B02.2 Map data on the move

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Wireless technology and geographic information content are made for each other.

With the proliferation of wireless technology, the mobile device will soon replace the desktop PC as the predominant user interface with the digital world. This is a critical point for the geographic information (GI) community . This article examines the implications for map data providers and the key role of geography in the provision of context-sensitive content in a world of pervasive computing. Will our perception of what constitutes a “map” be changed forever?

The hype about the wondrous benefits of forthcoming mobile and wireless technology has been echoed in miniature inside the GI industry. The success of the mobile phone, the proliferation of location-aware devices and the higher bandwidth of next generation networks, have fuelled expectations of a gold rush for businesses specialising in geographical content. Location Based Services (LBS) really were supposed to be the next big thing.

While the recent downturn in profit forecasts for the whole mobile telecom sector has been reflected in a lowering of expectations of the LBS bonanza, hope still remains. The potential for geographic data being exposed to a huge new market is still there. It is no coincidence that the specialist ranks of GI software vendors and data suppliers have been infiltrated by mainstream giants like Microsoft and Oracle in recent years. There is a wide recognition across information technology that where things are matters.

The landscape of pervasive computing

Pervasive computing is one of several terms being used to describe the new information and communication technology landscape brought by wireless data exchange and portable devices. Pervasive computing assumes the cohabitation of a mix of technologies: wireless networks, mobile telephony, new devices, new modes of user interface, web services, standards.. and more. Perhaps more vision than reality right now, it’s cornerstone is ubiquity: the mode of interaction with the digital domain is fully integrated with the fabric of our everyday lives, at home and at work. Furthermore, the user experience is sensitive to context; the location of the user is known to the system, along with other details of their current environment.

In the vision of pervasive computing humans no longer spend dedicated time, sat at desks, extracting information from the internet. We get on with our lives, having access to exactly the bits of information we need, at exactly the right moment, in exactly the right place, in exactly the right format. The fact that we are interacting with a computer at all becomes sub-conscious. Currently this environment exists only in embryonic form, in the shape of WiFi hotspots, data access via mobile phones and tailored WAP services. The days of internet access via the fridge, or from clothing, await.

Why is geographic content important?

Two main reasons: people need maps and directions (hence multimap.com being in the top ten most visited websites in UK); and because the system knows where you are.

Without delving into the complexities of positioning technology in detail, an approximate coordinate fix can be obtained from the network cell ID currently in use (to within about 100m, but this varies widely). As global positioning system (GPS) chips begin to be incorporated into more mobile devices, this tracking capability will become very accurate. Also, the location of fixed nodes in the pervasive computing infrastructure, like WiFi hotspots, can be hard coded. It can be expected that identifying location of users close to 1m accuracy will become typical in the next few years.

This is the basic precept of LBS. By correlating the current user location against a range of geographically referenced information sources, specific services can be supplied relevant to that place and time. The most widely quoted example is that your phone could be spammed with special offers from a particular retailer as you walk past one of its outlets. Indeed, such a glittering utopia could become a reality. But there are almost limitless other applications (that people might actually want).

The LBS applications expected to be most popular include finding the location of other users ("find-a-friend"), locating the nearest amenity (cash machines etc), navigation instructions, live feeds of public transport arrival times and gaming. Rudimentary examples of these are already available from the mobile network operators' WAP offerings, based on cell ID location. More compelling examples are well established on 3G systems like i-mode in Japan.

These applications rely on some kind of spatial query performed against a geo-referenced database. The results can be portrayed in different ways. With WAP services, typically the results are returned in textual form. For example, a query screen will return the distance in metres to the nearest bank and detail its address. Of course, it is also possible to use map images to convey the information. With a location-sensitive device you can stream maps that automatically display your current location. This is where the fun starts – the challenge of providing meaningful graphical content against the constraints of screen size and bandwidth.

WAP

FIG 1 – early experiments with WAP maps

The early WAP phones gave you screen space of about 90 x 50 pixels and the option of monochrome wireless bitmap (WBMP) format images. This presented interesting challenges in a new form of minimalist cartography – see fig 1. Yet GIS vendors, internet mapping sites and mobile network operators invested in products and services designed for this platform.

The current levels of anticipation amongst general consumers regarding graphic content via the mobile internet remains coloured by those early experiences.

What's different now?

Since then, Europeans have been tantalised by the prospect of the wireless internet really kicking off on the back of 3G and beyond. A sense of inertia has crept in with delays to the rollout of those networks. A big cast of players have jockeyed for position to see which brands will come to the fore in the wireless world: the operators, handset manufacturers, infrastructure providers, system integrators, mobile virtual network operators, content portals, data providers.. etc. Meanwhile a relatively mature wireless market has established itself in Japan with tens of thousands of subscription services becoming available via platforms like i-mode and J-Phone.

But things have started to happen. The latter part of 2002 saw the arrival of colour screen GPRS-enabled camera phones, capable of exploiting the new multimedia messaging (MMS) protocol, like the Nokia 7650. Such phones carry advanced operating systems (Symbian or mobile versions of Windows) and sophisticated software development toolkits are available – many also support Java. Other variants have appeared; hybrids of phone and palmtop like the O_2 XDA. It is relatively easy to build and implement applications on the new breed of mobile device. The colour screens are a revelation compared to the example in fig 1. They are larger and have much better resolution. Furthermore the latest WAP protocol means that much richer content can be served than before. Colour images in familiar web graphics formats like GIF and JPEG can be displayed, and WAP sites can achieve improved functionality with advances in the format of wireless markup language (WML) and WMLScript.

The other part of the equation is bandwidth. With GPRS, in practise although actual recorded data transfer rates fluctuate considerably, download is generally at least 4 times faster than via GSM - nearly always faster than the 28.8 kbps modems on which many of us first experienced the wired internet. With images smaller anyway by necessity, response times for receiving graphic content are fast. You can download genuinely readable map images, and applications for serving colour maps to phones will appear very rapidly. Bring together the principles of LBS and the likely enthusiasm for MMS and it is easy to envisage people sending maps as picture messages.

Map maker, make me some maps

When generating map images there are two fundamental options: serve portions cut from larger map images with predetermined cartographic style; or, generate the map image 'on the fly' from features in a database. The former method will tend to generate more aesthetically pleasing images. However the file sizes can be larger and the source mapping is less easy to keep up-to-date. Serving direct from a database means you always get the latest features but there are challenges in generating a satisfactory map style. It is easy for objects to appear too cluttered or to have unhelpful text labelling.

Automatic generation of maps from a database has the advantage of being adaptive to different view scales. When techniques like automatic image rendering are combined with the level of topographic detail captured by Ordnance Survey, really compelling results are possible. Fig 2 shows an experimental WAP application (running via an emulator, for clarity) using OS MasterMap™, Britain's definitive digital map database. This revolutionary database uniquely identifies over 400 million real world features within a consistent, national framework and is updated continually. When user tracking becomes sufficiently accurate, applications will need content with this level of detail and currency in order for the location fix to appear in the right place on the map.

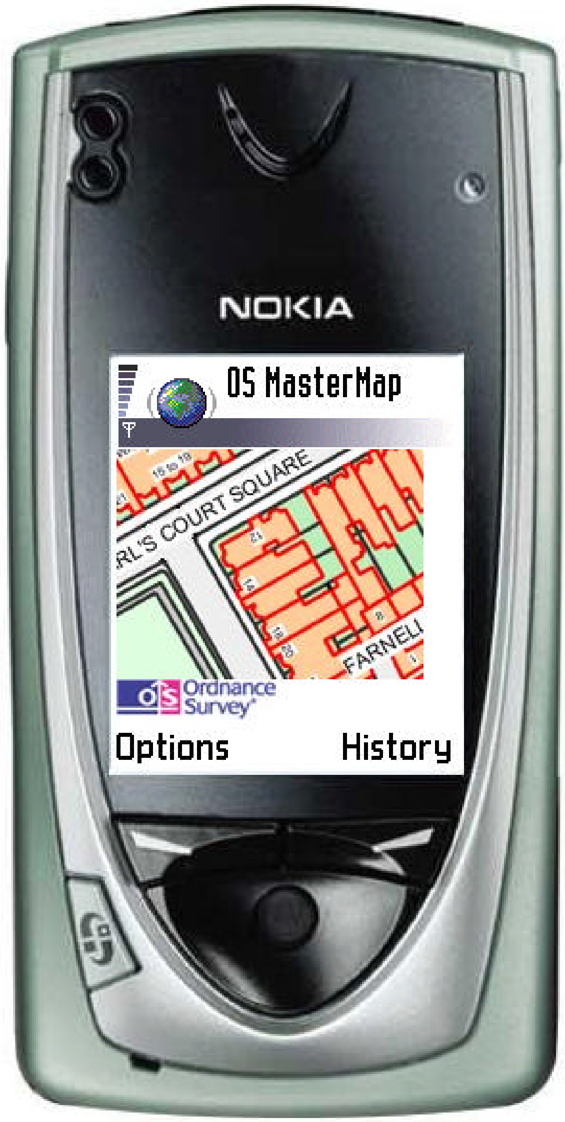

FIG 2 – experimenting with OS MasterMap on Nokia 7650

Many major database vendors now support spatial data types in their core products. This combined with a range of internet GIS tools and web map serving standards emanating from the Open GIS Consortium (www.opengis.org) means varied options for building mobile mapping applications. Hutchison 3G (www.three.co.uk) are using maps and location at the heart of their 3G offerings and it will be fascinating to see how successful they are… and whether their competitors will follow suit.

Everyone likes maps don't they?

There is a serious fly in the ointment with all this. Speak it softly amongst carto-philes, but there is actually a silent majority out there to whom maps are meaningless pictures. The attraction of the spread of internet based GIS applications to mobile phones is the potential exposure to a huge market of new users. But it is believed that only a subset of the general population understand the two-dimensional abstract symbolisation of the real world into a flat picture. It has been estimated that 75% of people in America cannot read a map.

Furthermore, the representation of information in graphic form is not always appropriate. One of the best examples of LBS in current usage is the in-car navigation system. There is controversy about the suitability of using a graphical map based display for such systems, given the potential for distracting the driver. In that environment, the portrayal of the geographical content using voice synthesis may be the best way forward.

Different people see the world in different ways. If the purveyors of popular psychology are to be believed, men and women have different ways of thinking in spatial terms – allegedly women are more likely to turn a map upside down to make it point in the right direction; men are happier in associating north with up. In general, when we stop in a strange location to ask directions, the local will not draw a map. Neither will they talk in the terminology extractable from the road network data underlying most current in-car systems – i.e. "travel down this road for 250 metres, then bear left on the A3057 for 1.5km". Real people talk in terms of points of interest – i.e. "go left at the next set of lights, keep going past the church, and its opposite the King's Head".

Thus, for a number of reasons, the representation of geographic content needs to become more flexible in order to be accessible to the widest range of users. Much research is needed to identify new ways of portraying map information. There are many possible options, including speech, tactile responses through wearable devices, virtual reality, new types of 3D symbology, even the use of cartoon characters. Similarly, future geographic databases need to more reflect the way real people perceive the world, not just the geometry of physical topographic features. The map of the future is likely to be very different from how we see them today.

Information everywhere

Map data will be integral to wireless services. Not only storing information valuable to users in its own right, geographic databases provide a unique key for real world objects. This means they can play a role in identifying related services relevant to the same object. The use of unique addresses, postcodes and object identifiers in geographic databases means they act as referencing systems to content from other sources. One of the major obstacles to the success of wireless may be that people will expect information services to support real-time decision making much more than before. Users will be desperate for reliability, and the myriad of different content suppliers will become confusing. Recognisable, dependable and harmonising data sources will be at a premium and location based information will have an important underpinning role.

Another key issue in the likely enthusiasm for wireless data access is the very ability to pinpoint the user's location. Having argued the benefits of this phenomenon above, it cannot be avoided that many people will be uncomfortable with the idea that their movements can be tracked. This has profound implications for privacy and security. The social aspects of LBS in a world of pervasive computing need careful consideration. A vast amount of information is already being collected about the passage of mobile phone users through the cell networks. As GPS tracking becomes more commonplace this information is going to increase even more in volume.

The data collected in this way, in real-time, itself becomes valuable content. Examples of this are present now, for example real-time sensors measuring traffic flow, thereby providing live information on road congestion. Other kinds of sensor will become more extensively used as the pervasive computing environment develops, providing instant feedback on aspects like pollution and flooding. The ownership of all this live content will be another contentious issue to overcome.

Conclusion

So, the spread of wireless technology and the evolution of the pervasive computing environment will have an enormous impact on the geographic data industry. In addition, the role geographic data plays within the wireless domain will be fundamental, given the mobile nature of the human computer interaction. Through the ability to identify the location of users, the spatial element will be a key driver behind the relevance of wireless content. Maps, and a range of other LBS applications are likely to be instrumental in driving wireless traffic, and promising results with map graphics can be achieved now with the latest mobile phone technology. Wireless and geographic data are inextricably linked, and each will shape the future of the other.

For more information about how geographic content will be integral to wireless services visit www.g-intelligence.co.uk