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The OpenGIS Consortium's Purpose and Technical Approach

LANCE MCKEE, Wayland and WERNER KUHN, Münster

1. INTRODUCTION

This paper describes the OpenGIS Consortium, Inc. (OGC) and the OpenGIS (TM) geoprocessing interface standards that OGC is developing to enable distributed geoprocessing. This topic is relevant to photogrammetry and remote sensing researchers and practitioners for three primary reasons: The OpenGIS Specification ushers in a new paradigm in which geodata discovery and access roughly follow the model of the World Wide Web. The difference is that in OGC's scheme, spatial queries, not html-based text queries, find geodata in multiple heterogeneous databases. Only the spatial “answer” is returned to the querying client, not a data file which requires conversion and further processing. The OpenGIS Specification is general enough in its “coverages” definition to include image data, digital elevation models, triangulated irregular networks, and other rasterized or continuously varying non-polygonal kinds of data. Because the OpenGIS Specification adheres to a rigorous photogrammetric treatment of imagery, the door is open to easier and more useful integration of photogrammetry and imagery into practical applications of many kinds.

2. DESCRIPTION OF OGC

The goal of the OGC's OpenGIS Project is to provide a comprehensive suite of open interface specifications that enable developers to write interoperating components that provide transparent access to geodata and geoprocessing resources over networks. The OpenGIS Project was begun in 1993 with limited support from a few US federal agencies and commercial organizations who funded meetings to discuss the feasibility and scope of the proposed OpenGIS Specification (informally known as "OGIS") and specification-writing project. After the original participants determined that a useful specification could be developed, OGC was founded in August, 1994 to provide a formal structure and process for developing the specification.

OGC now manages the OpenGIS Project as a formal consensus process involving key organizations in the commercial, academic, and government sectors of the global geographic information community. All members participate in the OGC Technical Committee and its working groups under the supervision of the OGC Management Committee which develops OGC's business plan and makes all final decisions regarding the scope of the specifications and the project. The Management Committee is comprised of representatives of the OGC's Principal Members, Strategic Members, Board of Directors, and key organizations in the GI world, such as ISO TC/211 and the US Federal Geographic Data Committee.

Through an open consensus process in its Technical Committee, OGC is creating the OpenGIS Specification, a software specification for standard interfaces which are a prerequisite for geoprocessing interoperability. Through meetings, promotional activities, and publications, OGC also educates the industry and promotes development partnerships, business alliances, and market demand for new geotechnology-based products and services. OGC's diverse membership reflects its significance to key application markets such as telecommunications, transportation, environmental management, defense, and urban information systems.

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OGC was founded in response to wide-spread recognition of the following needs:

- The users' need to integrate geographic information contained in heterogeneous data stores whose incompatible formats and data structures have prevented interoperability. This incompatibility has limited use of geoprocessing in enterprise and Internet computing environments, and the time, cost, and expertise required for data conversion have slowed adoption of geoprocessing across all market segments.
- The larger community's need for improved access to public and private geodata sources, with preservation of the data's semantics.
- Agency and vendor needs to develop standardized approaches for specification of geoprocessing requirements for information system procurements.
- The industry's need to incorporate geodata and geoprocessing resources into national and enterprise information infrastructures, in order that these resources be found and used as easily as any other network-resident data and processing resources.
- Users' need to preserve the value of their legacy geoprocessing systems and legacy geodata while incorporating new geoprocessing capabilities and geodata sources.

To solve the problems listed above, OGC has created what will soon become the common unit of global commerce in geospatial information - the OpenGIS Feature Collection. This is not a data format in the usual sense but rather the data encapsulation model in a common application programming interface addressable by dissimilar geoprocessing systems. It is the basis for an industry-wide architecture for real-time geodata discovery and access, an activity quite different from batch transfer and conversion of geodata files. This concept is flexible enough to enable the integration of GIS, Earth Imaging and spatial databases with virtual reality, multimedia, network computing and non-spatial desktop applications. It has been designed to meet the business need for software infrastructure that enables Internet delivery of spatially-enabled applications to business and government enterprise networks, education, small business, home and mobile computing, and entertainment.
OGC trademarked the term "OpenGIS" to constrain the definition of OpenGIS so that vendors will be able to put authentic labels on OpenGIS compliant geodata access and distributed geoprocessing products. OGC branding of products will give users precise information about the kind and degree of interoperability these products afford.
OGC has enlisted the active involvement of official representatives from more than 100 organizations, including: GIS and computer product vendors, integrators, telecommunications company development groups, database developers, federal agencies, and universities. All these organizations are committed to supporting both the development of OpenGIS specifications and the creation of a new generation of products positioned to stimulate global markets for geodata and geoprocessing resources. About one-third of OGC's members are non-US organizations, and this fraction is growing.
OGC is organized as a tax-exempt "membership corporation," as defined in section 501(c)(6) of the US tax code, whose mission is to promote the development and use of advanced open systems standards and techniques in the area of geoprocessing and related information technologies. OGC is supported by Consortium membership fees and, to a lesser extent, development partnerships and publicly funded cooperative programs. The membership fee structure distinguishes between several classes of members.

2. OGC ORGANIZATION AND PROCESS

Strategic, operational, and technical decisions are the responsibility of the OGC Board of Directors, Management Committee, and Technical Committee, respectively. Collectively, these organizational

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levels represent the major sectors of the geoprocessing community, each level operating by consensus, and each level linked to the others by common representation and process.

2.1 OGC Board of Directors

The OGC Board of Directors is comprised of respected industry leaders who set OGC's overall direction and character. The Board maintains OGC's bylaws and strategic plan and authorizes implementation of the corporate business plan.

2.2 OGC Staff

The OGC staff reports to the Board through the president of the corporation. Their responsibilities include member services, budget preparation and the financial management of the corporation. Staff responsibilities also include management of OGC's consensus process, and promotion and member recruitment activities.

2.3 OGC Management Committee

The OGC Management Committee provides guidelines and a management structure for the OGC Technical Committee and the OpenGIS Project. Comprised of management-level representatives from Principal Members of the consortium, official liaisons to key standards groups, and representatives from the Technical Committee, the Management Committee is charged with business planning for the OpenGIS Project as well as management of the consortium's technology release process and strategic programs. The Management Committee scopes consortium specifications, sets priorities for all Technical Committee development activities, and elects OGC Board members. It is positioned through its membership and responsibilities to play an important role in shaping critical elements of the world's emerging spatial data infrastructure.

2.4 OGC Technical Committee

The OGC Technical Committee is the primary operational unit of the OpenGIS Project. It is comprised of the technical representatives of all OGC member organizations and is charged with creating the OpenGIS Specification. The Technical Committee does the bulk of its work through its Working Groups and Task Forces.

3. THE TECHNOLOGY DEVELOPMENT PROCESS

The OGC Technical Committee and Management Committee have a formal process for developing and officially approving technology. In brief, the Technical Committee first creates elements of the Abstract OpenGIS Specification. A series of RFPs is issued by the Technical Committee requesting from the members proposed specifications which codify these abstract elements in engineering specifications for the different distributing computing environments such as Microsoft's DCOM and OMG's CORBA. Sometimes requests for information (RFIs) are used to solicit input from industry at large to ensure that the Technical Committee's approach is comprehensive. Technology providers with well developed technology to submit for adoption can submit requests for comment (RFCs). Submissions received in response to RFPs are reviewed and, if approved, become the standard, publicly available specifications for OpenGIS Specification conformant interfaces or services. OGC's conformance testing program will provide a basis for an "OpenGIS stamp of approval" which will assure buyers of software that the software will interoperate with other similarly labeled software.

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Much remains to be done at this early stage in the development of spatial data infrastructures. OGC is doing the work described above on "core technology," technology which is generally applicable across all application domains. OGC will also undertake "domain technology" which will address specific geoprocessing interoperability requirements in application domains such as telecommunications and transportation. Within application domains, or Information Communities, professionals will need to discuss and write down all the technology that underlies their specific ways of geographical communication. Each discipline association, each trade association, and each professional organization must shoulder its share of the formalization of the technology foundations. This must be accomplished before unconstrained information sharing within and between different Information Communities can happen. OGC will provide tools that will make this work easier, and it will create the distributed open computing infrastructure which will make such activities as metadata standards conformance much more highly leveraged in terms of their benefits.

4. OPENGIS TECHNOLOGY SUMMARY

The OpenGIS Specification is a comprehensive software architecture specification that provides a standard way to represent all kinds of geodata in software and a common set of services to support distributed geoprocessing in heterogeneous environments. Programming interfaces based on this specification will enable true interoperability between applications on the desktop, and they will enable access (often but not necessarily object-based) to heterogeneous geodata and geoprocessing resources across local and wide area networks. The OpenGIS Specification releases GIS, remote sensing, and other geoprocessing disciplines from the constraints of proprietary and incompatible data formats and isolated applications, and moves these disciplines into the emerging world of software components and network-based computing.

Developers adhering to the OpenGIS Specification will create applications able to handle the full range of geodata types and able to automatically negotiate vast geodata and geoprocessing resources on the network. Users of geodata will be able to share a huge networked data space in which all kinds of spatial data will be usable without difficult and time-consuming batch transfers and conversions, even though the data may have been produced at different times by unrelated groups using different production systems for different purposes. Of course, different data models do not overlap completely in the types of information they can store, and different Geographic Information Communities define geographic features differently and use different metadata schemas. But compliant services will support the highest possible degree of data integration, including services to manage semantics and services to automatically track data lineage, quality, and error budgets. In many cases automated methods will bring older data into conformance.

4.1 How the OpenGIS Specification Achieves Interoperability

The problem of non-interoperability begins with different vendors' software using different internal structures for defining the basic geometry of geographic features, but it doesn't end there. Any GIS software system is likely to be adapted by users in necessarily different ways for different applications, and this adds new obstacles to information sharing. Each of the hundreds of branching Geographic Information Communities is distinguished by its specific information representation technologies such as data dictionaries, feature schema, geometry rules, catalog schema, etc. The branching of Information Communities occurs as individuals and communities with new purposes borrow from, but also alter or add to schemas developed for previous related efforts or professional disciplines.

The OpenGIS Specification does not put forward a standard schema model. The OpenGIS Specification's Open Geodata Model (OGM) is not a schema model in the sense that a set of type instances is a schema model. ("Type" here is used as software developers use the word, to refer to

specific simple or complex data constructions which are repeatedly "instantiated" or configured with particular collections of data. A byte, for example, is a very simple type that can be instantiated as a particular ASCII character.) Rather, the OGM is a set of types which the OGC Technical Committee has agreed are sufficiently primitive and varied to be used for constructing interfaces between dissimilar schema models. Every GIS, Earth imaging, digital cartography, and location/navigation system has a geodata model, or schema model, which is expressible in terms of the OGM's system of "well-known types."

Information Communities' higher level schema models are also expressible in terms of the OGM's well-known types. The OGM is the low-level language by which geographic entities are expressed within the diverse higher level "geographic languages" of different Information Communities. Two different Information Communities, for example, may have different ways of describing the geometry of geographic entities - "roads" may in one community be lines, in the other polygons. They may also not have the same attributes - in one community numbers of lanes is critical, in another surface type is critical. The OGM provides the only practical universal means of describing geometry and attributes. Furthermore, the OpenGIS Specification's OGIS Services Architecture defines the only practical universal means of publishing over networks the community-specific definitions and the means of discovering these definitions and the data they describe.

There are two definitions or views of the Information Community. One view sees a human community of people who share a set of feature definitions and semantics. Participants in a human Geographic Information Community communicate among themselves to standardize as they elaborate upon the software's simple native schema models to meet their particular professional needs, elaborating a common schema model. The phrase "Information Community" also refers to a mechanism which describes in the OpenGIS Specification how geographic information is organized in a human Information Community. This mechanism is essential to the function of catalogs, traders, and other mechanisms for geodata discovery across networks populated by many sources of heterogeneous geodata and geoprocessing resources.

The easiest and most efficient interfaces are those between the basic "simple features" schemas of different GIS systems. These are the interfaces specified in OGC members' submissions to the OGC Technical Committee's first request for proposals (RFP), which was released in August, 1996.

5. RELATIONSHIPS TO THE STANDARDS COMMUNITY

The OpenGIS Project is being tracked closely by all the groups interested in geoprocessing standards. OpenGIS technology was cited by the U.S. Federal Geographic Data Committee (FGDC) in its 1994 Plan for the National Spatial Data Infrastructure (NSDI) in recognition of its potential as an enabling technology for the NSDI. OGC maintains a class A liaison with the GIS/Geomatics Committee of the International Standards Organization, ISO TC/211. When this paper went to print, OGC had just launched a proactive approach to coordinated standardization with ISO TC/211 in the form of a common white paper outlining strategies. OGC has also maintained representation on the GIS standards committee of the American National Standards Institute, ANSI X3L1, through OGC's members and members of the OGC Management Committee. Through common members and formal collaboration, the OpenGIS Project is linked to the Object Management Group (OMG), whose CORBAgis SIG was founded by OGC members. Through OGC members, the OpenGIS Project stays in step with other de facto distributed computing standards.

6. CONCLUSIONS

The Open GIS Consortium has, within only three years, attained the status of a de facto standard setting organization in the field of geo-spatial information technology. With 100 members from industry,

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government organizations, and academia, it has reached the strength to push for interoperable geoprocessing at the global level and to engage in more research activities helping its longer term goals. A major effort is currently under way to broaden the member basis in Europe and thereby focus on the special traditions and needs resulting from the high professional standards for geospatial data in Europe. At the same time, European universities have shown a keen interest to contribute research on interoperability through OGC membership. A new research initiative of the U.S. National Center for Geographic Information and Analysis (NCGIA), in cooperation with OGC, will channel such research efforts from North-America, Europe and other continents into a coordinated effort to remove obstacles against interoperability. Among these obstacles are the lack of means to describe the semantics of data and services and to map among different semantics. Finally, a series of coordinating activities with international standards organizations in the field, such as ISO TC/211 or OMG, is making sure that the geoprocessing business can grow to its full potential.

For more information on OGC and its growing international activities, please contact one of the authors or visit http://www.opengis.org. A Symposium on OpenGIS in Europe will take place at Strasbourg on November 11-12, 1997.