IEC 62325-451-4

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INTERNATIONAL STANDARD

**Framework for energy market communications –
Part 451-4: Settlement and reconciliation business process, contextual and assembly models for European market**

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Framework for energy market communications –
Part 451-4: Settlement and reconciliation business process, contextual and
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INTERNATIONAL
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FRAMEWORK FOR ENERGY MARKET COMMUNICATIONS –

Part 451-4: Settlement and reconciliation business process, contextual and assembly models for European market

FOREWORD

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International Standard IEC 62325-451-4 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Removal of the attributes "quantity" and "secondary quantity" of the class "Point";

b) Introduction of the class "Quantity" from IEC 62351-351 UML package, with the following attributes "quantity" as mandatory and "quality" as optional, and create two association 1..1 between the class "Quantity" and the class "Point" with the role "In_Quantity" and "Out_Quantity".

c) Introduction of the class "Reason" from IEC 62351-351 UML package, with the following attributes "code" as mandatory and "text" as optional, and create an association 0..* from the class "Reason" to the class "Point" with the role "Reason".

The text of this International Standard is based on the following documents:

CDV	Report on voting
57/1737/CDV	57/1804/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62325 series, published under the general title *Framework for energy market communications*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This standard is one of the IEC 62325 series which define protocols for deregulated energy market communications.

The principal objective of the IEC 62325 series is to produce standards which facilitate the integration of market application software developed independently by different vendors into a market management system, between market management systems and market participant systems. This is accomplished by defining message exchanges to enable these applications or systems access to public data and exchange information independent of how such information is represented internally.

The common information model (CIM) specifies the basis for the semantics for this message exchange.

The European style market profile (ESMP) is based on different parts of the CIM IEC standard. The CIM is defined through a series of standards, i.e. IEC 62325-301, IEC 61970-301 and IEC 61968-11.

This document provides the settlement and reconciliation business process that can be used throughout a European style market. This standard was originally based upon the work of the European Transmission System Operators (ETSO) Task Force EDI (Electronic Data Interchange) and then on the work of the European Network of Transmission System Operators (ENTSO-E) Working Group EDI.

This document describes the settlement and reconciliation process for wholesale markets; it is brought to the attention of the reader that it is envisaged to initiate work on a combined reconciliation process for retail and wholesale markets.

FRAMEWORK FOR ENERGY MARKET COMMUNICATIONS –

Part 451-4: Settlement and reconciliation business process, contextual and assembly models for European market

1 Scope

Based on the European style market profile (ESMP) (IEC 62325-351), this part of IEC 62325-451 specifies a package for the settlement and reconciliation business process and the associated document contextual model, assembly model and XML schema for use within European style markets.

The relevant aggregate core components (ACCs) defined in IEC 62325-351 have been contextualised into aggregated business information entities (ABIEs) to satisfy the requirements of this business process. The contextualised ABIEs have been assembled into the relevant document contextual models. Related assembly models and XML schema for the exchange of information between market participants are automatically generated from the assembled document contextual models.

This part of IEC 62325 provides a uniform layout for the transmission of aggregated data in order to settle the electricity market. It is however not the purpose of this document to define the formula to be taken into account to settle or reconcile a market. The purpose of this document is only to enable the information exchange necessary to carry out the computation of settlement and reconciliation.

The settlement process or reconciliation process is the way to compute the final position of each market participant as well as its imbalance amounts.

2 Normative references

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

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

IEC 62325-301, *Framework for energy market communications – Part 301: Common information model (CIM) extensions for markets*

IEC 62325-351, *Framework for energy market communications – Part 351: CIM European market model exchange profile*

IEC 62325-450:2013, *Framework for energy market communications – Part 450: Profile and context modelling rules*

IEC 62325-451-1, *Framework for energy market communications – Part 451-1: Acknowledgement business process and contextual model for CIM European market*

IEC 62325-451-2, *Framework for energy market communications – Part 451-2: Scheduling business process and contextual model for CIM European market*

IEC 62361-100, *Power systems management and associated information exchange – Interoperability in the long term – Part 100: CIM profiles to XML schema mapping*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 61970-2 and the following apply.

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

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

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

3.1
aggregate business information entity
ABIE
collection of related pieces of business information that together convey a distinct business meaning in a specific Business Context

Note 1 to entry   Expressed in modelling terms, this is the representation of an object class, independent of any specific business context.

[SOURCE: ISO/TS 15000-5:2014, 3.1]

3.2
aggregate core component
ACC
collection of related pieces of business information that together convey a distinct business meaning, independent of any specific Business Context

[SOURCE: ISO/TS 15000-5:2014, 3.2]

3.3
application program interface
API
set of public functions provided by an executable application component for use by other executable application components

3.4
assembly model
model that prepares information in a business context for assembly into electronic documents for data interchange

3.5
based on
IsBasedOn
use of an artefact that has been restricted according to the requirements of a specific business context

[SOURCE: IEC 62325-450:2013, 3.4]

3.6
business context
formal description of a specific business circumstance as identified by the values of a set of context categories, allowing different business circumstances to be uniquely distinguished

[SOURCE: UN/Cefact, Unified Context Methodology Technical Specification]

3.7
information model
representation of concepts, relationships, constraints, rules, and operations to specify data semantics for a chosen domain of discourse

Note 1 to entry It can provide shareable, stable, and organized structure of information requirements for the domain context.

3.8
market management system
MMS
computer system comprised of a software platform providing basic support services and a set of applications providing the functionality needed for the effective management of the electricity market

Note 1 to entry These software systems in an electricity market may include support for capacity allocation, scheduling energy, ancillary or other services, real-time operations and settlements.

3.9
message business information entity
MBIE
aggregation of a set of ABIEs that respects a define set of assembly rules

4 Document contextual model and message assembly model basic concepts

4.1 Overview

IEC 62325-450 defines a set of CIM profiles that follows a layered modelling framework as outlined in Figure 1 going from the common information model (CIM, IEC 61968-11, IEC 61970-301 and IEC 62325-301), to different regional contextual models and their subsequent contextualized documents for information exchange; the final step being the message specifications for information interchange.
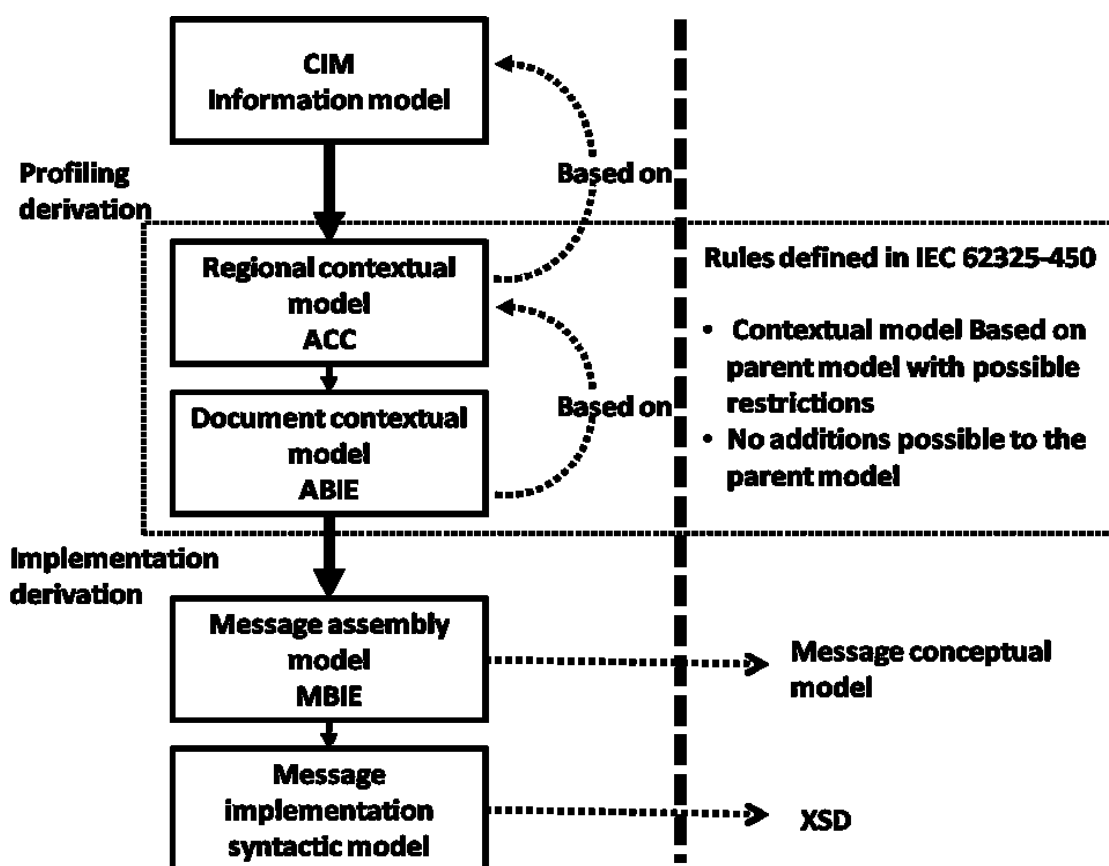
Figure 1 – IEC 62325-450 modelling framework

The regional contextual models are the basic core components that are necessary to build electronic documents for information interchange. This is defined in the European style market contextual model (IEC 62325-351). These core components are also termed aggregate core components (ACCs).

A document contextual model is based upon a specific business requirements specification and is constructed from the contextualisation of the ACCs that can be found in the European style market contextual model. The contextualised ACCs at this stage are terms aggregate business information entities (ABIEs) These ABIEs are the constructs that are assembled together into a specific electronic document to satisfy the information requirements outlined in the business requirements specification. The transformation from an ACC to an ABIE shall respect the rules defined in IEC 62325-450.

Once a document contextual model has been built that satisfactorily meets the business requirements, a message assembly model can be automatically generated from it.

XML schema may then be automatically generated from the message assembly model. If necessary, specific mapping can take place at this stage to transform the CIM class names and attribute names into legacy market names.

4.2 European style market package structure

Figure 2 describes the main package structure of the European style market profile (ESMP).
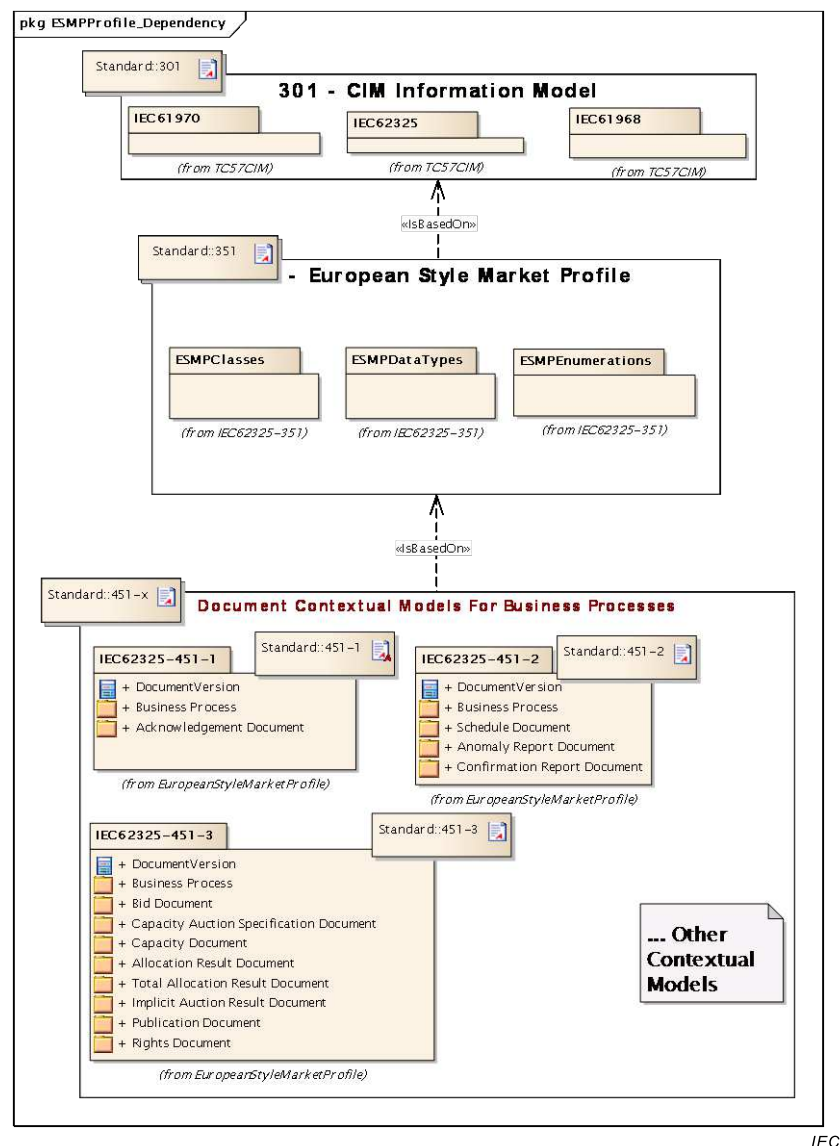
**Figure 2 – Overview of European style market
profile dependency**

For each business process, a business process package is described in an IEC 62325-451-x (x from 1 to n) standard. A business process package contains:

- The document contextual model (ABIE) and the automatically generated message assembly model (MBIE) for each electronic document required to enable the completion of the business process. Each document is a sub contextual model derived by restriction from the European style market profile.

- The XML schema of the business document that is automatically generated from the message assembly model.

The European style market profile (ESMP), as defined in IEC 62325-351, provides the core components permitted for use in an IEC 62325-451-x standard as all ABIEs shall be "based on" the IEC 62325-351 core components:

- ESMPClasses: Defining all the semi-contextual classes of the European style market profile derived by restriction from the CIM model.

- ESMPDataTypes: Defining all the core datatypes used within the ESMP classes.

All the core components that are used in every electronic document structure have been harmonized and centralized in the European style market profile. These core components are consequently the basic building blocks from which all electronic document ABIEs are derived.

4.3 From the European style market profile to the document contextual model

The document contextual model for a given business process is constructed by an information analyst who identifies all the information requirements necessary to satisfy the business process.

Once the information requirements have been identified the information analyst identifies the related ACCs that are available in the European style market profile and contextualises them to meet the information requirements. This contextualisation step creates a set of aggregate business information entities (ABIEs).

In a final step the information analyst assembles together into a specific document contextual model package the ABIEs to form a document model satisfying the business requirements.

4.4 From the document contextual model to the message assembly model

Once the document contextual model has been finalised, the message assembly model may be automatically generated.

All document contextual models share the same core components and core datatypes. These are defined in the European style market profile (IEC 62325-351) and are contextualised and refined in all document contextual models (IEC 62325-451-x series) respecting the rules as described in IEC 62325-450.

4.5 From the assembly model to the XML schema

The final modelling step applies a standardized set of criteria in order to generate a uniform XML schema from the assembly model. This transformation process respects the rules defined in IEC 62361-100.

5 The settlement and reconciliation business process

5.1 Balance responsible party and settlement

As indicated in the IEC 62325-301 "MarketRoleKind enumeration", in the European style electricity market, a balance responsible party could be defined as:

- A party that has a contract proving financial security and identifying balance responsibility with the imbalance settlement responsible for the market balance area entitling the party to operate in the market. This is the only role allowing a party to nominate energy on a wholesale level.

    NOTE   The meaning of the word "balance" in this context signifies that the quantity contracted to provide or to consume shall be equal to the quantity really provided or consumed.

The role of balance responsible party is linked to the role of balance supplier, i.e.

- A party that markets the difference between actual metered energy consumption and the energy bought with firm energy contracts by the party connected to the grid. In addition the balance supplier markets any difference with the firm energy contract (of the party connected to the grid) and the metered production. There is one balance supplier for each accounting point.

Figure 3 – Balance responsible party relations
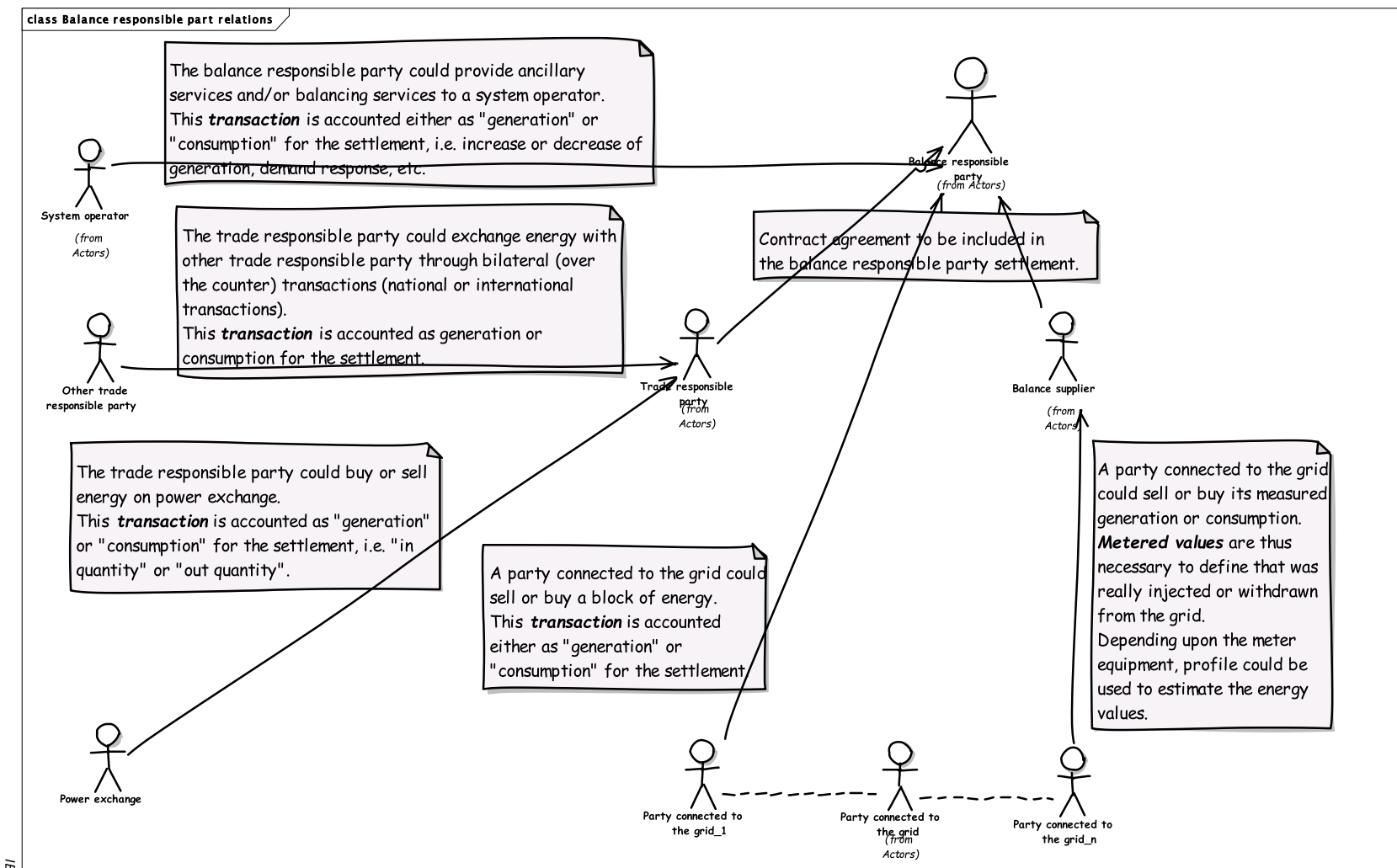
A party connected to the grid could be defined as:

- A party that contracts for the right to consume or produce electricity at an accounting point.

Figure 3 describes the different transactions of a balance responsible party which could have to be considered when carrying out a settlement or a reconciliation process:

The settlement process thus enables the reconciliation of all the "commercial transactions" with the actual measured values either from meters, estimated values or profiles.

The main purpose is thus to assess, after the fact, that the balance responsible party was balanced and if not to compute the deviations and to settle them.

5.2 Overall business context

Within an electricity market, actors are buying/selling energy between themselves as well as selling energy to end users or buying energy from generating units. These activities are carried out from the time of early planning and trading, until the intraday processes.

When the market business processes as well as the operational processes (real-time operation) are closed, then comes the time to settle or reconcile the market, i.e. to compute for each balance responsible party what he has injected in a market area and what he has withdrawn from this market area.

For proper operation of a European style electricity market, each balance responsible party shall be balanced, i.e. he should have the sufficient "generation" (physical inputs or buying transactions) to cover its "consumption" (physical outputs or selling transactions) at each time.

The settlement process is the basic process to compute an imbalance deviation based on commercial transactions and accounting energy values. It should be pointed out that the accounting energy values could be energy meter readings, estimated energy meter readings or profiles (derived from an index value and not based upon a load/generation curve).

Settlement and reconciliation processes are often carried out several times, i.e. typically there are one or more re runs of the processes based on more accurate accounting energy values. Typically, the reconciliation process is spread over the period until all metering values have been read.

Depending upon local regulation, additional information could be used to compute the kinds of imbalance, or deviation between the planned and the realized schedules.

It is not the purpose of this document to state how to collect the energy meter readings, the index values, etc. Only aggregated values per balance responsible party are used for the settlement process; the way to aggregate the data from the energy meter readings is not within the scope of this document.

5.3 Use cases

The settlement or reconciliation process takes place once the market and operation processes have been completed from the long term planning down to the intraday market and through the day ahead market as well as the real time operations of the bulk power system.

The settlement or reconciliation process is composed of three basic activities.

- The first activity is the computation and aggregation per balance responsible party of all agreed transactions including over the counter transactions, cross-border transactions, power exchange transactions, and balancing transactions.

- The second activity is the computation and aggregation per balance responsible party of all the accounting energy values, measured, estimated, or profiled for its physical injection or withdrawal.

- The third activity is the settlement or reconciliation of these values, i.e. computes the imbalances and establishes the imbalance settlement amounts.

Figure 4 describes the actors and main use cases of the settlement or reconciliation process.

The roles that take parts in the settlement or reconciliation process are, for example:

- Balance responsible party, who receives the settlement information.

- Nomination validator, who provides the cross-border transactions.

- Merit order list (MOL) responsible, who provides the balancing transactions.

- System operator, who provides the aggregated schedules, balancing and system frequency data.

- Metered data aggregator, who provides the aggregated metered information. The metered data aggregator may have local metered data aggregators that provide initial aggregated input for consolidation and validation before being sent to the imbalance settlement responsible.

- Imbalance settlement responsible, who establishes the imbalances (quantities and amounts).

- Billing agent, who invoices the balance responsible party.

The information necessary to run the settlement or reconciliation process for a given market area is the following:

- Aggregated executed schedules per balance responsible party that originate at the last stage of the scheduling process; these schedules could be day ahead, or intraday transactions and could originate from a nomination validator for cross border transactions.

- Aggregated metered data or estimated data per balance responsible party.

- Balancing and system frequency data that originate from the merit order list responsible and from ancillary services activation by the system operator.

- Settlement pricing information. This is outside the scope of this document and is dependent on local market rules.

uc Business Process

Nomination **validator** *(from Roles)*

Balance responsible **party** *(from Roles)*

Metered data **aggregator** *(from Roles)*

System operator *(from Roles)*

Confirm schedules

Compute aggregate executed schedules

Establish balancing data and system frequency **data**

Aggregate metered data or estimated data

Generate invoice

Provide information on **balancing**

Compute imbalances and **provide details information** (meter data, schedules, **etc.).**

Obtain settlement **prices**

MOL responsible *(from ENTSO-E roles)*

Imbalance settlement **responsible** *(from Roles)*

Billing agent *(from Roles)*

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Figure 4 – Settlement/reconciliation use case

The settlement or reconciliation cycle could be daily, weekly, monthly or yearly.

5.4   Process flow

The sequence diagram in Figure 5 outlines the information that is exchanged between the different actors in the settlement or reconciliation process.
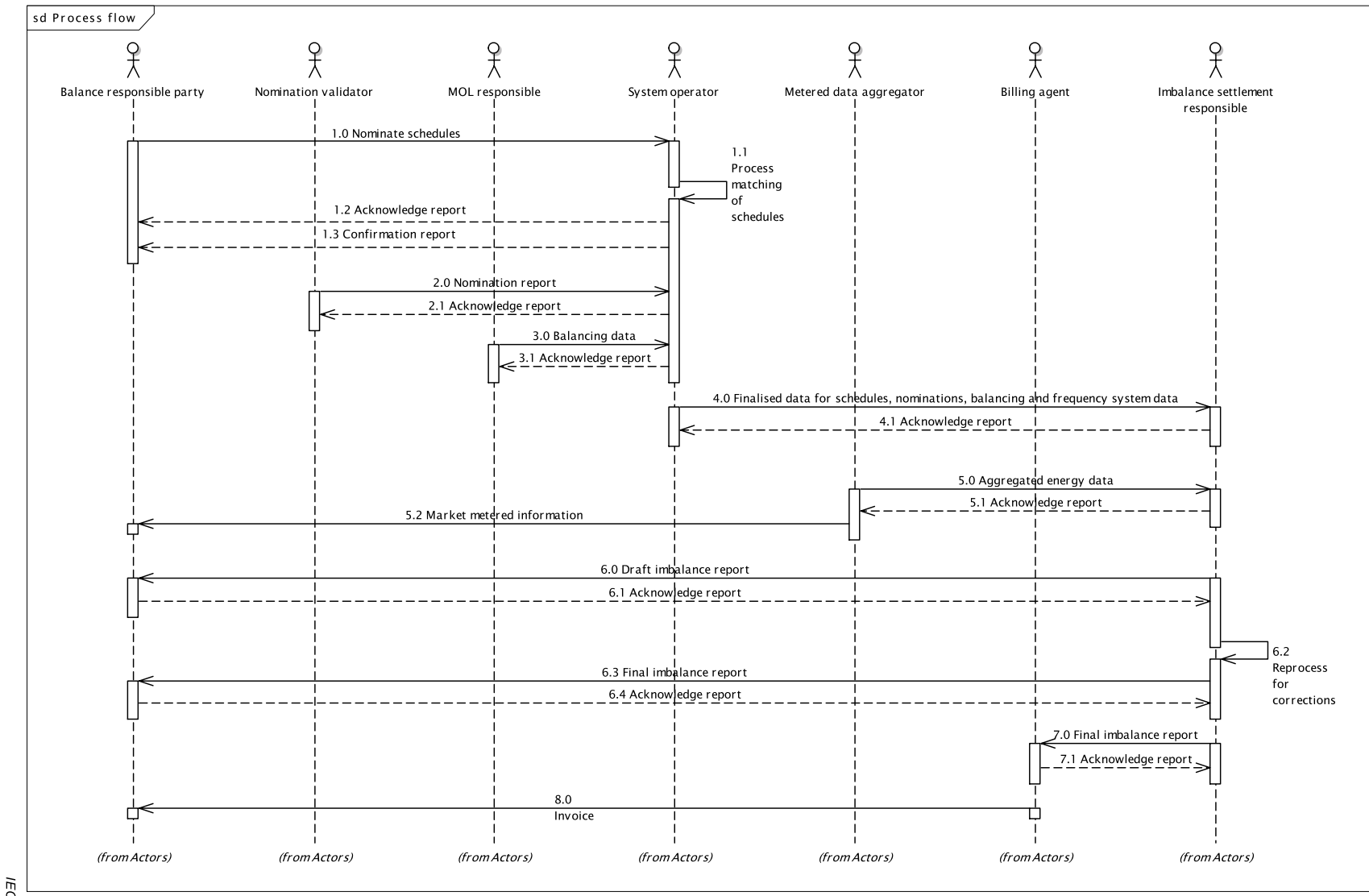
Figure 5 – Sequence diagram of the information flow

NOTE In some markets, bilateral trades between balance responsible parties are sent directly to the imbalance settlement responsible.

As concerns flow 4.0, the market operator may also send the trades on their platform to the imbalance settlement responsible.

The following flows are handled through electronic document described in other IEC documents, mainly IEC 62325-451-1 and IEC 62325-451-2.

- Flows 1.0 to 1.3 are related to over the counter transactions, i.e. mainly bilateral exchanges between balance responsible parties.

- Flows 2.0 and 2.1 are related to cross-border transactions.

- Flows 3.0 and 3.1 are related to the balancing data.

Once the system operator has received this information, aggregation per balance responsible party of the finalised data could be carried out.

Flow 4.0 could include several energy account reports for the various kind of information to be provided by the system operator to the imbalance settlement responsible; these data being the aggregated schedules, the balancing data, the frequency system data, etc.

In a similar way, the involved metered data aggregators provide for their respective areas the aggregated information per party, e.g. balance responsible party or balance supplier, flow 5.0, to the imbalance responsible party using the energy account report. This information may be also provided to each balance responsible party, flow 5.2, for verification.

Based on these inputs as well as pricing information (that may be provided by different actors depending upon the market design), the imbalance settlement responsible computes the draft imbalance report per balance responsible party. The draft imbalance report, flow 6, contains the values calculated by the imbalance settlement responsible on the basis of aggregated metered data, finalised schedules and regulation data.

The energy account report is the document to be used for the exchanges (flows 6.0, 6.3, and 7.0) together with the acknowledgement document.

Each balance responsible party could check its imbalance deviation and acknowledge or not the settlement.

There may be a number of iterations, loop 6.2, of the draft imbalance report up to the final settlement.

The final imbalance report is sent to each balance responsible party, flow 6.3, but also to the billing agent, flow 7.0. The docStatus attribute shall have the value "Final". The marketParticipant.mRID attribute in the TimeSeries class shall identify the party to be invoiced.

Then, the billing agent issues the invoice to the balance responsible party (flow 8.0).

The reconciliation process involves the metered data aggregators providing a new set of aggregated data when the accounting energy values are available in a better quality (profiling and reading of index). Thus the operations 5.0 to 7.0 could be iterated a number of times depending upon the local market rules.

5.5 Business rules for the settlement and reconciliation process

5.5.1 General

All the business rules described in IEC 62325-351 are also valid for this standard. Additional rules are provided hereafter.

As shown in Figure 5, an acknowledgement document, as defined in IEC 62325-451-1, should be generated either accepting the received document or rejecting it.

A received document for which a positive acknowledgement document was issued, and having a revisionNumber greater than the previous received document, shall completely replace it.

5.5.2   Attributes area_Domain.mRID and domain.mRID and quantity

The in_Quantity.quantity and out_Quantity.quantity attributes are related to the area_Domain.mRID.

The value of the in_Quantity.quantity attribute indicates the amount of product that enters the area identified by the area_Domain.mRID; the value of the out_Quantity.quantity attribute is the amount of product that leaves the area identified by the area_Domain.mRID. The value of each of these attributes shall be positive.

The area_Domain.mRID could be either the area of the settlement or a "subarea".

As an example, in a market area composed of several distribution areas each one with a different metered data aggregator, each metered data aggregator should provide for its own area_Domain.mRID the in_Quantity.quantity and out_Quantity.quantity of each balance responsible party active on its own area. In such a case, the domain_mRID should identify the market area.

5.5.3   Dependency matrix for type, processType and businessType

Table 1 provides the recommended categorization for the type of document, the process type and the associated business type.

Depending upon the implementation and the way the settlement is computed additional types of processes or businesses could be added.

Table 1 – Dependency table for type, processType and businessType

type (Document)	processType	businessType (TimeSeries)
A09 – Finalised schedule	A04 – System operation closure	A02 – Internal trade A03 – External trade explicit capacity A06 – External trade without explicit capacity A09 – Independent power producer
A10 – Regulation data report	A04 – System operation closure	A10 – Tertiary control A11 – Primary control A12 – Secondary control
A11 – Aggregated energy data report	A05 – Metered data aggregation	A13 – Load profile A14 – Aggregated energy data A15 – Losses A16 – Transits
A12 – Imbalance report	A06 – Imbalance settlement	A02 – Internal trade A03- External trade explicit capacity A06 – External trade without explicit capacity A09 – Independent power producer A10 – Tertiary control A11 – Primary control A12 – Secondary control A13 – Load profile A14 – Aggregated energy data A15 – Losses A16 – Transits A17 – Settlement deviation A18 – Technical constraint deviation A19 – Balance energy deviation A20 – Imbalance volume A21 – Inadvertent deviation A22 – Frequency control A23 – Balance management A24 – Total trade A30 – Internal inter-area trade

5.5.4 Dependency of attributes of the TimeSeries

There are four attributes of the TimeSeries class that are dependent. The conditions for use of these depending attributes are provided in Table 2.

Table 2 – Dependency table for TimeSeries attributes

Dependent attribute	Set of conditions to use the depending attribute
marketParticipant.mRID	The process_classificationType attribute shall be "Detail".
	The objectAggregation attribute shall be "Party".
marketAgreement.mRID	The type attribute shall have one of the following values "A09 – Finalised schedule", "A11 – Aggregated energy data", or "A12 – Imbalance report".
	The process.processType shall have one of the following values "A04 – System operation closure", "A05 – Metered data aggregation", or "A06 – Imbalance settlement".
	The process_classificationType attribute shall be "Detail".
	The businessType attribute shall have one of the following values "A02 – Internal trade", "A03 – External trade", "A06 –External trade without explicit capacity" "A09 – Independent power producer", "A10 – Tertiary control", or "A16 – Transits".
currency_Unit.name	The type attribute shall be "A12 – Imbalance report".
	The process.processType attribute shall be "A06 – Imbalance settlement".
	The businessType attribute shall have one of the following values "A17 – Settlement deviation", "A18 – technical constraint deviation", "A19 – Balance energy deviation", or "A20 – Imbalance volume".
marketEvaluationPoint.mRID	The type attribute shall have one of the following values "A11 – Aggregated energy data", or "A12 – Imbalance report".
	The process.processType shall have one of the following values "A05 – Metered data aggregation", or "A06 – Imbalance settlement".
	The process_classificationType attribute shall be "Detail".
	The objectAggregation attribute shall be "Party".

Depending upon the local market rules, additional values can be included in this set of conditions.

5.5.5   Rules governing the Point class

The Point class contains the relative position within a time interval period, as defined in the timeInterval attribute, the quantities associated with that position, in_Quantity.quantity and out_Quantity.quantity attributes, and eventually the total monetary amount of the cost of any eventual imbalance, price.amount.

5.5.6   Attribute price.amount

The price.amount attribute could have positive or negative values (see Table 17).

The price.amount attribute is dependent. The conditions to use these depending attributes are provided in Table 3.

Table 3 – Dependency table for price.amount attribute

Dependent attribute	Set of conditions to use the depending attribute
Price.amount	The type attribute shall have the following value "A12 – Imbalance report".
	The process.processType shall have the following value "A06 – Imbalance settlement".
	The businessType attribute shall have one of the following values "A17 – Settlement deviation", "A18 – Technical constraint deviation", "A19 – Balance energy deviation" or "A20 – Imbalance volume".

6 Contextual and assembly models

6.1 Energy account contextual model

6.1.1 Overview of the model

Figure 6 shows the energy account contextual model.
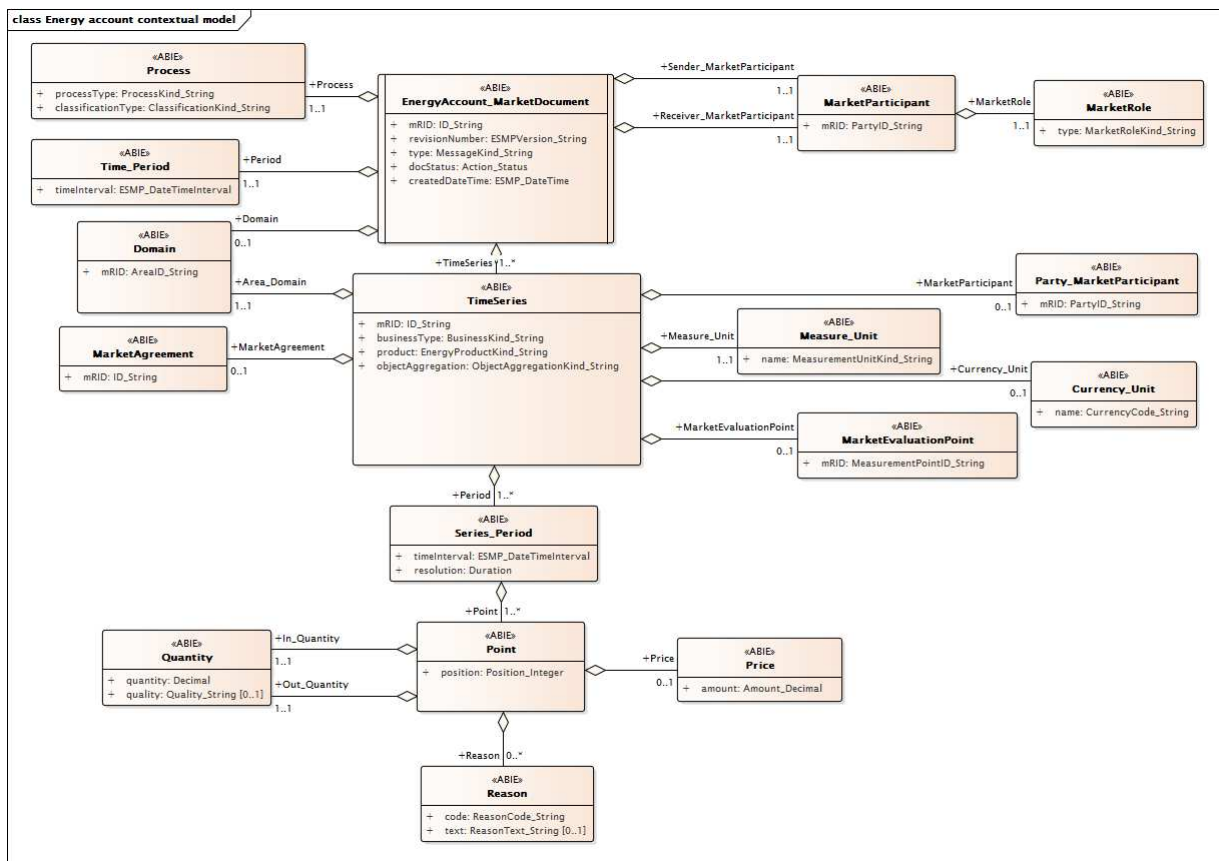
IEC

Figure 6 – Energy account contextual model

6.1.2 IsBasedOn relationships from the European style market profile

Table 4 shows the traceability dependency of the classes used in this package towards the upper level.

Table 4 – IsBasedOn dependency

Name	Complete IsBasedOn Path
Currency_Unit	TC57CIM::IEC62325::MarketManagement::Unit
Domain	TC57CIM::IEC62325::MarketManagement::Domain
EnergyAccount_MarketDocument	TC57CIM::IEC62325::MarketManagement::MarketDocument
MarketAgreement	TC57CIM::IEC62325::MarketManagement::MarketAgreement
MarketEvaluationPoint	TC57CIM::IEC62325::MarketManagement::MarketEvaluationPoint
MarketParticipant	TC57CIM::IEC62325::MarketCommon::MarketParticipant
MarketRole	TC57CIM::IEC62325::MarketCommon::MarketRole
Measure_Unit	TC57CIM::IEC62325::MarketManagement::Unit

Name	Complete IsBasedOn Path
Party_MarketParticipant	TC57CIM::IEC62325::MarketCommon::MarketParticipant
Point	TC57CIM::IEC62325::MarketManagement::Point
Price	TC57CIM::IEC62325::MarketManagement::Price
Process	TC57CIM::IEC62325::MarketManagement::Process
Quantity	TC57CIM::IEC62325::MarketManagement::Quantity
Reason	TC57CIM::IEC62325::MarketManagement::Reason
Series_Period	TC57CIM::IEC62325::MarketManagement::Period
Time_Period	TC57CIM::IEC62325::MarketManagement::Period
TimeSeries	TC57CIM::IEC62325::MarketManagement::TimeSeries

6.1.3   Detailed Energy account contextual model

6.1.3.1   EnergyAccount_MarketDocument root class

An energy account report for a given set of time series and a given accounting period Time_Period class, period.timeInterval attribute) shall have a unique identification assigned by the sender of the document for all transmissions to the receiver.

All additions, modifications, or suppressions for the time series and accounting period shall use the same identification.

An electronic document containing the information necessary to satisfy the requirements of a given business process.

Table 5 shows all attributes of EnergyAccount_MarketDocument.

**Table 5 – Attributes of Energy account contextual
model::EnergyAccount_MarketDocument**

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID ID_String	The unique identification of the document being exchanged within a business process flow.
1	[1..1]	revisionNumber ESMPVersion_String	The identification of the version that distinguishes one evolution of a document from another.
2	[1..1]	type MessageKind_String	The coded type of a document. The document type describes the principal characteristic of the document.
3	[1..1]	docStatus Action_Status	The identification of the condition or position of the document with regard to its standing.
7	[1..1]	createdDateTime ESMP_DateTime	The date and time of the creation of the document.

Table 6 shows all association ends of EnergyAccount_MarketDocument with other classes.

Table 6 – Association ends of Energy account contextual model::EnergyAccount_MarketDocument with other classes

Order	mult.	Class name / Role	Description
4	[1..1]	Process Process	Association Based On: ESMPClasses::MarketDocument.[] ESMPClasses::Process.Process[0..*]
5	[1..1]	MarketParticipant Sender_MarketParticipant	Document owner. Association Based On: ESMPClasses::MarketDocument.[] ESMPClasses::MarketParticipant.MarketParticipant[0..*]
6	[1..1]	MarketParticipant Receiver_MarketParticipant	Document recipient. Association Based On: ESMPClasses::MarketDocument.[] ESMPClasses::MarketParticipant.MarketParticipant[0..*]
8	[1..1]	Time_Period Period	This information provides the start and end date and time of the accounting period. The receiver shall completely reject documents with any time intervals outside the accounting period. Association Based On: ESMPClasses::MarketDocument.[] ESMPClasses::Time_Period.Period[0..*]
9	[0..1]	Domain Domain	The identification of the domain that is covered in the energy account report. This will frequently be the market balance area that is the subject of the report. However, other domains may also be used as defined by local market rules to enable the particular balancing markets to be identified. Association Based On: ESMPClasses::MarketDocument.[] ESMPClasses::Domain.Domain[0..1]
10	[1..*]	TimeSeries TimeSeries	Association Based On: ESMPClasses::MarketDocument.[] ESMPClasses::TimeSeries.TimeSeries[0..*]

6.1.3.2   Currency_Unit

The code specifying a monetary unit.

Table 7 shows all attributes of Currency_Unit.

Table 7 – Attributes of Energy account contextual model::Currency_Unit

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	name CurrencyCode_String	The identification of the formal code for a currency (ISO 4217).

6.1.3.3   Domain

A domain covering a number of related objects, such as market balance area, grid area, borders etc.

Table 8 shows all attributes of Domain.

Table 8 – Attributes of Energy account contextual model::Domain

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID AreaID_String	The unique identification of the domain.

6.1.3.4 MarketAgreement

A formal agreement between two parties defining the terms and conditions for a set of services. The specifics of the services are, in turn, defined via one or more service agreements.

Table 9 shows all attributes of MarketAgreement.

Table 9 – Attributes of Energy account contextual model::MarketAgreement

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID ID_String	The unique identification of the agreement.

6.1.3.5 MarketEvaluationPoint

The location where one or more products are measured. This may be a physical or virtual location.

Table 10 shows all attributes of MarketEvaluationPoint.

Table 10 – Attributes of Energy account contextual model::MarketEvaluationPoint

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID MeasurementPointID_String	A unique identification of the measurement point.

6.1.3.6 MarketParticipant

The identification of the party participating in energy market business processes.

Table 11 shows all attributes of MarketParticipant.

Table 11 – Attributes of Energy account contextual model::MarketParticipant

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID PartyID_String	The identification of a party in the energy market.

Table 12 shows all association ends of MarketParticipant with other classes.

**Table 12 – Association ends of Energy account contextual model::
MarketParticipant with other classes**

Order	mult.	Class name / Role	Description
1	[1..1]	MarketRole MarketRole	Association Based On: ESMPClasses::MarketParticipant.[] ESMPClasses::MarketRole.MarketRole[0..1]

6.1.3.7   MarketRole

The identification of the intended behaviour of a market participant played within a given business process.

Table 13 shows all attributes of MarketRole.

Table 13 – Attributes of Energy account contextual model::MarketRole

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	type MarketRoleKind_String	The identification of the role played by a market player.

6.1.3.8   Measure_Unit

A particular quantity, defined and adopted by convention, with which other quantities of the same kind are compared in order to express their magnitudes relative to that quantity.

Table 14 shows all attributes of Measure_Unit.

Table 14 – Attributes of Energy account contextual model::Measure_Unit

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	name MeasurementUnitKind_String	The identification of the formal code for a measurement unit (UN/ECE Recommendation 20).

6.1.3.9   Party_MarketParticipant

The identification of the party participating in energy market business processes.

Table 15 shows all attributes of Party_MarketParticipant.

**Table 15 – Attributes of Energy account contextual model::
Party_MarketParticipant**

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID PartyID_String	The identification of a party in the energy market.

6.1.3.10   Point

The identification of the values being addressed within a specific interval of time.

Table 16 shows all attributes of Point.

Table 16 – Attributes of Energy account contextual model::Point

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	position Position_Integer	A sequential value representing the relative position within a given time interval.

Table 17 shows all association ends of Point with other classes.

Table 17 – Association ends of Energy account contextual model ::Point with other classes

Order	mult.	Class name / Role	Description
1	[1..1]	Quantity In_Quantity	The quantity that is flowing into the Area_Domain.mRID. Association Based On: ESMPClasses::Quantity.Quantity[0..*] ----- ESMPClasses::Point.[]
2	[1..1]	Quantity Out_Quantity	The quantity that is going out of the Area_Domain.mRID. Association Based On: ESMPClasses::Quantity.Quantity[0..*] ----- ESMPClasses::Point.[]
3	[0..1]	Price Price	The amount due for the account interval in question. This information defines the settlement amount taking into consideration the in and out quantities and the pricing scheme based on local market rules. A negative value indicates that the settlement amount is due by the party in question (party to be debited). If the amount is positive it is due by the imbalance settlement responsible (party to be credited). Association Based On: ESMPClasses::Point.[] ----- ESMPClasses::Price.Price[0..*]
4	[0..*]	Reason Reason	Association Based On: ESMPClasses::Point.[] ----- ESMPClasses::Reason.Reason[0..*]

6.1.3.11   Price

The cost corresponding to a specific entity expressed in a currency.

Table 18 shows all attributes of Price.

Table 18 – Attributes of Energy account contextual model::Price

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	amount Amount_Decimal	A number of monetary units specified in a unit of currency.

6.1.3.12   Process

The formal identification of the business process in which a flow of information is exchanged.

Table 19 shows all attributes of Process.

Table 19 – Attributes of Energy account contextual model::Process

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	processType ProcessKind_String	The identification of the nature of process that the document addresses.
1	[1..1]	classificationType ClassificationKind_String	The classification mechanism used to group a set of objects together within a business process. The grouping may be of a detailed or a summary nature.

6.1.3.13   Quantity

Description of quantities needed in the data exchange.

The type of the quantity is described either by the role of the association or the quantityType attribute.

The quality attribute provides the information about the quality of the quantity (measured, estimated, etc.).

Table 20 shows all attributes of Quantity.

Table 20 – Attributes of Energy account contextual model::Quantity

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	quantity Decimal	The quantity value. The association role provides the information about what is expressed.
1	[0..1]	quality Quality_String	The description of the quality of the quantity.

6.1.3.14   Reason

The motivation of an act.

Table 21 shows all attributes of Reason.

Table 21 – Attributes of Energy account contextual model::Reason

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	code ReasonCode_String	The motivation of an act in coded form.
1	[0..1]	text ReasonText_String	The textual explanation corresponding to the reason code.

6.1.3.15 Series_Period

The identification of the period of time corresponding to a given time interval and resolution.

Table 22 shows all attributes of Series_Period.

Table 22 – Attributes of Energy account contextual model::Series_Period

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	timeInterval ESMP_DateTimeInterval	The start and end time of the period.
1	[1..1]	resolution Duration	The definition of the number of units of time that compose an individual step within a period.

Table 23 shows all association ends of Series_Period with other classes.

Table 23 – Association ends of Energy account contextual model:: Series_Period with other classes

Order	mult.	Class name / Role	Description
2	[1..*]	Point Point	Association Based On: ESMPClasses::Series_Period.[] ESMPClasses::Point.Point[1..*]

6.1.3.16 Time_Period

The identification of the accounting period.

The identification of a time interval.

Table 24 shows all attributes of Time_Period.

Table 24 – Attributes of Energy account contextual model::Time_Period

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	timeInterval ESMP_DateTimeInterval	The start and end date and time for a given interval.

6.1.3.17 TimeSeries

A set of time-ordered quantities being exchanged in relation to a product.

Table 25 shows all attributes of TimeSeries.

Table 25 – Attributes of Energy account contextual model::TimeSeries

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID ID_String	A unique identification of the time series.
1	[1..1]	businessType BusinessKind_String	The identification of the nature of the time series.
2	[1..1]	product EnergyProductKind_String	The identification of the nature of an energy product such as power, energy, reactive power, etc.
3	[1..1]	objectAggregation ObjectAggregationKind_String	The identification of the domain that is the common denominator used to aggregate a time series.

Table 26 shows all association ends of TimeSeries with other classes.

Table 26 – Association ends of Energy account contextual model:: TimeSeries with other classes

Order	mult.	Class name / Role	Description
4	[1..1]	Domain Area_Domain	The area of concern for the imbalance settlement responsible that the time series addresses. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::Domain.Domain[0..*]
5	[0..1]	Party_MarketParticipant MarketParticipant	The identification of the party of concern for the time series. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::MarketParticipant.MarketParticipant[0..*]
6	[0..1]	MarketAgreement MarketAgreement	This provides the identification of the agreement, such as a capacity agreement, that is relative to the time series. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::MarketAgreement.MarketAgreement[0..*]
7	[1..1]	Measure_Unit Measure_Unit	The unit if measurement is used for the quantities expressed within the time series. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::Measure_Unit.Measurement_Unit[0..*]
8	[0..1]	Currency_Unit Currency_Unit	The currency used for the monetary amount expressed within the time series. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::Currency_Unit.Currency_Unit[0..1]

Order	mult.	Class name / Role	Description
9	[0..1]	MarketEvaluationPoint MarketEvaluationPoint	The identification of the accounting point where the settlement information has been aggregated. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::MarketEvaluationPoint.MarketEvaluationPoint[0..1]
10	[1..*]	Series_Period Period	The receiver shall completely reject documents with any time intervals outside the accounting period. Association Based On: ESMPClasses::TimeSeries.[] ESMPClasses::Series_Period.Period[0..*]

6.2   Energy account assembly model

6.2.1   Overview of the model

Figure 7 shows the energy account assembly model.

class Energy account assembly model

«MBIE»
EnergyAccount_MarketDocument

+ mRID: ID_String
+ revisionNumber: ESMPVersion_String
+ type: MessageKind_String
+ docStatus: Action_Status
+ process.processType: ProcessKind_String
+ process.classificationType: ClassificationKind_String
+ sender_MarketParticipant.mRID: PartyID_String
+ sender_MarketParticipant.marketRole.type: MarketRoleKind_String
+ receiver_MarketParticipant.mRID: PartyID_String
+ receiver_MarketParticipant.marketRole.type: MarketRoleKind_String
+ createdDateTime: ESMP_DateTime
+ period.timeInterval: ESMP_DateTimeInterval
+ domain.mRID: AreaID_String [0..1]

+TimeSeries 1..*

«MBIE»
TimeSeries

+ mRID: ID_String
+ businessType: BusinessKind_String
+ product: EnergyProductKind_String
+ objectAggregation: ObjectAggregationKind_String
+ area_Domain.mRID: AreaID_String
+ marketParticipant.mRID: PartyID_String [0..1]
+ marketAgreement.mRID: ID_String [0..1]
+ measure_Unit.name: MeasurementUnitKind_String
+ currency_Unit.name: CurrencyCode_String [0..1]
+ marketEvaluationPoint.mRID: MeasurementPointID_String [0..1]

+Period 1..*

«MBIE»
Series_Period

+ timeInterval: ESMP_DateTimeInterval
+ resolution: Duration

+Point 1..*

«MBIE»
Point

+ position: Position_Integer
+ in_Quantity.quantity: Decimal
+ in_Quantity.quality: Quality_String [0..1]
+ out_Quantity.quantity: Decimal
+ out_Quantity.quality: Quality_String [0..1]
+ price.amount: Amount_Decimal [0..1]

+Reason 0..*

«MBIE»
Reason

+ code: ReasonCode_String
+ text: ReasonText_String [0..1]

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Figure 7 – Energy account assembly model

6.2.2   IsBasedOn relationships from the European style market profile

Table 27 shows the traceability dependency of the classes used in this package towards the upper level.

Table 27 – IsBasedOn dependency

Name	Complete IsBasedOn Path
EnergyAccount_MarketDocument	TC57CIM::IEC62325::MarketManagement::MarketDocument
Point	TC57CIM::IEC62325::MarketManagement::Point
Reason	TC57CIM::IEC62325::MarketManagement::Reason
Series_Period	TC57CIM::IEC62325::MarketManagement::Period
TimeSeries	TC57CIM::IEC62325::MarketManagement::TimeSeries

6.2.3   Detailed Energy account assembly model

6.2.3.1   EnergyAccount_MarketDocument root class

An energy account report for a given set of time series and a given accounting period Time_Period class, period.timeInterval attribute) shall have a unique identification assigned by the sender of the document for all transmissions to the receiver.

All additions, modifications, or suppressions for the time series and accounting period shall use the same identification.

An electronic document containing the information necessary to satisfy the requirements of a given business process.

Table 28 shows all attributes of EnergyAccount_MarketDocument.

**Table 28 – Attributes of Energy account assembly
model::EnergyAccount_MarketDocument**

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID ID_String	The unique identification of the document being exchanged within a business process flow.
1	[1..1]	revisionNumber ESMPVersion_String	The identification of the version that distinguishes one evolution of a document from another.
2	[1..1]	type MessageKind_String	The coded type of a document. The document type describes the principal characteristic of the document.
3	[1..1]	docStatus Action_Status	The identification of the condition or position of the document with regard to its standing.
4	[1..1]	process.processType ProcessKind_String	The identification of the nature of process that the document addresses.
5	[1..1]	process.classificationType ClassificationKind_String	The classification mechanism used to group a set of objects together within a business process. The grouping may be of a detailed or a summary nature.
6	[1..1]	sender_MarketParticipant.mRID PartyID_String	The identification of a party in the energy market. --- Document owner.

Order	mult.	Attribute name / Attribute type	Description
7	[1..1]	sender_MarketParticipant.marketRole.type MarketRoleKind_String	The identification of the role played by a market player. --- Document owner.
8	[1..1]	receiver_MarketParticipant.mRID PartyID_String	The identification of a party in the energy market. --- Document recipient.
9	[1..1]	receiver_MarketParticipant.marketRole.type MarketRoleKind_String	The identification of the role played by a market player. --- Document recipient.
10	[1..1]	createdDateTime ESMP_DateTime	The date and time of the creation of the document.
11	[1..1]	period.timeInterval ESMP_DateTimeInterval	The start and end date and time for a given interval. --- This information provides the start and end date and time of the accounting period. The receiver shall completely reject documents with any time intervals outside the accounting period.
12	[0..1]	domain.mRID AreaID_String	The unique identification of the domain. --- The identification of the domain that is covered in the energy account report. This will frequently be the market balance area that is the subject of the report. However, other domains may also be used as defined by local market rules to enable the particular balancing markets to be identified.

Table 29 shows all association ends of EnergyAccount_MarketDocument with other classes.

Table 29 – Association ends of Energy account assembly model::EnergyAccount_MarketDocument with other classes

Order	mult.	Class name / Role	Description
13	[1..*]	TimeSeries TimeSeries	Association Based On: Energy account contextual model::TimeSeries.TimeSeries[1..*] Energy account contextual model::EnergyAccount_MarketDocument.[]

6.2.3.2   Point

The identification of the values being addressed within a specific interval of time.

Table 30 shows all attributes of Point.

Table 30 – Attributes of Energy account assembly model::Point

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	position Position_Integer	A sequential value representing the relative position within a given time interval.
1	[1..1]	in_Quantity.quantity Decimal	The quantity value. The association role provides the information about what is expressed. --- The quantity that is flowing into the Area_Domain.mRID.
2	[0..1]	in_Quantity.quality Quality_String	The description of the quality of the quantity. --- The quantity that is flowing into the Area_Domain.mRID.

Order	mult.	Attribute name / Attribute type	Description
3	[1..1]	out_Quantity.quantity Decimal	The quantity value. The association role provides the information about what is expressed. --- The quantity that is going out of the Area_Domain.mRID.
4	[0..1]	out_Quantity.quality Quality_String	The description of the quality of the quantity. --- The quantity that is going out of the Area_Domain.mRID.
5	[0..1]	price.amount Amount_Decimal	A number of monetary units specified in a unit of currency. --- The amount due for the account interval in question. This information defines the settlement amount taking into consideration the in and out quantities and the pricing scheme based on local market rules. A negative value indicates that the settlement amount is due by the party in question (party to be debited). If the amount is positive it is due by the imbalance settlement responsible (party to be credited).

Table 31 shows all association ends of Point with other classes.

Table 31 – Association ends of Energy account assembly model:: Point with other classes

Order	mult.	Class name / Role	Description
6	[0..*]	Reason Reason	Association Based On: Energy account contextual model::Reason.Reason[0..*] Energy account contextual model::Point.[]

6.2.3.3   Reason

The motivation of an act.

Table 32 shows all attributes of Reason.

Table 32 – Attributes of Energy account assembly model::Reason

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	code ReasonCode_String	The motivation of an act in coded form.
1	[0..1]	text ReasonText_String	The textual explanation corresponding to the reason code.

6.2.3.4   Series_Period

The identification of the period of time corresponding to a given time interval and resolution.

Table 33 shows all attributes of Series_Period.

Table 33 – Attributes of Energy account assembly model::Series_Period

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	timeInterval ESMP_DateTimeInterval	The start and end time of the period.
1	[1..1]	resolution Duration	The definition of the number of units of time that compose an individual step within a period.

Table 34 shows all association ends of Series_Period with other classes.

Table 34 – Association ends of Energy account assembly model:: Series_Period with other classes

Order	mult.	Class name / Role	Description
2	[1..*]	Point Point	Association Based On: Energy account contextual model::Point.Point[1..*] Energy account contextual model::Series_Period.[]

6.2.3.5 TimeSeries

A set of time-ordered quantities being exchanged in relation to a product.

Table 35 shows all attributes of TimeSeries.

Table 35 – Attributes of Energy account assembly model::TimeSeries

Order	mult.	Attribute name / Attribute type	Description
0	[1..1]	mRID ID_String	A unique identification of the time series.
1	[1..1]	businessType BusinessKind_String	The identification of the nature of the time series.
2	[1..1]	product EnergyProductKind_String	The identification of the nature of an energy product such as power, energy, reactive power, etc.
3	[1..1]	objectAggregation ObjectAggregationKind_String	The identification of the domain that is the common denominator used to aggregate a time series.
4	[1..1]	area_Domain.mRID AreaID_String	The unique identification of the domain. --- The area of concern for the imbalance settlement responsible that the time series addresses.
5	[0..1]	marketParticipant.mRID PartyID_String	The identification of a party in the energy market. --- The identification of the party of concern for the time series.
6	[0..1]	marketAgreement.mRID ID_String	The unique identification of the agreement. --- This provides the identification of the agreement, such as a capacity agreement, that is relative to the time series.
7	[1..1]	measure_Unit.name MeasurementUnitKind_String	The identification of the formal code for a measurement unit (UN/ECE Recommendation 20). --- The unit if measurement is used for the quantities expressed within the time series.

Order	mult.	Attribute name / Attribute type	Description
8	[0..1]	currency_Unit.name CurrencyCode_String	The identification of the formal code for a currency (ISO 4217). --- The currency used for the monetary amount expressed within the time series.
9	[0..1]	marketEvaluationPoint.mRID MeasurementPointID_String	A unique identification of the measurement point. --- The identification of the accounting point where the settlement information has been aggregated.

Table 36 shows all association ends of TimeSeries with other classes.

**Table 36 – Association ends of Energy account assembly model::
TimeSeries with other classes**

Order	mult.	Class name / Role	Description
10	[1..*]	Series_Period Period	The receiver shall completely reject documents with any time intervals outside the accounting period. Association Based On: Energy account contextual model::Series_Period.Period[1..*] Energy account contextual model::TimeSeries.[]

6.2.4   Primitives

6.2.4.1   DateTime primitive

Date and time as "YYYY-MM-DDThh:mm:ss.sssZ", which conforms with ISO 8601 UTC time zone.

NOTE   The time within ESMP is expressed in UTC.

6.2.4.2   Decimal primitive

Decimal is the base-10 notational system for representing real numbers.

6.2.4.3   Duration primitive

Duration as "PnYnMnDTnHnMnS" which conforms to ISO 8601, where nY expresses a number of years, nM a number of months, nD a number of days. The letter T separates the date expression from the time expression and, after it, nH identifies a number of hours, nM a number of minutes and nS a number of seconds. The number of seconds could be expressed as a decimal number, but all other numbers are integers.

6.2.4.4   Integer primitive

An integer number. The range is unspecified and not limited.

6.2.4.5   String primitive

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

6.2.5   Datatypes

6.2.5.1   General

The list of datatypes used for the Energy account assembly model is as follows.

6.2.5.2 Action_Status compound

The coded identification of the status of an object.

Table 37 shows all attributes of Action_Status.

Table 37 – Attributes of ESMPDataTypes::Action_Status

mult.	Attribute name / Attribute type	Description
[1..1]	value Status_String	Main Core value Space.

6.2.5.3 ESMP_DateTimeInterval compound

This datatype enables to express the start date and time, and the end date and time of a time interval with a specific pattern. This pattern is the YYYY-MM-DDThh:mmZ.

Table 38 shows all attributes of ESMP_DateTimeInterval.

Table 38 – Attributes of ESMPDataTypes::ESMP_DateTimeInterval

mult.	Attribute name / Attribute type	Description
[1..1]	start YMDHM_DateTime	The start date and time of the interval with a minute resolution.
[1..1]	end YMDHM_DateTime	The end date and time of the interval with a minute resolution.

6.2.5.4 Amount_Decimal datatype

The coded identification of a monetary value.

Table 39 shows all attributes of Amount_Decimal.

Table 39 – Attributes of ESMPDataTypes::Amount_Decimal

mult.	Attribute name / Attribute type	Description
[1..1]	value Decimal	Main Core value Space.

Table 40 shows all restrictions applied to the attributes of Amount_Decimal.

Table 40 – Restrictions of attributes for ESMPDataTypes::Amount_Decimal

Name	Constraint	Type	Expression of constraint
value	totalDigits	OCL	inv: self->TotalDigits(17)

6.2.5.5 AreaID_String datatype

The coded identification of a domain, i.e. balance area, grid area, etc.

In the ESMP context, it is an authorized issuing office that provides an agreed identification coding scheme for domain identification.

Table 41 shows all attributes of AreaID_String.

Table 41 – Attributes of ESMPDataTypes::AreaID_String

mult.	Attribute name / Attribute type	Description
[1..1]	codingScheme CodingSchemeTypeList	DomainQualification.
[1..1]	value String	Main Core value Space.

Table 42 shows all restrictions applied to the attributes of AreaID_String.

Table 42 – Restrictions of attributes for ESMPDataTypes::AreaID_String

Name	Constraint	Type	Expression of constraint
value	maxLength	OCL	inv: self->MaxLength(18)

6.2.5.6 BusinessKind_String datatype

The coded identification of the business type.

Table 43 shows all attributes of BusinessKind_String.

Table 43 – Attributes of ESMPDataTypes::BusinessKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value BusinessTypeList	Main Core value Space.

6.2.5.7 ClassificationKind_String datatype

The coded identification of the classification mechanism used to group a set of objects together. The grouping may be of a detailed or a summary nature.

Table 44 shows all attributes of ClassificationKind_String.

Table 44 – Attributes of ESMPDataTypes::ClassificationKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value ClassificationTypeList	Main Core value Space.

6.2.5.8 CurrencyCode_String datatype

The coded identification of legal tender using ISO 4217 3 alpha codes.

Table 45 shows all attributes of CurrencyCode_String.

Table 45 – Attributes of ESMPDataTypes::CurrencyCode_String

mult.	Attribute name / Attribute type	Description
[1..1]	value CurrencyTypeList	Main Core value Space.

6.2.5.9   EnergyProductKind_String datatype

The identification of the nature of an energy product such as power, energy, reactive power, etc.

Table 46 shows all attributes of EnergyProductKind_String.

Table 46 – Attributes of ESMPDataTypes::EnergyProductKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value EnergyProductTypeList	Main Core value Space.

6.2.5.10   ESMP_DateTime datatype

In ESMP, the dateTime shall be expressed in UTC as YYYY-MM-DDThh:mm:ssZ.

Table 47 shows all attributes of ESMP_DateTime.

Table 47 – Attributes of ESMPDataTypes::ESMP_DateTime

mult.	Attribute name / Attribute type	Description
[1..1]	value DateTime	Main Core value Space.

Table 48 shows all restrictions applied to the attributes of ESMP_DateTime.

Table 48 – Restrictions of attributes for ESMPDataTypes::ESMP_DateTime

Name	Constraint	Type	Expression of constraint
value	pattern	OCL	inv: self->Pattern(((((([0-9]{4})[\-](0[13578]|1[02])[\-](0[1-9]|[12][0-9]|3[01]))|([0-9]{4})[\-]((0[469])|(11))[\-](0[1-9]|[12][0-9]|30))T((01][0-9]|2[0-3]):[0-5][0-9]:[0-5][0-9])Z)|((([13579][26][02468][048]|[13579][01345789](0)[48]|[13579][01345789][2468][048]|[02468][048][02468][048]|[02468][1235679](0)[48]|[02468][1235679][2468][048]|[0-9][0-9][13579][26])[\-](02)[\-](0[1-9]|1[0-9]|2[0-9])T((01][0-9]|2[0-3]):[0-5][0-9]:[0-5][0-9])Z)|((([13579][26][02468][1235679]|[13579][01345789](0)[01235679]|[13579][01345789][2468][1235679]|[02468][048][02468][1235679]|[02468][1235679](0)[01235679]|[02468][1235679][2468][1235679]|[0-9][0-9][13579][01345789])[\-](02)[\-](0[1-9]|1[0-9]|2[0-8])T((01][0-9]|2[0-3]):[0-5][0-9]:[0-5][0-9])Z))

6.2.5.11   ESMPVersion_String datatype

In ESMP, the coded value is restricted to digits.

A code that distinguishes one evolution of an identified object from another. Information about a specific object may be sent several times, each transmission being identified by a different version number.

Table 49 shows all attributes of ESMPVersion_String.

Table 49 – Attributes of ESMPDataTypes::ESMPVersion_String

mult.	Attribute name / Attribute type	Description
[1..1]	value String	Main Core value Space.

Table 50 shows all restrictions applied to the attributes of ESMPVersion_String.

Table 50 – Restrictions of attributes for ESMPDataTypes::ESMPVersion_String

Name	Constraint	Type	Expression of constraint
value	pattern	OCL	inv: self->Pattern([1-9]([0-9]{0,2})

6.2.5.12 ID_String datatype

A code to uniquely distinguish one occurrence of an entity from another.

In the ESMP context, the code is defined either by:

– an emitting company that provides an agreed identification unique within a business context such as capacity auction identification, market agreement identification, etc.
– a party (originator of the exchange) that provides a unique identification in the framework of a business exchange such as document identification, time series identification, bid identification, etc.

Table 51 shows all attributes of ID_String.

Table 51 – Attributes of ESMPDataTypes::ID_String

mult.	Attribute name / Attribute type	Description
[1..1]	value String	Main Core value Space.

Table 52 shows all restrictions applied to the attributes of ID_String.

Table 52 – Restrictions of attributes for ESMPDataTypes::ID_String

Name	Constraint	Type	Expression of constraint
value	maxLength	OCL	inv: self->MaxLength(35)

6.2.5.13 MarketRoleKind_String datatype

The identification of the role played by a party.

Table 53 shows all attributes of MarketRoleKind_String.

Table 53 – Attributes of ESMPDataTypes::MarketRoleKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value RoleTypeList	Main Core value Space.

6.2.5.14 MeasurementPointID_String datatype

The coded identification of a domain covering a number of related objects, such as metering point, accounting point, etc.

In the ESMP context, it is an authorized issuing office that provides an agreed identification coding scheme for measurement point identification.

Table 54 shows all attributes of MeasurementPointID_String.

Table 54 – Attributes of ESMPDataTypes::MeasurementPointID_String

mult.	Attribute name / Attribute type	Description
[1..1]	codingScheme CodingSchemeTypeList	DomainQualification.
[1..1]	value String	Main Core value Space.

Table 55 shows all restrictions applied to the attributes of MeasurementPointID_String.

Table 55 – Restrictions of attributes for ESMPDataTypes:: MeasurementPointID_String

Name	Constraint	Type	Expression of constraint
value	maxLength	OCL	inv: self->MaxLength(35)

6.2.5.15 MeasurementUnitKind_String datatype

The coded identification of a unit of measure that is applied to a quantity. The measurement units shall be in compliance with UN/ECE Recommendation 20.

Table 56 shows all attributes of MeasurementUnitKind_String.

Table 56 – Attributes of ESMPDataTypes::MeasurementUnitKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value UnitOfMeasureTypeList	Main Core value Space.

6.2.5.16 MessageKind_String datatype

The coded type of a document.

Table 57 shows all attributes of MessageKind_String.

Table 57 – Attributes of ESMPDataTypes::MessageKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value MessageTypeList	Main Core value Space.

6.2.5.17 ObjectAggregationKind_String datatype

The coded identification of the aggregation object.

Table 58 shows all attributes of ObjectAggregationKind_String.

Table 58 – Attributes of ESMPDataTypes::ObjectAggregationKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value ObjectAggregationTypeList	Main Core value Space.

6.2.5.18 PartyID_String datatype

The identification of an actor in the energy market.

In the ESMP context, it is an authorized issuing office that provides an agreed identification coding scheme for market participant identification.

Table 59 shows all attributes of PartyID_String.

Table 59 – Attributes of ESMPDataTypes::PartyID_String

mult.	Attribute name / Attribute type	Description
[1..1]	codingScheme CodingSchemeTypeList	DomainQualification.
[1..1]	value String	Main Core value Space.

Table 60 shows all restrictions applied to the attributes of PartyID_String.

Table 60 – Restrictions of attributes for ESMPDataTypes::PartyID_String

Name	Constraint	Type	Expression of constraint
value	maxLength	OCL	inv: self->MaxLength(16)

6.2.5.19   Position_Integer datatype

An integer value, this value is used as a sequential value representing the relative position of an entity within a space such as a time interval.

Table 61 shows all attributes of Position_Integer.

Table 61 – Attributes of ESMPDataTypes::Position_Integer

mult.	Attribute name / Attribute type	Description
[1..1]	value Integer	Main Core value Space.

Table 62 shows all restrictions applied to the attributes of Position_Integer.

Table 62 – Restrictions of attributes for ESMPDataTypes::Position_Integer

Name	Constraint	Type	Expression of constraint
value	maxInclusive	OCL	inv: self->maxInclusive(999999)
value	minInclusive	OCL	inv: self->minInclusive(1)

6.2.5.20   ProcessKind_String datatype

The coded identification of the nature of process.

Table 63 shows all attributes of ProcessKind_String.

Table 63 – Attributes of ESMPDataTypes::ProcessKind_String

mult.	Attribute name / Attribute type	Description
[1..1]	value ProcessTypeList	Main Core value Space.

6.2.5.21   Quality_String datatype

The coded identification of the quality of the information.

Table 64 shows all attributes of Quality_String.

Table 64 – Attributes of ESMPDataTypes::Quality_String

mult.	Attribute name / Attribute type	Description
[1..1]	value QualityTypeList	Main Core value Space.

6.2.5.22   ReasonCode_String datatype

The coded motivation of an act.

Table 65 shows all attributes of ReasonCode_String.

Table 65 – Attributes of ESMPDataTypes::ReasonCode_String

mult.	Attribute name / Attribute type	Description
[1..1]	value ReasonCodeTypeList	Main Core value Space.

6.2.5.23   ReasonText_String datatype

The textual explanation of an act as a string of characters.

Table 66 shows all attributes of ReasonText_String.

Table 66 – Attributes of ESMPDataTypes::ReasonText_String

mult.	Attribute name / Attribute type	Description
[1..1]	value String	Main Core value Space.

Table 67 shows all restrictions applied to the attributes of ReasonText_String.

Table 67 – Restrictions of attributes for ESMPDataTypes::ReasonText_String

Name	Constraint	Type	Expression of constraint
value	maxLength	OCL	inv: self->MaxLength(512)

6.2.5.24   Status_String datatype

The identification of the status of an object.

Table 68 shows all attributes of Status_String.

Table 68 – Attributes of ESMPDataTypes::Status_String

mult.	Attribute name / Attribute type	Description
[1..1]	value StatusTypeList	Main Core value Space.

6.2.5.25   YMDHM_DateTime datatype

In ESMP, the date and time is expressed as "YYYY-MM-DDThh:mmZ", which conforms with ISO 8601 UTC time zone. This date and time is without the seconds.

Table 69 shows all attributes of YMDHM_DateTime.

Table 69 – Attributes of ESMPDataTypes::YMDHM_DateTime

mult.	Attribute name / Attribute type	Description
[1..1]	value DateTime	The date and time as "YYYY-MM-DDThh:mmZ", which conforms with the ISO 8601 UTC time zone.

Table 70 shows all restrictions applied to the attributes of YMDHM_DateTime.

Table 70 – Restrictions of attributes for ESMPDataTypes::YMDHM_DateTime

Name	Constraint	Type	Expression of constraint
value	pattern	OCL	inv: self->Pattern(((([0-9]{4})[\-](0[13578]|1[02])[\-](0[1-9]|[12][0-9]|3[01])|([0-9]{4})[\-]((0[469])|(11))[\-](0[1-9]|[12][0-9]|30))T((01][0-9]|2[0-3]):[0-5][0-9])Z)|(([13579][26][02468][048]|[13579][01345789](0)[48]|[13579][01345789][2468][048]|[02468][048]|[02468][048]|[02468][1235679](0)[48]|[02468][1235679][2468][048]|[0-9][0-9][13579][26])[\-](02)[\-](0[1-9]|1[0-9]|2[0-9])T((01][0-9]|2[0-3]):[0-5][0-9])Z)|(([13579][26][02468][1235679]|[13579][01345789](0)[01235679]|[13579][01345789][2468][1235679]|[02468][048][02468][1235679]|[02468][1235679](0)[01235679]|[02468][1235679][2468][1235679]|[0-9][0-9][13579][01345789])[\-](02)[\-](0[1-9]|1[0-9]|2[0-8])T(((01][0-9]|2[0-3]):[0-5][0-9])Z))
value	TruncationOrReduced	INV	choice=gYearMonthDayHourMinute

6.2.6   Enumerations

The list of enumerations used for the Energy account assembly model is as follows:

- BusinessTypeList
- ClassificationTypeList
- CodingSchemeTypeList
- CurrencyTypeList
- EnergyProductTypeList
- MessageTypeList
- ObjectAggregationTypeList
- ProcessTypeList
- QualityTypeList
- ReasonCodeTypeList
- RoleTypeList
- StatusTypeList
- UnitOfMeasureTypeList

7   XML schema

7.1   XML schema URN namespace rules

In order to provide a generic and stable means of declaring a URN for the European style market profile XML schemas, the namespace will be composed in the following manner:

urn:iec62325.351:tc57wg16:\<process\>:\<document\>:\<version\>:\<release\>

where:

- iec62325.351 shall be the stem of all European style market profile XML schema namespaces.

- tc57wg16 identifies the organisation or group of organisations within the IEC that owns the object being referenced. In this example, this is Technical Committee 57, working group 16.

- <process> identifies the specific process where the object is situated, e.g. the part of the IEC 62325 standards in which the XML schema is defined, e.g. 451-1, 451-2, 451-3, etc.

- <document> identifies the electronic document schema.

- <version> identifies the version of the document schema.

- <release> identifies the release of the document schema.

Every XML schema representing an electronic document shall have a default namespace corresponding to the namespace that identifies the document and respects the above URI namespace construction.

Every XML schema representing an electronic document shall have a targetNamespace corresponding to the default namespace.

Every XML schema shall have an elementFormDefault as "qualified".

Every XML schema shall have an attributeFormDefault as "unqualified".

7.2   Code list URN namespace rules

In the case of the codelist library that shall be used for the European style market profile the URN shall be as follows **urn:entsoe.eu:wgedi:codelists**.

7.3   URI rules for model documentation

7.3.1   Datatype

All the datatypes are documented in IEC 62325-351.

In the case of the base datatype library that shall be used for the European style market profile, the URI shall use the sawsdl:modelReference as follows:

http://iec.ch/TC57/<CIM-version-year>/CIM-schema-<cimxx>#[datatype-name]

where:

- <CIM-version-year> is the year of the released CIM version used for generating market profile.

- <cimxx> is the CIM version name.

- [datatype-name] is the name of the CIM datatype or primitive.

Examples:

http://iec.ch/TC57/2012/CIM-schema-cim16#String

http://iec.ch/TC57/2012/CIM-schema-cim16#Money

7.3.2   Class

In the case of the base class library that shall be used for the European style market profile, the URI shall use the sawsdl:modelReference as follows:

http://iec.ch/TC57/<CIM-version-year>/CIM-schema-<cimxx>#[class-name]

where:

- <CIM-version-year> is the year of the released CIM version used for generating market profile

- <cimxx> is the CIM version name

- [class-name] is the name of the CIM class

Example: http://iec.ch/TC57/2012/CIM-schema-cim16#TimeSeries

7.3.3   Attribute

In the case of the base attribute library that shall be used for the European style market profile, the URI shall use the sawsdl:modelReference as follows:

http://iec.ch/TC57/<CIM-version-year>/CIM-schema-<cimxx>#[class-name].[attribute-name]

where:

- <CIM-version-year> is the year of the released CIM version used for generating market profile

- <cimxx> is the CIM version name

- [class-name] is the name of the CIM class

- [attribute-name] is the name of a class attribute

Example: http://iec.ch/TC57/2012/CIM-schema-cim16#TimeSeries.product

7.3.4   Association end role name

In the case of the base association library that shall be used for the European style market profile, the URI shall use the sawsdl:modelReference as follows:

http://iec.ch/TC57/<CIM-version-year>/CIM-schema-<cimxx>#[class-name].[association-end-role-name]

where:

- <CIM-version-year> is the year of the released CIM version used for generating market profile

- <cimxx> is the CIM version name

- [class-name] is the name of the CIM class

- [association-end-role-name]

Example: http://iec.ch/TC57/2012/CIM-schema-cim16#MarketDocument.TimeSeries
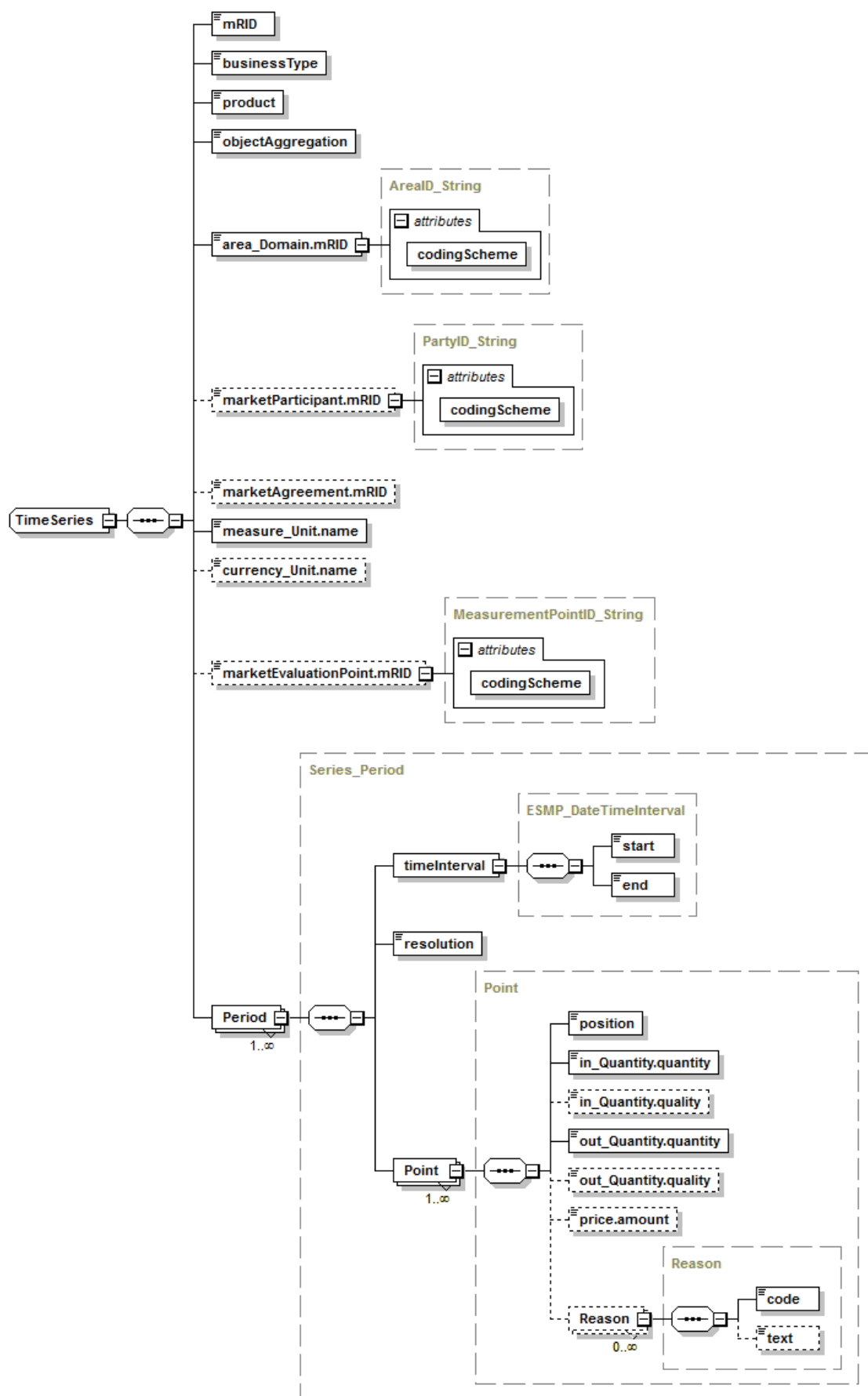
7.4   EnergyAccount_MarketDocument schema

7.4.1   Schema Structure

Figure 8 and Figure 9 provide the structure of the schema.
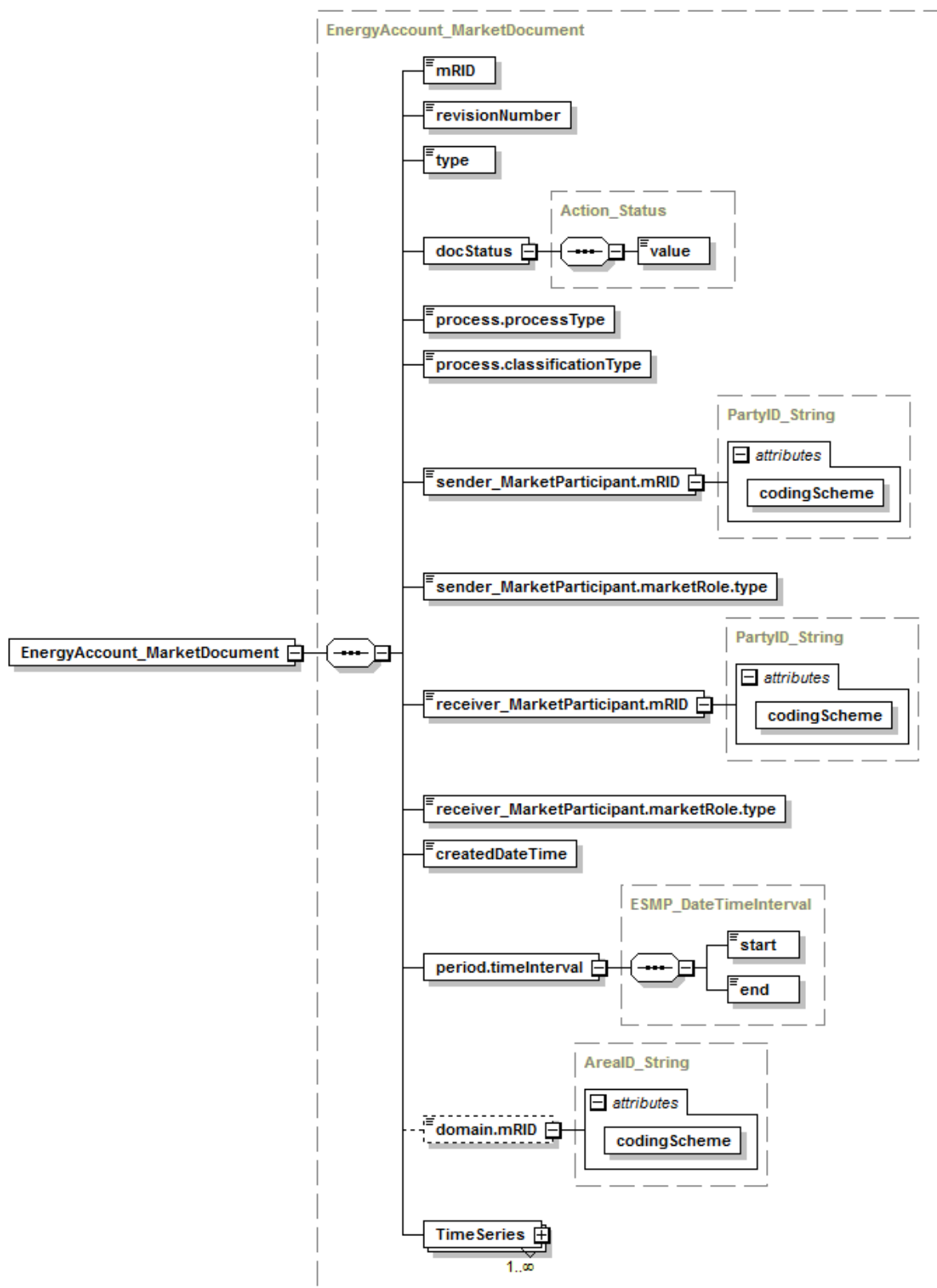
Figure 8 – EnergyAccount_MarketDocument XML Schema Structure 1/2

Figure 9 – EnergyAccount_MarketDocument XML Schema Structure 2/2

7.4.2   Schema description

```xml
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:cl="urn:entsoe.eu:wgedi:codelists"
xmlns:sawsdl="http://www.w3.org/ns/sawsdl" xmlns="urn:iec62325.351:tc57wg16:451-
4:energyaccountdocument:4:0" xmlns:cimp="http://www.iec.ch/cimprofile"
attributeFormDefault="unqualified" elementFormDefault="qualified"
targetNamespace="urn:iec62325.351:tc57wg16:451-4:energyaccountdocument:4:0"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:import schemaLocation="urn-entsoe-eu-wgedi-codelists.xsd"
namespace="urn:entsoe.eu:wgedi:codelists" />
  <xs:element name="EnergyAccount_MarketDocument" type="EnergyAccount_MarketDocument"
/>
  <xs:simpleType name="ID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#String">
    <xs:restriction base="xs:string">
      <xs:maxLength value="35" />
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="ESMPVersion_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="xs:string">
      <xs:pattern value="[1-9]([0-9]){0,2}" />
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="MessageKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:MessageTypeList" />
  </xs:simpleType>
  <xs:simpleType name="ProcessKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:ProcessTypeList" />
  </xs:simpleType>
  <xs:simpleType name="ClassificationKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:ClassificationTypeList" />
  </xs:simpleType>
  <xs:simpleType name="PartyID_String-base"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="xs:string">
      <xs:maxLength value="16" />
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="PartyID_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:simpleContent>
      <xs:extension base="PartyID_String-base">
        <xs:attribute name="codingScheme" type="cl:CodingSchemeTypeList"
use="required" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>
  <xs:simpleType name="MarketRoleKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:RoleTypeList" />
  </xs:simpleType>
  <xs:simpleType name="ESMP_DateTime"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#DateTime">
    <xs:restriction base="xs:dateTime">
      <xs:pattern value="(((([0-9]{4})[\-](0[13578]|1[02])[\-](0[1-9]|[12][0-
9]|3[01])|([0-9]{4})[\-]((0[469])|(11))[\-](0[1-9]|[12][0-9]|30))T(([01][0-9]|2[0-
3]):[0-5][0-9]:[0-5][0-
9])Z)|(([13579][26][02468][048]|[13579][01345789](0)[48]|[13579][01345789][2468][048]
|[02468][048][02468][048]|[02468][1235679](0)[48]|[02468][1235679][2468][048]|[0-
9][0-9][13579][26])[\-](02)[\-](0[1-9]|1[0-9]|2[0-9])T(([01][0-9]|2[0-3]):[0-5][0-
9]:[0-5][0-
9])Z)|((([13579][26][02468][1235679]|[13579][01345789](0)[01235679]|[13579][01345789][
2468][1235679]|[02468][048][02468][1235679]|[02468][1235679](0)[01235679]|[02468][123
```

```
5679][2468][1235679]|[0-9][0-9][13579][01345789])[\-](02)[\-](0[1-9]|1[0-9]|2[0-
8])T((([01][0-9]|2[0-3]):[0-5][0-9]:[0-5][0-9])Z)" />
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="AreaID_String-base"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="xs:string">
      <xs:maxLength value="18" />
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="AreaID_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:simpleContent>
      <xs:extension base="AreaID_String-base">
        <xs:attribute name="codingScheme" type="cl:CodingSchemeTypeList"
use="required" />
      </xs:extension>
    </xs:simpleContent>
  </xs:complexType>
  <xs:simpleType name="Status_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:StatusTypeList" />
  </xs:simpleType>
  <xs:complexType name="Action_Status"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Status">
    <xs:sequence>
      <xs:element minOccurs="1" maxOccurs="1" name="value" type="Status_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Status.value">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="YMDHM_DateTime"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#DateTime">
    <xs:restriction base="xs:string">
      <xs:pattern value="((([0-9]{4})[\-](0[13578]|1[02])[\-](0[1-9]|[12][0-
9]|3[01])|([0-9]{4})[\-]((0[469])|(11))[\-](0[1-9]|[12][0-9]|30))T(([01][0-9]|2[0-
3]):[0-5][0-
9])Z)|((([13579][26][02468][048]|[13579][01345789](0)[48]|[13579][01345789][2468][048]
|[02468][048][02468][048]|[02468][1235679](0)[48]|[02468][1235679][2468][048]|[0-
9][0-9][13579][26])[\-](02)[\-](0[1-9]|1[0-9]|2[0-9])T(([01][0-9]|2[0-3]):[0-5][0-
9])Z)|((([13579][26][02468][1235679]|[13579][01345789](0)[01235679]|[13579][01345789][
2468][1235679]|[02468][048][02468][1235679]|[02468][1235679](0)[01235679]|[02468][123
5679][2468][1235679]|[0-9][0-9][13579][01345789])[\-](02)[\-](0[1-9]|1[0-9]|2[0-
8])T((([01][0-9]|2[0-3]):[0-5][0-9])Z)" />
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="ESMP_DateTimeInterval"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#DateTimeInterval">
    <xs:sequence>
      <xs:element minOccurs="1" maxOccurs="1" name="start" type="YMDHM_DateTime"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#DateTimeInterval.start">
      </xs:element>
      <xs:element minOccurs="1" maxOccurs="1" name="end" type="YMDHM_DateTime"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#DateTimeInterval.end">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="EnergyAccount_MarketDocument"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#MarketDocument">
    <xs:sequence>
      <xs:element minOccurs="1" maxOccurs="1" name="mRID" type="ID_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
      </xs:element>
      <xs:element minOccurs="1" maxOccurs="1" name="revisionNumber"
type="ESMPVersion_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Document.revisionNumber">
      </xs:element>
```

```
        <xs:element minOccurs="1" maxOccurs="1" name="type" type="MessageKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Document.type">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="docStatus" type="Action_Status"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Document.docStatus">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="process.processType"
type="ProcessKind_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Process.processType">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="process.classificationType"
type="ClassificationKind_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#Process.classificationType">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="sender_MarketParticipant.mRID"
type="PartyID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1"
name="sender_MarketParticipant.marketRole.type" type="MarketRoleKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#MarketRole.type">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="receiver_MarketParticipant.mRID"
type="PartyID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1"
name="receiver_MarketParticipant.marketRole.type" type="MarketRoleKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#MarketRole.type">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="createdDateTime"
type="ESMP_DateTime" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Document.createdDateTime">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="1" name="period.timeInterval"
type="ESMP_DateTimeInterval" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#Period.timeInterval">
        </xs:element>
        <xs:element minOccurs="0" maxOccurs="1" name="domain.mRID" type="AreaID_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
        </xs:element>
        <xs:element minOccurs="1" maxOccurs="unbounded" name="TimeSeries"
type="TimeSeries" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#MarketDocument.TimeSeries">
        </xs:element>
     </xs:sequence>
   </xs:complexType>
   <xs:simpleType name="Position_Integer"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Integer">
     <xs:restriction base="xs:integer">
       <xs:maxInclusive value="999999" />
       <xs:minInclusive value="1" />
     </xs:restriction>
   </xs:simpleType>
   <xs:simpleType name="Quality_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
     <xs:restriction base="cl:QualityTypeList" />
   </xs:simpleType>
   <xs:simpleType name="Amount_Decimal"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Decimal">
     <xs:restriction base="xs:decimal">
       <xs:totalDigits value="17" />
     </xs:restriction>
   </xs:simpleType>
   <xs:complexType name="Point" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#Point">
     <xs:sequence>
       <xs:element minOccurs="1" maxOccurs="1" name="position" type="Position_Integer"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Point.position">
```

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      </xs:element>
      <xs:element minOccurs="1" maxOccurs="1" name="in_Quantity.quantity"
type="xs:decimal" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Quantity.quantity">
      </xs:element>
      <xs:element minOccurs="0" maxOccurs="1" name="in_Quantity.quality"
type="Quality_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Quantity.quality">
      </xs:element>
      <xs:element minOccurs="1" maxOccurs="1" name="out_Quantity.quantity"
type="xs:decimal" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Quantity.quantity">
      </xs:element>
      <xs:element minOccurs="0" maxOccurs="1" name="out_Quantity.quality"
type="Quality_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Quantity.quality">
      </xs:element>
      <xs:element minOccurs="0" maxOccurs="1" name="price.amount"
type="Amount_Decimal" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Price.amount">
      </xs:element>
      <xs:element minOccurs="0" maxOccurs="unbounded" name="Reason" type="Reason"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Point.Reason">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="ReasonCode_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:ReasonCodeTypeList" />
  </xs:simpleType>
  <xs:simpleType name="ReasonText_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="xs:string">
      <xs:maxLength value="512" />
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="Reason" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#Reason">
    <xs:sequence>
      <xs:element minOccurs="1" maxOccurs="1" name="code" type="ReasonCode_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Reason.code">
      </xs:element>
      <xs:element minOccurs="0" maxOccurs="1" name="text" type="ReasonText_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Reason.text">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="Series_Period"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Period">
    <xs:sequence>
      <xs:element minOccurs="1" maxOccurs="1" name="timeInterval"
type="ESMP_DateTimeInterval" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#Period.timeInterval">
      </xs:element>
      <xs:element minOccurs="1" maxOccurs="1" name="resolution" type="xs:duration"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Period.resolution">
      </xs:element>
      <xs:element minOccurs="1" maxOccurs="unbounded" name="Point" type="Point"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#Period.Point">
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="BusinessKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:BusinessTypeList" />
  </xs:simpleType>
  <xs:simpleType name="EnergyProductKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
    <xs:restriction base="cl:EnergyProductTypeList" />
  </xs:simpleType>
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    <xs:simpleType name="ObjectAggregationKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
        <xs:restriction base="cl:ObjectAggregationTypeList" />
    </xs:simpleType>
    <xs:simpleType name="MeasurementUnitKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
        <xs:restriction base="cl:UnitOfMeasureTypeList" />
    </xs:simpleType>
    <xs:simpleType name="CurrencyCode_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
        <xs:restriction base="cl:CurrencyTypeList" />
    </xs:simpleType>
    <xs:simpleType name="MeasurementPointID_String-base"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
        <xs:restriction base="xs:string">
          <xs:maxLength value="35" />
        </xs:restriction>
    </xs:simpleType>
    <xs:complexType name="MeasurementPointID_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#String">
        <xs:simpleContent>
          <xs:extension base="MeasurementPointID_String-base">
            <xs:attribute name="codingScheme" type="cl:CodingSchemeTypeList"
use="required" />
          </xs:extension>
        </xs:simpleContent>
    </xs:complexType>
    <xs:complexType name="TimeSeries"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-cim16#TimeSeries">
        <xs:sequence>
          <xs:element minOccurs="1" maxOccurs="1" name="mRID" type="ID_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
          </xs:element>
          <xs:element minOccurs="1" maxOccurs="1" name="businessType"
type="BusinessKind_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#TimeSeries.businessType">
          </xs:element>
          <xs:element minOccurs="1" maxOccurs="1" name="product"
type="EnergyProductKind_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#TimeSeries.product">
          </xs:element>
          <xs:element minOccurs="1" maxOccurs="1" name="objectAggregation"
type="ObjectAggregationKind_String"
sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#TimeSeries.objectAggregation">
          </xs:element>
          <xs:element minOccurs="1" maxOccurs="1" name="area_Domain.mRID"
type="AreaID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
          </xs:element>
          <xs:element minOccurs="0" maxOccurs="1" name="marketParticipant.mRID"
type="PartyID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
          </xs:element>
          <xs:element minOccurs="0" maxOccurs="1" name="marketAgreement.mRID"
type="ID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#IdentifiedObject.mRID">
          </xs:element>
          <xs:element minOccurs="1" maxOccurs="1" name="measure_Unit.name"
type="MeasurementUnitKind_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#Unit.name">
          </xs:element>
          <xs:element minOccurs="0" maxOccurs="1" name="currency_Unit.name"
type="CurrencyCode_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#Unit.name">
          </xs:element>
          <xs:element minOccurs="0" maxOccurs="1" name="marketEvaluationPoint.mRID"
type="MeasurementPointID_String" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-
schema-cim16#IdentifiedObject.mRID">
```

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        </xs:element>
        <xs:element minOccurs="1" maxOccurs="unbounded" name="Period"
type="Series_Period" sawsdl:modelReference="http://iec.ch/TC57/2013/CIM-schema-
cim16#TimeSeries.Period">
        </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:schema>
```

Bibliography

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

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

ISO/TS 15000-5:2005, *Electronic Business Extensible Markup Language (ebXML) – Part 5: ebXML Core Components Technical Specification, Version 2.01 (ebCCTS)*

UN/ECE Recommendation 20, *Codes for units of measure used in international trade*

UN/CEFACT, *Unified Context Methodology Technical Specification*

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