European Network of
Transmission System Operators
for Electricity

MONITORING AREA PROFILE SPECIFICATION

2023-05-10

APPROVED DOCUMENT
VERSION 2.2

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NOTE CONCERNING WORDING USED IN THIS DOCUMENT

The force of the following words is modified by the requirement level of the document in which they are used.

- SHALL: This word, or the terms “REQUIRED” or “MUST”, means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase, or the phrase “MUST NOT”, means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective “RECOMMENDED”, means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase “NOT RECOMMENDED”, means that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
- MAY: This word, or the adjective “OPTIONAL”, means that an item is truly optional.

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Revision History

Version	Release	Date	Paragraph	Comments
2	2	2023-03-24		For review.
2	2	2023-05-10		ICTC approved.

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1 Introduction

The monitoring area profile enables the exchange of monitoring area related information like the influence factors. These influence factors allow defining the observability area and external contingency list as detailed by Art 5.5 and Art 6.2 of CSA methodology.

For information, the observability area and the external contingency list influence factors are published in the SO GL related deliverables in ENTSO-E webpage, under SO GL Art 75.1 Methodology for coordinating operational security analysis.

2 Application profile specification

2.1 Version information

The content is generated from UML model file CIM100_CGMES31v01_501-20v02_NC22v95_MM10v01.eap.

This edition is based on the IEC 61970 UML version 'IEC61970CIM17v40', dated '2020-08-24'.

- Title: Monitoring area Vocabulary
- Keyword: MA
- Description: This vocabulary is describing the monitoring area profile.
- Version IRI: http://entsoe.eu/ns/CIM/MonitoringArea-EU/2.2
- Version info: 2.2.0
- Prior version:
- Conforms to: urn:iso:std:iec:61970-600-2:ed-1|urn:iso:std:iec:61970-301:ed-7:amd1|file://iec61970cim17v40_iec61968cim13v13a_iec62325cim03v17a.eap|urn:iso:std:iec:61970-401:draft:ed-1|urn:iso:std:iec:61970-501:draft:ed-2|file://CGMES-30v25_501-20v01.eap
- Identifier: urn:uuid:41075091-91f0-4b14-a5b8-93945aa528ed

2.2 Constraints naming convention

The naming of the rules shall not be used for machine processing. The rule names are just a string. The naming convention of the constraints is as follows.

"{rule.Type}:{rule.Standard}:{rule.Profile}:{rule.Property}:{rule.Name}"

where

rule.Type: C – for constraint; R – for requirement

rule.Standard: the number of the standard e.g. 301 for 61970-301, 456 for 61970-456, 13 for 61968-13. 61970-600 specific constraints refer to 600 although they are related to one or combination of the 61970-450 series profiles. For NC profiles, NC is used.

rule.Profile: the abbreviation of the profile, e.g. TP for Topology profile. If set to "ALL" the constraint is applicable to all IEC 61970-600 profiles.

rule.Property: for UML classes, the name of the class, for attributes and associations, the name of the class and attribute or association end, e.g. EnergyConsumer, IdentifiedObject.name, etc. If set to "NA" the property is not applicable to a specific UML element.

rule.Name: the name of the rule. It is unique for the same property.

Example: C:600:ALL:IdentifiedObject.name:stringLength

2.3 Profile constraints

This clause defines requirements and constraints that shall be fulfilled by applications that conform to this document.

This document is the master for rules and constraints tagged "NC". For the sake of self-containment, the list below also includes a copy of the relevant rules from IEC 61970-452, tagged "452".

- C:452:ALL:NA:datatypes

  According to 61970-501, datatypes are not exchanged in the instance data. The UnitMultiplier is 1 in cases none value is specified in the profile.

- R:452:ALL:NA:exchange

  Optional and required attributes and associations must be imported and exported if they are in the model file prior to import.

- R:452:ALL:NA:exchange1

  If an optional attribute does not exist in the imported file, it does not have to be exported in case exactly the same data set is exported, i.e. the tool is not obliged to automatically provide this attribute. If the export is resulting from an action by the user performed after the import, e.g. data processing or model update the export can contain optional attributes.

- R:452:ALL:NA:exchange2

  In most of the profiles the selection of optional and required attributes is made so as to ensure a minimum set of required attributes without which the exchange does not fulfil its basic purpose. Business processes governing different exchanges can require mandatory exchange of certain optional attributes or associations. Optional and required attributes and associations shall therefore be supported by applications which claim conformance with certain functionalities of the IEC 61970-452. This provides flexibility for the business processes to adapt to different business requirements and base the exchanges on IEC 61970-452 compliant applications.

- R:452:ALL:NA:exchange3

  An exporter may, at his or her discretion, produce a serialization containing additional class data described by the CIM Schema but not required by this document provided these data adhere to the conventions established in Clause 5.

- R:452:ALL:NA:exchange4

  From the standpoint of the model import used by a data recipient, the document describes a subset of the CIM that importing software shall be able to interpret in order to import exported models. Data providers are free to exceed the minimum requirements described herein as long as their resulting data files are compliant with the CIM Schema and the conventions established in Clause 5. The document, therefore, describes additional classes and class data that, although not required, exporters will, in all likelihood, choose to include in their data files. The additional classes and data are labelled as required (cardinality 1..1) or as optional (cardinality 0..1) to distinguish them from their required counterparts. Please note, however, that data importers could

potentially receive data containing instances of any and all classes described by the CIM Schema.

- R:452:ALL:NA:cardinality

The cardinality defined in the CIM model shall be followed, unless a more restrictive cardinality is explicitly defined in this document. For instance, the cardinality on the association between VoltageLevel and BaseVoltage indicates that a VoltageLevel shall be associated with one and only one BaseVoltage, but a BaseVoltage can be associated with zero to many VoltageLevels.

- R:452:ALL:NA:associations

Associations between classes referenced in this document and classes not referenced here are not required regardless of cardinality.

- R:452:ALL:IdentifiedObject.name:rule

The attribute “name” inherited by many classes from the abstract class IdentifiedObject is not required to be unique. It must be a human readable identifier without additional embedded information that would need to be parsed. The attribute is used for purposes such as User Interface and data exchange debugging. The MRID defined in the data exchange format is the only unique and persistent identifier used for this data exchange. The attribute IdentifiedObject.name is, however, always required for CoreEquipment profile and Short Circuit profile.

- R:452:ALL:IdentifiedObject.description:rule

The attribute “description” inherited by many classes from the abstract class IdentifiedObject must contain human readable text without additional embedded information that would need to be parsed.

- R:452:ALL:NA:uniqueIdentifier

All IdentifiedObject-s shall have a persistent and globally unique identifier (Master Resource Identifier - mRID).

- R:452:ALL:NA:unitMultiplier

For exchange of attributes defined using CIM Data Types (ActivePower, Susceptance, etc.) a unit multiplier of 1 is used if the UnitMultiplier specified in this document is “none”.

- C:452:ALL:IdentifiedObject.name:stringLength

The string IdentifiedObject.name has a maximum of 128 characters.

- C:452:ALL:IdentifiedObject.description:stringLength

The string IdentifiedObject.description is maximum 256 characters.

- C:452:ALL:NA:float

An attribute that is defined as float (e.g. has a type Float or a type which is a Datatype with .value attribute of type Float) shall support ISO/IEC 60559:2020 for floating-point arithmetic using single precision floating point. A single precision float supports 7 significant digits where the significant digits are described as an integer, or a decimal number with 6 decimal digits. Two float values are equal when the significant with 7 digits are identical, e.g. 1234567 is equal 1.234567E6 and so are 1.2345678 and 1.234567E0.

- R:NC:ALL:Region:reference

  The reference to the Region is normally a reference to the capacity calculation region, which is identified by “Y” EIC code of the capacity calculation region.

- R:NC:ALL:SystemOperator:reference

  The reference to the System Operator is normally identified by “X” EIC code of TSO.

- C:NC:MA:MonitoringArea:associations

  MonitoringArea can have either of the following associations, i.e., not both of them: nc:MonitoringArea.Region or nc:MonitoringArea.SystemOperator.

2.4 Metadata

ENTSO-E agreed to extend the header and metadata definitions by IEC 61970-552 Ed2. This new header definitions rely on W3C recommendations which are used worldwide and are positively recognised by the European Commission. The new definitions of the header mainly use Provenance ontology (PROV-O), Time Ontology and Data Catalog Vocabulary (DCAT). The global new header applicable for this profile is included in the metadata and document header specification document.

The header vocabulary contains all attributes defined in IEC 61970-552. This is done only for the purpose of having one vocabulary for header and to ensure transition for data exchanges that are using IEC 61970-552:2016 header. This profile does not use IEC 61970-552:2016 header attributes and relies only on the extended attributes.

2.4.1 Constraints

The identification of the constraints related to the metadata follows the same convention for naming of the constraints as for profile constraints.

- R:NC:ALL:wasAttributedTo:usage

  The prov:wasAttributedTo should normally be the “X” EIC code of the actor (prov:Agent).

2.4.2 Reference metadata

The header defined for this profile requires availability of a set of reference metadata. For instance, the attribute prov:wasGeneratedBy requires a reference to an activity which produced the model or the related process. The activities are defined as reference metadata and their identifiers are referenced from the header to enable the receiving entity to retrieve the “static” (reference) information that is not modified frequently. This approach imposes a requirement that both the sending entity and the receiving entity have access to a unique version of the reference metadata. Therefore, each business process shall define which reference metadata is used and where it is located.

3 Detailed Profile Specification

3.1 General

This package contains monitoring area profile.

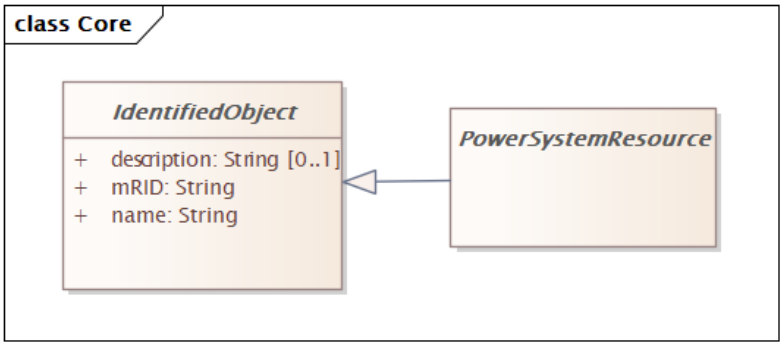

Figure 1 – Class diagram MonitoringAreaProfile::Core

Figure 1: The diagram shows classes from Base CIM used in the profile.

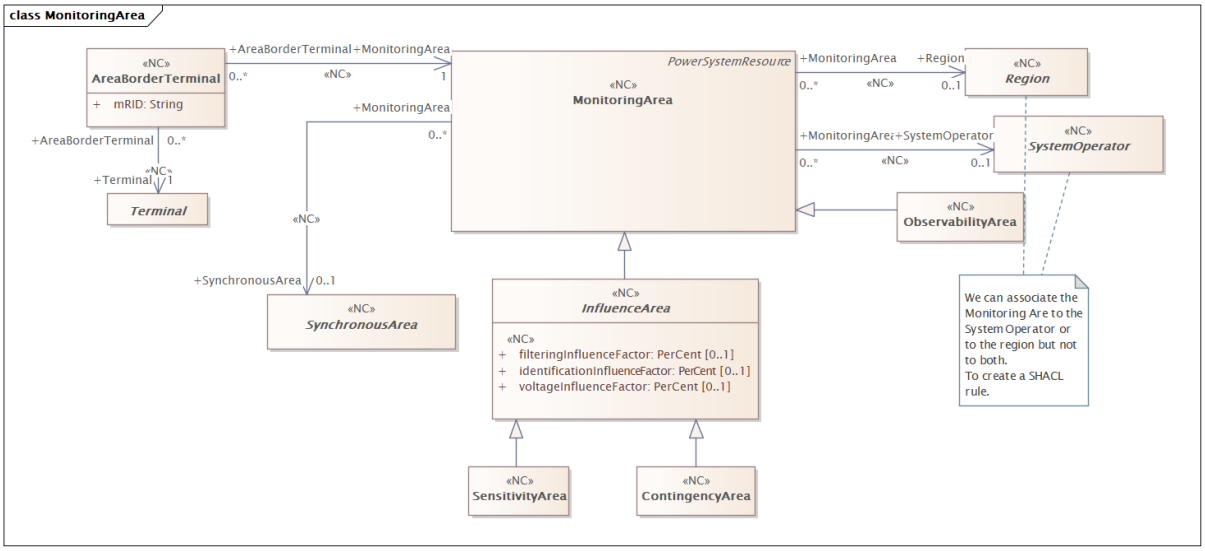

Figure 2 – Class diagram MonitoringAreaProfile::MonitoringArea

Figure 2: The diagram shows monitoring area related classes.

3.2 (NC) AreaBorderTerminal root class

Area border terminal defines the terminals that are defining a monitoring area.
Table 1 shows all attributes of AreaBorderTerminal.

Table 1 – Attributes of MonitoringAreaProfile::AreaBorderTerminal

name	mult	type	description
mRID	1..1	String	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, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements.

Table 2 shows all association ends of AreaBorderTerminal with other classes.

Table 2 – Association ends of MonitoringAreaProfile::AreaBorderTerminal with other classes

mult from	name	mult to	type	description
0..*	MonitoringArea	1..1	MonitoringArea	(NC) The MonitoringArea defined by this AreaBorderTerminal.
0..*	Terminal	1..1	Terminal	(NC) The Terminal that is part of an AreaBorderTerminal.

3.3 (NC) ContingencyArea

Inheritance path = InfluenceArea : MonitoringArea : PowerSystemResource : IdentifiedObject
A monitoring area that defines the required contingency elements. This includes elements that are part of the external contingency list.
Table 3 shows all attributes of ContingencyArea.

Table 3 – Attributes of MonitoringAreaProfile::ContingencyArea

name	mult	type	description
identificationInfluenceFactor	0..1	PerCent	(NC) inherited from: InfluenceArea
filteringInfluenceFactor	0..1	PerCent	(NC) inherited from: InfluenceArea
voltageInfluenceFactor	0..1	PerCent	(NC) inherited from: InfluenceArea
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	1..1	String	inherited from: IdentifiedObject

Table 4 shows all association ends of ContingencyArea with other classes.

Table 4 – Association ends of MonitoringAreaProfile::ContingencyArea with other classes

mult from	name	mult to	type	description
0..*	SynchronousArea	0..1	SynchronousArea	(NC) inherited from: MonitoringArea
0..*	SystemOperator	0..1	SystemOperator	(NC) inherited from: MonitoringArea
0..*	Region	0..1	Region	(NC) inherited from: MonitoringArea

3.4 (abstract) IdentifiedObject root class

This is a root class to provide common identification for all classes needing identification and naming attributes.
Table 5 shows all attributes of IdentifiedObject.

Table 5 – Attributes of MonitoringAreaProfile::IdentifiedObject

name	mult	type	description
description	0..1	String	The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy.
mRID	1..1	String	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

name	mult	type	description
			4122, for the mRID. The use of UUID is strongly recommended. For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements.
name	1..1	String	The name is any free human readable and possibly non unique text naming the object.

3.5 (abstract,NC) InfluenceArea

Inheritance path = MonitoringArea : PowerSystemResource : IdentifiedObject

Influence area is a monitoring area that is defined by calculating the equipment that is affected by the influence factors.

Table 6 shows all attributes of InfluenceArea.

Table 6 – Attributes of MonitoringAreaProfile::InfluenceArea

name	mult	type	description
identificationInfluenceFactor	0..1	PerCent	(NC) Power flow identification influence factor of a network element that is normalised in order to take into account potential impacts induced by differences in Permanently Admissible Transmission Loading (PATL) values. This is referred as identification influence threshold in CSA methodology. The allowed value range is [0,100].
filteringInfluenceFactor	0..1	PerCent	(NC) Power flow filtering influence factor of a network element not normalised. This is referred as power flow influence threshold in CSA methodology. The allowed value range is [0,100].
voltageInfluenceFactor	0..1	PerCent	(NC) Voltage influence factor of a network element as defined in the CSA methodology. The allowed value range is [0,100].
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	1..1	String	inherited from: IdentifiedObject

Table 7 shows all association ends of InfluenceArea with other classes.

Table 7 – Association ends of MonitoringAreaProfile::InfluenceArea with other classes

mult from	name	mult to	type	description
0..*	SynchronousArea	0..1	SynchronousArea	(NC) inherited from: MonitoringArea
0..*	SystemOperator	0..1	SystemOperator	(NC) inherited from: MonitoringArea
0..*	Region	0..1	Region	(NC) inherited from: MonitoringArea

3.6 (NC) MonitoringArea

Inheritance path = PowerSystemResource : IdentifiedObject

A coherent part of the interconnected electrical power system, that includes the system operators' responsibility area and the surrounding parts of other system operators' responsibility area, that need to be monitored for security assessment.

Table 8 shows all attributes of MonitoringArea.

Table 8 – Attributes of MonitoringAreaProfile::MonitoringArea

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	1..1	String	inherited from: IdentifiedObject

Table 9 shows all association ends of MonitoringArea with other classes.

Table 9 – Association ends of MonitoringAreaProfile::MonitoringArea with other classes

mult from	name	mult to	type	description
0..*	SynchronousArea	0..1	SynchronousArea	(NC) The synchronous area that has this monitoring area.
0..*	SystemOperator	0..1	SystemOperator	(NC) The system operator that operates this monitoring area.
0..*	Region	0..1	Region	(NC) Region that has monitoring areas.

3.7 (NC) ObservabilityArea

Inheritance path = MonitoringArea : PowerSystemResource : IdentifiedObject
A monitoring area that is given by a real time measurement.
Table 10 shows all attributes of ObservabilityArea.

Table 10 – Attributes of MonitoringAreaProfile::ObservabilityArea

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	1..1	String	inherited from: IdentifiedObject

Table 11 shows all association ends of ObservabilityArea with other classes.

Table 11 – Association ends of MonitoringAreaProfile::ObservabilityArea with other classes

mult from	name	mult to	type	description
0..*	SynchronousArea	0..1	SynchronousArea	(NC) inherited from: MonitoringArea
0..*	SystemOperator	0..1	SystemOperator	(NC) inherited from: MonitoringArea
0..*	Region	0..1	Region	(NC) inherited from: MonitoringArea

3.8 (abstract) PowerSystemResource

Inheritance path = IdentifiedObject
A power system resource (PSR) can be an item of equipment such as a switch, an equipment container containing many individual items of equipment such as a substation, or an organisational entity such as sub-control area. Power system resources can have measurements associated.
Table 12 shows all attributes of PowerSystemResource.

Table 12 – Attributes of MonitoringAreaProfile::PowerSystemResource

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	1..1	String	inherited from: IdentifiedObject

3.9 (abstract,NC) Region root class

A region where the system operator belongs to.

3.10 (NC) SensitivityArea

Inheritance path = InfluenceArea : MonitoringArea : PowerSystemResource : IdentifiedObject
A monitoring area that defines the required observability area given by the sensitivity factors.
Table 13 shows all attributes of SensitivityArea.

Table 13 – Attributes of MonitoringAreaProfile::SensitivityArea

name	mult	type	description
identificationInfluenceFactor	0..1	PerCent	(NC) inherited from: InfluenceArea
filteringInfluenceFactor	0..1	PerCent	(NC) inherited from: InfluenceArea
voltageInfluenceFactor	0..1	PerCent	(NC) inherited from: InfluenceArea
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	1..1	String	inherited from: IdentifiedObject

Table 14 shows all association ends of SensitivityArea with other classes.

Table 14 – Association ends of MonitoringAreaProfile::SensitivityArea with other classes

mult from	name	mult to	type	description
0..*	SynchronousArea	0..1	SynchronousArea	(NC) inherited from: MonitoringArea
0..*	SystemOperator	0..1	SystemOperator	(NC) inherited from: MonitoringArea
0..*	Region	0..1	Region	(NC) inherited from: MonitoringArea

3.11 (abstract,NC) SynchronousArea root class

A synchronous area is an electrical area covered by interconnect with a common system frequency in a steady-state.

3.12 (abstract,NC) SystemOperator root class

System operator.

3.13 (abstract) Terminal root class

An AC electrical connection point to a piece of conducting equipment. Terminals are connected at physical connection points called connectivity nodes.

3.14 PerCent datatype

Percentage on a defined base. For example, specify as 100 to indicate at the defined base.
Table 15 shows all attributes of PerCent.

Table 15 – Attributes of MonitoringAreaProfile::PerCent

name	mult	type	description
value	0..1	Float	Normally 0 to 100 on a defined base.
unit	0..1	UnitSymbol	(const=none)
multiplier	0..1	UnitMultiplier	(const=none)

3.15 UnitMultiplier enumeration

The unit multipliers defined for the CIM. When applied to unit symbols, the unit symbol is treated as a derived unit. Regardless of the contents of the unit symbol text, the unit symbol shall be treated as if it were a single-character unit symbol. Unit symbols should not contain multipliers, and it should be left to the multiplier to define the multiple for an entire data type.
For example, if a unit symbol is "m2Pers" and the multiplier is "k", then the value is k(m**2/s), and the multiplier applies to the entire final value, not to any individual part of the value. This can be conceptualized by substituting a derived unit symbol for the unit type. If one imagines that the symbol "Þ" represents the derived unit "m2Pers", then applying the multiplier "k" can be conceptualized simply as "kÞ".
For example, the SI unit for mass is "kg" and not "g". If the unit symbol is defined as "kg", then the multiplier is applied to "kg" as a whole and does not replace the "k" in front of the "g". In this case, the multiplier of "m" would be used with the unit symbol of "kg" to represent one gram. As a text string, this violates the instructions in IEC 80000-1. However, because the unit symbol in CIM is treated as a derived unit instead of as an SI unit, it makes more sense to conceptualize the "kg" as if it were replaced by one of the proposed replacements for the SI mass symbol. If one imagines that the "kg" were replaced by a symbol "Þ", then it is easier to conceptualize the multiplier "m" as creating the proper unit "mÞ", and not the forbidden unit "mkg".
Table 16 shows all literals of UnitMultiplier.

Table 16 – Literals of MonitoringAreaProfile::UnitMultiplier

literal	value	description
none	0	No multiplier or equivalently multiply by 1.

3.16 UnitSymbol enumeration

The derived units defined for usage in the CIM. In some cases, the derived unit is equal to an SI unit. Whenever possible, the standard derived symbol is used instead of the formula for the derived unit. For example, the unit symbol Farad is defined as "F" instead of "CPerV". In cases where a standard symbol does not exist for a derived unit, the formula for the unit is used as the unit symbol. For example, density does not have a standard symbol and so it is represented as "kgPerm3". With the exception of the "kg", which is an SI unit, the unit symbols do not contain multipliers and therefore represent the base derived unit to which a multiplier can be applied as a whole.
Every unit symbol is treated as an unparseable text as if it were a single-letter symbol. The meaning of each unit symbol is defined by the accompanying descriptive text and not by the text contents of the unit symbol.
To allow the widest possible range of serializations without requiring special character handling, several substitutions are made which deviate from the format described in IEC 80000-1. The division symbol "/" is replaced by the letters "Per". Exponents are written in plain text after the unit as "m3" instead of being formatted as "m" with a superscript of 3 or introducing a symbol as in "m^3". The degree symbol "°" is replaced with the letters "deg". Any clarification of the meaning for a substitution is included in the description for the unit symbol.
Non-SI units are included in list of unit symbols to allow sources of data to be correctly labelled with their non-SI units (for example, a GPS sensor that is reporting numbers that represent feet instead of meters). This allows software to use the unit symbol information correctly convert and scale the raw data of those sources into SI-based units.

The integer values are used for harmonization with IEC 61850.
Table 17 shows all literals of UnitSymbol.

Table 17 – Literals of MonitoringAreaProfile::UnitSymbol

literal	value	description
none	0	Dimension less quantity, e.g. count, per unit, etc.

3.17 String primitive

A string consisting of a sequence of characters. The character encoding is UTF-8. The string length is unspecified and unlimited.

3.18 Float primitive

A floating point number. The range is unspecified and not limited.

Annex A (informative): Sample data

A.1 General

This Annex is designed to illustrate the profile by using fragments of sample data. It is not meant to be a complete set of examples covering all possibilities of using the profile. Defining a complete set of test data is considered a separate activity to be performed for the purpose of setting up interoperability testing and conformity related to this profile.

A.2 Sample instance data

Test data files are available in the CIM EG SharePoint.