ICA Commission on Standards for the Transfer of Spatial Data
Commission ACI sur les normes d'échange de données localisées

Standardization in the Field of Geographic Information : The European Efforts

François Salgé
Institut Géographique National - France
Directeur Exécutif du Groupe MEGRIN
Président du CEN/TC 287
Vice-Chair of the ICA Commission on Standards for the Transfer of Spatial Data

ABSTRACT

The European efforts for standardization in the field of Geographic Information are made in several forums. The natural place for discussing de-jure standards is the European committee for standards (CEN). This paper provides an extensive description of CEN activities in the field of Geographic Information. The role of Mapping Agencies is often central to the development of Geographic Information. As there is no central European mapping agency in Europe, National Mapping Agencies group themselves together in CERCO and MEGRIN to create the conditions to provide standard topographical datasets over Europe. This paper describes briefly CERCO and MEGRIN activities related to standards.

Geographic Information is not limited to topography and users in some cases are also producers of information. EUROGI as an umbrella organisation for Geographic Information is now involved in the standardization discussion; its related activities are also described. The European Commission is certainly a dominant actor in Europe. Not surprisingly, the Commission is active in the field of standardization incuding geographical standards and this is also described. Concluding remarks stress the missing pieces in the standardization discussion in Europe.

INTRODUCTION

Geographic Information is often perceived in Europe as a sign of sovereignty and standardization in that field was first seen as a national concern. In 1989 the AM/FM European Division organized in Montreux a workshop dealing with transfer standards. At that moment the challenge was national or discipline-specific. National solutions such as NTF or discipline orientated solutions such as DIGEST were compared. In 1991, it was felt necessary to set up a specific European working party at the European committee for standards (CEN) level. The first part of this paper presents the efforts of CEN in developing standards for Geographic Information.

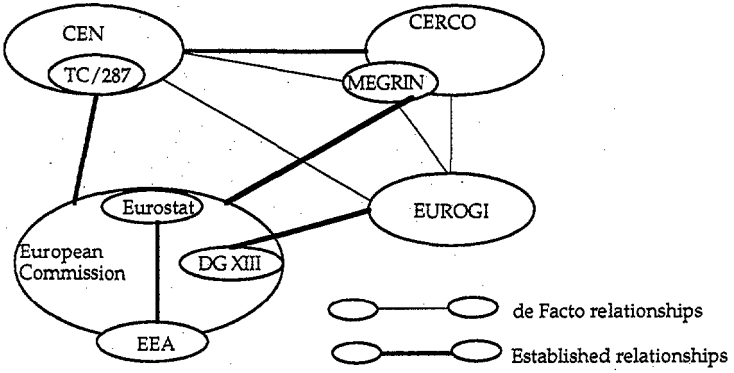
CERCO (Comité Européen des Responsables de la Cartographie Officielle) is the forum where the heads of the Official National Cartographic Agencies of Europe meet. It has been involved in cooperative activities of exchanging information on mutual problems and in collaborative initiatives towards a better integration of the products of its members. From its start in 1980 CERCO has depended on periodic assemblies and working groups. In 1991 CERCO created its Permanent Technical Group to initiate thinking on the Multipurpose European Ground Related Information Network concept (MEGRIN). A group of 18 Mapping Agencies from CERCO decided, in 1993, to create the MEGRIN Group. The second part of this paper presents the activities of both CERCO and MEGRIN.

In 1990, the DG XIII (Directorate General XIII in charge of Telecommunications, Information Market and Exploitation of Research) of the Commission of the European Communities (now the European Commission EC) organised a workshop in Brighton on the activities that the Commission could undertake in the field of Geographic Information. At the meeting there was a consensus on the possible benefits that could be gained by the Geographic Information economical sector from the creation of a European umbrella organisation. A team of four prominent experts worked between 1991 and 1993 to investigate the feasibility, the desirability and the practical details of creating such an organisation. In 1993 EUROGI, the EUROpean organisation for Geographic Information was set up. The promotion of standardization is one of its activities. The third part of this paper presents the efforts of EUROGI to stimulate standardization in Europe.

The European Commission has long been involved in standardization. As one of its major projects, CORINE was developed in the field of the environment. EUROSTAT, the European statistical office of the Commission is leading the GISCO project (GIS for the Commission). All these activities are related to standards, and are presented in the fourth part of this paper.

The general relationship between these European groups is proposed in Figure 1. What will be the future of European efforts in this field ? Concluding remarks stress the missing pieces in the standardization discussion in Europe

Figure 1: Relationships between European Groups



CEN

CEN, the European committee for standards (Comité Européen de Normalisation) is an association of the official national standardization bodies of the European countries. Initially composed of European Union and European Free Trade Association countries, it is progressively extending to Eastern and Central European countries. CEN Standards, called EN (for European Standards in German), when formally adopted become national standards. That means that any national standard which conflicts with adopted ENs must be removed from the national collection of standards. Therefore the work undertaken at CEN level supersedes national works.

CEN/TC 287

Historical background

In 1991, after the development of the French standard EDIGéO (Echange de Données Informatisées Géographiques), CNIG (Comité National de l' Information Géographique), the French umbrella for Geographic Information , and AFNOR (Association Française de NORmalisation),the French standardization body, proposed to CEN the creation of a technical committee for standardization in the field of geographical information. The main reason for this was to set up a single place for devising standards and norms and thus to assemble energy in Europe for a common project.

This proposal was combined with an important explanatory process in order to obtain agreement from the experts in the field. Late in October 1991 CEN officially decided to create CEN/TC 287 the working party responsible for standardization in the field of geographical information. AFNOR is responsible for the TC secretariat and the author was appointed as its Chairman.

Members of CEN/TC 287 are delegates from 22 countries (see Table 1) and observers from DGIWG (Digital Geographic Information Working Group), CERCO and IHO (International Hydrographic Organisation).

Table 1: CEN/TC 287 members. (*) indicates observer status

Austria	*Greece*	*Poland (*)*
Belgium	*Hungary (*)*	*Portugal*
Czech Republic (*)	*Iceland*	*Spain*
Denmark	*Ireland*	*Sweden*
Finland	*Italy*	*Switzerland*
France	*Luxembourg*	*Turkey (*)*
Germany	*Netherlands*	*United Kingdom*
	Norway	

CEN/TC 287 holds on average 3 meetings a year: Brussels February 1992, Paris June 1992, Brussels December 1992, Paris, March 1993, Stockholm, June 1993, The Hague, December 1993, Venice, March 1994, Helsinki, June 1994, Copenhagen, December 1994, London, May 1995.

Objectives and Organisation

CEN/TC 287 officially set up its title and scope at its first meeting as follows:

TITLE: Geographic Information

SCOPE: Standardization in the field of digital Geographic Information :

This comprises a structured set of standards which specifies a methodology to define, describe and transfer representations of the real world. This will allow understanding and usage of digital information related to any location in the real world.

The objective is to facilitate the use of digital information related to real world location through information technology as a whole. This standardization work will influence and be influenced by developments in the field of information technology.

NOTE 1:

Location in the real world may be represented by coordinates, textual description or codified name.

Since the beginning there has been a concensus to follow a general approach taking account of national efforts and benefiting from existing results such as SQL, IRDS or the STEP family of standards.

As defined by CEN/TC 287, the basic purpose of standardization in the field of Geographic Information is to enable Geographic Information to be shared between different users, applications, systems and locations. This requires a standard way of defining and describing this information a standard method for structuring and encoding data and a standard way of accessing, transferring and updating this information via data processing and communication functions.

The family of standards developed by CEN/TC 187 will bring benefits such as a greater understanding of Geographic Information , harmonisation of concepts concerning the sharing of geographic data, the integration of data. It will enable the increase of the availability of data, simplify the transfer of data between systems, and reduce the costs of data and systems. It will allow new market opportunities. Sharing of common data between applications will be easier.

Mandate

The European Commission mandated CEN/TC 287 to draft a set of European standards (ENV in the first phase) which directly condition the circulation and sharing of Geographic Information among partners in a context which gains benefit from information technology as a whole. The mandate given by the commission also includes a financial committment.

CEN/TC 287 Working Groups

Four working groups (WG) are responsible for the technical work of CEN/TC 287, and five project teams (PT), financed by the mandate of the Commission, now exist to actually write the draft standards.

WG 1 deals with the framework for standardization in Geographic Information and is convened by Norway. Its tasks are to provide an overview of the standardization work of TC 287, to provide a reference model as a basis for the standardization area, to assist in harmonizing definitions, to define methods for data descriptions and to investigate the means by which all types of geographic data be queried and operated upon.

WG 2 is in charge of models and applications for Geographic Information and is convened by France. Its tasks are to define conceptual schemas and subschemas for geometry, quality and metadata in accordance with the reference model and to recommend procedures for developing application schemas.

WG 3 is concerned with Geographic Information transfer with the United Kingdom as convenor. It will define transfer schemas and encoding methodologies by which all types of geographic data can be transferred.

WG 4 deals with Locational Reference Systems for Geographic Information. Germany convenes the group. It will provide the definition of methods for describing locational systems and time.

PT 1 has to define a conceptual schema for the metadata which are required to encourage the widespread use of Geographic Information , which is partly constrained by the lack of information about existing datasets. Metadata in this context is defined as data about data which describes the characteristics of a dataset. It includes classification of data, geographic coverage, quality, geometric structure and how to access the data and under which conditions. WG 2 monitors the work of PT1. Target date for a draft standard is April 1995.

PT 2's task is to produce the transfer standard, i.e. to define the transfer schemas and implementation mechanisms for the transfer of geographic data. This shall include application data and metadata, both for parts defined by the standard schemas and for parts defined by application specific schemas. The standard is intended to cover file transfer, messaging and dialogue. WG 3 monitors the work of PT2. Target date for a draft standard is September 1995.

PT 3's role is to investigate and list which indirect positioning systems are already used in Europe and to advise CEN on whether standardization efforts are required and feasible in the field of locational identifier. Indirect positionning systems are non-map-based spatial references such as postal addresses, postcodes or road numbering schemas. Little effort has been made so far to coordinate these identifiers. The aim is to also describe methods for documenting and disseminating standards for geographic identifiers. WG 4 monitors the work of PT3. Target date for a draft standard is February 1996.

PT 4 is concerned with query and update, i.e. enabling information systems to inter-operate. This requires a standard way to access and maintain data. The work is to identifiy any additional standardization needed for geographic data in both SQL and STEP as well as the possibility for the two standards to interwork. WG 1 monitors the work of PT4. Target date for recommendations is June 1995.

PT 5's work programme is to draft the standard on data quality. Because a multitude of inconsistent definitions concerning geometric quality aspects exist and because there is a lack of definitions about non-geometric quality aspects, a standard quality model needs to be made based on theoretical-analytical quality concepts. WG 2 monitors the work of PT5. Target date for a draft standard is May 1995.

Achievements

At the end of 1994, four draft standards were available at the TC level. The formal process for the adoption of ENs includes several steps. Any document (TC draft) proposed by a working group to the TC enters a two month period to decide whether it is suitable for CEN enquiry or not. If not the relevant WG has to modify it. If yes then its French, German and English versions (draft prEN) are sent for a 6 month CEN enquiry. Member bodies are asked to provide technical comments to be incorporated into a new document (prEN). A formal vote then leads to the adoption of an EN which must be included into their national collection of standards and all conflicting previous national standards must be removed.

Reference Model

The reference model is the first standard that was created. A first version was available in March 1993 and served as an internal reference. After several improvements, CEN/TC 287 decided in December 1994 that the document was suitable for the 6 month CEN enquiry.

The reference model serves as a foundation for the development of standards in the field of Geographic Information.

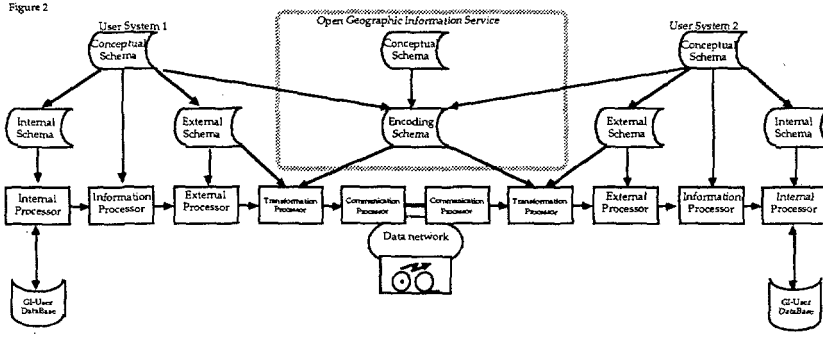
As such the reference model:

- describes and clarifies the field of Geographic Information and relationships and differences between Geographic Information and non-Geographic Information ,
- identifies and defines components which can be standardised, their interfaces and relationships between components,
- provides a safeguard against duplication of effort and avoids the creation of new standards where others already exist or are under consideration,
- makes it possible for new components to be adopted as new standards and technology develop.

The standard is based on established information technology basics such as conceptual schemas, the three schema architecture, the open-EDI, the open systems interconnection (OSI), the data management reference models, the information resource dictionary system framework and the levelling and layering concepts commonly used in the information technology world. However, the reference model does not prescribe any specific standard for Geographic Information.

The basic fuctional structure of the reference model is given in Figure 2

Figure 2



Conceptual Schema Language

A conceptual schema is the specification of all facts (in logic: necessary assertions) about a universe of discourse. The description of Geographic Information in conceptual schema and subschema, whether they are standardized or not, requires the use of a formal lexical language to ensure consistency, avoid ambiguity and allow computer processing. A generic language ensures that the variety of applications involving Geographic Information is supported.

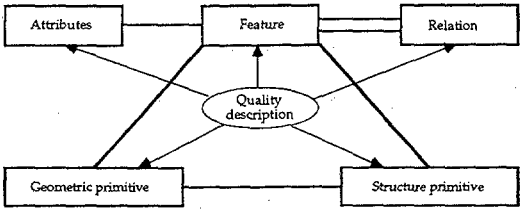
After analysis of possible existing lexical language, CEN/TC 287 selected EXPRESS as the Conceptual Schema Language to be used for Geographic Information. The appropriate document is ISO 10303-11:1994 the EXPRESS Language Reference Manual

Data Description - Geometry

Geographic Information is specific because it provides information related to a specific location in the real world. The scope of the "standard on data description - geometry" is to define and represent geometric primitives and their constructs in Geographic Information using the formal languages defined by CEN/TC 287 (EXPRESS). It includes the identification of the types of geometric relationships, the rules for expressing them and the definition of any constraints together with non-geometric elements.

The basic concept of a feature is defined as a digital representation of a geographic object. The representation includes identification, attributes, relations, geometric primitives and structure primitives (Figure 3).

Figure 3: Feature representation



Referencing - Position

Two main types of position information can be distinguished: those based on coordinates (direct referencing) and those not based on coordinates(indirect referencing). For the former, in the broad sense given by differential geometry, the position is identified to an element of a specified space and is then in a one-to-one mapping with a set of n numbers (n being the dimension of the space). This mapping is called a (local) coordinate system. For the latter, the position is given as a reference to another geographic object such as administrative unit, postal address, road number and kilometric point, that allows mapping to a specific geographic location.

The "referencing - position" standard defines the basic concepts related to position information (geodetic reference systems, geodetic ellipsoid and zero meridian, geoids and heights, map projection and units) and how the position information shall be described (time, two dimensional horizontal reference, three dimensional spatial reference, non-coordinate based spatial reference). The choice of any particular system is outside of the scope of this standard.

Other Work Items

CEN/TC 287 is involved in the drafting of other work items. Some of them are within the remits of the project team the others will be directly drafted by the working groups. Briefly, the scope of each work item is presented together with the WG in charge of doing the work and the target date for adoption:

Geographic Information : Overview
to provide an overview of the family of standards, to describe the areas of application to which the family applies, to explain the overall context within which the family will operate (WG 1 - June 1996).

Geographic Information : Definitions
to produce a set of definitions for use in standards developed in the field of Geographic Information (WG 1 - May 1996).

Geographic information : Data description - guidelines for application
to give guidelines about use the of data description techniques in developing application schemas for Geographic Information. **Justification** : To aid the description of specific applications, to ensure that such development does not create unnecessary conflicts or restrictions and to facilitate the use of the family of standards in any application (WG 2 - April 1996).

Geographic Information : Data description - Quality (PT5 - May 1995).

Geographic Information : Data description - Metadata (PT1 - April 1995).

Geographic Information : Data descriptions - Transfer (PT2 September 1995).

Geographic Information : Referencing- Indirect positionning systems (PT3 February 1996).

Geographic Information : Referencing - Time
To identify how the temporal dimension of geographic data shall be handled in Geographic Information. ***Justification*** : Much geographic data changes with time. There is currently no common way by which the temporal dimension can be handled (WG 4 - October 1996).

Geographic Information : Processing - Query and Update (PT4 June 1995).

CEN/TC 278: Road Transport and Traffic Telematics

Road transport is one of the main challenges for Europe without frontiers, reienforced by the changes in the central and eastern part of Europe. More than 500 billion ECU are spent by Europeans on road transport products and services each year. The free movement of people and goods dramatically increases road traffic, especially in central European regions. An extensive political discussion took place on the effects of traffic growth, concerning its influence on the ecological situation, on the health of people and on the economy (costs of congestion delays, costs of traffic infrastructure). Politicians have to find political solutions that decrease the amount of traffic and improve traffic security and traffic flow by law. They have decided to support research and development in numerous European projects, especially in the DRIVE I and DRIVE II programmes. Technicians have to offer technical solutions according to the needs defined by the politicians. Table 2 gives an overview about the existing positioning techniques used in road traffic and transport telematics.

In 1991 CEN set up a technical committee CEN/TC 278 on Road Transport and Traffic Telematics (RTTT). One of its working groups, WG VII, has to draft the standards in the field of geographic road databases from the GDF (Geographic Data File) proposal.

The GDF standard (Geographic Data File) was first developed in the context of the EC framework programmes on R&D (EDRM: European Digital Road Map). The core activity of EDRM included a field test on digital road data collection based on the GDF specification and covering main traffic axes in France, Belgium, Netherlands, Germany, and Switzerland. The polishing of GDF then moved to CEN/TC 278 WG VII. GDF is a product-related standard already in use and prescribed for the projects within DRIVE. As such it has not been devised as a general standard for any type of geographical data whereas the results of CEN/TC 287 will be the base for data exchange standards for a lot of different applications.

Table 2: Positioning techniques for RTTT

	GPS	*map matching*	*beacons*
Problems	*phase lock situation (especially in cities)*	*white areas; information density; long road elements without curvature*	*area not completely covered (only cities)*
inside-car equipment	*GPS receiver; communication unit*	*digital map; magnetic field sensors wheel sensors*	*communication unit;*
outside-car equipment	*satellites; reference station network (differential GPS); (digital map)*		*beacons; centralized supervising computer; (digital map)*
preferred applications	*fleet management; car navigation*	*car navigation*	*traffic control and supervision*

The status of GDF, at the end of 1994, was "first draft prENV" and the document was submitted to the CEN members for review. GDF provides a general data model compatible with the CEN/TC 287 geometric model, a feature catalogue (road-related features), an attribute catalogue, a relationship catalogue, feature representation scheme, quality description specification, global data catalogue scheme, logical data structures and media record specifications.

One of the remaining tasks will be to make further versions of GDF compatible with the results of CEN/TC 287 in transforming them into profiles of the more general standards of CEN/TC 287.

CERCO AND MEGRIN

Members of CERCO as at 1-1-1995 are given in Table 3. As far as standardization is concerned, CERCO was active in proposing commonly agreed specifications such as the ETDB (European Territorial Data Base) proposed by its WG V (Sept 86- Feb 92) or a 1:1 000 000 digital map proposed by its WG II (results in 1988). Its WG VIII provided a basis for CEN/TC 287 to develop its standards on geodetical references and a list of all the referencing systems in use for official cartography. Working Group VII "Road Database" accompanied the EDRM test. Working Group X proposed MEGRIN in 1991.

Table 3: CERCO members. (*) indicates observer status

Albania(*)	*Germany*	*Northern Ireland*
Austria	*Great Britain*	*Norway*
Belgium	*Greece*	*Poland*
Bulgaria (*)	*Hungary*	*Portugal*
Croatia	*Iceland*	*Romania*
Cyprus	*Ireland*	*Slovakia*
Czech Republic	*Italy*	*Slovenia*
Denmark	*Latvia*	*Spain*
Estonia	*Lithuania*	*Sweden*
Finland	*Luxembourg*	*Switzerland*
France	*Netherlands*	*Turkey*

At the 1991 CERCO Plenary Assembly in Southampton, it was decided to strengthen the work of CERCO by creating two permanent groups. One had the task of advising on commercial, legal and economic issues, the other on technical matters. The Permanent Economic Group was handled by the marketing function of the Ordnance Survey of Great Britain. The Permanent Technical Group (PTG) was set up in September 1991, in Paris, as a team of three people. The tasks proposed were wide ranging but the initial study was an evaluation of MEGRIN - Multi-purpose European Ground-Related Information Network.

The PTG presented its findings in a preliminary study which concluded that merging national databases is not technically difficult but impinged on commercial, legal, economical and organisational barriers. A second result was a business plan which allowed the creation of the MEGRIN Group to start.

The aim of MEGRIN is to build a technical and organisational framework which simplifies the provision of Geographic Information in any country to any European user. The studies undertaken for the MEGRIN concept demonstrated the importance of a topographical infrastructure and proposed a way forward.

- The development of a Geographical Data Description Directory (GDDD) in which all existing datasets are described. It includes, among other information on existing datasets, the description of the content, the geographical extent, the quality level and the conditions of use, sale and access. The system to provide this information to potential users of data is now in place.
- The development of seamless datasets over Europe based on existing national databases. Merging national data includes transforming them into the same projection, the same content definition and the same structure. As a first experiment of merging data from diverse origin, the Seamless Administrative Boundaries of Europe dataset (SABE) is now available.
- The creation of European Topographical Information Template specifications which will serve as a basis for a geographical infrastructure for Europe. The ETDB (European Territorial Data Base) is the very first version of that template.

The MEGRIN-Group was created to allow it to happen. Eighteen of the Official National Cartographic Agencies (see Table 4) have chosen to proceed with MEGRIN.

Table 4: MEGRIN Group members

Belgium	*Germany*	*Portugal*
Cyprus	*Great Britain*	*Slovakia*
Denmark	*Hungary*	*Slovenia*
Ireland	*Iceland*	*Spain*
Finland	*Northern Ireland*	*Sweden*
France	*Norway*	*Switzerland*

Standards, at least at the European level, underpin the whole concept of MEGRIN. In summary, they are required for:

- languages for describing geographical data,
- conceptual data models,
- the content of geographical data, including classification systems,
- data quality,
- geodetic referencing,
- data formats.

The development of MEGRIN is likely to change the way in which geographical data is regarded in Europe. It will also change the way in which the national mapping agencies do business. At present there is little scope or incentive for cooperation on selling paper maps. The need for datasets covering more than one country will force cooperation in selling data. The standards necessary for MEGRIN will start coming through from late 1995 onwards. By 1996 the way in which geographical data is traded in Europe, and the data that becomes easily available as a result, will help in the overall growth of the use of GIS.

EUROGI

As part of the general structure facilitating the development of the European market for Geographical Information , a European Umbrella Organisation (EUROGI) was thought necessary by most of the important actors of the Geographic Information sector. In 1993 EUROGI was created as a Dutch Foundation grouping two categories of members: the interdisciplinary national GI organisations such as AGI (Association for Geographic Information) in the UK or CNIG in France (see Table 5) and the European GI-oriented organisations, such as AM/FM, EGIS (European GIS foundation) or UDMS (Urban Data Management System).

Table 5: EUROGI members.

Belgium	*Ireland*	*Portugal*
Finland	*Italy*	*Spain*
France	*Luxembourg*	*Sweden*
Germany	*Netherlands*	*Switzerland*
Greece		*United Kingdom*

EUROGI has a clear mission statement "to stimulate, encourage, coordinate and where necessary initiate or directly support:

a) international and interdisciplinary cooperation between national interdisciplinary Geographic Information organisations,

b) academic and industrial research, development and training in a wide range of interdisciplinary Geographic Information application areas including mapping, utilities, environment and natural resources, health and planning and the development of practical and novel applications, and

c) disseminate information about Geographic Information and Geographic Information activities through European conferences, seminars and newsheets."

EUROGI has a strategic role in the development of the economical sector of geographical information. A political role could also be recognised for EUROGI as its legitimacy is now more and more accepted by the Geographic Information professionals and therefore its ability to give technical and strategic advice could be useful for data providers to fulfil European requirements and for the Commission to draw European policies.

EUROGI's activities aim to reach European technical harmonisation. EUROGI will publish documents which may or may not be binding. EUROGI's involvement in their elaboration and the follow-up of their application may differ from one document to the other.

Five levels of harmonisation exist in Europe:

- **Directives**: they are discussed and finalised at the European Commission before adoption by the Council of Ministers of the European Union. EUROGI's function shall be to propose and think about directives in order to assist the Commission.
- **(de-jure) standards**: CEN is the only European official body for standardization active in the field of Geographical information. EUROGI's function shall then be that of a European club of standards users. Its tasks will be information exchange, standards promotion, needs analysis and international coordination
- **Recommendations**: such documents shall not be binding but can be used as a framework for developing national policies. EUROGI can develop and propose recommendations.
- **Specifications**: EUROGI shall contribute to the definition of the specification of European Geographic Information products by inviting producers to finalise them and by validating them. It could also act as a technical advisor.
- **Reference documents**: EUROGI could create such documents (common glossaries, control procedures, etc.) and promote their use.

These activities, whatever the level of intervention may be, shall be carried out with the "view of removing all technical obstacles to the development of the European market for Geographic Information through reducing interface cost and maximising technical transparency".

THE EUROPEAN COMMISSION

The commission has increasing interests in Geographic Information and GIS including internal needs, external requirements and the stimulation of the market place.

Internal requirements for Geographic Information and GIS exist in order to improve the definition and monitoring of community decisions. The GISCO project, Geographic Information System for the Commission, run by EUROSTAT, is federating the Commission's internal users in the development and use of Geographic Information. Standards are required to enhance the efficiency of the provision of Geographic Information to the Commission and to improve its dissemination within the Commission by means of computer networks.

Externally orientated considerations also exist within the Commission in sectorial directorates (DG: Directorate General). Their approach is to stimulate the use of GIS solutions within the economic sector they are in charge of: for example, DG VI for the monitoring of the common agricultural policy (CAP), DG VII for the European infrastructure network and transport policy, DG XI and the European Environmental Agency (EEA) for the environment or DGXVI in which regional policy will be improved by using Geographic Information Systems in local governments.

Last but not least, the EU is interested in stimulating the information market and relevant technologies, including the area of geographical information. Among other IMPACT programmes (DG XIII), a programme on the diffusion of Geographic Information is on its way with the aim of developing information services based on GIS technology. Similarly, DG XIII is sponsoring EUROGI.

CORINE

From 1985 to 1990, the Commission realised the CORINE programme (Coordination of Information on the Environment). The results are essentially of three types, corresponding to the three aims of the Programme:

- an information system on the state of the environment in the European Union (the system is mainly used in the orientation and application of the EU's environment policy),
- nomenclatures and methodologies within the programme (e.g. Corinair and CORINE Land Cover) which were also used in non-member states,
- a systematic effort to cooperate with all bodies involved in the production of environmental information.

One of the major tasks undertaken in the framework of the CORINE Programme was the establishment of a computerised inventory of land cover. The objectives were to provide

quantitative data on land cover (consistent and comparable across the EU), to prepare one land cover base for the 12 EU countries (2,36 million Km^2) at an original scale of 1:100 000 using the CORINE nomencature, and to extend the work to other European countries and to North African countries.

Table6: extracts of the Land Cover nomenclature:

LEVEL 1	LEVEL 2	LEVEL 3
1. ARTIFICIAL SURFACES	*1.1 Urban fabric*	*1.1.1 Continuous*
		1.1.2 Discontinuous
	1.2 Industrial, commercial and transport units	*1.2.1 Industrial or commercial units*
		1.2.2Road and rail networks and associated land
		1.2.3 Port areas
		1.2.4 Airports
	1.3 Mine, dump and construction site	*1.3.1 Mineral extraction sites*
		1.3.2 Dump site
		1.3.3 Construction site
	1.4 Artificial non-agricultural vegetated areas	*1.4.1 Green urban areas*
		1.4.2 Port and leisure facilities
2 Agricultural Areas	*2.1 Arable Land*	*2.1.1 Non-irrigated*
.....	.....	.....

The CORINE land cover nomenclature is a de-facto standard. It distiguishes 44 classes which are grouped in a 3-level hierarchy (see example in Table 6). The main level categories are: artificial surfaces (cities, etc.), agricultural areas, forests and semi-natural areas, wetlands and water bodies. Each country can add supplementary 4th and 5th hierarchical levels, according to its special conditions and priorities, but the first three levels are identical for all countries.

Among other tasks, one task of the newly created EEA is to be responsible for the collection, processing and analysis of data in the field of the environment. In cooperation with the member states it will continue the work started in 1985 on CORINE and will develop CORINE data inventories.

EUROSTAT

The close links between statistical data and methods of spatial analysis oblige statisticians to pay more attention to the new problems encountered with regard to Geographic Information and the rules for its management. They necessitate the formulation of precise rules for the collection, treatement and distribution of spatial statistics. EUROSTAT, the European statistical office, considers it must play an active role in the standardization and the harmonisation of information in this domain by carrying out applications which are already mature enough to have attracted a substantial number of users.

Until recently, Europe was surprisingly short of services based on GIS. The Commission is in a good position to note the presence of certain barriers to the exploitation of this technology: problems of harmonisation, education, training and research, not to mention the fact that many end users were unaware of what GIS could do for them. Although it started by prioritising the needs of the other services of the Commission, EUROSTAT's intervention now covers a wider domain in which it is under increasing pressure to act as coordinator and central operator. The mission of EUROSTAT's GISCO service involve actions in getting GIS up and running within the Statistical Office, in serving as a contact and reference point within the Commission, (accessible to every user), in ensuring the systematic utilisation of the data to be processed, and in developing a wide range of value-added products.

As an internal coordinator for the Commission, EUROSTAT will develop internal standards and will disseminate geostatistical data within the commission. Statistical data are georeferenced through the georeferencing of statistical units: administrative units and census units. Presently national units follow different rules which need to be harmonised. This is linked to the general issue of indirect positioning as defined within CEN/TC 287 and there is no doubt that EUROSTAT will be actively involved in this topic.

EUROSTAT is obliged by its new role as a processor of geo-referenced statistical data to construct, in collaboration with the mapping agencies a new network enabling it to obtain the information it requires. Consequently, EUROSTAT will be one of the stimuluses for the creation of an European Topographical Information Template.

CONCLUDING REMARKS

As for any kind of information, turning Geographic Information into a digital form and using it in computer based systems implies a new vision of the information itself and a rethinking of its deeper nature. After the time where computers have been mainly used to simplify repetitive and time consuming operations (such as drawings), the increase in computer power and progress in information and process formalisation make it possible to handle geographic problems in a more efficient way. Geographic Information utility is much more important because it makes it possible to compare, derive, interpret, deduce, or simulate the behaviour of spatially referenced phenomena. In Europe three main challenges must be addressed as issues for R&D, technology and organisation for the benefit of the standardization work.

National programmes exist in several countries which make progress in Geographic Information sciences addressing such key issues as conceptual data models or data quality as well as identification of generic methodologies to be applied, and specialised, in application domains. Problems at the application level, such as environment, town & regional planning and public works, require the use of GIS and spatially related reasoning as tools for decision-making processes.

The development of Geographic Information Sciences in Europe requires further research in modeling the behaviour of spatially related phenomenon and methodologies for deriving pertinent knowledge from one level of abstraction to another.

In Europe, most of the problems to be studied with Geographic Information techniques overpass borders and address the analysis of consequences of present decisions on the evolution of territories : "What happens to the territories if such a decision is taken?" Our continent is an "open" system in which its components interact between themselves and with outside. The administrative structure of Europe is based on a hierarchy of "decision making units": from the town mayor to the council of Ministers at the EU level. Each of these decision centres is going to use GIS and Geographic Information as part of is decision support systems.

The challenge for the future is to allow the interoperability of all systems based on spatially related information. That will allow for example synthetic views to be derived from analytical views. This leads to concepts such as generalisation or change of abstraction level and standards will be required to simplify the descriptions of models of reality.

There is a requirement for the creation of a "Geographic Information Market" where information of any kind which allow a better understanding of our environment and our society could be easily accessed. Most of the discussions in the GIS community stress the need for sharing data, multiplexing data from various origins, and the requirements for a multi-disciplinary approach.

There is evidence that in few year's time the information systems based on geographical data that are becoming widespread in every type of organization will need to interrelate with similar data throughout Europe. These systems will not be able to avoid a European common geographic reference to which specialized data can be registered.

Standardization in the field of Geographic Information is certainly the key to success in this "Geographic Information market". Standardization has been addressed in the past by the simple problem of transfer format. This is nothing but the upper and most visible part of the iceberg. The challenge is more complex in the sense that not only the data need to be exchanged but also their structure, some intelligent information and somewhere the skills!

The technical committee of CEN and now ISO are defining generic standards which will need to be consistently customised in all application domains. It will be essential to clarify which are the standards required at national, regional and international levels and also to define standards that are versatile and flexible enough to allow imagination and to allow experts to remain in their actual domain of expertise.

It is very common to state: "implementing a GIS in an organism implies reconsidering its structure". Similarly the "objectivity" of the results of analysis based on spatial reasoning often impinge on the intuitive perception of the reality and therefore often contradicts with the political power. Within the context of Geographic Information exchange as solved by the technology, organisational challenge addresses the issue of cooperation between organisms and even integration of services. Exchanging information between partners is cooperating. How will it be possible to organize cooperation between organizations separated by their strategy, their culture and which are structurally unable to naturally cooperate?

As stated in the previous sections, GIS and Geographic Information are increasingly being used in Europe in an increasing number of disciplines and there will be a need for elements of seamless and comparable topographic infrastructure of Europe. Without that continuity, considerable efforts must be made to reach a common understanding. Failure to do so will inevitably lead to costs, errors and misunderstanding. In each country specific products meet the requirements of national users. These national specifications are different. That is due to the respective administrative nature and history of the countries in Europe. The general trend to recover at least part of expenses from the market has increasingly led to data production meeting the immediate requirements of national users and to delivery of them to customers on a commercial basis (a right of use).

An effect of this is that the national specifications do not at present take account of international requirements. The remits of Official National Cartographic Agencies are only to meet the requirements of the nation and the national markets. Because the demand for international data and the use of digital geographic data of one country in another country is limited at present, European requirements have been considered to be marginal. But as previously stated this requirement is bound to increase. People are going to expect the same services in foreign countries as those they get in their own. This will have a cost and although Official National Mapping Agencies have already started to consider this new requirement, and MEGRIN demonstrates their willingness to make significant progress in that area, they are unable to commit the large resources required on their own. The organisational challenge here is to allow structurally the topographical infrastructure to emerge from the national investments as a result of the "subsidiarity" principle.

Information is not an apple! When you buy an apple and you eat it, the apple no longer exists. When you use an information you create a new information but the original information is still present. There is a need to reconsider the economic mechanisms of the information market and set up the legal and organisational framework in which the right of using Geographic Information together with the rights of the data owner are reconciled. The level of the information price should be low enough to have as many users as possible but also high enough to allow its capture and updating. There need to be further investigation into the funding mechanisms of making data widely available in Europe. The example of the United States freedom of access to the federal data does not apply in an Europe in which governments ask producers to recover part of their resources from the market. In the U.S. the low-cost data made available is largely subsidised by the U.S. government. The GATT negotiations on the emerging information society may have to investigate the situation in the Geographic Information field.

All the issues rapidly presented as a conclusion require a place to be organized where they are discussed institutionally. The ultimate key issue is to allow EUROGI to get legitimacy and to support its activities. The strengthening of EUROGI will help us to win the challenge for the European economic sector of Geographic Information , and to act together towards a better awareness of the benefits in using information based on spatial references and the spatial reasoning it allows.

REFERENCES

Brand Michael, P Burrough, F Salgé, K Schüller; (1993); Report of the committee for investigating the feasibility of creating a European Umbrella Organisation for Geographic Information - Phase II. Proposals for setting up EUROGI; Instigated by the Commission of the European Communities DG XIII-E2 (Information Technology); Luxembourg.

CEN/TC 278 N 356; First draft prENV - Geographic Road Database - GDF for Road Traffic and Transport Telematics;1994; NNI

CEN/TC 287 N 21; Resolution of CEN/TC 287 first meeting in Brussels ;1992; AFNOR

CEN/TC 287 N 160; Standardization Mandate M 039 on Geographic Information ; 1993; AFNOR

CEN/TC 287 N 235; Terms of reference of the project team on "Geographic Information - data description - Metadata; PT01; 1994; AFNOR

CEN/TC 287 N 236; Terms of reference of the project team on "Geographic Information - data description - Transfer; PT02; 1994; AFNOR

CEN/TC 287 N 237; Terms of reference of the project team on "Geographic Information - Indirect Position - list of indirect positionning systems; PT03; 1994; AFNOR

CEN/TC 287 N 238; Terms of reference of the project team on "Geographic Information - Processing - Query and Update; PT04; 1994; AFNOR

CEN/TC 287 N 239; Terms of reference of the project team on "Geographic Information - data description - Data quality model; PT05; 1994; AFNOR

CEN/TC 287 N 295; Geographic Information - data description - Geometry; Working Draft; 1994; AFNOR

CEN/TC 287 N 303; CEN/TC 287 Work Programme version 7; 1995; AFNOR

CEN/TC 287 N 319; Geographic Information - Referencing - Position; Working Draft; 1994; AFNOR

CEN/TC 287 N 321; Geographic Information - data description - Conceptual schema language; Working Draft; 1994; AFNOR

CEN/TC 287 N 327; Unreconfirmed minutes of the 10th meeting of CEN/TC 278/WG 7; 1994; AFNOR

CEN/TC 287 N 353; Geographic Information - Reference model; TC Draft; 1995; AFNOR

EUROGI; (1994); EUROGI's work Programme for standardization; paper presented at the first General Assembly of EUROGI; May 1994

European Commission; (1992); CORINE LAND COVER - A European Community project; the International Space Year; European Environment Agency Task-Force DG XI

EUROSTAT; (1994); GISCO: Le système d'informations géographiques de la Commission Européenne, la dimension spatiale du système statistique Européen;

Masser Ian, A Morais Arnaud, F Salgé, H Scholten; (1993); GISDATA research Programme - Newsletter Number 1 to 4; European Science Foundation; Strasbourg

Salgé François; (1992);Topographic Infrastructure for Europe: A Cultural Revolution?; GIS-LIS Hungary 1992

Salgé François; Heinz Brüggemann;(1992);Conditions for the Development of European -Wide Geographical Reference Information ; EURNAV 92 conference, London UK, 17-19 November 1992)

Salgé François, N Smith; (1993); Press release - European National Mapping Agencies Agree on Co-operation - MEGRIN (Multi-purpose European Ground-Related Information Network); The MEGRIN Group; Paris

Salgé François; (1994); Geographic Information : the challenge for Europe; The 1994 European GIS Yearbook; edited by Peter J Shand and Peter J Ireland; Blenheim

ACRONYMS

AFNOR	Association Française de NORmalisation
AGI	Association for Geographic Information
AM/FM	Automated Mapping and Facility Management
CAP	Common Agricultural Policy
CEN	Comité Européen de Normalisation
CEN/TC 287	CEN/ Technical Committee 287 in the field of Geographic Information
CERCO	Comité Européen des Responsables de la Cartographie Officielle
CNIG	Comité National de l' Information Géographique
CORINE	COoRdination of INformation on the Environment
DG XIII	Directorate General XIII: Telecommunications, Information Market and ...
DGIWG	Digital Geographic Information Working Group
DIGEST	DIgital Geographic Information Exchange STandard
EC	the European Commission
ECEC	Eastern and Central European Countries
EDIGéO	Echange de Données Informatisées Géographiques
EDRM	European Digital Road Map
EEA	European Environmental Agency
EFTA	European Free Trade Association
EGIS	European GIS foundation
EN	European Norm
ENV	Experimental EN
ETDB	European Territorial Data Base
EU	the European Union
EUROGI	EUROpean organisation for Geographic Information
EUROSTAT	EUROpean STATistical office
GATT	General Agreement on Trade and Tarifs
GDDD	Geographical Data Description Directory
GDF	Geographic Data File
GISCO	GIS for the COmmission
IHO	International Hydrographic Organisation
IRDS	Information Ressource Dictionary System
ISO	International organisation for standardization
MEGRIN	Multipurpose European Ground-Related Information Network
NTF	National Transfer Format
OSI	Open Systems Interconnection
prEN	draft EN
PTG	CERCO's Permanent Technical Group
RTTT	Road Traffic and Transport Telematics
SABE	Seamless Administrative Boundaries of Europe
SQL	Standard Query Language
UDMS	Urban Data Management System

TABLE OF MEMBERSHIPS

Country	ISO 3166	CEN	CERCO	MEGRIN	EUROGI
European Union					
Austria	AUT	√	√		
Belgium	BEL	√	√	√	√
Denmark	DNK	√	√	√	
Finland	FIN	√	√	√	√
France	FRA	√	√	√	√
Germany	DEU	√	√	√	√
Greece	GRC	√	√		√
Ireland	IRL	√	√	√	√
Italy	ITA	√	√		√
Luxembourg	LUX	√	√		√
Netherlands	NLD	√	√		√
Portugal	PRT	√	√	√	√
Spain	ESP	√	√	√	√
Sweden	SWE	√	√	√	√
United Kingdom	GBR	√	√	√	√
European Free Trade Association					
Iceland	ISL	√	√	√	
Liechtenstein	LIE				
Norway	NOR	√	√	√	
Switzerland	CHE	√	√	√	√
Eastern and Central European Countries					
Albania	ALB				
Belarus	BLR				
Bosnia and Herzegovina	BIH				
Bulgaria	BUL		√		
Croatia	HRV		√		
Czech Republic	CZE	√	√		
Estonia	EST		√		
Hungary	HUN	√	√	√	
Latvia	LVA		√		
Lithuania	LTU		√		
Macedonia	MKD				
Moldova	MDA				
Poland	POL	√	√		
Romania	ROM		√		
Russian Federation	RUS				
Slovakia	SVK		√	√	
Slovenia	SVN		√	√	
Ukraine	UKR				
Yugoslavia	YUG				
Other European Countries					
Andorra	AND				
Cyprus	CYP		√	√	
Faroe Islands	FRO				
Gibraltar	GIB				
Malta	MLT				
Monaco	MCO				
San Marino	SMR				
Turkey	TUR	√	√		
Vatican city state	VAT				