State Boundaries of Europe (SBE) Data Model

Specification and Technical Guidelines

Author: SBE KEN Coordination Committee

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Version: v5.4

Change Summary

Version	Date	Author/Editor	Change Summary
5.0	05/12/2017	Marcus Brühl	This new document replaces the previous document “State Boundaries of Europe (SBE) - Guidelines”, version 4.13 from 20.02.2014. Main changes: • new document template • data model adapted to INSPIRE
5.1	08/05/2018	Marcus Brühl	Changes according to comments by Alain Wicht, Robert Balanche, Jan Řezníček, Andreas Schramm, Nestoras Papadopoulos new sections: 2.3, 2.6, 3
5.2	26/07/2018	Marcus Brühl	Changes according to comments, new annex
5.3	08/11/2018	Marcus Brühl	Changes according to comments by Jan Řezníček and Pierre Vergez, document cleaned
5.4	22/11/2018	Marcus Brühl	Final adaptions for publishing

References

Ref.	Title/Version/Publication Date/Author
[1]	State Boundaries of Europe (SBE) – Guidelines / version 4.13 / 20.02.2014
[2]	INSPIRE Data Specification on Administrative Units – Guidelines / v3.1 / 17.04.2014

Contents

1 Scope

The main objective of the State Boundaries of Europe Knowledge Exchange Network (SBE KEN) is to collect and provide the defined international boundaries in Europe. These boundaries are needed as reference for matching of national topographical data in order to provide seamless European coverage.

One main task of SBE is to create a dataset of the European boundaries, with the highest possible accuracy on the base of the bilateral boundary treaties and by the help of a common data model and a data network in Europe.

This document specifies the data model of the SBE database and provides technical guidance how to populate it. The SBE data model has been developed by the SBE KEN. The actual version of the SBE data model is based on an older version [1], which has been adapted to the structure of INSPIRE data specifications. The responsibility for the maintenance is at the SBE KEN Coordination Committee.

The document structure follows the ISO 19131 (Data product specifications) standard, but it lists only those chapters, which are considered relevant for SBE.

In case of questions please contact:

- Marcus Brühl (BKG), responsible for the SBE data model, email: marcus.bruehl@bkg.bund.de
- Gert Steinkellner (BEV), chair of SBE KEN, email: gert.steinkellner@bev.gv.at

2 SBE Data Model – Data content and structure

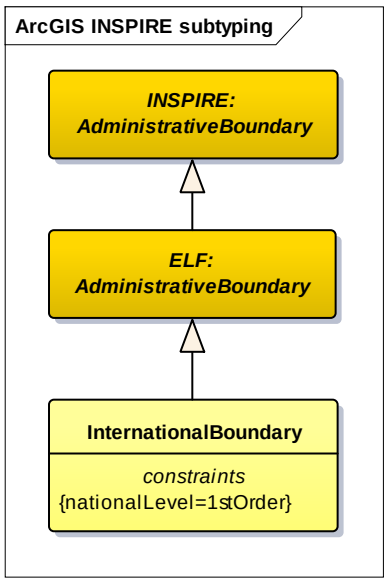
2.1 Basic notions

The conceptual data model is described with the Unified Modelling Language (UML). The UML diagrams have been drafted in Enterprise Architect (EA). This EA model allows the implementation of the data model as ESRI ArcGIS Geodatabase, see section 6.

2.2 INSPIRE compliancy

INSPIRE does not provide a dedicated data specification for international boundaries. The only appropriate INSPIRE feature type is **AdministrativeBoundary** included in INSPIRE theme Administrative Units. This feature type is already subtyped for the European Location Framework (ELF) data model. As the ELF data model is used for the European Location Services (ELS) run by EuroGeographics, it has been considered also for SBE. The SBE subtype restricts the administrative boundaries to those which are international boundaries (national level = 1st order).

The subtyping from INSPIRE is visualised in the following diagram:



In that way, the SBE feature type **InternationalBoundary** inherits a number of INSPIRE properties. Those attributes are amended by additional attributes needed for SBE demands.

All other elements of the SBE data model have no correspondent in INSPIRE. Nevertheless, the SBE elements have been defined following the INSPIRE principles for data modelling.

2.3 SBE identifiers

To manage an efficient European dataset, it is necessary to manage unique and stable identifiers, to identify each object clearly.

INSPIRE defines the inspireId for this purpose. But inspireId is a data type of three properties: namespace, localId and versionId. SBE reuses the inspireId, as defined by the data providers, in the following way:

- In order to provide an identifier for SBE in one attribute, the namespace and localId have to be concatenated by a colon (namespace: localId).
- The namespace should be listed in a national registry.
- There are no additional requirements for the localId. Data providers may structure the localId in a way that it reflects boundary segments and the relation between boundary lines and points; but this is not a SBE demand.
- The concatenation of the versionId is optional and has not to be provided.

The former SBE identifiers will be migrated to inspireId in the following way:

- The former SBE identifier will be used as localId.
- The namespace has to be added either by asking the data providers or by adding "_EG.SBE" as default.
- For example: former SBE identifier "AT_CZ_VI_6-10" → inspireId = "_EG.SBE: AT_CZ_VI_6-10"

Features which have been agreed between neighbouring countries and which are commonly provided will always start with the namespace "_EG.SBE".

2.4 Narrative description

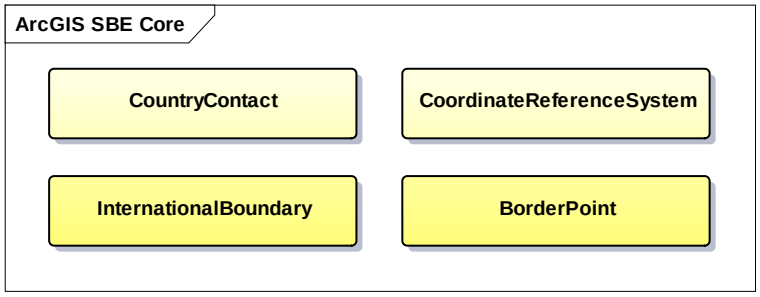
The SBE data model consist of geographic information and metadata information. The full SBE data model contains not only the geometry of border points and boundary lines, but also information about the treaty where a boundary is legally defined, relevant boundary documents and contact information about the organisation which has provided the SBE data.

As it might be difficult to gather all information for the full SBE data model, a simplified version has been derived. This core SBE data model is the minimum requirement for SBE data delivery.

Data provider have to deliver the core SBE data model. But they are asked to provide as much content as possible even if it doesn't completely fulfil the requirements of the full SBE data model.

2.4.1 Core SBE Data Model

The essential elements of SBE are the geometrical feature types **InternationalBoundary** (boundary lines) and **BorderPoint** (points which define the border line). Additionally, there are the data types **CountryContact** and **CoordinateReferenceSystem** providing core metadata information.



All four elements of SBE Core carry a number of attributes. The most important attributes have to be provided as mandatory, the other attributes are optional. See section 2.5.1.

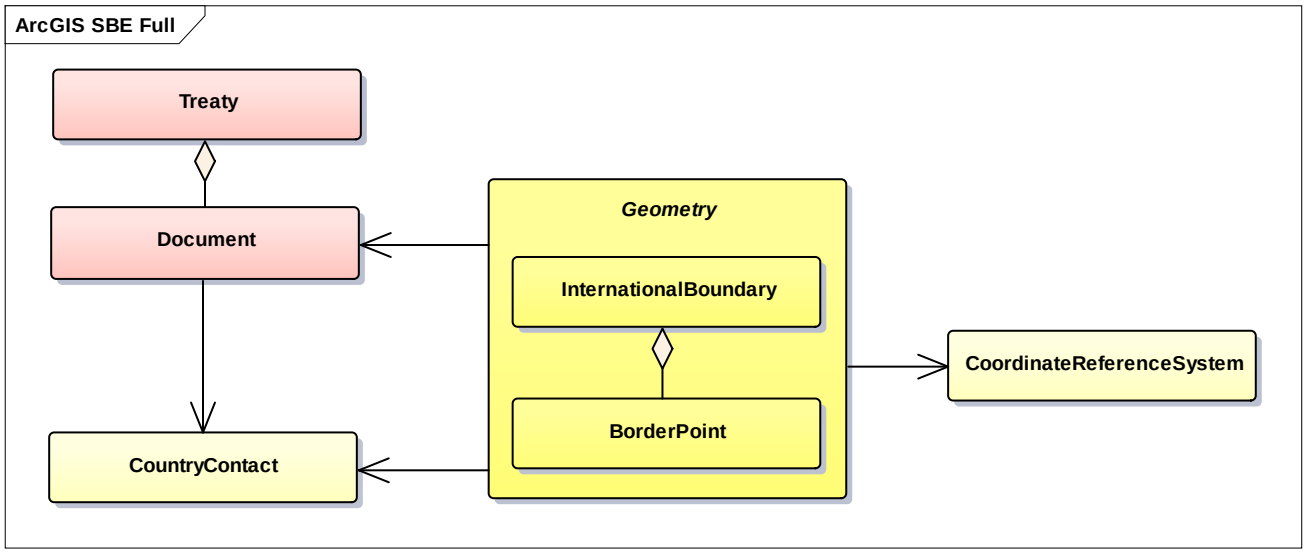
The SBE Core does not contain relationships between the elements of the data model. Nevertheless, it's obvious that all elements supplied within one dataset relate to each other.

2.4.2 Full SBE Data Model

The Full SBE data model adds two data types referencing the treaty where boundaries and border points are legally defined:

Treaty contains basic information about a bilateral treaty between neighbouring countries for the definition of their common international boundary. This data type is a kind of envelop of all documents related to the specific boundary. The information have to be given in English to provide core information to users not familiar with the national languages.

Document references the different textual, tabular, sketchy or photographic descriptions of the boundary. Those descriptions may be provided in the national languages. But it is recommended, if available, to provide also English versions of the documents.



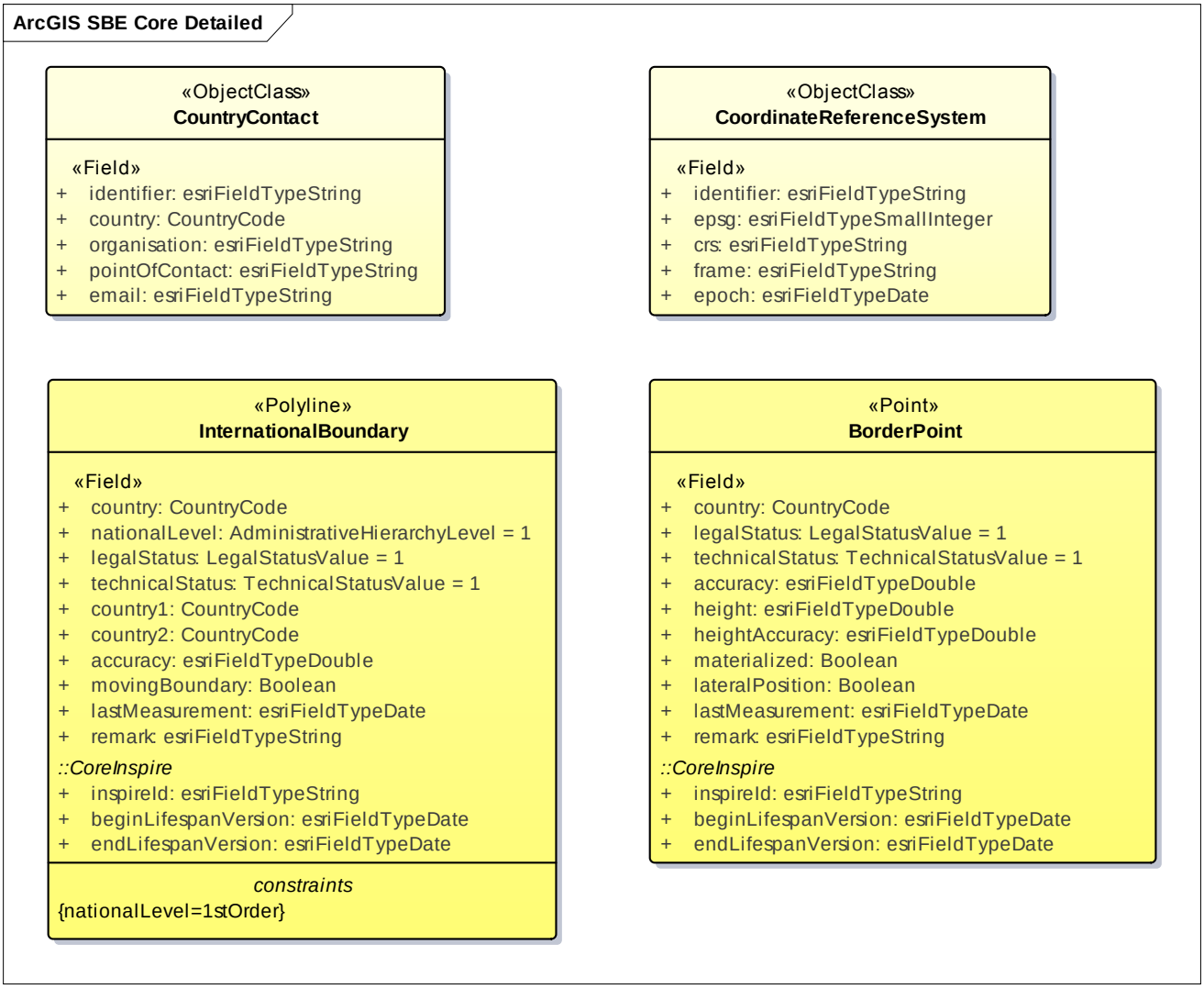
All elements of SBE Full are related to each other in the following way:

- InternationalBoundary is an aggregation of BorderPoint. This means that a boundary is built of points (at least 2), where all vertices of the boundary line relate to a border point. Vice versa, all border points relate to boundaries (usually to 1; to 3 in case of triplexes).
- Treaty is an aggregation of Documents. For instance, a treaty may consist of two documents, one for each language (in case of neighbouring countries with different languages).
- The Geometry (boundaries as well as points) has an association with Document. This means that the document, where the legal definition of the geometrical boundary representation is described, should be provided.
- The Geometry has an association with CountryContact. This provides basic information of the data supplier of the geometry.
- The Geometry has an association with CoordinateReferenceSystem. For all geometrical data the exact coordinate reference system (including reference frame and epoch) has to be known, see section 3.
- Document has an association with CountryContact. This provides basic information of the point of contact supplying the treaty documents. The point of contacts for geometry and treaty documents may differ.

All elements, attributes and relations of SBE Full are mandatory by default – they have to be supplied if valid. Some attributes may not be applicable in specific cases.

2.5 UML overview

2.5.1 Core SBE Data Model



InternationalBoundary contains the boundary lines with a number of properties (attributes). The following mandatory properties have to be provided as SBE Core: inspireId, country (data provider), legalStatus, technicalStatus, country1, country2.

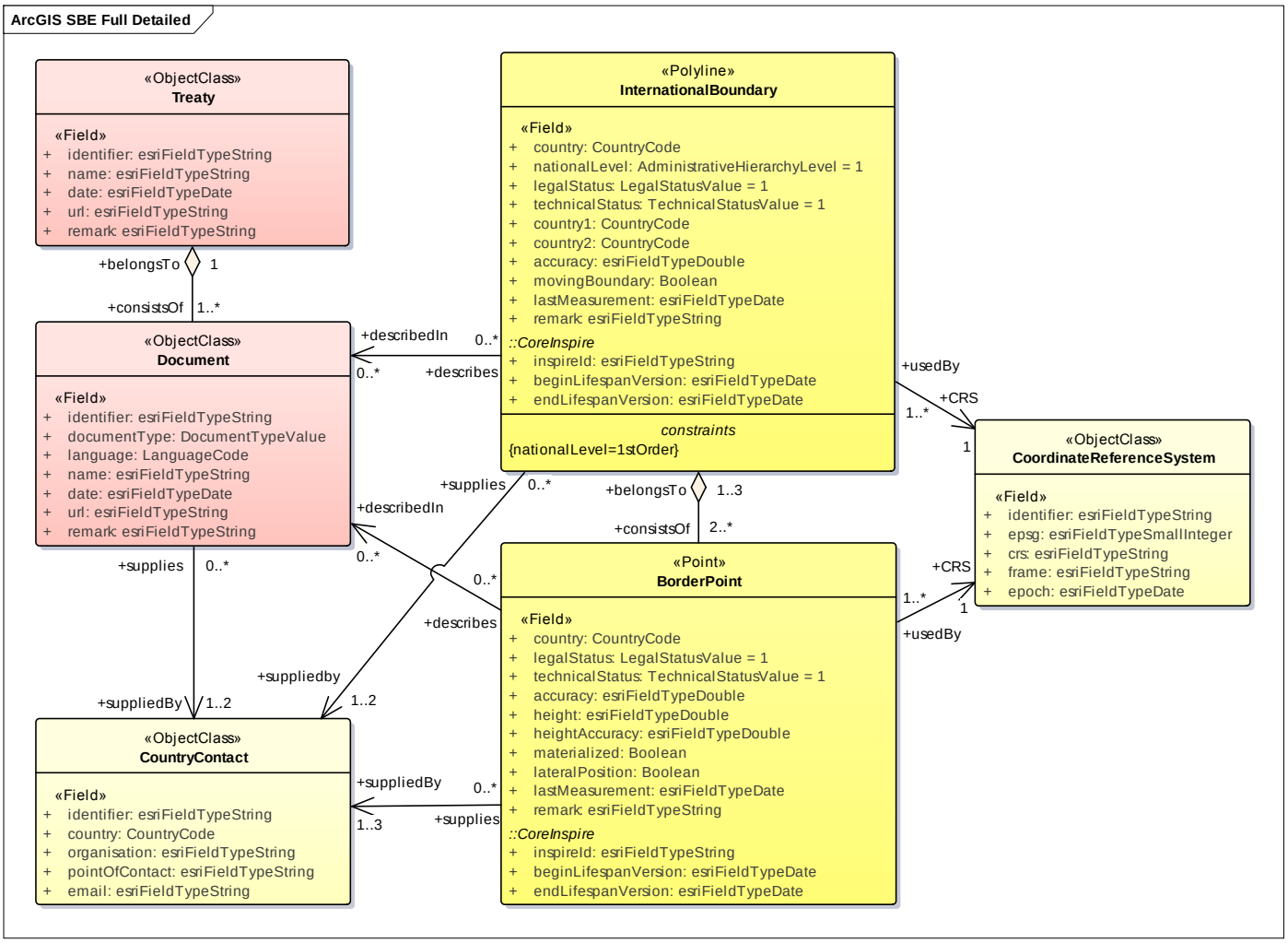
The attributes country1 and country2 identify the neighbouring countries of the international boundary. If the feature is oriented, the country code of the left country has to be provided as country1 and the code of the right country as country2.

BorderPoint contains the points which define the border line. The mandatory properties are: inspireId, country, legalStatus, technicalStatus.

CountryContact identifies the organisation which provides the SBE dataset and the main point of contact. The properties country and organisation are mandatory. Although, the name and email of the point of contact may change often, it is interesting to identify as optional information the contact who has provided the data.

CoordinateReferenceSystem identifies the geodetic reference of the geometrical feature types. The CRS should be ETRS89 by default. The information about reference frame and epoch are important as well, but both properties are not mandatory.

2.5.2 Full SBE Data Model



2.6 Feature catalogue

This section is not complete yet. Up to now, only SBE Core is described. Detailed descriptions of Relationships and data types Treaty and Document will be added later.

2.6.1 Feature Types

2.6.1.1 InternationalBoundary

Definition: A line of demarcation between countries

Description: A boundary line is an aggregation of border point. This means that a boundary is built of points (at least 2), where all vertices of the boundary line relate to a border point.

Geometry: GM_Curve (Polyline); the geometry may be an oriented polyline

List of Attributes	
inspireId	
Definition	External object identifier of the spatial object
Description	An external object identifier is a unique object identifier, which may be used by external applications to reference the spatial object.
Value Type	CharacterString (Text, 255)
Mandatory	Yes
Example	_EG.SBE:AT_CZ_VI_6-10
beginLifespanVersion	
Definition	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Value Type	DateTime
Mandatory	No
endLifespanVersion	
Definition	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Description	Empty by default, as SBE doesn't contain retired data
Value Type	DateTime
Mandatory	No
country	
Definition	Country code of the data provider
Description	Two-character country code according to the Interinstitutional style guide published by the Publications Office of the European Union. If both neighbouring data providers have agreed on the boundary (technicalStatus = 'edgeMatched'), both country codes will be concatenated (separated by #).
Value Type	CountryCode (code list)
Mandatory	Yes
Example	AT *(Austria)* AT#CZ *(agreed and identical boundary of Austria and Czech Republic)*
nationalLevel	
Definition	The hierarchy level of the boundary in the national administrative hierarchy
Description	Always 1stOrder, as SBE contains only the international boundaries

Value Type	AdministrativeHierarchyLevel (code list)
Mandatory	No
legalStatus	
Definition	Legal status of the international boundary
Description	The legal status is considered in terms of political agreement or disagreement. See additional table below.
Value Type	LegalStatusValue (enumeration)
Mandatory	Yes
technicalStatus	
Definition	Technical status of the international boundary
Description	The technical status of the boundary is considered in terms of its topological matching or not-matching with the borders of the neighbouring country. Edge matched means that the same set of coordinates is used. See additional table below.
Value Type	TechnicalStatusValue (enumerations)
Mandatory	Yes
country1	
Definition	Country code of the country of one side of the boundary
Description	If the feature is oriented, the country code of the left country has to be provided as country1.
Value Type	CountryCode (code list)
Mandatory	No
Example	AT *(Austria)*
country2	
Definition	Country code of the country of the other side of the boundary
Description	If the feature is oriented, the country code of the right country has to be provided as country2.
Value Type	CountryCode (code list)
Mandatory	No
Example	CZ *(Czech Republic)*
accuracy	
Definition	Accuracy in meter of the position of the boundary
Value Type	Decimal
Mandatory	No
Example	0.2 *(20 cm)*
movingBoundary	
Definition	Indication if the boundary is not fixed but moving
Description	For example the middle of a river
Value Type	Boolean
Mandatory	No
lastMeasurement	
Definition	Date of the last measurement of the boundary
Value Type	Date
Mandatory	No

remark	
Definition	Additional information
Description	Additional information, which cannot be expressed by the other attributes, and which may be relevant for users. This attribute is free text, where different information shall be separated by semicolon. This text has to be given in English only.
Value Type	CharacterString (Text, 255)
Mandatory	No
Example	Middle of the river; discussion about final delineation ongoing in technical commission AT-CZ

The following table explains the valid attribute combinations of legalStatus and technicalStatus. It is recommended to explain the description in the attribute remark.

legalStatus	**technicalStatus**	**Description**
notAgreed	notEdgeMatched	There may be different reasons: • There is no bilateral commission. • There are no actual surveying results. • Discussions between technical commissions are ongoing, but are not finalised yet. • Boundary is in dispute in general. In most cases, such in dispute areas will not be solved in short time.
notAgreed	edgeMatched	Boundary is agreed on technical level (by technical commissions). A unique set of coordinates is existing. This representation of the boundary may be already implemented in national datasets. But the agreed boundary is not yet approved by legal bodies (boundary commissions and/or national parliaments).
agreed	notEdgeMatched	*attribute combination is not valid*
agreed	edgeMatched	Boundary is agreed on technical level (by technical commissions) and approved by legal bodies (boundary commissions and/or national parliaments).

2.6.1.2 BorderPoint

Definition: Points which define international boundaries

Description: Border points relate to boundaries (usually to 1; to 3 in case of triplexes).

Geometry: GM_Point

List of Attributes	
inspireId	
Definition	External object identifier of the spatial object
Description	An external object identifier is a unique object identifier, which may be used by external applications to reference the spatial object.
Value Type	CharacterString (Text, 255)
Mandatory	Yes
Example	_EG.SBE:AT_CZ_VI_6-10_99
beginLifespanVersion	
Definition	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Value Type	DateTime
Mandatory	No
endLifespanVersion	
Definition	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Description	Empty by default, as SBE doesn't contain retired data
Value Type	DateTime
Mandatory	No
country	
Definition	Country code of the data provider
Description	Two-character country code according to the Interinstitutional style guide published by the Publications Office of the European Union. If both neighbouring data providers have agreed on the boundary (technicalStatus = 'edgeMatched'), both country codes will be concatenated (separated by #).
Value Type	CountryCode (code list)
Mandatory	Yes
Example	AT *(Austria)* AT#CZ *(agreed and identical border point of Austria and Czech Republic)*
legalStatus	
Definition	Legal status of the border point
Description	The legal status is considered in terms of political agreement or disagreement. See additional table in 2.6.1.1.
Value Type	LegalStatusValue (enumeration)
Mandatory	Yes
technicalStatus	
Definition	Technical status of the border point
Description	The technical status of the boundary is considered in terms of matching or not-matching with the border point of the neighbouring country. Edge matched means that the same set of coordinates is used.

	See additional table in 2.6.1.1.
Value Type	TechnicalStatusValue (enumerations)
Mandatory	Yes
accuracy	
Definition	Accuracy in meter of the position of the border point
Value Type	Decimal
Mandatory	No
Example	0.2 *(20 cm)*
height	
Definition	The height in meter of the border point in EVRS
Description	The frame (EVRF2000, EVRF2007, future realisation) has to be identical for edge matched (agreed) border points. If EVRS heights are not determined, it is possible to use ETRS89 ellipsoidal heights. In case of not edge matched border points, height may be provided in a national height system. Information about the used height reference system shall be included in the metadata.
Value Type	Decimal
Mandatory	No
Example	123.400 *(123.4 m)*
heightAccuracy	
Definition	Accuracy in meter of the height of the border point
Value Type	Decimal
Mandatory	No
Example	0.2 *(20 cm)*
materialzied	
Definition	Indication if the border point is materialized
Value Type	Boolean
Mandatory	No
lateralPosition	
Definition	Indication if the border point is located directly on the boundary or if it is situated besides it
Description	Example of lateral border point: boundary is in the middle of a river, but the points are situated on the bank
Value Type	Boolean
Mandatory	No
lastMeasurement	
Definition	Date of the last measurement of the border point
Value Type	Date
Mandatory	No
remark	
Definition	Additional information
Description	Additional information, which cannot be expressed by the other attributes, and which may be relevant for users. This attribute is free text, where different information shall be separated by semicolon. This text has to be given in English only.

Value Type	CharacterString (Text, 255)
Mandatory	No

2.6.2 Data Types

2.6.2.1 CountryContact

Definition: Identifies the organisation which provides the SBE dataset

Description: The country contact shall include the name and email of the main point of contact in the organisation

List of Attributes	
identifier	
Definition	External object identifier of the feature
Description	By default, this identifier should be a concatenation of the country code and the abbreviation of the organisation (separated by a dot)
Value Type	CharacterString (Text, 100)
Mandatory	Yes
Example	DE.BKG
country	
Definition	Country code of the data provider
Description	Two-character country code according to the Interinstitutional style guide published by the Publications Office of the European Union.
Value Type	CountryCode (code list)
Mandatory	Yes
Example	DE *(Germany)*
organisation	
Definition	Name of the data providing organisation
Description	Full name of organisation (English name preferred); abbreviation can be added in brackets.
Value Type	CharacterString (Text, 255)
Mandatory	Yes
Example	Federal Agency for Cartography and Geodesy
pointOfContact	
Definition	Name of the person responsible in the organisation for data provision
Value Type	CharacterString (Text, 255)
Mandatory	No
Example	Hans Meier
email	
Definition	Email address of the point of contact
Value Type	URI (Text, 255)
Mandatory	No
Example	hans.meier@bkg.bund.de

2.6.2.2 CoordinateReferenceSystem

Definition: Identifies the geodetic reference of the geometrical feature types

Description: The CRS should be ETRS89 by default. The information about reference frame and epoch are important as well.

List of Attributes	
identifier	
Definition	External object identifier of the feature
Description	By default, this identifier should be a concatenation of crs, frame and epoch (separated by a dot). In cases when frame and epoch are not specified, identifier is identical with crs.
Value Type	CharacterString (Text, 100)
Mandatory	Yes
Example	ETRS89.ETRF89.19890101
epsg	
Definition	Unique thematic identifier for coordinate reference systems
Description	4 or 5 digit code established by the former European Petroleum Survey Group Geodesy (EPSG) and maintained by the International Association of Oil & Gas Producers (IOGP)
Value Type	Integer
Mandatory	Yes
Example	4258 *(ETRS89, default)*
crs	
Definition	Coordinate reference system
Value Type	CharacterString (Text, 50)
Mandatory	Yes
Example	ETRS89 *(default)*
frame	
Definition	Reference frame of the Coordinate reference system
Value Type	CharacterString (Text, 50)
Mandatory	No
Example	ETRF89
epoch	
Definition	Time corresponding to the initial definition of a reference frame or system
Value Type	Date
Mandatory	No

2.6.3 Enumerations, code lists

All Enumeration or code lists are inherited from INSPIRE

2.6.3.1 CountryCode

List of Values	
AT	Austria
BE	Belgium
CH	Switzerland
…	

2.6.3.2 AdministrativeHierarchyLevel

List of Values	
1stOrder	International boundary

2.6.3.3 LegalStatusValue

List of Values	
agreed	Politically agreed
notAgreed	Politically not agreed

2.6.3.4 TechnicalStatusValue

List of Values	
edgeMatched	Boundaries of neighbouring countries have the same set of coordinates
notEdgeMatched	Boundaries of neighbouring countries have not the same set of coordinates

3 Reference Systems

To ensure the accuracy and homogeneity of the data, the representation in a consistent and known coordinate reference system is important. All data providers must deliver the data in a terrestrial reference system and his frame defined as ETRS89/ETRFXX. To allow the transformation of all national data provisions in an ETRF of the same epoch, it is important to deliver the frame epoch corresponding to the transformation in ETRF available in the country.

A reference system is represented with a mathematic model containing the definition of the system (ellipsoid, geoid model and map projection). Whereas a reference frame is the realization of the reference system in the form of coordinates set of terrestrial points. For each terrestrial reference system an official data frame is chosen.

All information about the reference system have to be provided with the SBE data type **CoordinateReferenceSystem.**

3.1 ETRS89

The European Terrestrial Reference System 1989 (ETRS89) is the mathematical model earth-centered and earth-fixed defined as reference system for the Europe. It is also required by INSPIRE.

ETRS89 is defined with the ellipsoid GRS80, and its spatial orientation was chosen to follow the movements of the Eurasian tectonic plate, and to ensure a time-invariant coordinates representation. Whereas European stations have movements of several centimeters within one year in the ITRS, ETRS89 was fixed to the stable part of Europe Most European countries generated since 1989 reference frame realizations, mainly based on GPS campaigns.

The ETRS89 Coordinates should be provided as geographic coordinates, that means longitude, latitude in decimal degrees.

3.2 ETRF

The ETRF domain defines the European Terrestrial Reference Frame used by each European country. ETRF89 is the data sets of coordinates for the ETRF89-fix points defined in 1989. ETRF89 was aligned to the International Terrestrial Reference Frame ITRF89 at the epoch 1989.0.

National coordinates constituting a Terrestrial Reference Frame were defined at different times and different reference frame (ETRFyy) by governmental institutes. Thus in 2000 a new Reference Frame was computed with the name of ETRF2000, matching with the ITRF2000. But not all European countries have measured and computed a new frame simultaneously; each country has his own correspondent ETRFXX. For this reason the information of frame (ETRS89/ ETRFXX) and correspondent epoch is important.

The transformation from ETRS89 to ITRS is time-dependent. For each ITRS solution, a matching ETRS89 solution is calculated. For example, ETRF2000, is an ETRS89 solution, which corresponds to ITRF2000.

3.3 Epoch

This domain defines the time corresponding to the initial definition of a reference frame or system. It is in different format represented: year and month (e.g. 1992.05), year and day, with from 0 to 365 (e.g. 1989.0) or year, month and day (e.g. 1993.01.01).

3.4 Height reference system

Previous SBE data model v4.13 defined the geometry with xyz coordinates (real 3D). For the new SBE data model, the geometry is defined basically with xy coordinates (2D). Additionally, attribute for border points include also height information as attribute (2.5D).

The heights of border points shall be provided in EVRS. The frame (EVRF2000, EVRF2007, future realisation) has to identical for edge matched (agreed) border points. If EVRS heights are not determined, it is possible to use ETRS89 ellipsoidal heights.

In case of not edge matched border points, height may be provided in a national height reference system.

Information about the used height reference system shall be included in the metadata.

4 Data quality / Technical guidance

To be added later

5 Metadata

The SBE data models inherits core metadata information as essential context for the geographic information.

An additional SBE metadata profile following the ISO 19115 (Metadata) standard will be provided by SBE KEN Coordination Committee.

6 Delivery

The standard delivery format is ESRI ArcGIS Geodatabase (version 10.3). A template of the SBE Geodatabase is provided by the SBE KEN Coordination Committee. It can be downloaded from the SBE webpages on the EuroGeographics website.

The use of alternative encodings, e.g. Shapefile, has to be clarified with the SBE KEN Coordination Committee.

The use of GML and the delivery by web services is not intended at the moment.

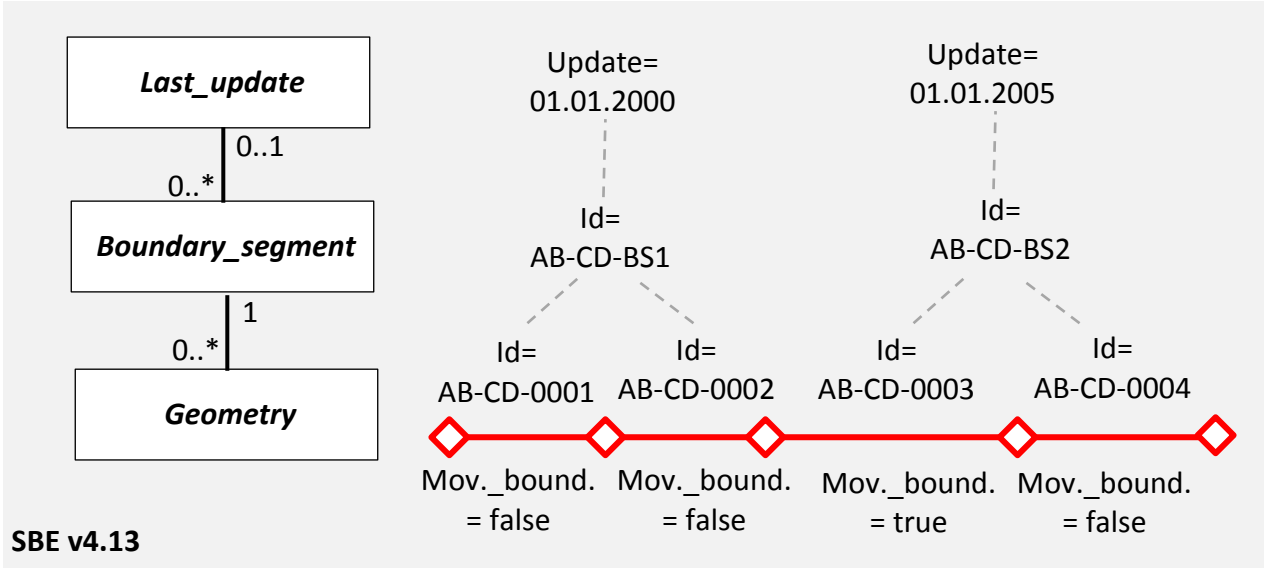
7 Maintenance

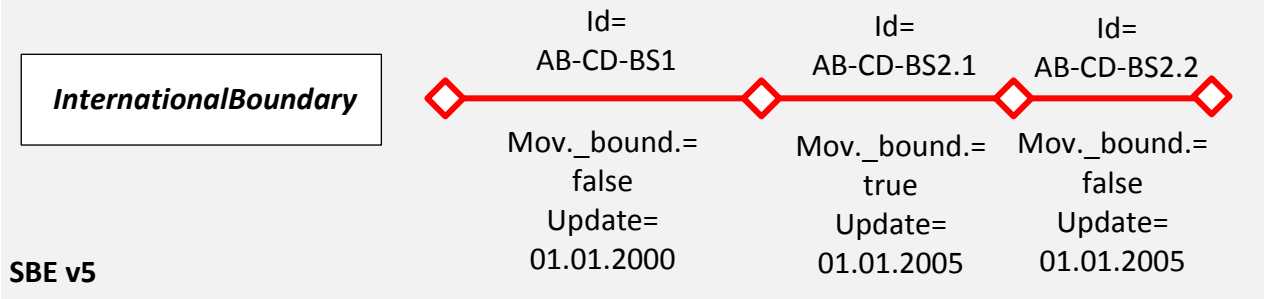
To be added later

Annex A – Changes from v4.13 to v5

The content of the SBE database in data model v4.13 was migrated to the new data model v5.0 in the following way:

- ***InternationalBoundary***:
  - The boundary lines have been mainly adopted from data type ***Boundary_segment***.
  - The geometry and the main attributes (*Accuracy, Country_left, Country_right, Moving_boundary, Political_status, Technical_status*) have been taken from the linked feature type ***Geometry***. All features with the same set of attributes were merged.
  - The identifier has been adopted from ***Boundary_segment***. In case that one new feature consists of parts with different sets of attributes, the identifier has been artificially extended by a dot and a sequential number.
  - The new attribute *lastMeasurement* has been filled by the date given in the linked data type ***Last_Update***.
  - From the linked data type ***Geometry_description*** only attribute *Remark* has been adopted.
  - The information included in the linked data type ***Boundary_description*** have not been adopted for the new data model.





- ***BorderPoint***:
  - The border points have been mainly adopted from data type ***Point*** (geometry and main attributes).
  - The new attribute *lastMeasurement* has been filled by the date given in the linked data type ***Last_Update***.
  - From the linked data type ***Point_description*** only attributes *Remark* and *Description* has been adopted by concatenating both into the new attribute *remark*.
- ***CoordinateReferenceSystems:***
  - A feature was created for each unique combination of *Reference_frame* and *Epoch* in the feature types ***Geometry*** and ***Point***.
  - Attributes *epsg* and *crs* where populated with default values.
  - The *identifier* was concatenated by *crs*, *frame* and *epoch.*
- ***CountryContact:***
  - This data type was created as combination of the data types ***Country*** (attributes *ISO_Code* and *Organisation*) and ***Contact_Point*** (attributes *Contact* and *Email*).
  - The *identifier* was concatenated by the country code and the abbreviation of the organisation (if part of the organisation name) or a sequential number.