Exploitation of Network Technologies for GeoSpatial Data Research and Commerce

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Introduction

There is a fortunate coincidence in the timing of the development of two independent phenomena: the wide acceptance and use of earth-observation and related geospatial technologies, and the vigorous growth of the network communications technology known as the Internet. As with a variety of other human endeavours, -earth-observation in both its applied and research forms has quickly exploited the Internet for its speed, convenience and global pervasiveness.

The Canada Centre for Remote Sensing (CCRS) has embraced Internet technologies in the 1990s in order to deal more efficiently and effectively with its programs, administrative needs, clients and partners. This decision was taken not only from the "technological push" afforded by the Internet, but by the economic realities of budget and human resources constraints. It was recognized that the Internet allowed new initiatives related to communications, marketing, service and product delivery, etc., as well as replacement of some older, more labour-intensive mechanisms. This two-pronged benefit gives foundation to the otherwise esoteric maxim of "doing more with less".

Internal Networking

The work of the Canada Centre for Remote Sensing is organized on a project basis. This is particularly true of research and development work. The projects usually involve several people, sometimes from different sections or divisions. Much of the project work is now conducted through internal network systems. In addition to internal communications via e-mail, project staff exchange software, documents, images and other forms of data via shared network lines and disks. These same networks handle specialized printing requirements, such as very large format and high quality colour outputs. Databases are often at the heart of a project, and network connectivity to these allows distributed manipulation of the data contained therein. Security issues and backup copies of critical information are easily facilitated when the information is in a networked environment. The project leader will use networks to manage, analyze and report on project schedules and milestones. More and more often, project (interim and final) reports will not be printed on paper, but will live entirely in their 'softcopy' form.

Internal administrative processes and information distribution are greatly facilitated by internal networks. When these internal networks use Internet technologies, they are referred to as 'Intranet'. At CCRS, more and more of the bureaucratic logistics are handled through electronic means. Financial systems, human resources systems, contact information, forms and templates,

and much more are offered to staff electronically. Further, these systems and data are acquired, handled and passed from hand to hand through internal electronic networks.

It is quite common for a staff member to start up not only word processing and e-mail applications on his or her computer as the commencement 'ritual' of the working day, but increasingly the Web 'browser' software too. This software allows access to the Centre's Intranet, which offers a number of datasets that will be useful throughout the workday. The browser will be the link to accessing corporate reference information on policy, guidelines, and rules. It will allow access to software information and upgrades, as well as the reporting mechanism for correcting computer-related problems. The worker can check on scheduled events such as internal seminars, book boardrooms, check travel expense rates and make monthly reports on project time spent. Overhead presentation slide sets by CCRS staff are maintained electronically too, and may be browsed, downloaded and then edited to suit a particular new need. The full contact/mailing list used by the Centre is kept in a searchable electronic form, so that staff can access in one location, the most up to date information available on those organizations and individuals that we deal with. As more and more internal services like these are offered to staff via the Intranet, we are tending to rely increasingly on this technology as a single source of support, rather than the traditional 'distributed' bureaucratic sources of the past.

External Networking

Dealing effectively with the outside world is a prerequisite to any organization. For CCRS it is critical to develop excellent communications with our business partners, other government departments, domestic and foreign clients, individual users and the general public. Internet technologies have become the prime mechanisms for enabling this crucial rapport. Implementation has been primarily through the corporate CCRS Web site and several other special-topic Web sites.

International Partnerships

CCRS has traditionally developed a wide range of international partnerships in its efforts at applications development, data reception and processing, technology transfer and training, and basic research. There are usually quite a number of active partnerships ongoing at any one time. The Internet allows us to maintain close and convenient contact with our foreign partners, exchange information, datasets, analyses, etc. on a regular basis. This has also reduced our reliance on the slower and riskier parcel delivery systems as well as the time consuming and expensive necessity of making personal visits. Our corporate Web site (http://www.ccrs.nrcan.gc.ca) is the vehicle of choice for showing the progress and the results achieved by some of these international projects. New results are easily updated on the site, and displayed to the world at large on behalf of all partners in the collaborative effort.

One of our best current examples of international collaboration demonstrated on the Web is the GlobeSAR2 program. This partnership with eleven South and Central American countries for developing radar remote sensing applications is well elaborated on the CCRS Web site. The wide distribution of partners with diverse projects, schedules, resources and applications is efficiently brought together with Web technology. The visitor can check activity details on a country, project or application basis. The schedules of activities, contact information for the participants, bibliographies of related papers and sample imagery are all accessible and interlinked. As the program advances, changes and new results are implemented so the viewer is always presented with current information.

Educational Services

One of the most active and enthusiastic groups of clients for CCRS is the academic community. Their demand for materials and information related to remote sensing education is insatiable. Their electronic 'visits' to the CCRS Web site covers most of the contents therein, but the 'Education and Reference' chapter is of special interest. In order to address their needs, a number of special features have been created and posted. The most popular of these is the 'Images of Canada' section, providing remote sensing images with detailed interpretations, descriptions and technical specifications. A comprehensive glossary of remote sensing terminology is presented, as well as exercises in digital image analysis, the complete and searchable CCRS publications list, a showcase of special images reflecting our research, our newsletter "Remote Sensing in Canada", a number of RADARSAT images which highlight specific applications, and a comprehensive listing of Canadian universities with remote sensing course offerings. In this way, we present opportunities for both on-line, interactive learning with interconnected (linked) materials, as well as downloadable modules for use off-line.

Through our participation in the 'SchoolNet' project on the World Wide Web (http://www-nais.ccrs.nrcan.gc.ca/schoolnet), we are offering to the student, teacher and the general public, the opportunity to create customized thematic maps. The user is able to select a combination from over a hundred thematic layers of information, as well as a variety of other cartographic parameters to come up with a unique map. Such an opportunity to manipulate a product elicits a lasting educational effect on the visitor, in addition to the downloadable product of his/her making.

On-Line Retailing

Considering the digital nature of the products that we deal with, it becomes obvious that the Internet can also handle the necessary aspects of retailing. We are currently experimenting with an on-line 'storefront' (GeoCommerce) on behalf of the Canadian earth-observation community, with the expectation that eventually most product dealings can be accomplished electronically. This 'commercial server' (http://GMS.NRCan.GC.CA/) allows for the browsing, searching and selection of products by means of an electronic catalogue. Subsequently the user can place an order for certain products and have the opportunity for payment on-line as well. This type of retailing is well established in the marketplace for a variety of goods. In a matter of time, most organizations dealing with geospatial products will surely be also established in a similar manner. It is envisioned that eventually this will be the focal point for all those involved in geospatial data: data suppliers, system integrators, application developers and the end users.

Distributed Data Sources

Geospatial data is created, manipulated and offered to users by a wide variety of suppliers and value-added retailers. Just the earth-observation component of geospatial data sees a myriad of data sources, formats and data manipulation tools that are geographically wide spread and easily confuse or frustrate the user. It is useful to provide a single 'meeting place' for all those who are at the supply end of the data chain, as well as for those at the demand end. In such a place, it is befitting to provide a simplified and unified offering of products and services to the user community. It is the objective of the CEONet (Canadian Earth-Observation Network) project, conducted by CCRS, to create a national infrastructure for providing improved access to earth-observation archives and other complementary geospatial databases. CEONet brings together the primary data suppliers (the major organizations within the earth-observation and geomatics community that provide the raw geospatial data), the consumers (the users of earth-observation

data), and the value-added suppliers (who acquire raw data and then alter it into a higher-level product).

These participants in the supply/demand community of earth-observation data are offered a central meeting point, wherein commerce takes place. At the CEONet Web site (http://CEONet.CCRS.NRCan.GC.CA/) the participants are offered a number of services:

- an advertising service for services and products,
- a directory service for suppliers, products or groups of products,
- a distributed search service on suppliers' product inventories for discrete products

In addition, CEONet has close links to similar international initiatives such as the International Directory Network (IDN), the European-Wide Service Exchange (EWSE), the U.S. Federal Geographic Data Committee Clearinghouse, and NASA's Earth Observing System Data and Information System (EOSDIS).

Customer Profiling

Using the Internet to deal with the commerce of geospatial data offers the opportunity to collect valuable information about customers, which can lead to smarter business practices. When visiting Web sites, users inadvertently provide a number of descriptive bits of information about themselves and their interests. These can be easily collected and studied statistically for insight into the user community. While this is a more passive approach to collecting information, a more pro-active approach would be to ask users to provide specified information about themselves and their business/product interests, via an electronic form. The results from obliging visitors can be automatically collected and statistically reduced to useful information.

Benefits and Limitations

There are obvious shortcomings to the Internet as a form of communication and distribution. It is certainly one step removed from the familiarity and intimacy of face-to-face communications. Also, the limitations of bandwidth still preclude the transfer of large digital files that are commonplace in earth-observation datasets. As well, not all clients are yet fitted with Internet connectivity. Still, these limitations are being overcome at quite a fast pace, and the benefits to be derived from even the current state of this technology are very attractive.

Connectivity to, and therefore use of, the Web is becoming the norm for governments, businesses, organizations and even individuals. To offer products and services on the Web as well as to expect to find what one is looking for, is now all pervasive in many countries, and is spreading quickly throughout the world. It is normal business practice to establish a presence on the Web and it would be unthinkable for any major organization not to exploit Internet e-mail, for example, as one of the primary means of communication. Such connectivity is a functional necessity and is an economical enhancement or replacement of older mechanisms of communication.

For those who deal internationally, the nuisance factor of time zones which are potentially several hours 'distant' can be mollified by using e-mail. Web sites, which are usually 'on-line' 24 hours per day, accommodate the temporally displaced visitor too. In this way, electronic networks link the world together and bypass some awkward space and time constraints.

The interactive nature of the Web and the automated processes available for dealing with visitor requests allow for much more efficient dealings with our customers. Besides the 24 hour service provided, we can 'interact' with visitors to our site and transact simple or complex business, without the intervention (and labour costs) of staff. Typically, we receive about 150,000 'requests' for information in a month through our Web site. These requests are replied to instantaneously and automatically. This would be an impossible task if it had to be handled through direct human intervention.

Implications for the Future

The technological improvements to networking that are anticipated in the next several years make it even more promising that we can interact with our partners and clients with substantially more efficiency, effectiveness and economy. Bandwidth improvements are inevitable and will accommodate delivery of full satellite images for instance, as well as other large data sets. Collaboration on networked services by diverse suppliers of geospatial data will allow for 'one-stop-shopping' for visitors. Such collaboration will also enable value-added-retailers to act as 'middlemen' between raw data providers and the end user, who wants higher level products or customized data delivery.

As we gain proficiency with interactive Web technologies, it will be advantageous to demonstrate analysis or data processing algorithms on line. New algorithms and associated data sets will be made available for real-time manipulation and assessment by all interested parties. Such offerings will encourage scientists to share their ideas and open them for informal peer review. These will likely produce collaborative research partnerships more frequently, and will also be beneficial as a teaching mechanism.

'Extranets' are inter-organizational networks with restricted access, usually using Web technology. Multiple organizations that are collaborating on projects can electronically define a delimited 'community', which can share information within its membership for the duration of a project. This is commonly done today as a special Web site which has a publicly accessible section providing public relations materials, as well as a confined and secure internal section for accomplishing the day-to-day work of the project at hand. We will see more of this process in the future, as projects requiring international cooperation proliferate.

Plans are underway for an electronic remote sensing journal to join the other technical journals that are already available on the Web. Implications for Web publishing are far-reaching. Articles do not have to wait in line (sometimes for years), to be published in a particular issue. They can be posted (and therefore 'published') as soon as they are cleared by the editor. Articles can carry any number of colour images without the usual colour page printing charges. Subscribers can be notified of new articles automatically by e-mail. Articles can be interlinked as well as linked to the author's own Web site for additional details. They can be searched by topic, keyword, author; letters to the editor can be posted along with the article they refer to. The flexibility of Web publishing is nothing short of dramatic in comparison to traditional methods.

We see a bright future in exploiting networking technologies to the benefit of our organization and community. We have already experienced the benefits of providing improved services while dealing with reduced labour. Judicious selection of which technologies to embrace at which time will enable us to reap ever more beneficial results from the exploitation of the Internet for geospatial research and commerce.