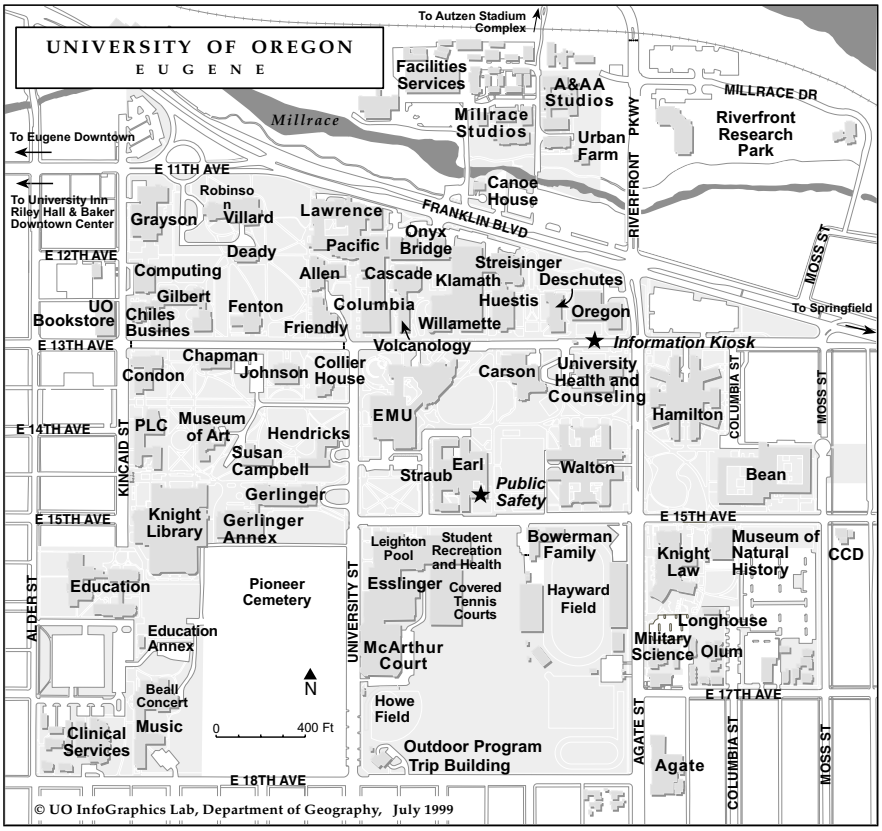

Figure 7. Main campus web map (published in GIF format).

format into a PDF for web publication.

By using a diverse number of tools and data formats we are able to solve a wide range of multi-disciplinary problems and provide better and more extensive service to the university community. We anticipate that the use of the campus map information will continue to increase and become more widespread as the web applications develop.

online mapping

Critical Success Factors when Publishing Internet Mapping Services

Kirk Mitchell
Business Development Manager
Tele Atlas BV
Moutstraat 92, Gent B9000 BELGIUM
Email: kirk.mitchell@teleatlas.com

The internet has changed the way cartographer's package and distribute maps. Rather than dwell upon previously well documented technical considerations of internet mapping, this paper concentrates upon the commercial and logistical factors which determine the success of an internet mapping service.

Internet Growth

The current annual rate of internet growth is estimated to be 46%[1]. This rate is driven primarily by an increasing range of access points, improved bandwidth and the growing availability of diverse content[2]. If the internet continues to expand exponentially, and is soon accessed by significant portions of the population, then the challenge for cartographers will be to deliver effective internet mapping services across this new publishing medium.

Internet Mapping Services

In the rapid transition from a paper to online medium the key needs of any map user have not altered greatly. The desire to conveniently navigate and locate places and people still exists today as it did during the previous centuries of paper based mapping.

What has altered is the technology with which we use to publish and distribute maps. Printing technology enabled cartographers to reach critical mass by making mul-

tiple copies of any one map edition[3]. Today, internet technology is enabling the re-packaging of maps and spatial information into more service based applications which have interactivity and customisation as their core function.

There are indeed many ways to segment the current range of mapping services available on the internet. The following attempts to do so across 5 broad application areas:

1. Mapping & Routing Services: Often with localisation (geocoding) functionality, used to position addresses, towns, POIs (Points of Interest) or other relevant locations (www.mapquest.com).
2. Dealer Locator Services: Published by organisations wishing to display the location of their dealer networks and thus assist customers in accessing and purchasing their goods and services (www.visa.com).
3. Directory Services: Location based mapping of directory databases such as White Pages, Yellow Pages or even classified advertising (www.whitepages.com.au).
4. City Guide Services: Online information regarding the leisure, entertainment and touristic activities of a particular town or city (www.newyork.sidewalk.com).
5. Telematic Integrated Services: Real time local information (such as traffic congestion) provided using internet protocols and increasingly delivered over wireless networks (www.etaktraffic.com).

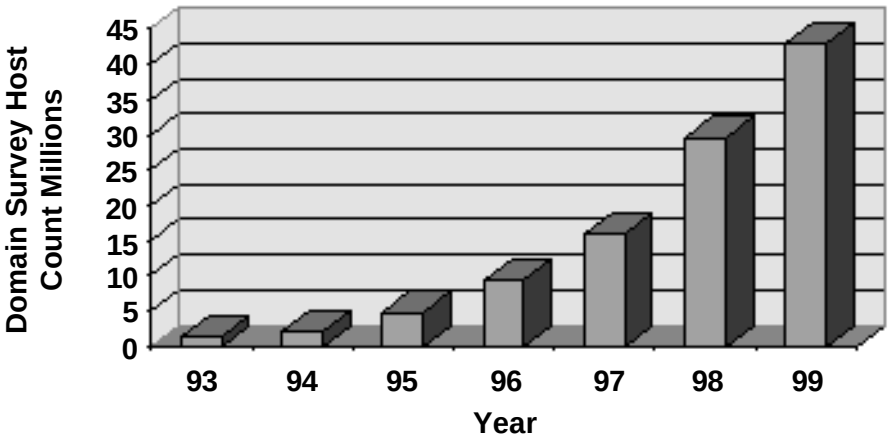

Figure 1. Annual Internet Growth Rate '93 - '99[1].

Figure 2. The VISA ATM locator service developed by InfoNow Corp. (www.visa.com).

Critical Success Factors

As with any mapping product, it is in the best interests of the internet map publisher to ensure that the user receives a more than satisfactory service. This will encourage repeat usage and hopefully enable the publisher to reach and maintain profitability. Factors which determine this are typically related to the cost and quality of the actual service.

Valued Eye Balls

The internet community represents a small, but rapidly growing, percentage of the population and as such has considerable power. This power has been used to quickly establish a marginal, if not free, expectation of the cost of any internet offering.

However, many users fail to realise that although they believe they are receiving a genuinely free service that they are in fact paying dearly with their time and attention rather than cash[4]. Online advertising has quickly established itself as the predominant model used to finance most web services with global advertising revenues estimated at $2.7 Billion US in 1999[5]. As such, it is in the map publishers interests

to not only increase the number of users accessing their web site, often referred to in the internet world as 'eye balls', but also to lengthen the amount of time users spend accessing the site. This motive conflicts with most users desire to spend less time on the web accessing difficult to find and slow to use sites. If end users collectively desire more control over the quality of any internet based service then they must realise that this can only occur once the services receive greater funding, perhaps through more traditional payment methods. This will in turn provide sound justification for publishers to steer away from advertising as their sole source of internet revenue.

Payment after Delivery

Another unique aspect regarding the cost of any internet mapping service is that maps have to be virtually given away before they can be purchased. This has largely to do with the fact that electronic information cannot be shown without first giving it away (or portions of it). Either way, when a user pays for information (either with funds or through time) they are always paying for the last piece of information they received, not the next piece of information they are going to receive[6]. This is in complete contrast to what occurs when purchasing traditional maps and both the end users and publishers must also quickly adapt, and respect, this new online payment paradigm.

Value of Content

The cost of any internet mapping service is partly determined by the cost associated in securing content (ie digital map data, directory information, traffic information etc.). Unlike traditional cartographic publishers, who over many years were able to build and develop their own proprietary content, it is highly unlikely that publishers of electronic media will also be able to support the cost of sourcing, digitising and monitoring their own digital content. More often than not, publishers of internet mapping services will need to license the actual maps from dedicated content providers whose sole task is to develop and maintain digital mapping databases and other related information.

Regardless of whether it is the actual publisher who owns the intellectual rights, or whether the rights are held by a 3rd party, digital content providers themselves have several important issues to consider when licensing or publishing data over the internet which in turn directly effect the cost of any given service.

Unlike traditional forms of content, electronic content is not a scarce resource. For example, 10,000 un-sold maps are considered an asset because they are the last remaining titles of an expensive print edition. As such, these remaining maps are a scarce finite resource and, as basic economic principals state, will hold their value given no change in demand[7]. This is not the case for electronic information which, as a potentially infinite resource, can run the risk of not remaining scarce and therefore experience a dramatic decrease in value when distributed widely. This is a major dilemma electronic map providers face today when confronted with the massive distribution power of the internet.

Content or Context

If map content providers continue to focus upon the actual information they supply in licensing data online then they risk of running into a limited revenue stream as information approaches marginal commodity rates. Rather, content providers must study the context under which their data is distributed and used online. For example, an anxious tourist arriving in Paris without any idea of how to find a hotel will most probably pay more for this information then than prior to their arrival. It is in understanding this context, not the actual content, that providers of information will find successful models under which to license their data. More often than not, this means locking into the actual transaction which occurs when users access internet based services. Only through the establishment of transaction based licensing, or other related price models, will map content providers ensure that they also benefit from future internet growth.

Creating Friction

The main goal of any internet map publisher is to create friction[8]. The internet is a frictionless medium, owing to the fact that it takes no effort for a user to switch between sites. In fact, movement and navigating amongst different page views and hyperlinks is something that is encouraged and is one of the fundamental aspects of the world wide web.

The quality of any online service varies significantly and end users tend to remain loyal to those services from which they receive consistent results. Many believe that services will not improve until a viable commerce system, together with a range of suitable payment options, is put in place. Until such a time, maps of any real value will tend to stay with other media, such as printed publications, which have well established distribution models that support map publishers and their respective suppliers.

Quality internet mapping services can best be described as those which profit from the interactivity and multimedia opportunities implicit within electronic devices[9]. It is not simply enough to translate the all too familiar paper based product directly online. Utilising the implicit interactivity of the internet is key.

Interactive Functionality

Simple functionality, such as tools from which users can generate and email a customised route, will assist publishers in differentiating the internet service from paper. With end users now rapidly questioning the amount of time spent accessing unsatisfactory sites it will be only those few compelling services, which effectively couple mapping content with customisation and interactivity, that earn the repeat usage of a demanding map user.

Sophisticated internet solutions are now also possible which promote mobility and are expected to completely revolutionaise the way users interact with geographical information. Several European mobile phone operators are now trialing the next generation devices which utilise WAP (Wireless Application Protocols) to distribute map related services (www.webraska.com). Such technology will enable the map user to access internet mapping services while actually in the field and not restrict internet usage to the desktop.

Necessity of Brand

Making users aware of internet based services, and enabling them to easily access such services, is indeed a difficult task. Most first time users tend to locate services via major portal sites (ie www.yahoo.com). The internet is 'intangible' and often the only aspect with which a user can identify is the actual brand associated with particular services. The relationship, established between service providers and end users, must be packaged in a way that users instantly recognise and appreciate.

It is true that existing publishers over traditional mediums are able to benefit from their prior established brands when migrating to the internet. Michelin, who have a strong brand in European paper maps and travel guides, were able to benefit from their dominant consumer awareness when migrating their mapping services to the internet (www.michelin-travel.com). However, the internet also provides tremendous opportunities for new web-specific brands to quickly develop rapport. For example, MapQuest.com was a brand virtually unheard of 3 years ago and is now quickly becoming a 'household name' within the United States.

CONCLUSION

There are indeed many critical success factors that publishers must address when attempting to deliver internet mapping services. Unfortunately, many of the issues highlighted in this paper are currently unresolved, some even creating more questions than they do answers. Publishers of successful internet mapping services will be those who are quick to address

Figure 3. An example of an internet based mapping service, combined with real-time traffic information, and delivered to a WAP enabled mobile phone.

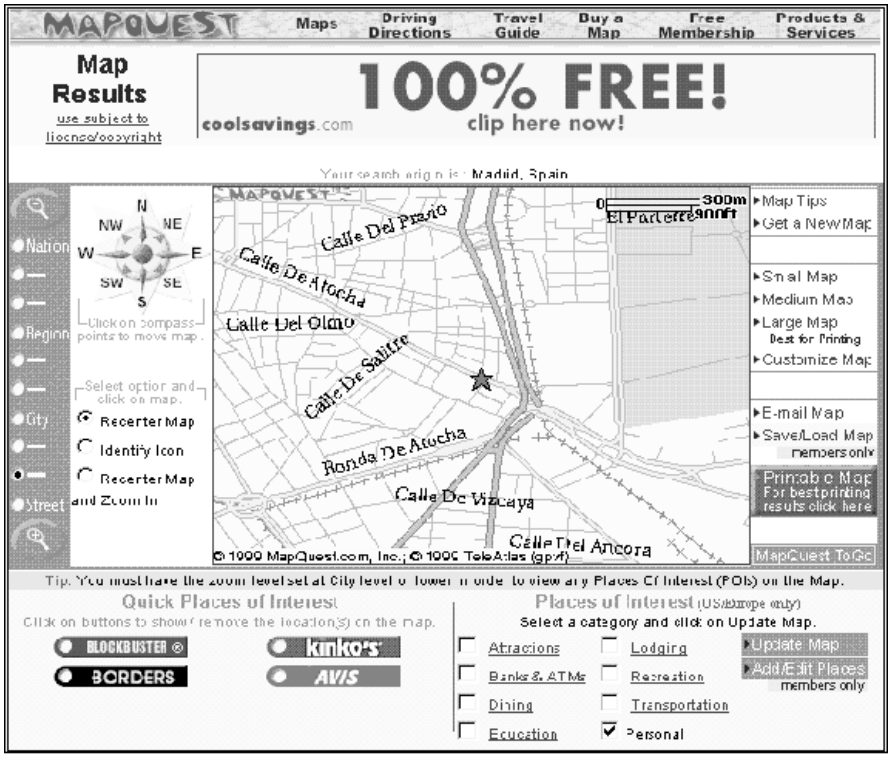

Figure 4. MapQuest.com is now an established global internet mapping brand (www.mapquest.com).

these issues and work towards appropriate solutions. Fortunately, the pace of internet growth will ensure that this occurs sooner than latter.

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Building an Atlas of Cyberspace

Martin Dodge
Centre for Advanced Spatial Analysis (CASA)
University College London

What is Cyberspace and can cartographers map it? Cyberspace is the multifaceted digital space in and of computer networks. At the very heart of Cyberspace, and its golden children, the Internet and the Web, are a rich and deep foundation of spatial metaphors, both literary and visual (Adams 1997, Graham 1998). Given how deeply ingrained spatial metaphors are throughout the emerging Cyberspace, it would seem that cartographers have much to contribute in mapping out this new geography and advancing our understanding of it. Scholars in a number of disciplines have done valuable work critically examining Cyberspace through the lens of geographic space at varying scales; for example, urban planning (Graham & Marvin 1996), architecture (Mitchell 1995, Anders 1998), urban sociology (Castells 1996), and geography (Kitchin 1998, Crang et al. 1999). The field of information visualisation has emerged in the 1990s from computer science and computer graphics, and has contributed significantly to mapping Cyberspace (Card et al. 1999). Also, we should also not overlook the expertise in the graphic design community in charting Cyberspace (Jacobson 1999).

There is no one single map of Cyberspace that can show everything, just as there is no one map of the geography of a country like Britain. Instead, we compile atlases to show the complex and many fold geographies of a country. A comprehensive atlas of Britain covers all aspects - the landscape, the soil, the buildings, the roads, the people, disease, crime, wealth and poverty, rivers and rainfall. In just the same manner, an atlas of Cyberspace will contain many different kinds of maps, mapping the myriad distinct virtual spaces of Cyberspace (e.g. telephone & fax, email, web, chat rooms, multi-user games, intranets, and electronic financial flows). There are also different dimensions of the spaces to be mapped and understood (infrastructure, protocols, content and traffic). As yet, you can not buy an atlas of Cyberspace in the shops, but over the past couple of years I have attempted to construct one by combining the best maps of Cyberspace from many diverse sources. Appropriately enough the current version is available on the Web at *<http://www.cybergeography.org/atlas/>*. In the rest of this article I present five exemplars from the Atlas showing how different aspects of Cyberspace are being mapped and the diversity of cartographic forms being employed.

It is important to realise the Cyberspace is not new, it builds on decades of technological evolution in computing and telecommunications. While maps of Cyberspace have been drawn since its earliest times, for example there are the black and white line drawn maps of topological structure of ARPANET, the cold war forefather of today's Internet (figure 1). The maps were drawn for the engineers who built and managed the network and they are strictly utilitarian and functional, simply showing the nodes of the network - the advanced research labs of universities and corporations doing defence related research - and the links between them on an outline of the Continental USA. Figure 1 shows an example from October 1980, but a whole series were produced through the 1970s and 1980s from which one can trace the growth and eventual decline of the ARPANET. This map is particularly interesting for me, as it shows the satellite linkage from the US to London, installed in 1973, which connected to UCL where I now work. This wavy line on the map is significant as it