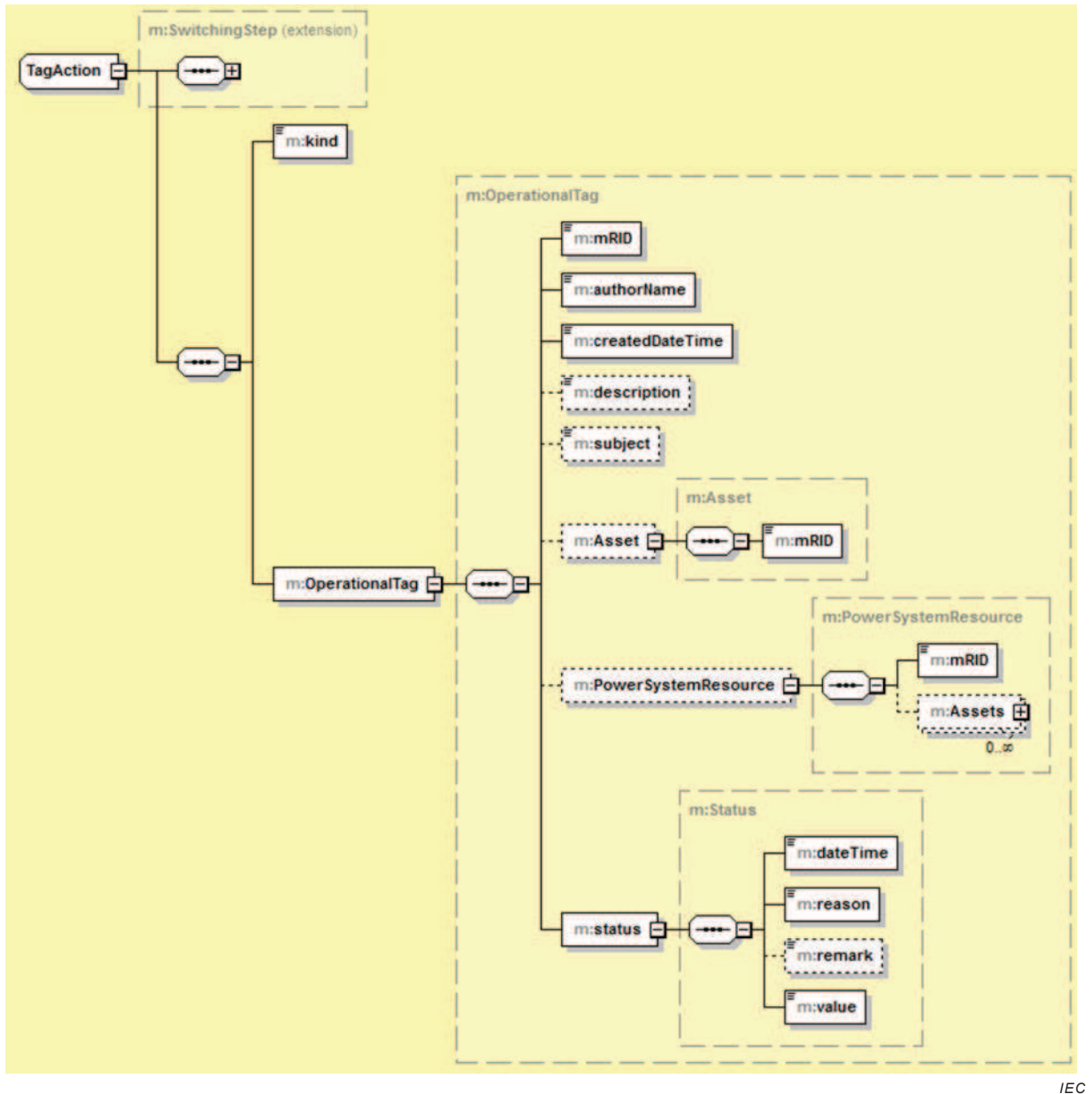


Figure 25 – SwitchingPlan message payload, TagAction detail

For details of Temporary Network Changes such as **Cut**, **Ground** and **Jumpers**, see also 0.

For details of Operation Tags see also 0.

5.6 OperationalTags payload

5.6.1 General

OperationalTags message payloads are designed to communicate creation and removal of tags such as Do Not Operate, Control Inhibit, Out of Service, etc. A tag is associated with a field resource and typically constrains the operation of the respective field resource. Tags are created and removed in SCADA typically upon a user's request. Tags may also be created and deleted as part of switching plans. Figure 26 shows the sequence diagram to create and delete an **OperationalTag**.

Tag message payloads may be used by applications that need to consider the existence of tags as constraints when operating field resources. Use cases include:

- When performing fault isolation, the field crew applies a Do Not Operate tag to all isolating switches, which means those switches may not be operated for purposes other than isolating the respective equipment as long as the fault is under repair
- After a fault is repaired, the Do Not Operate tags are removed by the field crew.
- An operator may apply a control inhibit tag to a switch in case the equipment may not be operated due to known technical or communication problems.
- An operator changes the comments on a tag to communicate details with the next operator after a shift change
- After the problems are resolved, the control inhibit tag is removed by the operator.

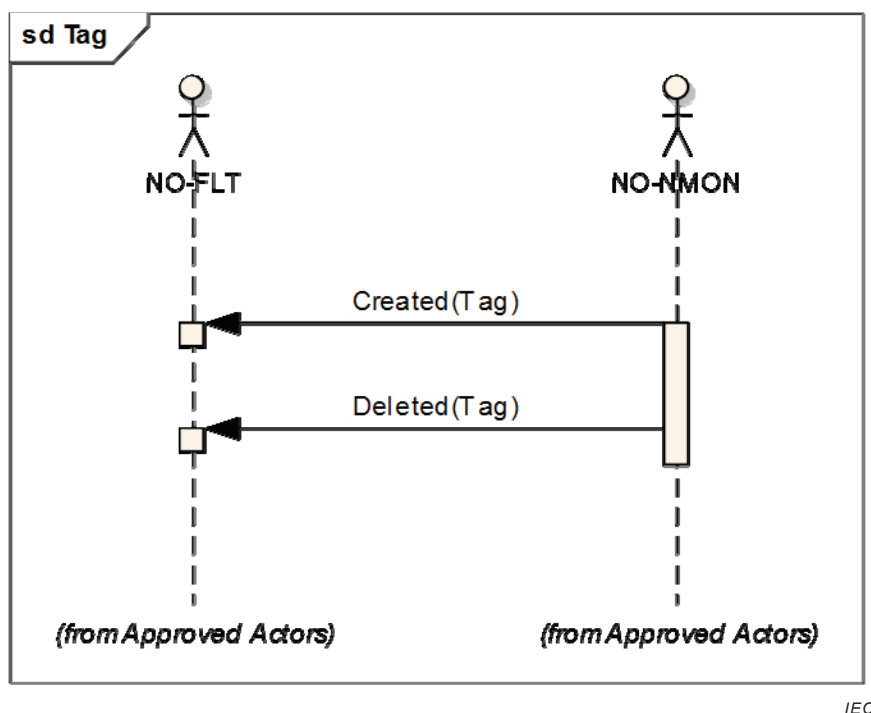
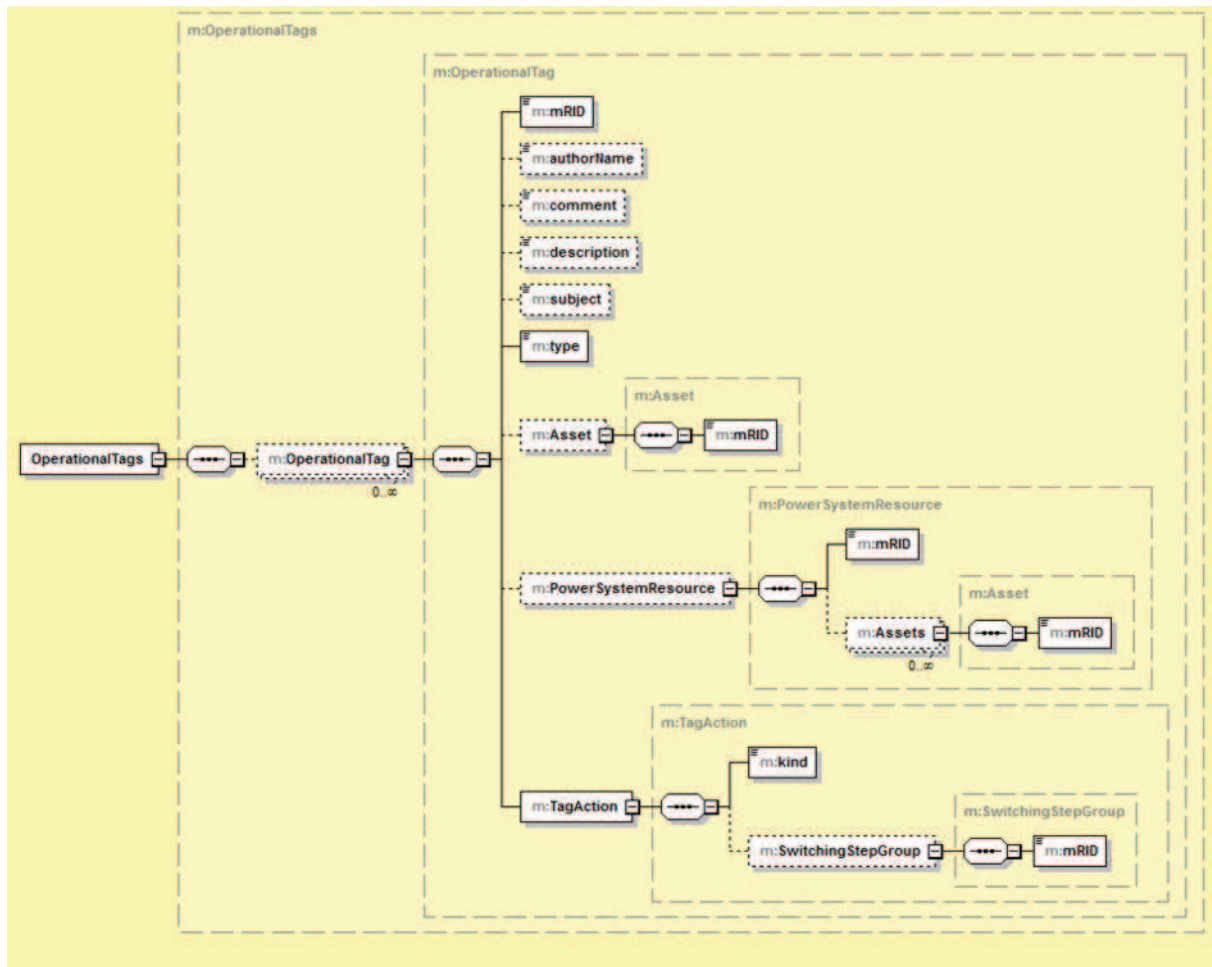


Figure 26 – Tags

5.6.2 Message payload

This message payload, shown in Figure 27, can be used to communicate creation and removal of operational tags.



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Figure 27 – OperationalTags message payload

5.7 TroubleTicket payload

TroubleTicket message payloads are designed to communicate customer reported outages and related information through the lifecycle of a trouble call. Typically Trouble Call Management (TCM) notifies of new outages reported by customers. OMS and DMS may use this information for outage/fault analysis. After the outage is identified, an incident is created for response to the outage. Figure 28 shows the sequence for creating a **TroubleTicket**, creating an **Incident** and updating an **Incident**.

- TCM creates a Trouble Ticket to notify fault management of a new outage
- TCM updates a Trouble Ticket to notify of changes due to another call from the customer
- Fault management checks whether this trouble ticket relates to an outage that is already in progress.
 - If the trouble ticket relates to an outage that is already in progress, Fault Management replies with the corresponding Incident. The incident includes the information whether the outage is already confirmed or still in a predicted state
 - If the trouble ticket identifies a new outage, fault management replies with a new created incident
- Fault Management processes the outage based on all available information such as SCADA events, meter power off events and information from the field crew. As result of this processing, the outage will be confirmed or not confirmed. In both cases, fault management will update TCM with the Incident which will show the confirmation status to either “confirmed” or “not confirmed”.

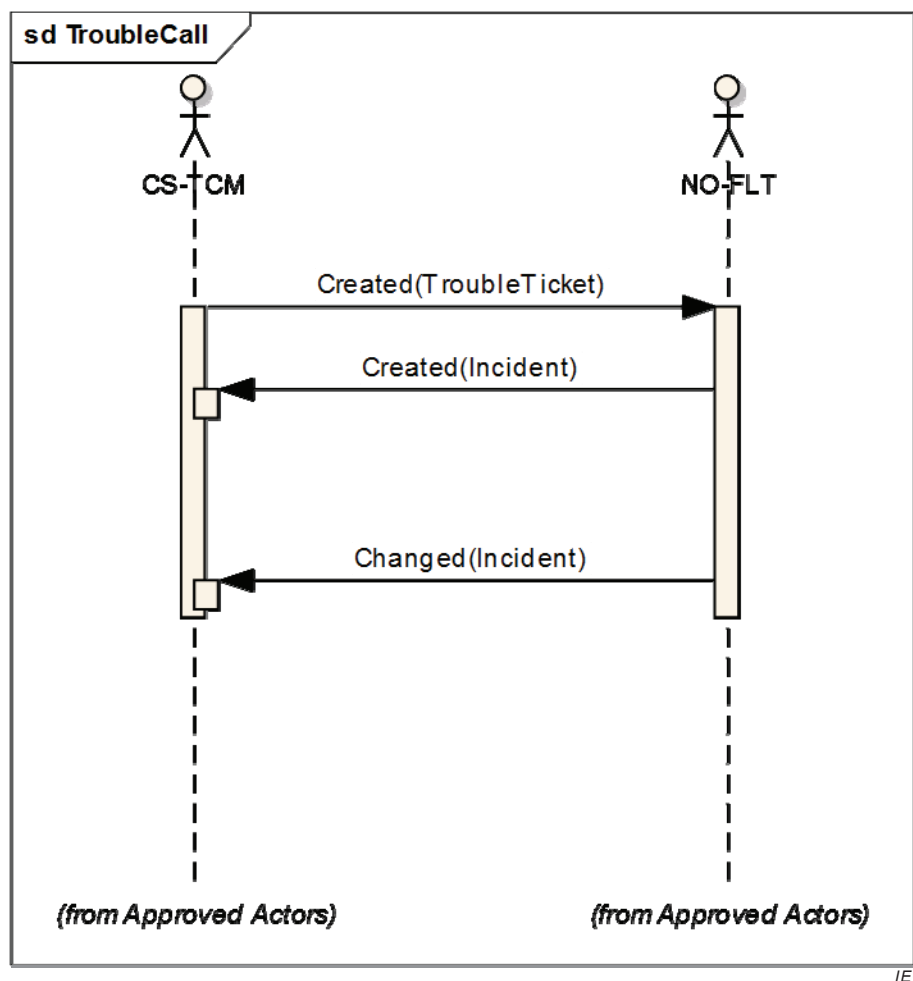


Figure 28 – Trouble Ticket

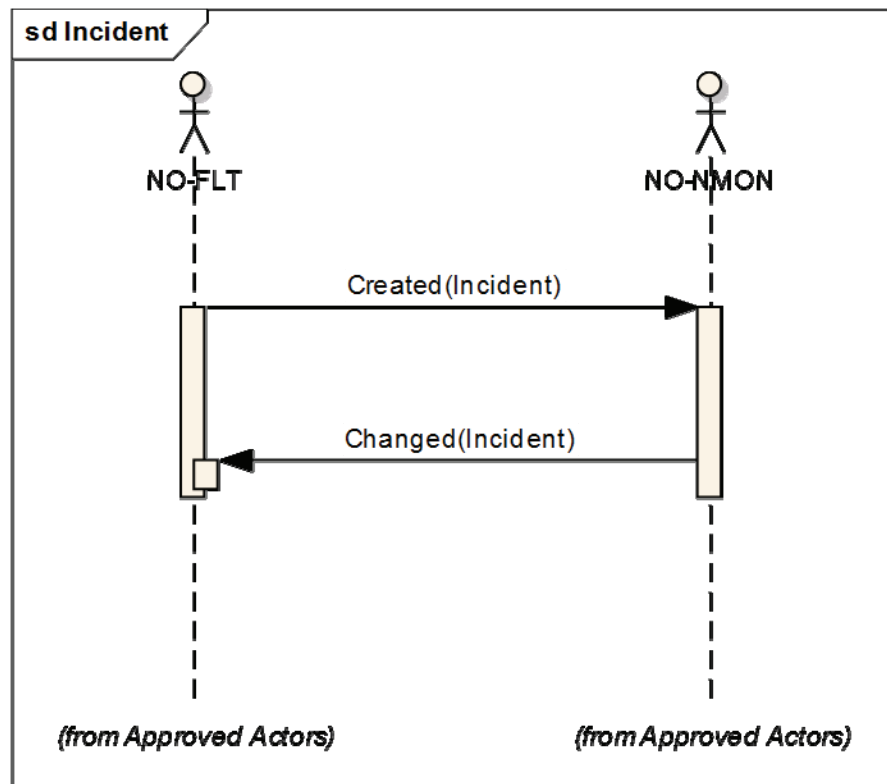
For further details regarding TroubleTickets payload, see IEC 61968-8.

5.8 Incident payload

5.8.1 General

Incident message payloads are designed to communicate a problem in the field and are shown in Figure 30. Typically, but not always, an **Incident** is associated with an **Outage**.

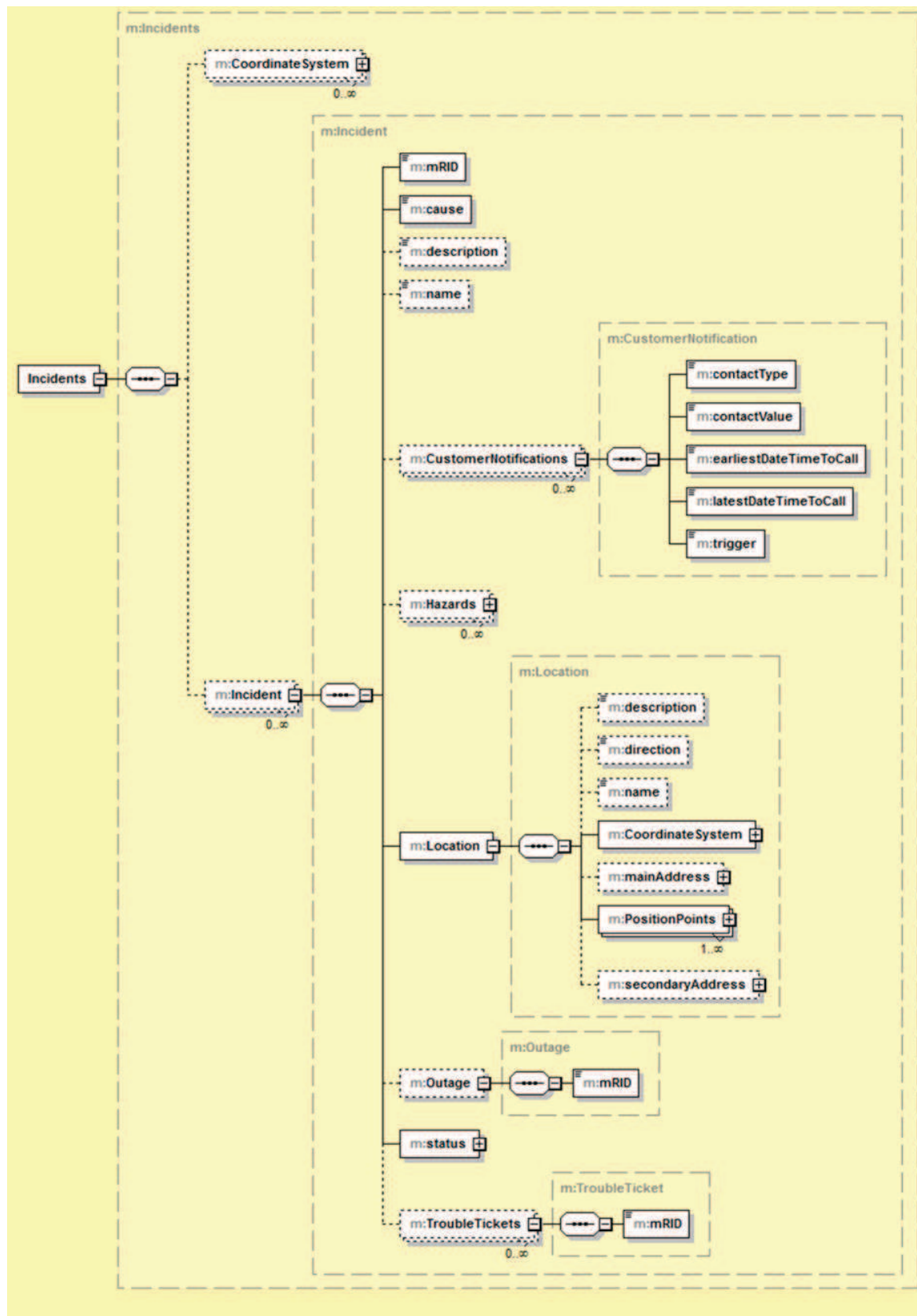
- Fault Management creates an incident for each identified outage (see Figure 29). An outage is identified based on any of the following inputs or any combination of these inputs:
 - A customer reported outage reported through a Trouble Ticket from TCM
 - A breaker trip reported through a Digital Measurement by a SCADA system
 - A meter power down status reported through an End Device Event by an AMI.
- Fault Management updates the Incident based on the state of outage analysis (see Figure 29); this is to provide the following information to TCM:
 - Is the corresponding outage confirmed or not
 - Is the respective customer still out of power or is the outage already resolved and the trouble ticket can be closed.
 - The hazard that is causing the trouble, e.g. line down, transformer fire, etc.



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Figure 29 – Incident

5.8.2 Message payload



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Figure 30 – Incident message payload

5.9 Outage payload

5.9.1 General

Outage message payloads, shown in Figure 32, are designed to communicate planned or unplanned outages. An **outage** is created and changed as shown the sequence diagram, Figure 31.

- Unplanned outages occur as result of faults such as short circuit faults and downed lines.
- Planned outages occur during maintenance work and during network extension and modification work.

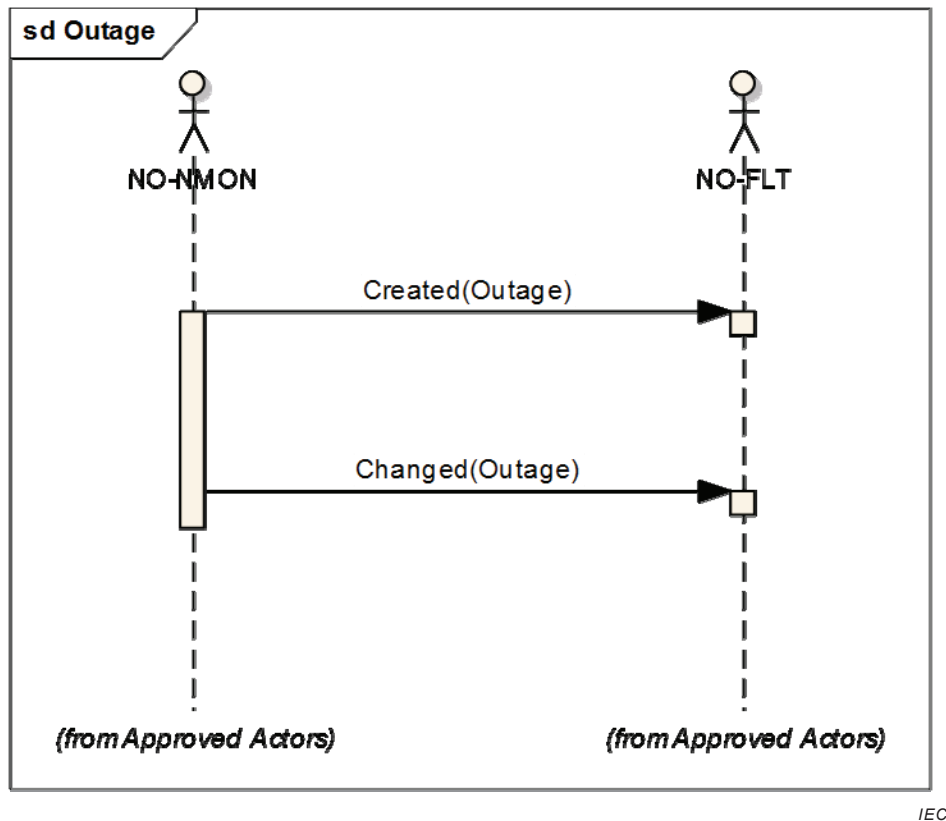


Figure 31 – Outage

Outage information may be used by different applications depending on the type and cause of the outage:

- Unplanned outages
 - After an outage is detected via remote devices, for instance a device trip detected by SCADA, Network Management will inform Fault Management for further processing of this outage.
 - In the case of a customer reported outage, Trouble Call Management will inform Fault Management for further processing of this outage as part of the Incident information.
 - In case AMI detects and reports meter power out, Trouble Call Management will inform Fault Management for further processing after this is evaluated to be a potential outage.
 - After an outage is confirmed, Fault Management will request a switching plan for isolation and service restoration. Based on this request an application (i.e. Switch Action Scheduling) will determine the necessary steps to isolate the fault and to restore power to the healthy islands of the network. The variants may show additional information that supports the user in choosing the best alternative.

- During the lifecycle of outages, the outage information is updated, e.g. to notify about changed outage state (expected restoration time, customers are partially or completely restored to power, etc.).
- Planned outages
 - While planning maintenance and construction work, Fault Management notifies interested parties about outages that will occur as result of this work. This notification includes affected customers, outage schedule, etc.
 - During the lifecycle of those outages, the outage information is updated, including changed outage state (outage is in effect, outage is completed, customers are partially or completely restored to power, etc.)