EUROSPEC – A CORNERSTONE FOR THE BUILDING OF THE EUROPEAN SPATIAL DATA INFRASTRUCTURE

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ABSTRACT:

The European Spatial Data Infrastructure (ESDI) has long been a dream lost in the far future, and only heard from in a small community of a few visionaries and missionaries. Their preaching has finally been heard, and the INPIRE initiative, launched by the European Commission in autumn 2001 has given much press to the concepts that underlay the ESDI.
One of the main concepts is that of the Common Reference Data as a key to interoperability, and one of these early and dedicated missionaries was EuroGeographics (or rather its early avatars CERCO and MEGRIN).
The unambiguous mission of EuroGeographics – Europe's Association of National Mapping and Cadastre Agencies (NMCAs) – is to achieve interoperability of European mapping and other GI data. From the perspective of the data providers this is an ambitious target but, from the perspective of the data users the need for interoperable geographic information is already a need – today.
The paper highlights the requirements, context and rationale for interoperable geographic information, with a particular focus on the delivery of reference data. It will then go on to describe how EuroGeographics plans to meet these requirements – in collaboration with the other key players. This will include a description of the current 'state of play' in Europe's GI interoperability (including the results of a recent survey and a summary of relevant 'cross border' initiatives).
The EuroSpec programme includes the identification of the key issues that need to be addressed; and the main activities (and outcomes) of the EuroSpec project. It covers the process that will change the data integration/harmonization and provision from the current centralized architecture, to on-line on-the-fly service based on distributed architecture and web services.

1. EUROSPEC : THE CONTEXT

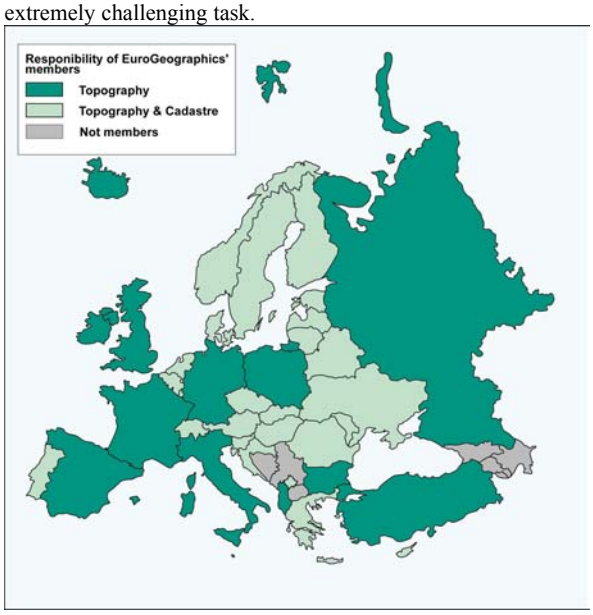
1.1 Introduction

The requirements for implementing the EuroGeographics core mission (achieve interoperability of mapping and other GI data within 10 years) and the initial steps envisaged by INSPIRE (the European Commission initiative for developing the ESDI) converge in recognising the need for common specifications for reference data. This is the challenge that the EuroSpec project has accepted to meet.

EuroSpec is a long term – 10 years – process that will be developed in stages. The ultimate goal – interoperability of all reference data, and other geolocated data, across boundaries, themes and resolution ranges – will be aimed at by a step-by-step approach. Practically, it is envisaged to focus firstly on some themes and scale ranges, selected according to priority user requirements, and to a realistic assessment of the operational result expected in the short and medium terms. These first stages will be based on the analysis of the current state of the art, the sharing of best practice in the fields relevant to the initiative, and on the assessment of what is realistically achievable in that very ambitious programme.

1.2 Background

The growth in the use of geographic information is accelerating at all levels within the public and private sectors and in particular within Governments at all levels, European, national and local. The power of geography can help us manage our environment, our resources and our own day to day lives better than we ever have done before. Geography knows no boundaries, and therefore the demand is not just at national level but extends to continents and global levels. Such aspirations must, however, be tempered with reality and justification since experience has shown that the creation and maintenance of harmonised detailed geographic datasets is an extremely challenging task.



EuroGeographics today: 44 organisations from 40 countries.

Already pan-European datasets exist, such as SABE developed from the NMCAs official data through EuroGeographics; and road databases by the private operators such as Tele-Atlas and Navtech. Over the past 24 months the level of activity and pan-European collaboration has reached unprecedented levels through the INSPIRE initiative. The market demand for pan-European data to underpin pan-European solutions is growing.

This opportunity provides a window for a wider range of data providers using new affordable technologies. These providers may in some cases work with the NMCAs or may opt to offer competing products. This presents a challenge to the European NMCAs who devote much of their resources and energy to data maintenance which is rarely a priority for competitors.

Many of the NMCAs are also re-engineering their data and are currently migrating from "digital mapping" to "geographic information" to support a maturing customer need. This provides an ideal opportunity to harmonise concepts, data models and approaches. This is important to provide the foundations for easily assembled harmonised and maintained pan-European datasets. The delays in the introduction of Location Based Services also provide a short but valuable window of opportunity to develop a generic pan-European specification.

There are examples where regional European activity is already evident, for example the GiMoDig project involving Sweden, Denmark, Finland and Germany to demonstrate LBS services ; the Ordnance Survey Ireland, Ordnance Survey of Northern Ireland and Ordnance Survey Great Britain collaboration (www.osmaps.org) and the harmonisation of the Länder datasets in Germany by BKG (www.bkg.bund.de). These examples provide evidence that successful collaboration is possible and in turn could provide building blocks towards a wider spatial data infrastructure.

There will be areas that require further research and development and where resources and projects can be shared to offer quicker and more proven results.

1.3 Early steps

Building an harmonised European Geographic Infrastructure has been a concrete objective of EuroGeographics for a decade now, starting in 1993 with EuroGeographics first avatar, MEGRIN, named after an acronym for an early designation of what we call now the ESDI : Multipurpose European Ground Related Information Network. MEGRIN started pioneering work with the first on-line CEN standard pan-European metadata service – the GDDD.

MEGRIN also initiated the SABE project, the Seamless Administrative Boundaries of Europe, a harmonised dataset assembled from the official data provided by member countries. SABE is permanently maintained by EuroGeographics, and the current version now available covers some 35 countries – more than the EU-25 and EFTA countries – and continues to expand eastwards.

These two initiatives, although valuable, are only prototyping the European infrastructure. Our Expert Group on Geodesy; in collaboration with EUREF has defined a common European geodetic reference system - ETRS89 - and is working on the definition of e common vertical reference system. The first is now adopted by the European Commission, that is also today supporting the development of the second. Further, MEGRIN has actively contributed to defining the ESDI by a diligent participation in the GI2000 initiative, and later in the ETeMII project for which MEGRIN was the main author and editor of the White Paper on Reference Data.

EuroGeographics has continued its involvement in promoting and defining the ESDI by its participation in the INSPIRE Expert group and Working groups, directly through its Head Office, and through the active contribution of many of its member NMCAs.

In parallel to these high level discussions on strategies and policies, EuroGeographics continues its own strategy of concrete step by step implementation, among which the EuroGlobalMap project is the first to bring a new pan-European service on the market, a one million pan-European (30 countries in the current version) topographic database comprising the following themes : administrative boundaries, hydrography, transport, settlements, vegetation, named locations and miscellaneous (monuments, power lines, towers etc). A more ambitious project, EuroRegionalMap, aims at a 1:250.000 scale. A large 'sample' covering 7 countries, including France and Germany, is already on the market, while work is in progress aiming at covering the most part of Europe-25 by end 2006.

To make its vision into a reality, EuroGeographics has proposed the development of a data specification to support the pan-European harmonisation of geographic information. Early work on the ETeMII research and more recently INSPIRE provides supporting evidence. However, a comparison of the NMCAs and their products and services today demonstrate just how big a challenge the development of a harmonised European Specification is. This is not a reason to avoid such a task, but the task is large and needs to be broken into manageable phases with check points at regular intervals.

1.4 Common Reference Data

While INSPIRE is primarily driven by the critical actuality of environmental issues, it has also recognised that the infrastructure, beyond environment, is eventually to cover all other main sectors as well, such as transport, agriculture, etc. The number one requirement for an operational infrastructure is interoperability of data from different sources, and the key to this interoperability is the linkage to a unique reference, designated as the 'Common Reference Data'. The needs for definition, development and interoperability have been researched in depth within the ETeMII project, of which most findings have been later endorsed within INSPIRE.

The EteMII "White paper" and INSPIRE "Position papers" defined the meaning of the term "reference data" on two main principles:

- *It is a series of datasets that everyone involved with geographic information uses to reference his/her own data as part of their work;*
- *It provides a common link between applications and thereby provides a mechanism for the sharing of knowledge and information amongst people.*

In this context, reference data must fulfil three functional requirements:

- *Provide an unambiguous location for users information;*
- *Enable the merging of data from various sources;*
- *Provide a context to allow others to better understand the information that is being presented.*

1.5 Basic Data

The long debate on the definition of the reference data and of its components had reached a peak within the ETeMII project. By the time that INSPIRE has reviewed the ETeMII findings, we

may consider that a rather stable consensus was reached already in 2001. The latest work within INSPIRE has reviewed the original concepts and requirements, and arrived to choose a new term "Basic Data", that comprise the following components:

1) Referencing systems

- *Coordinate reference systems*
- *Geographical grid systems*
- *Geographical Names*
- *Addresses*

2) Common reference data

- *Administrative units*
- *Transport*
- *Hydrography*
- *Elevation*
- *Cadastral parcels*
- *Ortho-imagery*

3) Other priority environment common themes

- *Protected sites*
- *Land cover*

This basically lists the main body of most NMCAs mission and remits; it is their 'core-businesses', except possibly for the two last items. Therefore EuroGeographics recognise its responsibility into leading this part of the work of building the ESDI.

1.6 State of the art

A first step in EuroSpec was to assess today's current situation, as well as plans and capacities to change, in relation to the Common Reference Data. A survey has been realised in the beginning of 2003, which main results confirm the timeliness of the EuroSpec project. The survey has been conducted by Antti Jakobsson and EuroGeographics Expert Group on Quality, and the results are available on EuroGeographics web site (see references).

The survey was made trough a questionnaire sent to all European NMCAs, and covered three themes: organisations, databases, and reference data components. Components were selected after the INSPIRE definition, and the FACC data dictionary has been used for feature types. Twenty-seven countries answered the questionnaire, which gives a quite good overview of the situation in Europe. Here is a summary of the answers.

In about one-third of the countries only one organisation – the primary EuroGeographics member – is producing all reference data components. This responsibility can also be shared between 2 organisations (in 8 countries) or more, with a maximum of 18 in Germany, due to its federal status.

Topographic databases exist in 19 countries, but all countries had topographic data in some format. The database structures are illustrating the fact that we are in an era of change, as the following numbers measure the on-going transition from 'digital mapping' to 'geographic information': object-based in 8 countries; plan to convert to object-based in 6 countries; point-line in 5 countries; digitised themes in 7 countries. This same pattern shows also with Cadastral databases which exist in 21 countries (no data in 6 countries): object-based in 10 countries; plan to convert to object-based in 5 countries; point-line in 6 countries.

Most topographic databases are at scale 1:10.000, three at a larger scale (maximum 1:1.250), and three at a smaller scale (minimum 1:100.000). Digital Elevation Models exist in 20 countries, with a typical resolution of 25m in 10 countries (maximum 5m, minimum 100m); orthophotos in 21 countries, with typical resolutions between 20cm and 1m for most. Most countries apply national standards, and the move towards international standards is only starting (eg. in Germany, the Netherlands).

A more detailed exploration of the available individual components and main feature types brings the following preliminary conclusions:

- Reference data themes are generally available in Europe (but less than 80% availability in some themes or features: addresses, parcels, interchanges and built-up areas)
- Topographic data is not yet object-based in majority of countries but the change is in progress (14 out of 19 in few years)
- Data is in two accuracy levels according to the source (digitised from maps or direct surveys using aerial imagery)

1.7 Interoperability

It is assumed (ETeMII, INSPIRE, etc.) that interoperability of geographic information is a requirement of the ESDI, and that the development of common specifications, in particular for the Common Reference Data is necessary for that interoperability. But exactly 'what interoperability?' and 'what specification?' is still under discussion. Although there are many aspects to interoperability, they may be brought – for GI – within two main levels, according to the aim.

Hybrid Mapping:

In "Hybrid Mapping" current framework data is brought together (juxtaposed) and eventually superimposed with business data. Initially this is on an 'as-is' basis, but using coordinate reference systems services to establish common coordinate reference. If discrepancies arise, they are due to 'error' – i.e. in edge-matching or because of different accuracy standards or capture specifications (across framework data jurisdictions or 'vertically' between layers). There will of course also be coding discrepancies.

Hybrid Mapping is achievable using the current OGC Web Map Service (WMS) and Web Feature Service (WFS) specifications. The Style Layer Description (SLD) or Scalable Vector Graphics (SVG) specifications will support suitable cartographic styles (but not a consistent cross-border style, unless by good fortune).

Hybrid Mapping, despite its deficiencies, would offer a considerable step towards interoperability. In theory, all the (horizontal) coordinate reference issues should be dealt with correctly. There would be a significant degree of selectivity (of 'layers' or 'themes' within the reference data) and freedom to superimpose business data. A simple level of query would be supported (simple feature basis), although the results would not be consistent across boundaries.

Consistent Mapping:

Ultimate interoperability should keep all the intelligence of the information after the integration process, and must be seamless: only thus can be fully exploited the data for any spatial

application. This is where we think that common specifications are really required. This 'real' interoperability must be achievable at different levels:

- Across borders, the borders being typically the national borders, but also any geographic or horizontal boundary between providers
- Across scales, as source data may be provided in different scale or resolution levels
- Across themes, as the interrelations between themes should be significantly preserved in the integration processes – 'vertical' interoperability.

We know from current projects (SABE, EuroGlobalMap & EuroRegionalMap previously mentioned, as well as GiMoDig), that this is a challenge that needs harmonisation of

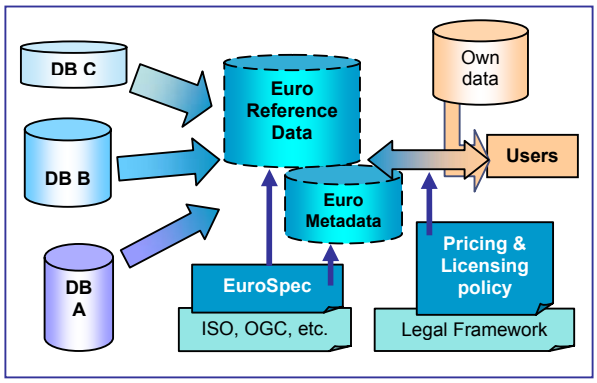
- Coordinate reference systems (a quite well understood process, but which is not as simple and rigorous a we would expect)
- Positional accuracy and matching (at borders – horizontally , and between themes – vertically)
- Semantic description of the real world (beyond languages and cultures)
- Data modelling (beyond individual platforms and technology).

This is where EuroSpec can make the difference by proposing specifications for the Common Reference Data, recognising also that technical specifications will not solve all interoperability issues: organisational aspects will be critical for matching data from different sources, and the efforts required for the reengineering of the existing databases must not be minimized.

2. EUROSPEC, THE PROJECT

2.1 Vision

The general vision is to achieve sustainable interoperability of European mapping (and other GI) – thus answering one of the main concerns of the GI industry and user community. The goal therefore is not to create one single centralised database, but is to implement specifications, processes and services built upon a decentralised strategy within which a user can identify, transform, integrate and access the information they require when they want to.



This vision is shared with INSPIRE, and is the core of the EuroGeographics strategy, which also sets out a number of key projects that are designed to facilitate achieving the goal of interoperability. These projects include:

- A new metadata service to provide better information about, and access to, existing national and European reference data;
- Pricing and licensing guidelines to remove some of the 'business' barriers to using geographic information; and,
- The development of European specifications for reference data.

This paper addresses the latter project, as being the core of the EuroSpec strategy and implementation, as well as its position within the wider programme context.

2.2 Rationale

A large part of the work done within the INSPIRE work groups is justification enough of the needs for common specification for reference data. It would in particular support some the most fundamental of the 12 key policy principles underlying INSPIRE (INSPIRE data policy position paper, http://www.ec-gis.org/inspire/) ;
Principle 3- Datasets made available through the INSPIRE programme shall be provided to harmonised data specifications and to common standards.
Principle 6- Reference Data, the scope and composition of which shall be specified by INSPIRE, will provide the underpinning framework to which INSPIRE thematic data will be referenced.
Principle 11- The unimpeded flow of data and information between (a) the Commission and Member States, (b) Member States, (c) local authorities and (d) members of the public shall be assured.

The development of European specifications and the move towards the broader goal of interoperability is timely for a number of reasons.

Improve efficiency and effectiveness of governance

At the European level the development of a European Spatial Data Infrastructure (ESDI) has gained considerable momentum through the INSPIRE initiative. The National Mapping and Cadastre Agencies have a key role to play in providing the reference data that will underpin the ESDI, and the development of European specifications through this project will be an important component of the infrastructure.

The European Commission needs 'borderless' geographic information to inform the development, implementation and monitoring of policies. This covers the environment (including impact assessment), water quality, forest monitoring, regional development and planning, agriculture and transport. Greater access and use of geographic information is also important within the context of the EC's ambition to develop the 'e' economy as part of its eEurope action plan. EuroGeographics is already supplying data (SABE, EuroGlobalMap) to support some of the functions of the European Commission, data that is also being adopted at the national level to meet Member State reporting requirements, for example, for the Water Framework Directive. User experience with these products however, is already creating demand for larger scale (and higher quality) datasets.

While European governance will be the primary beneficiary of harmonised data specifications, they will also benefit national and sub-national government. As for any user, interoperability will allow all administrations a much wider, more economical and more efficient use of GI and other geo-located data.

Provide new business opportunities

The development of these specifications as a means to providing data suitable for trans-national applications will be important for a number of users, not limited to governments.
Within the commercial market sector there is also demand for data that can be transformed to consistent European specifications. The most obvious example is in-car navigation systems (addressed, with other road sector requirements by the EuroRoadS project), but others include asset management (utilities and transport) and market analysis companies – all of whom are using trans-national GI today. The demand is likely to grow further, particularly for location based services where European rather than national solutions are essential to the viability of their business.

Facilitate production and maintenance of reference data

The benefits for users – governments, industry, or end-users – are obvious and immediate. One should not however minimise the benefits that harmonised specifications will bring to the production and maintenance of GI and geo-located data, primarily for common reference data.
Harmonised specifications will immensely facilitate the sharing of information between the various data providers/producers. The current practice of parallel and sometimes conflicting maintenance of the same information in different databases, due to data incompatibility, will significantly decrease. Reducing duplication will reduce the cost of maintenance, increase the quality and reliability of the data, and reduce the time interval between the occurrence of an event and the availability of the relevant information to the users.

All of the above points to an increasing need for 'borderless' geographic information that can only be realised once agreed European specification are in place. Common specification will greatly benefit a large number of applications ranging from navigation, workforce and fleet management, environment, disaster and emergency monitoring and management, to a variety of tourism and hobby services. Facilitating access and exploitation of the data for governance, the industry and the citizen, it will multiply the actual value of GI manifold.

2.3 Objectives

The primary goal for the EuroSpec project is to develop common and agreed European specifications for reference data into which national - and sub-national - specifications can be transformed for trans-national applications.

EuroSpec main deliverable – the specification – comprises two main parts:
A common description of the data content, as a feature and attribute catalogue; ideally this would be scale-less or valid, say, from scale 1:1.000 to 1:1 million, and uniformly understood throughout Europe, across languages and cultures
Common structure(s) or data model(s) that would probably need to be narrower in terms of scale range; considering the current availability of data across Europe, it is envisaged to focus on a typical scale of 1:10.000; data model(s) applicable to smaller scale range(s) may also be necessary, and developed according to needs.

Further, EuroSpec does not deal only in the abstractions, so the project aims also to

- Build a community of key stakeholders (including customers, system and application developers, and other project partners) and involve them in the development and implementation testing of the specifications;
- Test the feasibility of implementing the specifications through development of prototypes - " to learn by doing";
  and,
- Develop implementation guidelines for NMCAs to ensure national datasets can be transformed to the European specification(s).

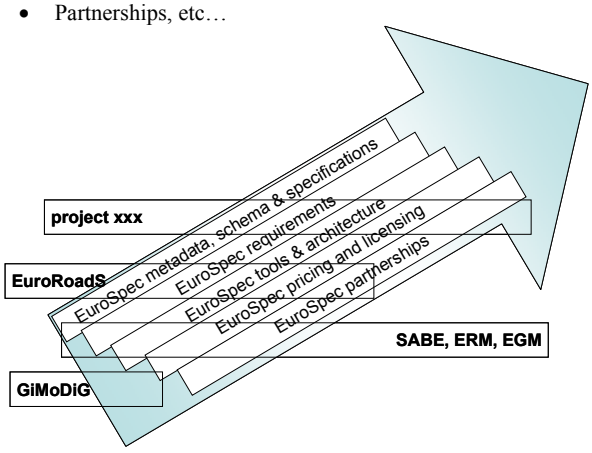
2.4 EuroSpec : a process and a programme

The long term vision of EuroSpec being interoperability of geolocated data across Europe, cannot be reduced to a simple project. It is a complex programme and a long process with many dimensions. It is expected that the EuroSpec strategy will aggregate the main GI actors, a prerequisite for the vision to become reality. Meanwhile, as required by its nature – of being the Association of the main custodians of the Common Reference Data, EuroGeographics, is leading the kick-off stage, within the scope of its enlargement to a wider collaboration.

In terms of content, EuroSpec will initially focus on the "Basic Data" define by INSPIRE (see above).

The internal process will be to synchronise with the different existing and future EuroGeographics and other relevant projects, and create suitable mechanisms for converging on the series of issues that are required for interoperability, such as :

- Identification of needs and requirements
- Schema, specifications and metadata
- Technical tools and architecture
- Pricing and licensing strategies
- Partnerships, etc…

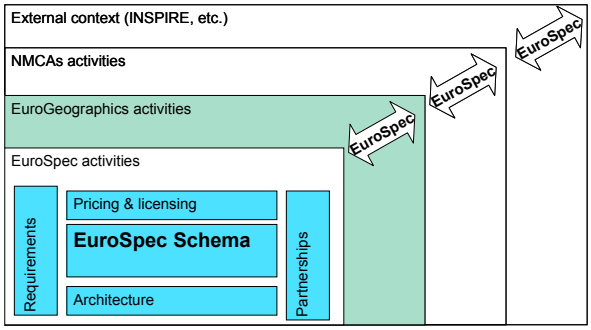


The figure shows how it is expected that each individual project would contribute to different interoperability aspects, in an iterative process that will build the common framework for the ESDI.

As for positioning the different components of the strategy within the European context, the management of the EuroSpec programme will need to also monitor the integration and

compatibility of the core EuroSpec activities at three main levels :

- Coordination with all other EuroGeographics activities,
- Compatibility and alignment with the evolution of the NMCAs own strategies, and
- Integration within the wider European context.



2.5 Conclusion

In a 20-page report titled "Geographic Information Systems: Challenges to Effective Data Sharing" published on 10th June 2003, by the US government's General Accounting Office one can read that "*... to date, the potential of GIS has not been fully realized. While steps have been taken to improve the coordination of government GIS efforts, much more work still needs to be done to round out a comprehensive set of standards and to ensure that they are being broadly applied. Geospatial One-Stop, in particular, while addressing useful near-term tasks, has not focused on the need for a longer-term strategy for facing the challenges of implementing the NSDI. ... significant investments have already been made in existing non-standard systems, and the task of replacing those systems and migrating their data to new standards cannot be accomplished overnight. ... until these challenges are addressed, the goal of a single, coordinated, nationwide system of geospatial data will remain out of reach."*

This may tend to show that the US federal investments for their NSDI, much higher than its equivalent in Europe, has not been sufficient – or not appropriately focused – for giving life to the expected operational infrastructure. The ESDI will also not arise spontaneously, and the US experience helps us to understand that central (European) vision and investments are a key to future savings.
Now is the right time: what mechanisms could allow to allocate a relatively small budget (eg. a small portion of Galilleo or of GMES) to fund this necessary first step that is a prerequisite for future much larger savings in data collection, maintenance and exploitation?

The concepts of EuroSpec are not original: they flow naturally from previous research work related to defining an operational SDI in general, and more particularly to the implementation of the ESDI. What EuroSpec proposes as a new approach, following a long period of talks is: "now let's start doing it!". EuroSpec, as a fundamental part of the setting-up of the infrastructure, is a long-term process, which cannot be grasped in its entirety from the start. Therefore the "talking" must continue in parallel with the "doing". However some doing is necessary to give substance and relevance to the talking, and more importantly to satisfy needs that are already there.

The main challenge is not technical, but – as usual – political. Will Europe be capable of the adopting the vision and of taking the political decisions – which go with organising and providing the resources – that will allow this prerequisite to interoperability to be developed within an appropriate timescale?

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