Wireless Location-based Services
Technologies, Applications and Management

By Graham Chen
Let’s Begin...

- Overview
- Drivers and markets
- Wireless positioning technology
- Applications and services
- LBS Platform
- Market outlook
A Fundamental Paradigm Shift

- By 2005 most wireless devices will be location-aware.
- This means that over 500 million people (consumers, employees and employers) will be able to access where they are, and use location based services.
- This is possibly the most fundamental paradigm shift in spatial information usage since the invention of the map......
Wireless Market Overview

- McKinsey’s definition of 3 waves:
  - Wireless Internet Access
  - Location-based personalized services
  - 3G
Wireless Market Overview

- AllNetDevices classification of applications:
  - Messaging (personal) services
  - Financial services
  - Navigation (telematics) and location services

- There will be continued strong growth in personal SMS market and its combination with LBS
Wireless Market Overview

- Market still searching for the right revenue model
- Revenue sharing an established model in SMS services:
  - Revenue from SMS messages
  - Service subscription
  - Transactions
Wireless Market Overview

The reality:
- Wireless Internet access is only a novelty
- Wireless applications still live in a virtual world (hard to compete against internet)
- LBS shows no sign of reaching maturity, revenue prediction a wide range (3.7b to 20b by 2006)
- 3G is a question mark. What do you want bandwidth on your phone for if there are no contents? (Strategic Analytics predicts 2.5G will dominate for the next decade)
Wireless Market Overview

- Transaction model not well defined:
  - Customers don’t want to pay transaction cost for some apps
  - Operators need increase the usage volume to reduce per-transaction cost
  - Data service providers don’t have the billing systems to generate and collect transaction revenue
  - Network operators accounting and billing OSS can’t support value-added data services for billing purposes

- Packet-based charging model (led by DoCoMo) need more test
LBS Market Overview...

- Ovum predicts the LBS market will reach 20 billion p.a. by 2006

- Ovum findings:
  - Personalize contents by location information the key
  - No clear dominance of location technology yet
  - No clear-cut business model emerged
  - Accuracy not very important

- Analysys says $18.5 billion pa by 2006

- BWCS says, pessimistically $3.7 billion pa by 2006
LBS Market Overview

Which one do you believe?
Progress Check...

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Business Drivers for Mobile LBS

- The mandate from the FCC: Government regulations
- The desire for service providers to recoup the cost
- Upsurge in interest in wireless data services
- A perceived future demand for such services
North America: FCC E911

- FCC Timetable (Phase II)
  - Position enabled handsets
    - 1 October 2001: selling and activating
    - 31 Dec 2001: 25% new handsets
    - 30 June 2002: 50% new handsets
    - 31 Dec 2002: 100% new handsets
  - Accuracy (handset based)
    - 67% handsets at 50 meters
    - 95% handsets at 150 meters
  - Accuracy (network based)
    - 67% handsets at 100 meters
    - 95% handsets at 300 meters
North America: FCC E911

Most recent commitments by Operators

- AT&T (E-OTD): Ship only E911 compliant phones by end 2002
- Sprint (A-GPS): Will ship only E911 compliant phones by end 2002
- Verizon (A-GPS): Will ship only E911 compliant phones by end 2003
- Cingular Wireless (E-OTD): Will ship only E911 compliant phones by Sept 2002

Source: FinPro North America Dec 2001
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Europe

- Gradually moving to a unified emergence service number 112.
- Europe Commission decided against issuing a minimum accuracy requirements.
- EC’s 1999 Communications Review sets 1 January 2003 as the start data.
- Most European countries have Cell-ID based positioning in operation and in process of positioning trials/rollouts.
Asia Pacific

- Most countries have no formal move towards regulation.
- Asia Pacific countries have Cell-ID based positioning in operation
- Singapore leading with high accuracy E-OTD network rollout.
- Japan and Korea made most progress:
  - Japan already has advanced network positioning on its mobile systems
  - KDDI selling 288,000 GPS and video enabled phones
  - SK completes GPS-based positioning system trial
Handset Drivers

- Semi-conductor manufacturers diversifying into “internet appliances”
- Handsets will be the largest population of any electronic device by 2003 (more than TVs or PCs)
- Handset manufacturers driving for competitive edge in innovative use of new data networks
- The speed of innovation is astounding with handsets superseded in months!
Business Driver Stakeholders

- Carriers: Return on wireless data network investments
- Semi-conductor manufacturers: Diversification into huge handset and wireless appliance mass market
- Network Equipment Vendors: Significant sales in network upgrades – 2.5G, 3G and positioning
Business Driver Stakeholders

- Electronics Vendors: Handset differentiation & faster handset renewal rates
- Positioning Technology Vendors: Significant return on positioning technology sales
- Portals—Chargeable applications
- Governments: Emergency tracking (E911), government “oversight”, military & overall economy improvements
Technology Drivers

- 2.5G networks are now extensively deployed
- North America mobile handset penetration will equal Europe by 2006
- Positioning systems are rolling out, with blanket US coverage by 2005
- Some handsets are GPS enabled now
- Handsets are rapidly evolving to color screen, data capable, positioning capable units
- Extensive spatial & navigation datasets are now available

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Business Needs

✔ Services and products to :-
✔ Reduce Costs
✔ Reduce asset losses
✔ Increase employee and asset safety
✔ Increase Revenue and Return on Investment
✔ Increase effectiveness in the workforce
✔ Increase customer loyalty
✔ Fulfill legislative requirements
Consumer Needs

- Need to feel secure
- Need to keep loved ones secure
- Desire for asset/property protection
- Desire for entertainment
- Desire for *Time and Frustration Saving* services
- Desire for “cool” services and services that create peer bonding
Many cars in design now will roll off production lines in 2005 with in-built wireless telematics. This includes GPS positioning, wireless communications and in-vehicle computer screens. Cars will be a mobile device just like a handset or a PDA.
Market Development

Market development hindrances
- Privacy concerns
- Network evolution
- Handsets and device interoperability
- Multi-technology and multi-standards
- Operators’ caution and lack of speed
- Other location centric services
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LBS Technologies

- Network-based position technologies
- Handset-based positioning technologies
- Handsets
- Technology hindrances
Network-based Position Technology

Cell-ID

- Relies on the cell a mobile is connecting to. Different variations exist: with Timing Advance (CELL-ID TA), with SIM Toolkit (STK), with IN and with WAP.
- All suitable in a home network and roaming environment
- Poor accuracy (cell size, 500m in large cell size)
Network-based Position Technology

- Time of Arrival (TOA)
  - triangulation technology requires three or more base stations to locate mobile units
  - Expensive to deploy, requires location measurement unit (LMU) for each base station and Position Calculation functions on each Serving Mobile Location Centre (SMLC)
  - 100m accuracy if 3 base stations are in range
Network-based Position Technology

Angle of Arrival (AOA)
- Requires array of antenna elements to determine the direction of mobile signal
- Good for tracking continuous signal
- Very expensive to deploy, accuracy >125m
Handset-based Position Technology

- Global positioning system GPS
  - Satellite-based position technologies
  - Navstar of USA, Glonass of Russia
  - Accuracy to 10 metres
- European based GPS Systems
  - EGNOS and Galileo
Handset-based Position Technology

- Observed time difference of arrival (OTDOA)
  - Positioning technology with UMTS
- Enhanced observed time difference (E-OTD)
  - GSM and UMTS network
- Bluetooth
- Other hybrid solutions
## Positioning Accuracy Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location independent</td>
<td>Stock price, sport reports</td>
</tr>
<tr>
<td>Regional (~200km)</td>
<td>Weather reports, localized weather warnings, traffic information (pre-trip)</td>
</tr>
<tr>
<td>District (~20km)</td>
<td>Local news, traffic reports</td>
</tr>
<tr>
<td>Up to 1 km</td>
<td>Vehicle asset management, targeted congestion avoidance advice</td>
</tr>
<tr>
<td>500m to 1 km</td>
<td>Rural and suburban emergency services. Manpower planning, information services (where is ...?)</td>
</tr>
<tr>
<td>100m (67%)</td>
<td>US FCC mandate for wireless emergency</td>
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<tr>
<td>300m (95%)</td>
<td>Calls using network-based positioning</td>
</tr>
<tr>
<td>75-125m</td>
<td>Urban SOS, localized advertising, home zone pricing, network maintenance, network demand monitoring, asset tracking, information services (where is nearest?)</td>
</tr>
<tr>
<td>50m (67%)</td>
<td>US FCC mandate for wireless emergency</td>
</tr>
<tr>
<td>150m (95%)</td>
<td>Calls using handset-based positioning</td>
</tr>
<tr>
<td>10-50m</td>
<td>Asset location, route guidance</td>
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</table>
Handsets

Phones have become “smart” and data capable (and are further evolving), by:

- Integrating advanced graphic screens & PDA functionality
- Using Bluetooth to give access to other advanced portable devices, like PDAs
- Adding Java processing functionality to become “smart” on a small device
- Obeying Moores Law
Handsets

- Handsets are not limited by their screens
- With Bluetooth handsets become the connection point between a “wireless personal area network” and the “wireless data communications network”
- Hence the user is free to use any device with the phone providing the connection to the outside world.
Technology Hindrances

- Complexity
- Expenses
- Privacy concerns
- Network evolution
- Handsets and device interoperability
- Multi-technology and multi-standards
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Location-based Services

- Lifestyle Information
- Business Information
- Traffic Information

- Vehicle Tracking
- People Tracking
- Assets Tracking

- Medical
- Crime
- Distress

- Information in the field
- Enterprise Integration
- Customer Service
Search for Kill Apps

Recent Ericsson ConsumerLab survey with 16,000 users in 8 different markets concluded that most desirable LBS is personal safety services:

- emergency location
- alarm notification (home break-ins, or car break-ins)
- road-side assistance
Personal Safety and Security

- Some trial commercial services:
  - Keep tracking of children or aged relatives
  - Personal locator devices, locating individuals through GPS
  - Tracking family members
- Dubious long term revenue model (initial device plus subscription)
- Cumbersome GPS technology and coverage
- Will remain in very niche market for some time.
Mobile Advertising and mCommerce

- Push model advertising causes so much annoyance to consumers
- Some opt-in pull model commercial trials:
  - High operation cost to know how opted to receive what advertising
  - Can easily repeat “junk mail” scenario with much less consumer control
- Dubious long term revenue model
- Users reluctance to purchase (mCommerce)
- Annoyance factor much worse than internet
Traffic and Transport Services

Fueled by telematics industry:

- GM’s OnStar reports 1.8m wireless-enabled cars in more than half of its models
- Wingcast (JV, Ford and Qualcomm) deal with Verizon
- DoCoMo and Nissan with advanced telematics service
- Vodafone with Ford
- Fiat install in-car wireless systems
- Ericsson, Volvo and Telia form WirelessCar
- Mercedes launches TeleAid
Traffic and Transport Services

Marriage of convenience between car manufacturers offering in-car wireless equipment, and operators offering services.

Basis for revenue model exists for value-added services:

- roadside assistance
- traffic information
- routing information
- maps on the phone
Personal Find-a-Friend Services

- Multiple commercial trials
  - SignalSoft Bfound service
  - Omnisky (Nomad IQ)
- Build on the huge success of Instant Messaging service
- Extended to groups and communities including to the corporate world
- May become a sticky service
- Likely a niche application for youth market
Consumer Market Characteristics...

- Diversity in its service requirements, handsets, and spending capacity.
- Most dominant successful applications are still personal messaging service.
- Difference between “like the service” and “pay for the service”
- Difference between “use the service” to “stick to the service”
Consumer Market Characteristics

_consumer acceptance hurdles:
- usage cost, hardware and software costs, and satisfactory viewing conditions
- significant consumer education and marketing exposure
- significant modification of current systems
- correlation to basic human needs
- cultural and social conformity.
Enterprise Market Applications

Key demand for LBS for corporate customers:
- Asset tracking and management
- CRM tools and sales and marketing tool
- Fleet management
- Workforce management
Premises Wireless Market

- Solutions are location, venue, campus or area-based
- Support a physical community of interest
- Numerous Premises wireless infrastructure providers exist but lack the applications
- Opportunities exist to provide mobile users with access to information and services within a particular geographic area
- Opportunities are in two segments: venue-based wireless and campus-based wireless.
Venue-based Wireless

Target public places to implement premises wireless for broadband localised access.

Sports Stadiums—Order popcorn from your seat, view statistics, find concessions and receive promotions.

Airports—Internet access, e-mail, travel information, send/receive faxes, get directions, automatically update your pocket organizer.

Trade Shows—Find exhibits, monitor session changes, access coupons or special events.

Shopping Centres—Directions, specials, coupon sales, locate empty parking spaces.
Campus-based Wireless...

- Provide services to a community with common interests.
  - Universities—Campus based communications, alerts, administration, faculty and student operations.
  - Hospitals—Nurse call, pharmacy, test results.
  - Hotels, Motels and Resorts—Staff, concierge, rental to guests for premises access, specials, food-beverage-media, conference planning, ordering, information access.
Campus-based Wireless

- Provide services to a community with common interests.
  - Shopping Centres—maintenance, security, availability of merchandise check.
  - Large Enterprises—Multi-floor or multi-building environments. Voice mail control and access.
New Application Paradigm

- Personalized services
- Intelligent personal devices and networks
- More fusion of physical world (GIS domain) and virtual world (Internet domain)
- More mixed independent and inter-dependent entities (devices, people, networks)
- People, places and things model
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Structure of LBS Platform

- Positioning platform
- Application middleware
- GIS and mapping
- Location server
- Personal agent
- Service directory
Functional Structure of LBS Platform

Presence and Access
(multi-channel, Web, WAP, SMS, Voice, registration, enrollment)

LBS Applications and Services

Location Server  Personal Agent

Service Directory

mService Transaction Platform
(Transactions, billing, service repository, security)

Communications Infrastructure
(WAP, SMS, GPRS, 3G, MPS, GPS)
Supply Chain of LBS Platform

Presence and Access

Service Provider

Wireless Applications and Services

Application Provider

Location Server

Personal Agent

Platform Provider

Service Directory

mService Transaction Platform

Wireless Communication Infrastructure

Infrastructure Provider
Location Server...

- Support different level of location concept:
  - Physical location
  - GIS location
  - Logic (application defined) location
- Conduct different mappings
- Interface with MPS, GPS and GIS
Location Server

- Personalize location information
  - Give a location a name
  - Mapping of logical location to physical and GIS locations
  - User control to set their location
  - User control over the release of location information
  - User permission to allow another entity to track a user
  - Support for location-related alerts, e.g. proximity, within an area
Personal Agent...

- Customers exist independently of services
- Individuals have different needs and preferences
- Customers should be able to control the content of their own profiles if they wish
- Customer properties are important to the services offered but need to be managed separately from the services
Personalisation deals with the following aspects of a service delivery:

- Service contents, to personalise services and service features
- Alerts, to be notified when required information is available
- Multiple modality, using customer defined modality to interact with services. This often contains strong wireless flavour, i.e. to support mobile access and delivery of services.
Personal Agent

- Supports a customer-centred, multi-service personalisation requirements
- Provides multiple levels of personalisation:
  - Presentation level
  - Contents level
  - Rule based personal services
  - Cross service personalisation
Notifications and Alerts

- Support for real-time monitoring of customer-configured alert conditions
- Generation of an appropriate alert (Voice, SMS, Email) with relevant information when a condition is met
GIS and Mapping

- Interact with GIS datasets
- Generate maps and direction instructions
- Provide logical view of physical positioning (coordinates)
- Provide “you are here” marks on map
- Support points of interest for different applications
- Support routing and navigation
Directory Services

- Multilevel directory and catalog information
  - Level 1 – White Pages (Name, Address, Phone)
  - Level 2 – Yellow Pages (Business Information)
  - Level 3 – Catalog of products and services supplied by a business
- Data management capability – businesses manage their own catalog data
- Advanced natural-language search capability
- Integrates with location services for location-based search
mService Transaction

- Transaction processing support such as transactional messaging
- Accounting and billing functions
- Interfaces and adaptors with databases
- Underlying security support
Communications Infrastructure

- The Web and IP (Internet Protocol)
- Wireless protocols
  - Interfaces with multiple wireless technologies such as SMS gateways, WAP gateways, and other wireless platforms.
- Positioning technologies
  - Interfaces with different positioning technologies such as MPS and GPS.
Characteristics: Platforms

- Fragmented solution portfolio:
  - Physical positioning systems
  - Servers to process the physical location information
  - Middleware for integration apps with positioning equipment
  - Accounting, billing and authentication functions
  - Software components to support application development
  - Maps and contents
  - Directory or database systems
Characteristics: Platforms

- Too many players
  - Positioning technology vendors, (GPS and MPS)
  - GIS/map vendors
  - Wireless data application providers
  - Startups
  - Contents providers
  - Wireless hardware and software infrastructure providers
  - Middleware platform providers shifting to wireless market
  - Big guys: Microsoft, HP, IBM and Sun
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By 2006……

- Convergence will be complete
- Most mobile users (>500M) will have location aware devices
- A vast range of services will exist which take advantage of that location awareness
- It will be *abnormal* for a carrier, portal or enterprise service not to capitalize on the location awareness, data delivery and functional capabilities of these new smart devices – its expected as a standard service.
By 2006...

- You (and a billion others) will have a smart phone, bluetooth enabled, on at least a 2.5G network
- Your smart phone will be positioning capable to 50-100m
- You will have access to a wide range of Location Services, many using accurate, navigable map datasets
- You, (plus half a billion others), will use these services.
- 3G may or may not be here…..
Growth of LBS User Base

Source: BWCS

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Growth of LBS Revenue Base

Source: BWCS

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Fragmented Value Chain...

- Customers
  - Handset Vendors
  - Mobile Service Providers
  - Mobile Network Operators
  - Mobile Portal Providers
  - Content Providers & Aggregators
  - Application Developers
  - Application Platform Vendors
  - Infrastructure & Equipment Vendors
  - Technology Platform Vendors

- Service Providers
- Application Providers
- Technology Providers
Fragmented Value Chain

- Current supply chain in LBS market:
  - MPS vendors, GIS vendors
  - Application and content vendors
  - Network operators
  - Systems integrators and IT vendors
- Lack of integrated LBS platforms
- Lack of integrated application/service providers
Future LBS Value Chain

- LBS platform suppliers:
  - MPS vendors, GIS vendors
  - Tools
  - Service development and deployment environment
  - Portal tools
- Integrated application/service providers
- Network operators
- Mobile portals
Continued Search for Applications

- Personalised services
- Reflect new interaction model centred on individuals—location is an attribute of a personal property
- Lowest available technology
- Offer business values beyond a novelty value.
Further Readings

- BWCS, Mobile location-based services: where is the revenue?
- Ovum, Mobile location services: market strategies
- LOCUS, Overview of location services.
- FINPRO, North American wireless market review: Personal location-based services.
- FINPRO, A market study on personal navigation in Japan