

BS EN 61968-9:2014



BSI Standards Publication

Application integration at electric utilities — System interfaces for distribution management

Part 9: Interfaces for meter reading and control

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

National foreword

This British Standard is the UK implementation of EN 61968-9:2014. It is identical to IEC 61968-9:2013. It supersedes BS EN 61968-9:2009 which is withdrawn.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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2014.
Published by BSI Standards Limited 2014

ISBN 978 0 580 79197 0
ICS 33.200

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2014.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 61968-9

April 2014

ICS 33.200

Supersedes EN 61968-9:2009

English version

**Application integration at electric utilities -
System interfaces for distribution management -
Part 9: Interfaces for meter reading and control
(IEC 61968-9:2013)**

Intégration d'applications pour les services
électriques -
Interfaces système pour la gestion de
distribution -
Partie 9: Interfaces pour le relevé et la
commande des compteurs
(CEI 61968-9:2013)

Integration von Anwendungen in Anlagen
der Elektrizitätsversorgung -
Systemschnittstellen für Netzführung -
Teil 9: Zählerfernauslesung und -
steuerung
(IEC 61968-9:2013)

This European Standard was approved by CENELEC on 2013-11-20. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels

© 2014 CENELEC - All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Ref. No. EN 61968-9:2014 E

AVA Documents
Document Sharing Hub

Foreword

The text of document 57/1377/FDIS, future edition 1 of IEC 61968-9, 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 61968-9:2014.

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) 2014-10-11
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-11-20

This document supersedes EN 61968-9:2009.

EN 61968-9:2014 includes the following significant technical changes with respect to EN 61968-9:2009:

- a) changes to and addition of new profiles to support PAN and Usage Points;
- b) extensions to support PAN devices generically as EndDevices;
- c) extensions to the MeterReading model and profiles to support richer descriptions of metered quantities and to accommodate coincident readings;
- d) addition of CIM Name class and corresponding revisions to profiles to allow reference by name instead of by mRID. Where the document may identify the use of mRID values as references, Name.name values may be alternatively used. This is described in more detail in Annex G;
- e) reference of ReadingTypes, EndDeviceEventTypes and EndDeviceControlTypes using name references;
- f) definition of normative enumerations for ReadingTypes, EndDeviceEventTypes and EndDeviceControlTypes in annexes;
- g) various corrections to example sequence diagrams;
- h) Removal of MeterAssetReading profile, where functionality is supported using the MeterReading profile;
- i) MeterAsset class is now named Meter;
- j) MeterAssetConfig profile now named MeterConfig;
- k) EndDeviceAssets profile now named EndDeviceConfig;
- l) removal of EndDeviceFirmware profile, where functionality is supported using the EndDeviceConfig profile;
- m) use of new namespaces to reflect the new edition, where the namespaces is reflective of the year in which a profile is defined;
- n) adoption of UsagePoint as a replacement for and a generalization of

ServiceDeliveryPoint;

- o) SDPLocationConfig has been deprecated in favor of UsagePointLocationConfig;
- p) some profiles previously defined have been moved into the new subclause 5.10 which is focused on data linkages;
- q) elimination of the MeterSystemEvents profile, as it provided no functionality that could not be achieved with the EndDeviceEvents profile;
- r) there were several profiles originally defined in support of prepayment use cases that were identified to be more general in nature, and were consequentially moved to 5.10. Subclause 5.8 now consists of only those profiles that are specific to prepayment. In all cases there has been some refactoring of these profiles to reflect other necessary changes that have been described;
- s) supplierConfig has been renamed ServiceSupplierConfig;
- t) messages using the SUBSCRIBE verb have been removed as these are related to the underlying communication transport and do not reflect actual EN 61968 messages.

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 61968-9:2013 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 61970-552	NOTE	Harmonised as EN 61970-552 (not modified).
IEC 62056 (Series)	NOTE	Harmonised as EN 62056 (Series) (not modified).

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 60050-300	-	International Electrotechnical Vocabulary - Electrical and electronic measurements and measuring instruments - Part 311: General terms relating to measurements - Part 312: General terms relating to electrical measurements - Part 313: Types of electrical measuring instruments - Part 314: Specific terms according to the type of instrument	-	-
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 61968-11	-	Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distribution	EN 61968-11	-
IEC 61968-100	2013	Application integration at electric utilities - System interfaces for distribution management - Part 100: Implementation profiles	EN 61968-100	2013
IEC 61970-301	-	Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base	EN 61970-301	-
IEC/TR 62051-1 + corr. June	-	Electricity metering - Data exchange for meter reading, tariff and load control - Glossary of terms - Part 1: Terms related to data exchange with metering equipment using DLMS/COSEM	-	-
ISO 8601	2004	Data elements and interchange formats - Information interchange - Representation of dates and times	-	-

CONTENTS

INTRODUCTION.....	12
1 Scope.....	14
2 Normative references	15
3 Terms, definitions and abbreviations	16
3.1 Terms and definitions.....	16
3.2 Abbreviations	17
4 Reference and information models	18
4.1 General approach to metering systems	18
4.2 Reference Model.....	19
4.2.1 General	19
4.2.2 Metering system (MS) – Data collection	22
4.2.3 Metering system (MS) – Control and reconfiguration	23
4.2.4 Load control	23
4.2.5 Load management system (LMS).....	23
4.2.6 Meter asset management (MAM) system	24
4.2.7 Meter data management (MDM) system.....	24
4.2.8 Customer information system (CIS)	24
4.2.9 Outage management system (OMS)	24
4.2.10 Network operations (NO)	25
4.2.11 Meter maintenance (MM)	25
4.2.12 Planning	25
4.2.13 Work management (WM)	25
4.2.14 Point of sale (POS).....	25
4.2.15 Meter.....	25
4.2.16 Load control devices.....	25
4.2.17 PAN devices	26
4.2.18 Demand response management system (DRMS)	26
4.3 Interface reference model	26
4.4 Meter reading and control functions and components.....	26
4.5 Static information model	27
4.5.1 General	27
4.5.2 Classes for meter reading and control	28
4.5.3 Classes related to meter reading and control	32
5 Meter reading and control message types.....	33
5.1 General.....	33
5.2 End device event messages.....	33
5.2.1 General	33
5.2.2 Applications	34
5.2.3 Message format	40
5.3 Meter reading messages	42
5.3.1 General	42
5.3.2 Applications	42
5.3.3 Message formats	47
5.4 End device control messages.....	58
5.4.1 General	58

5.4.2	Applications	58
5.4.3	Message format	65
5.5	Meter service requests	68
5.5.1	General	68
5.5.2	Applications	69
5.5.3	Message format	72
5.6	Metering system events	73
5.6.1	General	73
5.6.2	Applications – Firmware upgrade	74
5.6.3	Message formats	74
5.7	Customer switching	74
5.7.1	General	74
5.7.2	Message formats	75
5.8	Payment metering service messages	75
5.8.1	General	75
5.8.2	Auxiliary agreements	75
5.8.3	Applications	76
5.8.4	Message formats	77
5.9	Premise area networks	80
5.9.1	General	80
5.9.2	Applications	81
5.9.3	Message formats	83
5.10	Master data management messages	83
5.10.1	General	83
5.10.2	Applications	84
5.10.3	Message formats	91
6	Document conventions	104
6.1	UML diagrams	104
6.2	Message definitions	105
6.2.1	General	105
6.2.2	Mandatory vs. optional	105
6.2.3	Verb tense	105
6.3	Synchronous versus asynchronous messages	105
6.4	Depiction of simple acknowledgment messages	105
Annex A (normative)	Description of message type verbs	106
Annex B (informative)	Reply error codes	108
Annex C (normative)	Procedure for the generation of a ReadingType name	115
Annex D (normative)	Quality code enumerations	170
Annex E (normative)	EndDeviceEventType enumerations	183
Annex F (normative)	EndDeviceControlType enumerations	221
Annex G (normative)	Conventions for naming and identifying objects	224
Annex H (normative)	XML schemas for message payloads	227
Annex I (informative)	XML schemas for message payloads	314
Annex J (normative)	Request parameters	389
Annex K (normative)	Master data management transaction processing	395
Annex L (informative)	Master data management use cases and sample XML	402
Annex M (informative)	Notes on extended use of IEC 61968-100	438

Bibliography.....	440
Figure 1 – IEC 61968-9 scope	15
Figure 2 – Example of an end device with functions	20
Figure 3 – IEC 61968-9 reference model.....	21
Figure 4 – IEC 61968-9 Reference model with customer information and billing system.....	22
Figure 5 – Outage Detection, request/reply message exchange, example 1	35
Figure 6 – Outage Detection, request / reply message exchange, Example 2.....	36
Figure 7 – Outage Detection, publish/subscribe exchange, Example 1	37
Figure 8 – Outage Detection, publish/subscribe exchange, Example 2.....	37
Figure 9 – Meter Health Event exchange, Example 1	38
Figure 10 – Meter Health Event exchange, Example 2	39
Figure 11 – Power quality event exchange, Example 1	39
Figure 12 – Power quality event exchange, Example 2	40
Figure 13 – End device event message format.....	41
Figure 14 – Example use of meter read schedule to create subscription	43
Figure 15 – Example manual meter reading exchange	44
Figure 16 – Example On-Request meter read	45
Figure 17 – Historical MeterData exchange.....	46
Figure 18 – Example billing inquiry message exchange	46
Figure 19 – Meter readings message format	47
Figure 20 – Reading structure.....	48
Figure 21 – Timestamps assigned between systems.....	49
Figure 22 – Conventions for timeStamp and timePeriod	49
Figure 23 – IntervalBlock structure	50
Figure 24 – Interval data timestamp generation	51
Figure 25 – Time interval conventions.....	51
Figure 26 – ReadingType structure	52
Figure 27 – Meter read schedule message format.....	57
Figure 28 – Example load control message exchange	59
Figure 29 – Example message exchange for LC unit installation	60
Figure 30 – Example message exchange for change of customer program	61
Figure 31 – Example message exchange for change of customer program w/o MDM	61
Figure 32 – Example for change of customer program with meter change out	62
Figure 33 – Example message exchange for meter connect/disconnect	63
Figure 34 – Example of remote connect/disconnect directly between CIS and MS	64
Figure 35 – Example message exchange for real-time price signal	65
Figure 36 – End device controls message format.....	66
Figure 37 – Example meter installation and removal message exchange	69
Figure 38 – Example end device event message exchange due to meter changeout.....	70
Figure 39 – Example message exchange due to CIS alarms	71
Figure 40 – Example message exchange when meter is changed out for recalibration.....	72
Figure 41 – Meter service requests message format	73

Figure 42 – Example firmware upgrade message exchange	74
Figure 43 – Example customer switching message exchange	75
Figure 44 – Message exchange for transferring auxiliary agreement information	76
Figure 45 – Message exchange for transferring receipt information	77
Figure 46 – Message exchange for transferring transaction information	77
Figure 47 – Auxiliary agreement configuration message format	78
Figure 48 – ReceiptRecord message format	79
Figure 49 – TransactionRecord message format	80
Figure 50 – Pairing of a PAN device	81
Figure 51 – PAN device events	82
Figure 52 – PAN device controls	83
Figure 53 – Master data linkages	85
Figure 54 – Message exchange for transferring supplier information	86
Figure 55 – Message exchange for transferring customer information	87
Figure 56 – Message exchange for transferring customer agreement information	87
Figure 57 – Message exchange for transferring customer account information	88
Figure 58 – Message exchange for transferring service category information	88
Figure 59 – Message exchange for transferring usage point information	89
Figure 60 – Message exchange for transferring meter information	89
Figure 61 – Message exchange for transferring end device information	90
Figure 62 – Message exchange for transferring service location information	91
Figure 63 – Message exchange for transferring pricing structures	91
Figure 64 – MasterDataLinkageConfig message format	92
Figure 65 – Service supplier configuration message format	93
Figure 66 – Customer configuration message	94
Figure 67 – Customer agreement configuration message	95
Figure 68 – Customer account configuration message	96
Figure 69 – ServiceCategoryConfig message format	96
Figure 70 – UsagePointConfig message format	97
Figure 71 – UsagePointLocationConfig message format	99
Figure 72 – End device config message format	100
Figure 73 – Meter configuration message	101
Figure 74 – ComModuleConfig message format	102
Figure 75 – ServiceLocationConfig message format	103
Figure 76 – PricingStructureConfig message format	104
Figure B.1 – Reply Message States	114
Figure C.1 – Typical enumerations for accumulation behaviour	123
Figure C.2 – Typical enumerations for direction of flow	130
Figure C.3 – Voltage measurements	137
Figure E.1 – Event data	184
Figure G.1 – CIM naming	224
Figure G.2 – Example XML structure for names	225
Figure G.3 – Use of names for references	226

Figure J.1 – Message request structure	389
Figure J.2 – GetMeterReadings	390
Figure J.3 – GetEndDeviceConfig	391
Figure J.4 – GetCustomerMeterDataSet.....	392
Figure J.5 – GetMeterServiceRequests	393
Figure K.1 – Message Envelope Extension	396
Figure K.2 – OperationSet	397
Figure K.3 – Pattern 1: Request/response (non-OperationSet).....	398
Figure K.4 – Pattern 2: published event (non-OperationSet)	399
Figure K.5 – Pattern 3: Request/response (OperationSet).....	400
Figure K.6 – Pattern 4: published event (OperationSet)	401
Figure M.1 – Get/cancel pattern which is not recommended.....	438
Figure M.2 – Get/cancel pattern which is recommended	439
Table 1 – Document overview for IEC 61968-9	13
Table 2 – Business functions and abstract components	27
Table 3 – Classes for meter reading and control	28
Table 4 – Classes related to meter reading and control.....	32
Table 5 – IEC 61968-9 configuration profiles	84
Table A.1 – Commonly used verbs.....	106
Table B.1 – ReplyCode Categories	108
Table B.2 – Error-free Enumerations.....	109
Table B.3 – Missing-element Enumerations	109
Table B.4 – Bad-value Enumerations	109
Table B.5 – Too-many-values enumerations	110
Table B.6 – Request-timed-out enumerations	110
Table B.7 – Application-error enumerations	111
Table B.8 – Business-rule-violation enumerations.....	111
Table B.9 – Security issue enumerations	111
Table B.10 – Common enumerations	112
Table C.1 – Time-period of interest enumerations.....	116
Table C.2 – Data qualifier enumerations	116
Table C.3 – measuringPeriod enumerations.....	117
Table C.4 – Demand normalization scalars	119
Table C.5 – Accumulation behaviour enumerations.....	121
Table C.6 – Customary accumulation behaviour enumerations	123
Table C.7 – Direction of flow enumeration.....	124
Table C.8 – DirectionOfFlow enumeration equivalencies.....	130
Table C.9 – Commodity	131
Table C.10 – measurementKind Index	132
Table C.11 – Harmonic and Interharmonic enumerations	138
Table C.12 – Argument enumerations	138
Table C.13 – Time Of Use Enumerations	139

Table C.14 – Critical Peak Period Enumerations	140
Table C.15 – Consumption Tier Enumerations	141
Table C.16 – Example Combinations of TOU and Consumption Tier Enumerations	141
Table C.17 – Phase enumerations	142
Table C.18 – Power of ten enumerations	146
Table C.19 – Historical concentration multiplier enumerations	147
Table C.20 – Base SI units of measure	149
Table C.21 – Derived SI units of measure with special names	149
Table C.22 – Derived SI Units of Measure without Special Names	151
Table C.23 – Non-SI Units of Measure accepted for use with the International System of Units	154
Table C.24 – Dimensionless and Concentration Units of Measure.....	155
Table C.25 – Non-SI units whose values in SI units shall be obtained experimentally	157
Table C.26 – Other Non-SI Units of Measure	158
Table C.27 – Non-SI Units Associated with the CGS and the CGS-Gaussian System of Units	162
Table C.28 – Currency units of measure (from ISO 4217)	163
Table C.29 – ReadingType Examples	165
Table D.1 – System identifier	171
Table D.2 – Example quality code categories.....	171
Table D.3 – Validity related codes	172
Table D.4 – Diagnostics related codes	173
Table D.5 – Power quality related codes	173
Table D.6 – Tamper / revenue protection related codes	174
Table D.7 – Data collection related codes	174
Table D.8 – Failed reasonability testing related codes	176
Table D.9 – Failed validation testing related codes	176
Table D.10 – Edit related codes	177
Table D.11 – Estimation related codes	178
Table D.12 – Questionable related codes.....	179
Table D.13 – Derived related codes	180
Table D.14 – Projected related codes	181
Table D.15 – Example Quality Codes.....	182
Table E.1 – EndDeviceType codes	185
Table E.2 – EndDeviceDomain Codes.....	187
Table E.3 – EndDeviceSubdomain codes.....	188
Table E.4 – EndDeviceEventOrAction codes.....	193
Table E.5 – Battery events.....	200
Table E.6 – Billing events	200
Table E.7 – Cartridge events	201
Table E.8 – Clock events	201
Table E.9 – Communication events	202
Table E.10 – Configuration events	203
Table E.11 – Demand events	204

Table E.12 – Firmware events	204
Table E.13 – GasSupply events	206
Table E.14 – Installation events	206
Table E.15 – LoadControl events	207
Table E.16 – LoadProfile events	207
Table E.17 – Logs events	208
Table E.18 – Memory events	208
Table E.19 – Metrology events.....	209
Table E.20 – MobileSecurity events	210
Table E.21 – Modem events.....	211
Table E.22 – ModuleFirmware events	211
Table E.23 – Network events	211
Table E.24 – PAN / HAN events.....	212
Table E.25 – Power events	213
Table E.26 – Pressure events	216
Table E.27 – RCDSwitch events	217
Table E.28 – Security events	217
Table E.29 – Temperature events	219
Table E.30 – VideoDisplay events.....	219
Table E.31 – WaterSupply events	220
Table F.1 – Demand Controls	221
Table F.2 – LoadControl Controls	222
Table F.3 – PAN / HAN Controls	222
Table F.4 – RCDSwitch Controls.....	222
Table L.1 – Exemplary master data management / data synchronization use cases	403

INTRODUCTION

The purpose of this document is to define a standard for the integration of Metering Systems (MS), which would include traditional (one or two-way) Automated Meter Reading (AMR) Systems, with other systems and business functions within the scope of IEC 61968. The scope of this standard is the exchange of meter reading, transactions, event and control information between systems within the utility enterprise and between enterprises. The specific details of communication protocols those systems employ are outside the scope of this standard. Instead, this standard will recognize and model the general capabilities that can be potentially provided by advanced and/or legacy meter infrastructures, including two-way communication capabilities such as load control, dynamic pricing, outage detection, distributed energy resource (DER) control signals and on-request read. In this way, this standard will not be impacted by the specification, development and/or deployment of next generation meter infrastructures, 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. IEC 61968, by contrast, is intended to support the inter-application integration of a utility enterprise that needs to connect disparate applications that are already built or new (legacy or purchased applications), each supported by dissimilar runtime environments. Therefore, these 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, *Interface architecture and general requirements*.

This part of IEC 61968 contains the clauses listed in Table 1 below.

Table 1 – Document overview for IEC 61968-9

Clause	Title	Purpose
1	Scope	The scope and purpose of the document are described.
2	Normative References	Documents that contain provisions which, through reference in this text, constitute provisions of this International Standard.
3	Terms, Definitions and Abbreviations	
4	Reference and Information Models	Description of general approach to metering system, reference model, use cases, interface reference model, meter reading and control functions and components, message type terms and static information model.
5	Meter Reading and Control Message Types	Message types related to the exchange of information for documents related to meter reading and control.
6	Document Conventions	
Annex A	Message Type Verbs	Description of the Verbs that are used for the message types
Annex B	CIM Extensions	CIM extensions to support the recommended message structure for meter reading and control
Annex C	Procedure for the generation of a ReadingTypeIcd	Technique for constructing, and offers recommended enumerations for the ReadingTypeIcd textual name and mRID.
Annex D	QualityCode enumerations	Technique for constructing, and offers recommended enumerations for reading quality codes
Annex E	EndDeviceEvent Code enumerations	Defines EndDevice alarm and event codes
Annex F	EndDeviceControl code enumerations	Defines EndDevice control codes.
Annex G	Maintaining Relationships Between Objects	Describes the use of the master resource identifier (mRID) and Names.
Annex H	XML Schemas for message payloads	To provide xsd information for use by developers to create IEC 61968-9 messages.
Annex I	Mappings	To provide mappings between IEC 61968-9 MeterReadings and other standards.
Annex J	Request Parameters	Describes the qualification of GET requests using Request parameters.
Annex K	Master Data Management Transaction Processing	Describes how complex Master data Management / Data Synchronization transactions are conveyed and the associated processing rules.
Annex L	Master Data Management Use Cases and Sample XML	Describes many of the common Master Data Management use cases and provides sample XML to illustrate intended usage of the various Master Data Management related profiles.

Future editions of IEC 61968-9 will strive to have changes be 'non-breaking', where the namespace of the previous version may be preserved, but the Revision attribute in the XSD is incremented.

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

Part 9: Interfaces for meter reading and control

1 Scope

This part of IEC 61968 specifies the information content of a set of message types that can be used to support many of the business functions related to meter reading and control. Typical uses of the message types include meter reading, controls, events, customer data synchronization and customer switching. Although intended primarily for electrical distribution networks, IEC 61968-9 can be used for other metering applications, including non-electrical metered quantities necessary to support gas and water networks.

The purpose of this part of IEC 61968 is to define a standard for the integration of metering systems (MS), which includes traditional manual systems, and (one or two-way) automated meter reading (AMR) systems, and meter data management (MDM) systems with other enterprise systems and business functions within the scope of IEC 61968. The scope of this part of IEC 61968 is the exchange of information between metering systems, MDM systems and other systems within the utility enterprise. The specific details of communication protocols those systems employ are outside the scope of this International Standard. Instead, this International Standard will recognize and model the general capabilities that can be potentially provided by advanced and/or legacy meter infrastructures, including two-way communication capabilities such as load control, dynamic pricing, outage detection, distributed energy resource (DER) control signals and on-request read. In this way, this standard will not be impacted by the specification, development and/or deployment of next generation meter infrastructures either through the use of standards or proprietary means.

The diagram in Figure 1 describes the scope of this part of IEC 61968 from the perspective of direct and causal or indirect impacts of IEC 61968-9 messages. Where the focus of IEC 61968-9 is to define standard messages for the integration of enterprise applications, these messages may be directly or indirectly related to information flows within a broader scope. Examples would include messaging between head end systems and meters or PAN devices. The various components described later in this document will typically fall into either the category of a metering system (MS) head end, an MDM or other enterprise application (e.g. OMS, DRMS, CIS).

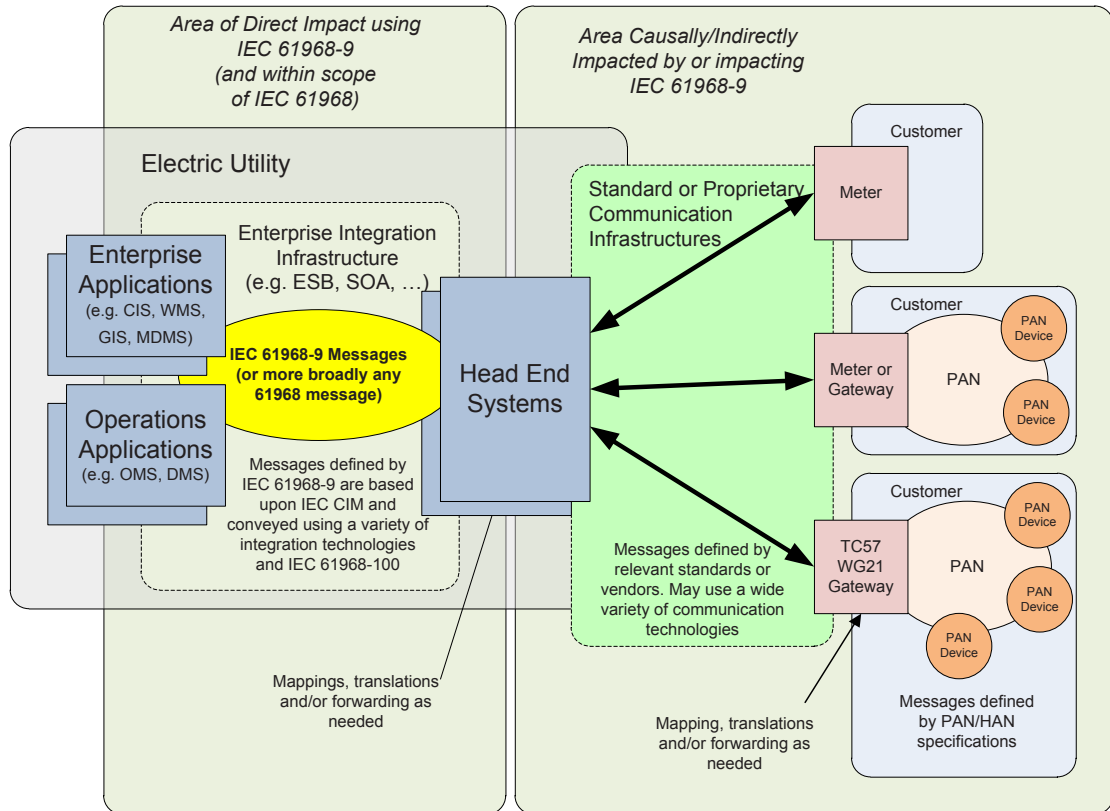


Figure 1 – IEC 61968-9 scope

The capabilities and information provided by a meter reading and meter data management systems are important for a variety of purposes, including (but not limited to) interval data, time-based demand data, time-based energy data (usage and production), outage management, service interruption, service restoration, quality of service monitoring, distribution network analysis, distribution planning, demand response, customer billing and work management. This standard also extends the CIM (Common Information Model) to support the exchange of meter data.

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 60050-300, *International Electrotechnical Vocabulary (IEV) – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements – Part 312: General terms relating to electrical measurements – Part 313: Types of electrical measuring instruments – Part 314: Specific terms according to the type of instrument*

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

IEC/TS 61968-2, *Application integration at electric utilities – System interfaces for distribution management – Part 2: Glossary*

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

IEC 61968-100:2013, *Application integration at electric utilities – System interfaces for distribution management – Part 100: Implementation profiles*

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

IEC/TR 62051-1, *Electricity metering – Data exchange for meter reading, tariff and load control – Glossary of terms – Part 1: Terms related to data exchange with metering equipment using DLMS/COSEM*

ISO 8601:2004, *Data Elements and Interchange Formats – Information Interchange – Representation of Dates and Times*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this standard, the terms and definitions given in IEC 60050-300, IEC/TS 61968-2, IEC/TR 62051-1, IEC 62055-31 and the following terms apply.

NOTE Where there is a difference between the definitions in this standard and those contained in other referenced IEC standards, then those defined in IEC/TS 61968-2 shall take precedence over the others listed, and those defined in IEC 61968-9 shall take precedence over those defined in IEC/TS 61968-2.

3.1.1

customer program

classification scheme for the sale of energy to consumers according to a particular tariff

Note 1 to entry: The program may specify the purpose, conditions on the time of use, the service voltage(s), the volumes consumed, and/or other terms as a condition of the sale.

Note 2 to entry: Utilities may promote particular programs to their industrial, commercial, agricultural, and residential customers in an effort to encourage a particular behaviour, or to make them aware of their options.

3.1.2

demand response

set of processes and programs that are used to reduce consumption

Note 1 to entry: This may be done on an economic, mandatory or emergency basis.

3.1.3

end device

equipment located at the end of the communication system, usually on the customer premises

Note 1 to entry: An end device may perform functions such as metrology, connect/disconnect, load control, demand response, or other functions, and may have power relay and/or local communications capability. This is represented within the CIM using the EndDevice class. Meters and PAN devices are examples of end devices.

3.1.4

head end

component of a metering system that collects data from and issues controls to end devices

Note 1 to entry: A head end may also manage the communication system used to communicate with the end devices. From the perspective of enterprise integration, the head end acts as a proxy for end devices.

3.1.5

gateway

device that may be used to manage devices on a PAN and participate in internet-based interactions

Note 1 to entry: A gateway may apply a transformation from one protocol to another.

3.1.6

load control device

type of EndDevice which can receive signals causing it to shed load for the purposes of maintaining network reliability and/or commercial agreements

3.1.7

meter

type of end device which performs metrology and supports the tariffing of the distribution and/or transmission network

Note 1 to entry: This is represented using the CIM Meter class, which is a subclass of EndDevice.

Note 2 to entry: As an end device, a meter will typically, but not always, have a communication link with a head end system.

3.1.8

meter changeout

meter exchange

process of replacing an existing meter with a new meter

Note 1 to entry: The installer will customarily follow a work order which specifies a given location, and usually requires that he or she capture readings from the old and new meters, and record the time and day in which the work was performed.

3.1.9

meter data manager

system that manages meter data, and typically provides a variety of value added functionalities such as VEE

3.1.10

premise area network

fully inclusive of the scope of a home area network (HAN) as it also covers commercial premises

3.1.11

PAN device

type of end device that is located on a customer premise and communicates using a PAN

Note 1 to entry: A PAN device can typically accept controls and/or report events.

Note 2 to entry: PAN devices commonly use meters as communication gateways.

3.1.12

payment meter

electricity meter with additional functionalities that can be operated and controlled to allow the flow of energy according to agreed payment modes

Note 1 to entry: Typically this involves prepayment for electricity.

3.1.13

prepayment mode

payment mode in which automatic interruption occurs when available credit is exhausted

3.2 Abbreviations

AM	asset management
AMR	automated meter reading
AMI	advanced metering infrastructure
CIM	common information model
CIS	customer information system

COSEM	companion specification for energy metering
DLMS UA	device language message specification user association
DMS	distribution management system
DR	demand response
DRMS	demand response management system
HAN	home area network
IDR	interval data recorder
IEC	International Electrotechnical Commission
LC	load control
LDC	load control system
LMS	load management system
MAM	meter asset management
MDM	meter data management
MDM	master data management
MM	meter maintenance
MR	meter reading
MS	metering system
NO	network operations
OMS	outage management system
POS	point of sale
PAN	premise area network (includes scope of HAN)
RF	radio frequency
SM	smart meter
UML	unified modeling language
VEE	validating, editing, and estimating
WM	work management
XSD	XML schema

4 Reference and information models

4.1 General approach to metering systems

The spinning disk in an electromechanical meter generally serves as a pulse initiator to the meter recorder module. In a similar fashion, solid-state meters may also employ a metrology unit that generates pulses which represent a fraction of a kWh, and if more sophisticated, the solid-state meter may have a meter recorder which is able to accumulate many different kinds of information and store it for presentation to the meter communications module using a message and table-driven protocol such as ANSI C12.19 or IEC 62056.

The most common metered data element is kWh, but many electricity meters can also capture kW, kVAr, kVArh, and other similar billing quantities. Some meters can also capture pure engineering quantities such as voltage, current, power factor, etc.

Some AMR systems attempt to add value to meters by adding functionality that the meter may lack. For simple meters (e.g. energy only) it is common for an AMR meter module to add the capability to perform demand metering, Interval Data Recording (IDR), maintain an energisation count, or even provide estimates of certain engineering quantities such as voltage.

Commercial and Industrial meters often employ current transformers and voltage transformers to meter the actual service. Primary voltages and currents are scaled down using potential transformers (PTs) and current transformers (CTs) so that the meter does not have to be constructed to withstand the high voltages and currents actually delivered to the load. Secondary voltage or current values are those that are often measured directly by the meter. Secondary values are small percentage of the primary values that may actually delivered to or connected to the load. If secondary voltages and currents are measured by the meter, these can be converted back to primary values using the PT and CT ratios, which are just the ratio of primary to secondary values.

The metering system will convey meter data and other value-added data through the metering system network to the destination. Depending on the system, the journey may involve multiple steps through public or private networks, licensed or unlicensed RF spectrums, standardized or proprietary systems, in a one-way or two-way fashion.

Some general operations or services can be defined for a metering system. These general operations will translate to specific actions in the context of a given metering solution.

General operations can be scheduled or called on-demand. Each operation returns an answer with an optional status. A message encapsulates a general operation.

Readers of IEC 61968-9 interested in additional information may refer to other standards including IEC 62056, DLMS UA (Device Language Message Specification User Association) and the COSEM model: COmpanion Specification for Energy Metering.

4.2 Reference Model

4.2.1 General

The following diagrams serve as reference models and provide examples of the logical components and data flows related to this International Standard. Subclause 4.5.2 provides references to terms that are defined by the CIM.

The “meter” is a specialization of an “end device”. The end device may contain a metrology capability, it may contain a communications capability, it may be a load control unit, and it may contain a mixture of many different types of functionality. Figure 2 attempts to describe the concept of essentially a shopping-list of functionality which may be available in the (logical or physical) end device.

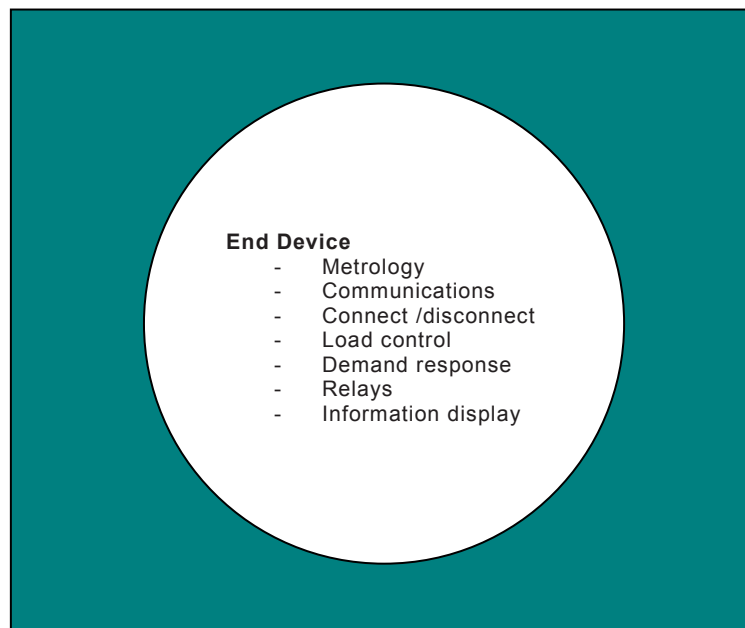


Figure 2 – Example of an end device with functions

The end device itself, while presenting a myriad of functionality, is not the subject of this standard. There are many interactions which ultimately affect the end device but occur as a result of a communication between systems at a much higher level in the control architecture. The interaction between systems is within the scope of this standard, and Figure 3 is an informative view of the systems involved and provides an overview to the stakeholder community.

From the perspective of this standard, an end device:

- has a unique identity (mRID and/or one or more instances of the Names class)
- is managed as a physical asset
- may issue events
- may receive control requests
- may collect and report measured values
- may participate in utility business processes

The following diagrams of Figures 3 and 4 describe the flows between the components in the reference model. Two diagrams are used in order to reduce the complexity that would be experienced by a single diagram. The numbers in brackets provide linkages to the flow definitions.

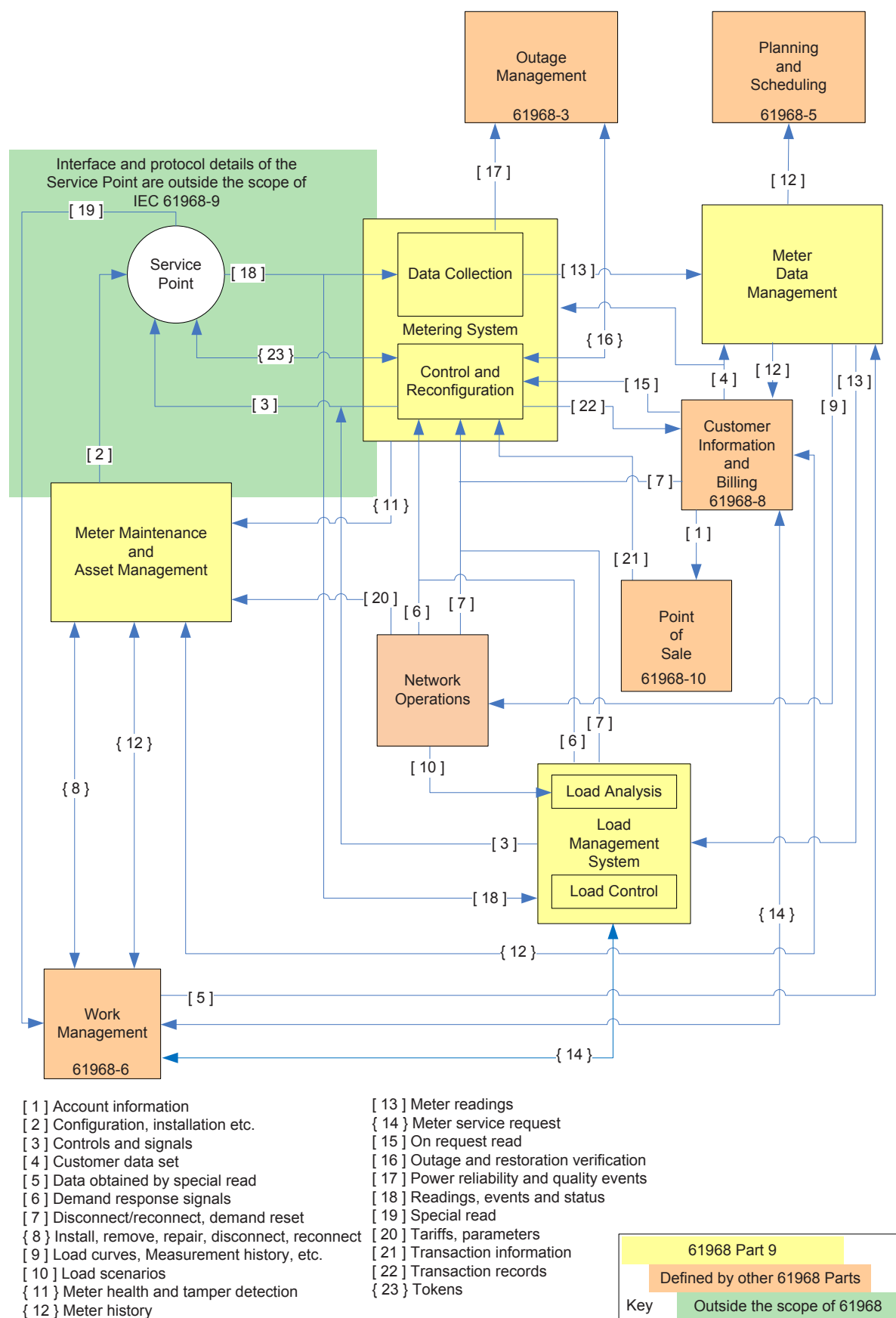


Figure 3 – IEC 61968-9 reference model

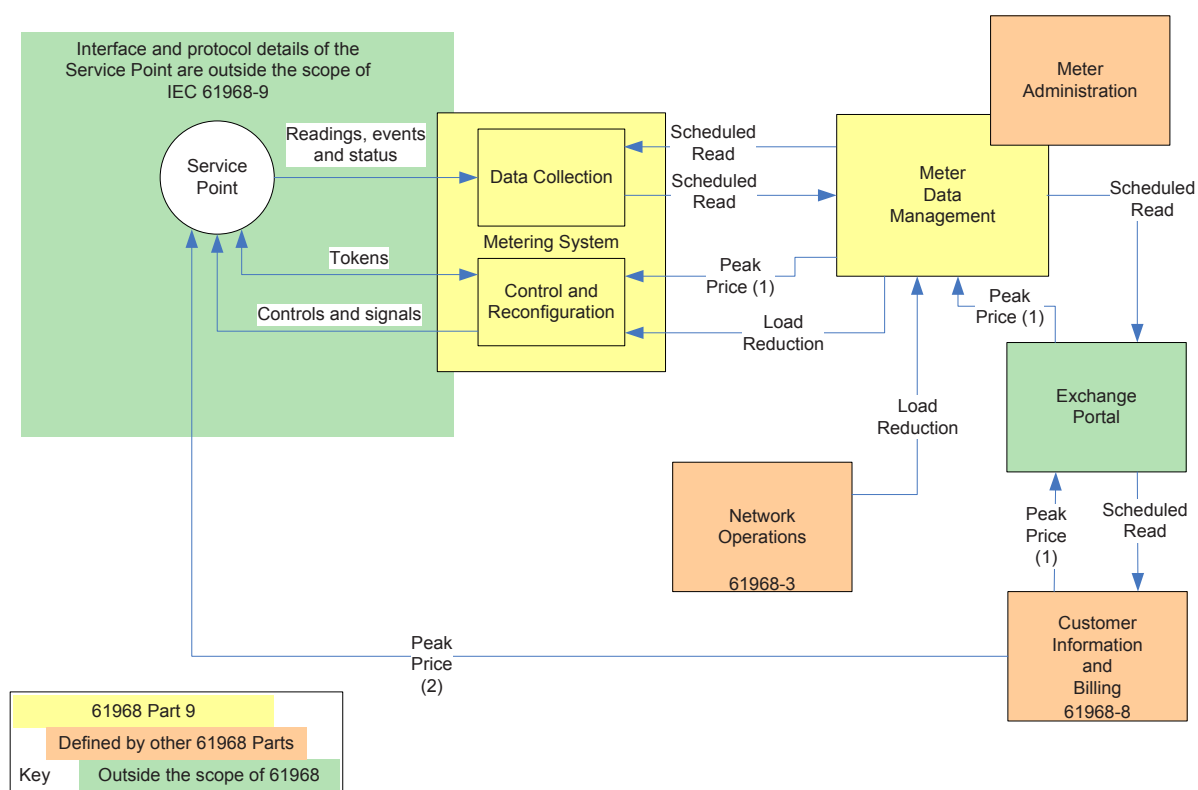


Figure 4 – IEC 61968-9 Reference model with customer information and billing system

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

- metering system, potentially including data collection and control and reconfiguration functionality
- meter data management, which may include meter administration functions
- meter maintenance
- load management, potentially including load control and load analysis functionality
- meter asset management.

The metering system and meter maintenance system components may be bound to a specific meter and associated communication technology or they may support multiple meters (and more generically end devices) types and associated communication technology. The meter data management system component may support and consolidate meter data from more than one metering system. The metering system may also support consolidation of various measurement and data collection implementations, providing a consistent interface to the meter data management system component.

4.2.2 Metering system (MS) – Data collection

The tasks of the data collection sub-component within the metering system may include:

- readings and status collection. Readings and status may be obtained through either manual or automated means, on a scheduled or on-request basis
- transmission of meter readings and status to a meter data management system

- transmission of power reliability and quality event data to outage management, network operations, and capacity planning systems
- transmission of communication network health information to those responsible for maintaining the communications network.

It is important to note that metering systems are significantly diverse with respect to technologies used, protocols used, capabilities and frequency of data collection. The details of the internals of meters, communication transports and protocols are outside the scope of this international standard.

A handheld device used by a human meter reader could be regarded as a metering system. In a typical meter reading by human, a reader inputs meter data into a handheld device in a field. The handheld device is not connected to a communication network in a field. At the end of day work, the handheld device is connected to a communication network at reader's home (not in an office), and meter data is uploaded to a meter data management system. In this case, this communication network should be part of a metering system. Data collection is described in IEC 61968-1 as "MR-RMR."

4.2.3 Metering system (MS) – Control and reconfiguration

The tasks of the control and reconfiguration subcomponent within the metering system are:

- primary interface in executing meter control commands
- communicating payment system information
- act as a communication gateway for load control devices
- service connect / disconnect
- configuration of tariff units of measure and calendar
- configuration of power quality measurement
- configuration of meter event recording
- relay of load control signals
- configuration of meter identity and security credentials
- fraud detection.

This subcomponent is identified separately within the metering system in order to recognize the existence of metering systems that do not have the ability to send messages to meters. IEC 61968-1 describes this subcomponent as "MR-MOP-Meter Configuration." Metering systems with these capabilities are often referred to as "AMI".

4.2.4 Load control

The Metering System Infrastructure may often be used as a communication gateway to load control units. Load control units are end devices with load control (LC) capability. These are wired to control individual, target devices. End devices with LC functionality can take on different forms. Quite often a dedicated LC unit can be located at (or near) the device to be controlled. Another approach is to use meters that have relays which are configured to serve as LC devices. Still another approach is to interface with a customer energy management system (which would be another type of end device).

4.2.5 Load management system (LMS)

A load management system is used to manage and control load by the utility in order to promote system reliability. A load management system may perform load forecasting, contingency analysis, and other simulations prior to issuing a load control command.

4.2.6 Meter asset management (MAM) system

Utilities will employ some form of asset management software in an effort to maintain detailed records regarding their physical assets. Asset management is treated categorically in IEC 61968-4. However, metering has such special requirements that it is common for a utility to use specialized Meter Asset Management software. The software inventories the asset – providing a record of its physical attributes as well as its location. For sake of discussion, the IEC 61968-9 document will talk about a MAM system which is closely coupled to the MS and MDM, though some implementations will successfully generalize the asset management application sufficiently so that it can live within a more generic AM system.

4.2.7 Meter data management (MDM) system

From a historical perspective, it was common for a utility to have more than one automated meter reading system. Alternatively, a utility might outsource meter reading services to one or more third-party service providers who operate an AMR system and/or read the meters manually. The meter data management (MDM) system is used to provide a common repository, and point of management and access of meter data that is collected from disparate metering systems. In addition to data aggregation, quite often the MDM will also make an effort to scrutinize the data collected from the various metering systems, and provide a validating, editing, and estimating (VEE) capability. MDM systems will frequently also provide functionality involving issue, control, and tracking of EndDeviceControls and endDeviceEvents.

4.2.8 Customer information system (CIS)

A CIS will typically encompass functionality related to customer care and billing. This is a subject which is external to the IEC 61968-9 standard. The billing function is driven by readings, typically demand or time-of-use, obtained from the meter. The CIS is also often involved with processes related to billing inquiries, meter disconnect and meter reconnect, rate program changes.

The CIS is frequently the “source of record” in utility enterprises for master data defining key entities such as meters, other end devices, usage points, service suppliers, customers, pricing structures, etc. and the relationships between these entities. See 5.10 and Annexes K and L for additional information related to master data management / data synchronization.

4.2.9 Outage management system (OMS)

An outage management system (OMS) is used by distribution operators to detect and track outages, and to assist in the process of verification and/or restoration of service. An OMS typically combines (or has ties to) functionality such as network operations fault management; operational planning and optimisation, network operation simulation; maintenance and construction; maintenance and inspection; and work scheduling and dispatching.

The metering system can be an important source of information for identifying the existence and extent of outages, and can be used to verify the restoration of outages. The MS might have the ability to publish outage and restoration data to the OMS as it finds it. This type of information typically joins customer call-ins in the OMS to allow it to better predict the location of the outage. However, due to the time-sensitive nature of outage detection, there is also the potential need for a request/reply interface with the MS, where the OMS can ask for specific equipment on the distribution network to be tested by the MS, and an energisation status returned for analysis. The request/reply interface can be used by the OMS to supply critical data needed to make an outage prediction, or by a dispatcher who would like to verify that power has been restored to all of the metered endpoints downstream of a particular switch prior to sending the lineman to the next location.

It is also relatively common for MDM systems to act as an intelligent agent in the brokering of outage related messages between Metering Systems and Outage Management Systems.

4.2.10 Network operations (NO)

Network Operations (IEC 61968-3) may occasionally need to issue load control and pricing signals to meters. This can be done for both economic and emergency reasons.

4.2.11 Meter maintenance (MM)

Meter Maintenance is responsible for functionality related to the configuration and installation of meters. This type of functionality generally falls under Meter Asset Management, or Asset Management in general. Performing meter maintenance may require exchanges with Work Management.

4.2.12 Planning

The planning function is described as operational planning and optimisation, network operation simulation.

4.2.13 Work management (WM)

A Work Management system is responsible for work that is performed by field resources. This subject is covered in maintenance and construction maintenance and inspection (IEC 61968-6).

With respect to metering, WM includes the installation, maintenance and replacement of meters. This may also involve the process of special reads.

4.2.14 Point of sale (POS)

A Point of Sale (POS) system is used for the management of payment meters, where a customer either purchases a token or makes a payment for service.

4.2.15 Meter

The meter records the data used for tariffing public networks, and data used for network balancing mechanisms. Meters are a subtype of EndDevice.

Readings captured by the metering system are collected by a system such as the MDM before being presented for billing purposes. Billing entities may correct the data, or, in some regions, the energy supplier may perform validating, editing, and estimating (VEE) according to rules established by the appropriate supervising regulatory agency. In any case, those corrections are made available to the user who requests them.

Where this international standard refers to a "Meter", it should be realized that a "Meter" is an end device that has metrology capability, it may or may not have communications capability, it may or may not have connect/disconnect capability, or a host of other capabilities. Given that a meter will have metrology capability, electricity meters will in all likelihood meter kWh, but possibly also demand, reactive energy and demand, time of use quantities, interval data, engineering quantities and more. In like manner, meters for other commodities such as gas and water may monitor analogous quantities.

4.2.16 Load control devices

Load control devices are used to control loads at a UsagePoint. The metering system may often have a communication network which can be used for transmitting load control signals (EndDeviceControls) in order to control the load presented by the EndDevice(s). Alternatively, the communication network could be used to communicate demand response (price) signals to devices in order to affect the load presented by the EndDevice(s). PAN devices can also provide load control functions.

4.2.17 PAN devices

PAN devices are used for a variety of purposes within a customer premise. The meter is often used as a gateway for communication between the head end system and the PAN device. PAN devices may react to control messages or generate EndDeviceEvents. Some PAN devices, such as in-home displays, may also present information to consumers. PAN devices may be configured to react to pricing or other demand response related signals that are issued as EndDeviceControls. PAN devices are modelled as EndDevices in the CIM.

4.2.18 Demand response management system (DRMS)

Demand Response Management Systems are used to manage registration in DR programs, send events to program participants and collect related performance information as needed for settlements.

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 Parts 3 to 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 to -9 define the details of the information exchanged for specific types of abstract component.

IEC 61968 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 sections of IEC 61968-3 to -9.
- b) An application interface is compliant if it supports the interface standards defined in IEC 61968-3 to -9 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 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 Meter reading and control functions and components

It should be noted that the message types defined in this "standard may be sent or received by any type of component within a distribution management system (DMS) system.

Table 2 shows these functions and typical abstract components that are expected to be producers of information for these message types. Typical consumers of the information include, but are not restricted to, the other components as listed in IEC 61968-1.

Table 2 – Business functions and abstract components

Business functions	Business sub-functions	Abstract components
Meter reading and control (MR)	Metering system (MS)	Data collection
		End point controls
		End point reconfiguration
		Disconnect/reconnect
		Demand reset
		On request read
		Point of sale
		Outage detection and restoration verification
		Power reliability and quality events
		Metering system events
	Meter maintenance and asset management	End point install, configure, remove, repair, disconnect, reconnect
		End point asset history
		End point reconfiguration
		Special read
		Meter service request
		Tariffs
	Meter data management (MDM)	Meter data repository
		Usage history
		Validation, estimation and editing
		Customer billing data
		End device controls and events
	Demand response (DR)	Real-time pricing
		Emergency reductions
		Economic reductions
		Program registration
	Load management (LM)	Load analysis
		Load control
		Demand response
		Performance measurements
		Risk management

4.5 Static information model

4.5.1 General

The information model relevant to meter reading and control consists of classes that provide a template for the attributes for each message.

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 for meter reading and control

Table 3 lists classes used within message types. Usually all the attributes of these classes are contained within a message type. The descriptions provided describe usage within this part.

Classes described as type "Asset" are defined in the 61968/Assets package of the CIM.

Classes described as type "Customer" are defined in the 61968/Customers package of the CIM.

Classes described as type "Metering" are defined in the 61968/Metering package of the CIM.

Classes described as type "PaymentMetering" are described in the 61968/PaymentMetering" package of the CIM.

Classes described as type "Profile" are contextual profiles defined for 61968-9 that describe message definitions defined using CIM objects.

Table 3 – Classes for meter reading and control

Class/Noun	Type	Description
AuxiliaryAccount	PaymentMetering	Variable and dynamic part of AuxiliaryAgreement, generally representing the current state of the account related to the outstanding balance defined in AuxiliaryAgreement.
AuxiliaryAgreement	PaymentMetering	An ad-hoc auxiliary account agreement associated with a customer agreement, not part of the customer's account, but typically subject to formal agreement between customer and supplier (utility). Typically this is used to collect revenue owing by the customer for other services or arrears accrued with the utility for other services. It is typically linked to a prepaid token purchase transaction, thus forcing the customer to make a payment towards settlement of the auxiliary account balance whenever he needs to purchase a prepaid token for electricity. The present status of AuxiliaryAgreement can be defined in the context of the utility's business rules, for example: enabled, disabled, pending, over recovered, under recovered, written off, etc.
AuxiliaryAgreementConfig	Profile	Message profile for AuxiliaryAgreements.
Card	PaymentMetering	Documentation of the tender when it is a type of card (credit, debit, etc).
Cashier	PaymentMetering	The operator of the point of sale for the duration of CashierShift. Cashier is under the exclusive management control of Vendor.
CashierShift	PaymentMetering	The operating shift for a cashier, during which he may transact against the CashierShift, subject to VendorShift being open.
Channel	Metering	A single path for the collection or reporting of register values over a period of time. For example, a register which measures forward energy can have two channels, one providing bulk quantity readings and the other providing interval readings of a fixed interval size.
Charge	PaymentMetering	A charge element associated with other entities such as tariff structures, auxiliary agreements or other charge elements. The total charge amount applicable to this instance of Charge is the sum of fixedPortion plus percentagePortion.
Cheque	PaymentMetering	The actual tender when it is a type of cheque. Cheque reference number (as printed on the cheque) is specified in 'name.'
ComFunction	Metering	Communication function of communication equipment or a device such as a meter.
ComModuleConfig	Profile	Profile for configuring communications modules.

Class/Noun	Type	Description
ConfigurationEvent	Metering	Used to report details on creation, change or deletion of an entity or its configuration.
ConsumptionTariffInterval	PaymentMetering	One of a sequence of intervals defined in terms of consumption quantity of a service such as electricity, water, gas, etc. It is typically used in association with TariffProfile to define the steps or blocks in a step tariff structure, where startValue simultaneously defines the entry value of this step and the closing value of the previous step. Where consumption is $\geq$ startValue it falls within this interval and where consumption is $<$ startValue it falls within the previous interval.
Customer	Customers	Organisation receiving services from ServiceSupplier.
CustomerAccount	Customers	Assignment of a group of products and services purchased by the Customer through a CustomerAgreement, used as a mechanism for customer billing and payment. It contains common information from the various types of CustomerAgreements to create billings (invoices) for a Customer and receive payment.
CustomerAccountConfig	Profile	Message profile for CustomerAccounts.
CustomerAgreement	Customers	Agreement between the Customer and the ServiceSupplier to pay for service at a specific ServiceLocation. It records certain billing information about the type of service provided at the ServiceLocation and is used during charge creation to determine the type of service.
CustomerAgreementConfig	Profile	Message profile for CustomerAgreements.
CustomerMeterDataSet	Profile	The CustomerMeterDataSet includes one or more CustomerAccounts for one or more ServiceLocations for one or more UsagePoints. TheCustomerMeterDataSet may include one or more EndDeviceGroups.
DemandResponseProgram	Metering	Demand response program.
DeviceFunction	Metering	Function performed by a device such as a meter, communication equipment, controllers, etc.
EndDevice	Metering	The EndDevice is equipment that performs the role of an end device. It may contain functionality such as metrology, communications, load control, connect/disconnect, or other capabilities. It is known as "the meter", "a smart meter", an "advanced meter", "air conditioner", "refrigerator", "pool pump", etc. that a CommModule and/or Meter may monitor and/or control. The asset may be owned by a consumer, a service provider, utility or other party.
EndDeviceConfig	Profile	Message used to convey descriptions of one or more EndDevices.
EndDeviceControl	Metering	Used to issue commands to EndDevices such as meters. May be addressed by EndDevice or by EndDeviceGroup. EndDeviceControls may have control types and parameters.
EndDeviceControls	Profile	Message used to convey one or more EndDeviceControls
EndDeviceControlType	Metering	Defines types of EndDeviceControls
EndDeviceEvent	Metering	Used to report events detected by end devices such as meters. Each EndDeviceEvent has an event type and a timestamp.
EndDeviceEvents	Profile	Message used to convey one or more EndDeviceEvents.
EndDeviceEventType	Metering	Defines types of EndDeviceEvents
EndDeviceFirmware	Profile	Profile for EndDevice firmware configuration messages.
EndDeviceGroup	Metering	An EndDeviceGroup is used for grouping end devices for a variety of purposes including, but not limited to, load control and other types of demand response. An EndDeviceGroup may belong to another EndDeviceGroup, and an end device may belong to zero or more EndDeviceGroups. In some cases the group ID is maintained within the end device, but in other cases it can be managed by a metering system.
EndDeviceGroups	Profile	Use to convey changes in group membership
GetCustomerMeterDataSet	Profile	Profile for GET requests. See annex J.

Class/Noun	Type	Description
GetEndDeviceConfig	Profile	Profile for GET requests. See annex J.
GetMeterReadings	Profile	Profile for GET requests. See annex J.
GetMeterServiceRequests	Profile	Profile for GET requests. See annex J.
Get<ProfileName>	Profile	Each profile will have a corresponding ""Get" profile that is used to convey parameters on GET requests.
IntervalBlock	Metering	Time sequence of Readings of the same ReadingType. Contained IntervalReadings may need conversion through the application of an offset and a scalar defined in associated Pending.
IntervalReading	Metering	Data captured at regular intervals of time. Interval data could be captured as incremental data, absolute data, or relative data. The source for the data is usually a tariff quantity or an engineering quantity. Data is typically captured in time-tagged, uniform, fixed-length intervals of 5, 10, 15, 30, or 60 minutes. Note: Interval Data is sometimes also called "Interval Data Readings" (IDR).
MasterDataLinkageConfig	Profile	A message profile used to establish or modify relationships between objects.
MerchantAccount	PaymentMetering	The operating account controlled by MerchantAgreement, against which Vendor may vend tokens or receipt payments. Transactions via VendorShift debit the account and bank deposits via BankStatement credit the account.
MerchantAgreement	PaymentMetering	A formal controlling contractual agreement between Supplier and Merchant, in terms of which Merchant is authorised to vend tokens and receipt payments on behalf of Supplier. Merchant is accountable to Supplier for revenue collected at PointOfSale.
Meter	Metering	The Meter class is used to describe meters. A Meter is a type of EndDevice typically used to measure and potentially monitor a customer load. The EndDevice class definition should be used as the basis for Meter class.
MeterConfig	Profile	Message profile for Meter configuration messages.
MeterReading	Metering	A set of values obtained from the meter. Each MeterReading may have multiple ReadingTypes, and each ReadingType may contain multiple values.
MeterReadings	Profile	Profile for conveying MeterReadings.
MeterReadSchedule	Profile	A MeterReadSchedule message is used to schedule meter readings.
MeterServiceRequests	Profile	A meter service request is a type of work that can be used for a variety of meter service related activities. These activities would include meter installation, meter change out, customer disconnect/reconnect, , etc.
MeterServiceWork	Metering	Work involving meters.
ObjectNamesConfig	Profile	Used to add, change, or delete Names class identifiers of CIM objects.
Pending	Metering	When present, a scalar conversion that is associated with IntervalBlock and which needs to be applied to every contained IntervalReading value. This conversion results in a new associated ReadingType, reflecting the true dimensions of interval reading values after the conversion.
PointOfSale	PaymentMetering	Logical point where transactions take place with operational interaction between Cashier and the payment system; in certain cases PointOfSale interacts directly with the end customer, in which case Cashier might not be a real person: for example a self-service kiosk or over the internet.
PricingStructure	Customer	Grouping of pricing components and prices used in the creation of customer charges and the eligibility criteria under which these terms may be offered to a customer. The reasons for grouping include state, customer classification, site characteristics, classification (i.e. fee price structure, deposit price structure, electric service price structure, etc.) and accounting requirements.

Class/Noun	Type	Description
PricingStructureConfig	Profile	Profile for configuring pricing structures.
Reading	Metering	Specific value measured by a meter or other asset. Each Reading is associated with a specific ReadingType.
ReadingQuality	Metering	Quality of a specific reading value or interval reading value. Note that more than one Quality may be applicable to a given Reading. Typically not used unless problems or unusual conditions occur (i.e., quality for each Reading is assumed to be 'Good' unless stated otherwise in associated ReadingQuality).
ReadingQualityType	Metering	Defines types for qualities that can be associated with a reading value.
ReadingType	Metering	Type of data conveyed by a specific Reading.
Receipt	PaymentMetering	Record of total receipted payment from customer.
ReceiptRecord	Profile	Profile for receipt messages.
ReceiptSummary	PaymentMetering	Record of detail of receipts pertaining to one shift of operation (one record per 'tenderKind').
Register	Metering	Display for quantity that is metered on an end device such as a meter.
ServiceCategory	Customers	Category of service provided to the customer.
ServiceCategoryConfig	Profile	Profile for ServiceCategory configuration messages.
ServiceLocationConfig	Profile	Profile for ServiceLocation configuration messages.
ServiceSupplier	PaymentMetering	Organisation that provides services to Customers.
ServiceSupplierConfig	Profile	Profile for service supplier configuration messages.
Shift	PaymentMetering	Generally referring to a period of operation or work performed. Whether shift is open/closed can be derived from attributes 'activityInterval.start' and 'activityInterval.end'. The grand total for receipts (i.e., cumulative total of all actual receipted amounts during this shift; bankable + non-bankable; excludes rounding error totals) can be derived from Receipt attributes: =sum(Receipt.receiptAmount); includes bankable and non-bankable receipts.
SimpleEndDeviceFunction	Metering	Simple end device function distinguished by 'kind'; use this class for instances that cannot be represented by another end device function subtype.
Tariff	PaymentMetering	Document, approved by the responsible regulatory agency, listing the terms and conditions, including a schedule of prices, under which utility services will be provided. It has a unique number within the state or province. For Rate Schedules it is frequently allocated by the affiliated Public Utilities Commission.
Tender	PaymentMetering	Tender is what is "offered" by the customer towards making a payment and is often more than the required payment (hence the need for 'change'). The payment is thus that part of the Tender that goes towards settlement of a particular transaction. Tender is modelled as an aggregation of Cheque and Card. Both these tender types can exist in a single tender bid thus 'accountHolderName' shall exist separately in each of Cheque and Card as each could have a different account holder name.
TimeTariffInterval	PaymentMetering	One of a sequence of time intervals defined in terms of real time. It is typically used in association with TariffProfile to define the intervals in a time of use tariff structure, where startDateTime simultaneously determines the starting point of this interval and the ending point of the previous interval.
Transaction	PaymentMetering	The record of details of payment for service or token sale.
TransactionRecord	Profile	Profile for Transactions messages.
TransactionSummary	PaymentMetering	The record of detail of payment transactions pertaining to one shift of operation (one record per 'transactionKind').

Class/Noun	Type	Description
Transactor	PaymentMetering	The entity that ultimately executes the transaction and who is in control of the process; typically this is embodied in secure software running on a server that may employ secure hardware encryption devices for secure transaction processing.
UsagePointLocation	Metering	Location of an individual usage point. For residential or most businesses, it is typically the location of a meter on the customer's premises. For transmission, it is the point(s) of interconnection on the transmission provider's transmission system where capacity and/or energy transmitted by the transmission provider is made available to the receiving party. The point(s) of delivery is specified in the service agreement.
UsagePointLocationConfig	Profile	Message used to establish associations to UsagePointLocations.
UsagePoint	Metering	Logical point on a Distribution Network to which Meter Readings and/or End Device Events can be attributed. Used at the place where a physical or virtual meter may be located; however, it is not required that a Meter be present.
UsagePointConfig	Profile	Message used to establish associations to UsagePoints.
UsagePointGroup	Metering	Abstraction for management of group communications within a two-way AMR system or the data for a group of related usage points. Commands can be issued to all of the usage points that belong to a usage point group using a defined group address and the underlying AMR communication infrastructure.
UsagePointGroups	Profile	Message used to establish UsagePointGroups.
Vendor	PaymentMetering	The entity that owns PointOfSale and contracts with Cashier to receipt payments and vend tokens using the payment system. Vendor has a private contract with and is managed by Merchant who is a type of Organisation. Vendor is accountable to Merchant for revenue collected, who is in turn accountable to Supplier.
VendorShift	PaymentMetering	The operating shift for a vendor during which he may transact against the merchant's account. It aggregates transactions and receipts during the shift and periodically debits a merchant account. The totals in VendorShift should always = sum of totals aggregated in all cashier shifts that were open under the particular vendor shift.
NOTE The class definitions provided here are for convenience purposes only. The normative definitions are provided by the CIM.		

4.5.3 Classes related to meter reading and control

Table 4 lists those classes that are associated with meter reading and control classes but only the name of an instance is given within messages defined in this standard. The detailed attributes of these classes are used in message types defined in other parts of IEC 61968.

Table 4 – Classes related to meter reading and control

Related Class	Reference	Description
Organisation	Common	This class is used to identify companies or divisions within companies. Organisations might have roles as utilities, contractors, suppliers, manufacturers, etc.
PowerSystemResource	Core (IEC 61970-301)	An entity that describes the logical view of a component part of the utility business. PowerSystemResources are further classified as EquipmentContainers e.g. Substations, ConductingEquipment, ProtectionEquipment etc. Instances of type PowerSystemResource may be related to instances of type Asset.
PowerTransformer	Wires (IEC 61970-301)	An electrical device consisting of two or more coupled windings, with or without a magnetic core, for introducing mutual coupling between electric circuits. Transformers can be used to control voltage and phase shift (MW flow).

Related Class	Reference	Description
ServiceLocation	Customers	A customer ServiceLocation has one or more UsagePoint(s). Meters are related to a UsagePoint. The location may be a point or a polygon depending on the specific circumstances For distribution, the ServiceLocation is typically the location of the utility customer's premise. Because a customer's premise may have one or more meters, the UsagePoint is used to define the actual conducting equipment that the EndDevice attaches to at the utility customer's ServiceLocation. For transmission, it is the point(s) of interconnection on the transmission provider's transmission system where capacity and/or energy transmitted by the transmission provider is made available to the receiving party.
TransformerTank	Wires (IEC 61970-301)	A transformer winding.

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 Meter reading and control message types

5.1 General

The purpose of this Clause 5 is to describe the message types related to IEC 61968-9. It is important to note that some of these message types 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 messages 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 5.

The normative XML schemas for messages defined by this part are provided in Annex H, providing more detailed, annotated descriptions of the message structures. Annex I provides XML schemas that are currently informative. Message structures are diagrammed within Clause 5. 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 this standard are informative in nature, and are intended to provide examples of usage for the normative messages definitions. There is no intent by this standard to standardize specific business processes.

5.2 End device event messages

5.2.1 General

An event is a report of a change of state that may be of potential interest. End device event messages are designed as a means to convey changes in the state of an end device, either by the end device itself or by a proxy on behalf of an end device. End device events are viewed as a potential data stream which is not necessarily synchronized to the collection of meter reading for billing purposes. However, it may still be relevant to the billing process. A meter health alarm might be so severe that all readings from the meter have to be considered invalid. The data consumer (e.g. the MDM System) may receive the available relevant event data, and consider such during the validation, editing, and estimation process. It may also report event data to other enterprise systems and use the data to initiate actions such as creation of a MeterServiceRequest to repair or exchange a faulty meter.

5.2.2 Applications

5.2.2.1 General

This standard views “events” as being different than “statuses.” Most MR systems don’t guarantee a timely delivery of an EndDeviceEvent. A “status” on the other hand is only useful if it is fresh. The status of an EndDevice is generally obtained using an “OnRequest” GetMeterReadings. The report of an EndDeviceEvent will eventually arrive to the utility back office and will be processed in turn. This implies that different applications will naturally fall into different types of message exchanges depending on both the underlying communication technology used by the MR system, as well as the need for having timely data. Some systems may have the ability to report an outage as an event. Other systems may treat it as a status. Most MR systems will report a change to meter health as an event, some may require it to be read as a status. Similarly most MR systems will report power quality as an event although some may treat it as a status.

5.2.2.2 Outage detection

When an outage is not due to a SCADA trip, electric utilities typically depend on the calls from the customers to identify the location of the fault. However, the use of a MS can provide another means to identify the location of trouble. It is often possible for a MS to determine that it has lost contact with a meter, in which case this can be reported as an EndDeviceEvent for potential use by an outage management system. It is important to note that loss of communications with a meter may not be sufficient to identify the existence of an outage, as it is common for some MS technologies to occasionally lose contact with meters for brief periods of time.

Some MS systems may be prone to false alarms as a result of the particular technology used to communicate with the meters. Many vendors are working to improve their technology and the accuracy of the data. The MDM, much like the role it sometimes plays in cleaning up metered data for billing applications, in many instances, can also play a role in cleaning up outage data supplied by the MS before it is relayed to the OMS. Such a decision, to route outage data through the MDM, depends on the capability of the MS to supply accurate data, the ability of the MDM to clean up data without introducing excessive delays, and the ability of the OMS to tolerate false alarms and delays. To support outage analysis and filtering of bad data, the MS may supply audit-trail data and quality of measurement data for the outage event, much like it supplies audit-trail data for billing reads. Figure 5 describes a deployment in which the MDM is employed to broker outage information.

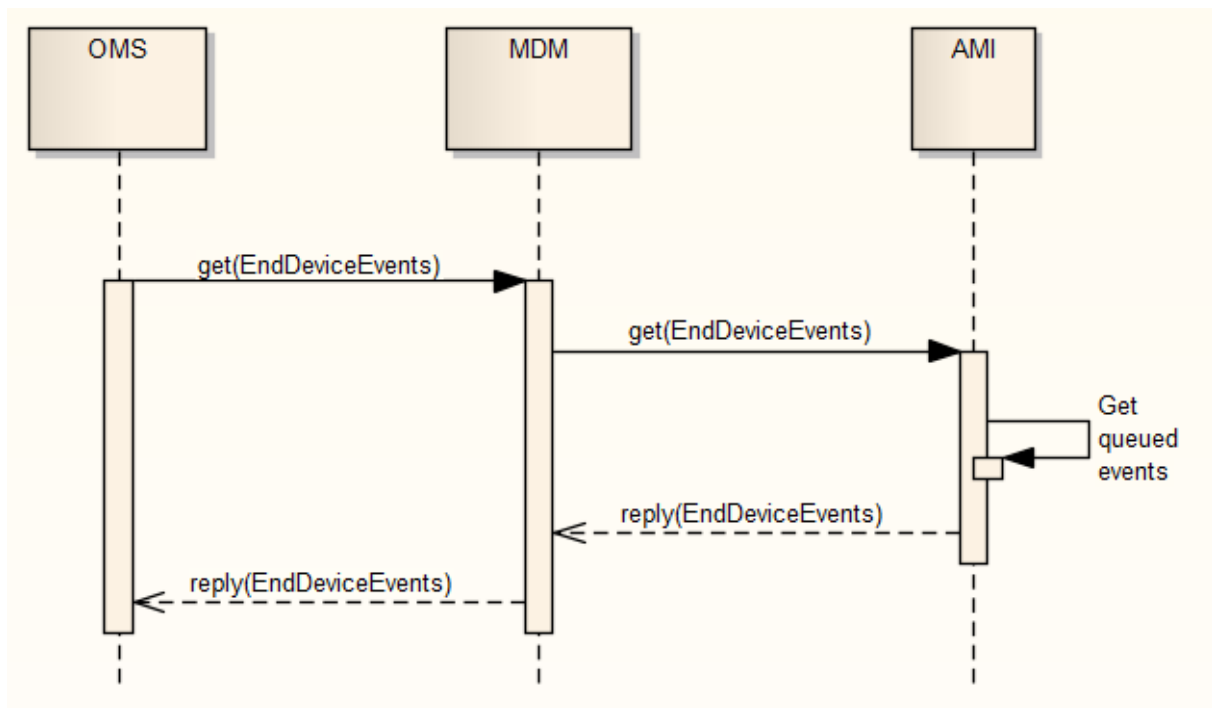


Figure 5 – Outage Detection, request/reply message exchange, example 1

Outage management systems analyze the circuit in terms of network topology. The `EndDeviceEventType` can indicate an event as detected by an end device for consideration in the analysis, as well as other information such as trouble tickets. Where an `EndDeviceEvent` can indicate a condition of interest that may in fact be an outage, an outage is usually the consequence of outage analysis within an OMS that will group potentially many events together within a single outage.

The use of an MDM to broker outage data is at the discretion of the utility. In some deployments, the outage detection request from the OMS may be issued directly to the MS as in the example of Figure 6.

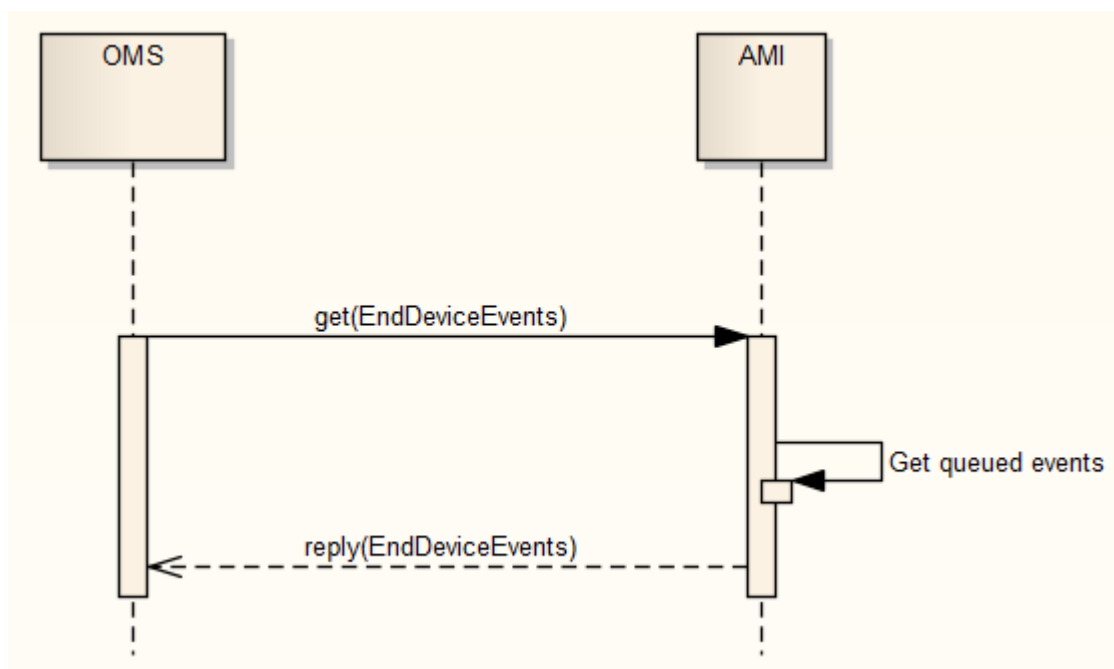


Figure 6 – Outage Detection, request / reply message exchange, Example 2

A reply (synchronous or asynchronous) from the MS will likely be in the form of zero or more `EndDeviceEvents`. The `mRID` or names structure will identify the end devices (e.g. meters) affected by the outage or restoration. Some data consumers that interact with the MS might only know how to deal with meter ID"s. Depending on the deployment, it may be required to limit the scope of exchanged `mRID`"s to that of meters ID"s using the `Name` class and not to that of power system resources in general. `EndDeviceEvent.status` can indicate "live" or "dead". Some metering systems may supplement the status information with collaborative evidence using the `EndDeviceEventDetails` class. `EndDeviceEventType` can be used to indicate that the status applies to a meter or power transformer. The reason for the event can be described (e.g. `EndDeviceEvent.reason` = "consecutiveFailCounter") and quantified (e.g. `EndDeviceEvent.severity` = "3").

While the request/reply exchange is useful whenever the OMS needs supplementary information, some MS are able to self-detect outages. A pub/sub exchange is ideal in these situations. Figure 7 shows such an exchange at a deployment where the MDM serves as an information broker. Figure 8 shows a deployment with information going directly from the MS to the OMS.

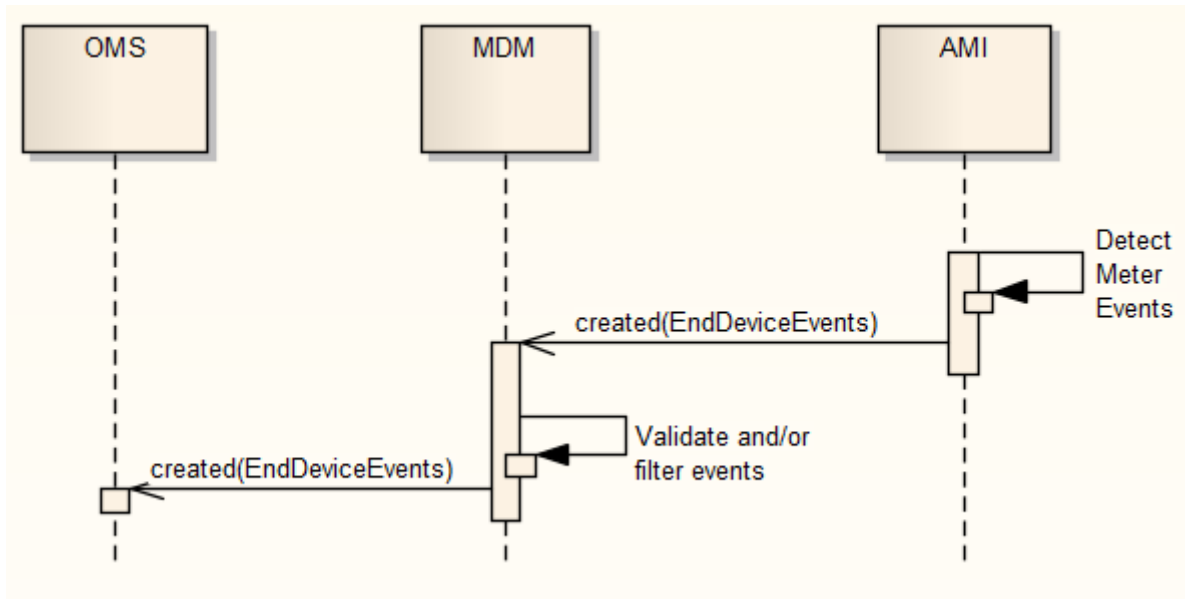


Figure 7 – Outage Detection, publish/subscribe exchange, Example 1

The following sequence diagram shows an example of event propagation without the use of an MDM.

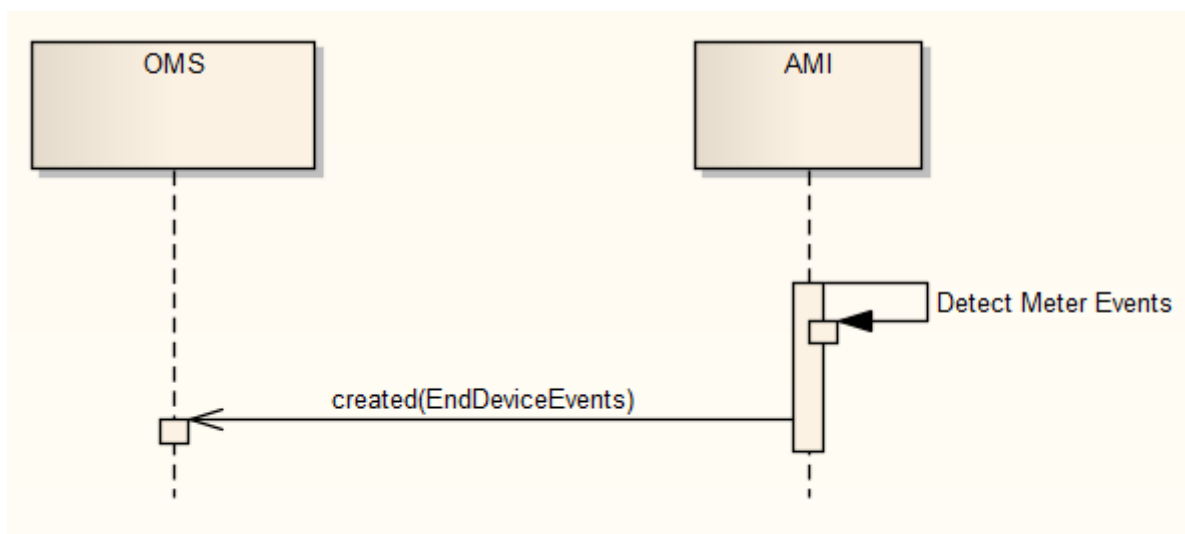


Figure 8 – Outage Detection, publish/subscribe exchange, Example 2

Some deployments may wish to limit the number of interfaces supported. The MeterReadings message structure also provides the means to convey EndDeviceEvents.

The preceding examples reflect the exchange of end device event messages to support outage management functions. As discussed previously, it is also frequently desirable to have an Outage Management System or MDM System make an on-demand read request to the Metering System to obtain the current energization status of a device. This is accomplished using a get(MeterReadings) exchange as described in 5.3. In such cases, the ReadingType (see Annex C) requested will indicate that it is the energization state that is being requested.

5.2.2.3 Meter Health Events

Some types of meters can sometimes generate meter health events, which can be used to identify issues with meter hardware, configuration or connection that should be resolved. The

alarms include such things as diagnostic alarms, tamper alarms, or other unusual conditions. The severity of the alarm might range from a simple notification to “fatal”. Often times, resolution of meter health events require a site visit, so typically they result in the creation of a MeterServiceRequest. Meter Health Events events are communicated using EndDeviceEvent messages.

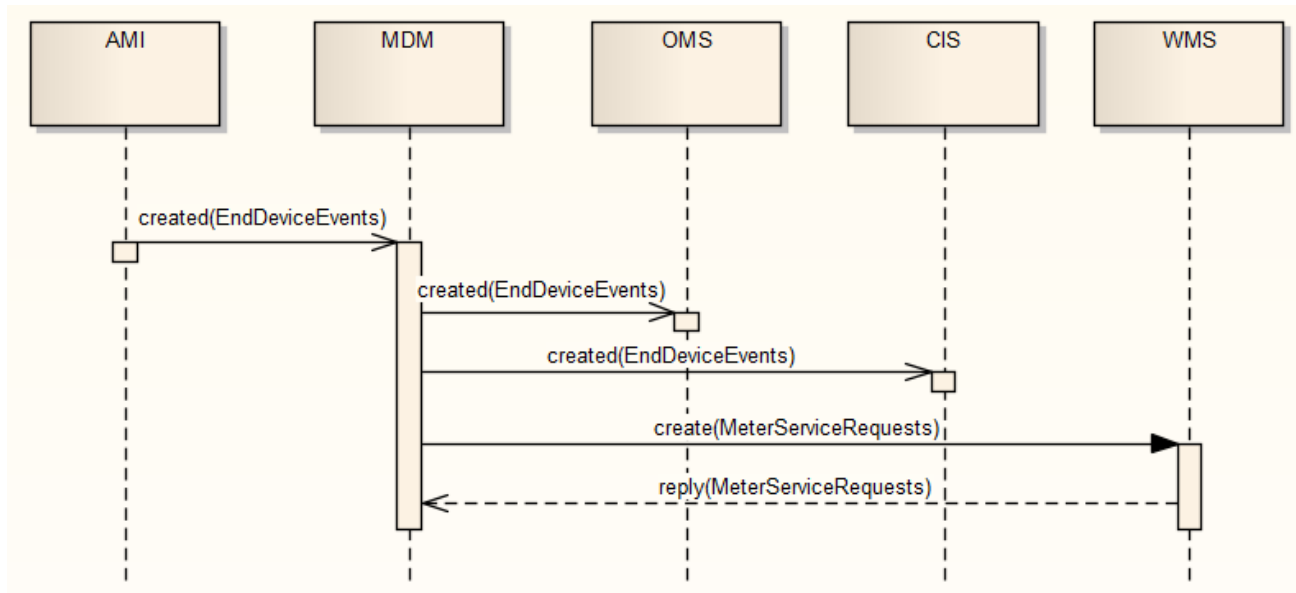
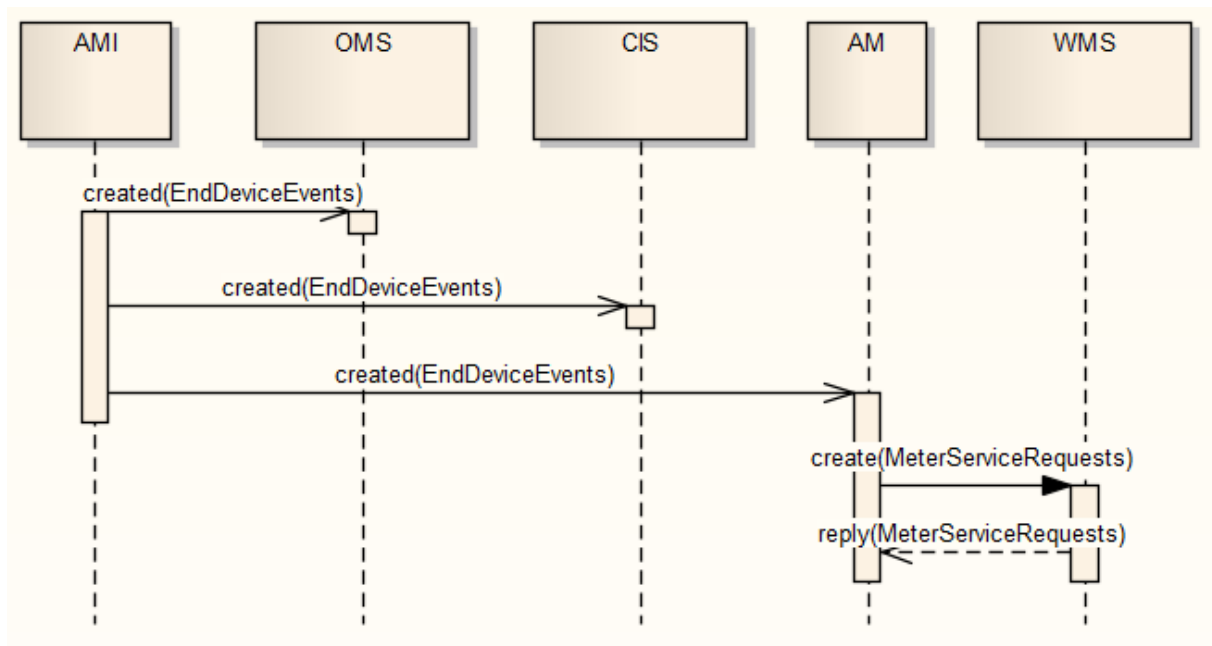


Figure 9 – Meter Health Event exchange, Example 1

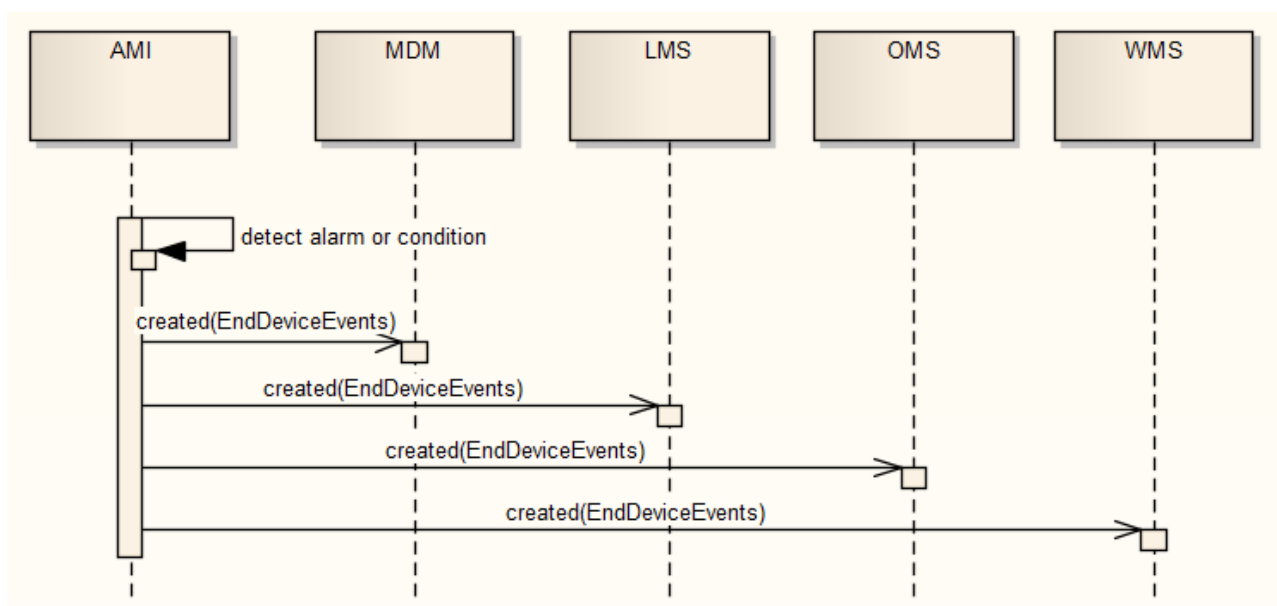
In some deployments, the MDM will be present to broker meter health data for other stakeholders and potentially take action to initiate corrective actions as described in the scenario of Figure 9. Other installations however might not have an MDM or use it in this way. It is possible for the MS to publish data directly to the stakeholders that are equipped to receive it. Such an exchange is depicted in Figure 10.

**Figure 10 – Meter Health Event exchange, Example 2**

5.2.2.4 Power Quality Event

Meters may collect information related to power quality, including but not limited to, momentary outage events, sustained outage events, low or high voltage events, and high distortion events. This information could be used for outage analysis, maintenance scheduling or capacity planning. Power quality events are a subtype of EndDeviceEvent.

Power quality events may be brokered (i.e. publications managed) by an MDM (as described in Figure 11), or sent directly to the various stakeholders (as described in Figure 12).

**Figure 11 – Power quality event exchange, Example 1**

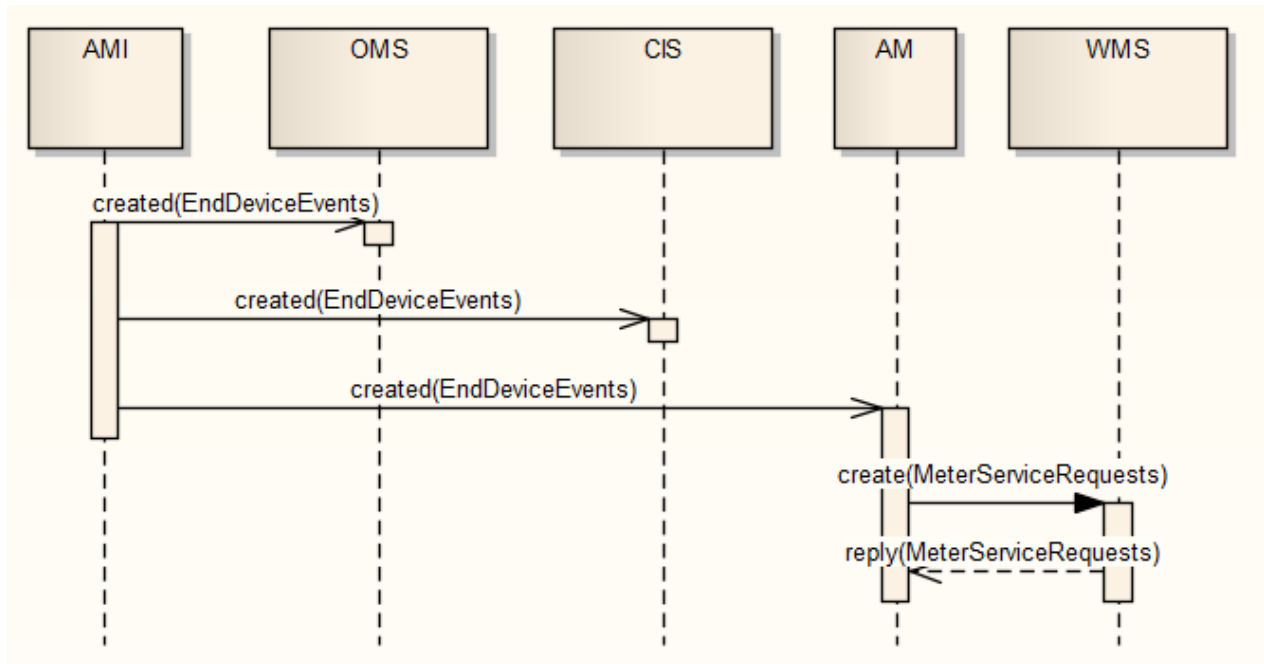


Figure 12 – Power quality event exchange, Example 2

5.2.3 Message format

Meter event messages are implemented using EndDeviceEvent structures in order to support a wider variety of event sources than just meters. The EndDeviceEvent.EndDeviceEventType (see Annex E) is a reference to an enumeration which indicates the type of event, such as outage detection, meter health, or power quality. The timestamp and mRID or a unique name of the end device are also required. The message format is described in Figure 13.

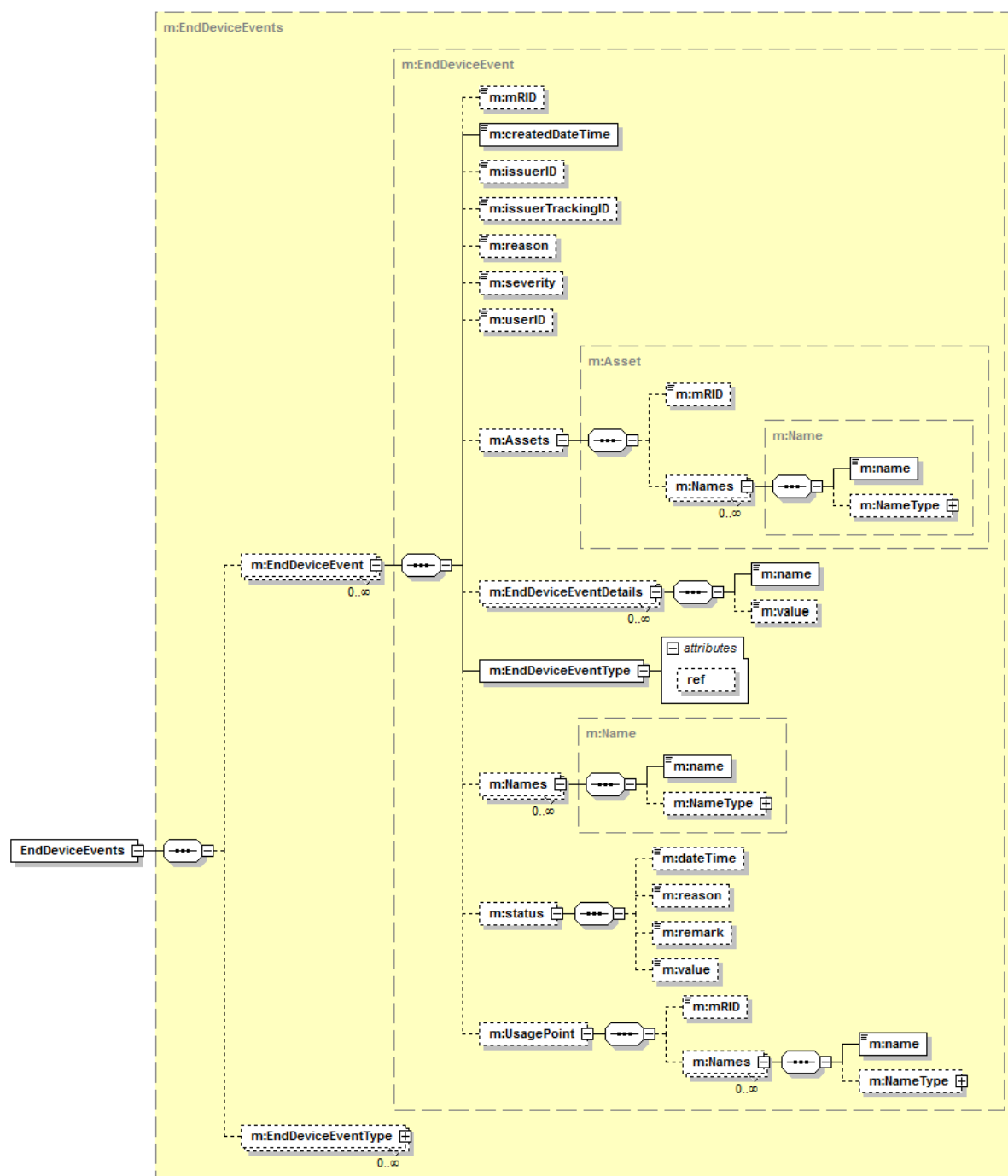


Figure 13 – End device event message format

As noted by Figure 13, only the timestamp and EndDeviceEventType elements are required, along with either an mRID or a unique name of the end device. The EndDeviceEventType element will allow different event types (e.g. meter health, outage detection, etc.) to be differentiated. Different event types would allow for an EndDeviceEvent message to convey events related (including but not limited) to:

- Sustained outage detection
- Momentary outage detection
- Low voltage threshold detection
- High voltage threshold detection

Distortion
Meter health
Tamper detection
Revenue event

The detailed XML schema is provided in Annex H. The following is an XML example for an EndDeviceEvent.

```
<?xml version="1.0" encoding="UTF-8"?> <end:EndDeviceEvents
xmlns:end="http://iec.ch/TC57/2011/EndDeviceEvents#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <end:EndDeviceEvent>
    <end:createdDateTime>2011-11-10T21:54:53.404+01:00</end:createdDateTime>
    <end:issuerID>External System 1</end:issuerID>
    <end:issuerTrackingID>123</end:issuerTrackingID>
    <end:severity>5</end:severity>
    <end:Assets>
      <end:mRID>01f8b2e5-a677-4f2c-a6c0-1e79b409c55e</end:mRID>
      <end:Names>
        <end:name>Meter 123</end:name>
        <end:NameType>
          <end:name>Meter Name</end:name>
          <end:NameTypeAuthority>
            <end:name>Utility ABC</end:name>
          </end:NameTypeAuthority>
        </end:NameType>
      </end:Names>
    </end:Assets>
    <end:EndDeviceEventType ref="3.12.0.257"/>
  </end:EndDeviceEvent>
</end:EndDeviceEvents>
```

The EndDeviceEvent is logically generated by an EndDevice and/or a UsagePoint, either of which can be identified by mRID and/or Name. As in IEC 61968-9:2009, an EndDeviceEvent is associated with an Asset, where typically this will be an EndDevice.

5.3 Meter reading messages

5.3.1 General

Meter readings messages are designed to allow data collected by or calculated on behalf of a meter to be conveyed. This may include measured quantities, calculated quantities, state information or collected history. Whenever a “measurement” is required from an end device, a MeterReading exchange is quite likely the appropriate tool for the job. The end device may have metrology capability, and if so, is most likely called a “meter.” But there are other potential applications for MeterReading. If a data consumer wishes to measure the position of the switch on a connect/disconnect switch, this can be done as a MeterReading exchange. If a data consumer wishes to measure the “energisation” status of the end device, this can be done with a MeterReading exchange or alternatively, with an EndDeviceEvent exchange as described in 5.2.

5.3.2 Applications

5.3.2.1 Periodic meter reads

It is necessary to periodically gather meter readings from a MS for billing through the customer billing system. The request for meter reading should specify a meter or group of meters, a type of reading to collect, and a frequency and duration of interest. The scheduled frequency may consist of regular or irregular periods.

The MeterReadSchedule request may be initiated to the MS from any of the following:

- the CIS (in an effort to collect billing determinants);

- a planning and scheduling application (in an effort to acquire engineering data about the distribution network);
- an OMS (to establish a stream of status information);
- a meter data management system (in an effort to broker data for any or all of the above applications);
- the MS itself may also self-initiate a MeterReadSchedule.

An example for one such exchange (this one using an MDM) is shown in Figure 14.

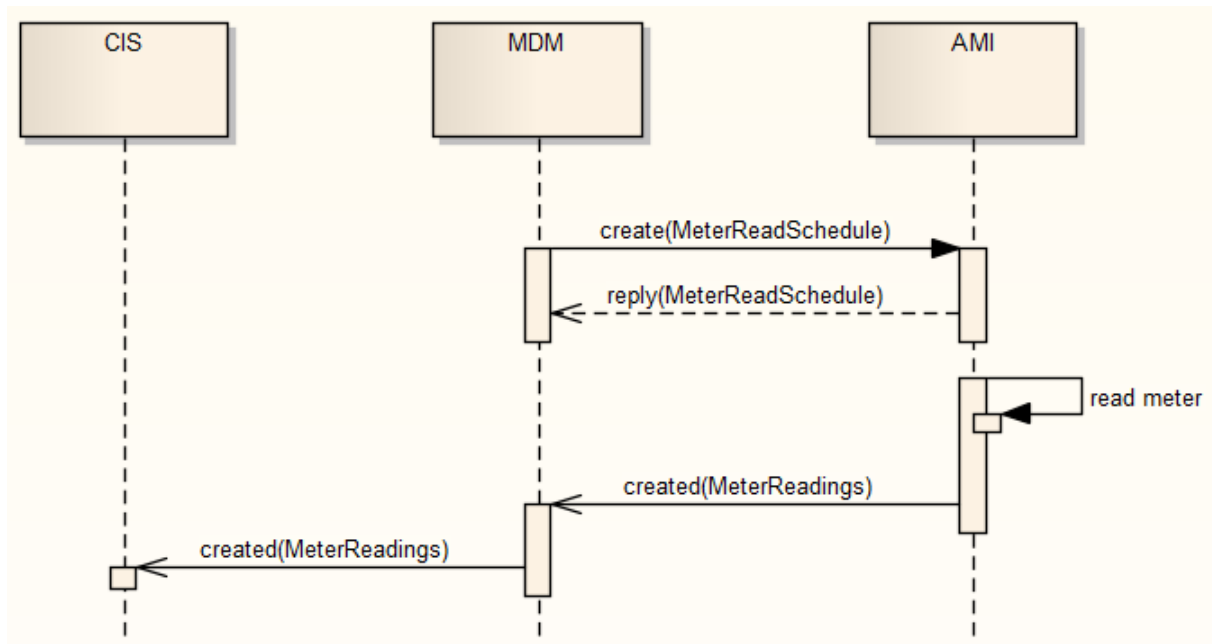


Figure 14 – Example use of meter read schedule to create subscription

Some metering systems may have the ability to decouple MeterReading collection from MeterReading reporting. For Metering Systems without this capability, readings may be reported immediately upon collection. In the MeterReadSchedule request, MeterReadings may be requested using a variety of parameters, including:

- Specific meter, using the EndDevice mRID or Names.name (see Annex G for discussion of the Names class)
- EndDeviceGroups, where a EndDeviceGroup identifies a group address used within the Metering System
- UsagePoint where a meter is located, using UsagePoint mRID or Names.name
- UsagePointGroups, where UsagePointGroup identifies a groupAddress used within the Metering System
- As specified using a TimeSchedule
- ReadingTypes can be specified to identify the desired reading types

5.3.2.2 Manual meter reading

Meter readings can be obtained manually by a meter reader. Data collected may be maintained by the meter data manager. Meters may collect a number of different measurement types. Some types of meters may measure more than one phase, or may collect values for non-electrical measurements, such as water or gas.

A meter reader may input data shown on the panel of meter into a handheld device, which could be regarded as a metering system. Data input may occur several hundred times per

day. A meter reader may present an account of the read to the customer. Note that this account is not an invoice. Billing would be generated normally by the CIS even in the manual reading case. Figure 15 shows such an exchange.

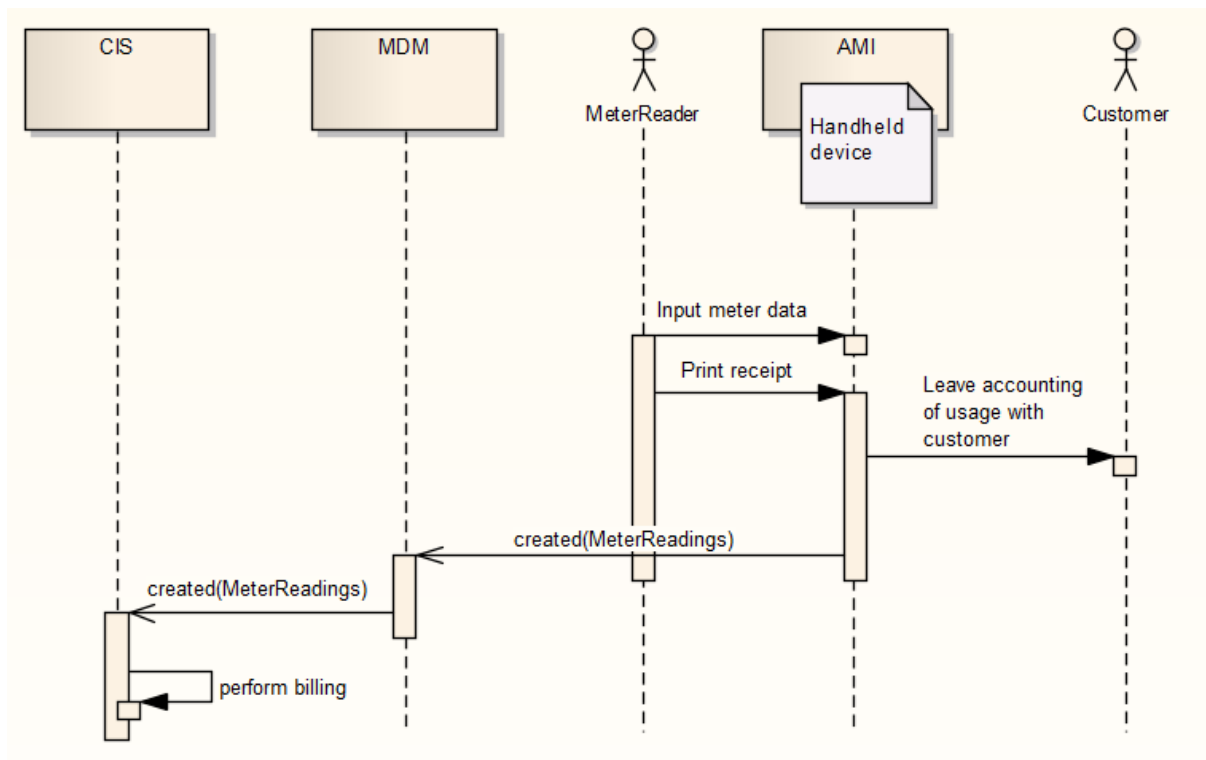


Figure 15 – Example manual meter reading exchange

At the end of the day of work, all data stored in the handheld device is sent to the MDM via a communication network. The MDM publishes a message to the CIS informing of the creation of MeterReading.

Schedules for walking a manual meter reading route are decided well in advance of performing the work.

5.3.2.3 On-Request meter read

Meter read requests are issued to a MS in order to obtain meter readings on a per request basis. The MS will send a request to the desired meters. These can be used for billing inquiries, outage extent verification, verification of restoration and other business purposes..

Many utilities have a policy of routing all revenue readings through the MDM so that all data will receive the same level of validation. However, not all MDM systems are able to offer validation services for outage data. For those that do, the utility shall weigh the value of MDM validation over the time delay it may introduce, as well as the ability of the particular OMS solution to reject incongruent data. For this reason, the example diagram shows revenue readings routed through the MDM, but outage data routed around it.

It is important to note that not all metering systems support "on request" readings. For those that do, the implementation can also vary significantly.

On-request reads may be initiated to the MS from systems such as any of the following:

- The CIS (in an effort to collect billing determinants).

- A Planning and Scheduling application (in an effort to acquire engineering data about the distribution network).
- An OMS (in order to verify if a customer is affected by an outage or has been restored)
- A meter data management system (in an effort to broker data for any or all of the above applications).
- The MS itself may also directly initiate a meter read.

An example for one such exchange (this one using an MDM) is shown in Figure 16.

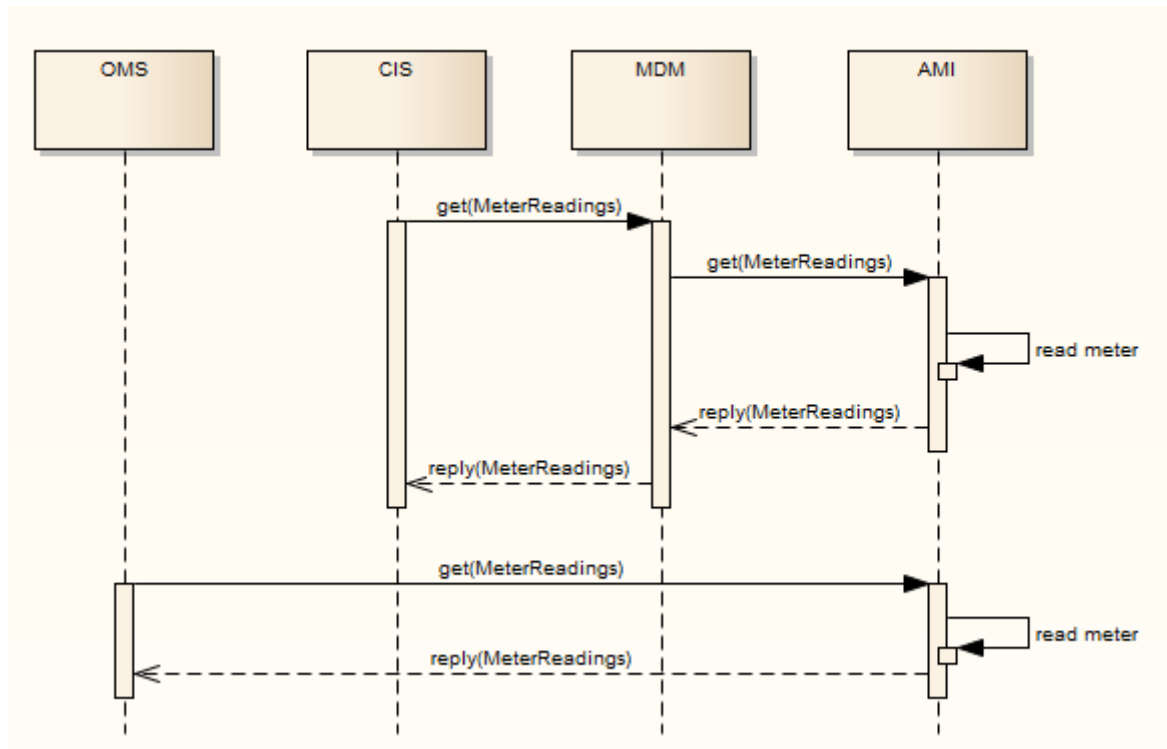


Figure 16 – Example On-Request meter read

5.3.2.4 Historical meter data access

A distribution network planner may use historical meter reading values as load information for capacity planning purposes. (See the request/reply example in Figure 17). This would permit usage to be aggregated to determine loads for a transformer or feeder.

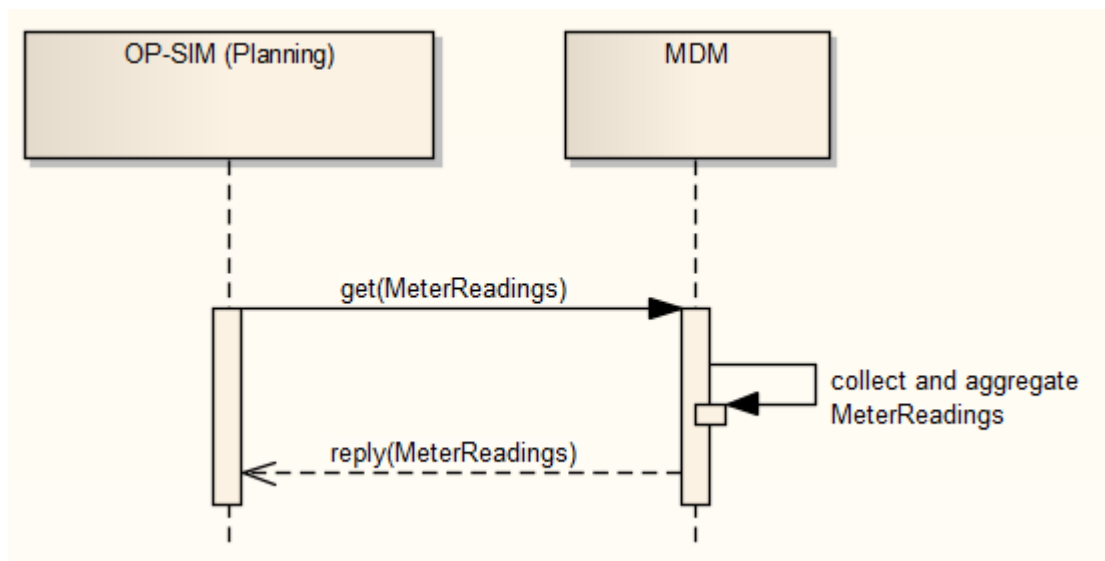


Figure 17 – Historical MeterData exchange

It is important to note the use of request parameters to qualify requests for meter data, filtering the results to obtain data for specific meters within specific timeframes.

5.3.2.5 Billing inquiry

A customer or an internal source may identify a customer billing issue. A meter read request in combination with historical meter reads may be used to resolve the billing issue. The top of Figure 18 shows an inquiry being satisfied by data which recently arrived, while later on in the day an inquiry is made which requires a fresh reading from the meter.

In some cases the desired data may be accessible from the MDM. In other cases, it may be necessary to issue a read request remotely through the MS, or manually through a meter service request.

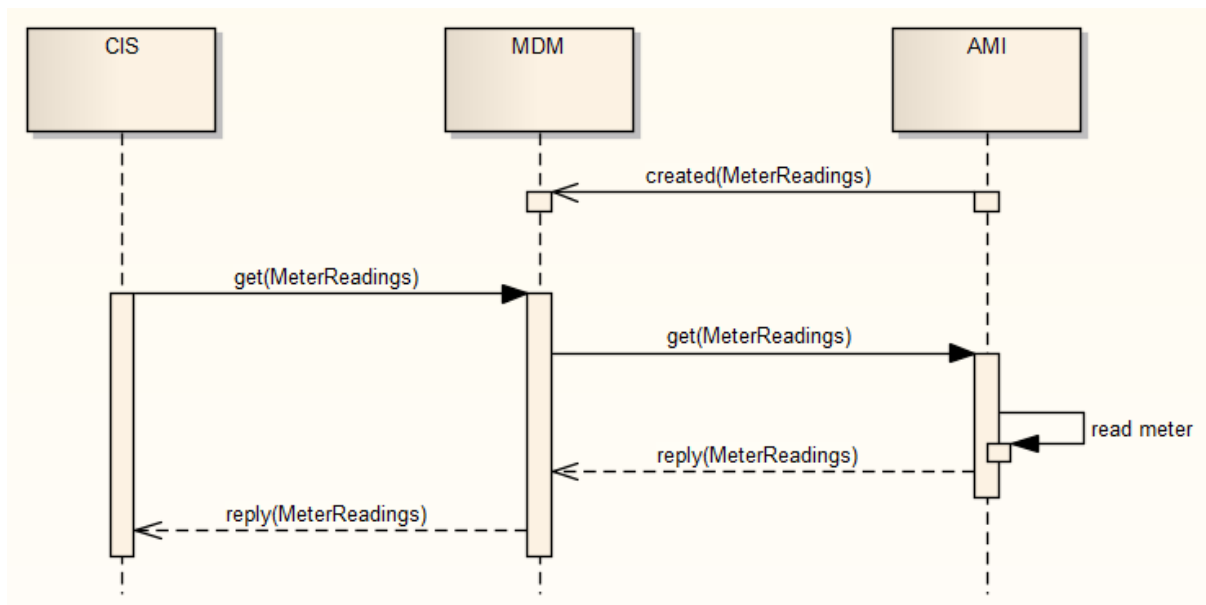


Figure 18 – Example billing inquiry message exchange

5.3.3 Message formats

The detailed XML schema for messages are described in Annex H. Figure 19 shows the message format used to present meter readings from one or more end devices.

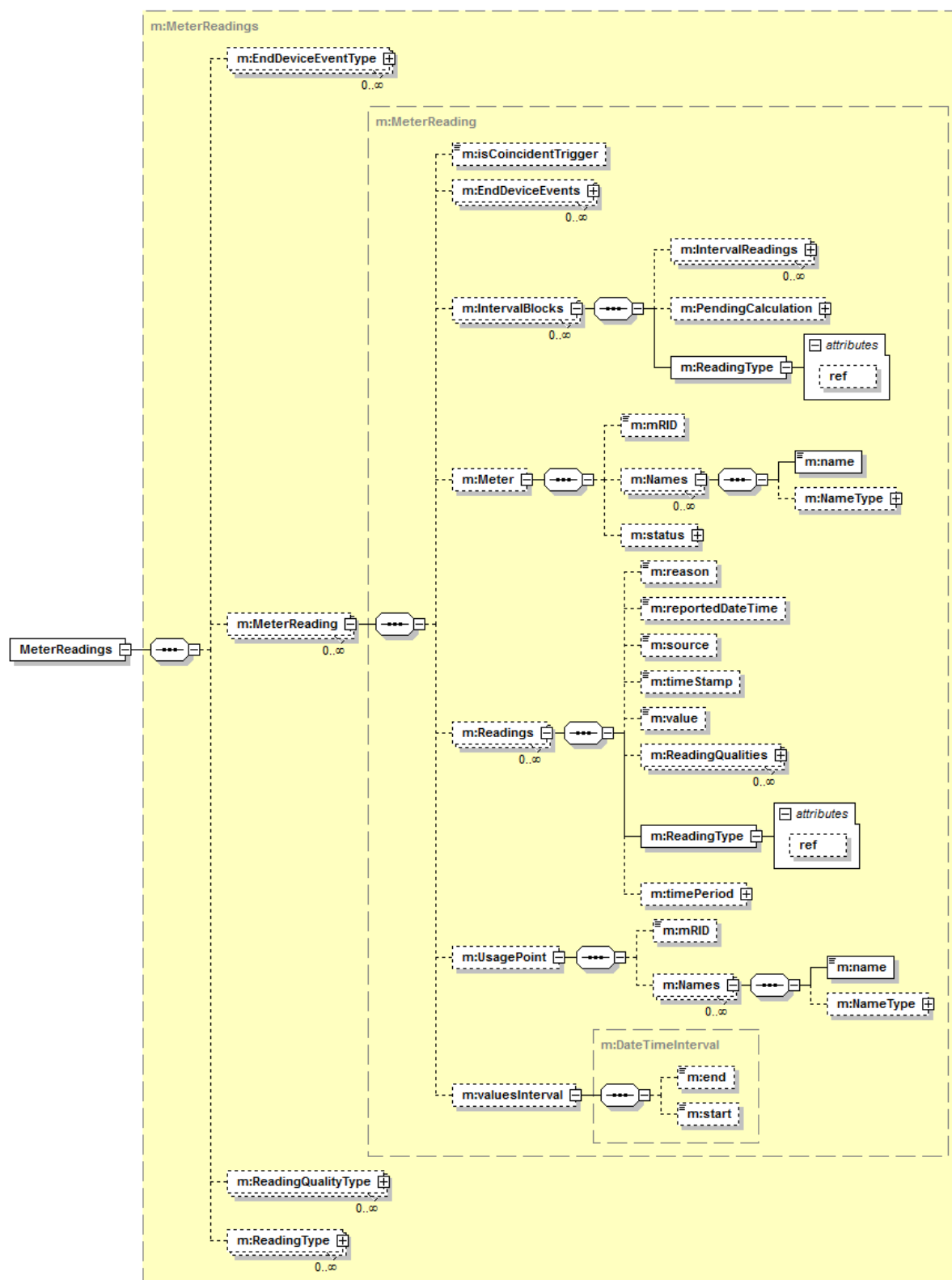


Figure 19 – Meter readings message format

The MeterReadings message structure allows for:

- readings from one or more meters
- reading values each have an associated reading type, timestamp and value
- many quality values can be associated with each reading value.
- readings can be supplied in the form of interval blocks, where readings of a common reading type are grouped together
- event histories can be returned with meter readings

Figure 20 shows the details of the structure used to convey Readings, where each Reading identifies a specific ReadingType (by reference), value and optional quality codes. The time Stamp is used to identify when the reading was captured. The timePeriod can be used to identify a specific time interval. The optional reportedDateTime can be used to identify when the reading was actually reported. The ReadingType is used to identify the meaning of the reading, data type of the value and the meaning of the different time values.

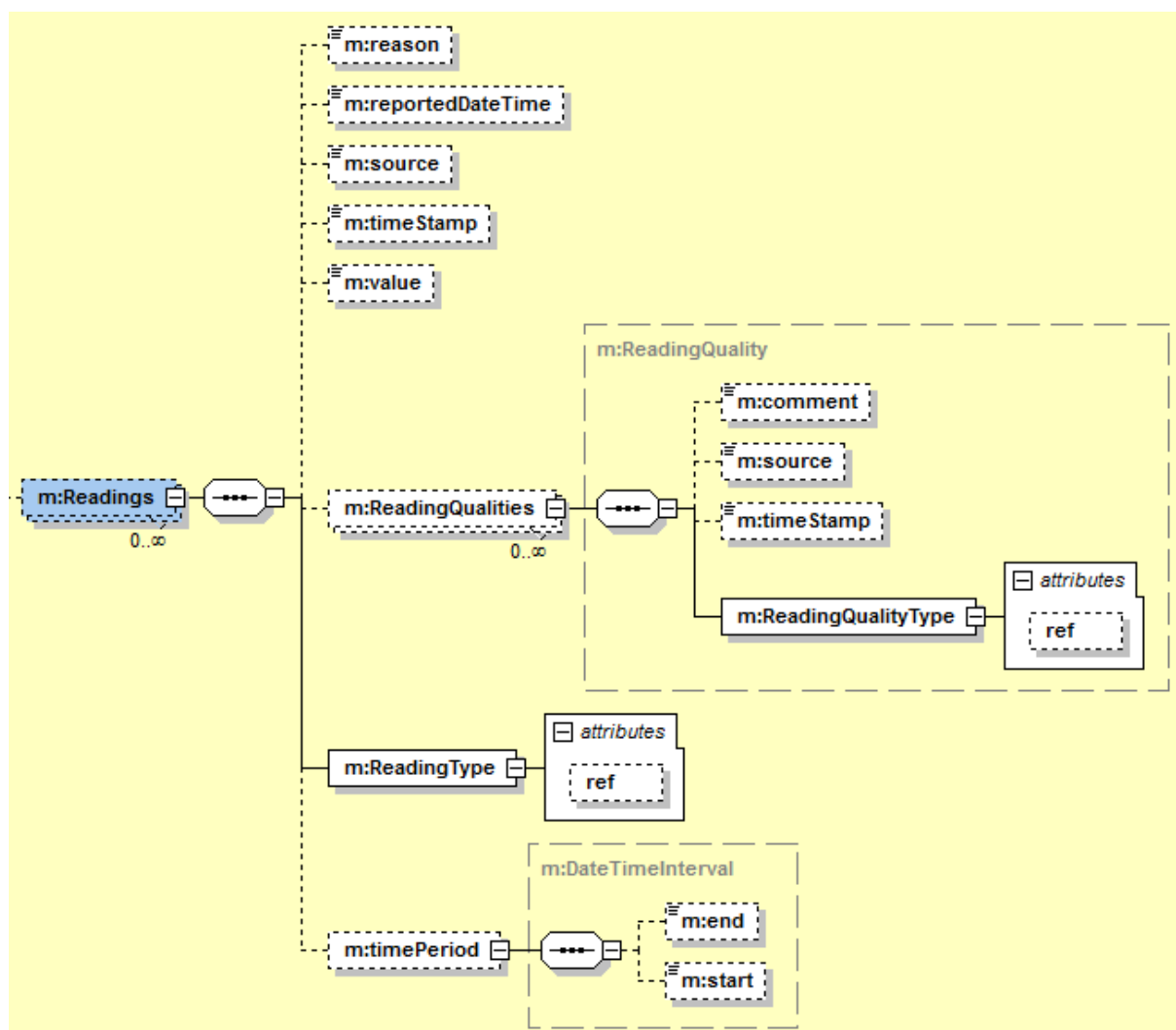


Figure 20 – Reading structure

Within a reading, the time Stamp and timePeriod attributes can be used to identify time-related aspects of the reading, with specific usage based upon reading type, where details are described in Annex C as needed. The following examples illustrate the general conventions for the use of time Stamp and timePeriod.