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**LOCATION BASED SERVICES - A SOUTH AFRICAN CASE STUDY THAT
CAN BE APPLIED TO AFRICA**



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In the age of information explosion and technological advancement, ubiquitous location-awareness is becoming a significant feature in the era of communication in the global village. The technology revolution has enabled many key business processes to be conducted via mobile devices such as cellular phones and Pocket PC's. In the pursuit of new and innovative ways to create differentiation one of the best ways to accomplish this is through the delivery of highly personalised services. A powerful means of achieving personalised service is by basing it on location.

Much has been documented on how location has become a strategic asset of wireless carriers and how the information afforded by location has enabled its users to experience value added services.

Examples of these services include locate a child, find a friend or proximity based services. Faced with the increasing challenge in raising both average revenue and the number of subscribers, a host of new products, services and business models have been created with location based services being the key.

The result of the introduction of location based services has allowed businesses to offer differentiation and incremental profitability.

The scope of location based services does however extend far beyond those offered by cellular networks. Any application that makes use of location to provide personalised services, can be included under the umbrella of location based services ... but in order to utilise any application that relies on location, accurate geospatial information is a necessity - - and as such, also the mapping that lies at the root of the application.

South African companies have not been shy in coming forward to enable key business processes to be conducted via mobile devices and desktop applications, and South African map bases have afforded many businesses the opportunity of exploring what location based services have to offer.

Full service navigation from a handheld device and real-time asset and fleet management from a desktop have been realised with the use of spatial information.

The successes in South Africa have spurred development further into Africa with Nigeria being one of the first African countries to start reaping the benefits. Africa faces many challenges in empowering the needs demanded by this promising continent in creating sustainable development. We believe location based services have a role to play - - but to ensure this, factually correct geographic information is an imperative if we are going to succeed.

Good morning, I am Ray Wilkinson, Managing Director of a spatial information company in South Africa whose successes might be of interest to any company, or country, wanting to leverage the opportunities that location based services have to offer.

I would like to extend a warm South African welcome to you all and wish to thank the organisers for the kind invitation.

My presentation will take an overview of the South African situation where location based services have been successfully used by a number of industries, and we shall also look at the digital mapping technology that enables these applications to succeed. I shall then appraise the South African scenario in a wider context with particular attention being paid to the practical application of this model for other countries.

But let's first take a look at what is meant by location based services:

Location based services answer the call from the market for systems that answer the questions: 'Where am I', 'Where is it', 'What's around me', 'What's around it' and 'How do I get there'. This has spawned a wide range of positional products and services that find people, places and things... and get you to them.

This emerging and widespread technology has seen an exciting array of geo-referenced services being taken up which include 'find it' and 'find me' type applications such as child location products, permission-based people locaters and directory information such as the content of the Yellow Pages.

So a location based service would determine the location of the user or requested item, by using one of several technologies for determining position, and then use this location and other information to provide a personalised application. In this way, a combination of location and other database information is used to find food, lodging, entertainment, your family, your car, your child, your fleet, your staff and conceivably

anything that exists – even love! – evidenced by a mobile application where the user physically locates a partner according to pre-listed criteria.

In South Africa the use of ubiquitous location awareness has been spurred on by the demands that technology is making for ever-increasing, feature rich applications and content. The cellular network providers have expanded their offering beyond mobile communication with the introduction of a range of location based services such as direction finding, traffic information, directory searches and family locaters. But the scope of location based services extends far beyond those offered by the cellular networks. In SA we have seen rapid development and fast uptake of a number of other business opportunities using locality: These include:

- Call centres;
- Emergency services;
- Full service navigation;
- Fleet and logistics management;
- Vehicle and asset tracking;
- Web services; and
- Business planning and market intelligence.

We shall look at the growing opportunities in these business areas, and those of the cellular networks in a moment. But before we do that, I would like to spend some time in explanation of one of the key ingredients to success in the efficacy of location based services.... that of the geographic information and electronic mapping data used to power the application.

Maps and map-like forms have served as both organisational structures for the location of human events and navigational aid for travellers since the dawn of time. With the coming of the digital age, cartographers have pushed maps into this new medium with geographic data performing a crucial role in any location based system.

The creation of intelligent *spatial* data and the process of manipulating it into a useful format is a specialised field, the results of which facilitate the wide range of location based services already mentioned. The performance of these services is as successful as the accurate mapping information that lies at the heart of it.

In our case we realised, years ago, the impact this would have on spatial development and the pressing need for accurate geo-located information in formats other than the already existing paper-based maps. THE KEY TO OUR SUCCESS in the South African environment was the creation of a solid, accurate digital mapping platform.

We were able to project mapping information into the digital era by leveraging 50 years of our mapping research and production in paper-based products.

By bringing together the resources provided by the paper mapping industry and the engineering, programming and GIS skills provided by geospatial operators, we were able to build a strong platform upon which we could create electronic maps. Along with creating an electronic map data base, paper based products could also now be geo-coded. This factually correct geospatial data has opened the door to countless numbers of location based projects.

At this point it might be of interest for us to review an abridged version of the process used to conquer the enormous task of creating usable electronic mapping data for use in location based services:

Traditionally, map making would start with the use of any and all available printed maps, such as those supplied by the Surveyor General's office or by local map publishers. But for use in a location related service in an electronic environment, these maps are not geographically accurate enough.

Although they usually characterize an excellent visual representation of the geography, they are insufficient for high-end applications such as those we are covering here, today... they're basically just a picture with no alignment to positioning or geographic accuracy. This has been our experience in South Africa and is even more exaggerated for other African countries.

We therefore had to tackle the task of our digital map construction differently. Using high-resolution ortho-rectified satellite imagery and aerial photography, we only refer, if necessary, to the paper-based maps for verification, cross checks and attribution.

Satellite and aerial photographic data has enabled us to interpret what is really on the ground rather than what has been planned. The satellite and aerial photography coupled with new map building technologies as supplied by software houses such as ESRI and MapInfo, have allowed us to keep costs down whilst maintaining highly accurate data.

Instrumentation corrected for the earth's curvature, the term being ortho-rectified, now provides the basis for the next process in the creation of accurate map data.

These slides show examples of satellite images and aerial photography we use.

From the satellite and aerial photography the meticulously detailed process starts of developing the data into a usable electronic format that can be integrated into different technologies such as the location based services covered in today's presentation.

So, let's take a look at how we capture and digitise data.

The next couple of slides will show the different stages in data development from the satellite and photographic references.

The first step involves digitising the satellite /aerial image by tracing the centre lines of the roads on the image. Where paper maps exist, as was the case with the South African data, we also use these as reference to enhance the final product or to resolve discrepancies.

One of the steps during this stage of the process is shown here on this slide where topographical points are used as a reference to enhance the accuracy of our data and to update any new features that have become apparent on the satellite image.

To enhance the accuracies even more, field teams with GPS technology verify the exact longitudinal and latitudinal co-ordinates.

These steps results in 'cartographic spaghetti'. This data is then given attributes such as dual carriageway, one way road, whether it is a street, road, avenue or lane and is then given a road number.

Looking at the line-work created from the digitising and attribution, a process of mapping out the shapes of different types of areas (polygons) are created, for

example on the picture you see on the slide, the grey areas represent industrial sections and the green areas indicate parks. These polygons are created to correctly geo locate defined areas and show them within their borders.

The next layer positions symbols onto the defined polygon areas. These symbols represent hospitals, shopping centres, traffic lights, schools and sports fields, for example.

As we advance with the process these maps become recognisable by adding the next set of information which indicates location based points of interest such as parking lots, hotels, gas stations, churches, restaurants, entertainment venues and historical sites .

As you can see, the picture starts to look more and more like a map... and the world of location based services becomes a reality.

One of the final stages of preparing the data to resemble a map is 'cartographic styling'. This process details the overall look-and-feel of the visual aspect of the map and involves two processes; one being the graphic styling and the other being a quality control check.

Traditionally, this map creation process formed the largest cost of any GIS project. Owing to the methodologies we've used, we have reduced the time period and managed to lower costs, revealing a time efficient and cost effective model.

But the importance here, is that the accurate and detailed execution of this process is the key ingredient to the success of any and all the applications further down the development chain. The process must include the use of every tool available for the map base creation, both traditional and hi-tech modalities, plus mobile GPS-verification.

With our mission statement being the creation of a seamless map for Africa, we believe that our methodology used in South Africa can be used as a blue-print for the rest of the continent.

Let's get back to the practical use of these mapsets in the provision of location based services where the manipulation of digital mapping into useful formats has been successful in a number of location related products and services in South Africa.

[EMERGENCY SERVICES AND DISASTER MANAGEMENT]

In an emergency, the ability of the disaster service to respond quickly can literally mean the difference between life and death. With sophisticated mapping technology, the speed and accuracy with which global emergency organisations, such as International SOS and Europe Assist, can react will prevent disaster. By more efficiently locating the scene of an accident, or connecting a traumatised person with the correct emergency service for their area, lives have been spared and reaction times, greatly reduced. Digital maps lie at the heart of this location related application and greatly improve its ability to field thousands of emergency calls at peak times.

International SOS, who also supplies these services to the 3 biggest GSM operators in South Africa, as well as other crisis control and insurance vendors in the country, are one of the world's largest medical assistance companies and managers of international medical risk.

[FLEET AND LOGISTICS MANAGEMENT]

Knowing a position is crucial to making the best decision in running a fleet or mobile workforce; the guesswork has been removed by the use of accurate electronic maps. Fleet managers, dispatch controllers and executives responsible for managing large fleets are able to reliably know the whereabouts of their fleet or goods, in real-time and from the comfort of their office. Features logging speed, fuel consumption, best routes and a number of key management processes are also built into the interface.

A South African transport consulting specialist has developed a state-of-the-art software solution that simulates any permutation of variables required by a fleet manager. The system capability calculates virtually any operational scenario including load distribution, route conditions, fuel consumption and vehicle performance within 5% of actual performance, arriving at an answer within 30 seconds.

This module is a tool that enables the user to configure a vehicle, including accessories and trailers, to calculate the maximum legal payload. It is used to dynamically simulate trip times, fuel consumption and productivity for a specific vehicle on any surveyed route, taking into account a variety of vehicle and/or route conditions such as drive-line performance, engine idle time, frontal area, coefficient of

drag, payload, tare mass, wind speed and direction, route topography, road surface factor and speed limits.

A global, stock exchange listed, fleet management operator with over 100,000 installed fleet management systems across four continents, has brought to market a leading edge asset management system. Using satellite technology, it allows the operator to track an entire fleet and check the precise status and location of each vehicle 24-hours a day, 365 days per year, from anywhere on the planet. The information is presented, in real-time, on the operators own PC using scalable digital maps, visible down to street level.

[NAVIGATION]

A number of portable and wireless devices such as PDA's and cellphones are now able to offer navigation capabilities enriched with an ever increasing range of location based products. With the advent of accurate digital cartography comprehensive navigation packages are available for a number of usages, these include:

On-board, factory fitted devices built into the console of the vehicle.

Off-board devices such as PDA's and Pocket PC's.

And mobile applications via a mobile phone.

Coupled to a navigation software package, full navigation capabilities are available including voice alerts as you drive, visual assistance in two map view options, exact positioning and a number of other custom settings to get the user to his/her destination.

Product extensions beyond this into the location based services we're talking about today are all in effect on ground level... and growing in intensity.

We look forward to the integration of live data from traffic control authorities into these applications; not yet a reality in South Africa, but certainly in our future.

[VEHICLE AND ASSET TRACKING]

High crime and vehicle theft are always headline news back in South Africa and stolen vehicle recovery operators are successfully using location and geo-referenced data as visual tools to locate and track vehicles and assets.

Combined with GPS technology, businesses within this field are now able to make decisions based on 'exceptions' such as the vehicle having left or entered certain areas, vehicle idle times and stationary periods, and react in a more pro-active way before incidents occur.

Using the GSM network infrastructures, a South African asset protection operator has created a system that communicates with a base station every 2-5 minutes, interpreting this information and reacting before an emergency is reported. This reduces risk as it is proactive in its methods providing early warning notification if a vehicle moves with the ignition off, if a unit is tampered with, the power supply interrupted or a panic button activated. Their criminal intelligence applications now stand a better chance of reducing recovery times, or avoiding possible danger. All their call centre applications integrate location based technology to make this possible.

[WEB SERVICES]

Businesses are increasing traffic to their website by providing added value with the provision of mapping services on their sites. A street map facility to search for an address on a map is driving hits to their sites. Additionally, the ever-increasing progress of customized maps offers the innovation of positioning branch networks, dealerships and outlets on a map and posting this to the site. Address searches are commonplace on web service provider websites such as Tiscali and 'paid for' routing applications where the user downloads visual and text directions for pre-selected addresses is in the offing.

[ENVIRONMENTAL CONSERVATION]

The use of spatial technology in tracking herds or individual animals without human interference has now become a reality. Once an animal has been fitted with a GPS unit, a satellite broadcast beams its position to a PC anywhere in the world. There are multiple benefits of geo-locating animals in this way. Roaming patterns, common routes and areas of migration can now be observed visually on a map with the capacity to play back these routes as a moving dot. This alleviates the need for conservationists to observe herds on foot or aerially and upset the animals by creating unnatural behaviour.

[BUSINESS PLANNING AND MARKET INTELLIGENCE]

This innovative use of location based electronic mapping has produced a software package - called MarketScope - displays information, based on pre-loaded data,

visually on a detailed digital map. Thus, the latest census information as well as various research databases, such as the living standards measures [LSMs], incomes, ages, education levels and a host of other statistics for every household and region in the country, can be studied as a single graphic interpretation of thousands of entries on a spreadsheet.

This is not only significant for the business arena, but governments needing intelligent demographic information for elections, city planning, infrastructure preparation and the like, will also find this of use.

Imagine being able to calculate virtually any demographic scenario for your marketplace, taking into account a variety of factors, including your customer profiles, census information, competitor analysis data and any other set of business-related statistics you wish to evaluate, and visually display the results, arriving at an answer within 30 seconds?

Business managers, marketers, media planners and researchers are able to compare, contrast and evaluate market information using digital mapping technology. This mapping and market analysis tool gives the professional marketer the ability to examine endless spreadsheets, tables of figures and pie-charts in a visual format revealing marketing intelligence previously unavailable. Drawing informed conclusions from an array of thematic maps and map charts is possible as the inner relationships of company data and market numbers reveal themselves according to geographic location.

The software allows users to zoom in on any part of the map to amplify the detail. The zooming capability even extends from a full-detail map, down to street level. Using cutting edge geographic information systems MarketScope allows companies to load their client database onto the system and have it visually represented on a digital map. MarketScope also allows companies to locate their branch networks, and those of competitors, on the map. Each branch is represented by an electronic flag, while competitors' locations can be represented by flags of a different colour. By clicking the mouse on any electronic flag, the user is able to access contact and other information on each branch.

[MOBILE]

The developed world is fairly saturated in terms of cellular usage and can be looked at for network upgrading only. Focus has been turned to Africa, Asia, Eastern Europe and the Middle East with African telecoms being a highly competitive arena.

Few technologies have affected entire continents as broadly as mobile telephony – and few continents have embraced it as warmly as Africa. News headlines bear testimony to this:

"MTN Uganda hits 400 000-subscriber mark"

"Vodacom aims for 2 million Mozambique users"

Mobile telephony is affecting every aspect of life on the continent – and the potential market has scarcely been touched. The GSM revolution which has swept across Africa is busy narrowing the digital divide at an unprecedented rate, dragging the continent into the economic mainstream in the process.

Mobile telephony is now firmly entrenched as the predominant mode of communication in almost every African nation.

By the end of 2003, the number of mobile users reached 51 million in Africa, according to the International Telecommunication Union (ITU). Recent figures report that this number has increased to as much as 82 million!

Putting an exact figure on the phenomenon that is Africa's GSM market is a tough call. Suffice it to say that in the first few years of the new millennium, Africa has added more telecommunication users than in the whole of the previous century and currently the world region with the highest level of mobile communication growth. This is good news for Africa!

According to a recent report, there is a clear link between the current exponential growth of telecoms on the continent and the rates of economic growth in poor countries. The result is explosive growth – 5000% in Africa between 1998 and 2003 according to Stephen Yeo, Chief Executive of the Centre for Economic Policy Research.

In the First World, cellular phones, email and the Internet are additional methods of communication, without which businesses and individuals can still function well. In Africa, a lack of functioning alternatives means the cellular phone and the Internet has become the default method of communication. Businesses from multinationals to

market traders cannot function effectively without them and according to a Vodafone-commissioned report:

- More than 85% of small businesses surveyed in South Africa, rely solely on mobile phones for telecommunication.
- 62% of businesses in South Africa, and 59% in Egypt, said mobile use was linked to an increase in profits – despite higher call costs.
- 97% of people surveyed in Tanzania said they could access a mobile phone, while just 28% could access a land line phone.
- Income, gender, age, education and even the absence of regular electricity supplies, do not create barriers to mobile access in rural areas. Handsets are often shared by smaller communities.

A uniquely African approach has seen the influence of mobile technology reach across the continent and go further than any other communications medium in terms of bridging the digital divide in Africa, identifying the cellular communication industry as a niche market for business development.

Globally, technologies such as the Internet, land usage, vehicle navigation, asset- and fleet management and mobile location based services have necessitated the rapid development of electronic mapping and geo-located data. In Africa this will be no different!

THERE IS AN ENTREPRENEURIAL OPPORTUNITY LINKED TO THE GROWTH OF THE CELLULAR MARKET:

Find and Seek and Look4it will allow users to find the nearest ATM, hospitals, filling stations, pharmacies, restaurants and bars, sporting spots, movie theatres, supermarkets and florists.

Look4me allows users to locate a mobile number via a mobile or the Internet, provided the user consents by the granting of location rights. Available 24hrs a day, people can find the general location of tens of thousands of consenting customers - having obvious value in emergency situations. Look4me users are discovering numerous applications for the service, from checking that their children are at school, to tracking their own cellphones when they are lost or stolen.

Look4help subscribers can trigger an SMS alert containing their location to four pre-specified cell numbers in emergency situations. Saving time and cutting out phoning and describing your positioning to those who can assist you.

ChildLocate locates a child's mobile phone via the web, via Text Messaging, or from a PC.

SmartRoute enables mobile users to download to their mobiles a detailed route to any destination by means of GPRS technology. It's like having your own navigation system in your car, comparable to those in luxury cars.

The device used, whether mobile telephone or PDA with GSM network capability, carries street-level mapping software of South Africa as one of its features.

SmartFleet utilizes the benefits of GPRS for a comprehensive fleet management system which seamlessly integrates vehicle surveillance software.

SmartTrak offers live tracking as an additional feature to SmartFleet.

This details just a few of the location based products that have hit the streets in South Africa and brings us to the question of privacy.

Privacy is a very important consideration when going forward with location based services. The user needs to be able to control who is allowed to receive his location and privacy checks need to be implemented to ensure that only people authorized by the user can gain access to their location.

It is imperative that location based services and applications allow customers to receive these services based on their geographic location, position or known presence, with their consent. Safeguarding individual's rights to the collection, use, retention, disclosure of and access to their location is essential.

Exciting GSM location based services such as these have already been successfully introduced in South Africa and can be introduced to the rest of Africa if the platform is in place.

So... what of location based services outside the borders of South Africa?

It is our experience that there is a lack of reliably accurate mapping information in most African countries. We see this as an opportunity of creating a 'best-of-breed' seamless map database of the continent and thereby meeting our own personal objective within our company enabling us to help the rest of Africa.

The rapid growth of cellular communication in Africa has necessitated the creation of digital map sets, and has been to this point, the main reason for our move into Africa. Let's have a look at what we've done so far in more technical depth...

Planning new networks and optimising the performance of current networks needs high quality map data provided in an instant.

This is crucial for effective planning due to the vast amounts of capital invested in a cellular network infrastructure. Not only is the data important for the network rollout but will also affect the performance and quality of the service. Thus planning and modelling a network prior to implementation provides the engineer with a picture of the real world.

The quality and accuracy of the map data required for propagation planning is most important for network roll-out and optimisation thereof.

Propagation of radio waves is characterised by several factors:

Free Space Loss: Geometric spreading of the wave-front, commonly known as free space loss, diminishes signal power.

Attenuation: Signal power is attenuated as the wave passes through solid objects such as trees, walls, windows and the floors of buildings.

Scattering: The signal is scattered and can interfere with itself if there are objects in the beam of the transmit antenna even if these objects are not on the direct path between the transmitter and the receiver.

The combination of free space loss, attenuation and scattering results in complex propagation environments. Propagation software can model a real world situation by using complex algorithms on quality map data where the influence of topography and land use can be analyzed against the radio wave signals.

Telecommunication Map Data for propagation planning usually consists of the following types of map data:

- Digital Elevation Models (3D Height Models) - A DEM can be defined as a three-dimensional model depicting a part of the earth surface in digital format.
- Clutter Data (Land Use Data) - Clutter data contains land use information on the structure and pattern of the urban, metropolitan and rural landscape. Clutter data is created using a combination of expert classification-based spatial modelling, combined with photo-interpretation techniques on satellite imagery.

- **Vector Data** - Vector data consists of the transportation network such as streets, main roads, secondary roads, highways and railways as well as other features such as coastlines and watercourses. These features are digitised from geo-referenced aerial photos, satellite imagery and topographical maps.
- **Text Data** (point data representing names of roads, suburbs, places of interest etc)
- Additional imagery or scanned maps are often added to enhance location analysis.

With the availability of data coverage for the African continent and low costs related to Radar related elevation data (Shuttle Radar Topography Mission, Aster, Lidar etc) and medium resolution satellite imagery (Landsat ETM), MapIT can now supply off-the-shelf Telecommunication Planning Data for all African countries. The data is supplied in all the known Telecommunication Planning software e.g. Asset, Planet, Tornado, ICS, Pathloss, EDX Signalpro, Decibel Planner, Quantum, Nokia Totum, TEMS.

And onto our next step - Nigeria

To empower the needs demanded by this promising country and to create sustainable development, factually correct geographic information is an imperative. In most African countries this is in short supply and as an advanced spatial data platform is needed to make a constructive contribution to the building process, we have been involved in its creation.

With the burgeoning mobile industry being created, there is more than enough incentive for involvement by Government, local business and a digital map specialist. In the case of Nigeria, a 3-way partnership was formed between ourselves, a West African media company and local government in order to set the Nigerian cartographic renaissance into motion!

The 3-phase project is an ambitious undertaking and will provide visually assistive tools to answer the need for geo-located data upon which location based services rely.

The first phase is reaching completion and will see a national road atlas being produced including all roads, rivers, mountains and topographical detail.

Phase 2 sees the daunting task of building highly detailed street level data for Lagos. Just imagine the job of tracing out the road network of inner Lagos - - this is not a job for the fainthearted.

Phase 3 sees the building of street level data for 4 major cities. The Nigerian atlas will be built in such a way that it is geographically correct to GPS standards and will allow the detailed street level data to be integrated seamlessly.

Once this project is completed Nigerian government will have an up-to-date, correct spatial vector platform to plan all government activities. Businesses and entrepreneurs will be able to exploit the various business opportunities around location based services and build an enterprise of map publishing in Nigeria.

My sentiments on the renewal of Africa concur with NEPAD's urge for the private sector to invest in NEPAD priorities - - - - Harnessing the skill and entrepreneurial spirit of the business community is crucial to the mobilisation of the capital, technology and human expertise to make the new Africa a reality.

A Working Model for Africa

To wrap up, we believe we have found a working model for Africa.

In order to help Africa help itself, we suggest a scenario where Government, international funders, private local enterprise and a specialist in the area of digital mapping join forces. We are poised to roll-out the model so successful in South Africa where the correct spatial development collaborations work together, with the basis being the accurate development of an intelligent spatial platform, to enable location based services.

In closing, we suggest that the South African working model can be successfully extrapolated to the rest of Africa in order to realise the benefits associated with location based services.

I thank you for your time and welcome questions in the time we have left.

[END].

