

THE DEVELOPMENT OF MAP DISTRIBUTION THROUGH THE INTERNET

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ABSTRACT

In a few short years, the World Wide Web has become a major medium for the distribution of maps. Hundreds of millions of people now access both static and user-defined maps through the web. A single website at www.mapquest.com reports distributing over 20 million maps on a daily basis. A large number of other sites consistently distribute over 100,000 maps on a day. The Internet is clearly redefining how maps are distributed and used, and represents a new and important area of research for cartography.

In 1999, the ICA established a Maps and Internet Commission to focus attention on the dissemination of maps and spatial data through distributed electronic networks. The first commission-sponsored symposium was held during 2000. Speakers presented research in two general areas: 1) The application of specific tools for Internet mapping such as Java, VRML, XML, the integration of various forms of media with maps, and the efficient transfer of the data through the Internet; and 2) Research in Internet map use examined map use and user characteristics of both maps and spatial data available through the web, the development of user-specific maps such as for education and travel, and ethical issues surrounding the availability of data in the form of maps that may be too sensitive for public viewing.

The development of map distribution through the Internet is affected by general trends that influence the spread and adoption of the technology. The adoption of the Internet has been particularly dramatic since the mid-1990s. The number of users has increased rapidly as the technology has spread beyond North America and Europe. Three major changes in the development of the Internet can be identified. In the first stage, the distribution of maps via the Internet was a novelty. In the second stage, beginning in about 1997, the web emerged as a major form of delivery for certain types of maps. In the current third stage, the continued development of this form of map delivery is dependent on solving specific problems. Solutions to these problems are both technical and philosophical and will have a major influence on how cartography as a whole develops in the future.

1.0 INTRODUCTION

The Internet is redefining how maps are used. No longer restricted to paper, maps are now transmitted almost instantly and delivered to the user in a fraction of the time required to distribute maps on paper. They are also viewed in a more timely fashion. Weather maps, for example, are updated continuously throughout the day. Most importantly, maps on the Internet are more interactive. They are accessed through a

hyperlinking structure that makes it possible to engage the map user on a higher-level than is possible with a map on paper. Finally, the Internet is making it possible to more easily distribute different kinds of cartographic displays such as animations. The Internet presents the map user with both a faster method of map distribution and different forms of human-map interaction.

Recognizing these changes in map distribution and map use, the International Cartographic Association (ICA) established a **Commission on Maps and the Internet** at its meeting in Ottawa, Canada, in August of 1999. Commissions of the ICA promote international cooperation and research in specific areas of cartography. The Maps and Internet Commission was established to promote multi-national cartographic research in order to solve scientific and applied problems related to the distribution and use of maps through the Internet. In addition, the commission promotes Internet-based cartographic education and professional and technical standards for maps available through the Internet. The web-site for the new commission is: "<http://maps.unomaha.edu/ica/>".

At the initial meetings in Ottawa, the commission adopted the following terms of reference:

- 1) Focus attention on disseminating maps and spatial data through distributed electronic networks;
- 2) Examine Internet map usage and project future areas of growth;
- 3) Examine web map user issues to better serve user needs;
- 4) Promote the exchange of information about effective Internet mapping for an international audience;
- 5) Improve user access to maps by examining the potential of Internet map metadata;
- 6) Promote instruction on Internet mapping through collaboration / coordination with other ICA commissions.

This paper reports on the activities of the commission and places the needed research within the broader context of general trends in Internet usage.

2.0 MAPS AND INTERNET SYMPOSIUM - 2000

The commission held its first international meeting in Knoxville, Tennessee, on October 10, 2000. The symposium examined various issues facing the distribution and use of maps through the Internet and consisted of a number of paper presentations and a round-table discussion.

Research in Internet map use and map creation are interrelated and the commission attempts to bring together researchers on both sides of this cartographic divide. Six major themes emerged from the symposium that can be divided equally in terms of map use and map creation. Under map use, an area of research centers on identifying the specific advantages and problems presented to cartography by the Internet. Two major advantages were identified: a) the increased accessibility to maps (maps in general but also historical maps that have limited copies); and b) the actuality of maps (for example, constantly updated weather and traffic maps) (von Elzaker, 2001).

The second map use theme concerned specific uses of maps on the Internet. One study investigated the use of tourism maps on the web and how they can be used to influence decisions on travel. A second study looked at the design of an Internet atlas for children. These two examples are only a small subset of the different applications of maps, and the different ways in which the Internet can improve their use.

The third general map-use theme involved questions of privacy and security in the distribution of Internet maps. "Webcams, Interactive Index Maps, and our Brave New

World's Brave New Globe" touched on the increased use of webcams as a monitoring device and the ability to integrate webcam images as point symbols within maps (Monmonier 2001). In contrast, Cammack and Svadbik (2001) presenting on "Internet Maps in the Context of Community Right-to-Know versus Public Safety" focused on the mapping of chemical hazard sites to provide environmental awareness. Government organizations, worried about the use of the maps by terrorists, have placed legal restrictions on the information available on chemical hazard sites.

Sessions on Internet map creation looked at new technologies that are available to distribute maps. Much interest was expressed in the eXtensible Markup Language (XML). XML is a simple text-based system to encode data and uses a system of tags like HTML. Ilya Zaslavsky (Supercomputer Center, University of California at San Diego) discussed the possibilities of XML and presented a working product called AxiMap in a presentation entitled "Client-Side 2D Vector Rendering and XML in Web Interactive Mapping" (Zaslavsky 2001).

A second theme under map creation involved the use of the Internet to gain access to large spatial data sets. An example that was presented was a method accessing a large database of passive-microwave data. Considerable progress needs to be made on accessing and distributing large spatial databases before the Internet can be considered a serious medium for cartographic applications traditionally associated with paper.

A third theme under map creation involved the use of the Internet to distribute not the finished maps but the spatial data that can be used to produce maps, conduct statistical inquiries, or perform other forms of analysis.

Working groups on Internet Map Use and Internet Map Creation then met to discuss future possibilities and problems. Possible research themes noted were the archiving of web maps, turning user questions or motivations into web map metadata, applying user research results to improve effectiveness of web maps, and methods of obtaining web map user feedback. Other likely activities of the commission were to agree on a classification of web maps and identify excellence in web map effectiveness by setting up a showcase. Issues also needing to be addressed were ownership, security and copyright.

3.0 WORLD WIDE INTERNET TRENDS

The development of map distribution through the web is largely dependent on the growth and expansion of the Internet as a medium of communication. According to the Computer Industry Almanac, there were over 400 million Internet users worldwide at year-end 2000 (www.c-i-a.com/200103iu.htm). This is up from 200 million users at year-end 1998. Most of the current users, almost 375 million, are located in the top 15 countries (see Table 1) while growth in the use of the Internet is coming from the Pacific Rim, Latin America, and Eastern Europe. Use of wireless Internet via cell phones is especially strong in Asia. Estimates of the number of Internet users in year-end 2002 are 673 million and over 1 billion by year-end 2005. While the total number of users at present only represents about 7% of the world's population, the rate of usage and growth in usage is remarkable considering the complexity of the required computing and communications infrastructure. There is clearly a high demand for this form of information dissemination.

Table 1. Number of Internet users by country for the top fifteen countries. The last column indicates the percent of the world total.

Top 15 Nations in Internet Use at Year-End 2000			
Rank	Nation	Internet Users (millions)	Share of World Users
1.	United States	135.7	36.2 %

2.	Japan	26.9	7.18 %
3.	Germany	19.1	5.10 %
4.	UK	17.9	4.77 %
5.	China	15.8	4.20 %
6.	Canada	15.2	4.05 %
7.	South Korea	14.8	3.95 %
8.	Italy	11.6	3.08 %
9.	Brazil	10.6	2.84 %
10.	France	9.0	2.39 %
11.	Australia	8.1	2.16 %
12.	Russia	6.6	1.77 %
13.	Taiwan	6.5	1.73
14.	Netherlands	5.4	1.45
15.	Spain	5.2	1.39
	Total	374.9	100
Source: eTForecasts, http://www.c-i-a.com/200010iuc.htm			

Internet usage has increased at a high rate in some countries since 1999. Table 2 shows changes in the percent of Internet users by country from 1999 to 2001.

Table 2. Percent of Internet Access by Country for 1999 and 2001. The percent of users is specific to the population of each country.

<i>Country</i>	<i>% of Users 1999</i>	<i>% of Users 2001</i>	<i>Change</i>
Australia	23%	28%	5
Austria	4.9%	10%	5.1
Belgium	3.9%	16%	12.1
Brazil	2.2%	2.3%	0.1
Canada	26%	48.3%	22.3
China	1.25%	1.5%	0.25
Denmark	13%	33%	20
Egypt	0.6%	NA	-
Finland	37%	43%	6
France	6%	16%	10
Germany	10.5%	30%	19.5
Iceland	61%	75%	14
India	1%	1.6%	0.6
Ireland	11%	27%	16
Israel	10%	NA	-
Italy	4.5%	10%	5.5
Japan	9.2%	15.3%	6.1
Malaysia	1.1%	11%	9.9
Mexico	0.5%	2.2%	1.7
Norway	30.4%	50%	19.6
Netherlands	27%	NA	-
Portugal	1.9%	20%	18.1
Saudia Arabia	0.5%	NA	-
Singapore	6.4%	50%	43.6
Slovak Rep.	9.5%	NA	-
South Africa	2.2%	5.5%	3.2
Sri Lanka	5.3%	NA	-

Sweden	33%	50%	17
Taiwan	11.4%	30%	18.6
UK	15%	30%	15
US	30%	48%	18
Vietnam	.02%	.05%	.03

http://cyberatlas.internet.com/big_picture/geographics/article/0,,5911_151151,00.html

4.0 INTERNET MAP USE

The number of maps that are distributed through the web has been tracked at four major sites since 1997 (Peterson 1997, 1999). The results indicate that usage continues to grow rapidly, particularly at commercial sites. Table 3 lists the average number of maps downloaded on a daily basis for the four mapping sites.

Table 3: Number of Maps Downloaded on a Daily Basis

Site	1997	1999	2001
www.mapquest.com	700,000	5,000,000	20,000,000*
www.fourmilab.ch	35,000	63,000	219,000
pubweb.parc.xerox.com	80,000	100,000	120,000
http://tiger.census.gov/	35,000	70,000	100,000
Total	850,000	5,233,000	20,439,000
* Personal communication, Kristin Nofi, Marketing Communications Manager, MapQuest			

Identified as the major map publisher in the world (Crampton 1998), MapQuest.com continues to grow rapidly. The growth is augmented significantly by agreements with other major web sites, including Yahoo.com, to provide a map-making service. Approximately half of the maps produced by MapQuest are a result of cooperative agreements with other sites. The company calculates map draws on a monthly basis, and thus estimates the daily map draws from the monthly number, which consistently reaches more than 300 million – or 10 million maps per day – just from MapQuest.com alone. When business partners such as Yahoo.com are included, they estimate that more than 20 million MapQuest maps are created and downloaded each and every day (Nofi, 2001). Usage dips slightly at the end of the calendar year, especially during November and December.

Another indication of the continued adoption of interactive mapping sites like MapQuest is the number of new visitors to the site. The company estimates that it receives more than 8 million unique visitors per month. These are people who have never used the site before to create a map. Not only does the site have a consistent base of return users, but it generates a significant amount of new traffic every month.

MapQuest.com is now a wholly owned subsidiary of America Online, Inc. As further integration occurs with America Online in the U.S. and abroad, usage numbers will be bolstered through promotion within AOL and subsequent trial and usage of MapQuest by AOL members. The company is expanding into Europe this year with localized sites in the United Kingdom, Germany and France. MapQuest.co.uk was launched in February 2001. MapQuest.de in Germany and MapQuest.fr for France are scheduled to begin in the summer of 2001 (Nofi, 2001).

5.0 CONCLUSION

The Internet clearly represents a new medium for cartography. While the first web map server dates to 1993 (Xerox Parc), the growth in map distribution through this medium, particularly at commercial sites, has been particularly dramatic since 1997. The growth in the distribution of maps has been mostly with interactive maps but sites that deliver static maps have also seen continued growth. The Internet is contributing to the delivery of all forms of maps.

New technological developments in Internet map distribution will certainly take place in the coming years. In this regard, the ability of the eXtensible Markup Language (XML) to download both the map data and the instructions for how to depict the data shows the greatest promise. Other technology, including the Map-on-Demand systems for large format maps in which maps are printed through centralized ink-jet printers, also show great promise for bringing maps to the public.

As the Internet expands, there will be a greater need to understand how Internet maps are being used. For example, many users already complain of the difficulty of finding an appropriate map on the Internet. Clearly, better search technologies need to be developed to help find the most appropriate map for a particular application. Certainly, there is a great deal of research and development still needed to make the Internet a more effective medium to distribute information in the form of maps.

6.0 REFERENCES

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