

State of the Art of National Boundaries Analysis and Open Issues

EuroBoundaries Project – WP2 Scope and Strategy



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Executive Summary

The EuroBoundaries project

The EuroBoundaries (EB) project's main objective is to create a 'EuroBoundaries' dataset, the Definitive and high resolution European National Boundaries. The EB project also offers a solution for the issues related to cross border geometric and topologic integration.

The work started by a survey, questionnaire-based, of the state of the art of national boundaries data availability, ownership, national regulations, conditions of use, etc. The present report analyses and synthesizes the results of the questionnaires, out of which the project scope and strategy may be refined.

Outcomes of the Questionnaire

The responses give encouraging arguments in favour of the technical feasibility of implementing EB, and in favour of the possibility to start it in short term:

- For half of the boundaries, the two neighbour countries are already in the process of defining a common vector representation.
- The feasible EB geometric accuracy seems compatible with EuroSpec, whose main target is large scale Base Reference Information.

On the other hand, there are still very significant gaps in available adequate data. Hence it will be very long to get a complete EB dataset covering all boundaries, a minimum duration of 10 years can be roughly evaluated for the implementation phase of the EB project.

The national suppositions concerning EB dissemination are very opposed, from free dissemination and no restriction, to commercial dissemination taking into account copyright and collection and distribution costs.

Strategy for the EuroBoundaries project

The EuroBoundaries project should:

- Define a sound and stable strategy in collaboration with the relevant EuroSpec projects and ExGs (mostly Geodesy, DSA and IDS), based on identified requirements, comprising a vision for a draft implementation plan.
- Disseminate and discuss this strategy and implementation plan with the relevant experts and EuroGeographics members.
- Work out a vision of what is achievable in two, three, five years (as ten years is very long), and design plans to reach those objectives. This will develop by stages, gradually increasing the coverage, the content and the accuracy/quality.

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2 Introduction

Thanks to the respondents

First of all we do want to thank all the respondents to the questionnaire, because their replies have really brought much information. Now, the state of the art of boundary representations is clearer. The responses have understandably raised the need for more questions or clarifications, but already general tendencies are shown.

Objectives of the EuroBoundaries project

The EuroBoundaries (EB) project's main objective is to create a 'EuroBoundaries' dataset, the Definitive and high resolution European National Boundaries, on the base of a common data model and a data network in Europe.

The EB project offers a solution for the issues related to cross border geometric and topologic integration by aiming at providing a net of agreed lines and points, to which an individual dataset can be plugged in, in order to create a seamless whole.

WP2 – Scope and Strategy

The Workpackage 2 of the EB project will contribute to defining the scope and strategy of the project, and of the implementation phase, based mostly on the needs and requirements, and in particular in relation with the EuroSpec (mostly DSA and IDS) concepts and future implementation.

The WP2 is also based on the understanding of the national situations regarding definition and management of national boundaries data. This is why the work started by a survey, questionnaire-based, of the state of the art of national boundaries data availability, ownership, national regulations, conditions of use, etc. This questionnaire was sent in April 2005 to all EuroGeographics members (PCs), the target experts were those in charge of national boundary data.

The present report analyses and synthesizes the results of the questionnaires, out of which the project scope and strategy may be refined.

The questionnaire was about the state of the art, so it did not address human resources and financial resources for the EB project, though these are important issues.

3 Results of the Questionnaire, Analysis

Brief overview of replies

We got 21 replies i.e. half of EuroGeographics members: Austria, Belgium¹, Croatia, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Latvia, the Netherlands, Northern Ireland, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Ukraine.

¹ There are two Belgian members of EG. General Administration of Patrimonial Documentation replied as it is in charge of boundaries, not IGNB.

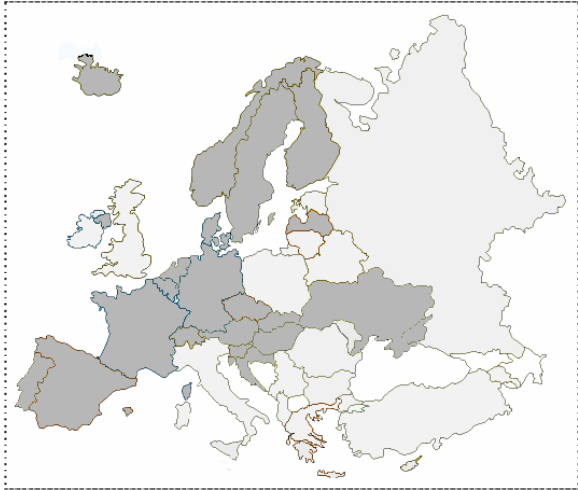


Figure 1. Countries that answered (in dark)

Iceland is an island in the North Atlantic Ocean. Therefore they could not answer to the questions and are not included in the analysis.

21 replies give quite a good rate of response, which shows that the EuroBoundaries concept is attractive. Though, some important countries and boundaries are lacking. However, we suppose that the lacking replies would not change very much the trends of this analysis, and that the 21 replies are quite representative of the whole Europe.

Some of the sections of this document were not numbered in order to keep the numbers of the questions as in the questionnaire.

3.1 Bilateral Regulations

3.1.1. Are there bilateral boundary treaties?

The answer is yes for most of the boundaries, with a few exceptions.

The exceptions are: Croatia – Serbia-Montenegro, Croatia – Slovenia, France – Andorra.

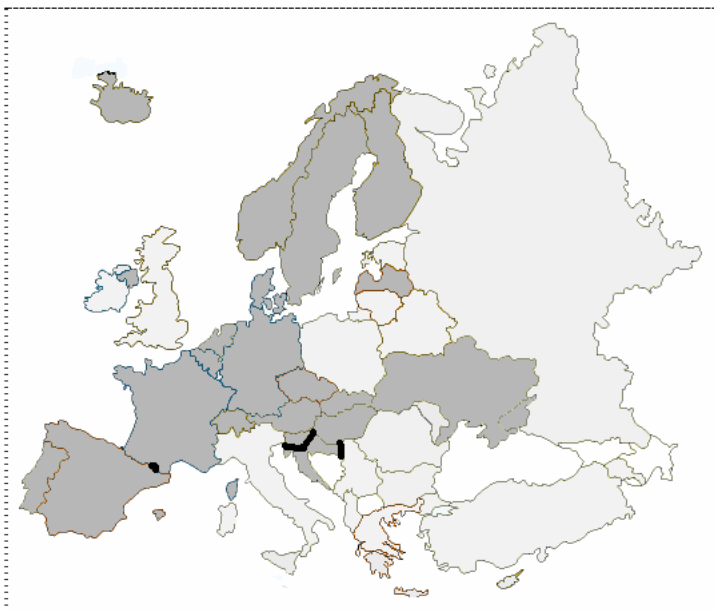


Figure 2. Boundaries without treaty

3.1.2. Are there agreed documents (e.g. maps, co-ordinates based on geodetic measurements, description of the boundary)?

The answer is yes for most of the boundaries, with a few exceptions.

The exceptions are: Croatia – Serbia-Montenegro, Croatia – Slovenia, Latvia – Russia.

However, some of the documents are old and not updated, which is mentioned by Finland and France. Some other countries mention dates that are quite old e.g. beginning of the 20th century.

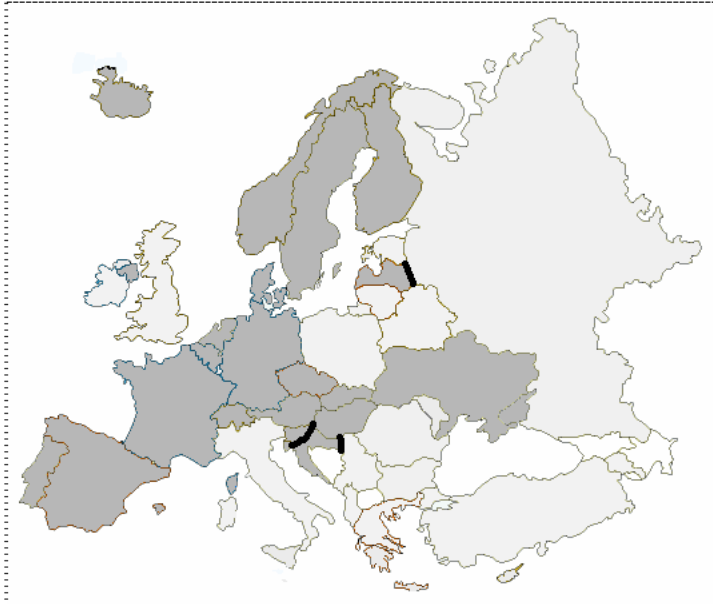


Figure 3. Boundaries without agreed documents

3.1.3. Are there active common boundary commissions with clear regulations for their tasks?

The answer is yes for most boundaries, with a few exceptions.

The exceptions are: Belgium – Luxembourg, Belgium – France, Croatia – Hungary, Croatia – Slovenia, France – Andorra, Germany – Switzerland, Hungary – Romania.

In Belgium, one of the results of the EuroBoundaries project could be the creation of permanent commissions. This would improve the definition of their boundaries.

Some commissions have long periods between official gatherings: Denmark – Germany every 10th year; Finland – Sweden, Finland - Norway and Norway - Sweden every 25th years.

However in the Finnish case, the ordinary commission every 25th year takes care of so called "Ordinary boundary inspection" when the whole boundary is checked, but between two of this kind of inspections exists also a boundary commission, which will take care of all kind of needed activities to manage boundary questions. So although the "big" inspection is not so often, they are active all the time.

In the Danish case, despite the 10 years cycle period, the commission can meet under exceptional circumstances. In addition the boundary is maintained frequently if boundary points are damaged.

3.1.4. Are there agreements on the definition of the boundaries with the neighbouring countries?

The answer is yes for all boundaries, with a few exceptions (Portugal and Spain).

This question 3.1.4 was a little ambiguous with respect to the questions 3.1.1 and 3.1.2, as boundary definitions are contained in treaties, However, the meaning of question 3.1.4 was that boundary detailed definitions may be contained in further documents.

Generally the answers to 3.1.4 are the same as the answers to 3.1.1 and 3.1.2.

Concerning the boundary between Portugal and Spain, there is a treaty defining it, but it left untraced the boundary in Olivença region. For this region, the boundary is not politically defined but there is no dispute.

3.1.5. Are there political issues or disputed areas between your country and its neighbours?

Approximately half of the respondent countries say they have no dispute. These are the following countries: Austria, Belgium, Czech Republic, Denmark, Finland, Hungary, Northern Ireland, Norway, Slovak Republic.

Many replies concerning disputes are asymmetric, e.g. country A mentions no dispute with country B while country B mentions one. Such asymmetric replies are comprehensible as they concern only small disputes that some countries did not find worth being mentioned, or sea limits that were addressed only by few responses.

There is a lot of disputes that are small and localised: France – Italy (Mont Blanc/Monte Bianco), France – Spain (some interpretation difficulties in the Pyrenees; “Faisans” Island shared sovereignty), Germany – Netherlands (Ems-Dollard region), Germany – Austria – Switzerland (Bodensee – Lake Constance), Germany – Denmark (in the following areas, with German names: north of Sylt and one “Förde”; with Danish names: inner part of Lister Dyb and Flensborg Fjord), Germany – Luxembourg (certain bodies of water form a “common territory”), Portugal – Spain (mouths of rivers Minho and Guadiana), Spain – Gibraltar, Sweden – Norway (in a smaller part of the Swedish-Norwegian boundary off-shore), Ukraine - Romania (EEZ in Black Sea).

There are also some disputes that seem to concern a longer part of the boundary, but for few boundaries. Such disputes seem to concern the following boundaries: Croatia – Slovenia, Croatia – Bosnia-Herzegovina, Croatia – Serbia-Montenegro, Latvia – Russia. However, there may be also such disputes in some countries that did not reply to the questionnaire.

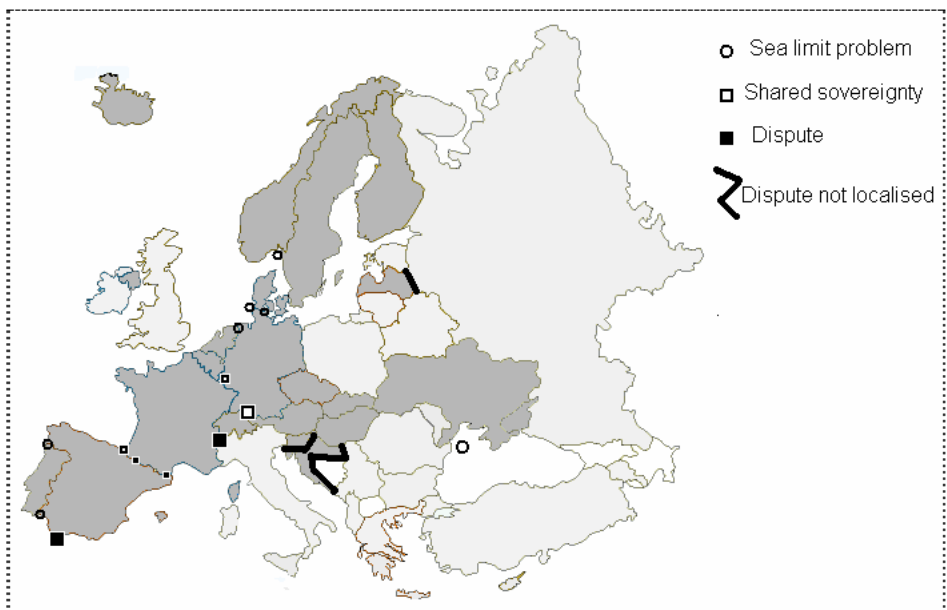


Figure 4. Disputed Areas.

3.2 Bilateral Boundary Data

Bilateral Boundary Points

3.2.1. Are there bilaterally agreed boundary points and coordinates with the neighbouring countries?

All the answers are positive about agreed boundary points, at least for part of the boundaries.

Almost all the answers are positive about agreed coordinates. The exceptions are Belgium, France (has agreed coordinates only with Italy), Spain.

However, we guess that the available points or coordinates are far from exhaustive, as they probably do not concern the disputed areas of previous section.

Which co-ordinate system and projection system do you use for the boundary points?

Almost all the respondents use national coordinate systems.

However ETRS89 is already directly used in some boundaries: Finland – Norway, France – Italy, Norway – Sweden.

And many countries are preparing to use ETRS89: Germany – Austria and Germany – Czech Republic (they prepare to transform into ETRS89), Slovak - Ukrainian boundary (work in ETRS89 has started this year 2005), Slovenia - Italy (new documentation will use ETRS89), Austria – Switzerland (pilot project to transform from both national systems to ETRS89).

3.2.2. What is the accuracy of the bilaterally agreed coordinates?

First it has to be mentioned that for several boundaries, there is not *one* accuracy but there are *several* accuracies, depending on the type of boundary points.

For natural boundary lines like watersheds or middle of rivers or unmarked boundary points, the accuracy is lower than for fixed boundary points or monument boundary points, which is mentioned by Austria, Czech Republic, and the Netherlands, and which is true for other countries too I guess. For such natural points, the accuracies indicated by these three countries are: 1 metre, 1 decimetre, up to metres.

Moreover, Austria rightly mentions that for natural points the source may be photogrammetry, which in general entails less accuracy than GPS measurements.

Therefore, the EB data model should contain an accuracy attribute for each single boundary point or line.

Now if we do not take into account natural points, here are the answered accuracies²:

- accuracy \leq 1 decimetre: 5 cases
- 1 decimetre < accuracy < 1 metre: 10 cases
- 1 m \leq accuracy < 3 m: 3 cases
- 3 m \leq accuracy: 1 case

These figures show that data with good geometrical accuracy are available.

Bilateral Boundary Vector Data

3.2.3. Do the SABE, EuroGlobalMap, EuroRegionalMap representations of the boundaries of your country rest on explicit bilateral agreements?

No: 11 countries. Yes: 6 countries.

So a majority of countries seems not to agree with the boundary representations of SABE, EGM, ERM. This can be explained as these projects rightly focussed on supplying edge-matched data in short term viewpoint, while getting proper agreements about boundary representation may take more time in a more long term viewpoint.

This is one more justification for the EuroBoundaries project, which should coordinate with the SABE, EGM, ERM projects so that they use the results of EuroBoundaries when available.

Belgium also points out that data concerning boundaries (and also data about administrative boundaries) of SABE, EGM, ERM are not official data.

3.2.4. Are you in a process for defining/improving a common vector representation of a boundary segment with the neighbouring countries?

The results cannot be counted according to countries, as for each country, the situation may differ depending on its neighbours, so the results are counted according to boundaries i.e. couples of neighbour countries.

Country 1	Country 2	Reply from country 1	Reply from country 2
Austria	Czech Republic	Yes, started	Yes
Austria	Germany (Bavaria)	Yes, started	yes: EGM, SABE, ERM
Austria	Hungary	Yes, started	No
Austria	Italy	Yes, soon starting	
Austria	Liechtenstein,	Yes, started	
Austria	Slovenia	Yes, soon starting	Yes
Austria	Switzerland	Yes, finished	Yes
Belgium	France	Not yet	Yes for ERM
Belgium	Germany	Not yet	yes: EGM, SABE, ERM
Belgium	Luxembourg	Not yet	
Belgium	The Netherlands	Not yet	No
Croatia	Bosnia-Herzegovina	Yes	
Croatia	Hungary		No
Croatia	Slovenia	Yes	No
Croatia	Serbia-Montenegro	Yes	
Czech Republic	Slovak Republic	Yes	Yes
Czech Republic	Poland	Yes	
Czech Republic	Germany	Yes	yes: EGM, SABE, ERM
Denmark	Germany	No – but a necessity is foreseen.	yes: EGM, SABE, ERM
Finland	Russia	Yes, under process.	

² The total of answered accuracies is not the same as the total of respondent countries, because some countries replied “accuracy unknown”, and some countries distinguished the accuracies depending on their boundaries with different countries.

Finland	Norway	Yes, completed (2000)	Yes
Finland	Sweden	Yes, under process.	Yes
France	Switzerland	Yes for ERM	Yes
France	Germany	Yes for ERM	yes: EGM, SABE, ERM
France	Luxembourg	Yes for ERM	
France	Spain	Yes for ERM	Yes
France	Andorra	Yes, under process	
France	Italy	Not yet	
Germany	Poland	yes: EGM, SABE, ERM	
Germany	The Netherlands	yes: EGM, SABE, ERM	No
Germany	Luxembourg	yes: EGM, SABE, ERM	
Germany	Switzerland	yes: EGM, SABE, ERM	Yes
Hungary	Romania	No	
Hungary	Ukraine	No	No
Hungary	Slovak Republic	No	No
Hungary	Slovenia	No	Yes
Hungary	Serbia-Montenegro	No	
Latvia	Russia	No	
Latvia	Estonia	No	
Latvia	Lithuania	No	
Latvia	Belarus	No	
Northern Ireland	Ireland	Yes	
Norway	Sweden	Yes	Yes
Portugal	Spain	Yes	Yes
Slovak Republic	Ukraine	Yes	No
Slovak Republic	Poland	No	
Slovenia	Italy	Yes	
Spain	Andorra	Yes	
Switzerland	Italy	Yes	
Ukraine	Russia	No	
Ukraine	Belarus	No	
Ukraine	Poland	No	
Ukraine	Romania	No	
Ukraine	Moldova	No	

54 boundaries are concerned by the responses.

For 28 boundaries (52%), there are positive and consistent replies (green lines).

For 8 boundaries (15%), there are different or inconsistent replies between the two neighbour countries (orange lines).

For 18 boundaries (33%), there are negative and consistent replies (red lines).

For Denmark – Germany, the Danish answer concerns only the legal border, which is why their answer does not include SABE, EGM and ERM.

In general, Germany responded "yes for SABE, EGM, ERM", and similarly France responded "yes for ERM", which implies a geometric accuracy that is not enough for EuroBoundaries. However, in

some cases, EGM and ERM are a first intermediate step of a bilateral negotiation that will have to be deepened for EuroBoundaries.

Another part of the different replies (orange lines) is inconsistent. The reason of such inconsistencies is probably that in the questionnaire the notion of what EuroBoundaries expects as agreed vector boundary representation was not so clear.

In conclusion, for approximately half of the boundaries, the two neighbour countries are in the process of defining or improving a common vector representation.

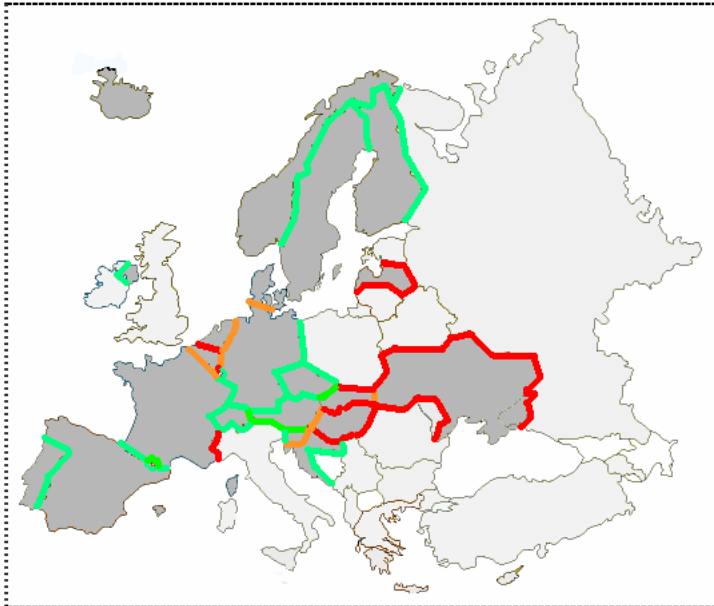


Figure 5. Boundaries in a process for defining a common vector representation

3.2.5. What are approximately the length of the agreed vector representations and its percentage with respect to the total length of the boundaries of your country?

The responded percentage is 0 in 7 cases, and is >0 in 7 cases: 7%; 30%; 44%; 60%; 68%; 70%; 88%, 100%.

However, in some cases, the vector representations considered are not bilateral. For example, in Belgium, all boundaries have a vector representation but not agreed.

3.2.6. What is the highest accuracy of the boundary vector geometry that could be used in the EuroGeographics project (in metres)?

As mentioned above, in the questionnaire the notion of what EuroBoundaries expects as agreed vector boundary representation was not so clear. According to the EB data modelling expert group, the vector representation required by EuroBoundaries will have to contain both the legal boundary points and the lines between the legal boundary points according to the boundary documentation i.e. continuous digital vector objects. Besides that, the EB dataset will have to contain the “connecting points” i.e. the intersections between the boundaries and topographic features e.g. hydrography or transport. These connecting points are necessary to enable the connection between the neighbouring national datasets – one of the aims of the EB project.

To answer to this question 3.2.6 (accuracy of boundary vector data), many respondents refer to question 3.2.2 (accuracy of boundary points). Not distinguishing these two questions is right

provided that boundary points mean all boundary vector data, i.e. boundary legal points plus boundary connecting points.

We guess this is right for some boundaries, for which topographic points would be captured and managed together with legal boundary points, so that the geometrical accuracy of both kinds of points would be high.

But it is likely that for some other boundaries, connecting points are not managed together with legal boundary points, but are managed in topographic vector datasets, whose accuracy is generally less than boundary points, because topographic data are generally captured through photogrammetry while boundary points are often captured through more accurate geodetic techniques e.g. GPS.

For example, Slovak Republic mentions that they cannot supply topographic nodes with the same accuracy as boundary coordinates. The accuracy they can supply depends on individual state border, so they cannot express by a number the accuracy of the boundary vector geometry that could be used in the EuroGeographics project.

Moreover, Slovak Republic and Hungary rightly mention the problem that the transformation into ETRS89 may alter the geometric accuracy available in each national system.

Because of these ambiguities about connecting points and about the accuracy of the transformation process into ETRS89, it is not possible at the moment to have a precise idea of the accuracy of the boundary vector geometry that could be used by EB, more enquiry with NMCAs would be necessary.

However, the responses to 3.2.6 give a rough idea about the accuracy of the boundary vector geometry that could be used by EB, here is our interpretation:

- 2 NMCAs will be able to supply data with accuracy in the region of one decimetre;
- 4 NMCAs will be able to supply data with accuracy in the region of one metre;
- 2 NMCAs will be able to supply data with accuracy of 3 to 5 metres;
- 1 NMCA will be able to supply data with accuracy 35 m.

3.2.7. Can the data be delivered in ETRS89 geographic co-ordinates?

There are very few negative responses (Belgium, Czech Republic, Portugal, Ukraine) and these negative responses are generally temporary concerning only the very present situation, generally these countries could be able to deliver ETRS89 coordinates if necessary.

15 countries out of 20 reply 'yes', which shows that ETRS89 is now widely spread.

However these positive responses are generally not clear about two issues:

- a) Is there bilateral calculating of ETRS89 coordinates?
- b) Is there uncertainty in the transformation parameters?

Concerning point a), Austria mentions that it has started bilateral calculating of ETRS89 coordinates with its neighbours, and also Hungary with Ukraine and Serbia-Monte Negro, also Norway with Finland and Sweden. In case of Austria: both sides calculate "their" ETRS89 co-ordinates in a common project and discuss how to get only ONE value for a point as from both sides agreed ETRS89 co-ordinate.

On the other hand, some countries mention that they can deliver boundary data in ETRS89 coordinates but also mention that such coordinates are not bilaterally agreed, for example Denmark, Hungary and Slovak Republic. If a country calculates the ETRS89 co-ordinates only for itself and not within a common project, they are not agreed co-ordinates, therefore they are not adequate for EB. The situation is probably the same for other countries, which should be clarified: for the other 'yes' responding countries it is not clear whether they have started bilateral calculating of ETRS89 coordinates.

Concerning point b), Denmark mentions that transformed values can be given, but only approximately. And Norway mentions that there is uncertainty in the transformation parameters. This issue is the same as the issue in previous section about transformation into ETRS89 altering the accuracy. Again, the situation is probably the same for other countries, which should be clarified.

ETRS89 is a new co-ordinate system and the NMCAs have not so much experience with it until now; besides that, the change to this new system makes problems in various ways, e.g. tradition, technical matters, financial and legal aspects, personnel aspects.

3.2.8. Can the boundary dataset include also topographic feature nodes and/or shared geometry with topographic features?

13 countries reply 'yes', and 6 countries reply 'no'.

a) Requirement from some countries to separate topographic data from boundary data: Sweden expressed some reluctance to supply connecting points by writing "Nodes on specific features can be delivered at the Swedish-Norwegian boundary but not as a part of the boundary!". The reason of that response is that the question seemed to mix boundary data and topographic data, while they have to be distinguished. The connecting points are not points in the sense of the boundary documentation, they just lay "flexible" on the boundary without disturbing its course.

In the Swedish case, the boundary is defined by a treaty, which indicates that in some areas the boundary follows a natural feature (e.g. a river, a Talweg) or another topographic feature (e.g. a road). Such topographic features may evolve or move in the real world, hence the boundary (for example the deepest part of a Talweg) is defined every 25 years by the two neighbour countries, then it does not change (i.e. the boundary is fixed) till the next update.

In the Swedish-Norwegian boundary dataset, roads are included for the purpose of interoperability between national data, but roads are in specific themes that are different from the legal boundary theme, and with a different update schedule. The boundary theme contains marks (e.g. every 8 km or 4 km), intermediate marks or signs, a cartographic line (e.g. a vertex every 20 m). The connecting points are in another theme and they may evolve independently from the boundary theme.

The EB data model satisfies Sweden, as it models no connection between topographic features and boundaries.

b) Technical inconsistency in some countries between topographic data and boundary data: Hungary wrote that it cannot supply topographic nodes at the level of boundary coordinates accuracy. This comment is true for many other countries too (cf. section 3.2.6).

Similarly, France replied 'no' because its topographic features are in layers different from administrative limits layer. The other NMCAs responding 'no' probably have digital topographic datasets from which connecting points might be extracted, but such data might be inconsistent with boundary data.

Such inconsistency is different from the Swedish-Norwegian case, in which the difference between boundary data and topographic data is meaningful and accurate.

For the Hungarian case and probably for many other countries too, as the EB data model contains no connection between topographic features and boundaries, the difference of accuracy between boundary points and topographic points seems not to be a problem.

In the French case, there is no sharing of topology between boundary data and topographic data, as they are in different layers, and topology is managed only internally to each layer. This is due to a general specification choice, and not to an accurate management of boundaries like in the Swedish-Norwegian case. However, the geometry of boundary data is shared with that of topographic data except for a small percentage of points. As the EB data model contains no connection between topographic features and boundaries, the French topographic points seem to be usable for compliant EB data.

3.3 National Regulations

3.3.1. Who are the boundary stakeholders? (e.g. Ministry of Interior, Ministry of Foreign Affairs, local authorities, authorities in charge of the maintenance of the boundaries...)
8 countries indicate only one stakeholder, 5 countries indicate 2 stakeholders, and 7 countries indicate 3 stakeholders or more. So for the majority of countries (12 out of 20), there are several stakeholders.

The kinds of stakeholders are the following:

- Ministry of Foreign Affairs: in 11 countries.
- NMCA: in 9 countries.
- Ministry of Interior: in 7 countries.
- Local Authorities: in 6 countries.
- Ministry of Economy: in 1 country.
- Ministry of Defence: 2 (including 1 military NMA).

3.3.2. Who is responsible for the national / bilateral boundaries, the boundary commission, for updating the documents, for making the geodetic measurements, for showing the boundary in the cadastral maps (if there are such) and in the topographic maps; is there a database for the documents and co-ordinates?

For some responses, these different responsibilities were not distinguished, or only parts of these responsibilities were indicated. So below, the number of quoted responses varies according to each item.

Responsibilities

Ministries are generally responsible for Boundary Commissions: ministry of foreign affairs (3 responses), ministry of interior (3 responses), ministry of economy (1 response), parliament (1 response).

The responsible body for updating the documents is varied: NMCA (4 responses), ministry of interior (2 responses), boundary commission (1 response).

For 5 responses out of 7, this is the NMCA which is the responsible body for making the measurements. There are also ministry of interior (1 response) and boundary commission (1 response).

Logically, the responsible body for showing the boundaries in cadastral maps is the Cadastral Office (if different from NMA: 2 responses), or the NMCA (2 responses).

Logically again, the responsible body for showing the boundaries in topographic maps is the NMCA or NMA (7 responses).

In conclusion, the answers to the previous question show that there are many players involved. The answers to the current question show that the responsibilities are dispatched between all these players in varied inter-relations.

For most of the cases, the NMCA (i.e. a EuroGeographics member) is directly involved in some of the boundary responsibilities. However, there are a few exceptions:

- in Germany, BKG is involved, but most of the work is assigned to the Surveying offices of the Federal States (which are not EuroGeographics members);
- in Portugal, this is the military NMA (not member of EuroGeographics) who is responsible for boundary tasks.

Database for coordinates

There exists a DB of coordinates for 4 responses.

For 2 responses, there is no DB of coordinates, but there is a digital file of coordinates.

Total DB or digital file existing: 6 responses.

There is no DB and no digital file for 4 responses.

The Danish case is interesting, as the situation is probably similar in several other countries: In Denmark, there is no specific "Border database" containing digital files for legal border coordinates or documents. However, in their digital cadastral and topographic maps the border coordinates are represented. These coordinates are not bilaterally agreed.

Database for documents

A DB of documents is under construction in Belgium, and is planned in Austria and Czech Republic.

3.3.3. Are there important national regulations about the boundaries to be noted here?

This question was not precise enough, this is why it got 7 negative answers.

The law/regulation about the responsibilities concerning national boundaries was mentioned by 5 countries: Austria, Czech Republic, Slovak Republic, Slovenia, Ukraine.

The law/regulation about state surveying, cadastre and mapping was mentioned by 3 countries: Croatia, Hungary, the Netherlands.

3.4 National Regulations concerning the Dissemination of Data

3.4.1. Who is owner of the documents and data about the boundaries? (e.g. NMA, Cadastre, local authorities, Military,...)

In most countries, there are several owners. Here are the occurrences:

- NMCA: in 16 countries.
- Ministry of Foreign Affairs: in 7 countries.
- Ministry of Interior: in 5 countries.
- Local Authorities: in 1 country.
- Ministry of Economy: in 1 country.
- Ministry of Defence: in 2 countries (including 1 military NMA)

For the purpose of disseminating EB data, it is of course better if the owner is the NMCA member of EuroGeographics (16 cases out of 20), and there might be a problem for the countries in which the NMCA is not owner (4 cases out of 20): Czech Republic, Latvia, Portugal, Spain.

However, it seems possible for EB to disseminate boundary data from these countries:

- In Czech Republic and Latvia there is no copyright for boundary data.
- In Portugal, IGP (EG member) is responsible for the updating and availability of administrative bounds – with which the boundary line coincides.
- For Spain, the question has to be clarified.

In many countries, though NMCA is not owner of the original boundary documents, it is owner of boundary geographic data usable by EB. For example in Belgium, Foreign Affairs keep original treaties and documents, but General Administration of Patrimonial Documentation (GAPD) is competent for the geometric description of boundary points. GAPD is building a database with all the documents and geometric descriptions. The same holds true for Sweden, originals from the overhauls are owned by the government, but copies are archived and maintained by Lantmäteriet, and data on the boundary is treated as other geographic data.

3.4.2. Are there national regulations concerning the dissemination of boundary data?

14 out of 20 countries reply no, which is in favour of the possibility to disseminate EB data. Moreover, Finland, the Netherlands and Sweden mention that boundary data are publicly accessible.

For the 6 other countries, there are such regulations. Such regulations are a problem for the EB project only for one country (Ukraine, cf. following question), and are not a problem for the EB project for the 5 below countries:

In Austria, there is regulation about the places where the boundary data have to be available, and about their dissemination to other administrative units. However (following question), there are no restrictions, the treaties and documents are open to the public.

In Croatia, there is regulation and restriction about the expense for using State survey and cadastre data, which does not prevent EB data dissemination provided it entails compliant expenses. Similarly in the Slovak Republic, there is a law on administrative fees. And Slovak Republic has no restriction (following question).

In Slovenia, there is a bill about Real estate property, national border and spatial units registration. And there are no restrictions (following question).

Portugal mentions that the national entity responsible for the updating and availability of boundary data is the IGP. And there are no restrictions (following question).

3.4.3. Are there confidentiality or other regulation restrictions?

17 out of 20 countries reply no, which again is in favour of the possibility to disseminate EB data.

There are only two countries in which the EB project will face restrictions: Hungary and Ukraine.

In Hungary, there is confidentiality restriction concerning the Ukrainian boundary maps. In Ukraine too there are restrictions.

Croatia is not a problem for EB, cf. previous section.

3.4.4. What are the prices for these products, is there a copyright?

The situation is very varied according to countries:

- In 3 countries there is no Copyright, in 11 countries there is a Copyright.
- In 4 countries the data are free, in 11 countries they have to be paid for.
- In 1 country, there has been no sale until now.

3.4.5. What dissemination principles and conditions do you recommend for the EuroBoundaries dataset?

Again, the recommendations concerning EB dissemination are very opposed:

- 3 countries say that EB dissemination should have no restriction.
- 4 countries point out copyright issues.
- 2 countries consider that there should be fees only for copies or for distribution.
- 3 countries say that EB data should be sold taking into account collection costs.
- 2 countries demand that EB dissemination principles remain compliant with national dissemination policy.

3.5 Data model

3.5.1. Do you already have a conceptual model for your boundary data?

The answer is no for 7 countries: Denmark, France, Germany, Latvia, Northern Ireland, Slovak Republic, Spain.

The answer is yes for 8 countries: Finland, Hungary, Netherlands, Norway, Slovenia, Sweden Switzerland, Ukraine.

The conceptual model is planned or in development for 5 countries: Austria, Belgium, Croatia, Czech Republic, Portugal.

3.5.2. Do you already have a model and a process to transform your national coordinates into ETRS89?

18 countries replied 'Yes' or 'Underway'.

Only 2 countries replied 'Not yet': Czech Republic, Portugal, but I guess that this situation is temporary, cf. section 3.2.7.

3.5.3. Are there agreed digital documents? Please indicate the percentage.

From my interpretation of the answers, 9 countries out of 20 have agreed digital documents: Czech Republic, Finland, Latvia, the Netherlands, Norway, Slovak Republic, Slovenia, Sweden, Switzerland.

The percentage was indicated by Czech Republic (40%), Finland (30%), Latvia (50%), and Switzerland (10%).

This question was ambiguous, as some respondents understood it addressed any kind of digital data, including DB of coordinates, while in fact it addressed documents about treaties, boundaries, or boundary points.

So it would be useful to clarify the definitions of digital documents expected by the EB data model.

4 Considerations on the EB Questionnaire

The below considerations consider pending problems and open issues raised by the questionnaire analysis, and suggest possible solutions for open discussion.

4.1 Questions about Bilateral Regulations and EB

There are treaties, agreed documents and Boundary Commissions for most boundaries. Hence, from the point of view of bilateral regulations, the EB project has a sound basis.

However, the fact that disputes are numerous (though generally small) has to be considered and raises the following issues:

- a) Is it required that EB provides a continuous boundary data including provisional data even on disputed areas?
- b) Are EB provisional data acceptable for disputed areas? Is it required that the EB dataset contains the (two national) different disputed representations?
- Concerning the technical aspects, it is necessary to identify who should be included in that discussion, as this goes beyond the competences of only the EuroBoundaries project.
 - It is suggested that EuroSpec/DSA gives requirements about continuous (a) or double (b) boundary data for interoperability and edge-matching between national datasets.
 - It is suggested that EuroSpec/IDS gives requirements about international boundaries as data included in large scale topographic data (issues a and b).
- Concerning the political aspects, it should be kept in mind that NMCA's have legal and political constraints that have to be taken into account by the EB project for issue b).

A possible solution might be to include three datasets in the disputed parts of the EB dataset: the two national datasets plus a third provisional dataset for interoperability. These three datasets could easily be distinguished through adequate attributes.

4.2 Comments about available boundary data and EB

4.2.1. Technical Feasibility of the EB project

The replies to the questions 3.2.1 to 3.2.8 lead to the following conclusions:

- Almost all the boundaries have bilaterally agreed coordinates.
- For half of the boundaries, the two neighbour countries are already in the process of defining a common vector representation.
- The feasible EB geometric accuracy (cf. 3.2.6) seems globally compatible with EuroSpec whose main target is large scale GI, i.e. Base Reference Information.

- In most countries, data can be delivered in ETRS89 geographic co-ordinates.
- In the majority of countries, connecting points can be delivered.

These are encouraging technical arguments in favour of:

- the technical feasibility of producing data compliant with the EB data model;
- the availability of a significant amount of input vector data adequate to start producing the EB dataset in short or medium term.

4.2.2. Gaps in Available Data

On the other hand, the 'other side of the coin' has to be considered:

- For half of the boundaries, the two neighbour countries are not in the process of defining a common vector representation. Though in the majority of countries ETRS89 geographic coordinates of boundary points and of connecting points can be delivered (cf. previous section), such coordinates and connecting points are not bilaterally agreed for at least half of the boundaries.
- 6 out of 20 countries cannot supply connecting points at the moment. Moreover, for the countries that can deliver connecting points, it is not clear whether such connecting points are bilaterally agreed.
- It is not very clear for some countries whether the transformation into ETRS89 may alter the geometric accuracy.

So many vector data are lacking at the moment to produce the EB dataset, there still remains a big and long term job to be carried out. Hence it will be very long to get a complete EB dataset covering all boundaries (at least all undisputed boundaries), a minimum duration of 10 years can be roughly evaluated for the implementation phase of the EB project.

This evaluation is very approximate, it is based on the varied experiences in bilateral boundary works. At the moment we do not have enough information to make a more precise assessment of the duration. Anyway, we should keep in mind the particular sensitive nature of boundaries, whose issues require a long time to be solved, so a long duration is unavoidable.

Consequently, temporary solutions are necessary (cf. below).

4.2.3. Need for more enquiry within EuroSpec about connecting points

The EB current data model contains no connection between connecting points and boundaries, which seems compatible with the following aspects of topographic data management by NMCAs:

- a) Concerning the accuracy inconsistency (boundary points are supposed to be more accurate than connecting points in NMCA data), it seems possible for the EB dataset to combine points with different levels of accuracy – which will be recorded as each EB point will have its own attribute indicating its accuracy.
- b) Concerning the fact that some NMCAs manage the boundary points and connecting points in different layers or different datasets, it seems possible for the EB dataset to combine points with different signification and source – which will be recorded as each EB point will have its own attribute indicating its meaning.

However, a discussion is necessary to enquire whether these aspects of the EB data model meet the requirements:

- It is suggested that EuroSpec/DSA enquires whether (a) and (b) do not prevent interoperability and edge-matching between national datasets. The problem is that (a) and (b) entail that connecting points are generally not located sharply on the boundary but more or less away from it.
- It is suggested that EuroSpec/IDS indicates whether (a) and (b) are acceptable for the needs and uses of large scale base data.

4.2.4. Need for more detailed information from NMCAs

In order to confirm the technical feasibility of the EB project and to define more in detail the EB implementation phase, there is a need for more detailed information from NMCAs and their boundary experts.

The EB project will need the cooperation of NMCAs and their boundary experts about using and introducing the EB data model.. Before the implementation phase of the EB project, it is suggested that the EB project communicates the EB vector data model and asks each NMCA to match this model with its national situation and assess what can be supplied.

Also, more detailed information is needed about the following issues:

- Is there bilateral calculating of ETRS89 boundary coordinates?
- Accuracy of the data that may be supplied to EB?
 - Accuracy of not only fixed boundary points but also natural boundary points and connecting points.
 - Consequences of the transformation into ETRS89 on the accuracy.

The latter issue would need in addition a specialised investigation.

4.2.5. Need for more enquiry with ExG on Geodesy

We also suggest a contact to the ExG on Geodesy to clarify ETRS89 issues.

- Does the transformation into ETRS89 alter the accuracy?
- Does this altering depend on countries?
- What is the reason of this altering?
- Can this situation be improved in future?

4.2.6. Ideas about temporary solutions for the continuity of the EB Dataset

To achieve interoperability of national data sets, EuroSpec requires for special programmes continuous and complete boundary datasets. This point has to be confirmed by EuroSpec experts.

Waiting for EB completion (i.e. for a very long time, at least 10 years), there are two possible solutions:

- a) EuroSpec uses in the meantime a complete boundary dataset other than EB e.g. ERM.
- b) EuroSpec uses a dataset mixture of EB definite boundary data and other data in EB 'holes' e.g. ERM.

Argument in favour of a mixed dataset

We should keep in mind that EuroSpec addresses large scale data, hence middle scale data (e.g. ERM) is not adequate and should be used as least as possible by EuroSpec. So both solutions a)

and b) seem bad, however solution b) seems less bad than a) as b) imposes less middle scale data to EuroSpec. This will be all the more true as EB completion will progress. Suppose for example that after 8 years, the completion rate of the EB dataset is 90%, then solution b) would be really better than solution a), for which it would be a pity that EuroSpec would not use the 90% large scale boundary data available.

The EB 'mixed' dataset might have many parts with a lower quality level - this might be managed through EB quality attributes. The issue here is more about metadata, or attribution of the boundary data rather than the data itself. The EB dataset will be built incrementally, and not all segments can have the same status and quality:

Inconvenience of middle scale data

However, solution b) entails that EB data will be heterogeneous, which may raise the problem how to connect properly the large scale EB definite boundary data with middle scale data (e.g. ERM)? This case is taken into consideration at the EB data model as the "constructed" value of the "technical status" attribute of the "boundary" feature class. This connection would have to be managed easily, as new EB definite data segments would be available step by step.

Moreover, international boundaries are needed by EuroSpec and INSPIRE at large scale not only for edge-matching but also as part of the administrative boundaries layer.

So the IDS expert group suggestion to temporarily fill EB holes would be that each couple of neighbour countries would agree to choose one of their two national large scale representations as temporary solution.

This suggested temporary solution would be possible provided that neighbour countries agree it, and would in no case be imposed by the EB project or by EuroGeographics which will not choose between national representations. EuroGeographics or EuroBoundaries cannot impose, or decide on data, but only integrate. A question is whether such temporary agreements between neighbour countries are feasible.

In conclusion, we suggest an exchange of views between the EB data modelling and EuroSpec expert groups (mostly DSA and IDS) to investigate about the continuity requirements, and about the feasibility and adequacy of a possible EB 'mixed' dataset.

4.3 Remarks to and analysis of National Regulations and EB

Organisation of Contacts

Concerning boundary management, there are many stakeholders to be brought together and to be co-ordinated, otherwise there would be a risk of discrepancies.

However, in such a complex multi-national context, the EB project itself is not able to co-ordinate all these national stakeholders. The EB project should ask the NMCAs to get in touch with the other stakeholders of their respective countries, for example with the Bilateral Boundary Commissions.

NMCAs will be asked to compile and use information and data coming from the national stakeholders of their respective countries concerning the national boundaries.

As asked by the EB questionnaire, every NMCA nominated an expert responsible for the national boundaries, in many cases being a member of the nation's boundary commission. They will be the national co-ordinators for the EB project.

Such contacts will allow the EB project to become a forum for NMCAs for sharing best experience and practice for the maintenance of the national boundaries.

Joining Two Cultures

The previous section shows that the EB project has both GI and legal aspects.

The aim of the project is to enable GI integration and interoperability. The culture of the personnel involved in such an aim is especially oriented towards GIS.

The mean considered by the project is to constitute a definitive boundaries dataset. The culture of the personnel involved in boundary data is oriented towards more legal aspects. NMCAs often have a department or specific personnel who are specialised in boundary issues.

This is important for the EB project to succeed in joining GI culture and boundary culture. The personnel specialised in boundary data have to keep in mind the aim of the EB project which deals with GI interoperability. And the personnel who aim at GI interoperability have to be aware of the legal aspects involved by the EB project³.

4.4 Consideration about the dissemination of EB Data

For disseminating EB data, it seems impossible to find a policy that would satisfy the very opposed recommendations of all NMCAs.

Anyway, it is not certain that even a small part of the cost of the EuroBoundaries project can be recovered by 'selling' the EBDB, the commercial profitability of the dissemination of EuroBoundaries is not the first aim of this project. We must ask ourselves the question 'who are the users?' before thinking of selling. The primary goal of EB is to provide interoperability and functionality. EuroGeographics needs the right to use the EBDB, not necessarily to distribute it.

However, if there were EBDB users external to EuroGeographics, the standard EuroGeographics licensing policies should apply. Therefore, we recommend to reuse the ERM production and distribution agreements for EuroBoundaries. The advantage is that these agreements have already achieved some consensus between NMCAs. This would not prevent the countries that wish to disseminate their own national boundary data with no restriction to do so at national level.

However, the EB legal situation is little more complicated than ERM, as in many cases EB boundary data will be jointly produced and owned by two neighbour countries. It seems possible to adapt the ERM agreements to that situation.

4.5 Economic Aspects of EB

This questionnaire did not focus on economic production aspects. However, the costs incurred by EB implementation are expected to be online with those of other EuroGeographics projects currently implemented (e.g. SABE, EuroGlobalMap, EuroRegionalMap). Therefore, the EuroBoundaries implementation seems economically feasible. For the countries that have already accurate digital representations of their boundaries, the costs are expected to be very reasonable (i.e. less than for the above projects). However, for the countries that do not have coordinates of boundary points, the costs are expected to be higher (e.g. surveying will be necessary).

Although EB production costs are expected to be reasonable on average, the potential direct revenues of EB data are not expected to be high.

However, in the future the EB data base will help to reduce costs and time for other projects (e.g. ERM) or products which use national boundaries or related topographic features as the EBDB offers agreed data about the boundaries. EB is first an interoperability tool.

Here are also some parameters that will influence EB costs:

- The level of the accuracy that will be required by EB will determine the cost.
- The cost will be lower if EB waits for the availability of a permanent geodetic network.

³ For example, the legal aspects of EB are the reason why the General Administration of Patrimonial Documentation (Belgium) decided to participate to the project.

- The cost will be lower if, within each couple of neighbour countries, each country does not impose itself an exhaustive control of all the measures carried out by the other country (especially GPS measurements) to get "mutually agreed coordinates". This issue has to be settled internally within each couple of neighbour countries, EB cannot impose any method in this respect.
- In the perspective of gradually improving the EB accuracy, estimations might be asked about the accuracy expected in the short term with available means.

Another economic aspect that will have to be considered is the maintenance of the EB database.

5 Conclusion: Recommendations for EuroBoundaries

Need to clarify the requirements with EuroSpec

The EuroBoundaries project needs technical exchange with EuroSpec (mostly DSA and IDS) in order to clarify the requirements. Such clarification should address especially temporary technical solutions to supply continuous boundary lines to EuroSpec during the long period of the EB implementation phase, when the EB coverage of definite boundary data is partial.

Need for more enquiry with NMCAs

In order to confirm the technical feasibility of the EB project and to define more in detail the EB implementation phase, we suggest to:

- precisely communicate the vector data model designed by the EB project;
- ask each NMCA to assess what can be technically supplied, how much time it would take and what are the economic aspects.

We also suggest a contact to the ExG on Geodesy to clarify the ETRS89 issues mentioned in sections 3.2.6 and 3.2.7.

Time Aspects of EB Implementation

Although the EB implementation phase will be very long, it would be useful to start it in short term, as it will stimulate NMCAs to progress on boundary representation issues. Otherwise, many unsettled situations will remain.

Production and Distribution Agreements

Concerning legal and dissemination aspects, we recommend to reuse and adapt the ERM production and distribution agreements to EuroBoundaries and to bear in mind the fact that boundaries have two owners.