18 - Geographic Information and Location Sensing

The provision of web services using geo-physical metatagged databases and the combination of location sensing through mobile telecommunications devices has the potential to alter many of our current work processes.

As the world moves from a paper-based and dial-up Internet connection to an "always-on" mobile work process and lifestyle, new ways of relating to our surroundings will be necessary. The focus will be on gathering information about our surroundings not from interacting with it but from data stored and delivered electronically.

At present much of the information about the geographic world is stored on data bases that use proprietary software. These systems are known as Geographic Information Systems (GIS) and there a number of vendors selling these systems. Many utilities and government organisations use these software applications to keep an asset register of infrastructure.

As has been demonstrated in other chapters of this report, there is a move to enable these separate systems to be more communicative. This move in geographic information is being driven by the OpenGIS Consortium (OGC)[1] towards an open systems that relies upon the use of a "web services" model. This consortium includes the Australian Department of Defense.

One of the more interesting developments from this project is that the open system will allow for users to define the information that is required rather than view unnecessary data. Additionally if a location sensing system is used, it will be possible for a person to load data onto their mobile computer that relates only to his or her physical location. These developments have the ability to change the way that we will live and work in the future.

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Current Geographic Information Systems

Geographic Information Systems (GIS) is a mature technology with a number of vendors providing this market with a range of application software. Nearly every organisation that needs to relate to geographic information has some type of system established to collect data and re-present this data at a later stage.

These systems are in use a wide range of applications. For example, government land administration, utility infrastructure mapping, real estate industry, health management and traffic management are a few obvious examples. Unfortunately, much of the data is unable to be shared across vendor software due the separate development of these applications. The issues of incompatible data sets require either the purchase of that vendor's software to read the data or a lengthy and expensive process of re-entering the data into the system.

OpenGIS

The OpenGIS Consortium is seeking to have geo-spatial data more compatible with other systems. The goal is to allow more individuals access to data stored by governments and enterprises to provide for improvements in economic productivity, decision making and service delivery.[2]

As the world becomes more mobile, there needs to be access to physical and geo-spatial data through mobile computers. This vision requires a number of systems to be put into place. These are:

- Integrated geographic information systems that share data accurately and resolve conflicts
- Reduced data sets that meet the needs of the user without additional information
- Economic distribution of the data to the mobile user
- User-friendly software applications for ease of interaction with the data.

The OpenGIS is working towards these goals using a range of Internet-standard software. The programming languages to be used are based around web services protocols such as the eXtensible Markup Language (XML). For more information about these protocols, see Box 18.1 - Web Services Protocols.

Significant work has already been completed and there are international standards available for these systems. Perhaps the most significant is the International Organization for Standardization's ISO 19115 – Standards for Metatagging. In Australia, the ANZLIC – Spatial Information Council[3] is managing the process through the Australian Spatial Data Infrastructure Distribution Network.

The goal of this distribution network is to provide for "Australia's and New Zealand's economic growth, and social and environmental interests are underpinned by quality spatially referenced information. Quality spatially referenced data means spatially referenced information that is current, complete, accurate, affordable, accessible and able to be integrated."[4] This data is planned to be available to anyone, built upon standards through a network of many organisations.[5]

The value of metadata which would be able to created by such a network is that it will help to build a strong spatial data infrastructure rather than having enterprises and governments rely on their data alone.[6] This integration requires each data base manager to put into place the ability to not only have others within the organisation be able to read the data but to also have this data available to the Internet. This will require data bases to move to open systems.

It is recognised that the cost of developing and maintaining data bases is expensive and free access is something that is unlikely to be given. Therefore billing arrangements will need to be put into place before much of this information is available. Additionally these organisations will need to establish a web services infrastructure to be able to provide this service.[7]

BOX 18.1 - WEB SERVICES PROTOCOLS

Web Services *- This services provides the opportunity for a range of separate and disassociated databases to be able to communicate with each other and to selectively draw data from each other on request. Providing that the databases are network connected, requests can be placed through standardised programming languages.*

Web Services Description Language *(WSDL) -this language describes the capabilities and capacity of a web content provider. It also describes the location and how the source is to be contacted.*

Extensible Markup Language *(XML) - this programming language is used by web content providers to provide data through industry-specific protocols within a vendor-neutral environment. Essentially, industry members define data labels to be used and can more efficiently transfer data using these arrangements.*

Simple Object Access Protocol *(SOAP) - this protocol is able to integrate computers using different operating systems. SOAP specifies how HTTP header and XML file should be encoded to allow a program in one computer to interact with a computer using a different platform.*

Universal Description, Discovery, and Integration *(UDDI) - This protocol describes the way that information regarding a web service is to be published and discovered.*

Geographic Data Display

At the beginning of this chapter there was a mention of a focus on mobile computing and geo-spatial information systems. What is demonstrated through OpenGIS is that attention is being paid to enabling this geographic data to be available through the Internet. Many current systems are able to be displayed through an Internet web browser using application software from the vendor.

This Intranet or Internet presentation of data is usually for intra-enterprise display. This means that individuals within the organisation are able to view the data very easily. However, when the data needs to be presented to individuals outside the organisation, this may present difficulties with interoperability issues.

Currently there are a number of service providers that can provide web-based geographic displays on a demand basis. The Yellow Pages[8] or City Search[9] has such a facility for locating specific geo-spatial locations and allow for a zoom-in or zoom-out facility. However, it is not possible to minimize the data that is presented on the screen and the entire data set (or graphic) must be viewed.

For distribution to a mobile computer, the amount of data needs to be minimised as the user will need to pay for all of the data sent rather than just the data that is required. For example, if a person only wishes to know the street layout and the nearest bus stop for a particular bus, this is the only data that will need to be downloaded to satisfy the user. In this case, a method of displaying selected data is required.

The Geography Markup Language (GML) will provide for the economic use of mobile Internet data. In a software application similar to a web browser the user can select which data is presented. This data is loaded in the form of text similar to a web page that uses Hyper Text Markup Language (HTML) to display text and colour. This then provides the user with a faster and less expensive method of gaining geo-spatial information.

Location Sensing

The ability to have a device located remotely provides for a number of benefits. Firstly, this capability allows those who are in an emergency situation to accurately describe where they are. This speeds emergency services to the correct location. The second benefit is that if data is requested by a user for his or her immediate location, this data can be sent based upon the location of the mobile computer.

One way of doing this is to use a Global Positioning System (GPS) transponder. This technology is very mature within transport and marine applications. A GPS transponder is also able to be included as an add-on to Personal Digital Assistants (PDAs) and in notebook computers. When combined with a mapping system, the individual knows where he or she is to within a few metres.

The GPS transponder works well in a vehicle as the size of the equipment can suit the application and does not need to be physically carried by the user. Additionally, a power source is available from within the vehicle. For mobile computing, the user will need to physically carry this equipment and have access to a mobile power source. Battery technology has not overcome the problems encountered with an “always on” society that requires longer-lasting batteries.

One way of being able to locate a mobile computing device is to use the mobile telephone network infrastructure. This is done by using the cellular network towers as measuring devices.[10] As it takes time for a radio signal to travel through space, a signal can be timed from the point of origin to the point of reception. If three reception points are established, it is possible to triangulate the signal and determine geo-spatial origin of the signal.[11]

The process of location sensing is accomplished by knowing the time of arrival of the signal at each of the three locations and the physical location of the points of reception. The network provider will make the various calculations and by using this method the location of the device can be estimated to around 31 metres. While this is less than the one to three metres for a GPS system, the process does not require the mobile device to do the calculations nor support a GPS transponder.[12] This eliminates the cost of the transponder and additional power requirements.

Combining Data and Location Sensing.

By combining these two technologies, it is possible to imagine that a person would be able with a mobile computer to send for information that is highly relevant and geographically specific. Following on from our example of locating a bus stop, the user could request from a public transport provider the quickest route home from where he or she was and receive only the necessary instructions.

Ordering a taxi from a wireline telephone has been facilitated with the combination of the E.164 telephone database with geo-spatial data. The taxi company knows from which address the call originated and can dispatch the taxi to that location. For mobile telephones this is an impossible task unless location sensing is used. Using this system, a call could be placed and the taxi driver will know where to go.

Summary

As this is a discussion of the emerging technologies likely to be used in five years time, it is not possible to be able to describe the applications that may eventuate for commercial use. What may be possible to state here is that as mobile computing becomes more widely adopted and as geo-spatial data bases become more interoperable, work processes will change to meet the opportunities available from these technologies.

It is possible that through the merging of these two technologies it will enable a greatly facilitated work process to develop. There would be no need for hard-copy work instructions and with the ability to accurately describe and confirm the physical location of the activity, greatly improved productivity could take place.

IMPLICATIONS FOR THE SHARED TECHNOLOGY INDUSTRIES

Automotive

Manufacturers provide CDROMs or DVDs to clients of roadmaps for cities around the world. When a client visits a new city, he or she will need to obtain a CD for that location (inexpensive option) or download the information from the Internet (very expensive option). A GPS system will be able to integrate with the geo-spatial data to provide for navigation.

The CD is a static database and is not able to be updated. The use of targeted information regarding temporal events through the GIS systems and linking this with an existing road map can provide for much greater functionality for these navigation systems.

Building and Construction

These technologies can provide for much more efficient asset management and maintenance activities. By providing a remote worker with specific information and location of the activity to be performed, work processes can be more efficiently planned.

Electrical

These technologies can provide for much more work processes and maintenance activities. By providing a remote worker with specific information and location of the activity to be performed, work processes can be more efficiently planned.

Electronics

These technologies can increase the number of devices to be used by individuals. The repair and maintenance of these devices would be an on-going requirement within this industry.

Engineering

These technologies can provide for much more efficient asset management and maintenance activities especially in large, geographically diverse sites.. By providing a remote worker with specific information and location of the activity to be performed, work processes can be more efficiently planned.

Information Technology

These technologies require an increase in the development of existing databases and infrastructure. New applications will need to be developed to support the requests by users as well as an increase in content management for commercial and retail involvement.

Telecommunications

While likely to be mainly contained at a network level, this industry will see a greater utilisation of existing and planned infrastructure as a result of the introduction of these services.

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[1] See OpenGIS Consortium. Available: http://www.opengis.org

[2] OpenGIS Consortium. (2002). *Vision, Mission & Values*. Author. Available: http://www.opengis.org/info/vm.htm Accessed: 22 April, 2003.

[3] See ANZLIC. Available: http://www.anzlic.org.au

[4] ANZLIC. (2003). *About us*. Canberra: Author. Available: http://www.anzlic.org.au/about.html Accessed: 22 April, 2003.

[5] ANZLIC (2003). *The Internet framework technical architecture.* Canberra: Author. Available: http://www.anzlic.org.au/publications.html Accessed: 22 April, 2003.

[6] Environmental Systems Research Institute. (2003). *Spatial data standards and GIS interoperability*. Redlands, CA: Author. Available: http://www.esri.com/library/whitepapers/pdfs/spatial-data-standards.pdf Accessed: 22 April, 2003.

[7] Baker, T. (2002). *A primer on Internet-based mapping technologies.* Author. Available: http://tbaker.com/papers/working/short_reports/Stateof_InternetMapping.pdf Accessed: 22 April, 2003.

[8] See the Yellow Pages. Available: http://www.yellowpages.com.au

[9] See City Search. Available: http://www.citysearch.com.au

[10] Basso, M. (2002). *Mobile location service market: Drivers and obstacles.* Gartner. Reference Number: M-16-8574.

[11] Hightower, J., Borriello, G. (2001). *A survey and taxonomy of location systems for ubiquitous computing.* Seattle, WA: University of Washington. Available: http://www.cs.washington.edu/homes/jeffro/pubs/hightower2001survey/hightower2001survey Accessed: 22 April, 2003.

[12] Roussos, G. (2002). *Location sensing technologies and applications.* London: University of London. Available: http://www.jisc.ac.uk/uploaded_documents/Location%20Sensing%20Technologies%20and%20Applications_v2.pdf Accessed: 22 April, 2003.