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A COMMUNICATION PROCESS ACCOUNT OF THE INTEROPERABILITY OF GEOGRAPHIC INFORMATION

(Extended abstract)

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Since 1990, we can note in the geographic information community that the number of geographic databases has increased over the years throughout the World. At the beginning, these geographic databases were developed by organizations for their specific needs. Each geographic database usually abstracted same phenomena in different manners, for instance *vegetation*[1], *trees*, *wooded area*, *wooded area*, *milieu boisé*, *zone boisée* (unknown geometry) (BC Ministry of Environment Lands and Parks (Geographic Data BC), 1992; Natural Resources Canada, 1996; New Brunswick, 2000; OBM, 1996; Québec, 2000; VMap, 1995). As the geographic information community required access to these databases, organizations began the dissemination of their respective data to the general public. As such, many countries have undertaken the development of Web infrastructures to simplify the access of geographic information (e.g. NSDI in United States, CGDI in Canada, GDI-DE in Germany).

As geographic data producers typically abstract the same geographic phenomena differently, this causes problems to locate geographic data that fulfill specific user's needs as well as to integrate data coming from different databases in a consistent dataset. As such, interoperability of geographic data and process has been developed since the nineties by standardization bodies (e.g. OpenGIS Consortium Inc., ISO/TC 211) as well as the research community as a solution to solve syntactic, structural, and semantic heterogeneities as well as spatial and temporal heterogeneities between data sources (Bishr, 1997; Charron, 1995; Laurini, 1998; Ouksel and Sheth, 1999; Sheth, 1999). Today, with the common availability of Internet technologies, interoperability has become a necessity for sharing and integrating geographic information. However, it still doesn't resolve semantic issues. A few models have been proposed to automatically overcome heterogeneity of geographic data, notably the Semantic Formal Data Structure (Bishr, 1997), the Matching Distance model (Rodriguez, 2000) and the *Isis* solution (Benslimane, 2001). These models help to increase the interoperability of geographic data but the addition of a framework of geographic data interoperability would contribute further towards the appreciation of where each model specifically applies. Therefore, to foster research in geographic data interoperability, we have recently developed a conceptual framework of geographic data interoperability based on cognitive sciences, the human communication process,

[1] Spatial pictograms description: :0D ; :1D ; :2D ; :multiple geometry ; : alternate geometry (see Bédard, Y, et M-J Proulx 2002 Perceptory Web Site. WWW Document, http://sirs.scg.ulaval.ca/Perceptory)

and developments on ontologies (Brodeur, 2004). In addition to the conceptual framework, we have defined a reasoning methodology to evaluate the semantic similarity, which is consistent with common spatial analysis methodologies in the geographic information realm and is.

Our conceptual framework compares geographic data interoperability to a communication process between human beings and takes into consideration the semantic issue. In a communication process, an individual receives signals as part of a message transmitted by another individual and uses its knowledge to interpret and assign a meaning to the message and to integrate it in its knowledge base. In our conceptual framework, a user agent, which wants information about a given geographic phenomenon (e.g. street) within a specific geographic area, sends a request to a data provider agent using its own vocabulary. When the data provider agent receives the request, he/she/it begins the recognition or the interpretation of the request based on its own knowledge and vocabulary. When he/she/it has recognized the request –i.e. assigned a meaning to the request, then he/she/it gathers the data that answers the request and sends it back to the user agent. When the user agent receives the answer, he/she/it must verify if the answer complies with the original request. If so, then interoperability happens between the two agents. As you can see interoperability is here presented has a bi-directional communication process between the two agents, which can exchange information in an interoperable manner.

Five different facets of the reality take part of this conceptual framework for interoperability: the reality itself, the reality abstracted by the two agents and the reality communicated by the two agents. Here, agents' specific abstraction of the reality refers to *ontology* (Gruber, 1995). In our context, we defines ontology as a formal representation of phenomena with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships. In geographic information, ontologies about geographic phenomena are usually elaborated using geospatial repositories, which capture the semantics of feature classes and their application as defined for an application. Basically, geospatial repository consists of a conceptual data model with a feature catalogue or a data dictionary to store the details of the data model (Brodeur et al., 2000). Typically, a conceptual data model is used as a tool for thinking, organizing, describing, communicating information about the structure and content of the geographic database during its implementation phase and is set aside afterward. Feature catalogues are documented within data product specification documents, which are rarely stored and used to support geographic data analysis and interoperability.

The present paper aims at describing the interoperability of geographic information from a human communication process account. More specifically, it will address the importance and the role of geospatial repositories as ontologies for computerized reasoning in order to support Web services in the interpretation of requests about geographic information by users, as well as to support client software and application in the interpretation of the data delivered by the data provider.

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