FLEXICIENCY

energy services demonstrations of demand response, FLEXibility and energy effICIENCY based on metering data

Deliverable D6.0

B2B Data Standard

EUropean Meter Exchange Data CIM

V1.1

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D6.0 – B2B Data Standard – EUMED CIM

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Document Responsible	Karima Boukir – Enedis
Author(s)	Bruno Traverson – EDF R&D Karima Boukir – Enedis Hervé Ngangmeni – Enedis
Reviewers	Matteo Murgida – Siemens Zvone Gazvoda - UL

Revision History

Version	Date	Author/Reviewer	Notes
0.1	19/10/2016	Enedis	First draft
0.2	16/12/2016	Enedis	EUMED – CIM data model included, circulation to the consortium
0.3	09/03/2017	Enedis	EUMED – CIM data model revised
	29/03/2017	Siemens	Review & Discussion with the consortium in Milan
0.4	24/04/2017	Enedis	EUMED – CIM completed with additional object from CIM after decision by the Consortium on the 29th March in Milan
0.5	18/05/2017	Enedis	Minor fixes
1.0	24/05/2017	Enedis	First version
1.1	03/07/2017	Enedis	Modifications in MeterReading and IntervalBlock. Circulation to Siemens for specification alignment
1.1	09/08/2017	Enedis	Tunning, Summary & Conclusion added. Circulation for official review (Siemens and UL)
	29/08/2017	Zvone Gazvoda UL	Review
1.1	05/09/2017	Enedis	Integration of UL comments

Changes from EUMED CIM 1.0 to EUMED CIM 1.1

The main changes between Version 1.0 and Version 1.1 of the EUMED SIM Specification are listed below.

- Paragraph 1.1 Figure 1: Association between IntervalBlock and ReadingType added. In conformance to (IEC 61968-11), an interval block may be associated to a specific reading type (if not indirectly associated by the association between MeterReading and ReadingType).
- Paragraph 1.1 Figure 1: Multiplicity of the association between MeterReading and ReadingType modified to 0..1 for the ReadingType role. In conformance to (IEC 61968-11), a meter reading may not be associated to a specific reading type (in this case, the association is established between IntervalBlock and ReadingType).
- Paragraph 1.2.5 Table 6: Attributes mRID, name, dsoCalendar, esoCalendar and briefId added (moved from IntervalBlock to MeterReading). Attributes mRID and name are no more marked as added because (IEC 61968-11) already supports them. This change is better aligned to (IEC 61968-11) in the sense that MeterReading is the identified object and IntervalBlock is the data set corresponding to a meter reading.
- Paragraph 1.2.5 Table 6: Multiplicity of attribute type changed to 0..1. Refer to rationale of change number 2.
- Paragraph 1.2.9 Table 10: Attributes mRID, name, dsoCalendar, esoCalendar and briefId deleted (moved from IntervalBlock to MeterReading). Refer to rationale of change number 3.
- Paragraph 1.2.9 Table 10: Attribute type added. Refer to rationale of change number 1.
- Paragraph B.1.1 Table B1: Lines mRID and name deleted. Refer to rationale of change number 3.
- Paragraph B.1.1 Table B1: Lines dsoCalendar, esoCalendar and briefId updated. Refer to rationale of change number 3.

Executive summary

The FLEXICIENCY project is constantly investigating standardization going always step forward in this domain. In the WP2, most areas to be shared and standardized among EU Energy Market Players have been gathered. As a first step, a common language and semantics for B2B data exchange at EU level was defined in D2.3. In particular, the data architecture was specified and data sets constituting the logical data model and objects to be shared were detailed to reach a standardization of common messages.

In this document, a detailed data modeling for B2B communication is defined to support the interactions between the main users of FLEXICIENCY. In particular, a detailed specification is provided for B2B Metering data exchanges. This model is based on CIM (Common Information Model) standard where further attributes have been added to fit to FLEXICIENCY use cases. This model is called EUMED CIM for **E**uropean **U**nion **M**etering **E**xchange **D**ata **CIM** format.

This model specifies the main inputs for B2B interface implementation. It may be amended in an incremental way after validation through FLEXICIENCY demonstrations.

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1 Introduction

The FLEXICIENCY project is constantly investigating standardization going always step forward in this domain. In the WP2, most areas to be shared and standardized among EU Energy Market Players have been gathered. As a first step, a common language and semantics for B2B data exchange at EU level was defined in D2.3. In particular, the data architecture was specified and data sets constituting the logical data model and objects to be shared were detailed to reach a standardization of common messages.

Indeed, a common exchange meter data model across Europe, assuring service continuity with existing data systems while hosting future data services, will bring of huge value for Energy Market efficiency. In this context, 3 main requirements towards the model are listed:

To be Generic, covering existing system and preparing future data services, through the same model:

- Historical energy metering Indexes (for billing)
- Individual Load Curve (for future & smart Energy Services)
- Aggregated data (for Demand Response and Energy efficiency purposes)

To play a pivot format function, for European interoperability, allowing:

- EU cross border exchanges among regulated and unregulated companies,
- Energy Market expansion for the benefits of residential customer,
- Collaboration between different companies,

To be multi commodity model, for future exploitation, allowing:

- Metering of different electricity usage (heat, air conditioning, white goods, …)
- Metering other commodities, for longer term horizon, such as : water, gas, etc

To achieve this goal, different analysis have been led in leveraging and reusing available standards during WP2 investigation. Those analysis have been shared in different documents and Workshops:

- D2.2 - requirements & references for standardization.
- FLEXICIENCY Workshop, Stockholm, June 2016 – discussion led by Siemens.
- FLEXICIENCY Workshop, Paris, September 2016 – discussion led by Enedis.

Finally, the consortium agreed to go for CIM based model. Before building the suited model, a ‘bottom up methodology’ (see figure below) has been developped, in order:

- to collect the main functional needs from the consortium use cases. For this purpose, we used inputs from D2.3.
- to adapt CIM standard from data model into exchange data model. For this purpose, we used some running data flows modeling for Individual & aggregated Metering data, published by Enedis and currently used by Market players in France. This mapping analysis is also part of the WP6, dealing with the Enedis DSO Platform enhancement and anticipating its adaptation to future interactions with Service Platforms within French demo.

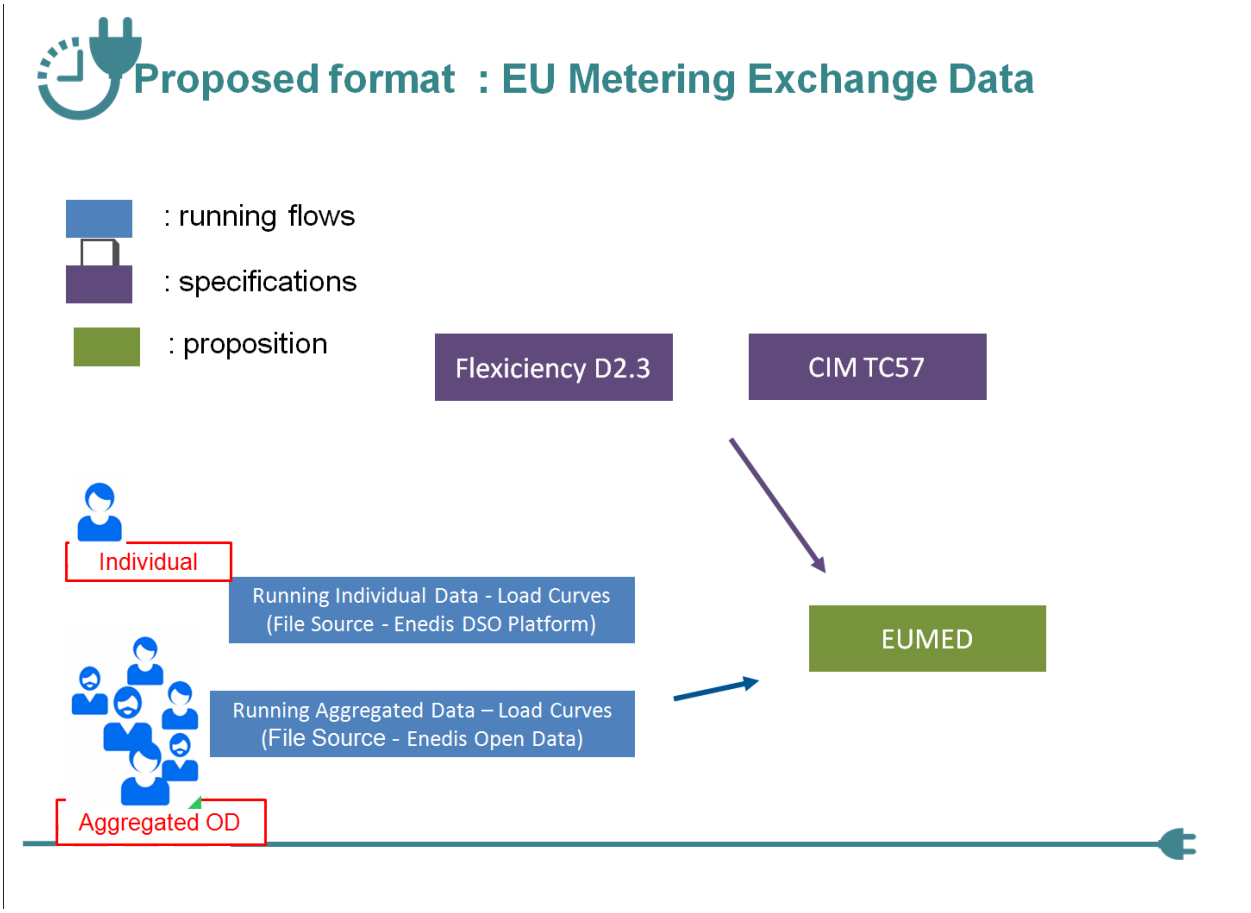

Figure – Framework used to define CIM based model

This analysis led to an extraction of a list of fields that are requested for Flexiciency demonstrations but currently not supported by CIM Objects. A CIM based model has been defined including both CIM and new fields. This model is called EUMED, standing for European Meter Exchange Data.

Two formats have been defined from this model in order to satisfy various constraints (understandability vs efficiency).

EUMED CIM - A full EUMED format that includes contextual information about the exchanged metering data in a structured way (to enhance understandability).
EUMED LIGHT - A light EUMED format that includes contextual information about the exchanged metering data in a compacted way (to enhance efficiency).

Both formats are based on CIM (Common Information Model).

(**IEC 61968-11**)
Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution. 2016.
(**IEC 61970-301**)
Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base. 2016.

(**IEC 61968-100**)
Application integration at electric utilities – System interfaces for distribution management – Part 100: Implementation Profiles for IEC 61968. 2015.

The EUMED LIGHT has been presented to the advisory board in Milan 28th March 2017. However, the consortium preferred to implement a model that is the closest to CIM, minimizing amendments to bring to the initial CIM standard. This model is called here EUMED CIM.

Fields that are requested for Flexiciency demonstrations but currently not supported by CIM Objects and Datatypes are indicated by the (+) sign throughout this document. To conclude, the full list of CIM amendments and their motivation have been gathered for future discussion with IEC CIM WG in the section called 'Gaps between EUMED CIM and CIM standards'.

2 EUMED CIM Global View

A global view of the message structure of the EUMED CIM format is given in this section. The list of EUMED CIM Objects is given in the following table.

Name	Description
MessageType[1]	Root of the message.
HeaderType	Header of the message.
UsagePoint	Logical or physical point in the network to which readings or events may 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.
UsagePointLocation	Location of an individual usage point.
MeterReading	Set of values obtained from the meter.
Meter	Physical asset that performs the metering role of the usage point. Used for measuring consumption and detection of events.
Customer	Organisation receiving services from service supplier.
ReadingType	Detailed description for a type of a reading value. Values in attributes allow for the creation of recommended codes to be used for identifying reading value types as follows: <macroPeriod>.<aggregate>.<measuringPeriod>.<accumulation>. <flowDirection>.<commodity>.<measurementKind>. <interharmonic.numerator>.<interharmonic.denominator>. <argument.numerator>.<argument.denominator>.<tou>.<cpp>. <consumptionTier>.<phases>.<multiplier>.<unit>.<currency>.
IntervalBlock	Time sequence of readings of the same reading type. Contained interval readings may need conversion through the application of an offset and a scalar defined in associated pending.

[1] MessageType can be considered as a "profile root" class. It can be added without breaking CIM compliance.

IntervalReading	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 min, 10 min, 15 min, 30 min, or 60 min. Note: Interval Data is sometimes also called "Interval Data Readings" (IDR).
ReadingQuality	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 reading quality type). It can also be used with the corresponding reading quality type to indicate that the validation has been performed and succeeded.

Table 1 – Objects of the EUMED CIM Format

The structure of the EUMED CIM format is given in the following figure.

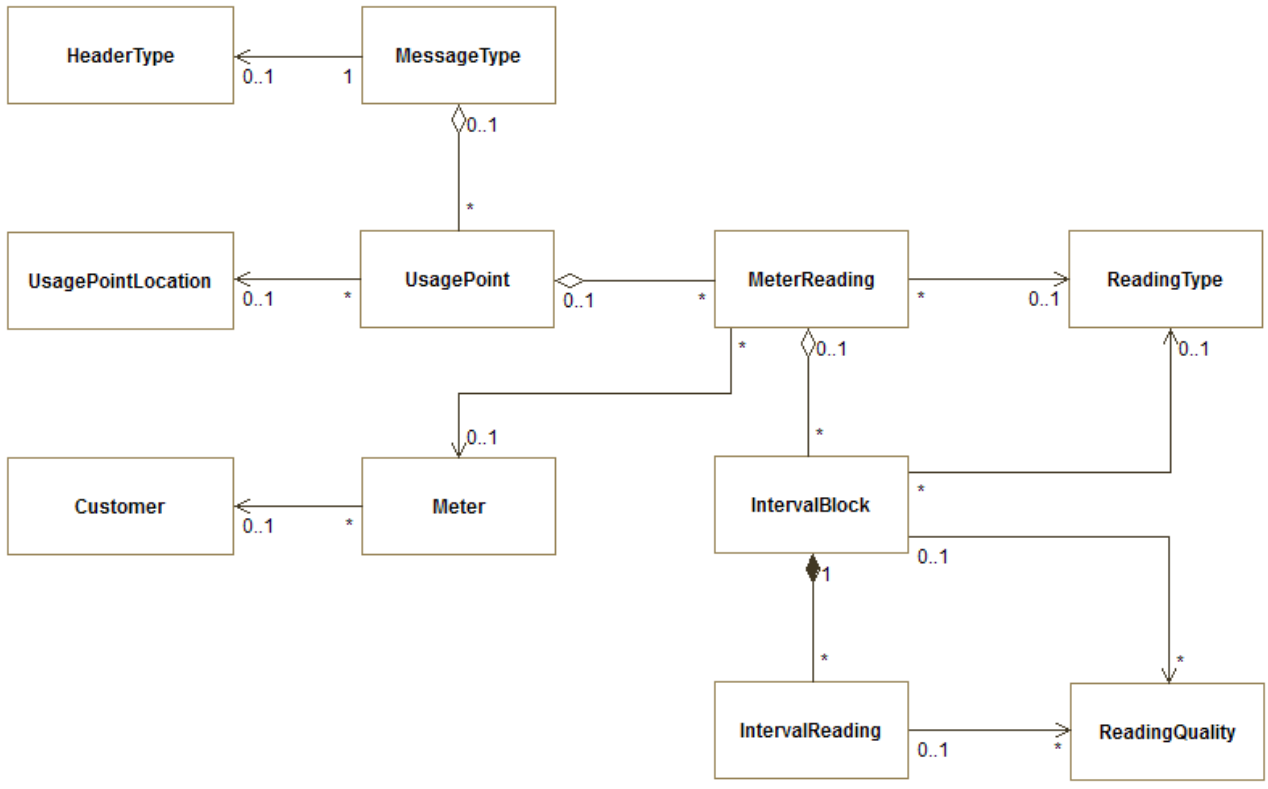

Figure 1 – EUMED CIM Objects

3 EUMED CIM Objects

EUMED CIM objects are detailed in this section. Specific data types used in these objects are detailed in section 4 ‘EUMED CIM Data Types’. CIM objects and data types referenced in this section are described in section 7 “CIM Objects and Data Types”.

3.1 MessageType Object

The following table gives the list of the fields of MessageType object.

Name	Type	Multiplicity	Description
header	HeaderType	0..1	Header of the message.
points	UsagePoint	*	List of usage points contained in the message.

Table 2 – MessageType Object

3.2 HeaderType Object

The following table gives the list of the fields of HeaderType object. Referenced CIM Object is described in (IEC 61968-100 § 4.3.2) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
messageID	String	1	Unique message ID to be used for tracking messages.
typeId (+)	String	0..1	Identifier of the type of the message.
typeName (+)	String	0..1	Description of the type of the message.
revision	String	0..1	Revision level of the message type.
source	String	0..1	Source system or application that sends the message.
receiver (+)	String	0..1	Identifier of the target of the message.
timestamp	DateTime	0..1	Application level relevant time and date for when this instance of the message type was produced. This is not intended to be used by middleware for message management.
contractId (+)	String	0..1	Identifier of the contract related to the portfolio of usage points referenced in the message.
subscriptionNb (+)	String	0..1	Subscription number of the data publication.
conditionsOfUse (+)	String	0..1	Conditions of use of the data publication.

Table 3 – HeaderType Object

3.3 UsagePoint Object

The following table gives the list of the fields of UsagePoint object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.51) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
mRID	String	0..1	Identifier of the usage point.
location	UsagePointLocation	0..1	Location of this usage point.

readings	MeterReading	0..*	Container of the meter readings.

Table 4 – UsagePoint Object

3.4 UsagePointLocation Object

The following table gives the list of the fields of UsagePointLocation object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.53) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
geoInfoReference	String	0..1	(if applicable) Reference to geographical information source, often external to the utility.

Table 5 – UsagePointLocation Object

3.5 MeterReading Object

The following table gives the list of the fields of MeterReading object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.36) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
mRID	String	1	Identifier of the meter reading.
name	String	0..1	Description of the meter reading.
dsoCalendar (+)	String	0..1	Contains DSO specific service delivery point information about the interval block.
esoCalendar (+)	String	0..1	Contains ESO specific service delivery point information about the interval block.
briefId (+)	String	0..1	Identifier of the event that triggered the collection of the interval block.
valuesInterval	DateTimeInterval	0..1	Specifies the time period during which the contained readings were taken.
meter	Meter	0..1	Identifier of the usage point that is related to the meter reading.
blocks	IntervalBlock	0..*	List of interval blocks contained in the meter reading.
type (+)	ReadingType	0..1	Reading type that characterizes the meter reading.

Table 6 – MeterReading Object

3.6 Meter Object

The following table gives the list of the fields of Meter object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.34) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
installCode	String	0..1	Installation code.
customer	Customer	0..1	Organisation receiving services from service supplier.

Table 7 – Meter Object

3.7 Customer Object

The following table gives the list of the fields of Customer object. Referenced CIM Object is described in (IEC 61968-11 § 6.7.5) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
Kind	CustomerKind	0..1	Kind of customer.

Table 8 – Customer Object

3.8 ReadingType Object

The following table gives the list of the fields of the ReadingType object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.47) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
mRID	String	1	Identifier of the reading type.

measuringPeriod	MeasuringPeriodKind	0..1	Time attribute inherent or fundamental to the reading value (as opposed to 'macroPeriod' that supplies an "adjective" to describe aspects of a time period with regard to the measurement). It refers to the way the value was originally measured and not to the frequency at which it is reported or presented. For example, an hourly interval of consumption data would have value 'hourly' as an attribute. However in the case of an hourly sampled voltage value, the meterReadings schema would carry the 'hourly' interval size information. It is common for meters to report demand in a form that is measured over the course of a portion of an hour, while enterprise applications however commonly assume the demand (in kW or kVAr) normalised to 1 hour. The system that receives readings directly from the meter therefore shall perform this transformation before publishing readings for use by the other enterprise systems. The scalar used is chosen based on the block size (not any sub-interval size).
multiplier	UnitMultiplier	0..1	Metering-specific multiplier.
unit	UnitSymbol	0..1	Metering-specific unit.
valueDatatype (+)	String	0..1	Datatype used for the value of the readings.
measurementKind	MeasurementKind	0..1	Identifies "what" is being measured, as refinement of 'commodity'. When combined with 'unit', it provides detail to the unit of measure. For example, 'energy' with a unit of measure of 'kWh' indicates to the user that active energy is being measured, while with 'kVAh' or 'kVArh', it indicates apparent energy and reactive energy, respectively. 'power' can be combined in a similar way with various power units of measure: Distortion power ('distortionVoltAmperes') with 'kVA' is different from 'power' with 'kVA'.
flowDirection	FlowDirectionKind	0..1	Flow direction for a reading where the direction of flow of the commodity is important (for electricity measurements this includes current, energy, power, and demand).

commodity	CommodityKind	0..1	Commodity being measured.

Table 9 – ReadingType Object

3.9 IntervalBlock Object

The following table gives the list of the fields of IntervalBlock object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.32) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
numberOfValues (+)	Integer	0..1	Number of values contained in this interval block.
qualities (+)	ReadingQuality	0..*	Indication of the quality of this interval block (for instance, based on the percentage of number of measured values on the total number of values in the interval block).
readings	IntervalReading	0..*	List of interval readings contained in this interval block.
type	ReadingType	0..1	Reading type that characterizes this interval block.

Table 10 – IntervalBlock Object

3.10 IntervalReading Object

The following table gives the list of the fields of IntervalReading object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.33) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
mRID	String	0..1	Identifier of the interval reading.
name	String	0..1	Description of the interval reading.
rank (+)	Integer	0..1	Rank value of the interval reading.
timePeriod	DateTimeInterval	0..1	Date time and duration of a reading. If not specified, readings for each “intervalLength” in Reading Type are present.
value	String	0..1	Value in units specified in Reading Type.
qualities	ReadingQuality	0..*	Indication of the quality of the interval reading (for instance, based on the fact that the value is metered or estimated).

Table 11 – IntervalReading Object

3.11 ReadingQuality Object

The following table gives the list of the fields of ReadingQuality object. Referenced CIM Object is described in (IEC 61968-11 § 6.8.45) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
comment	String	1	Elaboration on the quality code.

Table 12 – ReadingQuality Object

4 EUMED CIM Data Types

The following table gives the list of the EUMED CIM data types and the following figure gives detail on the structure of these data types.

Name	Description
DateTimeInterval	Interval of date and time. Duration is not included because it can be derived from the start and the end.
CustomerKind	Kind of customer.
MeasuringPeriodKind	Kind of period for reading / measuring values.
UnitMultiplier	The unit multipliers defined for the CIM. When applied to unit symbols that already contain a multiplier, both multipliers are used. For example, to exchange kilograms using unit symbol of kg, one uses the "none" multiplier, to exchange metric ton (Mg), one uses the "k" multiplier.
UnitSymbol	The units defined for usage in the CIM.
MeasurementKind	Name of physical measurement.
FlowDirectionKind	Direction associated with current related readings.
CommodityKind	Code for commodity classification of readings of Reading Type.

Table 13 – Data Types of EUMED CIM Format

4.1 DateTimeInterval Data Type

The following table gives the detail of the fields of DateTimeInterval data type. Referenced CIM Data Type is described in (IEC 61970) and in section 7 “CIM Objects and Data Types”.

Name	Type	Multiplicity	Description
start	DateTime	0..1	Start date and time of this interval.
end	DateTime	0..1	End date and time of this interval.

Table 14 – DateTimeInterval Data Type

4.2 CustomerKind Data Type

The following table gives the detail of the fields of CustomerKind data type. Referenced CIM Data Type is described in (IEC 61968) in an informative part and in section 7 “CIM Objects and Data Types”.

Name	Description
Residential	Residential customer.
residentialAndCommercial	Residential and commercial customer.
…	… (see complete table in Appendix A)

Table 15 – CustomerKind Data Type

4.3 MeasuringPeriodKind Data Type

The following table gives the detail of the fields of MeasuringPeriodKind data type. Referenced CIM Data Type is described in (IEC 61968) in an informative part and in section 7 “CIM Objects and Data Types”.

Name	Description
none	Not applicable
tenMinute	10-minute
…	… (see complete table in Appendix A)

Table 16 – MeasuringPeriodKind Data Type

4.4 UnitMultiplier Data Type

The following table gives the detail of the fields of UnitMultiplier data type. Referenced CIM Data Type is described in (IEC 61970) and in section 7 “CIM Objects and Data Types”.

Name	Description
y	yocto 10**-24.
z	zepto 10**-21.
…	… (see complete table in Appendix A)

Table 17 – UnitMultiplier Data Type

4.5 UnitSymbol Data Type

The following table gives the detail of the fields of UnitSymbol data type. Referenced CIM Data Type is described in (IEC 61970) and in section 7 “CIM Objects and Data Types”.

Name	Description
none	Dimension less quantity, e.g. count, per unit, etc.
m	Length in meter.
…	… (see complete table in Appendix A)

Table 18 – UnitSymbol Data Type

4.6 MeasurementKind Data Type

The following table gives the detail of the fields of MeasurementKind data type. Referenced CIM Data Type is described in (IEC 61968) in an informative part and in section 7 “CIM Objects and Data Types”.

Name	Description
none	Not applicable
apparentPowerFactor	-
…	… (see complete table in Appendix A)

Table 19 – MeasurementKind Data Type

4.7 FlowDirectionKind Data Type

The following table gives the detail of the fields of FlowDirectionKind data type. Referenced CIM Data Type is described in (IEC 61968) in an informative part and in annex “CIM Objects and Data Types”.

Name	Description
none	Not Applicable
forward	"Delivered," or "Imported" as defined 61968-2. Forward Active Energy is a positive kWh value as one would naturally expect to find as energy is supplied by the utility and consumed at the service. Forward Reactive Energy is a positive VArh value as one would naturally expect to find in the presence of inductive loading. In polyphase metering, the forward energy register is incremented when the sum of the phase energies is greater than zero:
…	… (see complete table in Appendix A)

Table 20 – FlowDirectionKind Data Type

4.8 CommodityKind Data Type

The following table gives the detail of the fields of CommodityKind data type. Referenced CIM Data Type is described in (IEC 61968) in an informative part and in section 7 “CIM Objects and Data Types”.

Name	Description
None	Not Applicable
electricitySecondaryMetered	All types of metered quantities. This type of reading comes from the meter and represents a “secondary” metered value.
…	… (see complete table in Appendix A)

Table 21 – CommodityKind Data Type

5 Gaps between EUMED CIM and CIM standards

The following tables give the list of changes requested with regards to the current version of CIM (see Appendix for object list extracted from CIM standards).

5.1 Changes to IEC 61968-11

5.1.1 Attributes

The following table gives the list of attributes to be added.

Name	Owner Class	Change	Motivation
valueDatatype	ReadingType	To be added	As the value in an IntervalReading is typed as a string but is usually a numerical value (integer, decimal or float), this attribute permits to known what is the precise numeric type of the value.
dsoCalendar	MeterReading	To be added	Reference to the DSO tariff applying to this MeterReading.
esoCalendar	MeterReading	To be added	Reference to the ESO tariff applying to this MeterReading.
briefId	MeterReading	To be added	Event that triggered the collection of this IntervalBlock.
numberOfValues	IntervalBlock	To be added	For checking reason: should be equal to the number of IntervalReadings aggregated in this IntervalBlock.
rank	IntervalReading	To be added	In case of fixed measuringPeriods, IntervalReadings may be positioned in the IntervalBlock using their ranks instead of timePeriods.

Table 67 – Attributes to be added to IEC 61968-11

5.1.2 Links

The following table gives the list of the links to be modified.

Starting Class	Ending Class	Change	Motivation
MeterReading	ReadingType	To be added	Avoids to repeat the ReadingType for all the IntervalBlocks of this MeterReading.
IntervalBlock	ReadingQuality	To be added	Permits to give some global quality informations about the IntervalBlock (and not only fo IntervalReading).
IntervalReading	MeasurementValueSource	Mandatory -> optional	The link to the MeasurementvalueSource should be made optional.
ReadingQuality	ReadingQualityType	Mandatory -> optional	The link to the ReadingQualityType should be made optional.

Table 68 – Links to be changed in IEC 61968-11

5.2 Changes to IEC 61968-100

5.2.1 Attributes

The following table gives the list of attributes to be added.

Name	Owner Class	Change	Motivation
typeId	HeaderType	To be added	Inspired by Enedis IT Data publication
typeName	HeaderType	To be added	Inspired by Enedis IT Data publication
receiver	HeaderType	To be added	Inspired by Enedis IT Data publication
contractId	HeaderType	To be added	Inspired by Enedis IT Data publication
subscriptionNb	HeaderType	To be added	Inspired by Enedis IT Data publication
conditionsOfUse	HeaderType	To be added	Inspired by Enedis Data Privacy Policy

Table 69 – Attributes to be added to IEC 61968-100

6 References

1. (**IEC 61968-11**)
   Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution. 2016.
2. (**IEC 61970-301**)
   Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base. 2016.
3. (**IEC 61968-100**)
   Application integration at electric utilities – System interfaces for distribution management – Part 100: Implementation Profiles for IEC 61968. 2015.

4. FLEXICIENCY, “D2.2 – Definition of project overall system architecture”. April 2016
5. FLEXICIENCY, “D2.1 – Definition of services and use cases description”. April 2016
6. FLEXICIENCY, “D2.3 – Data model and interfaces”. April 2016
7. FLEXICIENCY, “CIRED 2017 Modeling Metering Data Flows, from Use cases towards implementation”, Glasgow, 12-15 June 2017

Deliverable D2.1, D2.2 & D2.3 are available on http://www.flexiciency-h2020.eu/deliverables

7 Appendix - CIM Objects and Datatypes extracted from IEC CIM References

7.1 CIM Objects

7.1.1 HeaderType Object

The following table gives the list of the fields of HeaderType object (IEC 61968-100 § 4.3.2).

Name	Type	Multiplicity	Description
verb	VerbType	1	This enumerated list of verbs that can be used to form message types in compliance with the IEC 61968 standard.
noun	String	1	The Noun of the Control Area identifies the main subject of the message type, typically a real world object defined in the CIM.
revision	String	0..1	Revision level of the message type.
replayDetection	ReplayDetectionType	0..1	Use to introduce randomness in the message to enhance effectiveness of encryption.
context	String	0..1	Intended context for information usage, e.g. PRODUCTION, TESTING, TRAINING, ...
timestamp	DateTime	0..1	Application level relevant time and date for when this instance of the message type was produced. This is not intended to be used by middleware for message management.
source	String	0..1	Source system or application that sends the message.
asyncReplyFlag	Boolean	0..1	Indicates whether or not reply should be asynchronous.
replyAddress	String	0..1	Address to be used for asynchronous replies, typically a URL/topic/queue.
ackRequired	Boolean	0..1	Indicates whether or not an acknowledgement is required.
user	UserType	0..1	User information of the sender.
messageID	String	0..1	Unique message ID to be used for tracking messages.
correlationID	String	0..1	ID to be used by applications for correlating replies.
comment	String	0..1	Optional comment.

property	MessageProperty	0..*	Message properties can be used to identify information needed for extended routing and filtering capabilities.

Table 22 – HeaderType Object

7.1.2 UsagePoint Object

The following table gives the list of the fields of UsagePoint object (IEC 61968-11 § 6.8.51).

Name	Type	Multiplicity	Description
isSdp	Boolean	0.1	If true, this usage point is a service delivery point, i.e., a usage point where the ownership of the service changes hands.
isVirtual	Boolean	0..1	If true, this usage point is virtual, i.e., no physical location exists in the network where a meter could be located to collect the meter readings. For example, one may define a virtual usage point to serve as an aggregation of usage for all of a company's premises distributed widely across the distribution territory. Otherwise, the usage point is physical, i.e., there is a logical point in the network where a meter could be located to collect meter readings.
phaseCode	PhaseCode	0..1	Phase code. Number of wires and specific nominal phases can be deduced from enumeration literal values. For example, ABCN is three phase, four-wire, s12n (splitSecondary12N) is single-phase, three-wire, and s1n and s2n are single-phase, two-wire.
grounded	Boolean	0..1	True if grounded.
servicePriority	String	0..1	Priority of service for this usage point. Note that usage points at the same service location can have different priorities.
serviceDeliveryRemark	String	0..1	Remarks about this usage point, for example the reason for it being rated with a non-nominal priority.
estimatedLoad	CurrentFlow	0..1	Estimated load.

checkBilling	Boolean	0..1	True if as a result of an inspection or otherwise, there is a reason to suspect that a previous billing may have been performed with erroneous data. Value should be reset once this potential discrepancy has been resolved.
ratedCurrent	CurrentFlow	0..1	Current flow that this usage point is configured to deliver.
nominalServiceVoltage	Voltage	0..1	Nominal service voltage.
ratedPower	ActivePower	0..1	Active power that this usage point is configured to deliver.
outageRegion	String	0..1	Outage region in which this usage point is located.
readCycle	String	0..1	Cycle day on which the meter for this usage point will normally be read. Usually correlated with the billing cycle.
readRoute	String	0..1	Identifier of the route to which this usage point is assigned for purposes of meter reading. Typically used to configure hand held meter reading systems prior to collection of reads.
amiBillingReady	AmiBillingReadyKind	0..1	Tracks the lifecycle of the metering installation at a usage point with respect to readiness for billing via advanced metering infrastructure reads.
connectionState	UsagePointConnectedKind	0..1	State of the usage point with respect to connection to the network.
minimalUsageExpected	Boolean	0..1	If true, minimal or zero usage is expected at this usage point for situations such as premises vacancy, logical or physical disconnect. It is used for readings validation and estimation.
aliasName	String	0..1	inherited from: IdentifiedObject
mRID	String	0..1	inherited from: IdentifiedObject
name	String	0..1	inherited from: IdentifiedObject

Table 23 – UsagePoint Object

7.1.3 UsagePointLocation Object

The following table gives the list of the fields of UsagePointLocation object (IEC 61968-11 § 6.8.53).

Name	Type	Multiplicity	Description
accessMethod	String	0..1	Method for the service person to access this usage point location. For example, a description of where to obtain a key if the facility is unmanned and secured.
siteAccessProblem	String	0..1	Problems previously encountered when visiting or performing work at this location. Examples include: bad dog, violent customer, verbally abusive occupant, obstructions, safety hazards, etc.
remark	String	0..1	Remarks about this location.
type	String	0..1	inherited from: Location
mainAddress	StreetAddress	0..1	inherited from: Location
secondaryAddress	StreetAddress	0..1	inherited from: Location
phone1	TelephoneNumber	0..1	inherited from: Location
phone2	TelephoneNumber	0..1	inherited from: Location
electronicAddress	ElectronicAddress	0..1	inherited from: Location
geoInfoReference	String	0..1	inherited from: Location
direction	String	0..1	inherited from: Location
status	Status	0..1	inherited from: Location
aliasName	String	0..1	inherited from: IdentifiedObject
mRID	String	0..1	inherited from: IdentifiedObject
name	String	0..1	inherited from: IdentifiedObject

Table 24 – UsagePointLocation Object

7.1.4 MeterReading Object

The following table gives the list of the fields of MeterReading object (IEC 61968-11 § 6.8.36).

Name	Type	Multiplicity	Description
valuesInterval	DateTimeInterval	0..1	Date and time interval of the data items contained within this meter reading.
isCoincidentTrigger	Boolean	0..1	If true, this meter reading is the meter reading for which other coincident meter readings are requested or provided.
aliasName	String	0..1	inherited from: IdentifiedObject
mRID	String	0..1	inherited from: IdentifiedObject
name	String	0..1	inherited from: IdentifiedObject

Table 25 – MeterReading Object

7.1.5 Meter Object

The following table gives the list of the fields of Meter object (IEC 61968-11 § 6.8.34).

Name	Type	Multiplicity	Description
formNumber	String	0..1	Meter form designation per ANSI C12.10 or other applicable standard. An alphanumeric designation denoting the circuit arrangement for which the meter is applicable and its specific terminal arrangement.
isVirtual	Boolean	0..1	inherited from: EndDevice
isPan	Boolean	0..1	inherited from: EndDevice
installCode	String	0..1	inherited from: EndDevice
amrSystem	String	0..1	inherited from: EndDevice
timeZoneOffset	Minutes	0..1	inherited from: EndDevice
type	String	0..1	inherited from: Asset
utcNumber	String	0..1	inherited from: Asset
serialNumber	String	0..1	inherited from: Asset
iotNumber	String	0..1	inherited from: Asset
purchasePrice	Money	0..1	inherited from: Asset
critical	Boolean	0..1	inherited from: Asset
electronicAddress	ElectronicAddress	0..1	inherited from: Asset
lifecycle	LifecycleDate	0..1	inherited from: Asset
acceptanceTest	AcceptanceTest	0..1	inherited from: Asset
initialCondition	String	0..1	inherited from: Asset
initialLossOfLife	PerCent	0..1	inherited from: Asset
status	Status	0..1	inherited from: Asset
aliasName	String	0..1	inherited from: IdentifiedObject
mRID	String	0..1	inherited from: IdentifiedObject
name	String	0..1	inherited from: IdentifiedObject

Table 26 – Meter Object

7.1.6 Customer Object

The following table gives the list of the fields of Customer object (IEC 61968-11 § 6.7.5).

Name	Type	Multiplicity	Description
kind	CustomerKind	0..1	Kind of customer.
specialNeed	String	0..1	True if customer organisation has special service needs such as life support, hospitals, etc.
vip	Boolean	0..1	(use 'priority' instead) True if this is an important customer. Importance is for matters different than those in 'specialNeed' attribute.
pucNumber	String	0..1	(if applicable) Public utilities commission (PUC) identification number.
status	Status	0..1	Status of this customer.
aliasName	String	0..1	inherited from: IdentifiedObject

mRID	String	0..1	inherited from: IdentifiedObject
name	String	0..1	inherited from: IdentifiedObject

Table 27 – Customer Object

7.1.7 ReadingType Object

The following table gives the list of the fields of ReadingType object (IEC 61968-11 § 6.8.47).

Name	Type	Multiplicity	Description
macroPeriod	MacroPeriodKind	0..1	Time period of interest that reflects how the reading is viewed or captured over a long period of time.
aggregate	AggregateKind	0..1	Salient attribute of the reading data aggregated from individual endpoints. This is mainly used to define a mathematical operation carried out over 'macroPeriod', but may also be used to describe an attribute of the data when the 'macroPeriod' is not defined.
measuringPeriod	MeasuringPeriodKind	0..1	Time attribute inherent or fundamental to the reading value (as opposed to 'macroPeriod' that supplies an "adjective" to describe aspects of a time period with regard to the measurement). It refers to the way the value was originally measured and not to the frequency at which it is reported or presented. For example, an hourly interval of consumption data would have value 'hourly' as an attribute. However in the case of an hourly sampled voltage value, the meterReadings schema would carry the 'hourly' interval size information. It is common for meters to report demand in a form that is measured over the course of a portion of an hour, while enterprise applications however commonly assume the demand (in kW or kVAr) normalised to 1 hour. The system that receives readings directly from the meter therefore shall perform this transformation before publishing readings for use by the other enterprise systems. The scalar used is chosen based on the block size (not any sub-interval size).

accumulation	AccumulationKind	0..1	Accumulation behaviour of a reading over time, usually 'measuringPeriod', to be used with individual endpoints (as opposed to 'macroPeriod' and 'aggregate' that are used to describe aggregations of data from individual endpoints).
flowDirection	FlowDirectionKind	0..1	Flow direction for a reading where the direction of flow of the commodity is important (for electricity measurements this includes current, energy, power, and demand).
commodity	CommodityKind	0..1	Commodity being measured.
measurementKind	MeasurementKind	0..1	Identifies "what" is being measured, as refinement of 'commodity'. When combined with 'unit', it provides detail to the unit of measure. For example, 'energy' with a unit of measure of 'kWh' indicates to the user that active energy is being measured, while with 'kVAh' or 'kVArh', it indicates apparent energy and reactive energy, respectively. 'power' can be combined in a similar way with various power units of measure: Distortion power ('distortionVoltAmperes') with 'kVA' is different from 'power' with 'kVA'.
interharmonic	ReadingInterharmonic	0..1	Indication of a "harmonic" or "interharmonic" basis for the measurement. Value 0 in 'numerator' and 'denominator' means not applicable.
argument	RationalNumber	0..1	Argument used to introduce numbers into the unit of measure description where they are needed (e.g., 4 where the measure needs an argument such as CEMI(n=4)). Most arguments used in practice however will be integers (i.e., 'denominator'=1). Value 0 in 'numerator' and 'denominator' means not applicable.
tou	Integer	0..1	Time of use (TOU) bucket the reading value is attributed to. Value 0 means not applicable.
cpp	Integer	0..1	Critical peak period (CPP) bucket the reading value is attributed to. Value 0 means not applicable. Even though CPP is usually considered a specialised form of time of use 'tou', this attribute is defined explicitly for flexibility.

consumptionTier	Integer	0..1	In case of common flat-rate pricing for power, in which all purchases are at a given rate, 'consumptionTier'=0. Otherwise, the value indicates the consumption tier, which can be used in conjunction with TOU or CPP pricing. Consumption tier pricing refers to the method of billing in which a certain "block" of energy is purchased/sold at one price, after which the next block of energy is purchased at another price, and so on, all throughout a defined period. At the start of the defined period, consumption is initially zero, and any usage is measured against the first consumption tier ('consumptionTier'=1). If this block of energy is consumed before the end of the period, energy consumption moves to be reconed against the second consumption tier ('consumptionTier'=2), and so on. At the end of the defined period, the consumption accumulator is reset, and usage within the 'consumptionTier'=1 restarts.
phases	PhaseCode	0..1	Metering-specific phase code.
multiplier	UnitMultiplier	0..1	Metering-specific multiplier.
unit	UnitSymbol	0..1	Metering-specific unit.
currency	Currency	0..1	Metering-specific currency.
aliasName	String	0..1	inherited from: IdentifiedObject
mRID	String	0..1	inherited from: IdentifiedObject
name	String	0..1	inherited from: IdentifiedObject

Table 28 – ReadingType Object

7.1.8 IntervalBlock Object

The following table gives the list of the fields of IntervalBlock object (IEC 61968-11 § 6.8.32).

Name	Type	Multiplicity	Description
<no field>			

Table 29 – IntervalBlock Object

7.1.9 IntervalReading Object

The following table gives the list of the fields of IntervalReading object (IEC 61968-11 § 6.8.33).

Name	Type	Multiplicity	Description
value	Float	0..1	inherited from: BaseReading. Value of this reading.
source	String	0..1	inherited from: BaseReading. System that originally supplied the reading (e.g., customer, AMI system, handheld reading system, another enterprise system, etc.).
timePeriod	DateTimeInterval	0..1	inherited from: BaseReading. Start and end of the period for those readings whose type has a time attribute such as 'billing', seasonal' or 'forTheSpecifiedPeriod'.
reportedDateTime	DateTime	0..1	inherited from: BaseReading. (used only when there are detailed auditing requirements) Date and time at which the reading was first delivered to the metering system.
timeStamp	DateTime	0..1	inherited from: MeasurementValue. The time when the value was last updated.
sensorAccuracy	PerCent	0..1	inherited from: MeasurementValue. The limit, expressed as a percentage of the sensor maximum, that errors will not exceed when the sensor is used under reference conditions.
aliasName	String	0..1	inherited from: IdentifiedObject. The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.The attribute aliasName is retained because of backwards compatibility between CIM relases. It is however recommended to replace aliasName with the Name class as aliasName is planned for retirement at a future time.
mRID	String	0..1	inherited from: IdentifiedObject. Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended. For CIMXML data files in RDF syntax conforming to IEC 61970-552 Edition 1, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements.

name	String	0..1	inherited from: IdentifiedObject. The name is any free human readable and possibly non unique text naming the object.

Table 30 – IntervalReading Object

7.1.10 ReadingQuality Object

The following table gives the list of the fields of the ReadingQuality object (IEC 61968-11 § 6.8.45).

Name	Type	Multiplicity	Description
timestamp	DateTime	0..1	Date and time at which the quality code was assigned or ascertained.
source	String	0..1	System acting as the source of the quality code.
comment	String	0..1	Elaboration on the quality code.

Table 31 – ReadingQuality Object

7.2 CIM Data Types

The following table gives the list of CIM data types.

Name	Description
VerbType	Enumerated list of verbs that can be used to form message types in compliance with the IEC 61968 standard.
ReplayDetectionType	Used to detect and prevent replay attacks.
UserType	User type definition.
MessageProperty	Message properties can be used for extended routing and filtering.
PhaseCode	Enumeration of phase identifiers. Allows designation of phases for both transmission and distribution equipment, circuits and loads. Residential and small commercial loads are often served from single-phase, or split-phase, secondary circuits. For example of s12N, phases 1 and 2 refer to hot wires that are 180 degrees out of phase, while N refers to the neutral wire. Through single-phase transformer connections, these secondary circuits may be served from one or two of the primary phases A, B, and C. For three-phase loads, use the A, B, C phase codes instead of s12N.
CurrentFlow	Electrical current with sign convention: positive flow is out of the conducting equipment into the connectivity node. Can be both AC and DC.
Voltage	Electrical voltage, can be both AC and DC.
ActivePower	Product of RMS value of the voltage and the RMS value of the in-phase component of the current.
AmiBillingReadyKind	Lifecycle states of the metering installation at a usage point with respect to readiness for billing via advanced metering infrastructure reads.
UsagePointConnectedKind	State of the usage point with respect to connection to the network.
StreetAddress	General purpose street address information.
StreetDetail	Street details, in the context of address.
TownDetail	Town details, in the context of address.
TelephoneNumber	Telephone number.
ElectronicAddress	Electronic address information.
Status	Current status information relevant to an entity.
Minutes	Time in minutes.
Money	Amount of money.
LifecycleDate	Dates for lifecycle events of an asset.
AcceptanceTest	Acceptance test for assets.
PerCent	Percentage on a defined base. For example, specify as 100 to indicate at the defined base.
CustomerKind	Kind of customer.
MacroPeriodKind	Kind of macro period for calculations on read / measured values.
AggregateKind	Kind of aggregation for read / measured values from multiple end points.

MeasuringPeriodKind	Kind of period for reading / measuring values.
AccumulationKind	Kind of accumulation behaviour for read / measured values from individual end points.
FlowDirectionKind	Kind of flow direction for reading/measured values proper to some commodities such as, for example, energy, power, demand.
CommodityKind	Kind of commodity being measured.
MeasurementKind	Kind of read / measured value.
ReadingInterharmonic	Interharmonics are represented as a rational number 'numerator' / 'denominator', and harmonics are represented using the same mechanism and identified by 'denominator'=1.
UnitMultiplier	The unit multiplier, e.g. "k" to convert the unit "W-h" to "kW-h", using the standard conventions associated with the UnitMultiplier enumeration.
UnitSymbol	The units defined for usage in the CIM.
Currency	The currency in which the Commodity is traded, using the standard conventions associated with the Currency enumeration.
DateTimeInterval	Interval between two date and time points.

Table 32 – CIM Data Types

7.2.1 VerbType Data Type

The following table gives the detail of the fields of the VerbType data type (IEC 61968-100 Annex A).

Value	Description
cancel	-
canceled	-
change	-
changed	-
create	-
created	-
close	-
closed	-
delete	-
deleted	-
get	-
reply	-
execute	-
executed	-

Table 33 – QualityOfReading Data Type

7.2.2 ReplayDetectionType Data Type

The following table gives the detail of the fields of the ReplayDetectionType data type (IEC 61968-100 Annex A).

Name	Type	Multiplicity	Description
nonce	String	1	-
created	DateTime	1	-

Table 34 – ReplaydetectionType Data Type

7.2.3 UserType Data Type

The following table gives the detail of the fields of the UserType data type (IEC 61968-100 Annex A).

Name	Type	Multiplicity	Description
userID	String	1	User identifier.
organization	String	0..1	User parent organization identifier.

Table 35 – UserType Data Type

7.2.4 MessageProperty Data Type

The following table gives the detail of the fields of the MessageProperty data type (IEC 61968-100 Annex A).

Name	Type	Multiplicity	Description
name	String	1	-
value	String	0..1	-

Table 36 – MessageProperty Data Type

7.2.5 PhaseCode Data Type

The following table gives the detail of the fields of the PhaseCode data type (IEC 61970).

Value	Description
ABCN	Phases A, B, C, and N.
ABC	Phases A, B, and C.
ABN	Phases A, B, and neutral.
ACN	Phases A, C, and neutral.
BCN	Phases B, C, and neutral.

AB	Phases A and B.
AC	Phases A and C.
BC	Phases B and C.
AN	Phases A and neutral.
BN	Phases B and neutral.
CN	Phases C and neutral.
A	Phase A.
B	Phase B.
C	Phase C.
N	Neutral phase.
s1N	Secondary phase 1 and neutral.
s2N	Secondary phase 2 and neutral.
s12N	Secondary phases 1, 2, and neutral.
s1	Secondary phase 1.
s2	Secondary phase 2.
s12	Secondary phase 1 and 2.
none	No phases specified.
X	Unknown non-neutral phase.
XY	Two unknown non-neutral phases.
XN	Unknown non-neutral phase plus neutral.
XYN	Two unknown non-neutral phases plus neutral.

Table 37 – PhaseCode Data Type

7.2.6 CurrentFlow Data Type

The following table gives the detail of the fields of the CurrentFlow data type (IEC 61970).

Name	Type	Multiplicity	Description
value	Float	0..1	-
unit	UnitSymbol	0..1	-
multiplier	UnitMultiplier	0..1	-

Table 38 – CurrentFlow Data Type

7.2.7 Voltage Data Type

The following table gives the detail of the fields of the Voltage data type (IEC 61970).

Name	Type	Multiplicity	Description
value	Float	0..1	-
unit	UnitSymbol	0..1	-
multiplier	UnitMultiplier	0..1	-

Table 39 – Voltage Data Type

7.2.8 ActivePower Data Type

The following table gives the detail of the fields of the ActivePower data type (IEC 61970).

Name	Type	Multiplicity	Description
value	Float	0..1	-
unit	UnitSymbol	0..1	-
multiplier	UnitMultiplier	0..1	-

Table 40 – ActivePower Data Type

7.2.9 AmiBillingReadyKind Data Type

The following table gives the detail of the fields of the AmiBillingReadyKind data type (IEC 61968).

Value	Description
enabled	Usage point is equipped with an AMI capable meter having communications capability.
operable	Usage point is equipped with an AMI capable meter that is functioning and communicating with the AMI network.
billingApproved	Usage point is equipped with an operating AMI capable meter and accuracy has been certified for billing purposes.
nonAmi	Usage point is equipped with a non AMI capable meter.
amiDisabled	Usage point is equipped with an AMI capable meter; however, the AMI functionality has been disabled or is not being used.
amiCapable	Usage point is equipped with an AMI capable meter that is not yet currently equipped with a communications module.
nonMetered	Usage point is not currently equipped with a meter.

Table 41 – AmiBillingReadyKind Data Type

7.2.10 UsagePointConnectedKind Data Type

The following table gives the detail of the fields of the UsagePointConnectedKind data type (IEC 61968).

Value	Description
connected	The usage point is connected to the network and able to receive or send the applicable commodity (electricity, gas, water, etc.).
physicallyDisconnected	The usage point has been disconnected from the network at a point upstream of the meter. The usage point is unable to receive or send the applicable commodity (electricity, gas, water, etc.). A physical disconnect is often achieved by utilising a field crew.

logicallyDisconnected	The usage point has been disconnected through operation of a disconnect function within the meter present at the usage point. The usage point is unable to receive or send the applicable commodity (electricity, gas, water, etc.) A logical disconnect can often be achieved without utilising a field crew.

Table 42 – UsagePointConnectedKind Data Type

7.2.11 StreetAddress Data Type

The following table gives the detail of the fields of the StreetAddress data type (IEC 61968).

Name	Type	Multiplicity	Description
streetDetail	StreetDetail	0..1	Street detail.
townDetail	TownDetail	0..1	Town detail.
status	Status	0..1	Status of this address.
postalCode	String	0..1	Postal code for the address.
poBox	String	0..1	Post office box.

Table 43 – StreetAddress Data Type

7.2.12 StreetDetail Data Type

The following table gives the detail of the fields of the StreetDetail data type (IEC 61968).

Name	Type	Multiplicity	Description
number	String	0..1	Designator of the specific location on the street.
name	String	0..1	Name of the street.
suffix	String	0..1	Suffix to the street name. For example: North, South, East, West.
prefix	String	0..1	Prefix to the street name. For example: North, South, East, West.
type	String	0..1	Type of street. Examples include: street, circle, boulevard, avenue, road, drive, etc.
code	String	0..1	(if applicable) Utilities often make use of external reference systems, such as those of the town-planner's department or surveyor general's mapping system, that allocate global reference codes to streets.
buildingName	String	0..1	(if applicable) In certain cases the physical location of the place of interest does not have a direct point of entry from the street, but may be located inside a larger structure such as a building, complex, office block, apartment, etc.
suiteNumber	String	0..1	Number of the apartment or suite.

addressGeneral	String	0..1	First line of a free form address or some additional address information (for example a mail stop).
addressGeneral2	String	0..1	(if applicable) Second line of a free form address.
addresssGeneral3	String	0..1	(if applicable) Third line of a free form address.
withinTownLimits	Boolean	0..1	True if this street is within the legal geographical boundaries of the specified town (default).

Table 44 – StreetDetail Data Type

7.2.13 TownDetail Data Type

The following table gives the detail of the fields of the TownDetail data type (IEC 61968).

Name	Type	Multiplicity	Description
code	String	0..1	Town code.
section	String	0..1	Town section. For example, it is common for there to be 36 sections per township.
Name	String	0..1	Town name.
stateOrProvince	String	0..1	Name of the state or province.
country	String	0..1	Name of the country.

Table 45 – TownDetail Data Type

7.2.14 TelephoneNumber Data Type

The following table gives the detail of the fields of the TelephoneNumber data type (IEC 61968).

Name	Type	Multiplicity	Description
countryCode	String	0..1	Country code.
areaCode	String	0..1	(if applicable) Area or region code.
cityCode	String	0..1	City code.
localNumber	String	0..1	Main (local) part of this telephone number.
extension	String	0..1	(if applicable) Extension for this telephone number.
dialOut	String	0..1	(if applicable) Dial out code, for instance to call outside an enterprise.
internationalPrefix	String	0..1	(if applicable) Prefix used when calling an international number.
ituPhone	String	0..1	Phone number according to ITU E.164.

Table 46 – TelephoneNumber Data Type

7.2.15 ElectronicAddress Data Type

The following table gives the detail of the fields of the ElectronicAddress data type (IEC 61968).

Name	Type	Multiplicity	Description
lan	String	0..1	Address on local area network.
mac	String	0..1	MAC (Media Access Control) address.
email1	String	0..1	Primary email address.
email2	String	0..1	Alternate email address.
web	String	0..1	World wide web address.
radio	String	0..1	Radio address.
userID	String	0..1	User ID needed to log in, which can be for an individual person, an organisation, a location, etc.
password	String	0..1	Password needed to log in.

Table 47 – ElectronicAddress Data Type

7.2.16 Status Data Type

The following table gives the detail of the fields of the Status data type (IEC 61968).

Name	Type	Multiplicity	Description
value	String	0..1	Status value at 'dateTime'; prior status changes may have been kept in instances of activity records associated with the object to which this status applies.
dateTime	DateTime	0..1	Date and time for which status 'value' applies.
remark	String	0..1	Pertinent information regarding the current 'value', as free form text.
reason	String	0..1	Reason code or explanation for why an object went to the current status 'value'.

Table 48 – Status Data Type

7.2.17 Minutes Data Type

The following table gives the detail of the fields of the Minutes data type (IEC 61970).

Name	Type	Multiplicity	Description
value	Float	0..1	-
unit	UnitSymbol	0..1	-
multiplier	UnitMultiplier	0..1	-

Table 49 – Minutes Data Type

7.2.18 Money Data Type

The following table gives the detail of the fields of the Money data type (IEC 61970).

Name	Type	Multiplicity	Description
value	Decimal	0..1	-
unit	Currency	0..1	-
multiplier	UnitMultiplier	0..1	-

Table 50 – Money Data Type

7.2.19 LifecycleDate Data Type

The following table gives the detail of the fields of the LifecycleDate data type (IEC 61968).

Name	Type	Multiplicity	Description
manufacturedDate	Date	0..1	Date the asset was manufactured.
purchaseDate	Date	0..1	Date the asset was purchased. Note that even though an asset may have been purchased, it may not have been received into inventory at the time of purchase.
receivedDate	Date	0..1	Date the asset was received and first placed into inventory.
installationDate	Date	0..1	Date current installation was completed, which may not be the same as the in-service date. Asset may have been installed at other locations previously. Ignored if asset is (1) not currently installed (e.g., stored in a depot) or (2) not intended to be installed (e.g., vehicle, tool).
removalDate	Date	0..1	Date when the asset was last removed from service. Ignored if (1) not intended to be in service, or (2) currently in service.
retiredDate	Date	0..1	Date the asset is permanently retired from service and may be scheduled for disposal. Ignored if asset is (1) currently in service, or (2) permanently removed from service.

Table 51 – LifecycleDate Data Type

7.2.20 AcceptanceTest Data Type

The following table gives the detail of the fields of the AcceptanceTest data type (IEC 61968).

Name	Type	Multiplicity	Description
type	String	0..1	Type of test or group of tests that was conducted on 'dateTime'.

success	Boolean	0..1	True if asset has passed acceptance test and may be placed in or is in service. It is set to false if asset is removed from service and is required to be tested again before being placed back in service, possibly in a new location. Since asset may go through multiple tests during its lifecycle, the date of each acceptance test may be recorded in 'Asset.ActivityRecord.status.dateTime'.
dateTime	DateTime	0..1	Date and time the asset was last tested using the 'type' of test and yielding the current status in 'success' attribute.

Table 52 – AcceptanceTest Data Type

7.2.21 PerCent Data Type

The following table gives the detail of the fields of the PerCent data type (IEC 61970).

Name	Type	Multiplicity	Description
value	Float	0..1	Normally 0 - 100 on a defined base
unit	UnitSymbol	0..1	-
multiplier	UnitMultiplier	0..1	-

Table 53 – PerCent Data Type

7.2.22 CustomerKind Data Type

The following table gives the detail of the fields of CustomerKind data type (IEC 61968).

Value	Description
residential	Residential customer.
residentialAndCommercial	Residential and commercial customer.
residentialAndStreetlight	Residential and streetlight customer.
residentialStreetlightOthers	Residential streetlight or other related customer.
residentialFarmService	Residential farm service customer.
commercialIndustrial	Commercial industrial customer.
pumpingLoad	Pumping load customer.
windMachine	Wind machine customer.
energyServiceSupplier	Customer as energy service supplier.
energyServiceScheduler	Customer as energy service scheduler.
internalUse	Internal use customer.
enterprise	-
regionalOperator	-
subsidiary	-
other	Other kind of customer.

Table 54 – CustomerKind Data Type

7.2.23 MacroPeriodKind Data Type

The following table gives the detail of the fields of the MacroPeriodKind data type (IEC 61968).

Value	Description
none	Not applicable.
billingPeriod	Captured during the billing period starting at midnight of the first day of the billing period (as defined by the billing cycle day). If during the current billing period, it specifies a period from the start of the current billing period until "now".
daily	Daily period starting at midnight. If for the current day, this specifies the time from midnight to "now".
monthly	Monthly period starting at midnight on the first day of the month. If within the current month, this specifies the period from the start of the month until "now."
seasonal	A season of time spanning multiple months. E.g. "Summer," "Spring," "Fall," and "Winter" based cycle. If within the current season, it specifies the period from the start of the current season until "now."
weekly	Weekly period starting at midnight on the first day of the week and ending the instant before midnight the last day of the week. If within the current week, it specifies the period from the start of the week until "now."
specifiedPeriod	For the period defined by the start and end of the TimePeriod element in the message.

Table 55 – MacroPeriodKind Data Type

7.2.24 AggregateKind Data Type

The following table gives the detail of the fields of the AggregateKind data type (IEC 61968).

Value	Description
none	Not applicable.
average	The value represents average.
excess	The value represents an amount over which a threshold was exceeded.
highThreshold	The value represents a programmed high threshold.
lowThreshold	The value represents a programmed low threshold.
maximum	The highest value observed.
minimum	The smallest value observed.
nominal	The nominal value.
normal	The normal value.
secondMaximum	The second highest value observed.
secondMinimum	The second smallest value observed.
thirdMaximum	The third highest value observed.

fourthMaximum	The fourth highest value observed.
fifthMaximum	The fifth highest value observed.
sum	The accumulated sum.

Table 56 – AggregateKind Data Type

7.2.25 MeasuringPeriodKind Data Type

The following table gives the detail of the fields of MeasuringPeriodKind data type (IEC 61968).

Value	Description
none	Not applicable
tenMinute	10-minute
fifteenMinute	15-minute
oneMinute	1-minute
twentyfourHour	24-hour
thirtyMinute	30-minute
fiveMinute	5-minute
sixtyMinute	60-minute
twoMinute	2-minute
threeMinute	3-minute
present	Within the present period of time
previous	Shifted within the previous monthly cycle and data set
twentyMinute	20-minute
fixedBlock60Min	60-minute Fixed Block
fixedBlock30Min	30-minute Fixed Block
fixedBlock20Min	20-minute Fixed Block
fixedBlock15Min	15-minute Fixed Block
fixedBlock10Min	10-minute Fixed Block
fixedBlock5Min	5-minute Fixed Block
fixedBlock1Min	1-minute Fixed Block
rollingBlock60MinIntvl30MinSubIntvl	60-minute Rolling Block with 30-minute sub-intervals
rollingBlock60MinIntvlé0MinSubIntvl	60-minute Rolling Block with 20-minute sub-intervals
rollingBlock60MinIntvl15MinSubIntvl	60-minute Rolling Block with 15-minute sub-intervals
rollingBlock60MinIntvl12MinSubIntvl	60-minute Rolling Block with 12-minute sub-intervals
rollingBlock60MinIntvl10MinSubIntvl	60-minute Rolling Block with 10-minute sub-intervals
rollingBlock60MinIntvl6MinSubIntvl	60-minute Rolling Block with 6-minute sub-intervals
rollingBlock60MinIntvl5MinSubIntvl	60-minute Rolling Block with 5-minute sub-intervals
rollingBlock60MinIntvl4MinSubIntvl	60-minute Rolling Block with 4-minute sub-intervals

rollingBlock30MinIntvl15MinSubIntvl	30-minute Rolling Block with 15-minute sub-intervals
rollingBlock30MinIntvl10MinSubIntvl	30-minute Rolling Block with 10-minute sub-intervals
rollingBlock30MinIntvl6MinSubIntvl	30-minute Rolling Block with 6-minute sub-intervals
rollingBlock30MinIntvl5MinSubIntvl	30-minute Rolling Block with 5-minute sub-intervals
rollingBlock30MinIntvl3MinSubIntvl	30-minute Rolling Block with 3-minute sub-intervals
rollingBlock30MinIntvl2MinSubIntvl	30-minute Rolling Block with 2-minute sub-intervals
rollingBlock15MinIntvl5MinSubIntvl	15-minute Rolling Block with 5-minute sub-intervals
rollingBlock15MinIntvl3MinSubIntvl	15-minute Rolling Block with 3-minute sub-intervals
rollingBlock15MinIntvl1MinSubIntvl	15-minute Rolling Block with 1-minute sub-intervals
rollingBlock10MinIntvl5MinSubIntvl	10-minute Rolling Block with 5-minute sub-intervals
rollingBlock10MinIntvl2MinSubIntvl	10-minute Rolling Block with 2-minute sub-intervals
rollingBlock10MinIntvl1MinSubIntvl	10-minute Rolling Block with 1-minute sub-intervals
rollingBlock5MinIntvl1MinSubIntvl	5-minute Rolling Block with 1-minute sub-intervals

Table 57 – MeasuringPeriodKind Data Type

7.2.26 AccumulationKind Data Type

The following table gives the detail of the fields of the AccumulationKind data type (IEC 61968).

Value	Description
none	Not applicable, or implied by the unit of measure.
bulkQuantity	A value from a register which represents the bulk quantity of a commodity. This quantity is computed as the integral of the commodity usage rate. This value is typically used as the basis for the dial reading at the meter, and as a result, will roll over upon reaching a maximum dial value. Note 1: With the metering system, the roll-over behaviour typically implies a roll-under behavior so that the value presented is always a positive value (e.g. unsigned integer or positive decimal.) However, when communicating data between enterprise applications a negative value might occur in a case such as net metering. Note 2: A 'bulkQuantity' refers primarily to the dial reading and not the consumption over a specific period of time.
continuousCumulative	The sum of the previous billing period values and the present period value. Note: 'continuousCumulative' is commonly used in conjunction with 'demand', and it would represent the cumulative sum of the previous billing period maximum demand values (as occurring with each demand reset) summed with the present period maximum demand value (which has yet to be reset.)

cumulative	The sum of the previous billing period values. Note: 'cumulative' is commonly used in conjunction with “demand.” Each demand reset causes the maximum demand value for the present billing period (since the last demand reset) to accumulate as an accumulative total of all maximum demands. So instead of 'zeroing' the demand register, a demand reset has the effect of adding the present maximum demand to this accumulating total.
deltaData	The difference between the value at the end of the prescribed interval and the beginning of the interval. This is used for incremental interval data. Note: One common application would be for load profile data, another use might be to report the number of events within an interval (such as the number of equipment energisations within the specified period of time.)
indicating	As if a needle is swung out on the meter face to a value to indicate the current value. Note: An 'indicating' value is typically measured over hundreds of milliseconds or greater, or may imply a “pusher” mechanism to capture a value. Compare this to 'instantaneous' which is measured over a shorter period of time.
summation	A form of accumulation which is selective with respect to time. Note : 'summation' could be considered a specialisation of 'bulkQuantity' as it selectively accumulates pulses over a timing pattern (while 'bulkQuantity' accumulates pulses all of the time).
timeDelay	A form of computation which introduces a time delay characteristic to the data value.
instantaneous	Typically measured over the fastest period of time allowed by the definition of the metric (usually milliseconds or tens of milliseconds.) Note: 'instantaneous' was moved to attribute #3 in Ed.2 of IEC 61968-9, from attribute #1 in Ed.1 of IEC 61968-9.

latchingQuantity	When this description is applied to a metered value, it implies that the value is a time-independent cumulative quantity much like a 'bulkQuantity', except that it latches upon the maximum value upon reaching that value. Any additional accumulation (positive or negative) is discarded until a reset occurs. Note: A 'latchingQuantity' may also occur in the downward direction – upon reaching a minimum value. The terms 'maximum' or 'minimum' (for 'aggregate') will usually be included when this type of accumulation behaviour is present. When this description is applied to an encoded value (UOM= 'Code'), it implies that the value has one or more bits which are latching. The condition that caused the bit to be set may have long since evaporated. In either case, the timestamp that accompanies the value may not coincide with the moment the value was initially set. In both cases a system will need to perform an operation to clear the latched value.
boundedQuantity	A time-independent cumulative quantity much like a 'bulkQuantity' or a 'latchingQuantity', except that the accumulation stops at the maximum or minimum values. When the maximum is reached, any additional positive accumulation is discarded, but negative accumulation may be accepted (thus lowering the counter.) Likewise, when the negative bound is reached, any additional negative accumulation is discarded, but positive accumulation is accepted (thus increasing the counter.)

Table 58 – AccumulationKind Data Type

7.2.27 FlowDirectionKind Data Type

The following table gives the detail of the fields of FlowDirectionKind data type (IEC 61968).

Value	Description
none	Not Applicable (N/A)
forward	"Delivered," or "Imported" as defined 61968-2. Forward Active Energy is a positive kWh value as one would naturally expect to find as energy is supplied by the utility and consumed at the service. Forward Reactive Energy is a positive VArh value as one would naturally expect to find in the presence of inductive loading. In polyphase metering, the forward energy register is incremented when the sum of the phase energies is greater than zero:

lagging	Typically used to describe that a power factor is lagging the reference value. Note 1: When used to describe VA, “lagging” describes a form of measurement where reactive power is considered in all four quadrants, but real power is considered only in quadrants I and IV. Note 2: When used to describe power factor, the term “Lagging” implies that the PF is negative. The term “lagging” in this case takes the place of the negative sign. If a signed PF value is to be passed by the data producer, then the direction of flow enumeration zero (none) should be used in order to avoid the possibility of creating an expression that employs a double negative. The data consumer should be able to tell from the sign of the data if the PF is leading or lagging. This principle is analogous to the concept that “Reverse” energy is an implied negative value, and to publish a negative reverse value would be ambiguous. Note 3: Lagging power factors typically indicate inductive loading.
leading	Typically used to describe that a power factor is leading the reference value. Note: Leading power factors typically indicate capacitive loading.
net	|Forward| - |Reverse|, See 61968-2. Note: In some systems, the value passed as a “net” value could become negative. In other systems the value passed as a “net” value is always a positive number, and rolls-over and rolls-under as needed.
q1plusQ2	Reactive positive quadrants. (The term “lagging” is preferred.)
q1plusQ3	Quadrants 1 and 3
q1plusQ4	Quadrants 1 and 4 usually represent forward active energy
q1minusQ4	Q1 minus Q4
q2plusQ3	Quadrants 2 and 3 usually represent reverse active energy
q2plusQ4	Quadrants 2 and 4
q2minusQ3	Q2 minus Q3
q3plusQ4	Reactive negative quadrants. (The term “leading” is preferred.)
q3minusQ2	Q3 minus Q2
quadrant1	Q1 only
quadrant2	Q2 only
quadrant3	Q3 only
quadrant4	Q4 only
reverse	Reverse Active Energy is equivalent to "Received," or "Exported" as defined in 61968-2. Reverse Active Energy is a positive kWh value as one would expect to find when energy is backfed by the service onto the utility network. Reverse Reactive Energy is a positive VArh value as one would expect to find in the presence of capacitive loading and a leading Power Factor. In polyphase metering, the reverse energy register is incremented when the sum of the phase energies is less than zero: Note: The value passed as a reverse value is always a positive value. It is understood by the label “reverse” that it represents negative flow.

total	|Forward| + |Reverse|, See 61968-2. The sum of the commodity in all quadrants Q1+Q2+Q3+Q4. In polyphase metering, the total energy register is incremented when the absolute value of the sum of the phase energies is greater than zero:
totalByPhase	In polyphase metering, the total by phase energy register is incremented when the sum of the absolute values of the phase energies is greater than zero: In single phase metering, the formulas for “Total” and “Total by phase” collapse to the same expression. For communication purposes however, the “Total” enumeration should be used with single phase meter data.

Table 59 – FlowDirectionKind Data Type

7.2.28 CommodityKind Data Type

The following table gives the detail of the fields of CommodityKind data type (IEC 61968).

Value	Description
none	Not Applicable
electricitySecondaryMetered	All types of metered quantities. This type of reading comes from the meter and represents a “secondary” metered value.
electricityPrimaryMetered	It is possible for a meter to be outfitted with an external VT and/or CT. The meter might not be aware of these devices, and the display not compensate for their presence. Ultimately, when these scalars are applied, the value that represents the service value is called the “primary metered” value. The “index” in sub-category 3 mirrors those of sub-category 0.
communication	A measurement of the communication infrastructure itself.
air	-
insulativeGas	(SF6 is found separately below.)
insulativeOil	-
naturalGas	-
propane	-
potableWater	Drinkable water
steam	Water in steam form, usually used for heating.
wastewater	(Sewerage)
heatingFluid	This fluid is likely in liquid form. It is not necessarily water or water based. The warm fluid returns cooler than when it was sent. The heat conveyed may be metered.
coolingFluid	The cool fluid returns warmer than when it was sent. The heat conveyed may be metered.
nonpotableWater	Reclaimed water – possibly used for irrigation but not sufficiently treated to be considered safe for drinking.
nox	Nitrous Oxides NOX

so2	Sulfur Dioxide SO2
ch4	Methane CH4
co2	Carbon Dioxide CO2
carbon	-
hch	Hexachlorocyclohexane HCH
pfc	Perfluorocarbons PFC
sf6	Sulfurhexafluoride SF6
tvLicence	Television
internet	Internet service
refuse	Trash

Table 60 – CommodityKind Data Type

7.2.29 MeasurementKind Data Type

The following table gives the detail of the fields of MeasurementKind data type (IEC 61968).

Value	Description
none	Not Applicable
apparentPowerFactor	-
currency	Funds
current	-
currentAngle	-
currentImbalance	-
date	-
demand	-
distance	-
distortionVoltAmperes	-
energization	-
energy	-
energizationLoadSide	-
fan	-
frequency	-
fund	Dup with “currency”
ieee1366ASAI	-
ieee1366ASIDI	-
ieee1366ASIFI	-
ieee1366CAIDI	-
ieee1366CAIFI	-
ieee1366CEMIn	-
ieee1366CEMSMIn	-
ieee1366CTAIDI	-
ieee1366MAIFI	-
ieee1366MAIFIe	-
ieee1366SAIDI	-

ieee1366SAIFI	-
lineLoss	-
loss	-
negativeSequence	-
phasorPowerFactor	-
phasorReactivePower	-
positiveSequence	-
power	-
powerFactor	-
quantityPower	-
sag	or Voltage Dip
swell	-
switchPosition	-
tapPosition	-
tariffRate	-
temperature	-
totalHarmonicDistortion	-
transformerLoss	-
unipedeVoltageDip10to15	-
unipedeVoltageDip15to30	-
unipedeVoltageDip30to60	-
unipedeVoltageDip60to90	-
unipedeVoltageDip90to100	-
voltage	-
voltageAngle	-
voltageExcursion	-
voltageImbalance	-
volume	Clarified from Ed. 1. to indicate fluid volume
zeroFlowDuration	-
zeroSequence	-
distortionPowerFactor	-
frequencyExcursion	Usually expressed as a “count”
applicationContext	-
apTitle	-
assetNumber	-
bandwidth	-
batteryVoltage	-
broadcastAddress	-
deviceAddressType1	-
deviceAddressType2	-
deviceAddressType3	-
deviceAddressType4	-
deviceClass	-
electronicSerialNumber	-
endDeviceID	-

groupAddressType1	-
groupAddressType2	-
groupAddressType3	-
groupAddressType4	-
ipAddress	-
macAddress	-
mfgAssignedConfigurationID	-
mfgAssignedPhysicalSerialNumber	-
mfgAssignedProductNumber	-
mfgAssignedUniqueCommunicationAddress	-
multiCastAddress	-
oneWayAddress	-
signalStrength	-
twoWayAddress	-
signaltoNoiseRatio	Moved here from Attribute #9 UOM
alarm	-
batteryCarryover	-
dataOverflowAlarm	-
demandLimit	-
demandReset	Usually expressed as a count as part of a billing cycle
diagnostic	-
emergencyLimit	-
encoderTamper	-
ieee1366MomentaryInterruption	-
ieee1366MomentaryInterruptionEvent	-
ieee1366SustainedInterruption	-
interruptionBehaviour	-
inversionTamper	-
loadInterrupt	-
loadShed	-
maintenance	-
physicalTamper	-
powerLossTamper	-
powerOutage	-
powerQuality	-
powerRestoration	-
programmed	-
pushbutton	-
relayActivation	-
relayCycle	Usually expressed as a count
removalTamper	-
reprogrammingTamper	-
reverseRotationTamper	-
switchArmed	-

switchDisabled	-
tamper	-
watchdogTimeout	-
billLastPeriod	Customer's bill for the previous billing period (Currency)
billToDate	Customer's bill, as known thus far within the present billing period (Currency)
billCarryover	Customer's bill for the (Currency)
connectionFee	Monthly fee for connection to commodity.
audibleVolume	Sound
volumetricFlow	-

Table 61 – MeasurementKind Data Type

7.2.30 ReadingInterharmonic Data Type

The following table gives the detail of the fields of the ReadingInterharmonic data type (IEC 61968).

Name	Type	Multiplicity	Description
numerator	Integer	0..1	Interharmonic numerator. Value 0 means not applicable. Value 1 is used in combination with 'denominator'=2 to represent interharmonic 1/2, and with 'denominator'=1 it represents fundamental frequency. Finally, values greater than 1 indicate the harmonic of that order (e.g., 'numerator'=5 is the fifth harmonic).
denominator	Integer	0..1	Interharmonic denominator. Value 0 means not applicable. Value 2 is used in combination with 'numerator'=1 to represent interharmonic 1/2. Finally, value 1 indicates the harmonic of the order specified with 'numerator'.

Table 62 – ReadingInterharmonic Data Type

7.2.31 UnitMultiplier Data Type

The following table gives the detail of the fields of UnitMultiplier data type (IEC 61970).

Value	Description
y	yocto 10**-24.
Z	zepto 10**-21.
A	atto 10**-18.
F	femto 10**-15.
p	Pico 10**-12.
n	Nano 10**-9.

micro	Micro 10**-6.
m	Milli 10**-3.
c	Centi 10**-2.
d	Deci 10**-1.
none	No multiplier or equivalently multiply by 1.
da	deca 10**1.
h	hecto 10**2.
k	Kilo 10**3.
M	Mega 10**6.
G	Giga 10**9.
T	Tera 10**12.
P	Peta 10**15
E	Exa 10**18.
Z	Zetta 10**21
Y	Yotta 10**24

Table 63 – UnitMultiplier Data Type

7.2.32 UnitSymbol Data Type

The following table gives the detail of the fields of UnitSymbol data type (IEC 61970).

Value	Description
none	Dimension less quantity, e.g. count, per unit, etc.
m	Length in meter.
kg	Mass in kilogram. Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
s	Time in seconds.
A	Current in Ampere.
K	Temperature in Kelvin.
mol	Amount of substance in mole.
cd	Luminous intensity in candela.
deg	Plane angle in degrees.
rad	Plane angle in radian (m/m).
Sr	Solid angle in steradian (m2/m2).
Gy	Absorbed dose in Gray (J/kg).
Bq	Radioactivity in Becquerel (1/s).
degC	Relative temperature in degrees Celsius. In the SI unit system the symbol is ºC. Electric charge is measured in coulomb that has the unit symbol C. To distinguish degree Celsius form coulomb the symbol used in the UML is degC. Reason for not using ºC is the special character º is difficult to manage in software.
Sv	Dose equivalent in Sievert (J/kg).
F	Electric capacitance in Farad (C/V).
C	Electric charge in Coulomb (A·s).
S	Conductance in Siemens.

H	Electric inductance in Henry (Wb/A).
V	Electric potential in Volt (W/A).
ohm	Electric resistance in ohm (V/A).
J	Energy in joule (N·m = C·V = W·s).
N	Force in Newton (kg·m/s²).
Hz	Frequency in Hertz (1/s).
Lx	Illuminance in lux (lm/m²).
Lm	Luminous flux in lumen (cd·sr).
Wb	Magnetic flux in Weber (V·s).
T	Magnetic flux density in Tesla (Wb/m2).
W	Real power in Watt (J/s). Electrical power may have real and reactive components. The real portion of electrical power (I²R or VIcos(phi)), is expressed in Watts. (See also apparent power and reactive power.)
Pa	Pressure in Pascal (N/m²). Note: the absolute or relative measurement of pressure is implied with this entry. See below for more explicit forms.
m2	Area in square metre (m²).
m3	Volume in cubic metre (m³).
mPers	Velocity in metre per second (m/s).
mPers2	Acceleration in metre per second squared (m/s²).
m3Pers	Volumetric flow rate in cubic metres per second (m³/s)
mPerm3	Fuel efficiency in metre per cubic metre (m/m³).
kgm	Moment of mass in kilogram metre (kg·m) (first moment of mass). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
kgPerm3	Density in kilogram/cubic metre (kg/m³). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
WPermK	Thermal conductivity in Watt/metre Kelvin.
JPerK	Heat capacity in Joule/Kelvin.
ppm	Concentration in parts per million.
rotPers	Rotations per second (1/s). See also Hz (1/s).
radPers	Angular velocity in radians per second (rad/s).
VA	Apparent power in Volt Ampere (See also real power and reactive power.)
VAr	Reactive power in Volt Ampere reactive. The “reactive” or “imaginary” component of electrical power (VIsin(phi)). (See also real power and apparent power). Note: Different meter designs use different methods to arrive at their results. Some meters may compute reactive power as an arithmetic value, while others compute the value vectorially. The data consumer should determine the method in use and the suitability of the measurement for the intended purpose.
cosPhi	Power factor, dimensionless. Note 1: This definition of power factor only holds for balanced systems. See the alternative definition under code 153. Note 2 : Beware of differing sign conventions in use between the IEC and EEI. It is assumed that the data consumer understands the type of meter in use and the sign convention in use by the utility

Vs	Volt second (Ws/A).
V2	Volt squared (W^2/A^2).
As	Ampere seconds (A·s).
A2	Ampere squared (A^2).
A2s	Ampere squared time in square ampere (A^2s).
Vah	Apparent energy in Volt Ampere hours.
Wh	Real energy in Watt hours.
VArh	Reactive energy in Volt Ampere reactive hours.
VPerHz	Magnetic flux in Volt per Hertz.
HzPers	Rate of change of frequency in Hertz per second.
character	Number of characters.
charPers	Data rate (baud) in characters per second.
kgm2	Moment of mass in kilogram square metre ($kg \cdot m^2$) (Second moment of mass, commonly called the moment of inertia). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
dB	Sound pressure level in decibel. Note: multiplier “d” is included in this unit symbol for compatibility with IEC 61850-7-3.
WPers	Ramp rate in Watt per second.
lPers	Volumetric flow rate in litre per second.
dBm	Power level (logrithmic ratio of signal strength , Bel-mW), normalized to 1mW. Note: multiplier “d” is included in this unit symbol for compatibility with IEC 61850-7-3.
h	Time, hour = 60 min = 3600 s.
min	Time, minute = 60 s.
Q	Quantity power, Q.
Qh	Quantity energy, Qh.
ohmm	resistivity, Ohm metre, (rho).
APerm	A/m, magnetic field strength, Ampere per metre.
V2h	volt-squared hour, Volt-squared-hours.
A2h	ampere-squared hour, Ampere-squared hour.
Ah	Ampere-hours, Ampere-hours.
count	Amount of substance, Counter value.
ft3	Volume, cubic foot.
m3Perh	Volumetric flow rate, cubic metre per hour.
gal	Volume, US gallon (1 gal = 231 in3 = 128 fl ounce).
Btu	Energy, British Thermal Unit.
l	Volume, litre = dm3 = m3/1000.
lPerh	Volumetric flow rate, litre per hour.
lPerl	Concentration, The ratio of the volume of a solute divided by the volume of the solution. Note: Users may need use a prefix such a ‘µ’ to express a quantity such as ‘µL/L’.
gPerg	Concentration, The ratio of the mass of a solute divided by the mass of the solution. Note: Users may need use a prefix such a ‘µ’ to express a quantity such as ‘µg/g’.

molPerm3	Concentration, The amount of substance concentration, (c), the amount of solvent in moles divided by the volume of solution in m³.
molPermol	Concentration, Molar fraction (?), the ratio of the molar amount of a solute divided by the molar amount of the solution.
molPerkg	Concentration, Molality, the amount of solute in moles and the amount of solvent in kilograms.
sPers	Time, Ratio of time Note: Users may need to supply a prefix such as 'µ' to show rates such as 'µs/s'
HzPerHz	Frequency, Rate of frequency change Note: Users may need to supply a prefix such as 'm' to show rates such as 'mHz/Hz'.
VPerV	Voltage, Ratio of voltages Note: Users may need to supply a prefix such as 'm' to show rates such as 'mV/V'.
APerA	Current, Ratio of Amperages Note: Users may need to supply a prefix such as 'm' to show rates such as 'mA/A'.
VPerVA	Power factor, PF, the ratio of the active power to the apparent power. Note: The sign convention used for power factor will differ between IEC meters and EEI (ANSI) meters. It is assumed that the data consumers understand the type of meter being used and agree on the sign convention in use at any given utility.
rev	Amount of rotation, Revolutions.
kat	Catalytic activity, katal = mol / s.
JPerkg	Specific energy, Joule / kg.
m3Uncompensated	Volume, cubic metre, with the value uncompensated for weather effects.
m3Compensated	Volume, cubic metre, with the value compensated for weather effects.
WPerW	Signal Strength, Ratio of power Note: Users may need to supply a prefix such as 'm' to show rates such as 'mW/W'.
therm	Energy, Therm.
onePerm	Wavenumber, reciprocal metre, (1/m).
m3Perkg	Specific volume, cubic metre per kilogram, v.
Pas	Dynamic viscosity, Pascal second.
Nm	Moment of force, Newton metre.
NPerm	Surface tension, Newton per metre.
radPers2	Angular acceleration, radian per second squared.
WPerm2	Heat flux density, irradiance, Watt per square metre.
JPerkgK	Specific heat capacity, specific entropy, Joule per kilogram Kelvin.
JPerm3	energy density, Joule per cubic metre.
VPerm	electric field strength, Volt per metre.
CPerm3	electric charge density, Coulomb per cubic metre.
CPerm2	surface charge density, Coulomb per square metre.
FPerm	permittivity, Farad per metre.
HPerm	permeability, Henry per metre.
JPermol	molar energy, Joule per mole.
JPermolK	molar entropy, molar heat capacity, Joule per mole kelvin.
CPerkg	exposure (x rays), Coulomb per kilogram.
GyPers	absorbed dose rate, Gray per second.
WPersr	Radiant intensity, Watt per steradian.

WPerm2sr	radiance, Watt per square metre steradian.
katPerm3	catalytic activity concentration, katal per cubic metre.
d	Time, day = 24 h = 86400 s.
anglemin	Plane angle, minute.
anglesec	Plane angle, second.
ha	Area, hectare.
tonne	mass, “tonne” or “metric ton” (1000 kg = 1 Mg).
bar	Pressure, bar (1 bar = 100 kPa).
mmHg	Pressure, millimeter of mercury (1 mmHg is approximately 133.3 Pa).
M	Length, nautical mile (1 M = 1852 m).
kn	Speed, knot (1 kn = 1852/3600) m/s.
Vh	Volt-hour, Volt hours.
Mx	Magnetic flux, Maxwell (1 Mx = 10-8 Wb).
G	Magnetic flux density, Gauss (1 G = 10-4 T).
Oe	Magnetic field, Œrsted (1 Oe = (103/4p) A/m).
WPerA	Active power per current flow, watt per Ampere.
SPerm	Conductance per length (F/m).
onePerHz	Reciprocal of frequency (1/Hz).
VPerVAr	Power factor, PF, the ratio of the active power to the apparent power. Note: The sign convention used for power factor will differ between IEC meters and EEI (ANSI) meters. It is assumed that the data consumers understand the type of meter being used and agree on the sign convention in use at any given utility.
ohmPerm	Electric resistance per length in ohm per metre ((V/A)/m).
kgPerJ	Weigh per energy in kilogram/joule (kg/J). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
JPers	Energy rate joule per second (J/s),
m2Pers	Viscosity in metre square / second (m²/s).
JPerm2	Insulation energy density, Joule per square metre or watt second per square metre.
KPers	Temperature change rate in Kelvin per second.
PaPers	Pressure change rate in Pascal per second.

Table 64 – UnitSymbol Data Type

7.2.33 Currency Data Type

The following table gives the detail of the fields of Currency data type (IEC 61970).

Value	Description
AED	United Arab Emirates dirham.
AFN	Afghan afghani.
ALL	Albanian lek.
AMD	Armenian dram.
ANG	Netherlands Antillean guilder.

AOA	Angolan kwanza.
ARS	Argentine peso.
AUD	Australian dollar.
AWG	Aruban florin.
AZN	Azerbaijani manat.
BAM	Bosnia and Herzegovina convertible mark.
BBD	Barbados dollar.
BDT	Bangladeshi taka.
BGN	Bulgarian lev.
BHD	Bahraini dinar.
BIF	Burundian franc.
BMD	Bermudian dollar (customarily known as Bermuda dollar).
BND	Brunei dollar.
BOB	Boliviano.
BOV	Bolivian Mvdol (funds code).
BRL	Brazilian real.
BSD	Bahamian dollar.
BTN	Bhutanese ngultrum.
BWP	Botswana pula.
BYR	Belarusian ruble.
BZD	Belize dollar.
CAD	Canadian dollar
CDF	Congolese franc.
CHF	Swiss franc.
CLF	Unidad de Fomento (funds code), Chile.
CLP	Chilean peso.
CNY	Chinese yuan.
COP	Colombian peso.
COU	Unidad de Valor Real.
CRC	Costa Rican colon.
CUC	Cuban convertible peso.
CUP	Cuban peso.
CVE	Cape Verde escudo.
CZK	Czech koruna.
DJF	Djiboutian franc.
DKK	Danish krone.
DOP	Dominican peso.
DZD	Algerian dinar.
EEK	Estonian kroon.
EGP	Egyptian pound.
ERN	Eritrean nakfa.
ETB	Ethiopian birr.
EUR	Euro.
FJD	Fiji dollar.
FKP	Falkland Islands pound.

GBP	Pound sterling.
GEL	Georgian lari.
GHS	Ghanaian cedi.
GIP	Gibraltar pound.
GMD	Gambian dalasi.
GNF	Guinean franc.
GTQ	Guatemalan quetzal.
GYD	Guyanese dollar.
HKD	Hong Kong dollar.
HNL	Honduran lempira.
HRK	Croatian kuna.
HTG	Haitian gourde.
HUF	Hungarian forint.
IDR	Indonesian rupiah.
ILS	Israeli new sheqel.
INR	Indian rupee.
IQD	Iraqi dinar.
IRR	Iranian rial.
ISK	Icelandic króna.
JMD	Jamaican dollar.
JOD	Jordanian dinar.
JPY	Japanese yen.
KES	Kenyan shilling.
KGS	Kyrgyzstani som.
KHR	Cambodian riel.
KMF	Comoro franc.
KPW	North Korean won.
KRW	South Korean won.
KWD	Kuwaiti dinar.
…	…
ZWL	Zimbabwe dollar.

Table 65 – Currency Data Type

7.2.34 DateTimeInterval Data Type

The following table gives the detail of the fields of DateTimeInterval data type (IEC 61970).

Name	Type	Multiplicity	Description
Start	DateTime	0..1	Start date and time of this interval.
End	DateTime	0..1	End date and time of this interval.

Table 66 – DateTimeInterval Data Type