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DIN EN 61968-9:2014-10**Entwurf****Integration von Anwendungen in Anlagen der Elektrizitätsversorgung –
Systemschnittstellen für Netzführung –
Teil 9: Zählerfernauslesung und -steuerung
(IEC 57/2245/CD:2020);
Text Englisch**

Application integration at electric utilities –
System interfaces for distribution management –
Part 9: Interfaces for meter reading and control
(IEC 57/2245/CD:2020);
Text in English

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
(IEC 57/2245/CD:2020);
Texte en anglais

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Änderungen

Gegenüber DIN EN 61968-9:2014-10 wurden folgende Änderungen vorgenommen:

- a) Hinzufügung von normativen Aufzählungen für ReadingTypes, EndDeviceEventTypes und EndDeviceControlTypes in Anhängen;

- b) allgemeine Neufassung des Dokuments zum besseren Verständnis und zur besseren Benutzbarkeit;
- c) es gab mehrere Profile, die ursprünglich zur Unterstützung von Anwendungsfällen mit Vorauszahlung definiert wurden, die sich als allgemeiner Natur erwiesen und infolgedessen nach 5.10 verschoben wurden. Unterabschnitt 5.8 besteht jetzt nur noch aus den Profilen, die spezifisch für die Vorauszahlung sind. In allen Fällen wurden diese Profile etwas umstrukturiert, um andere notwendige Änderungen, die beschrieben wurden, widerzuspiegeln.

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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).

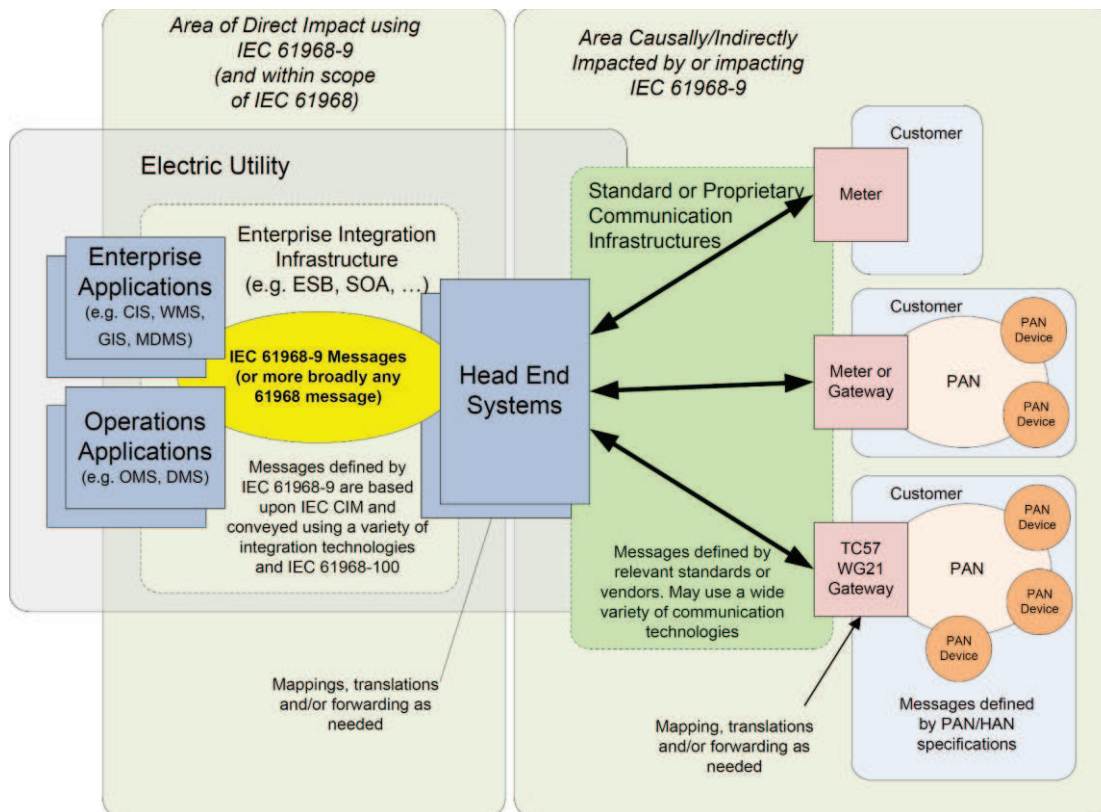


Figure 1 – IEC 61968-9 scope

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 61968-100:2020, *Application integration with IEC 61968*

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

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.

3.1.2

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.

3.1.3

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.

3.1.4

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.

3.1.5

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

3.1.6

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.

3.1.7

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.

3.1.8

meter data manager

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

3.1.9

premises area network

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

3.1.10

PAN device

type of end device that is located on a customer premises 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.

3.2 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	premises 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 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 1 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 1 – 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

Business functions	Business sub-functions	Abstract components
		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

4.3 Static information model

4.3.1 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*.

4.3.2 Classes for meter reading and control

Table 2 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 "Metering" are defined in the 61968/Metering 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 2 – Classes for meter reading and control

Class/Noun	Type	Description
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.
ComFunction	Metering	Communication function of communication equipment or a device such as a meter.
ComModuleConfig	Profile	Profile for configuring communications modules.
ConfigurationEvent	Metering	Used to report details on creation, change or deletion of an entity or its configuration.
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.

Class/Noun	Type	Description
EndDeviceGroups	Profile	Use to convey changes in group membership
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.
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.
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.

Class/Noun	Type	Description
Register	Metering	Display for quantity that is metered on an end device such as a meter.
SimpleEndDeviceFunction	Metering	Simple end device function distinguished by 'kind'; use this class for instances that cannot be represented by another end device function subtype.
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.

4.3.3 Classes related to meter reading and control

Table 3 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 3 – 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	<p>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</p> <p>For distribution, the ServiceLocation is typically the location of the utility customer's premises. Because a customer's premises 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.</p> <p>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.</p>
TransformerTank	Wires (IEC 61970-301)	A transformer winding.
<p>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.</p>		

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 2 describes a deployment in which the MDM is employed to broker outage information.

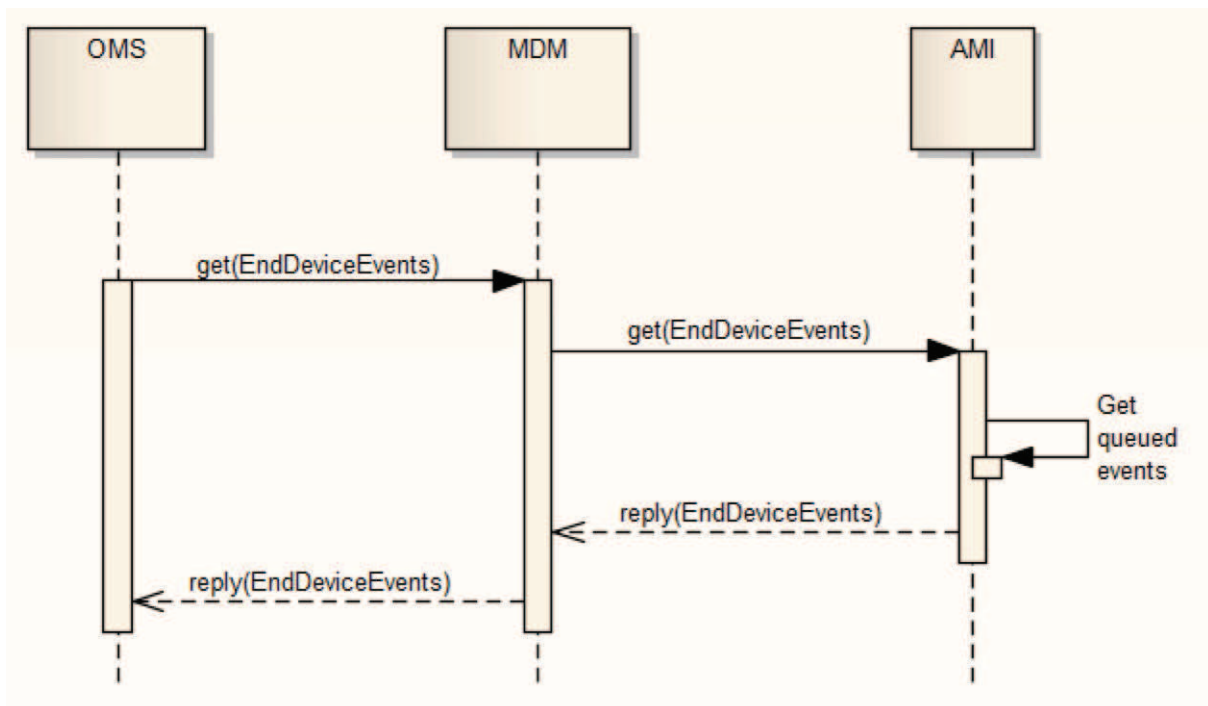


Figure 2 – Outage Detection, request/reply message exchange, example 1

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 3.

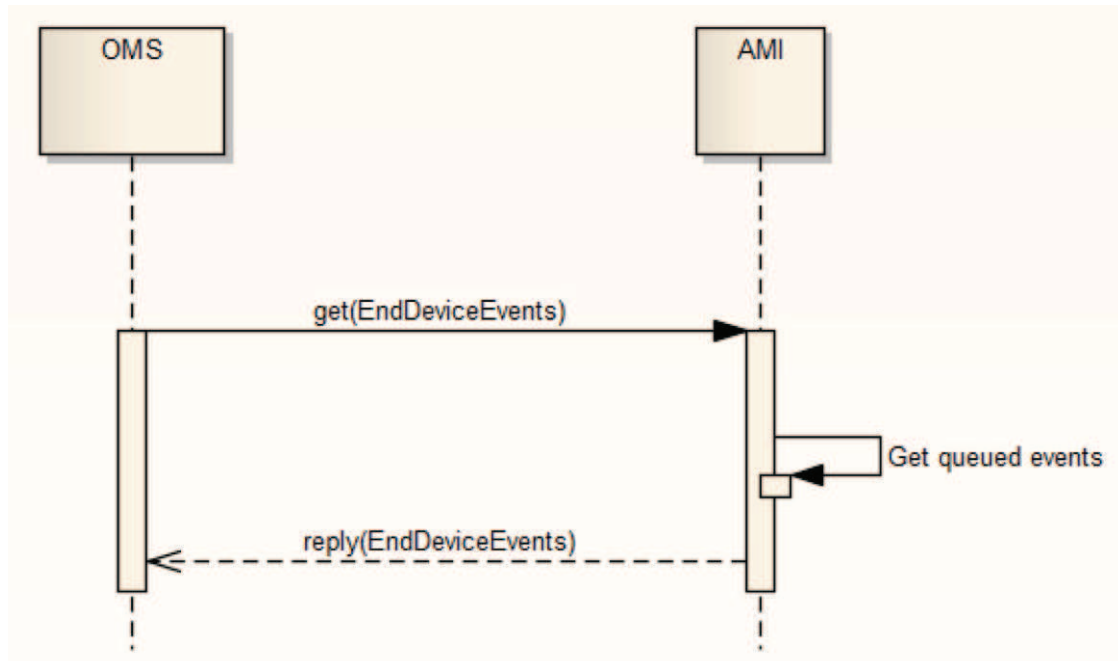


Figure 3 – Outage Detection, request / reply message exchange, Example 2

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 4 shows such an exchange at a deployment where the MDM serves as an information broker. Figure 5 shows a deployment with information going directly from the MS to the OMS.

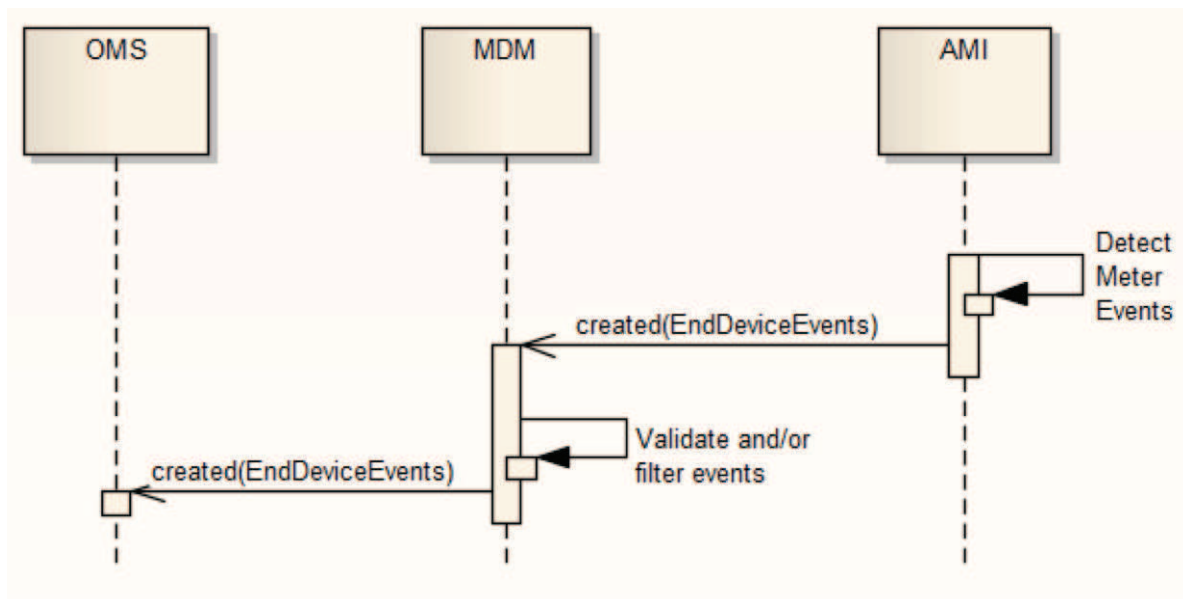


Figure 4 – Outage Detection, publish/subscribe exchange, Example 1

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

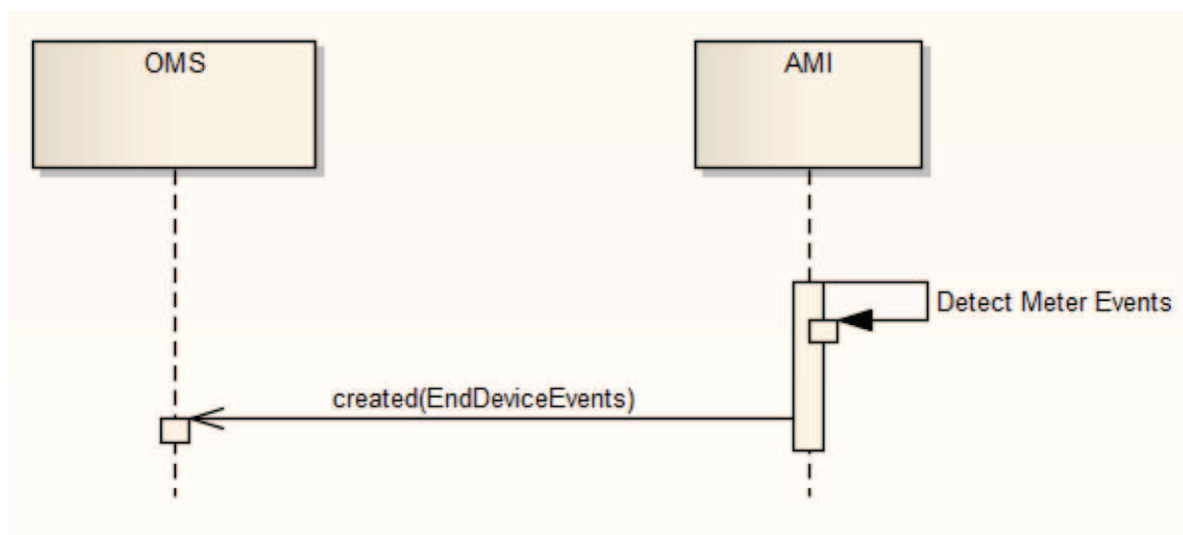


Figure 5 – Outage Detection, publish/subscribe exchange, Example 2

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.

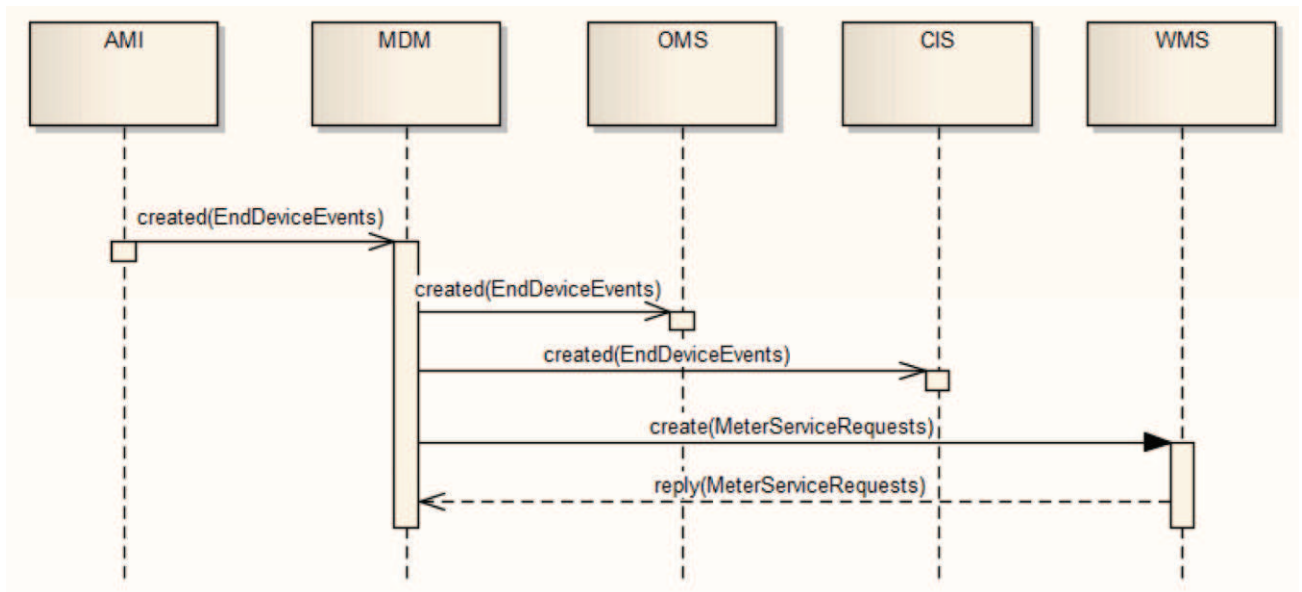


Figure 6 – Meter Health Event exchange, Example 1

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 6. 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 7.

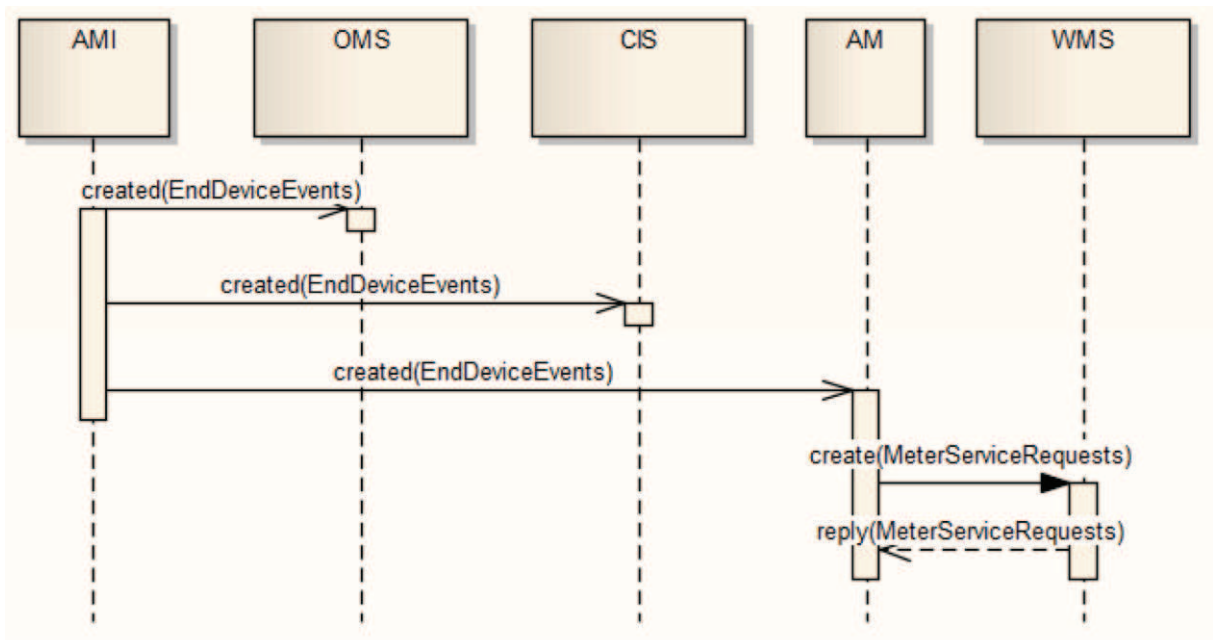


Figure 7 – Meter Health Event exchange, Example 2

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 8), or sent directly to the various stakeholders (as described in Figure 9).

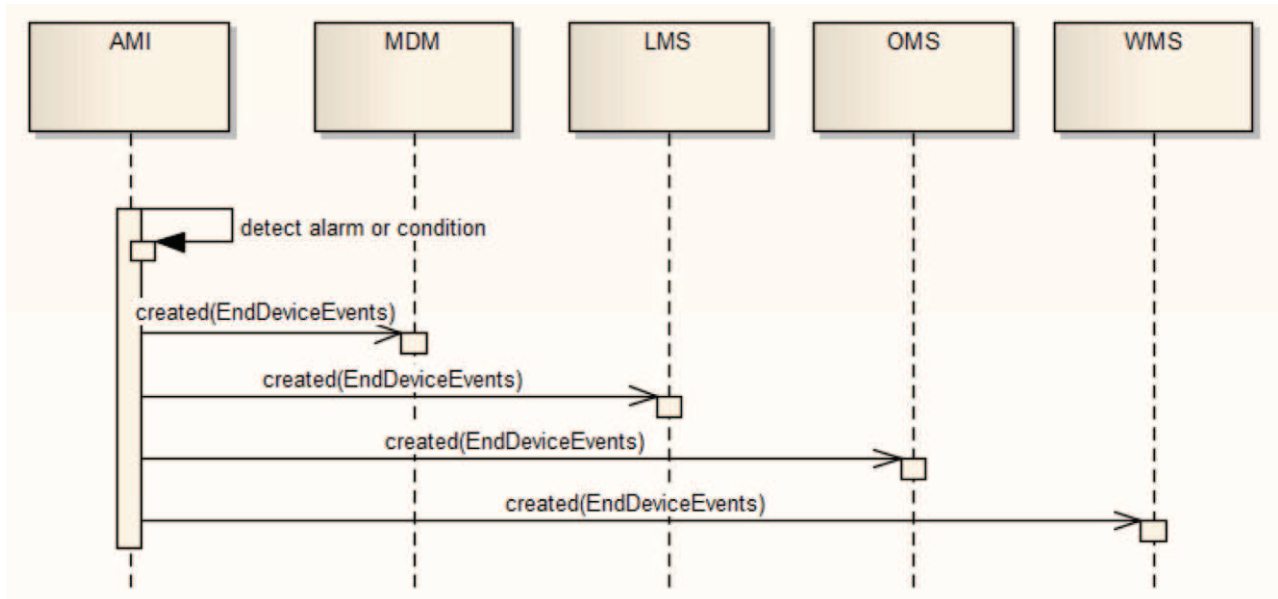


Figure 8 – Power quality event exchange, Example 1

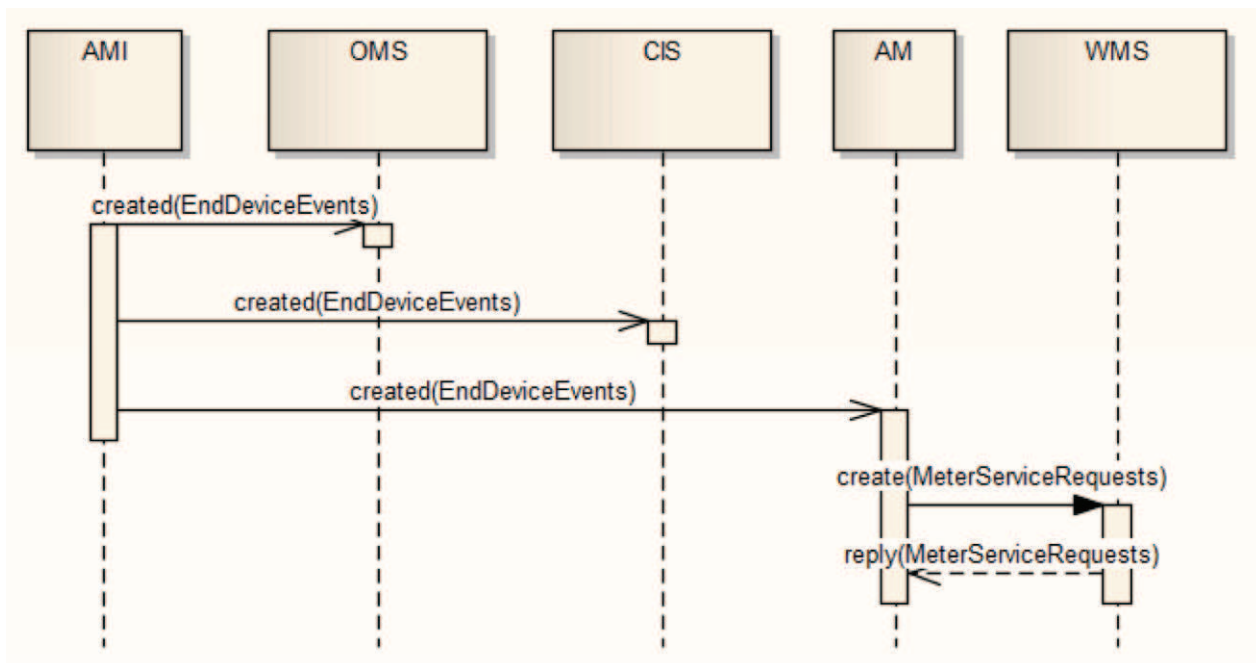


Figure 9 – Power quality event exchange, Example 2

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 10.

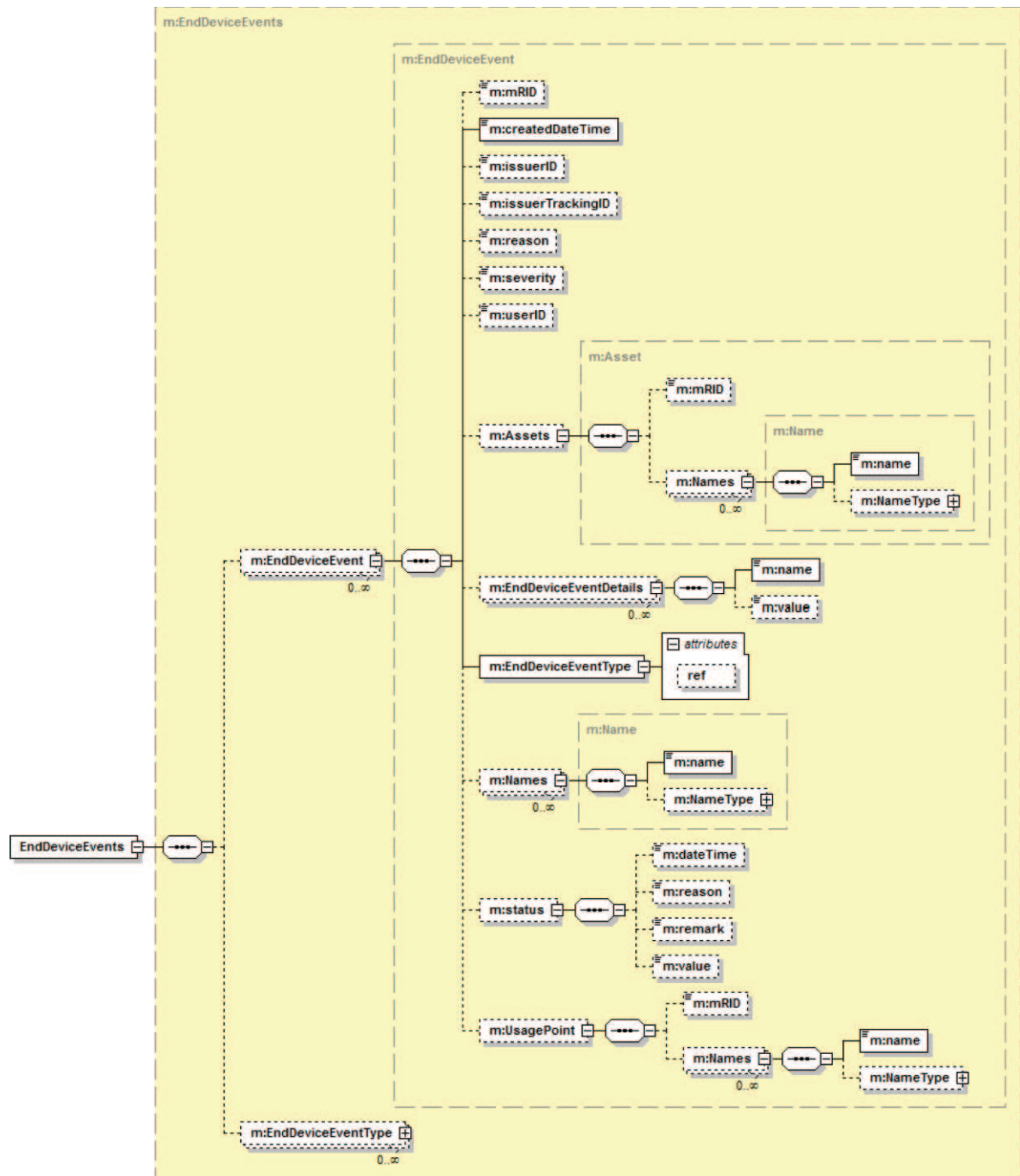


Figure 10 – End device event message format

As noted by Figure 10, 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 11.

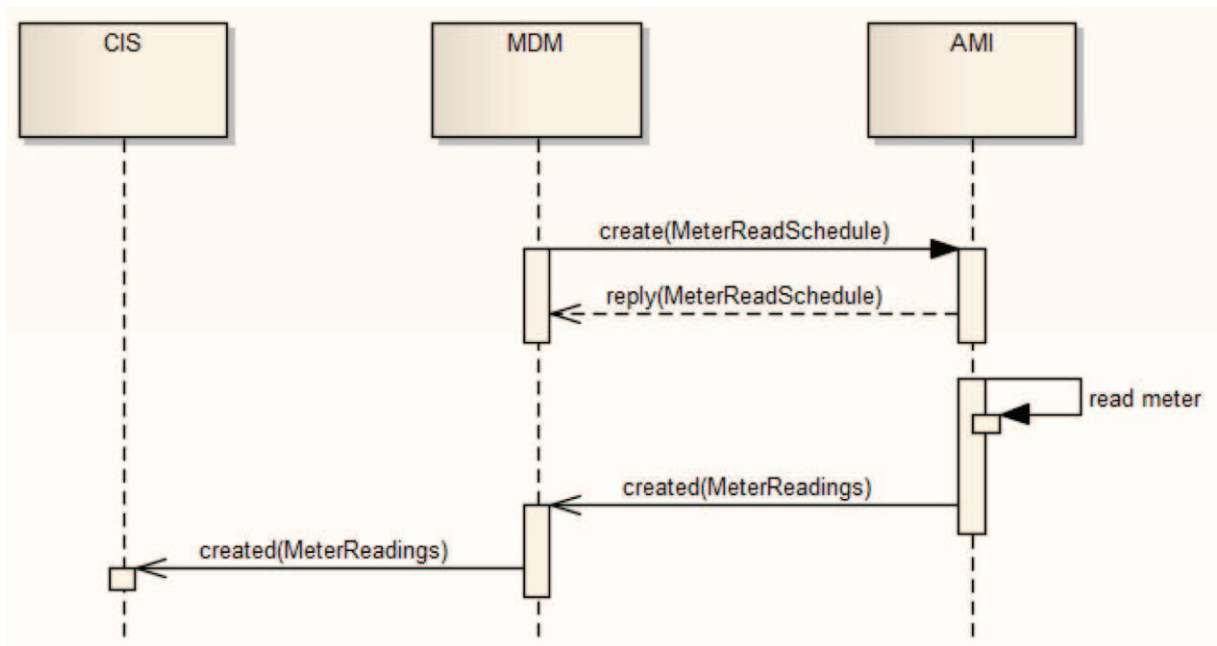


Figure 11 – Example use of meter read schedule to create subscription

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 12 shows such an exchange.

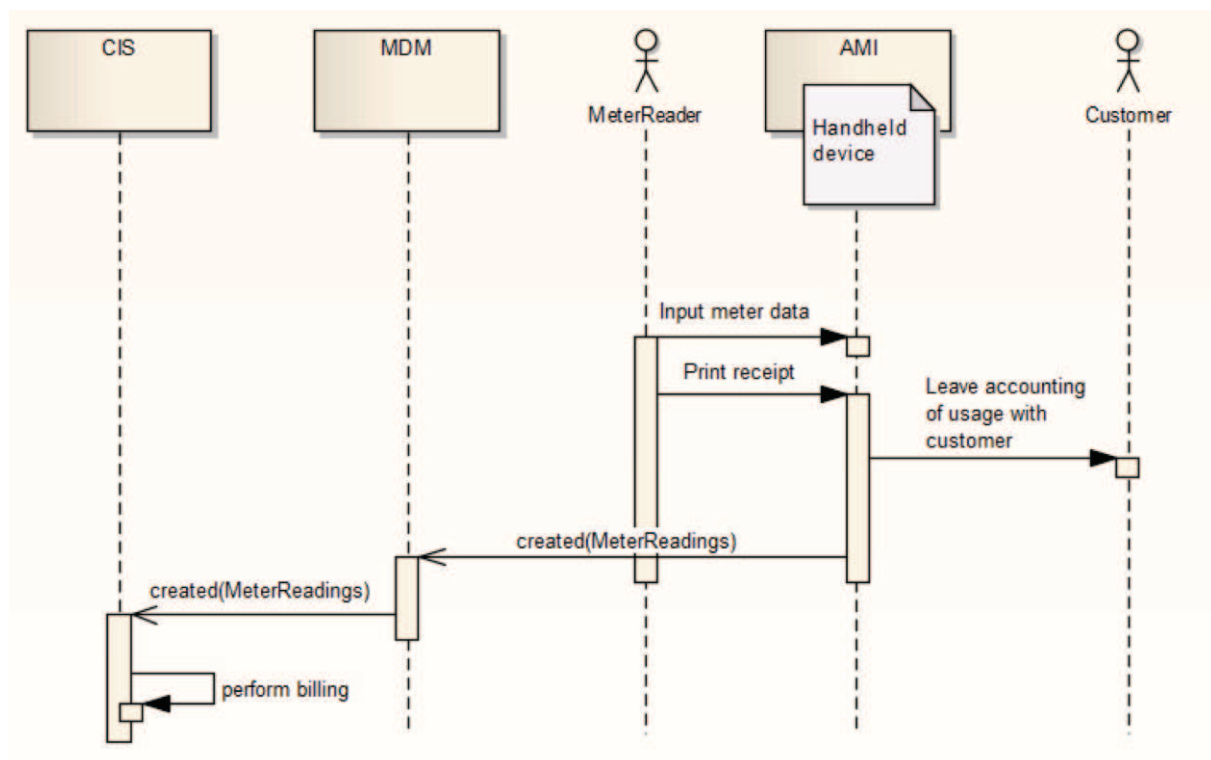


Figure 12 – Example manual meter reading exchange

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 13.

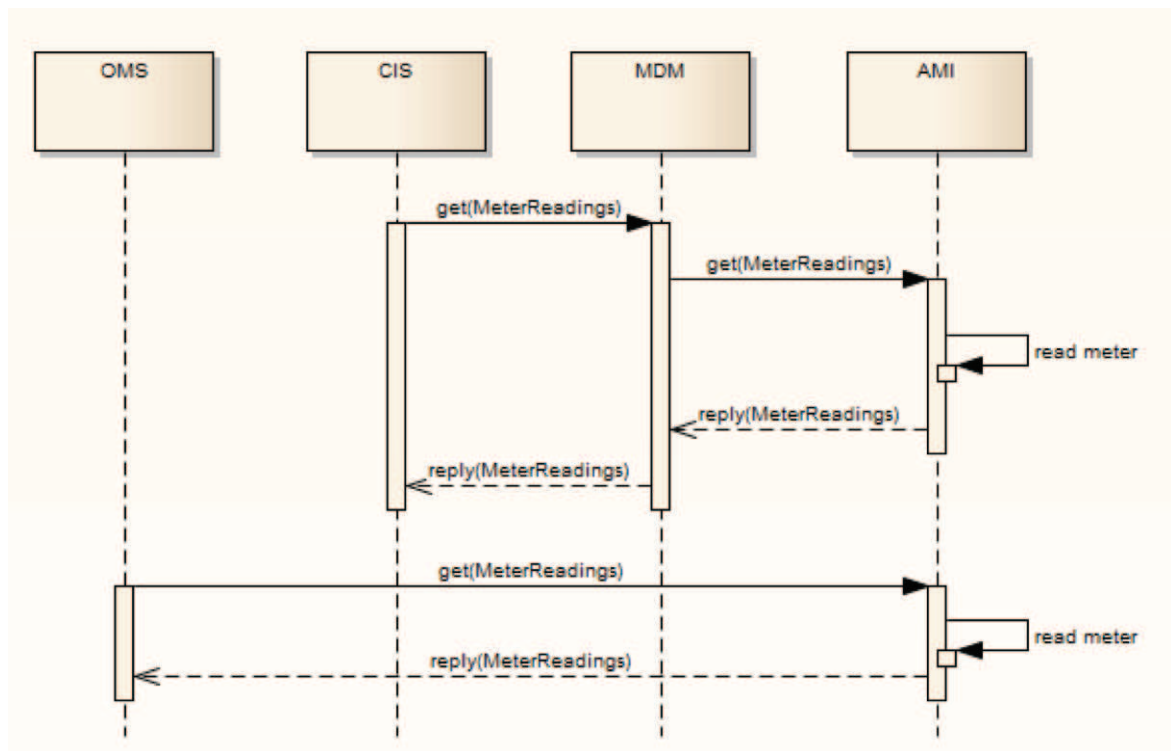


Figure 13 – Example On-Request meter read

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 14). This would permit usage to be aggregated to determine loads for a transformer or feeder.

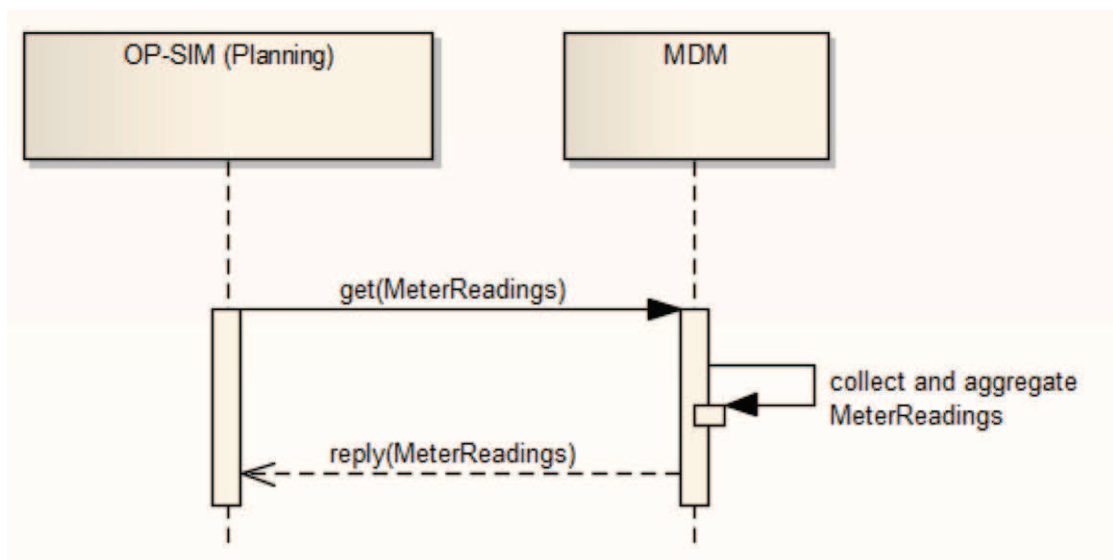


Figure 14 – Historical MeterData exchange

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 15 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.

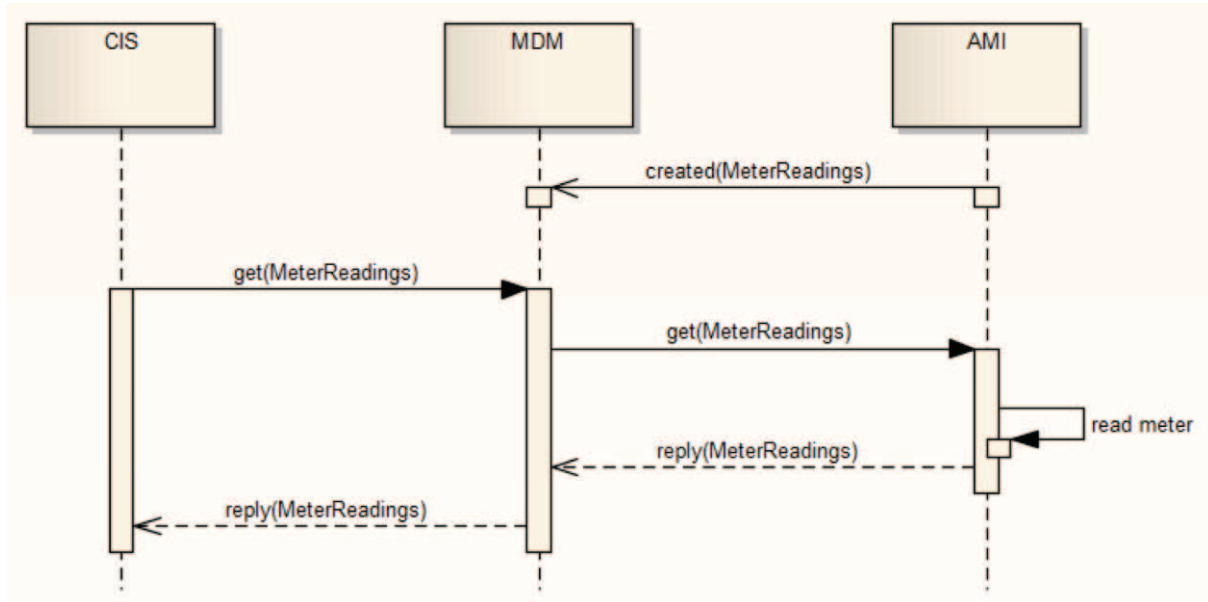


Figure 15 – Example billing inquiry message exchange

5.3.3 Message formats

The detailed XML schema for messages are described in Annex H. Figure 16 shows the message format used to present meter readings from one or more end devices.

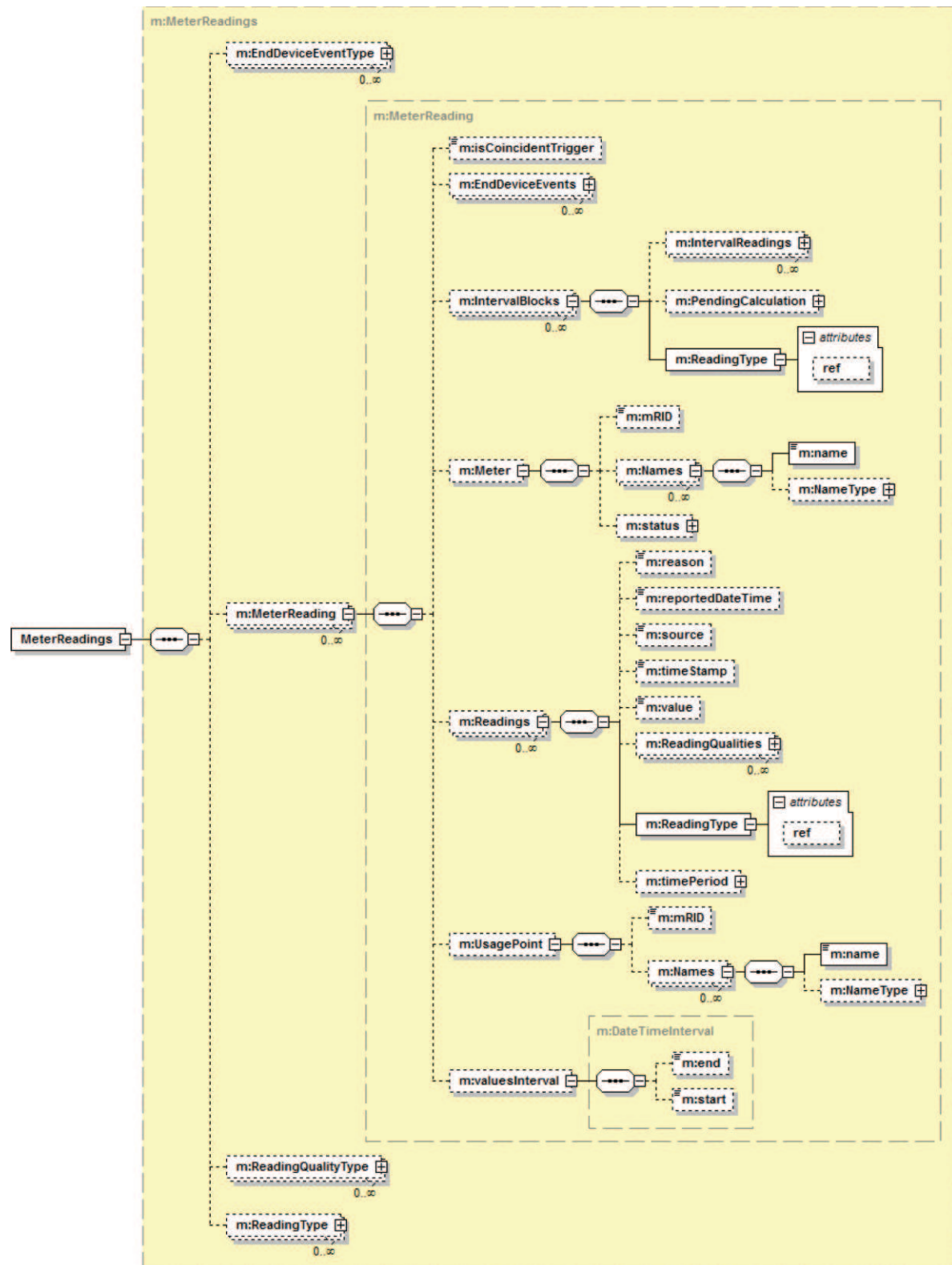


Figure 16 – Meter readings message format

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 17 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 timeStamp 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.

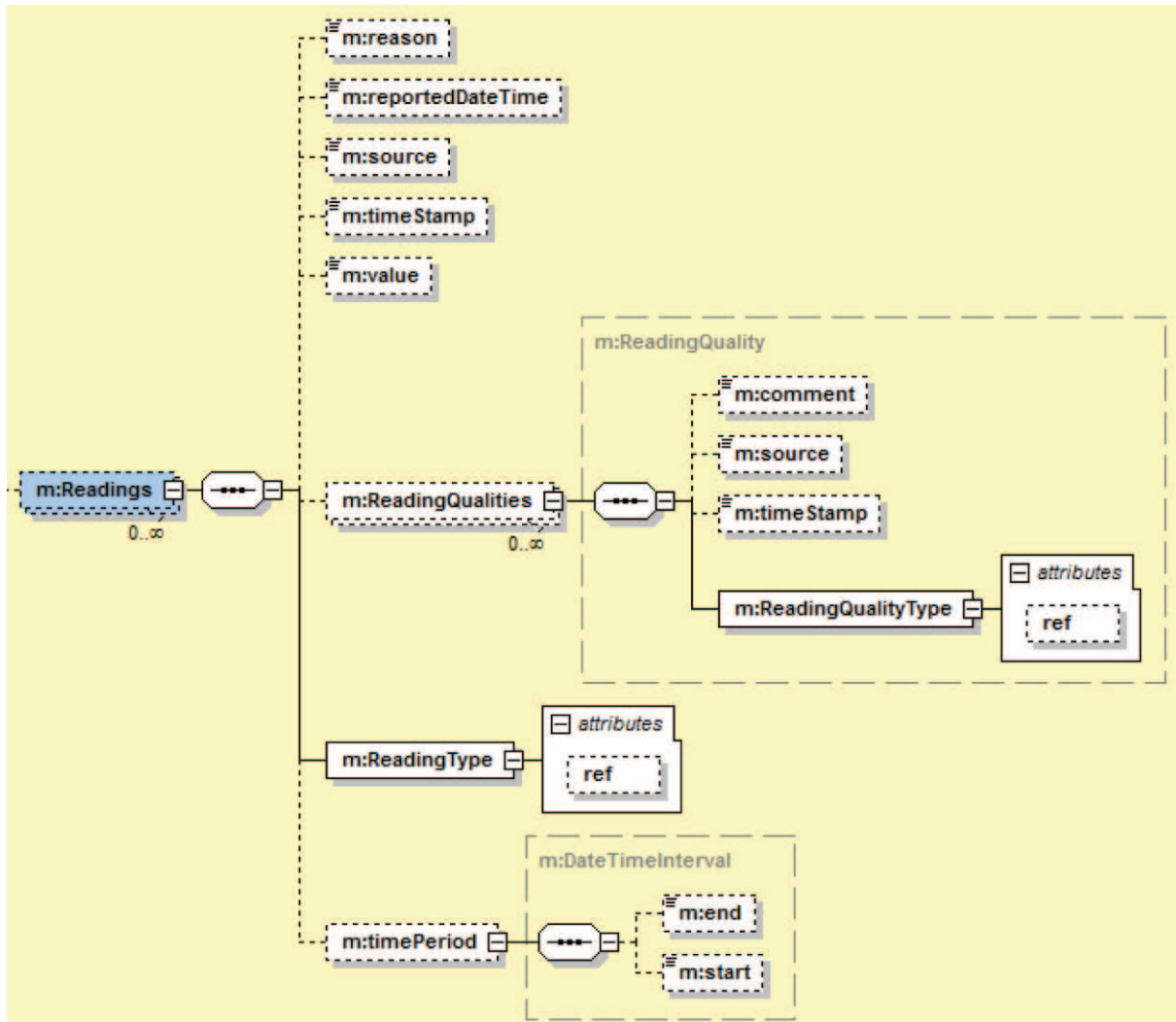


Figure 17 – Reading structure

Within a reading, the timeStamp 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 timeStamp and timePeriod.

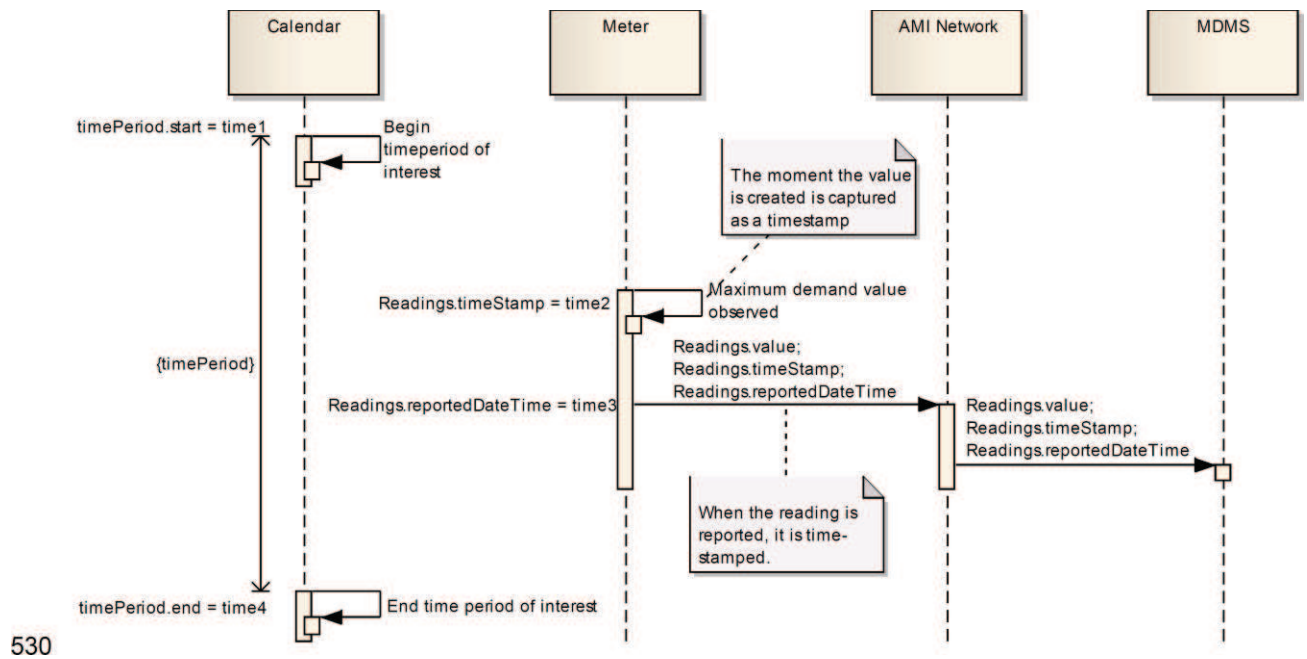


Figure 18 – Timestamps assigned between systems

Figure 18 shows the way that timestamps are assigned as values are created and passed between systems. From the perspective of the CIS and MDMS, there exists a “timePeriod” of interest for (perhaps) a billing period. A “get” request might specify this time range, and the AMI or MDMS would “reply” with readings that fall within this range. Important points in time regarding the generation and reporting of the value are also timestamped. All of these timestamps are found within the meterReadings schema. Another view of the same example (with real dates and times) is expressed below in Figure 19.

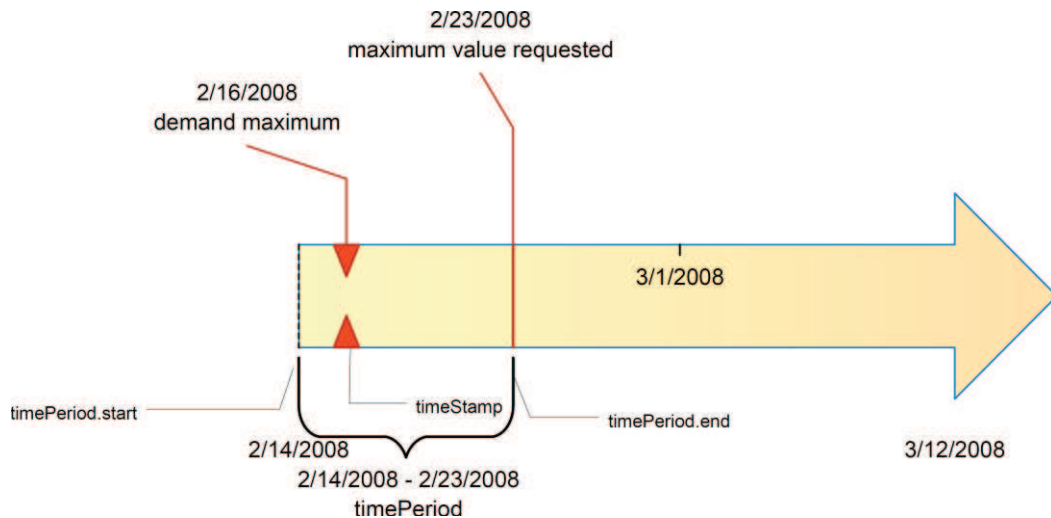


Figure 19 – Conventions for timeStamp and timePeriod

The IntervalBlock structure allows for a set of reading to be grouped by a common ReadingType and as a convenience for representation of a time series.

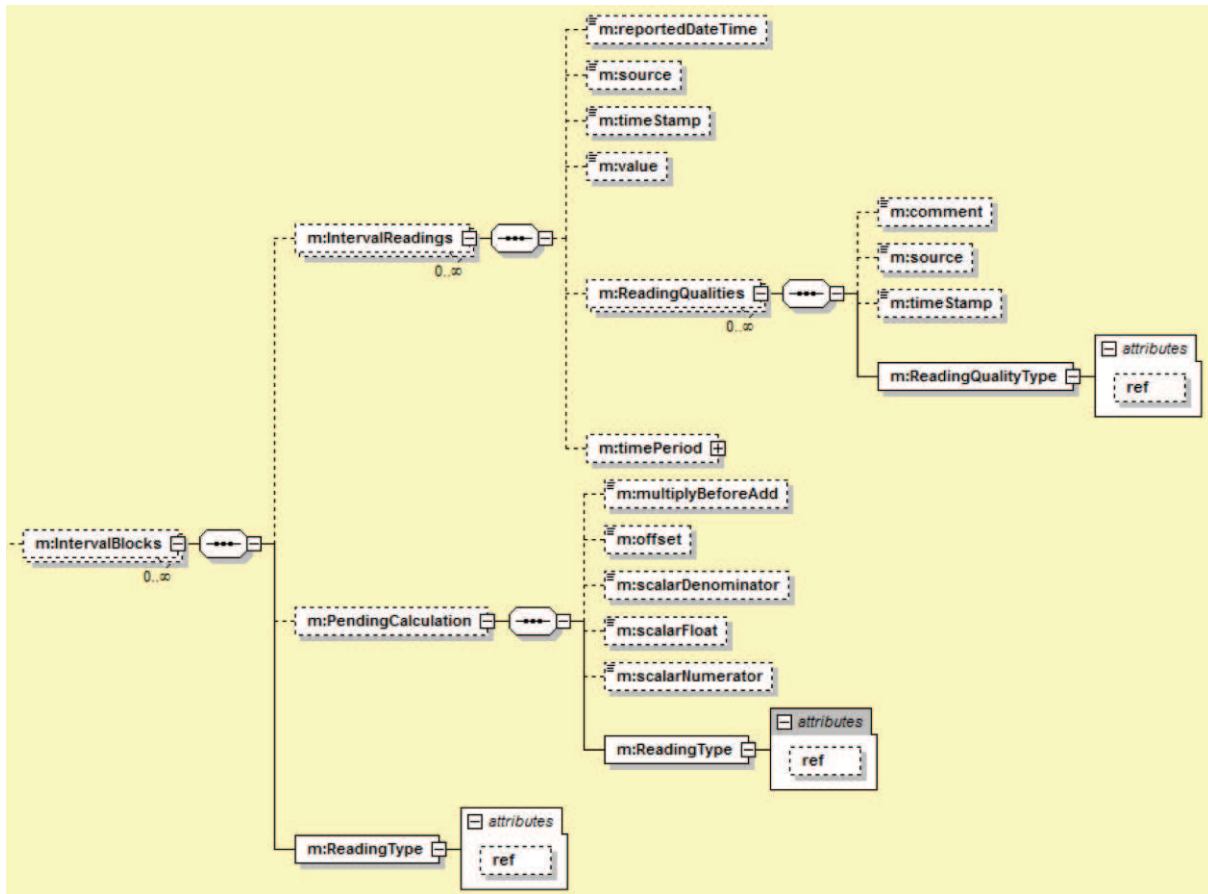


Figure 20 – IntervalBlock structure

The following diagram shows the convention for use of a timeStamp for interval data where an associated reading type identifies that the reading value is for a specified interval.

Different MR systems work in different ways, but for the purpose of the standard, timestamps denote the end of the interval. The implied generation process is described below in Figure 21.

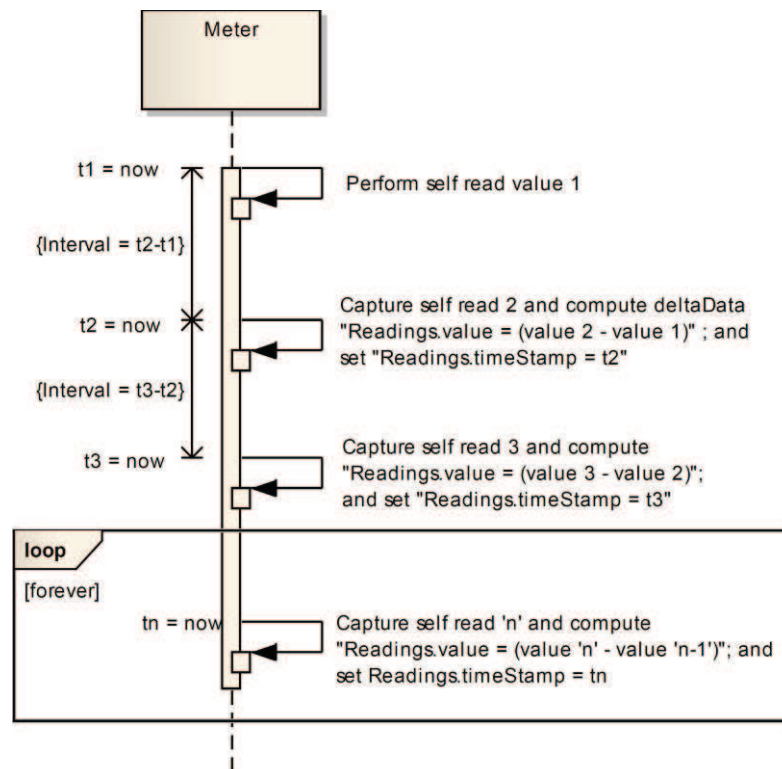


Figure 21 – Interval data timestamp generation

When a timestamp is used, it shall fall within a time range from 00:00:00 to 23:59:59 as depicted in Figure 22. A value of 23:59:59 plus 1 s places the time at midnight which is the start of the next day.



Figure 22 – Time interval conventions

Note that as defined by ISO 8601, the time 24:00 of the current day is the same as 00:00 for the next day. A day starts and ends at 00:00. It is important to note that interval data can be conveyed using IntervalBlocks with IntervalReadings or simply using Readings. IntervalBlocks shall be used in cases where the PendingCalculation elements are needed, otherwise they simply allow for a reduced XML footprint over Readings, which may be important in some situations.

Key to the reporting of a value from a meter is the reading type. The ReadingType class in the CIM is defined to allow capture of the following information as related to the description of a reading type, as is more thoroughly defined in Annex C.

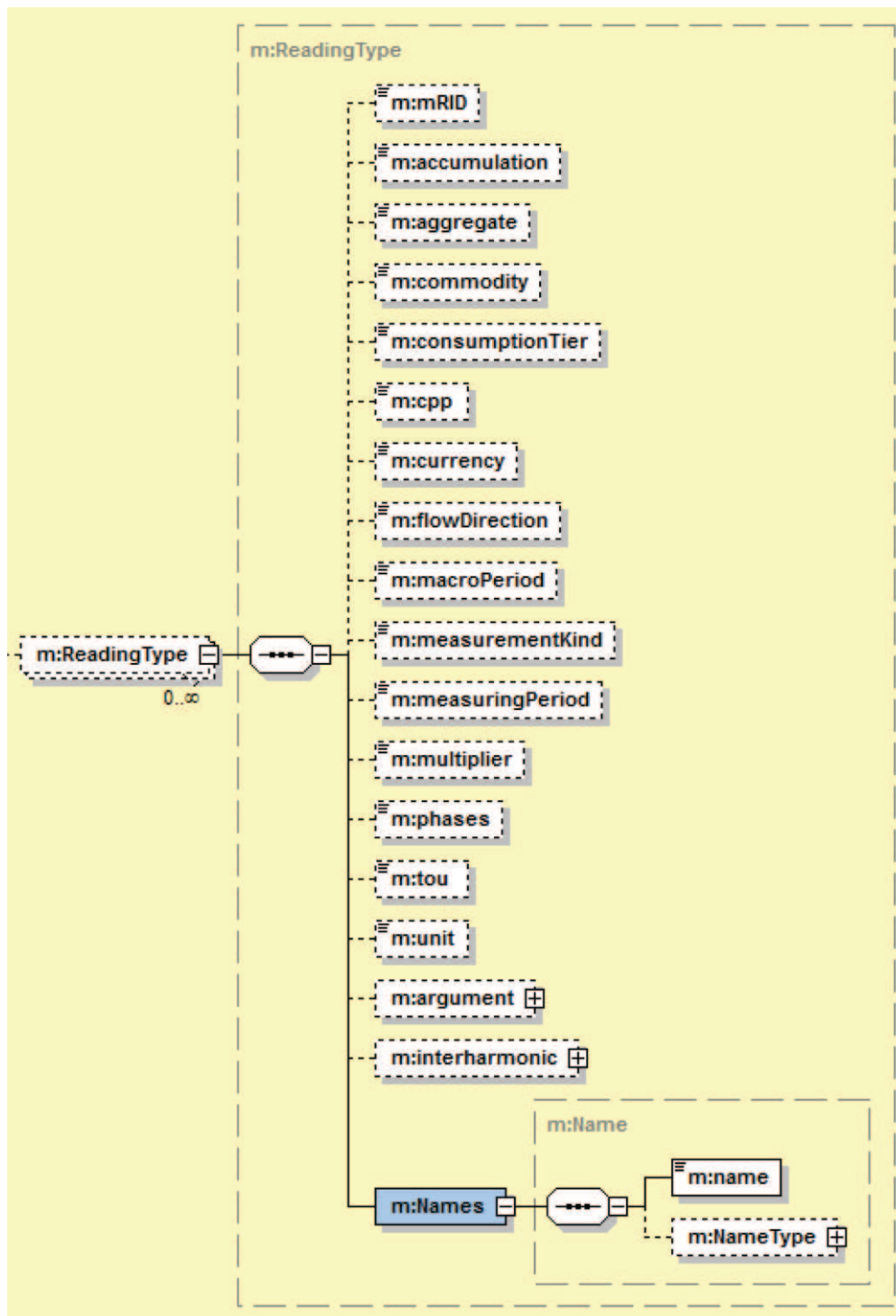


Figure 23 – ReadingType structure

While the ReadingType structure is present in the MeterReadings message, it should be expected that in normal practice it will not be populated, as it is anticipated that the consuming system will already be configured with the appropriate ReadingType definitions. The details of this and other classes specific to metering are described in the Metering package of the CIM. A more thorough discussion of reading types is provided in Annex C.

Readings are not limited to metering devices. Any EndDevice may potentially produce a measurement. In this edition of IEC 61968-9, the asset producing the reading shall be identified using the Meter class, even though the device may not be a meter. It is expected that all assets have a unique mRID or Names.name so that meters can be distinguished from remote connect/disconnect switches, and from other devices. It is expected

that the future edition of IEC 61968-9 will provide a more explicit method of dealing with readings from devices other than Meters.

Interval data has unique timestamp requirements. The extended capabilities of ISO 8601 provide the means to specify both a formal interval length (as an ISO 8601 “period” of time), as well as a fixed reference point.

The following XML provides some XML example payloads of MeterReadings messages.

```
<?xml version="1.0" encoding="UTF-8"?>
<mr:MeterReadings xmlns:mr = "http://iec.ch/TC57/2011/MeterReadings#">
  <mr:MeterReading>
    <mr:Meter>
      <mr:Names>
        <mr:name>63.89.98.184</mr:name>
        <mr:NameType>
          <mr:description>This is an endpoint serial number</mr:description>
          <mr:name>EndpointID</mr:name>
          <mr:NameTypeAuthority>
            <mr:description>AssetManagementSystem</mr:description>
            <mr:name>com.company.assets</mr:name>
          </mr:NameTypeAuthority>
        </mr:NameType>
      </mr:Names>
    </mr:Meter>
    <mr:Readings>
      <mr:timeStamp>2011-12-05T17:21:40.628Z</mr:timeStamp>
      <mr:value>25.633</mr:value>
      <mr:ReadingType ref = "0.0.0.1.4.1.12.0.0.0.0.0.0.0.3.72.0"/>
    </mr:Readings>
    <mr:Readings>
      <mr:timeStamp>2011-12-05T17:21:40.628Z</mr:timeStamp>
      <mr:value>10.0</mr:value>
      <mr:ReadingType ref = "0.0.0.12.1.1.37.0.0.0.0.0.0.0.3.38.0"/>
    </mr:Readings>
  </mr:MeterReading>
</mr:MeterReadings>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<mr:MeterReadings xmlns:mr = "http://iec.ch/TC57/2011/MeterReadings#">
  <mr:MeterReading>
    <mr:Meter>
      <mr:Names>
        <mr:name>63.89.98.184</mr:name>
        <mr:NameType>
          <mr:description>This is an endpoint serial number</mr:description>
          <mr:name>EndpointID</mr:name>
          <mr:NameTypeAuthority>
            <mr:description>AssetManagementSystem</mr:description>
            <mr:name>com.company.assets</mr:name>
          </mr:NameTypeAuthority>
        </mr:NameType>
      </mr:Names>
    </mr:Meter>
    <mr:IntervalBlocks>
      <mr:IntervalReadings>
        <mr:reportedDateTime>2001-12-17T09:30:47Z</mr:reportedDateTime>
        <mr:timeStamp>2001-12-17T09:30:47Z</mr:timeStamp>
        <mr:value>25.44</mr:value>
        <mr:timePeriod>
          <mr:end>2001-12-17T09:30:47Z</mr:end>
          <mr:start>2001-12-17T09:30:47Z</mr:start>
        </mr:timePeriod>
      </mr:IntervalReadings>
      <mr:ReadingType ref = "0.0.2.4.1.1.12.0.0.0.0.0.0.0.3.72.0"/>
    </mr:IntervalBlocks>
    <mr:Readings>
      <mr:timeStamp>2001-12-17T09:30:47Z</mr:timeStamp>
      <mr:value>10.0</mr:value>
      <mr:ReadingType ref = "0.0.0.12.1.1.37.0.0.0.0.0.0.0.3.38.0"/>
    </mr:Readings>
  </mr:MeterReading>
</mr:MeterReadings>
```

The concept of “coincident readings” deserves some attention. A coincident reading is a MeterReading that occurs at the same point in time as some other MeterReading or EndDeviceEvent.

Some meters have the ability to report a reading that was coincident with a certain other MeterReading or EndDeviceEvent (hereinafter referred to in IEC 61968-9 as the “trigger”). For example, it might record the “power factor coincident with the billing period maximum demand.

Additionally, some processes call for a coincident read to be reported. For example, when a meter is installed, it is common to capture an “initial reading.” Similarly, when a meter is disconnected, it is common practice to capture a “final read” coincident with the disconnection event.

Some systems may perform analysis of the data in storage to identify analytically derived coincident readings. For example:

- the voltage at UsagePoint A at the time of the peak daily demand on the distribution transformer (UsagePointB) that serves UsagePoint A. (UsagePoint “B” could be either a real or a virtual UsagePoint.)
- the 15-minute interval consumption at UsagePoint A at the time of the peak demand on a distribution network (UsagePoint C) on a hot, summer day
- a BulkQuantity kwh reading for a UsagePoint at the time of an EndDeviceEvent such as a meter disconnect.

The MeterReading class has an optional Boolean element called “isCoincidentTrigger.” The element doesn't have to be used in a message, but if it is, there are rules for its interpretation. If any instance of a MeterReading message is marked with the isCoincidentTrigger Boolean set to “true”, then all other MeterReadings within the same MeterReadings message are considered to be coincident with the so marked MeterReading. Only one MeterReading element within a single MeterReadings message may have its isCoincidentTrigger Boolean set to “true”. If the isCoincidentTrigger Boolean is absent, it is defined to be “false”. It is recommended that the “trigger” MeterReading should have a timeStamp if this information is available.

The GetMeterReadings profile can be used to request MeterReadings that are coincident with a given MeterReading. This can be accomplished by including in the GetMeterReadings message a MeterReadings element in which the isCoincidentTrigger Boolean is set to “true” – in other words by specifying the “trigger” MeterReading in the GetMeterReadings filter criteria.

NOTE It is recognized that there may be small differences in time between a coincident trigger and the reading(s) that are coincident with the trigger. For example, a reading taken in conjunction with a meter disconnect can actually be taken several seconds after the operation of the disconnect switch. It is outside the scope of this Standard to define the window for readings to be considered coincident.

In the following example, a metering system identifies a power factor measurement that is coincident with the maximum demand for a given meter when the exact date and time of the maximum demand is not known:

```
<mr:MeterReadings
  xsi:schemaLocation = "http://iec.ch/TC57/2011/MeterReadings#MeterReadings.xsd"
  xmlns:mr = "http://iec.ch/TC57/2011/MeterReadings#"
  xmlns:xsi = "http://www.w3.org/2001/XMLSchema-instance">
  <mr:MeterReading>
    <mr:Meter>
      <mr:Names>
        <mr:name>Meter_XYZ</mr:name>
      </mr:Names>
    </mr:Meter>
    <mr:Readings>
      <mr:value>0.0914159</mr:value>
      <mr:ReadingType ref = "0.0.0.6.0.1.38.0.0.0.0.0.0.0.0.0.65.0"/>
      <!--indicating electricitySecondaryMetered powerFactor (cos?)-->
    </mr:Readings>
  </mr:MeterReading>
  <mr:MeterReading>
    <mr:isCoincidentTrigger>true</mr:isCoincidentTrigger>
    <mr:Meter>
      <mr:Names>
        <mr:name>Meter_ABCx1</mr:name>
      </mr:Names>
    </mr:Meter>
  </mr:MeterReading>
</mr:MeterReadings>
```

```
<mr:Readings>
  <mr:ReadingType ref = "8.8.0.6.1.1.8.0.0.0.0.0.0.0.0.3.38.0"/>
  <!--billingPeriod maximum indicating forward electricitySecondaryMetered demand (kW)-->
</mr:Readings>
</mr:MeterReading>
</mr:MeterReadings>
```

In the next example, a metering system or MDMS identifies the final meter reading coincident with disconnection of service via RCD:

```
<mr:MeterReadings
  xsi:schemaLocation = "http://iec.ch/TC57/2011/MeterReadings#
    MeterReadings.xsd"
  xmlns:mr = "http://iec.ch/TC57/2011/MeterReadings#"
  xmlns:xsi = "http://www.w3.org/2001/XMLSchema-instance">
  <mr:MeterReading>
    <mr:isCoincidentTrigger>true</mr:isCoincidentTrigger>
    <mr:EndDeviceEvents>
      <mr:createdDateTime>2010-12-17T09:30:47Z</mr:createdDateTime>
      <mr:reason>moveOut</mr:reason>
      <mr:EndDeviceEventType ref = "3.31.0.68"/>
      <!--ElectricityMeter RCDSwitch Disconnected -->
    </mr:EndDeviceEvents>
    <mr:Meter>
      <mr:Names>
        <mr:name>Meter1</mr:name>
      </mr:Names>
    </mr:Meter>
  </mr:MeterReading>
  <mr:MeterReading>
    <mr:Meter>
      <mr:Names>
        <mr:name>Meter1</mr:name>
      </mr:Names>
    </mr:Meter>
    <mr:Readings>
      <mr:timeStamp>2010-12-17T09:30:49Z</mr:timeStamp>
      <mr:value>123456</mr:value>
      <mr:ReadingType ref = "0.0.0.1.4.1.12.0.0.0.0.0.0.0.0.3.72.0"/>
      <!--billingQuantity net electricitySecondaryMetered energy (kWh)-->
    </mr:Readings>
  </mr:MeterReading>
</mr:MeterReadings>
```

The next example demonstrates a request to get meter readings from a metering system or MDMS which are coincident with a disconnect that occurred within a specified time interval. The request is an open-ended invitation to send any type of MeterReading data which is coincident with an RCDSwitch disconnect for a given EndDevice (meter). The response to this request could very well be nothing more than the “final meter reading” example provided above. (If a more specific response was sought, it would be possible to filter for only the desired ReadingType(s) by populating the ReadingType element in the GetMeterReadings profile.)

```
<mr:GetMeterReadings
  xsi:schemaLocation="http://iec.ch/TC57/2011/GetMeterReadings#GetMeterReadings.xsd"
  xmlns:m="http://iec.ch/TC57/2011/GetMeterReadings#"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <mr:EndDevice>
    <mr:Names>
      <mr:name>Meter1</mr:name>
    </mr:Names>
  </mr:EndDevice>
  <mr:MeterReadings>
    <mr:isCoincidentTrigger>true</mr:isCoincidentTrigger>
    <mr:EndDeviceEvents>
      <mr:EndDeviceEventType>
        <mr:Names>
          <mr:name>3.31.0.68</mr:name>
          <!--ElectricityMeter RCDSwitch Disconnected -->
        </mr:Names>
      </mr:EndDeviceEventType>
    </mr:EndDeviceEvents>
  </mr:MeterReadings>
```

```
<mr:TimeSchedule>
  <mr:scheduleInterval>
    <mr:end>2010-12-31T23:59:59Z</mr:end>
    <mr:start>2010-12-01T00:00:00Z</mr:start>
  </mr:scheduleInterval>
</mr:TimeSchedule>
</mr:GetMeterReadings>
```

NOTE When using timestamps as filters, note that the TimeSchedule.scheduleInterval elements are used to frame a request for data falling within a certain range. The MeterReadings response may populate the MeterReadings.MeterReading.valuesInterval elements to identify the range of dates offered in the response. The user will also find that interval data (which contains a time-ordered series of values) has no place in a discussion of coincident data. Only one interval may be coincident with a given event or another MeterReading. It therefore seems inappropriate to populate a series of MeterReading.IntervalBlocks.IntervalReadings elements. A single value may be presented as an interval, or the single interval value may be presented as a stand alone MeterReading.Readings instead.

The ability to schedule when meter readings are obtained is provided through the use of a MeterReadSchedule request. The following is the structure used for the payload of a MeterReadSchedule request message:

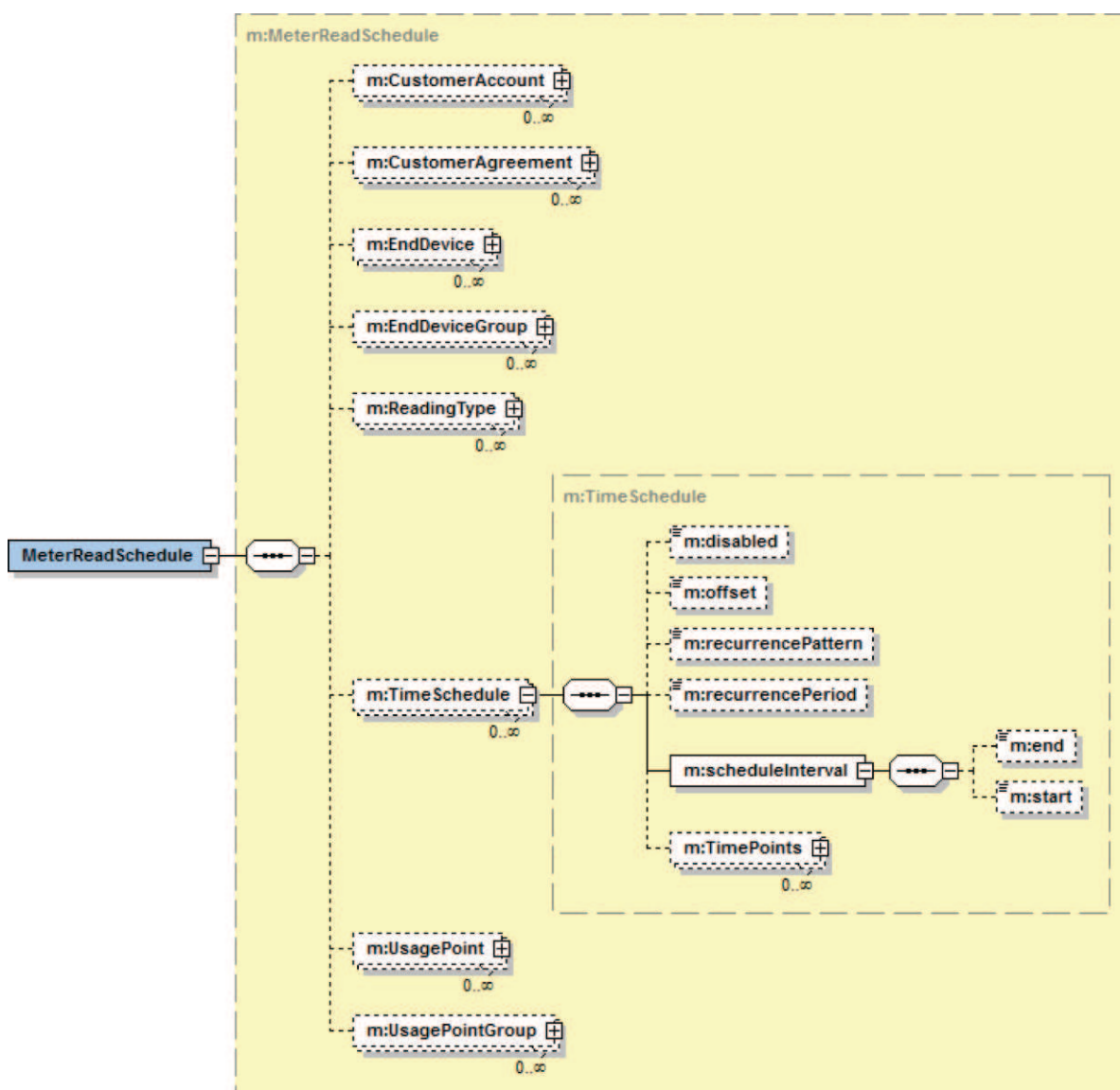


Figure 24 – Meter read schedule message format

Several elements in the TimeSchedule of the MeterReadSchedule are profile are unique to that profile and deserve special definition. These include:

disabled – True if this schedule is deactivated (disabled)

offset – The offset for the recurring (periodic) times in the TimeSchedule. Each point in the time series defined by scheduledInterval and either recurrencePeriod or recurrencePattern will be shifted by adding the offset value. The use of TimeSchedule.offset is not applicable when discrete TimePoints are specified in lieu of a recurrencePeriod or recurrencePattern.

recurrencePattern – Interval at which the scheduled action repeats, from the beginning of one action to the beginning of the next action (e.g., first Monday of every month, last day of the month, etc.). Used when the interval cannot be defined as a fixed number of seconds between points in time. The use of recurrencePattern is not applicable when recurrencePeriod is specified or when discrete TimePoints are specified in lieu of a recurrencePeriod or recurrencePattern.

recurrencePeriod – Duration between time points, from the beginning of one action to the beginning of the next action. Used when the interval can be defined as a fixed number of seconds between points in time. The use of recurrencePeriod is not applicable when recurrencePattern is specified or when discrete TimePoints are specified in lieu of a recurrencePeriod or RecurrencePattern.

5.4 End device control messages

5.4.1 General

There are many types of end device control messages. These are used to send instructions to one or more end devices. EndDeviceControls may result in one or more consequential EndDeviceEvent message.

5.4.2 Applications

5.4.2.1 Load control

Load control (a.k.a. direct load control) requests can often be made to a MS for the purpose of load curtailment. This request would typically be initiated from network operations. Not all MS will have load control capabilities.

It should also be noted that this is different from a disconnect, where a disconnect results in the complete loss of power to a single customer.

A load control will typically result in the shedding of specifically configured loads (e.g. air conditioning, pumps, etc.)

The load control function executes load shed commands which are computed by load management software (contained in the network operations block). The load management software is used to compute an appropriate load-shed amount, and could potentially include many factors including the predicted duration of generation shortfalls, historical usage patterns, real-time usage data, and weather.

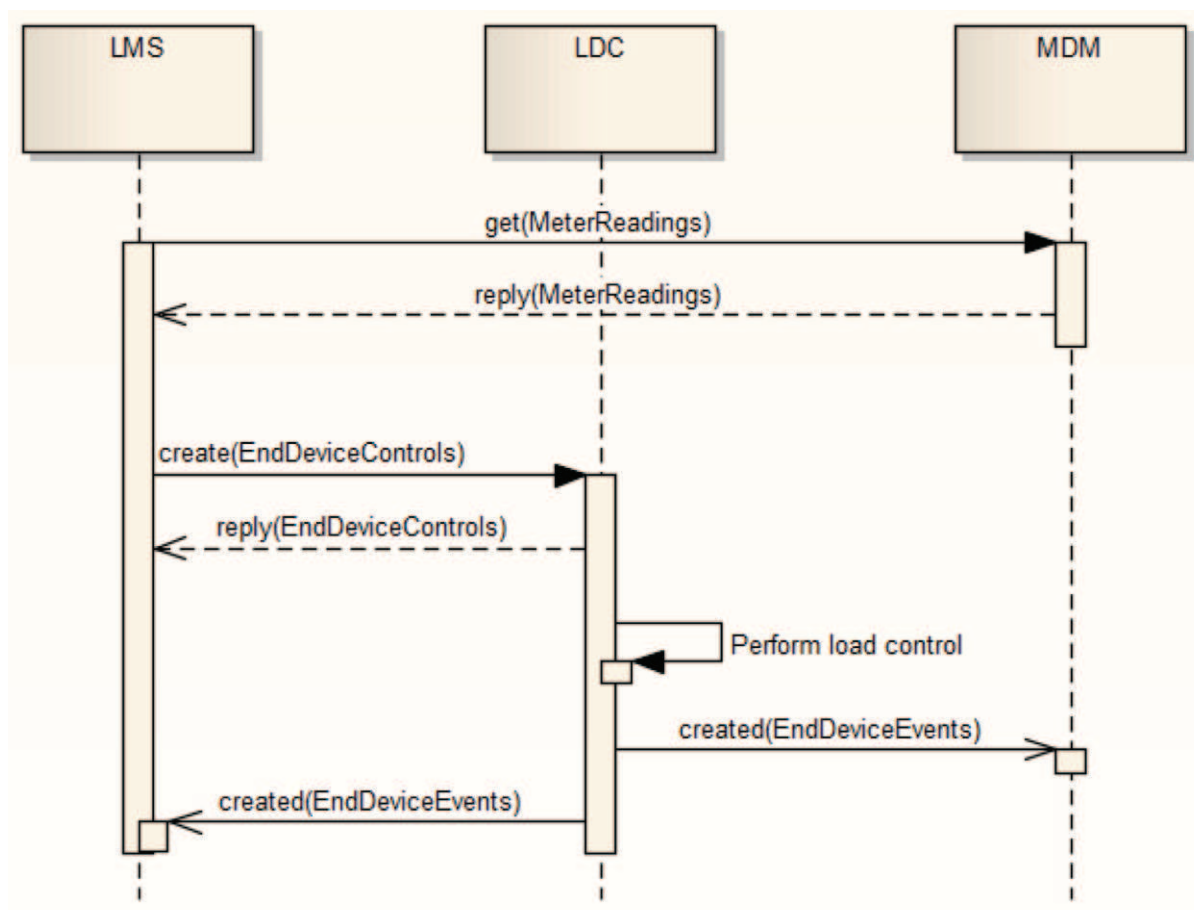


Figure 25 – Example load control message exchange

The example in Figure 25 shows how load history may be obtained from the MDM in the form of MeterReadings and used to perform load analysis. It also shows load control commands being issued by the LMS to the load control system. Deployments that don't support an MDM would interact directly with the MS instead.

Load control commands are implemented as a type of EndDeviceControl, where the command can be addressed by EndDeviceGroup (using a group address), by EndDevice (using mRID) or by CustomerAgreement.

Load control may also be implemented using PAN devices.

5.4.2.2 Load control device installation

The installation of load control units is usually more labour intensive than installing a meter, but the data exchange requirements are simpler. LC units are different from meters in the sense that they don't require periodic recalibration. Once an LC unit is installed it will probably remain in place for the life of the unit, even if the customer withdraws from the LC program, or if there is a change in tenancy.

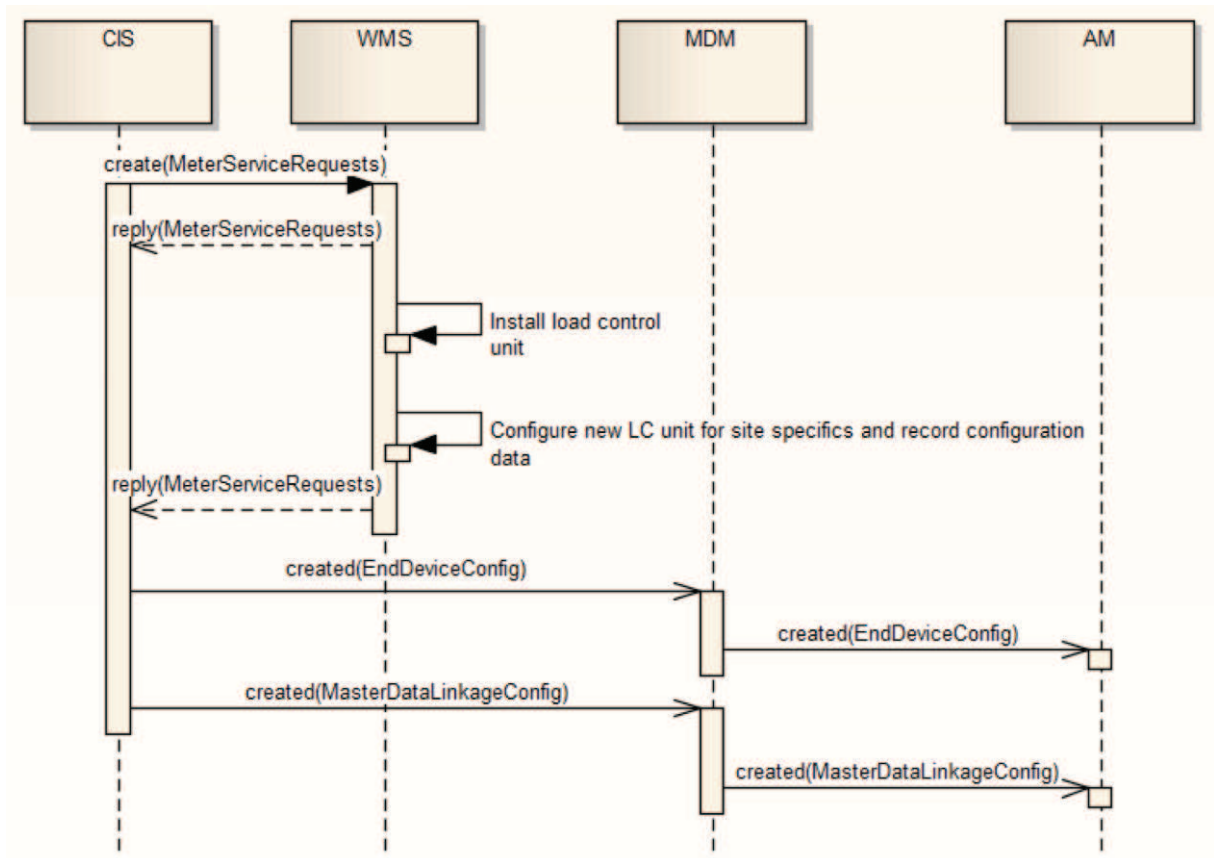


Figure 26 – Example message exchange for LC unit installation

Before travelling to the service location, the installer will know the customer account data, the type of load control unit to be installed, and the ratings of the device to be controlled. The installation data can confirm device ratings, and where appropriate, document the port number of the LC unit wired to the device. The results of the installation can be published to all of stakeholders as depicted in Figure 26.

5.4.2.3 Change of customer program

Particular metering solutions are usually chosen to fulfil specific metering needs as a result of customer program enrolment. In many cases, a flexible metering solution can provide coverage for a range of customer programs. When a customer transitions from enrolment in one program to another, it may simply require a change to the meter (or communication module) configuration. In extreme cases it may require a meter change out. In other cases, it may require no change at all. Changes to a configuration will need to be communicated amongst the stakeholders. An example exchange in which the deployment involves an MDM is described in Figure 27. Another example in which the deployment lacks an MDM is described in Figure 28.

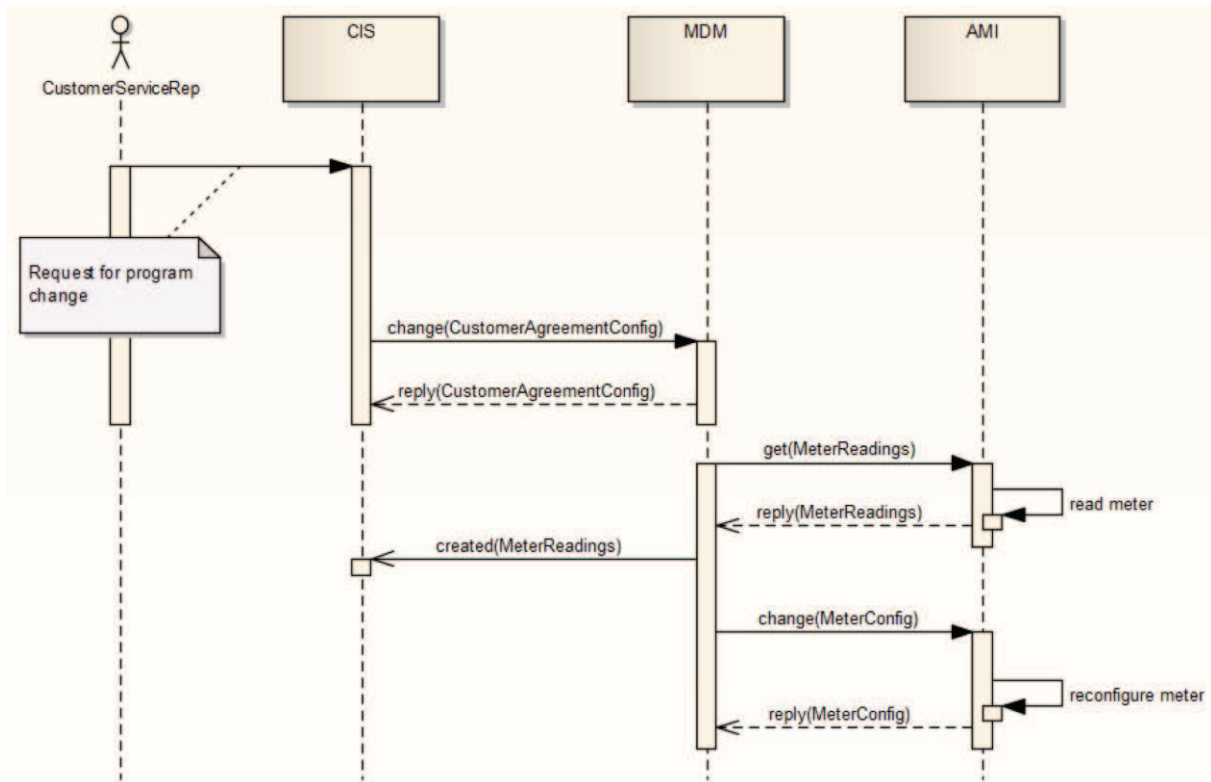


Figure 27 – Example message exchange for change of customer program

Changes to the meter configuration may be expressed as changes to the configuration of an EndDevice.

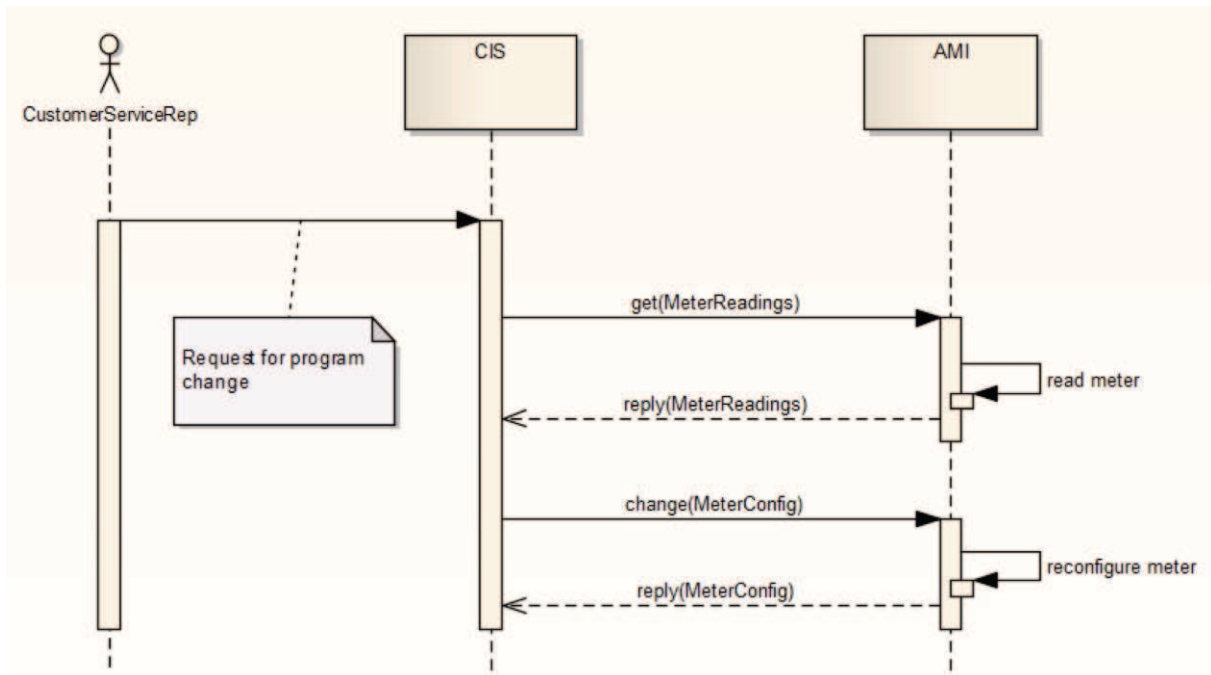


Figure 28 – Example message exchange for change of customer program w/o MDM

In other cases, a change to the customer program might not be accommodated with a meter reconfiguration. The program change may require a meter changeout (refer to 5.5 for more information on meter changeouts). Meter changeouts entail a different workflow than meter reconfigurations. This will be reflected in the message exchange between systems. An example exchange is depicted in Figure 29.

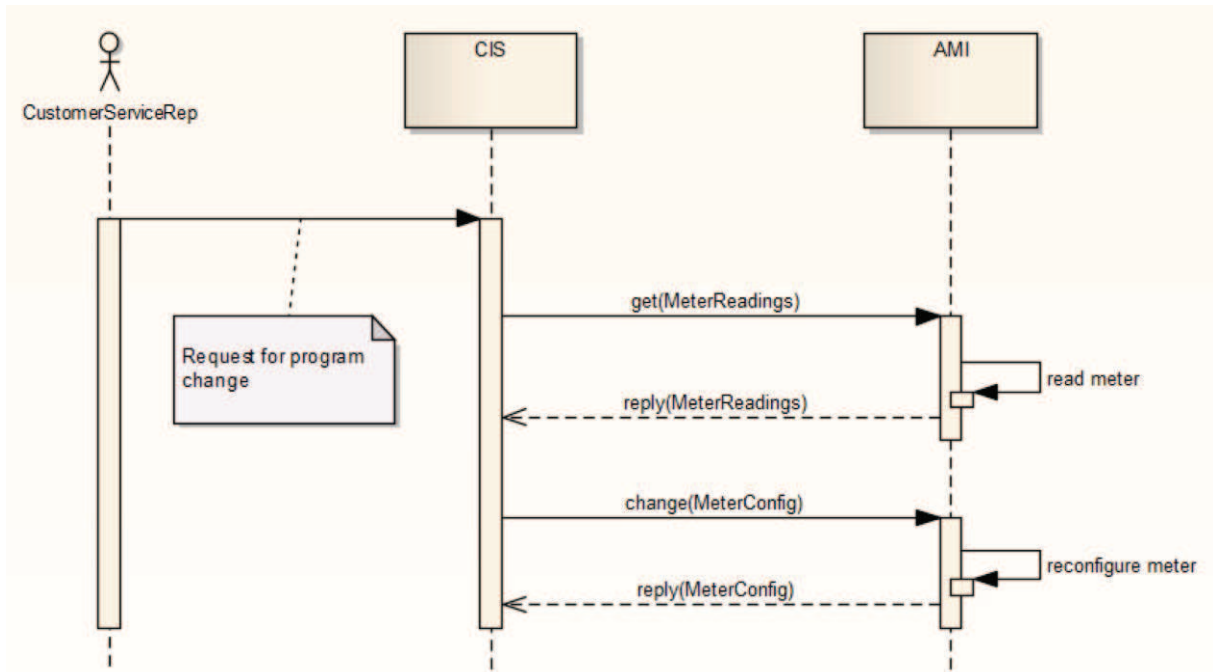


Figure 29 – Example for change of customer program with meter change out

See 5.6.2 on meter installation and removal for additional details on the MeterServiceRequest message.

5.4.2.4 Meter disconnect and reconnect

For a variety of reasons, such as non-payment, it may be necessary to disconnect or reconnect a customer. When disconnected, recorded usage should be zero and out of power complaints should be ignored. When it is not possible to perform a disconnect or reconnect remotely through an MS, a meter service request will typically be issued to perform the disconnect or reconnect manually. Example message exchanges for remote operation are depicted below in Figure 30 and Figure 31.

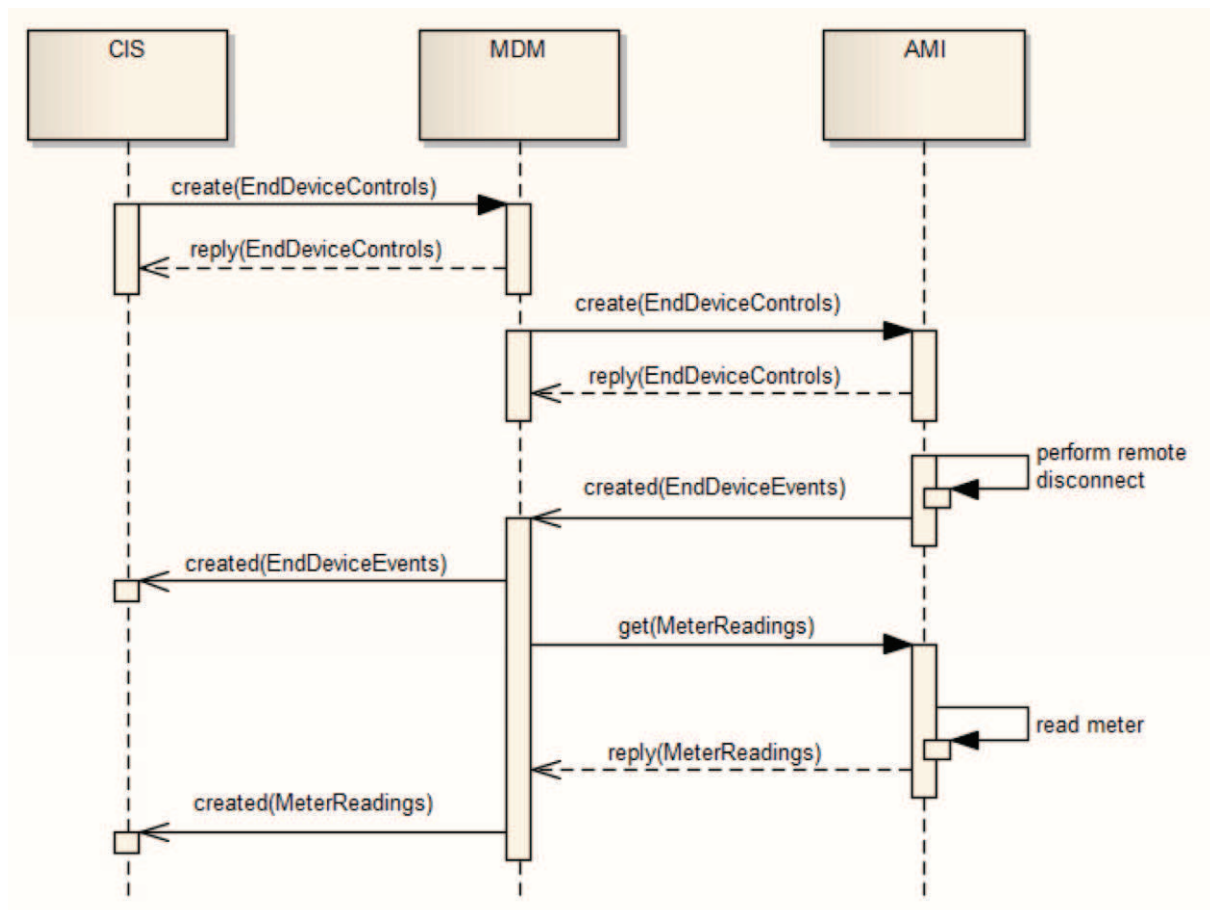


Figure 30 – Example message exchange for meter connect/disconnect

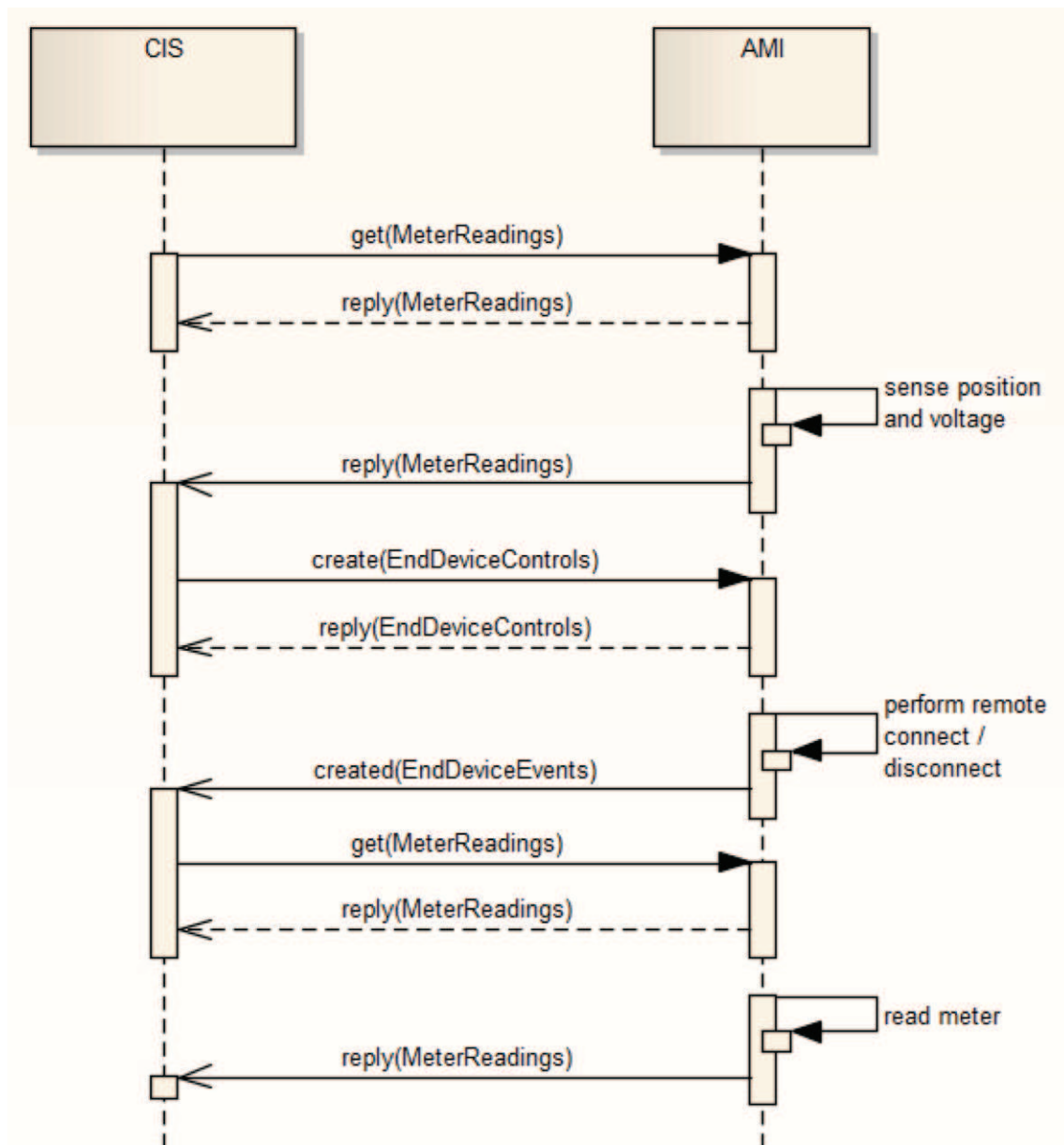


Figure 31 – Example of remote connect/disconnect directly between CIS and MS

5.4.2.5 Real-Time pricing

Real-time pricing signals and/or schedules can be sent to an end device via the MS. There are several ways this can be accomplished, such as:

- price signal issued in real-time identifying a price for a given time interval
- time of use (TOU) schedules published, which cause changes in the accumulation for each TOU Tier
- energy price schedules published in advance.

Often the EndDeviceGroup can be used to differentiate meters with different contracts or tariffs.

The example in Figure 32 shows a price signal being sent from network operations, to the MS. The MS then acts as a network service provider to communicate the price in real time to meters and other equipment.

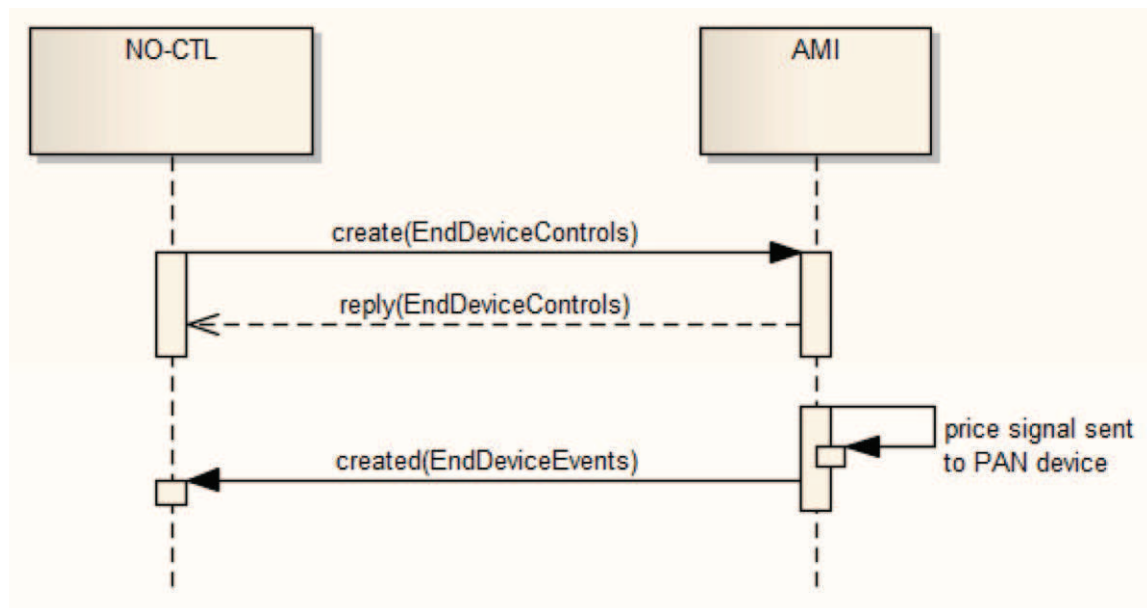


Figure 32 – Example message exchange for real-time price signal

Price signals are implemented as a subtype of EndDeviceControl, where the price is a message parameter.

5.4.3 Message format

5.4.3.1 General

Figure 33 describes the structure of an EndDeviceControls message. The XML schema for the EndDeviceControls message is defined in Annex H.