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Sharing data for GIS applications

Udostępnianie danych dla aplikacji SIG

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Integracja dużych przestrzennych baz danych w celu uzyskania przydatnej i zrozumiałej informacji jest istotnym wyzwaniem przyszłości. Projekt „Digital Earth", w ramach którego ma być zainstalowana sieć serwerów informacji przestrzennej pokrywającej całą Ziemię, wymaga kooperacji ludzi, firm, organizacji, uniwersytetów i rządów. Istotną rolę w promocji interoperacyjności systemów służących do przechowywania, udostępniania i analizy danych przestrzennych odgrywa Konsorcjum OpenGIS® (OGC).
Głównym celem OGC jest rozszerzenie rynku SIG poprzez zapewnienie całkowitej kompatybilności różnych systemów SIG, zawierających różne rodzaje i formaty danych. W tym celu OGC opracowuje specyfikacje: zarówno ogólne (dotyczące geometrii, standardu przesyłania danych przestrzennych przez internet *Web Mapping*, identyfikacji i relacji obiektowych, języka GML), jak i typowe dla konkretnych zastosowań (telekomunikacja, obronność, transport, ratownictwo drogowe). Do projektowania tych specyfikacji OGC stosuje metajęzyki: Unified Modelling Language (UML), eXtended Markup Language (XML) i Geographic Markup Language (GML), będący aplikacją XML służącą do zapisu i przesyłania danych przestrzennych. OGC wydaje również certyfikaty produktom i producentom, zaświadczające, że spełniają one wymogi specyfikacji OGC.
Język GML jest oparty na geograficznym modelu OpenGIS oraz metajęzyku XML. Pomimo że do transferu danych przestrzennych wykorzystywany jest GML, przed przekazem danych ich użytkownik musi zapoznać się z metodą transferu, zawartą w dokumentacji XML Schema Definition (pliki *.xsd). Dokumentacja ta obejmuje zestaw definicji obiektów GML, geometrii GML oraz samą aplikację.
Transformacje GML definiują wizualizację Digital Landscape Model w ramach Digital Cartographic Model. Obejmują graficzny zapis w języku SVG (Scalable Vector Geometry, opracowanym przez Konsorcjum WWW), VML (Vector Markup Language, opracowanym przez Microsoft) lub X3D (wariant XML języka VMRL, opracowany przez Konsorcjum WWW).

Abstract

The integration and combination of large amounts of spatial data to obtain useful and understandable information is a big challenge for the future. Already one speaks of a „Digital Earth" and, of course, this is the co-operation between hundreds of thousands of persons, companies, organisations, universities and governments. The OpenGIS® Consortium (OGC) plans to play an important role to promote the interoperability for spatial data for a Digital Earth.

The main aim of OGC is to increase the GIS market by complete compatibility of different GIS systems containing different types of data(sets) by designing generic (i.e. geometry, Web mapping, object-identification and relations, and GML) and application specific specifications (as telecommunication, defence, transport, emergency services, etc.) in working groups. OGC applies Unified Modelling Language (UML), eXtended Markup Language (XML) and Geographic Markup Language (GML) for these designs. OGC also certifies products of manufacturers to test whether they comply with the implementation specifications.

GML is based on two important developments: the OpenGIS geography model and XML. Although GML is used for the transfer of spatial data, prior to the transfer a XML Schema Definition (in *.XSD files) is required by the user to understand the way of the transfer. The schema definition is a collection of tech-

nology, the commerce in spatial data and geo-processing expends easily due to many environmental problems to be solved. It is expected that the European market in geo-processing may expend from 400 mln euro in 1994 to over 1300 mln euro in 2004. Unfortunately, spatial data often comes in a wide range of incompatible and vendor-proprietary forms. Also, due to the specific solutions, GIS is often applied in organisations with isolated collections of data, software and user expertise.

SDI, Standards and Metadata

Data transfer from one database to another, requires a system with four different aspects. They are data, computer communication technology, spatial data standardisation (Moellering, 1991; Moellering, Hogan, 1997) and agreements between the actors in the field of spatial data sharing.

With the growing number of users, nationally and internationally, the information about what data is available becomes an important knowledge. In many countries, governments, providers and private organisations have been building digital infrastructural networks to enable development of the countrywide spatial data and information flow.

Provisions for the distribution of spatial (or geographic) data can also be seen as an infrastructure (SDI, Spatial Data Infrastructure or GII, Geographic Information Infrastructure). Providers of such data often developed a common site in the Internet to display the type of data they have available, in order to make their product accessible and promote its use. Sometimes, they also make the data available through these channels. In order to understand not only the data but also the datasets their description can also be standardised. Descriptions of datasets are given in the providers' metadatasets (Moellering, Crane, 2001) containing a commonly defined, standard way of dataset description that can be interpreted by the data receiver to display the data meaningful.

The necessary dataset required for a specific application to fulfil the user requirements is given by the applications' description. Both providers and users have such descriptions sometimes in written or digital form sometimes only mentally in their mind; these descriptions are called Universe of Discourse. For data transfer between computer system(s) they should be in digital form but also standardised in order to allow digital interpretation of the data.

Globally, GSDI aims at the linking of national and international SDI into a global and open process for the co-ordination, organisation management and use of spatial data and related activities. The focus of GSDI is rather on implementation of SDIs rather than on research. GSDI has published a "Cookbook" for implementing SDIs, which will be published on the Internet (http://www.gsdi.org).

Using the forthcoming GSDI Cookbook may help each new SDI implementation to consider its capabilities and legal implications. A comparison of the aspects of the different implementations in different countries will enhance these implementations. Hence, this presentation will summarise and review these aspects for the ICA Commission on Spatial Data Standards to potentially research the existing SDIs including the technological, legal, administrative, financial and organisational aspects.

Data discovery and inventory

Data discovery and access for spatial information is achieved through catalogue gateways and catalogue services. The catalogue gateway contains a set of catalogue servers that have sets of metadata. The metadata files contain instructions of the manner to access the datasets itself. And they all have managers to update the respective information. Therefore, the data access through catalogue servers and metadata has three roles (see Fig. 1):

1. documenting and locating the data;
2. documenting the content and structures of the data model;
3. providing the end-users with detailed information on its appropriate use.

Such framework mechanisms also include:

— conceptual generalisation in order to enable display of spatial data at different scales, by changing the cartographic and spatial characteristics of objects;

— feature extraction to obtain objects from remote sensing and scanned images;

— co-ordinate transformations in order to enable combinations of data using different co-ordinate systems;

— annotation services to add ancillary information augmenting the interpretation of a dataset representation;

— image manipulations to change size, colour and contrast of an image and to conduct mathematical and statistical analyses;

— spatial object manipulations.

OpenGIS®

In order to enable the standardisation of spatial data and overcome the differences in the respective systems a new concept is developed called OpenGIS® and — after a difficult initial start — the geo-market is accepting this idea. Both commercial and non-commercial organisations co-operate in the OpenGIS® Consortium (OGC) to develop the possibility to accept data from different sources with different formats on any available geo-processing system. This concept embraces the idea of interoperability.

Interoperability can be described by (Buehler, McKee, 1998):

In short this means that GIS systems and its com-

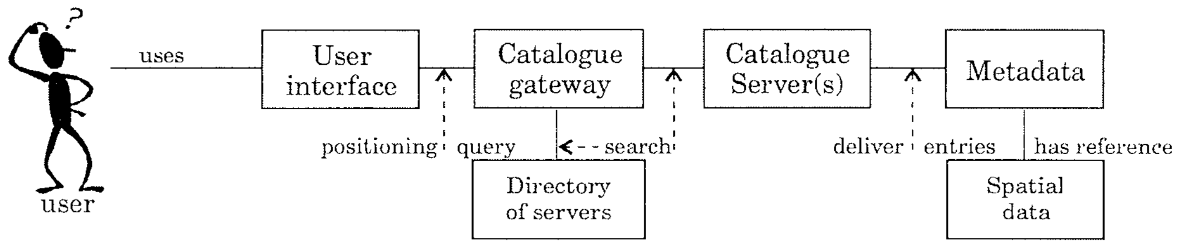

Fig. 1. Use of catalogue querying to locate specific datasets
Ryc. 1. Zastosowanie zapytań katalogowych do lokalizacji określonych danych

ponents co-operate to integrate data, no matter what manufacturer. OGC is a joint initiative of the GI industry, universities and governmental departments, initiated in the first half of the nineties. OpenGIS® enables to standardise the data and its transfer, as well as the geo-processes.

OGC operation

OGC members prepare conceptual descriptions of geo-processes, resulting in so-called „abstract specifications", which in turn are approved by the members and based on maximal consensus (Oosterom, en Schram, 1998).

Table 1.
Definition of interoperability
Definicja interoperacyjności

The ability for a system or components to provide information portability, inter-application and co-operative process control.
Interoperability, in the context of the OpenGIS® Specifications, is software components operating reciprocally (working with each other) to overcome tedious batch conversion tasks, import/export obstacles and distributes resource access barriers imposed by heterogeneous environments and heterogeneous data.

Abstract specifications include conceptual descriptions of geo-objects and are the bases for detailed software specifications for implementation, the so-called „implementation specifications", also to be approved by the members.

OGC makes a distinction between core (generic) technology (including geometry, WWW-mapping, object-identification and relations, GML, etc.) and domain specific technology (as telecommunication, defence, transport, etc.).

OGC meets bi-monthly; in technical meetings (TC -meetings) working groups (WGs) works on the abstract specifications and special interest groups (SIGs) discuss the implementation technology. Also the developments in the use of UML (Unified Modelling Language), XML (eXtented Mark-up Language) and the promotion of the application of OpenGIS® in Europe are discussed at these meetings.

An important aspect of the OGC strategy is its certification programme. GIS producers and users may have tested their implementation specifications by a specially designed test program. When accepted the product is «OpenGIS compliant». The OGC website states the OGC compliant products (http://www.opengis.org/techno/conformance.htm).

ISO and OGC

OGC has a close relation to the ISO/TC 211, the Technical Committee of the International Organisation for Standardisation on Geographic Information/Geomatics. This committee (http://www.statkart.no/isotc211) also develops standards for the transfer of spatial data (see Table 2) at a global level; some of the ISO standards have already reached the International Standards status. OGC has accepted some of these standards as their standards also (e.g.: metadata and quality, see Fig. 2).

OpenGIS® in Europe

During the OpenGIS TC&MC meeting in Mountain View, CA/USA, the OpenGIS management committee voted in favour of creating the European SIG according to a defined charter (December 1998), resulting in the OpenGIS EuropeanSIG. It is for members of the OpenGIS® who have vested interest in the European GI business (for non-members a forum is established called the GIPSIE Information Service, GIPSIE-IS).

GIPSIE (GIS Interoperability Project Stimulating the Industry in Europe) is funded by the European Commission (Directorate General 13: „Information Society") under Esprit, the EU information technologies programme. The GIPSIE project took off in June 1998 for 2 years. Its aim is to promote interoperability in the field of GI for European companies, as well as to participate actively in the OpenGIS Consortium (OGC).

Table 2.
ISO/TC 211 Standards
Standardy ISO/TC 211

Number	Name: Geographic Information/Geomatics	Date of issue
IS 19101	Reference model	2001-07
DIS 19102	Overview	IS: 2002-07
TS 19103	Conceptual schema language	2001-09
DIS 19104	Terminology	IS: 2002-07
IS 19105	Conformance and testing	2000-12
DIS 19106	Profiles	IS: 2002-07
IS 19107	Spatial schema	2001-12
IS 19108)	Temporal schema	2001-08
DIS 19109	Rules for application schema	IS: 2002-07
IS 19110	Feature cataloguing methodology	2001-12
IS 19111	Spatial referencing by co-ordinates	2001-09
IS 19112	Spatial referencing by geographic identifiers	2001-12
IS 19113	Quality principles	2001-11
IS 19114	Quality evaluation procedures	2002-01
IS 19115	Metadata	2002-01
DIS 19116	Positioning services	IS: 2002-06
FDIS 19117	Portrayal	IS: 2002-03
FDIS 19118	Encoding	IS: 2002-03
DIS 19119	Services	IS: 2002-04
TR 19120	Functional standards + Amendment 1	2002-04
TR19121	Imagery and gridded	2000-10
TR 19122	Qualifications and Certification of personnel	2001-12
CD 19123	Schema for coverage geometry and functions	DIS: 2002-02, IS: 2002-11
RS 19124	Imagery and gridded data components	
IS 19125:	Simple feature access	
IS 19125-1	Part 1: Common architecture	IS: 2001-08
IS 19125-2	Part 2: SQL	IS: 2001-08
FDIS 19125-3	Part 3: COM/OLE option	IS: 2002-02
DIS 19126	Profile- FACC Data Dictionary	IS: 2002-08
DTS 19127	Geodetic codes and parameters	TS: 2002-04
DIS 19128	Web Map server interface	IS: 2002-07
DTS 19129	Imagery, gridded and coverage data framework	TS: 2002-07
DTS 19130	Sensor and data models for imagery and gridded data	TS: 2002-09
WD 19131	Data product specifications	CD: 2002-05 (IS: 2004-07)
RS 19132	Location based services possible standards	
CD 19133	Location based services tracking and navigation	DIS 2002-05 (IS: 2003-07)

IS:	International Standard	TS:	Technical Specification
FDIS:	Final Draft International Standard	DTS:	Draft Technical Specification
DIS:	Draft International standard	TR:	Technical Report
CD:	Committee Draft	DTR:	Draft Technical Report
WD:	Working group Draft	RS:	Review Summary

In order to achieve its aims, GIPSIE focused on three main areas of activity:

— establish an OpenGIS interest group to unite the European industry and establish good communication with the OpenGIS Consortium;

— identify and resolve European issues and introduce them to the world-wide OpenGIS® specification process;

— inform European IT industry, in particular SME's, early and with sufficient detail about the OpenGIS movement.

Europe has special demands or interests in GIS, which should influence the development of world-wide standards. Examples are the multi-language support, catalogue services, adaptability to various national mapping standards, semantic issues, etc. But also, Europe offers a market-, industry- and research potential, which cannot and should not be ignored by OGC. Therefor GIPSIE should create a bridge between the Open GIS consortium (OGC) and the European GI-community; this means setting up a communication channel, a bi-directional information exchange, between the European GI-community and OGC and thereby lowering the threshold for Europeans to learn about, and participate in, the OpenGIS® process.

The relation between European Special Interest Group, in short European SIG, and GIPSIE is that the OGC's EuropeanSIG represents European (business) interests in OGC, and co-ordinates European issues and contributions.

Although most European organisations do not

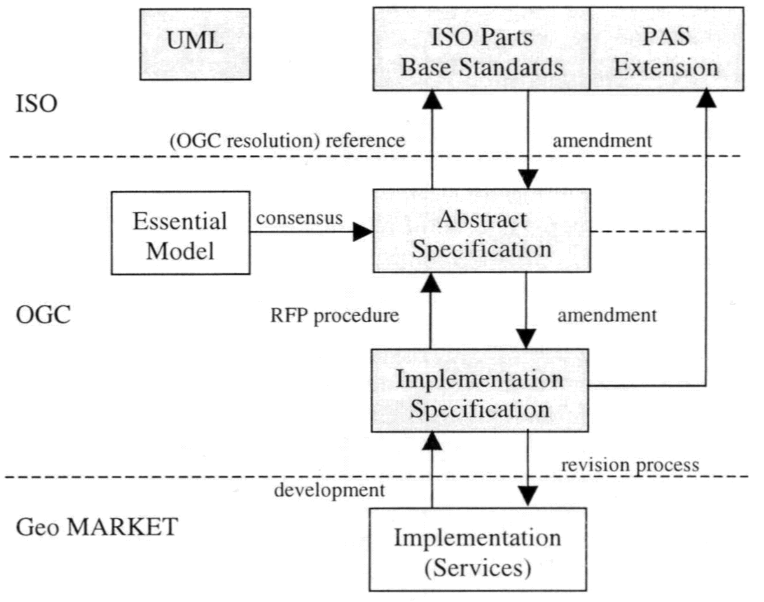

Fig. 2. The relation between ISO standards, OGC abstract and implementation specifications

Ryc. 2. Relacje pomiędzy standardami ISO oraz teoretycznymi i praktycznymi specyfikacjami OGC

have the awareness, manpower or motivation to invest in an OGC membership — which should be more than just the annual membership fee — their active participation by significant human and travel resources is required. For many people in Europe, OpenGIS® is still a distant concept, which results in a „wait-and-see" mentality. On top, many non-native English speaking Europeans have difficulties for the full grasp of the discussions in OGC.

OpenGIS® work programme

Till 2001 several OpenGIS® implementation standards have become available. Momentary are designed in the field of:

1. Abstract specifications (all version 4.x; revisions have occured when required due to new developments):

— Overview
— Feature Geometry
— Spatial Reference Systems
— Locational Geometry
— Stored Functions and Interpolation
— The Coverage Type
— Earth Imagery
— Relations Between Features
— Accuracy
— Feature Collections
— Metadata (due to the agreement between OGC and ISO/TC 211 this is in accordance with ISO IS19115)
— OpenGIS® Service Architecture
— Catalog Services

A geographic catalogue enables access to spatial datasets in which one may search for certain characteristics of objects. The content of a catalogue is only metadata. In order to enable the use of data of different datasets from different organisations, catalogue content should be standardised. On top, also the query language to search in such catalogues and the interface to access the catalogues should be standardised. The OGC concept for using catalogues services consist of a centralised catalogue database that can be searched and linked to other catalogue servers to explore the description of datasets listed in the central catalogue server.

— Semantics and Information Communities
— Image Exploitation Services
— Image Co-ordinate Transformation Services

2. Implementation specifications:

— Simple Feature Specification (SFS) for vector data for platforms OLE/Com, CORBA en SQL. For SQL two types exists: Normalised Geometry and types and functions. Application of SQL makes flexible spatial selection possible and enables the creation of spatial components;

— GRID Coverage Specification for satellite images, aerial photographs and scanned maps;

— Catalog Interface as basis for clearinghouses for geo-data and -services;

— Web Map Server Interface Specifications for Internet-GIS. GIS producer have adopted their software to allow users to browse through available maps. E.g.: ESRI's Internet Map Server (IMS), Intergraph's Geomedia Web Map or Autodesk's MapGuide. The basic method used is that the producer's server contains the mapdata, generate the map and send the result to the user, who can visualise the map by his browser.

This works for uniform systems on either end. OGC tries to develop this also for different systems at the user's and the producer's side through a Web Mapping Testbed: a system to develop the specifications together with the applications. 30 parties cooperate in this WMT by developing one or more components of the whole system. The system distinguishes three types of clients (see Fig. 3):

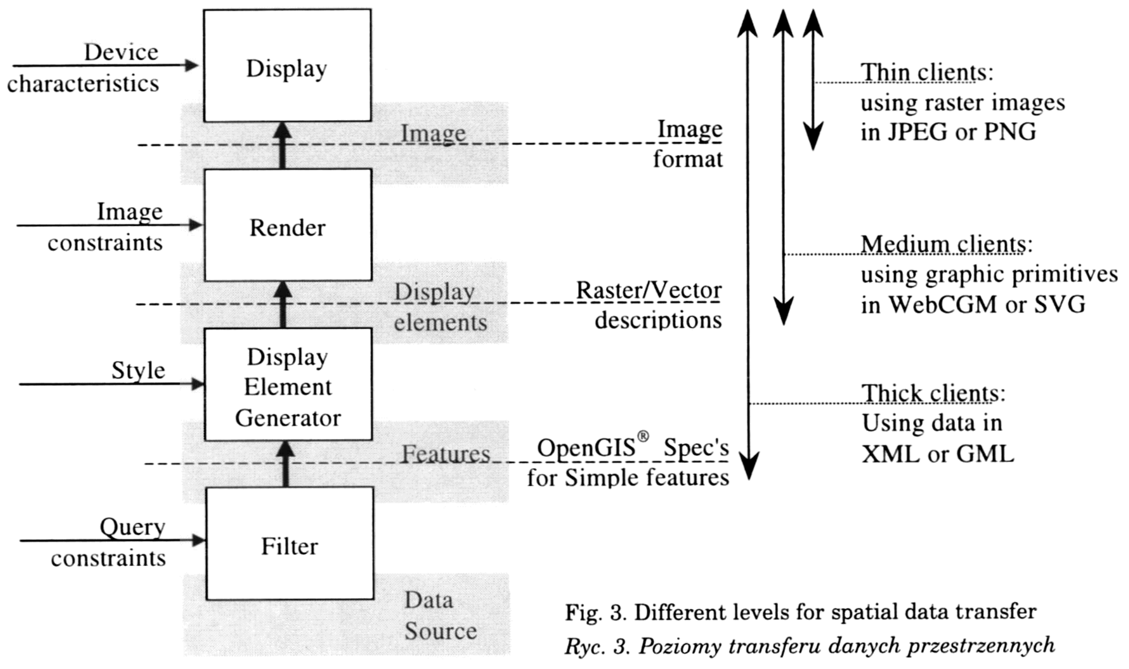

Fig. 3. Different levels for spatial data transfer
Ryc. 3. Poziomy transferu danych przestrzennych

— thin clients (using only raster images in JPEG or PNG);

— medium clients (using graphic primitives as in WebCGM and SVG);

— thick clients (accepting data as simple features XML or GML to be converted into images at the clients' side).

In the Web Mapping Testbed different communication protocols and compression techniques are used. URLs with standard parameters are used (see Table 3).

As a trade of the Web Mapping Testbed GML is developed. Because of the importance of the global Internet standard XML for data transfer, GML (a spatial version of XML, version 2.0 issued in February 2000) can be seen as the global standard for spatial data transfer.

— Co-ordinate Transformations to transform co-ordinates from one system into another

— GML version 2.0 for transfer of spatial data. Developed by the GML SIG GML V3.0 is scheduled for the beginning of 2002;

3. OpenGIS Recommendations:

— Recommended Definition Data for Co-ordinate Reference Systems and Co-ordinate Transformations.

Apart from the already mentioned developments OGC has:

— Service Architecture SIG, researching service clearinghouses according to the OMG mechanism (Object Management Group), service discovery, service quality measures and the relation to the OMG Business Object Component Architecture;

— Feature SIG, developing conceptual schemes to define spatial characteristics of geographic objects, especially vector geometry, topology 2- or 3D;

— Semantic SIG defining semantic aspects of geo-objects that are of concern for data transfer using concepts as ontology and finding corresponding objects in different datasets (map integration);

— Location Based/Mobile Services SIG. This SIG develop standards for instrument that indicate the relative position or mobility;

— Grid Coverage WG, specifying interfaces for the access to raster coverages, its re-sampling and image analyses and metadata transfer on raster images;

Table 3.
Example of Web Mapping query
Przykład zapytania typu Web Mapping

The OpenGIS® standard specifies the name of the query-parameters (e.g. BBX, LAYERS, FORMAT, etc., and its semantic in a URL-like Internet structure.

```
http://b-map-co.com/servlets/mapservlet?WMTSER=0.9&REQUEST=map&
BBOX    =   88.6815, 30.284573,087.46539,30.989218 &
WIDTH   =   792 & height=464 & SRS=4326 &
LAYERS  =   AL=Highway, AL+Highway, AL+Highway &
STYLES  =   casing, interior, label & FORMAT=GIF&TRANSPARENT=TRUE
```

— SF CORBA WG;
— Image Exploitation Services SIG;
— Telco SIG;
— Disaster management and Public Safety SIG;
— Catalog WG;
— Information & Semantics SIG.

GML Version 2.0

XML eXtended Markup Language is used to structure text documents for storage and transfer them through Internet. XML is developed according to the standards of the World Wide Web Consortium (W3C), designed as a simple open format.

GML is a XML coding for the storage and transfer of spatial objects, including the spatial and semantic characteristics. Topological and temporal characteristics will be developed in a later version. Converting geo-information in GML avoids the requirement for conversion agreements between partners, enabling to combination of different datasets.

XML uses DTDs (Documents Type Descriptions) and RDFs (Resource Description Formats) to structure metadata, data models, data constraints, objects hierarchies, compulsory and default attributes to objects, etc. Research still is required for the visualisation GML structured files and linkages to other datasets.

Though GML has become a continuous widening application area, its use is still limited. The GIS section of the Department of Geodesy of the Delft University of Technology has successfully developed a GML prototype for the Netherlands Topographic Service. Together with the Netherlands Federation of Geographic Information and Earth Observation a GML relay for GIS vendors has been executed with disappointing results.

GML is based in the OGC Abstract Feature Specification, which defines a geographic feature as indicated in table 4 (see http://www.opengis.org/techno/specs.htm) and so the digital representation of the real world can be seen as a set of features. The state of the features is defined by a set of properties, where each property has a name, type and value, defined by the type definition. Features can be combined into a set of features that, in itself, can be regarded as a feature again.

As a consequence, a feature collection has also a feature name, type and value, representing its properties.

Table 4.
OGC's definition of an abstract feature
Definicja obiektów abstrakcyjnych OGC

An Abstract Feature is an abstraction of a real world phenomenon; it is a geographic feature if it is associated with a location relative to the Earth

In GML 2.0 only simple features are considered, indicating that the geometric properties are restricted to 2-D constructs and the shape consists of linear interpolation only. GML 2.0 support the registration of 3-D co-ordinates but currently there is no direct support for 3-D constructs. In the GML geometry model the traditional 0, 1 and 2-D constructs, defined in a 2-D Spatial Reference System, are represented by points, line(string)s and polygons and collections of geometries, i.e.: homogeneous multi-point, multi-linestrings and multi-polygon collections, or heterogeneous geometry collections. In the case of collections of features the "parent" collections determines the spatial reference systems of its members.

Defined this way simple features only provide vector data and do not support topological characteristics and non-geometric complex properties.

The aims of the development of GML 2.0 are (some overlapping XML objectives):

— provide a means of encoding spatial information for data transport and storage in a Internet context;

— be extensible towards many tasks as portrayal and analysis;

— be the foundation for an Internet GIS;

— allow for data compression of geo-spatial data;

— provide encoding for spatial information and spatial relationships

— separate DLM (Digital Landscape Model, i.e. features content) from DCM (Digital Cartographic model, i.e. features representation);

— integrate feature's spatial and non-spatial characteristics by XML modelling;

— provide a set common geographic modelling objects for inter-operability of independent developed applications by sharing application schemas in XML.

GML basic schemas

GML 2.0 is compliant with XML schema definition describing classes of objects as defined in the XML Schema Candidate Recommendation published by W3C (World Wide Web Consortium) on October 24, 2001. GML 2.0 defines three base schemas for encoding spatial information:

Three basic XML schema documents are provided by GML:

1. feature.xsd defining the general feature property model supporting feature collections and common feature properties (as feature identifier, name and description);

2. geometry.xsd including the detailed geometric elements;

3. xlinks.xsd giving the Xlink attributes for linking functionality.

These schemas do not provide a schema suitable for transferring data instances but rather, they provide types and structures to be used by an application schema. The application schema declares the actual types and properties for a particular domain. The Feature Schema uses the <include> statement to connect the GML geometry and make them available for use in the defined feature types:

```
<include schemaLocation="geometry.xsd"/>
```

A geographic object is basically a set of properties (some of which are spatial oriented as position and shape) with a type (often also called class in object modelling) and attributes (representing the feature's property) that has an attribute name. The values of the properties are instances of classes or types.

Application schemas

A set of logically related GML schemas (with a Geometry, Feature and Xlink schema) is called a GML framework. Specific application types may include an application schema.

An application schema:

1. must adhere the rules for describing application schemas;
2. may not change the name, definition or data types of mandatory GML elements;
3. allow abstract type definitions to be extended or restricted;
4. receiving data need to include its appropriate application schema;
5. target namespace may not be http://www.opengis.net/gml (which is the 'gml' namespace).

Table 5.
Basic geometry property in GML 2.0
Podstawowa własność geometrii w GML 2.0

Formal name	Descriptive name	Geometry type	Element type
boundedBy	range, min/max co-ordinates	Box	
pointProperty	location, position, centreOf	Point	Primitive
lineStringProperty	centreLineOf, edgeOf	LineString	
polygonProperty	extentOf, area, coverage	Polygon	
geometryProperty	—	Any	
multipointProperty	multiLocation, multiPosition, multiCentreOf	MultiPoint	
multiLineStringProperty	multiCentreLineOf, multiEdgeOf	MultiLineString	Collections
multiPolygonProperty	multiExtentOf, multiArea, multiCoverage	MultiPolygon	
multiGeometryProperty	—	MultiGeometry	

GML 2.0 defines three levels of naming geometric properties:

1. *Formal names* that denote geometric properties based on the type of geometry;
2. *Descriptive names* i.e. a set of standardised synonyms for the formal names;
4. *Application-specific names* chosen by the users.

These basic GML schemas actually form a metaschema from which an user defined application schema can be constructed. They declare elements and/or types to name and distinguish features and features collections from each other.

Within a feature collection, a <featureMember> element can either contain a single feature or point to a feature stored remotely. A single link element is created, using the XML Linking Language (Xlink), to point extra functionality with `gml:Association AttributeGroup`, without changing the existing application schema e.g.:

```
<gml:featureMember xlink:type="simple"
xlink:title="Description of target instance"
xlink:href=http://www.myfavouritesite.com/
locations.xml#identifier/>
```

Conclusions

GML version 2.0 is proven to enable the transport of geometric data, although not many manufacturers support GML 2.0 yet (De Vries, 2001). Awaiting the implementation of GML by present manufacturers of GIS's will boost the use of GML in GIS applications. However GML 2.0 supports only the transport of simple features with linear interpolation, without topology; these properties are foreseen for the next generation of GML: GML 3.0 that is to be issued end 2001.

Also, GML will only have great success when the Internet communication will allow the transfer of data files for the general public. Many projects — around the world aim at the dissemination of spatial data for use by the general pubic. For these applications the metadata catalogue services are required. In region like Europe, Africa, and South East Asia, where so many different languages are in use the need for a common unambiguous query is required, preferably by automatic translation of queries into an SDI understandable syntax.

Also more functions like generalisation, co-ordinate transformations, common semantic definition, etc. are required. These services to a certain extent can be performed by automatic means; however, for certain applications these services need to be executed by specific service bureaus of GIS brokers.

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Henri Aalders ukończył studia geodezyjne w 1969 r. na Delfijskim Uniwersytecie Technicznym. Od tego czasu zajmował się fotogrametrią, teledetekcją, kartografią, geodezją oraz SIG w Departamencie Geodezji Ministerstwa Robót Publicznych oraz w Międzynarodowym Instytucie Geodezji Lotniczej i Nauk o Ziemi (ITC), gdzie kierował kartograficzną częścią projektu Katastru Holandii. Od 1998 r. jest profesorem technologii SIG na Wydziale Geodezji Delfijskiego Uniwersytetu Technicznego, a od 1995 r. również profesorem na Katolickim Universytecie Leuven w Belgii, w zakresie geodezji. Prof. Aalders był reprezentantem Holandii w komisji standaryzacji „Informacji Geograficznej" CEN/TC 287 oraz przewodniczącym grupy roboczej „Podstawy". Jest również przedstawicielem Holandii w Komisji Standaryzacji ICA. Jest ekspertem Banku Światowego oraz Unii Europejskiej w zakresie projektowania systemów katastralnych wielu krajów Europy centralnej, po politycznych i ekonomicznych zmianach w 1989 r.