Positioning Position Technology in the New Mobile Marketplace

By Yaser Bishr

*"When we talk about the new economy, we're talking about a world in which **people work with their brains instead of their hands**. A world in which **communications technology creates global competition** - not just for running shoes and laptop computers, but also for bank loans and other services that can't be packed into a crate and shipped. A world in which **innovation is more important than mass production**. A world in which **investment buys new concepts** or the means to create them, rather than new machines. A world in which **rapid change is a constant**. A world at least as different from what came before it as the industrial age was from its agricultural predecessor. **A world so different its emergence can only be described as a revolution.** "*

Wired's Encyclopedia of the New Economy

The primary assets of any enterprise in the new economy are its collective "brains" (corporate knowledge), its "nerves" made of fiber optics, and "synapses" of information firing across its nerve by-ways at the speed of light. People, communication infrastructure, and information … these are the central nervous system of any enterprise in the 21st century.

This is part I of a two-parts article on what I believe to be an essential recipe to ubiquitous geospatial applications that are woven into mainstream IT. In Part I, I will provide an overview on how the technology market, especially the mobile, is evolving, and how it is expected to fuse with the geospatial market. In part II, I will dive more into technology and try to draw a general picture of a futuristic Java-based geospatial technology that are well suited for the new market place.

Businesses in the new economy are changing at an amazingly fast pace with mergers, acquisitions, new strategic partnerships, and a constant flow of new offerings. The dynamics of the new economy require new technologies that reflect and accommodate its demands for continuous change. A merger requires immediate integration of corporate information systems, with minimal impact on operations. A company must provide new services to its customers before the competition. All of this demands distributed systems that are characterized by interoperability, scalability, security, integrity, and high availability. Add to this mobility and location awareness for the mobile, widely dispersed workforce, supply chain and customers.

> *Knowing our location and the location of others will allow us to provide the right information, to the right person, in the right place and time, on the Internet device at hand.*

Geospatial applications will be woven into the fabric of the 21st century enterprises. To achieve this goal, geospatial technology needs to be built in a way that allows it to cope with the rapid and ever changing business demands of the new economy. It needs to find its way into the mainstream IT market. This is not going to be accomplished solely through the use of the latest Internet technologies, like Java and XML, to build a new breed of GIS, nor is it going to happen simply by creating GIS servers that can display a map on a Web browser.

> *A map is a map, whether you print it on paper, display it on a desktop, ship it across the Internet to a Web browser, or to a micro browser on a mobile device. This is not enough to bring GIS into the mainstream IT marketplace.*

How then is it going to happen?
By 2006, I predict that telecommunications companies and other mobile service providers will acquire the majority of GIS vendors and assimilate their technologies into wireless Web service infrastructures. Only a hand full will remain to serve the classical GIS markets in utilities, environment, weather, etc. Large client-server GIS packages will disappear under new skins of corporate information systems, home appliances, cars, and every Web-accessible device out there that is stationary or mobile. Geospatial technology will only succeed in becoming ubiquitous if it is buried and hidden from our view within gadgets that do something we need or want, either as an embedded application in consumer electronics, or as middle-tier enterprise applications.

The Mobile Telecommunications Market

Mobile Internet access is a fact of life, and ubiquitous location-based mobile technology is just around the corner. The Universal Mobile Telecommunication Standards (UMTS) -- the successor of GSM -- is considered by many to be the third generation (3G) mobile technology. It will be available in Europe by 2002. The European Telecommunication Standards Institute (**Error! Hyperlink reference not valid.**) recommended that the cost of licensing UMTS should not exceed 50 US$ per capita, in order to have acceptable ROIs and reasonable pricing schemes. Wireless operators spent $30 billion in the UK and $45 Billion in Germany to obtain licenses to 3G radio spectrum, an average of $1000 per capita. This does not include the costs for new infrastructure and roll out. It will take some doing to gain back returns on these investments. We're going to be looking at quite an impressive array of wide-ranging and robust service bundles.

The life cycle of most technology, from its roll out to its replacement by a new technology, is between 8 to 10 years … and in today's market perhaps even shorter. After UMTS is deployed in 2002, mobile operators will have until approximately 2011 to gain back acceptable ROIs. It will be hard for them to get good returns with their present set of wireless offerings. There must be additional revenue streams. The only way to get back their returns will be through a host of new offerings that tap into other mega markets, like B2B, which is expected to generate $9 trillion annually worldwide by 2004. So the potential is much greater if we look at new offerings in new markets.

The new breed of location technology vendors

Several reports claim that the location services in B2B and B2C will reach 30 Billion US$ by 2004. After examining the current valuations of some dot COM companies that provide location services, I believe that the location services market will be much larger. Recently, AOL acquired Mapquest for 11 Billion US$. Add to this the recent announcement by GE concerning their acquisition of Smallworld for 210 million Dollars.

> *Location service providers will become major players in the future mobile market. If current market leaders in the geospatial industry don't provide location service solutions, somebody else will.*

Almost every day I'm bombarded with news bulletins about start-ups, acquisitions and partnerships between the players in the mobile technology value chain – nearly all of them tell us about location services. We have started to see a new breed of companies that provide location-based technologies. A few weeks ago, I opted to have a peak at the technologies of some of these new companies. To tell you the truth, I was not impressed. These technologies do not even come close to the sophistication that we now have in most off-the-shelf GIS products. But why are they succeeding, and why are investors lining up at the door to pour capital into these companies? Why are the current heavy weight players in the GIS market not making headline news like the newbies?

The new companies have dynamic, aggressive business models that are built around the new economy. They have business models that position them on the value chain of the booming mobile market. Technically, these companies have managed to bury the inherent complexity of their geospatial products, hiding them from the user, and even from the mobile operators who are gearing up to integrate such systems in their infrastructure. The PR machines of these companies don't even say GIS. Rather, they say location services, location awareness, localization, and a bunch of new buzzwords that wireless operators and the like want to hear. They don't want the complexity of GIS at the surface, only its redeeming value under the hood.

In this article, I want to draw with you a picture where geospatial technology is ubiquitous and plays a vital role in the new economy. The background of the picture shows extremely fast mobile and fixed networks, sophisticated technology for location determination, and a host of wide ranging location services that operate on Internet-enabled fixed and mobile devices.

Location … is that all?

Consider networked, location aware, domestic appliances. The appliances have home-network interfaces, but no hard-wired user interfaces, just blank panels. A hand-held customizable controller is then used to control all devices. When the controller is near the device and pointing at it, the device's user interface is loaded into the controller from the manufacturer's service location. User interface enhancements and device upgrades are then immediately available (and the number of remote controllers we have to lose is dramatically reduced). In addition, this controller can be personalized by customers to provide the interface that they prefer. So the interface to my TV on my handheld is different from that on my wife's handheld. Mine allows me to scan the channels for football games. With a location-based proximity service, the TV knows that I'm the only one watching it, so it only shows me

commercials about biking gear. It automatically filters out any other commercials. And the biking commercials draw premium revenues for the service provider, because I'm a targeted prospect.
There is a subtle difference between location aware devices and location aware systems. A location aware device is a device that is equipped with technology that allows it to know its location coordinates, e.g., GPS. A location aware system is one where its wired and wireless components know the relative location of each other, in addition to their own absolute locations, and can use this information to work cooperatively. These components can be servers, home appliances, mobile devices, office appliances, cars, active badges, passive badges, etc. The location information of the components can be used to enhance the overall system operation, enhance services, or provide a whole new set of services.

GSM already has some rudimentary location capability. The system knows the cell number that an active GSM user is currently located at, with an accuracy of few hundred meters in urban areas, and few kilometers in rural areas. This method is known as the Cell Of Origin (COO). For some location services, like location-based advertising, this granularity is sufficient. The European Telecommunications Standards Institute has ratified three location-fixing schemes, which operators could use for location services, in addition to COO. These are: The Global Position System (GPS), Time of Arrival (TOA), and Enhanced Observed Time Difference (E-OTD). Each method has its advantages and disadvantages.

GPS provides planet-wide location information using a constellation of satellites. It requires mobile devices that are equipped with GPS receivers. Present commercial GPS receivers attain accuracies of approximately 10 meters. However, after the removal of the selective availability, and with the use of differential systems, accuracies of these devices can reach sub-meter levels. GPS is limited by the weak penetration of the satellite signal. It cannot work directly inside buildings, and receivers can loose communication with the satellites in "urban canyons".
TOA requires that multiple base stations listen to handover access bursts from the mobile terminal, and then triangulate on its position. TOA requires equipment and software at the base stations. TOA has the advantage of working with existing GSM terminals, but has the disadvantage of requiring the most costly investments in supporting infrastructure.

For E-OTD, the handset listens to bursts from multiple base stations and measures the observed time difference. These measurements are used to triangulate the position of the mobile terminal. This requires modifications in the mobile terminal, and is less costly than TOA for supporting infrastructure.

The above three methods provide absolute location with respect to a well-known coordinate reference system, like WGS84. In most cases, however, relative location of stationary and mobile devices is more useful than absolute location. (In this case, relative location means the location of a mobile device relative to another device. For example, a mobile phone is 50 cm from an ATM.) There are several technologies that provide relative location. They mostly use Radio Frequency (RF) or Infrared (IrDA). These systems simply provide proximity information. A good example is active badges. A badge transmits a unique code every few seconds. If a receiver picks up the code then it knows the badge is within range, even though it can't say precisely where it is, in an absolute sense. Bluetooth technology uses antennas that have a 10 meter range to detect RF coming from beacons fitted in mobile devices. The Virtual Reality world has also spawned a number of absolute position and relative location tracking systems. Typically, these systems are based on magnetic sensors and have a very short range (under 1 meter), but they have high accuracies.

We are now witnessing a breakthrough in several new technologies, especially the Integrated MicroElectro Mechanical Systems (IMEMS®). With this technology, engineers are able to build accelerometers, gyroscopes, and digital compasses on small chips, at affordable prices. With these devices, we can calculate velocity, acceleration, altitude, orientation, temperature, and humidity based on dead-reckoning techniques. Not very far in the future, we will see mobile terminals that can send your location, orientation, velocity, altitude, and acceleration to value add location service providers. Location servers will be able to know where you have been, where you are now, where you are heading, and possibly where you will be in the next few minutes or hours. But, don't worry, service providers will only know this information if you allow them to serve you in this manner! If a location server knows your orientation, it can calculate your line of sight and describe to you the surrounding environment as you walk around (e.g., "the bank is right behind you"). If a location server knows your velocity and acceleration, it can

calculate the proper time to inform you about the next turn, while being your navigation assistant as you negotiate your way from the hotel to your next meeting. It can also turn up the heat at your house, because it knows that you will arrive soon.

Mobility and the UMTS

As the Information Society burgeons, users of data and multimedia telecommunications services will expect and demand that these services will continue to be available when they move away from their desks, offices or homes. UMTS is much more than just a fast mobile network. UMTS will be a mobile communications system that can offer significant user benefits, including high-quality wireless multimedia services to a convergent network of fixed, cellular and satellite components. It will deliver information directly to users and provide them with access to new and innovative services and applications. It will offer personalized mobile communications to the mass market, regardless of location, network or device *used*.

One factor that sets UMTS clearly above second generation mobile systems (e.g., GSM) is its potential to support 2Mbit data rates for users. This capability, together with Internet Protocol (IP) support by UMTS, is a powerful combination to deliver interactive multimedia services as well as other new wideband applications such as video telephony and video conferencing.

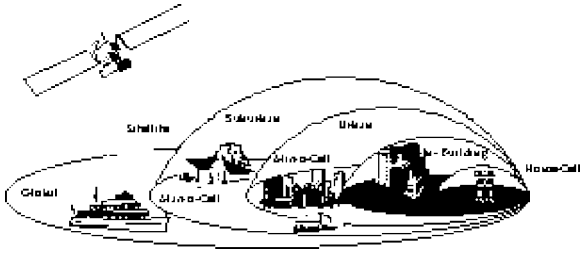

Figure 1. One device connects everywhere (Adopted from UMTS forum)

UMTS recommends that third generation mobile terminals should operate in multi-mode to support second-generation systems such as GSM 900 and 1800 to further extend the reach of many UMTS services. UMTS defines interfaces between fixed networks, private networks, and satellite networks. As shown in Figure 1, mobile devices are likely to be able to roam between different networks. This means that a subscriber will be able to roam from a private network, into a picocellular/microcellular public network, then into a wide area macrocellular network, e.g., a GSM network, and then to a satellite mobile network, with no interruptions of service.

UMTS is a modular concept that takes full regard of the trend towards convergence of fixed and mobile networks and services, enabling a huge number of applications to be developed. As an example, a laptop with an integrated UMTS communication module becomes a general-purpose communications and computing device for broadband Internet access, voice over IP, video telephony and teleconferencing, for either mobile or stationary use.

The number of IP networks and applications are growing fast. Most obvious is the Internet, but private IP networks show similar or even higher rates of growth and usage. UMTS will become the most flexible broadband access technology, as it allows for mobile, office and residential use in a wide range of public and non-public networks. UMTS can support both IP and non-IP traffic, in a variety of modes.

UMTS will be able to benefit from parallel work by the Internet Engineering Task Force (IETF), who is further extending its basic set of IP standards for mobile communication to support location services (**Error! Hyperlink reference not valid.**).

UMTS seeks to build on and extend the capability of today's mobile, cordless and satellite technologies by providing increased capacity, data capability and a far greater range of services, using an innovative radio access scheme and an enhanced, evolving core network. The introduction of UMTS relies on many elements being in place, including, for example, open standards for services, and Application Programming Interfaces (API) for service development and deployment environments. The latter issue brings us to an important concept that was developed by the UMTS community, known as the virtual home environment, VHE.

The Virtual Home Environment

The UMTS standards support the Virtual Home Environment (VHE), which is of particular importance to the geospatial industry. VHE is a concept that allows users to have the same computing environment while they are on the road, at home or in the office. With VHE, a network, which is foreign to a user, emulates the behavior of the user's *home network*. Users will then have the same services that they are accustomed to at home, on the road, or at their corporate environment. It is, therefore, obvious that location information will become extremely important for personalized services to the user.

> *Location services should support and differentiate between device mobility, personal mobility and service portability.*

A user profile depends on location: a profile for work is different from home, different while shopping, watching TV or playing sports, and so on. We should expect future mobile terminals that will provide profile / location-dependent services.

Conclusions

It should be recognized that the future mobile market, with ubiquitous location services, will not resemble the present market. Location services will play a far more important role than what we find in today's wireless marketplace. Additionally, the markets are likely to be more diverse than what we find in the current wireless marketplace, which is dominated by wireless providers, incorporating Internet service providers, application service and content providers, home appliance providers, car manufacturers, and a large number of other providers, serving vertical markets.

New and innovative services and content will be the main drivers for the development of third-generation mobile services, including UMTS. Market demand, combined with the creativity of the service providers, will lead to a wide range of new services. Service and provider diversity and proliferation will increase competition. Location services and technology should find its place in this evolving market.
To achieve the goal of ubiquitous location services, the GIS industry (vendors, content and service providers) must play a leadership role in spatially enabling 3G wireless technologies.

A good place to start is 3rd Generation Partnership Project, **Error! Hyperlink reference not valid.** (www.3gpp.org) which is developing technical specifications for the proliferation of the 3G services. 3GPP is a global co-operation between six Organizational Partners (ARIB, CWTS, ETSI, T1, TTA and TTC) who are recognized as the world's major telecommunications standards bodies from Japan, China, Europe, USA and Korea.

> *Having people and machines that always know the location of each other will have a profound effect on how we perceive the world and on how we interact within it.*

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