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Federal Department of the Environment, Transport, Energy and Communications (DETEC)

Swiss Federal Electricity Commission ElCom

Minimal geodata model documentation

Security of electricity supply: network areas

Basic geodata set

Identifier:	183.1
Title:	Security of electricity supply: Network areas
Legal basis:	Federal Electricity Supply Act (StromVG, SR 734.7); Art. 5 para. 1

Minimal geodata model

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Document information

Content	This document describes the minimal geodata model for Basic Geodata Set No. 183.1 “Security of electricity supply: network areas”.
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Document history

Version	Date	Comments
0.1	14/10/2014	Draft for project group
0.2	29/10/2014	Revision after discussion with Canton of Glarus
0.3	16/05/2015	Amendment after checking cantonal data
0.4	19/08/2015	Version for consultation
1.0	25/04/2016	Revision after consultation with cantons
1.1	06/05/2019	Adaptation of the cardinalities of relationships between the organisation and the network level

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1. Background

Geoinformation Act and Geoinformation Ordinance

The purpose of the Geoinformation Act (GeoIG, SR 510.62) is to ensure that geodata covering the territory of the Swiss Confederation is made available to the federal, cantonal and municipal authorities as well as for broad use by business, society and academia in a sustainable, up-to-date, rapid, simple manner, in the required quality and at a reasonable cost (Art. 1). The concept is to therefore make the data available to the public in an easily accessible form. In order to achieve this, the Federal Council shall define geodata under federal law in a catalogue and shall issue regulations on requirements for geodata (Art. 5).

The Geoinformation Ordinance (GeoIV, SR 510.620) defines the implementation of the GeoIG. Annex 1 contains the catalogue of basic geodata under federal law. This catalogue names a competent federal office for each entry. The federal offices are obliged to define minimal geodata models for basic geodata within their jurisdiction (Art. 9 para. 1). Minimal geodata models are determined within the technical legal framework by the technical requirements and the state of the art (Art. 9 para. 2).

Methodology for defining minimal geodata models

The Coordinating Agency for Federal Geographical Information, the GCG, recommends the model-based approach for defining minimal geodata models. It describes, structures and abstracts real-world objects that are of interest in a specific technical context. Data modelling takes place in two steps. The first step is to colloquially describe the selected real world detail (semantic description). The semantic description is developed by a project team of experts who are involved in the collection, storage, updating and use of the geodata. The second step is formalisation: the textual description is transferred into a formal language, both graphically (UML) and textually (INTERLIS).

This approach is reflected in the present document. The real world detail is defined in the introduction. The section entitled “Model description” contains the colloquial description of the technical context. This description forms the basis for the conceptual data model (see the section entitled “Model structure: the conceptual data model”).

2. Introduction

Thematic introduction

Approximately 630 electricity companies supply end customers with electricity in Switzerland. This means that the Swiss electricity market is very fragmented by international standards. Responsibility for a network area must be clarified to ensure frictionless supply. One reason for this is that guaranteeing the universal service and security of supply is a top priority for Switzerland. This is confirmed by the federal council dispatch of 03/12/2004 on the amendment of the Electricity Supply Act and the Federal Electricity Supply Act (BBl 2005 1611) and is addressed in Section 2 (entitled “Security of supply”) of the Electricity Supply Act (StromVG, SR 734.7). The second reason for clarifying responsibility for a network area is that the activities of the Federal Electricity Commission (ElCom) depends on knowing the network operator responsible for an area in order to clarify questions of connection obligation, cost solidarity and questions relating to site networks.

To ensure security of supply, the cantons are obliged to designate the network areas and to name the responsible network operators (Art. 5 para. 1 StromVG). The allocation of these network areas defines which network operator is bound by the connection obligation (Art. 5 para. 2) and the supply obligation (Art. 6 para. 1 and Art. 7 para. 1) in which geographic area. It also defines the responsibility for planning plants for generating electricity from renewable energy sources.

Allocation must be unambiguous and non-discriminatory, i.e. only one network operator is responsible for each network area and network level (Art. 5 para. 1 StromVG). The network areas must be allocated for the entire territory, i.e. the cantons must allocate the entire cantonal territory. This is in the interest of security of supply and is designed to ensure that all end consumers know which network operator is responsible for the connection and supply obligation at which network level. It is also designed to prevent orphan network areas or areas where several network operators are active.

In the interest of the universal service and security of supply, it is mandatory to allocate network level 7 in accordance with the *Marktmodell für die elektrische Energie – Schweiz, 2011* (Swiss Market Model for Electricity 2011) of the *Verband Schweizerischer Elektrizitätsunternehmen* (Association of Swiss Electricity Companies [VES]). Allocation of network levels 3 and 5 is optional.

In addition to the requirement of network area allocation as stipulated in the Federal Electricity Supply Act, the Geoinformation Act and Geoinformation Ordinance oblige the cantons to document the network area allocation in the form of digital geodata. In order to ensure that the structuring of geodata is conducted in the same way by all cantons, ElCom specifies the minimal geodata model presented here.

Origin and data management

The production, management and publication of geodata is the responsibility of the cantons. The legally valid status is displayed in each case. If this status should change, due to a new decision, the geodata is updated.

3. Basis for modelling

Federal Electricity Supply Act

The Federal Electricity Supply Act (StromVG, SR 734.7) forms the technical legal basis for the minimal geodata model presented here. The first section explains the purpose and scope of the act.

> **Art. 1** Purpose
> [1] The purpose of this act is to create the conditions for a secure electricity supply and a competitive electricity market.
> [2] It is also designed to define the framework conditions for:
> a. reliable and sustainable supply of electricity in all parts of the country;
> b. maintaining and strengthening the international competitiveness of the Swiss electricity industry.
>
> **Art. 2** Scope
> [1] This act applies to electricity networks that operate with 50 Hz alternating current.
> [2] The Federal Council may extend the scope of the act or of individual provisions to other electricity networks to the extent necessary to achieve the objectives of this act.
>
> **Art. 3** Cooperation and subsidiarity
> [1] The Confederation and, within the scope of their competence, the cantons shall cooperate with the organisations concerned, particularly those from business, in order to implement this act.
> [2] Before issuing implementing provisions, they shall examine voluntary measures taken by these organisations. Wherever possible and necessary, they shall incorporate their agreements in whole or in part into the implementing legislation.

Section 2 explains the network areas and their role in security of supply.

> **Art. 5** Network areas and guaranteed connection
> [1] The cantons shall designate the network areas of the grid operators active on their territory.
> The allocation of a network area must be non-discriminatory; it may be combined with a performance mandate for the network operator.
> [2] Network operators are obliged to connect to the network all end consumers within the construction zone, properties occupied year-round and settlements outside the construction zone as well as all electricity producers in their network area.
> [3] The cantons can oblige network operators active on their territory to connect end consumers to the grid even outside their network area.
> [4] The cantons may issue regulations regarding connections outside the construction zone as well as regarding their conditions and costs.
> [5] The Federal Council stipulates transparent and non-discriminatory rules for the allocation of end consumers to a specific voltage level. It may establish corresponding rules for electricity producers and network operators. When changing connections, it may oblige end consumers and network operators to pay proportionate compensation for the capital costs of systems that are no longer or only partially used and for a limited period of time to compensate for any adverse effect on network usage fees.

General technical conditions

The Confederation's basic model

The minimal geodata model presented here uses the Confederation’s basic modules (CHBase), which define general, cross-application aspects.

4. Model description

Semantic description

Network area

A network area represents the geographic area in which a network operator is active. The network operator is obliged to connect the end consumers in its network area within the construction zone, properties inhabited year-round, settlements outside the construction zone and all electricity producers to the electricity network. The network operator is not necessarily also the owner of the network.

A network area can comprise several sub-areas (see Fig. 1). Enclaves and exclaves are permissible in sub-areas. The boundaries of sub-areas are always closed. The boundaries of the sub-areas are defined by straight lines and/or circular arcs.

There is no overlap between different network areas (i.e. network areas with different network operators).

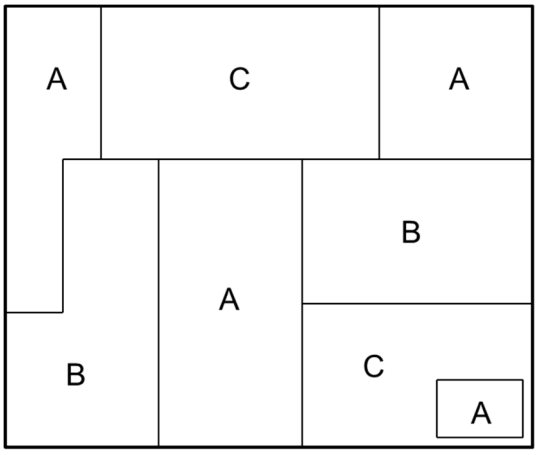

Fig. 1: Network areas of network operators A, B and C, consisting of several sub-areas.
The network area of network operator A consists, for example, of four sub-areas.

Electricity network and network levels

The electricity network is divided into network levels (see Fig. 2). The structure is based on the different voltages used to transport the electricity. The higher the voltage, the lower the transport losses. For this reason, high voltages are used for long transport distances. However, private end customers require a low voltage in order to use electricity.

Network level 1, the transmission network, is operated solely by the national grid operator (swissgrid). It is therefore not necessary to allocate network areas for this network level.

Network levels 3, 5 and 7 serve to distribute electricity. End customers are connected to these levels. Private households use the lowest voltage level (network level 7) and industrial consumers use higher voltage levels (network levels 3 and 5). Some cantons differentiate between a transport level (5a) and a distribution level (5b) at network level 5. However, this distinction is not provided for either in the standard network level model of the Association of Swiss Electricity Companies (VSE) or in the Confederation's model and would therefore have to be modelled in a cantonal extension.

Network levels 2, 4 and 6 serve to transform (convert) the electricity between the different voltage levels.

Network areas are allocated at the voltage levels at which end consumers are connected. These are voltage levels 3, 5 and 7. A minimum of network level 7 must be assigned. The other voltage levels can be optionally integrated into the minimal geodata model.

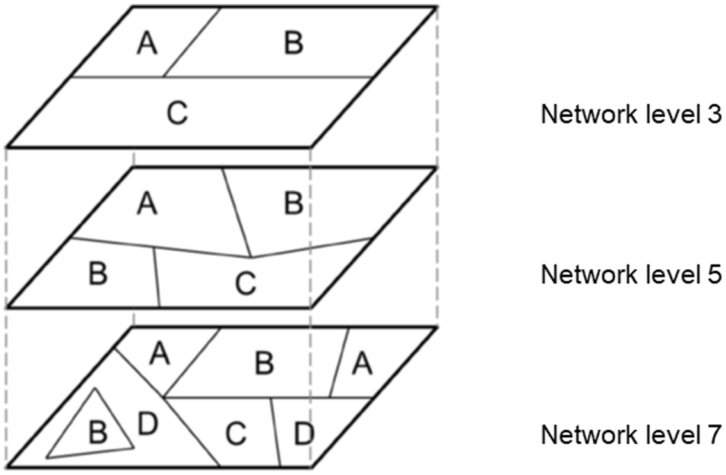

Fig. 2: Example of a network area division of network levels 3, 5 and 7.

Cantons and division of territory

A canton is a member state of the Swiss Confederation. A canton allocates network areas to network operators within its territory. The allocation must cover the entire cantonal area. No partial areas may remain unallocated. In most cantons, network zones are allocated by executive decision.

Dealing with the time dimension

The basic geodata set contains the current status of network area allocation, which is reflected in the use of the “WithOneState” historization concept for the Confederation’s basic modules[1]. Each network area thereby receives the attribute “ModInfo” with the specification “WithOneState”. It is consequently recorded in the data that they represent the current status.

[1] See http://www.geo.admin.ch/internet/geoportal/de/home/topics/geobasedata/models.html (only available in German, French and Italian).

5. Model structure: conceptual data model

UML class diagram of topics

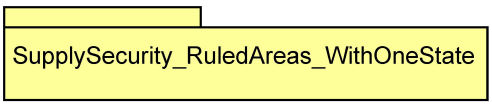

Figure 3: UML representation of topics

UML class diagram topic “SupplySecurity_RuledAreas_WithOneState”

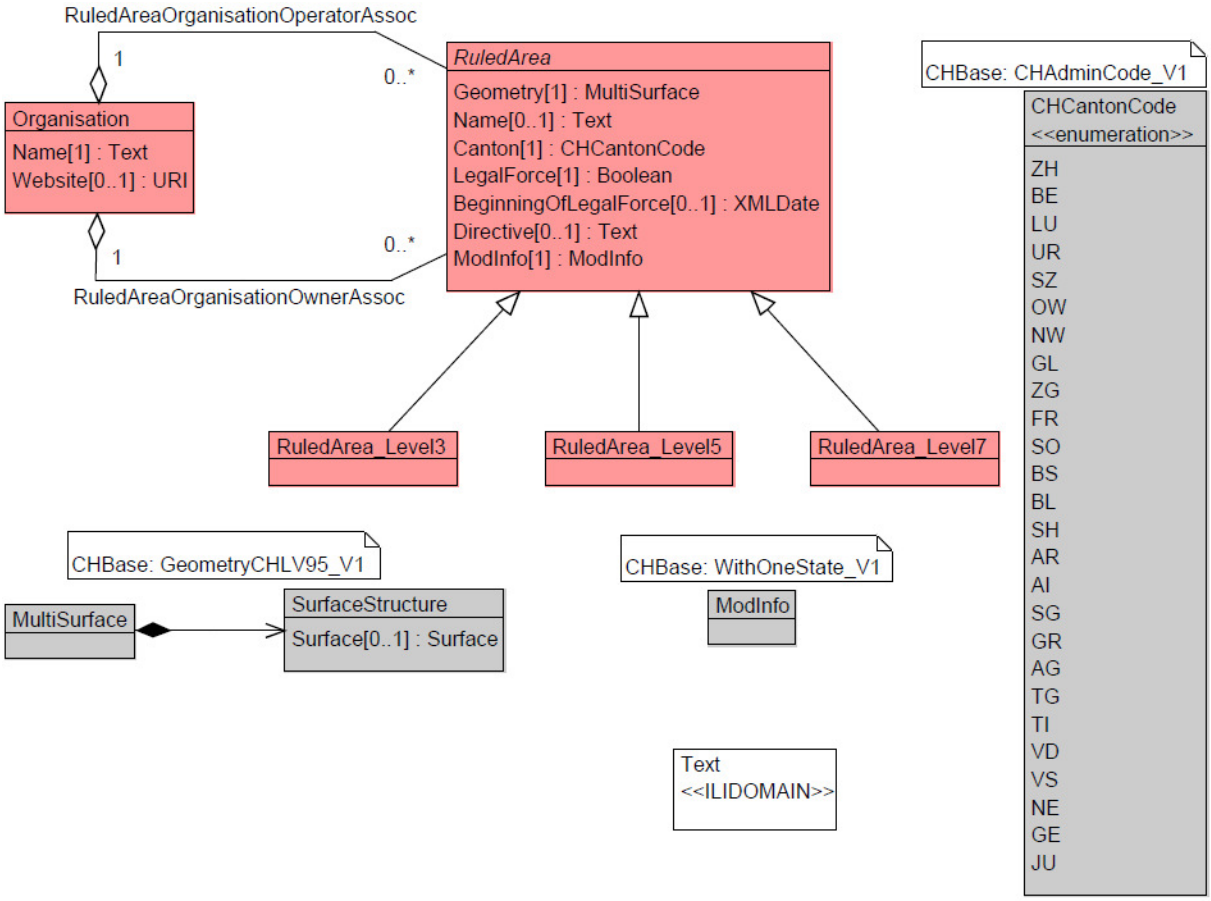

Figure 4: UML class diagram topic “SupplySecurity_RuledAreas_WithOneState”; network level 3 and 5 data collection is optional.

Object catalogue

Table 1: Object catalogue “SupplySecurity_RuledAreas_WithOneState”

Attribute name	Cardinality	Data type	Definition	Requirements
Organisation: “Organisation” class				
Name (“Name”)	1	Text	Official name of the organisation	
Website (“Website”)	0..1	URL	Organisation website	
Network area: “RuledArea” class				
Geometry (“Geometry”)	1	GeometryCHLV95_V1.MultiSurface	Multisurfaces	All surfaces must comply with a zoning system.
Name (“Name”)	0..1	Text	Designation of the network area	
Canton (“Canton”)	1	CHAdminCodes_V1.CHCantonCode	Canton in whose territory the network areas are allocated.	Two-digit code in accordance with the commonly used abbreviation
Legal force (“LegalForce”)	1	Boolean	Indication whether the extension of the network area is legally binding.	Yes or no
Beginning of legal force (“BeginningOfLegalForce”)	0..1	Date	Date from which the extension of the network area becomes legally binding.	
Directive (“Directive”)	0..1	Text	Link to the directive or designation of the decisions which make the network area legally binding.	
(“ModInfo”)	1	WithOneState_V1.ModInfo	Data historization concept	Indicates that the data represents the current status.
Relationships				
RuledAreaOrganisationOwnerAssoc	0..* - 1	Relationship (aggregation)	Relationship between the network area and the organisation which owns the network area.	One owner is assigned to one network area. An organisation owns 0 to several network areas. An organisation operates or owns at least 1 network area.
RuledAreaOrganisationOperatorAssoc	0..* - 1	Relationship (aggregation)	Relationship between the network area and the organisation that operates the network area.	One operator is assigned to one network area. An organisation operates 0 to several network areas. An organisation operates or owns at least 1 network area.

6. Document maintenance

If the network area allocation changes, the basic geodata set is updated and republished.

7. Display model

Network areas are displayed to cover the full surface. The colour of the surface depends on the network operator (“Operator” role). Each network operator is assigned a unique colour so that adjacent network areas do not have identical colours and can be distinguished as easily as possible.

8. Note for the production of INTERLIS geodata

In the INTERLIS geodata model the abstract class “RuledArea” (network area) is divided into three more specialised classes. The classes “RuledArea_Level3”, “RuledArea_Level5” and “RuledArea_Level7” inherit all attributes of “RuledArea” and represent the specific network levels 3, 5 and 7 as separate entities.

If the INTERLIS plugin for the FME (feature manipulation engine, safe software) is used for the production of INTERLIS geodata, the use of the subclass strategy is recommended.

The Canton of Glarus conducted a pilot implementation of the minimal geodata model. INTERLIS geodata were successfully produced using the interface tool ili2pg[2] . The procedure was documented in the white paper *Generische Umsetzung der minimalen Geodatenmodelle in der kantonalen Geodaten-Infrastruktur* (Generic implementation of the minimal geodata models into the cantonal geodata infrastructure) [3].

9. Comments on ensuring data quality

The INTERLIS conceptual description language cannot adequately model all the requirements relevant in the context of network area allocation. It is the responsibility of the data producers to check whether their data meets both these requirements and those of the INTERLIS geodata model. Table 2 shows which requirements it was possible to adequately model with INTERLIS and which requirements are checked by the software iG/Check for INTERLIS 2[4].

[2] http://www.eisenhutinformatik.ch/interlis/ili2pg/
[3] https://www.gl.ch/public/upload/assets/3691/Whitepaper_UmsetzungMGDM.pdf (only available in German)
[4] https://www.interlis.ch/downloads/igcheck

Table 2: Requirements for geodata and its consideration using modelling and testing

Requirements	Modelled	Testing iG/Check[5]
Specialisation of network levels	✓	✓
Overlap-free surfaces	✗	✗
Allocation across entire territory	✗	✗
Network areas must lie within the cantonal territory	✗	✗

To ensure data quality, the body responsible for data production must conduct the following control measures.

Control measure 1: Overlap-free surfaces

Individual surfaces must not overlap. According to the INTERLIS reference manual,[6] this can be modelled with the consistency condition `INTERLIS.areAreas` . However, practical tests have shown that this is not entirely the case for the specific issue of network areas. The problem has been reported to the INTERLIS core team and is being discussed there. For INTERLIS 2.4 this issue will be resolved and included in the INTERLIS reference manual. For this reason, `INTERLIS.areAreas` was not used for the present data model.

- Overlaps (intersections) of the individual surfaces of a network level. If there are no results (if no overlapping surfaces exist), the data is correct.

Control measure 2: Allocation across entire territory

In the case of INTERLIS area classifications, residual surfaces are permissible.[6] It is therefore not possible to model full coverage as a mandatory requirement in this way.

- Subtract network areas from the cantonal surface. If no residual surfaces exist, the network areas have been allocated to cover the entire territory.

Control measure 3: Network areas must lie within the cantonal territory

The INTERLIS data model cannot know the geographical extent of the canton. It is therefore also not possible to ensure that network areas are only allocated within the cantonal surface.

- Overlaps (intersections) of the cantonal territory with the network areas. If all network areas are included in the result, there are no areas outside the cantonal surface.

[5] Version used: 2016.0 06/03/2016
[6] INTERLIS 2 - Reference Manual. Edition of 13/4/2006, Section 2.8.13.3.

Annex A: Glossary

Table 3: Glossary

Term	Definition
Basic geodata	Geodata based on a legislative decree of the Confederation, a canton or a municipality.
Geodata	Spatial data which describes with a certain time reference the extent and characteristics of certain spaces and objects, in particular their location, condition, use and legal relationships.
INTERLIS	Platform-independent data description language and transfer format for geodata. INTERLIS makes it possible to model data models precisely.
Minimal geodata model	Real-world representation which defines the structure and content of geodata independently of the system and which, from the point of view of the Confederation (and, where appropriate, the cantons), is limited to what is essential and necessary in terms of content.
UML	Unified modelling language. Graphical modelling language for defining object-oriented data models.

Annex B: INTERLIS model file

Content of the model file entitled “SupplySecurity_RuledAreas_V1_1.ili”:

```
INTERLIS 2.3;

/** Minimal geodata model
 * Minimales Geodatenmodell
 * Modèle de géodonnées minimal
 */

!! Version    | Who   | Modification
!!------------------------------------------------------------------------
-------
!! 2019-05-06 | ElCOM | Anpassung der Kardinalitäten der Beziehungen zwi-
schen Organisation und Netzebene

!!@ technicalContact=mailto:info@elcom.admin.ch
!!@ furtherInformation=https://www.elcom.admin.ch
!!@ IDGeoIV=183.1

MODEL SupplySecurity_RuledAreas_V1_1 (en) AT "https://models.geo.ad-
min.ch/ElCom/" VERSION "2019-05-06"  =
  IMPORTS CHAdminCodes_V1,GeometryCHLV95_V1,WithOneState_V1;

  DOMAIN

    Text = TEXT*250;
```

```
  TOPIC SupplySecurity_RuledAreas_WithOneState =

    CLASS Organisation =
      Name : MANDATORY SupplySecurity_RuledAreas_V1_1.Text;
      Website : INTERLIS.URI;
    END Organisation;

    CLASS RuledArea (ABSTRACT) =
      Geometry : MANDATORY GeometryCHLV95_V1.MultiSurface;
      Name : SupplySecurity_RuledAreas_V1_1.Text;
      Canton : MANDATORY CHAdminCodes_V1.CHCantonCode;
      LegalForce : MANDATORY BOOLEAN;
      BeginningOfLegalForce : INTERLIS.XMLDate;
      Directive : SupplySecurity_RuledAreas_V1_1.Text;
      ModInfo : MANDATORY WithOneState_V1.ModInfo;
    END RuledArea;

    CLASS RuledArea_Level3
    EXTENDS RuledArea =
    END RuledArea_Level3;

    CLASS RuledArea_Level5
    EXTENDS RuledArea =
    END RuledArea_Level5;

    CLASS RuledArea_Level7
    EXTENDS RuledArea =
    END RuledArea_Level7;

    ASSOCIATION RuledAreaOrganisationOperatorAssoc =
      Operator -<> {1} Organisation;
      RuledArea1 -- {0..*} RuledArea;
    END RuledAreaOrganisationOperatorAssoc;

    ASSOCIATION RuledAreaOrganisationOwnerAssoc =
      Owner -<> {1} Organisation;
      RuledArea2 -- {0..*} RuledArea;
    END RuledAreaOrganisationOwnerAssoc;

    CONSTRAINTS OF RuledArea =
      MANDATORY CONSTRAINT DEFINED (Operator) OR DEFINED (Owner);
    END;

  END SupplySecurity_RuledAreas_WithOneState;

END SupplySecurity_RuledAreas_V1_1.
```