



European Network of  
Transmission System Operators  
for Electricity

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# COMMON INFORMATION MODEL (CIM) – MODEL EXCHANGE PROFILE

## SECOND EDITION

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31 JULY 2011

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DRAFT VERSION 21 - POST-IOP VERSION

## FOREWORD

This document is a draft version of the second edition of the European Network of Transmission System Operators for Electricity (ENTSO-E) Common Information Model (CIM) based data exchange format. The profile is an extension and correction of the first edition of the ENTSO-E CIM profile, which has been issued on 10 May 2009.

This document describes the second edition of the ENTSO-E CIM profile that is to be tested in the ENTSO-E interoperability test “CIM for System Development and Operations 2011”. Chapter 4 of the profile document references HTML profile documents that have been created after the IOP taking into account all profile related issues identified during the IOP.

In accordance with the roadmap of future updates of the CIM/XML based data exchange format, which was approved by ENTSO-E in 2009, decisions by ENTSO-E System Development Committee and System Operations Committee are required in order to approve this edition of the ENTSO-E Profile.

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## Abbreviations

IEC	The International Electrotechnical Commission, headquartered in Geneva.
TSO	Transmission System Operator
ENTSO-E	European Network of Transmission System Operators for Electricity. ENTSO-E has 41 TSO members.
MRID	CIM Master Resource Identifier
UCTE DEF	UCTE ASCII Data Exchange Format
CIM	Common Information Model (electricity)
DACF	Day-Ahead Congestion Forecast
MAS	Model Authority Set

# 1 SCOPE

The ENTSO-E CIM Model Exchange Profile is an ENTSO-E standard that is based on the CIM standards produced by IEC TC57/WG13 and WG14.

The purpose of this standard is to define the interface between ENTSO-E members' software and to describe how the members that use software from different vendors, will exchange network modelling information as required by the ENTSO-E business processes.

This edition of the ENTSO-E CIM Model Exchange Profile is intended to meet the requirements for accurate modelling of the ENTSO-E area for power flow and short circuit applications and allows exchange of any diagram layouts including GIS data of a model. It also covers a part of the requirements for exchange of datasets for dynamic models by including CIM specifications related to the exchange of such data. Additional dynamics models will be included in the profile specification as soon as they are agreed among ENTSO-E, IEC, IEEE and vendors.

Data content included in this edition of the profile is an extension and correction of the previous version of the ENTSO-E CIM profile

## 2 BUSINESS PROCESSES

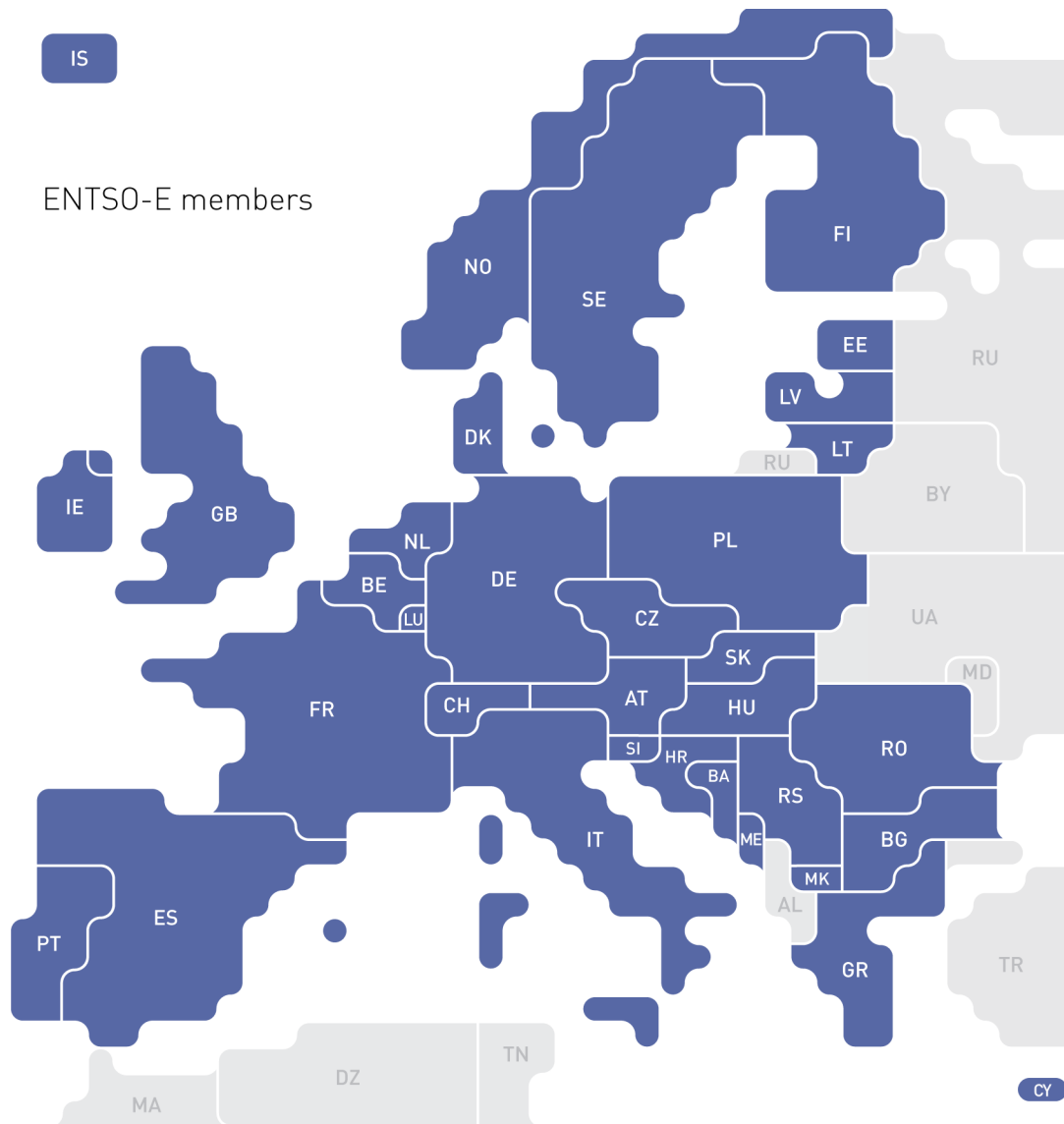
### 2.1 BACKGROUND

The European Network of Transmission System Operators for Electricity (ENTSO-E) speaks for all electric TSOs in the EU and others connected to their networks, with one voice for all regions, and for all their technical and market issues.

Important Europe-wide planning and operations roles are assigned to ENTSO-E in new European legislation: The Regulation on cross-border exchanges of electricity that is a part of the European Union 3rd Energy Package legislation adopted by the European Parliament in 2009 establishes the ENTSO for Electricity in order to ensure optimal management of the electricity transmission network and to allow trading and supplying electricity across borders in the Community. The Regulation sees the need for increased cooperation and coordination among transmission system operators to create network codes (legally binding standards to be applied by TSOs and other parties) for providing and managing effective and transparent access to the transmission networks across borders, and to ensure coordinated and sufficiently forward looking planning and sound technical evolution of the transmission system in the Community, including the creation of interconnection capacities, with due regard to the environment.

In ENTSO-E the TSOs cooperate regionally and on the European scale, and through ENTSO-E they communicate their needs and positions on European and regional issues. ENTSO-E's activities are organized in the four Committees for System Development, System

Operations, Market and Research & Development, and are supported by a Legal & Regulatory Group ([www.entsoe.eu](http://www.entsoe.eu)).



The activities are focused on:

- reliable operation,
- optimal management,
- sound technical evolution of the European electricity grid,
- security of supply,
- meeting the needs of the Internal Energy Market and facilitating market integration,
- network development statements,

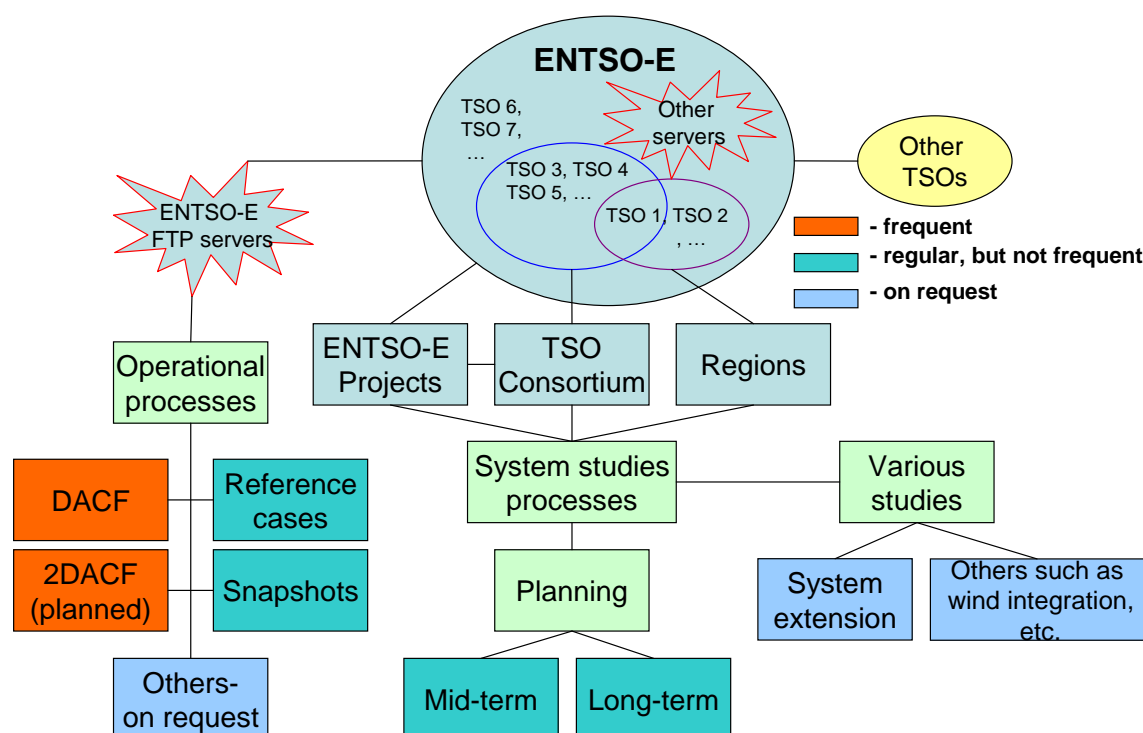
- network codes,
- promotion of relevant R&D and the public acceptability of transmission infrastructure,
- consultation with stakeholders and positions towards energy policy issue.

System Operations and System Development (planning) processes within ENTSO-E depend heavily on network analysis of the interconnection. The accuracy of such analysis depends in turn on accurate network models, which, as a general rule, must extend beyond the territory of any individual member TSO. In some cases, these models will need to cover the entire pan-European power system – in others only the immediate neighbourhood of a TSO. ENTSO-E is responsible for issuing of Ten-Year Network Development Plan that requires detailed and accurate modelling of the pan-European power system. Therefore:

- TSOs must be able to obtain models of one another's territory;
- TSO models must be able to be assembled into complete analytical models by processes that are cost-effective to implement and maintain, and are not error prone.

The ENTSO-E situation is not unique. There are many synchronous interconnections worldwide and they all have similar requirements. Because of this, IEC TC57/WG13 has developed standards covering model exchange based on IEC CIM standard data modelling.

The picture below describes how exchanges occur in ENTSO-E business processes.



All studies and data manipulation occur at one of the TSOs (or ENTSO-E body, TSO consortium, Regions – Regional Groups, etc.). In the most cases, the ENTSO-E server is simply a common server for file exchanges.

**TSO Model Management at a TSO may simply be a file management system for cases, but may also be a more sophisticated model management database application that allows:**

- **Exploration of cases.**
- **Modification of case data – especially of the TSO internal system (with change management and other aids).**
- **Mixing and matching of file components to build new cases.**

Applications of any TSO provide analytical functionalities that generate solved cases for various kinds of analytical studies. If those cases are to be shared, they must be generated in the standard ENTSO-E CIM Profile.

## **2.2 DATA EXCHANGE PROCESSES**

The business processes supported by CIM based file exchanges fall into two major categories:

- System Operations process;
- System Development (planning) process.

### **2.2.1 DAY-AHEAD CONGESTION FORECAST**

Day Ahead Congestion Forecast (DACF) process is a daily analytical operational process that is currently applied in the ENTSO-E Regional Group Continental Europe. In this process,

- Each TSO prepares a power flow case covering exactly its own territory representing each hour of the following day (based on day-ahead market outcomes). These cases are transferred to a central server.
- The full set of submitted cases may be checked for mutual compatibility.
- Once all cases are submitted, each TSO downloads from the central server the cases posted by their neighbouring TSOs. These are combined with their own models to form a set of study models on which they can analyse the congestion in their region for the next day.
- Congestion result cases may be exchanged among TSOs, as the situation warrants.

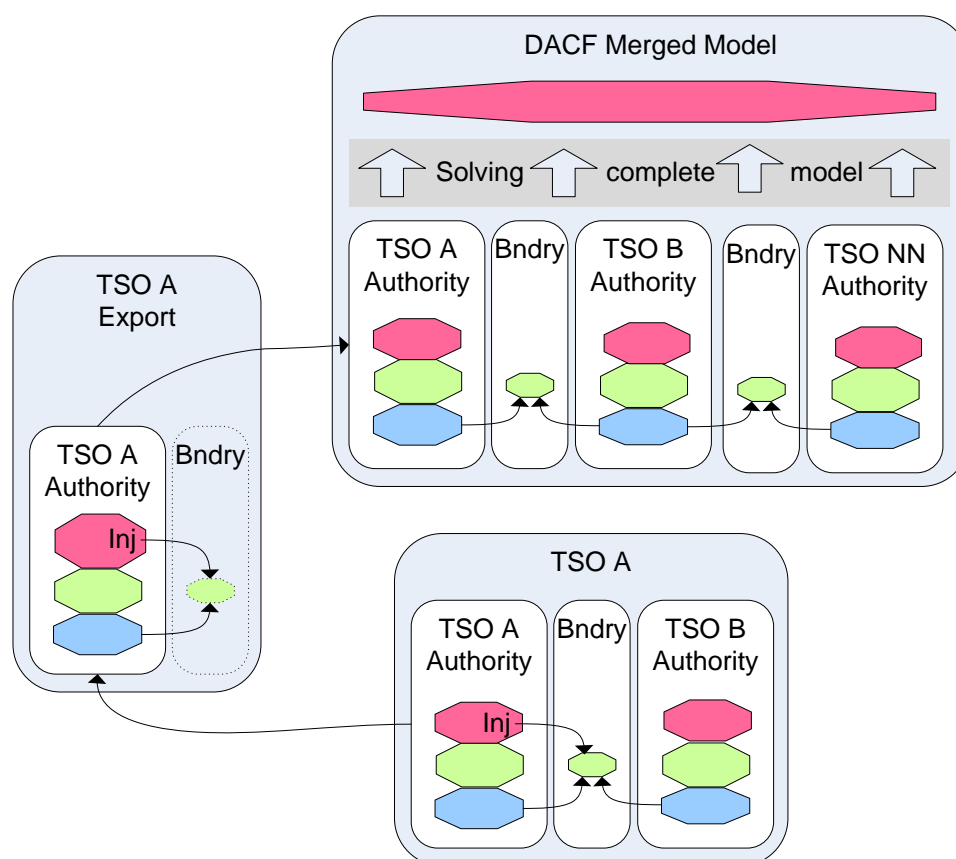
This work is carried out primarily with planning tools running bus-branch models (although an obvious possible variation on the process would be to generate cases with EMS tools).

Even though the DACF process is not a real-time process like state estimation, it is quite similar in that a sequence of cases is produced representing periodic intervals. The solution values will change at each case, but the network model will change rarely and the topology



will change occasionally. Conserving file size is a concern, and that concern is addressed if the standard allows the network model and topology to be exchanged incrementally.

Unlike the state estimator scenarios, which feature complete transfer of a solution, the DACF involves a lot of model assembling work and extracting of pieces of solutions. In the Figure below, TSO A runs power flows to develop a picture of its territory for the following day. This would be done with models that include representations of neighbouring TSOs. They must post, however, only the part of the model representing their own territory, and this must be a stand-alone solved power flow. In the ENTSO-E, boundaries between TSOs are, by agreement, always at the mid-point of tie-lines, and single TSO cases are formed with equivalent injections at each tie-line mid-point. At the central site, or at any TSO, submitted internal cases must be able to be reliably and automatically re-combined to form models with coverage appropriate to whatever task is at hand [2].



## 2.2.2 SYSTEM DEVELOPMENT PROCESS (PLANNING)

There are many synchronous interconnections worldwide that require cooperative construction of future models by its members in order to support planning of the interconnection. Typically, “base cases” are constructed representing future time frames by combining submittals from each interconnection member, a process that closely resembles operational process described above. Instead of day-ahead, a planning case may represent

years ahead; instead of daily update, a planning case must be reconstructed as plans change; instead of a known functioning power system, a planning case is not real yet. But in terms of process and in terms of data requirements, the assembly of base cases for planning is the same as above, and it is the objective of this profile to support both construction of base cases and the exchange of solution cases that necessarily occurs among members during the analysis based on these cases.

In ENTSO-E system development process requires accurate models for preparation of ENTSO-E Ten-Year Network Development Plan, executing various studies related to system development as well as system extensions studies (e.g. interconnection of additional power systems to the ENTSO-E synchronous areas). These models comprise regularly collected national models as well as assembled pan-European network models or other regional models for medium and long term time horizons. Due to the variety of system studies, responsibility for assembling the models is shared between different ENTSO-E bodies.

## 2.3 CIM MODEL EXCHANGE PROCESS

CIM model exchange process that serves ENTSO-E business processes covers the following basic types of exchanges:

- ENTSO-E boundary set.
- Exchanging a power system model that represents a TSO internal system at a point in time.
- Exchanging complete model for a particular ENTSO-E study.

Note that each power system model in CIM normally consists of multiple datasets (files) as defined in IEC CIM Standards [1, 2, 3, 5, 6, 7] and further specified in this document.

### 2.3.1 ENTSO-E BOUNDARY SET

The ENTSO-E boundary set is necessary to assemble a pan-European power system model or a regional model that consist of multiple TSO models. It contains information for ENTSO-E boundary nodes so called X-nodes (placed at the electrical mid-points of tie-lines). Additional regional boundary files can be created as a sub set of the ENTSO-E-wide boundary file in order to support regional initiatives. ENTSO-E Secretariat is responsible for updating of boundary files and ensures that they are available to all TSOs.

### 2.3.2 EXCHANGE OF AN INTERNAL TSO MODEL

A number of business processes require each TSO to publish models of its internal territory at a particular point in time. Some processes, like DACF, require a sequence of cases representing a sequence of points in time.

To describe its internal territory in a single stand-alone exchange, a TSO is treated as a single model authority set and must prepare the following files:

- An equipment file;
- A topology file;
- A state variables file;
- A dynamics file;
- A diagram layout file;
- A geographical (GIS) data file.

To update such a power system model in a sequence of cases the following approach is applied:

- The equipment file normally would not change in case of frequent data exchange process (DACF). It can be updated incrementally.
- The topology file is the result of network topology analysis. Depending of the data exchange process it could change or not frequently. Operational systems typically do not model TopologicalNodes explicitly. They are created on demand based on network topology analysis. In these cases, the topology file shall be exchanged as a whole, rather than incrementally. It can be updated incrementally for in case TopologicalNodes are kept persistent.
- The state variables file is always exchanged in full.
- The dynamics file normally would not change in case of frequent data exchange processes. It can be updated incrementally.
- The diagram layout file is exchanged in full, but it could be updated incrementally.
- The geographical data file is exchanged in full, but it could be updated incrementally.

### 2.3.3 EXCHANGE OF A COMPLETE POWER SYSTEM MODEL

Complete power system models generally include multiple TSO territory. To describe a complete power system model, the following files are required:

- Equipment files for all model authority sets;
- Topology files for all model authority sets;
- Dynamics files for all model authority sets;
- Diagram files for the complete power system model;
- Geographical files for all model authority sets;

- State variable file for the complete power system model. State injections of X-nodes are set to zero. Some state injections may differ from zero to represent the exchange with other areas not included in the assembled model;
- Boundary files (equipment and topology parts) that covers, but not limited to the area represented in the complete power system model.

## 3 PROFILE SPECIFICATIONS AND FUNCTIONALITIES

### 3.1 MAJOR UPDATES APPLIED IN THE 2ND EDITION OF THE PROFILE

The second edition of the ENTSO-E profile is a superset of the first edition and includes the following major updates:

- Equipment, topology and state variables profiles are modified to fit to the latest IEC CIM Standards (corresponding to CIM15). All classes, attributes and associations that are necessary to exchange a detail operational model and short-circuit data are marked with stereotype "Operation" and "ShortCircuit" respectively.
- Dynamics profile is added to the ENTSO-E profile.
- Diagram layout profile is added to the ENTSO-E profile.
- Geographical data profile is added to the ENTSO-E profile.

### 3.2 GENERAL PROFILE CONSTRAINTS

The following requirements are general in nature or involve multiple classes. Additional requirements are defined in the sections for the individual classes.

- Software developers should not count on the attribute "name" (inherited by many classes from the abstract class IdentifiedObject) to link the power system model.
- All objects must have a persistent and globally unique identifier (in most cases it is the MRID - see Section 3.4). In the ENTSO-E data exchange process this unique identifier will be exchanged as rdf:ID. The following rules apply to rdf:IDs [3]:
  - The rdf:ID defined in the data exchange process is the only globally unique and persistent identifier. A prefix could be added, if necessary, to ensure global uniqueness, but the rdf:ID including the prefix must be within the maximum character limit which is 60 characters.
  - The rdf:ID cannot begin with a number. An underscore "\_" should be added as the first character if necessary.

- If the data exchange process uses differential exchange rdf:IDs must be kept persistent. Otherwise all necessary for the process files are exchanged (e.g. equipment, topology, etc.).
- There is no requirement the rdf:IDs for state variable (Sv) classes to be kept persistent.
- There is no requirement the rdf:IDs DiagramObjectPoint and DiagramObject classes in the diagram layout profile to be kept persistent. The objects are identified by the diagram and the DiagramObject.IdentifiedObject.
- UTF-8 is the standard for file encoding. UTF-16 is not supported.
- Instance data to be exchanged must make use of the most detailed class possible within the profile.
- If an optional attribute does not exist in the imported file, it does not have to be exported in case exactly the same data set is exported, i.e. the tool is not obliged to provide this attribute automatically. This may not be valid if the user is able to process the data update the model and perform another export.
- Optional attributes and associations must be imported and exported if they are in the model file prior to import.
- If a power plant spans two substations, then the name of both substations should be the same.
- Breakers represent busbar couplers in a bus branch model exchange. In this case breakers are only included if they are to be retained. In SCADA/EMS models rules valid for detail operational model are applied as in IEC 61970-452.

### 3.3 INTERFACE FUNCTIONALITY

The following basic interface functionalities are sufficient to satisfy ENTSO-E network analyses requirements:

- TSO model export. A TSO uses this profile to export its internal network model in such a way that it is easily and unambiguously combined with other TSO internal models to make up complete models for analytical purposes.
- TSO model import. An analyst uses this profile to import exported TSO models in such a way that they are easily and unambiguously combined to make up complete models for analytical purposes.
- Complete power system model (solved power system model) exchange (model which contains more than one model authority sets). Any power system model created by one party, covering any territory, is sent to any other party using this profile. In such

an exchange, it is possible for the receiver to discern how the case modelling relates to TSO individual models.

ENTSO-E business processes are, of course, more complex than these operations, but what is important to notice is that all processes may be supported using only these basic kinds of interoperation.

### 3.4 MODEL AUTHORITY SETS (MAS)

The CIM concept of Model Authority Sets is applied to enable assembling or extraction of TSO models. Model Authority Sets allow an interconnection model to be divided into disjoint sets of objects, and that in turn allows different parties to take responsibility for different parts of the complete model.

- In any model exchange governed by the profile, each model object has an ENTSO-E MRID.
  - Across all ENTSO-E models, the model object instance that represents a given real world line, transformer, or whatever will always have the same MRID.
  - Within any one model, object MRIDs are unique, since the same element would not be represented twice.
  - By agreement, ENTSO-E MRIDs are the same as rdf:IDs.
- Each object instance is assigned to one and only one Model Authority Set. There are two types of Model Authority Sets:
  - Boundary sets contain boundary objects that mark the boundary between region models. Boundary sets are managed by one authority but defined by mutual agreement.
  - Regional sets contain regional model objects. Objects in regional sets have internal associations and may have associations to boundary objects, but regional objects may never have associations to objects in other regional sets. This allows regional modelling to be carried out independently of other regions.
- ENTSO-E has one boundary set.
  - The boundary set contains equipment and topology parts of the MAS. TopologicalNode objects (in case of bus branch model exchange) are located at the mid-points of the tie-lines between the TSO territories. Boundary set must correspond exactly to the common ENTSO-E X-nodes list used for all ENTSO-E data exchanges.
  - ENTSO-E (the Secretariat) is the Model Authority that manages the boundary set. By definition the boundary set is available to all ENTSO-E TSOs.

- Each TSO in ENTSO-E is a Model Authority and manages a Model Authority Set in its area of responsibility. The TSO as Model Authority is also responsible for assigning object MRIDs in its area set.
  - Note that in current practice, the territory that a TSO models may not be exactly the same as the territory it governs. In this standard, “TSO territory” always refers to the model responsibility territory.
- The IEC 61970-552 specification is still used to format a file, but the file only contains the objects in one Model Authority Set.

### 3.5 FILE HEADER

File header definition is specified in IEC 61970-552. ENTSO-E profile applies the same definition.

### 3.6 FILE BODY

The body of each file is formatted according to the IEC 61970-552 Specification – CIM Model Exchange Format.

Files may contain objects with associations to objects that will be packaged in a different file. This situation means that the file by itself is ‘incomplete’ – it may have dangling references and cannot be used except when combined with one or more other files as specified in the header dependencies. When this occurs, validation for completeness has to wait until all the parts are present.

### 3.7 ROLES AND MULTIPLICITY

In the profile UML, all associations are bidirectional but an association instance is specified only at one end in the XML. The profile documentation describes the association with the end used. It is legal to include both ends of an association in the XML, but only the end designated by the profile is required.

For example, the names “ConductingEquipment.Terminals” and “Terminal.ConductingEquipment” specify opposite ends of the association between the ConductingEquipment class and the Terminal class. By convention, in a one-to-many association, the association reference is included with the data of the “many side” class. In the example above, a ConductingEquipment can be associated with up to two Terminals, but a Terminal must be associated with one and only one ConductingEquipment. Consequently, the XML element corresponding to the ConductingEquipment class is not required to contain any “ConductingEquipment.Terminals” elements. However, the XML element corresponding to the Terminal class is expected to contain appropriate “Terminal.ConductingEquipment” elements.

## 3.8 FILE TYPES

This section defines the requirements for specific types of files important for correct partitioning of models. File types are in accordance with IEC standards [1, 2, 3, 5, 6, 7]. Detail specifications are provided in Section 4.

### 3.8.1 EQUIPMENT FILE

An equipment file describes the equipment in the TSO's internal territory. Each TSO is a separate model authority set. At this level (equipment) there are no connections to boundary model authority sets.

### 3.8.2 TOPOLOGY FILE

A topology file contains all topology objects for a TSO. They reference the corresponding equipment describing how equipment is electrically connected. Each model authority set is described in a separate file. TopologicalNodes (in case of bus branch model exchange) related to boundary set are not included.

- TopologicalNode objects
- Terminal objects
  - Expressed in 'rdf about' form because these objects are already defined in the Equipment file.
  - Connected attribute indicates whether the terminal end is connected or not. (i.e. Is the end open or closed?)
    - For an open retained breaker, both TopologicalTerminals are not connected.
  - Terminal – TopologicalNode associations.
    - External associations may exist to classes representing mid-points of tie lines (X-nodes) included in the boundary set.
    - If a terminal is not connected, it should still have an association to the TopologicalNode that it would close into.

### 3.8.3 STATE VARIABLES FILE

A TSO State Variable file contains all objects required to complete the specification of a steady-state solution.



### 3.8.4 BOUNDARY FILES

Boundary files (equipment and topology) transmit a boundary model authority set describing the X-nodes of the tie-lines between TSOs.

Boundary files are based on the equipment and the topology profiles for boundary. Boundary profiles are created to reflect the special rules that are required to exchange necessary information for the X-nodes. Detail information on the naming convention and the usage is provided in the html documents (see Chapter 4).

### 3.8.5 DYNAMICS FILE

Instance data in the Dynamics file represents parameters necessary to model dynamic behaviour of the power system [4], e.g. transient and subtransient reactances of synchronous machines, parameters of the control block diagrams of excitation systems, turbine, governors, power system stabilisers, etc.

### 3.8.6 DIAGRAM FILE

The Diagram file is constructed in accordance with IEC 61970-453 Diagram Layout Profile standard and contains data necessary for the model diagram.

### 3.8.7 GEOGRAPHICAL DATA FILE

The Geographical data file contains GIS data and it is constructed in accordance with IEC 61968-4, but limited to the classes that cover ENTSO-E needs.

## 3.9 FILE EXCHANGE

It is common that a given exchange consists of multiple files. All files in a given logical exchange must be zipped together. The tools use zip files directly when importing and exporting in order to minimize users' effort.

One zip file can only contain the following types of files:

- A single file of the following types: equipment (EQ), topology (TP), state variables (SV), dynamics (DY), diagram (DI), geographical (GE)
- combinations of equipment, topology, state variables, dynamics, diagram and geographical files which are allowed by the ENTSO-E profile and are related to one MAS only
- differential files of one MAS only when exchanging a TSO model
- equipment, topology, state variables, dynamics, diagram and geographical files per MAS (including boundary MAS) for an assembled model
- differential files per MAS (including boundary MAS) for an assembled model

**The zip file must not contain folders. It is only a container of \*.xml files.**

When exchanging full models, the following exchange dependencies should be considered for each individual model:

- If the equipment file is changed, all files (depending on the requirements of the exchange: equipment, topology, state variables dynamics, diagram and geographical files) must be sent as part of any exchange.
- If the topology file is changed, the topology file, the state variables file and diagram file (if required by the exchange) must be sent as part of any exchange.
- If only the state variables file is changed, only the state variables file must be sent as part of any exchange.
- If only the dynamics file is changed, only the dynamics file must be sent as part of any exchange.
- If only the diagram file is changed, only the diagram file must be sent as a part of any exchange.
- If only the geographical file is changed, only the geographical file must be sent as a part of any exchange.

It is not valid to exchange a topology file or a state variables file or a dynamics file or a diagram or a geographical file from one model and an equipment file from another model (or from an entity that has changed the equipment file) and attempt to assemble all files into one assembled model.

In case deference files are exchanged the same dependences are followed. The difference file (e.g. equipment, topology, dynamics) should refer to the base model that is subject to an update. Dependencies are listed in the file header of each file that is exchanged.

### **3.10 MODEL ASSEMBLING PROCESS**

A complete power system model for some purpose will normally be made up of information from multiple files (multiple regional, TSO, power system models). These files will be disjointed in terms of the XML content of their file bodies. In other words, among files that are to be combined, there is no overlap – each object, association or attribute appears in one and only one of the files being combined.

There are many possible ways of managing files and forming complete models from them. Part of the reason for the division into files is to create better flexibility in how complete models for different purposes are formed from base parts. Model management systems can be designed based around this capability that will be very useful. But there also needs to be a simple, easy-to-implement method of combining files, and that is the main focus of this section.

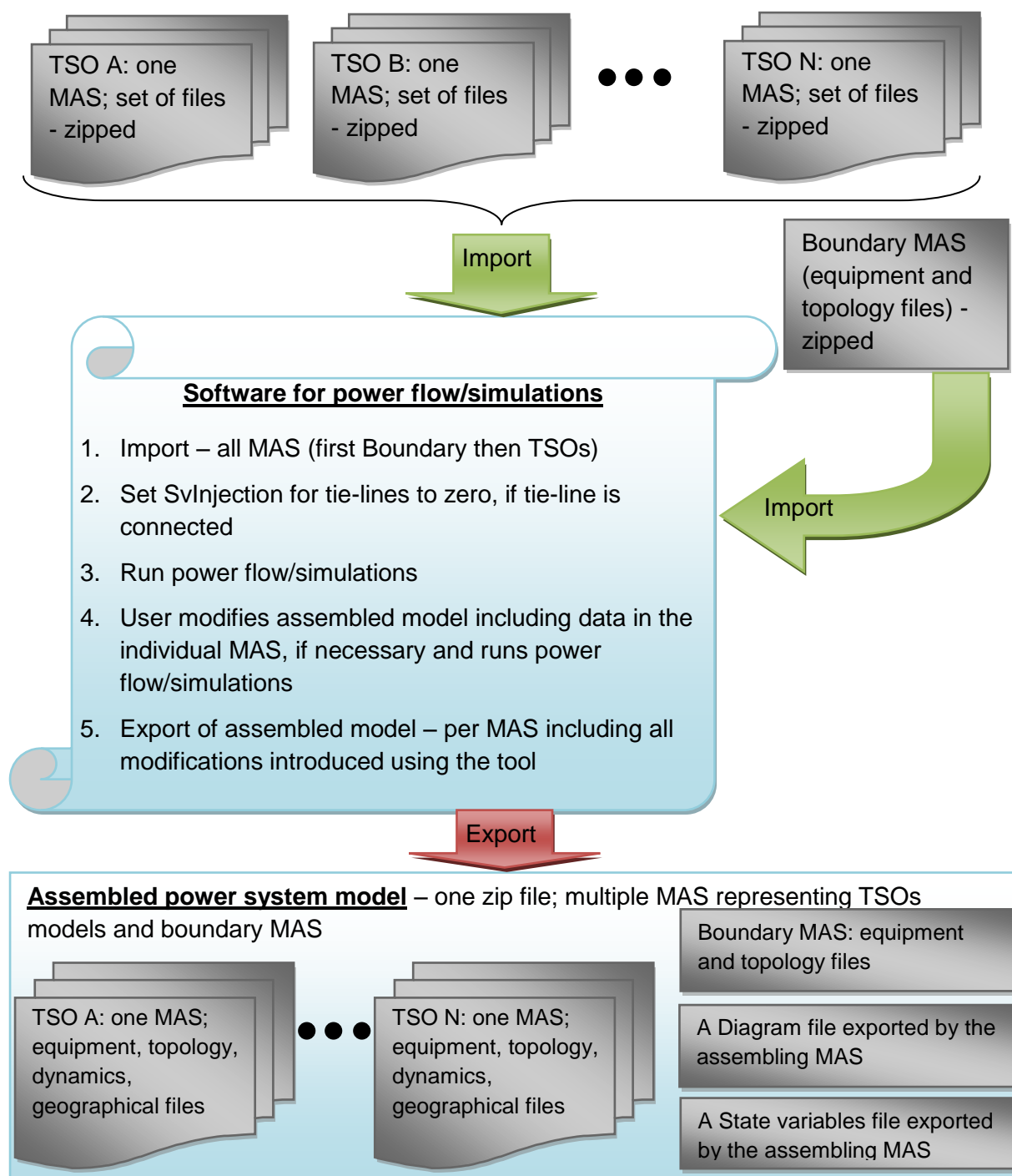
Model assembling procedure in ENTSO-E profile is based on Model Authority Sets concept. The procedure included the following steps:

- Prerequisites:
  - At least two models from TSOs are available and represented in two different MAS
  - Note that TSO model files on each side of a tie-line will have AC line segment terminals associated to the midpoint TopologicalNode (in case of bus branch model exchange), and there will also be SvInjection classes to represent the flow through the tie-line and SvVoltage classes to provide information on X-nodes voltages.
  - Boundary MAS is available
- Model management system (calculation tool/software) imports all MAS (full set of files for MAS for each TSO and Boundary MAS). Depending on the implementation of the import process Boundary MAS has to be imported first in case other MAS are imported subsequently.
- SvVoltage classes pointing to the Boundary set are set to the nominal voltage of the X-node with zero angles in case the values for SvInjection classes pointing to a X-node are different.
- Parameters of SvInjection classes are set to zero, if tie-line is connected. It is not necessary that the SvInjection is set to zero at the time of the import. Additional functions should be made available for users to cover all necessary use cases when dealing with TSO MAS and Boundary MAS.
- A power flow can be performed to obtain a solution for the assembled power system model

An update of the assembled power system model is performed by an update of the concerned MAS (i.e. replacing of MAS files). A power flow solution is necessary to update the common state variables file valid for the updated assembled model.

Exported assembled model contains multiple MAS. Exported multiple MAS include all changes that are introduced on the assembled model (changes done in the software which is used to assemble the model) per MAS. The following chart illustrates assembling process

The model authority set of the state variable file of the assembled model could be defined by the user who is exporting this model or automatically by the tool in case an appropriate logic is implemented.



### 3.11 XML MODEL VALIDITY

In order to be considered a valid model, a given combined set of XML must adhere to the following criteria:

- The file must be well-formed as defined by the Extensible Markup Language (XML) 1.0 (Second Edition) (<http://www.w3.org/TR/REC-xml>).
- The file must adhere to the rules set forth in the Simplified RDF Syntax for Power System Model Exchange as defined in IEC 61970-552.
- The file must contain CIM entities which are valid according to the CIM RDF Schema file.

## 3.12 PROFILE PROPERTIES

The profile is based upon a specific CIM UML version from EntsoeV19\_070711\_on\_iec61970cim15v31\_iec61968cim11v12\_iec62325cim01v07.eap. The UML namespace is <http://iec.ch/TC57/2010/CIM-schema-cim15#>. This namespace will appear in the rdf:IDs artifacts. Validating tools will likely assume an exact match with this namespace and the attributes used in the CIM/RDF/XML instance files (typically by defining the “cim” namespace the same as the above namespace string).

The namespaces for the profiles are the following:

- Equipment profile: <http://iec.ch/TC57/61970-452/Equipment/2>
- Topology profile: <http://iec.ch/TC57/61970-456/Topology/2>
- State variables profile: <http://iec.ch/TC57/61970-456/StateVariables/2>
- Dynamics profile: <http://iec.ch/TC57/61970-457/Dynamics/1>
- Diagram profile: <http://iec.ch/TC57/61970-453/DiagramLayout/1>
- Geographical profile: <http://iec.ch/TC57/2011/iec61968-13/CDPSM/Geographical>
- ENTSO-E extensions: <http://entsoe.eu/Secretariat/ProfileExtension/1>. The alias (prefix) is "entsoe:".
- Equipment Boundary profile: <http://iec.ch/TC57/61970-452/EquipmentBoundary/1>
- Topology Boundary profile: <http://iec.ch/TC57/61970-456/TopologyBoundary/1>
- File header (Model Definition - md): <http://iec.ch/TC57/61970-552/ModelDefinition/1>
- File header (Difference Model - dm): <http://iec.ch/TC57/61970-552/DifferenceModel/1>

Profile specific notes have been added to various classes and attributes to further clarify the profile and define specific rules.

### 3.12.1 DECLARING THE ENTSO-E EXTENSION URI AND THE CORRESPONDING ALIAS

The ENTSO-E extension URI and the corresponding alias, as defined in Section 3.12, shall be declared at the topmost element of your CIM/XML file along with CIM and other URI.

Example (URI of the ENTSO-E CIM extension and the alias):

```
<?xml version="1.0" encoding="utf-8"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:cim="http://iec.ch/TC57/2010/CIM-schema-cim15#"
  ....
```

```

xmlns:entsoe="http://entsoe.eu/Secretariat/ProfileExtension/1#">
....
</rdf:RDF>

```

### 3.12.2 USING EXTENSION URI ALIAS TO DECLARE THE EXTENDED DATA

In the example below the attribute `ACLineSegment.ShortCircuitEndTemperature` is declared as an extended attribute and prefixed with the extension alias “entsoe”.

Example (declaring an extended attribute):

```

<cim:ACLineSegment rdf:ID="_c1d5c0b88f8011e08e4d00247eb1f55e">
  <cim:IdentifiedObject.name>DFG-THY 1</cim:IdentifiedObject.name>
  <cim:ACLineSegment.bch>4.61157E-05</cim:ACLineSegment.bch>
  <cim:ACLineSegment.r>1.06601</cim:ACLineSegment.r>
  <cim:ACLineSegment.x>34.28535</cim:ACLineSegment.x>
  <entsoe:ACLineSegment.ShortCircuitEndTemperature>60</entsoe:ACLineSegment.ShortCircuitEndTemperature>
  <cim:Conductor.length>45</cim:Conductor.length>
  <cim:Equipment.aggregate>false</cim:Equipment.aggregate>
  <cim:ConductingEquipment.BaseVoltage
    rdf:resource="#_7891a026ba2c42098556665efd13ba94" />
</cim:ACLineSegment>

```

In the example below, an instance of the extended class is declared as extension. The extended class, i.e. `ExternalNetwork`, and the extended attribute `ExternalNetwork.ikSecond` must be prefixed with the extension alias “entsoe”.

Example (declaring an extended instance or object):

```

<entsoe:ExternalNetwork rdf:ID="_c1d5c1768f8011e08e4d00247eb1f55e_1">
  <cim:IdentifiedObject.name>EX11</cim:IdentifiedObject.name>
  <entsoe:ExternalNetwork.ikSecond>20</entsoe:ExternalNetwork.ikSecond>
  ....
</entsoe:ExternalNetwork>

```

The same principle should also apply to any other extensions. For example, if your CIM/XML contains some extensions specific to vendors' internal applications, the same method to declare such extended data in your CIM/XML file should be used.

## 3.13 NAMING CONVENTIONS

The ENTSO-E naming convention is embedded as notes in the detail profile specifications provided in Chapter 4. These notes are considered as **mandatory rules**.

## 4 ENTISO-E CIM MODEL EXCHANGE PROFILE SPECIFICATION

This chapter lists all classes that are used to define the data exchange. Only instances of concrete classes are used in actual exchanges. Those concrete classes may inherit attributes or associations from abstract classes, however. Such inherited attributes and associations are documented.

Included are all the classes that a data consumer would be expected to recognize in the data being consumed. Additional classes are referenced in this chapter, when the classes to be exchanged inherit attributes or associations. For instance, many classes inherit attributes from the class IdentifiedObject. However, no instances of the class IdentifiedObject would exist in the exchanged data, so IdentifiedObject has not been included in the set of concrete CIM classes for exchange.

Classes, attributes and associations that are necessary for exchange of a detailed operational model are marked with stereotype "Operation".

Classes and attributes that are necessary for exchange of short-circuit data are marked with stereotype "ShortCircuit".

Classes and attributes resulted as CIM extensions are marked with stereotype "ENTSOE" (see section 3.12).

Classes and attributes marked with stereotype "Operation", "ShortCircuit", "ENTSOE" or any other which are not marked can be used in ENTSO-E exchanges when required by the ENTSO-E body governing the data exchange process. Therefore, tools should be able to deal with all classes and attributes depending on the tools' functionalities, i.e. at least able to host the data and transfer with no change in case the tool is not able to use the data.

There are two types of HTML documentation that is exported to describe the profiles. The HTML documentation (*110731\_ENTSO-E\_CIM\_Profile\_2nd\_edition\_31July2011\_HTML.zip*) exported from the tool Enterprise Architect covers all profiles, i.e. Equipment, Topology, State variables, Dynamics, Diagram layout, Geographical and Boundary (boundary equipment and boundary topology). The HTML documentation exported from the tool CimConteXtor is summarised in the table below.

Profile		File name
Equipment		Entso-E-Equipment-Profile-Edition2v21-310711.html
Topology		Entso-E-Topology-Profile-Edition2v21-310711.html
State variables		Entso-E-StateVariables-Profile-Edition2v21-310711.html
Dynamics		Entso-E-Dynamics-Profile-Edition2v21-310711.html
Diagram layout		Entso-E-DiagramLayout-Profile-Edition2v21-310711.html
Geographical		Entso-E-GeographicalLocation-Profile-Edition2v21-310711.html
Boundary	Equipment	Entso-E-EquipmentBoundary-Profile-Edition2v21-310711.html
	Topology	Entso-E-TopologyBoundary-Profile-Edition2v21-310711.html

## 5 REFERENCES - PROFILE DEPENDENCY

The ENTSO-E CIM based data exchange format is dependent on the following normative IEC standards and other documents:

- [1] IEC 61970-452: CIM Static Transmission Network Model Profiles (Revision 8.02, 24 May 2011).
- [2] IEC 61970-456: Solved Power System State Profiles (Revision 2, 31 May 2011).
- [3] IEC 61970-552: CIM XML Model Exchange Format (Revision 2, 22 June 2011).
- [4] Reference Manual for Exchanging Standard Power System Dynamic Models: Based on the IEC 61970 Common Information Model (CIM). EPRI, Palo Alto, CA: 2009. 1020200.
- [5] IEC 61970-453: Diagram Layout Profile (Revision 2.6, 2 February 2011).
- [6] IEC 61970-301: Common Information Model (CIM) Base (Revision 027).
- [7] IEC 61968-4: Application integration at electric utilities - System interfaces for distribution management - Part 4: Interfaces for records and asset management