



ARC Group's Strategic Report:
Location Based Services
Worldwide Market Analysis & Strategic Outlook 2002-2007

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1. Executive Summary



Drivers for LBS

- ◆ Market pressures
 - ARPU, increasing ROI, competition, reduce churn
- ◆ Technology demand
 - Roaming, multiple bearers, different handsets etc.
- ◆ User demand
 - Increased value, relevant content, timely solutions
- ◆ User solutions
 - Proximity, information, games, fleet mgmt



LBS market trends

- ◆ Business services for management and tracking applications first to enter
- ◆ Infotainment among first for mass markets
- ◆ Mass market to create greater revenue than business services
- ◆ Tough economic conditions has made operators cautious to invest



Success of LBS depends on

- ✦ Accessible anytime and anywhere
- ✦ User-centric and user-friendly
- ✦ Support for various platforms and over a variety of network technologies

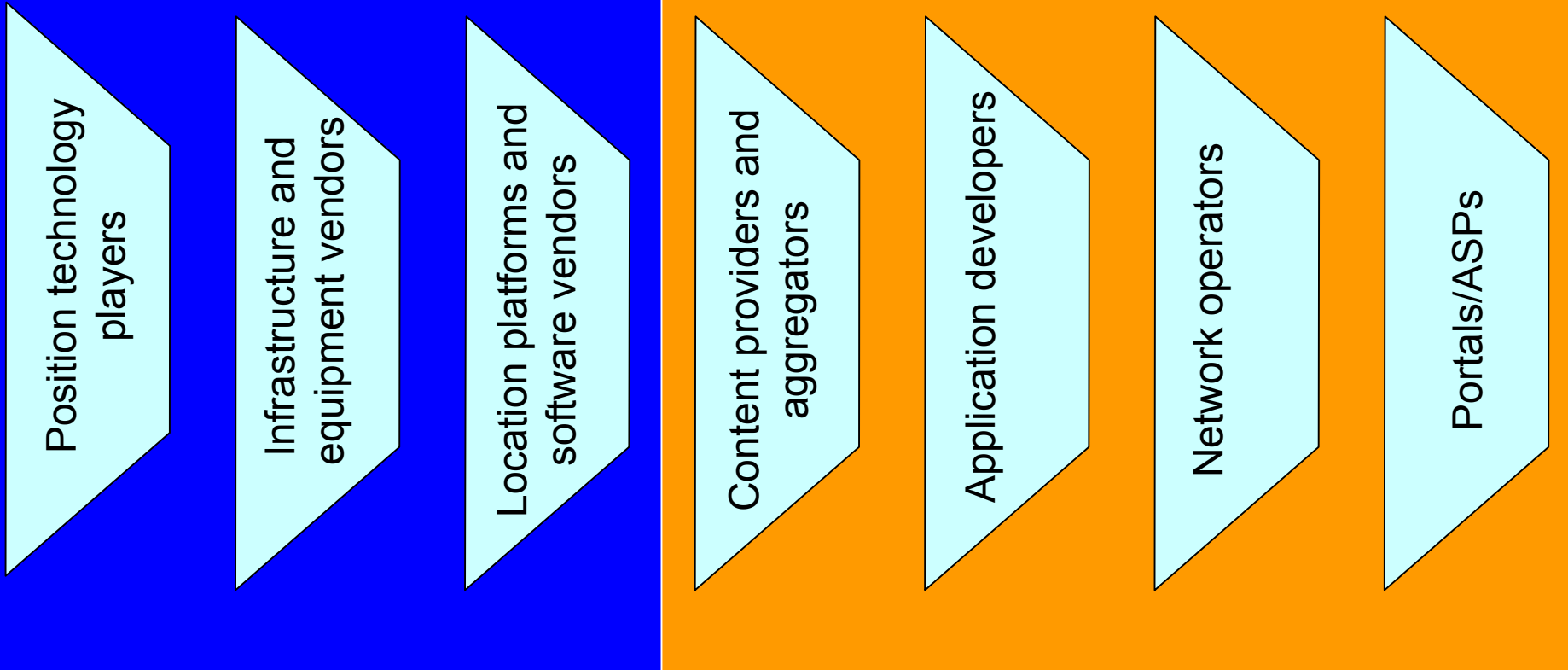


Personal Location Value Model

1. Safety needs
2. Operational needs
 - ◆ Navigation, routing, travel services
3. Social needs
 - ◆ Communication, Buddy lists, community services
4. Entertainment needs
5. M-commerce



LBS Value Chain





Relationships between value chain players

Increased competition over the control of customer experience demands:

- ✦ Strategic partnerships
- ✦ Customer-supplier relationships
- ✦ Royalty models
- ✦ Joint ventures
- ✦ Consolidation



Business and revenue models

i-mode model

- ◆ Outsourcing of content development
- ◆ Content is free or low priced, monthly fees (\$2,50)
- ◆ DoCoMo collects content charges, keeps 9 %, rest passed to developer
- ◆ Low cost and simple payment mechanism for content and application providers



Issues for LBS services

- ◆ Handling of sensitive personal data
- ◆ Location information control by the user
- ◆ Interoperability requires open standards for data exchange and APIs
- ◆ Avoiding spam: opt-in and pull model
- ◆ M-commerce security



Positioning technology

- ◆ In short term Cell-ID will dominate
- ◆ Enhanced Cell-ID by some operators
- ◆ Plans for medium term uncertain
- ◆ In long term higher accuracy dominates:
 - For subscriber: Greater choice of applications, routing information, reduced number of clicks
 - For application developers/middleware vendors: sustainable revenue
 - For operators: increased ARPU, reduced churn, competitive advantage



Higher Accuracy Methods

- ◆ Some operators chosen A-GPS
 - Wider popularity requires the development of low cost, small footprint single-chip solution
 - Mass market GPS solutions so far mainly in Japan
- ◆ US GSM carriers chosen E-OTD
 - Success in US crucial for deployments elsewhere
- ◆ Different solutions dominate in different markets for different applications
 - High accuracy by business users (e.g. fleet mgmt) and certain consumer applications (tracking, navigation); For many other apps not critical



LBS Roadmap

- ◆ Operators concentrate in consumer market
 - Targeting existing customers and current handsets to test business and revenue models, marketing strategies and segmentation models
- ◆ Commercial consumer rollout of services to increase significantly in 18-24 months
- ◆ Short term emphasis on improving service offerings, focusing on market, branding and pricing
- ◆ Resolution of privacy, data protection, roaming and pricing will ease deployment and uptake of services
- ◆ Operators need to collaborate to improve offerings for vertical markets



LBS Rollout

Phase	Trend	Emphasis	Services	Devices
2002 / 2003	Initial consumer and corporate services.	Technology deployed. Middleware in place. First consumer services. First corporate services.	Games, Community, Proximity traffic information	WAP SMS/Voice Basic positioning technology Bluetooth Colour displays Java Presence technology
2004 / 2005	Wider consumer services. Corporate market extends but yet underdeveloped.	Increased partnerships, standards, marketing and service rollouts. Initial roaming agreements.	In-car advertising, Fleet and asset tracking, Personnel tracking, Basic navigation	Bigger displays IVR Easy data entry Accurate positioning.
2006 / 2007	Mass-market consumer LBS. Corporate market and vertical market growing.	Cross-platform support. Full integration with multiple application platforms. Full scale services roaming.	Telematics, Billing, M-commerce, Music/video, Enterprise / mobile office, Personal / in-car navigation, Breakdown recovery	



2. Market Dynamics



Cellular Network Evolution: Analogue Networks

- ◆ Advanced Mobile Phone System (AMPS)
 - Analogue cellular standard in the Americas since 1980's
 - Operates on the 800MHZ frequency
 - Based on the Frequency Division Multiple Access (FDMA), which allocates different frequencies to each call
 - Still wider coverage in USA than current digital networks
- ◆ Narrow-band AMPS (N-AMPS)
- ◆ Total Access Communications System (TACS)
 - Derived from AMPS, the analogue standard for UK
- ◆ Nordic Mobile Telephone (NMT)
 - First operational analogue system
- ◆ Cellular Digital Packet Data (CDPD)
 - Based on IP overlaying an AMPS network



Evolution cont.: Digital Networks

- ◆ Majority of mobile phone systems digital
- ◆ Future digital networks provide higher-rate data
 - Some apps such as video-conferencing require guaranteed constant bandwidth requirements: circuit switched networks more suited
 - Most new applications to have close relationship with the Internet, and push apps more suited for packet networks
- ◆ Time Division Multiple Access (TDMA)
 - Uses time division multiplexing to divide frequencies into timeslots into which calls are allocated to allow one frequency to carry multiple calls
 - Widely used in North and South America
- ◆ Personal Digital Cellular (PDC)
 - Uses TDMA system that is directly related to that of GSM
 - Used only in Japan



Evolution cont.: Digital Networks

✦ Global System for Mobile Communication (GSM)

- Most popular worldwide, based upon time division call allocation process
- Phase 2 specifications: data rate 9,6kbps, fax line, international data roaming capabilities, SMS
- Phase 2+: additional service customisation, up-to 64kbps data speed, global roaming
- High Speed Circuit Switched Data (HSCSD)
 - Uses max four timeslots, max data rate 57,6kbps
- GPRS (General Packet Radio Service)
 - 1-8 time slots are shared, interleaving data packets from different users
 - Highest theoretical data rate 171,2 kbps
- EDGE (Enhanced Data for GSM Evolution)
 - Redefines the modulation and coding schemes
 - 48kbps per time slot, maximum data rate 384kbps



Evolution cont.: Digital Networks

◆ Code Division Multiple Access CDMA

- Originally developed by Qualcomm
- Uses individual code designations to distinguish carrier channels in the spectrum from one another
- CdmaOne – upgrade
 - Also known as IS-95B
 - Korean and Japanese operators have implemented commercially
- CDMA wide coverage in North America and large number of subscribers in Korea and Japan



3G Developments

- ◆ ITU* has set minimum requirements for data speeds for 3G (IMT-2000 Standards)
 - High mobility - 144kbps
 - Full mobility - 384kbps
 - Limited mobility - 2Mbps
- ◆ EDGE (max 384 kbps)
 - Developed as an progression path to UMTS for GSM
 - Evolution path for TDMA operators (option for 3G)
 - Leading NA TDMA operator AT&T intends to migrate to GSM

**International Telecommunications Union*



3G Developments (cont.)

- ◆ CDMA2000 1xRTT (or 1x)
 - Follower for CdmaOne
 - Max data rate 144kbps
 - CDMA2000 1xEV (wireless broadband) developed by Qualcomm and CDMA2000 1xEV DO (data only) launched in Korea (peak data rates 2,4Mbps)
 - Phase 2 1xEV DV to support voice and data
 - ARC Group forecasts 9,4 million CDMA 1x subscribers globally by the end 2002, compared to 800 000 for W-CDMA (majority in Japan)



3G Developments (cont.)

- ◆ W-CDMA (Wideband code-division multiple access)
 - Supports images, data and videos up to 2Mbps
 - Most GSM systems likely to follow
- ◆ TD-SCDMA (Time division Synchronous Code Division Multiple Access)
 - Developed by China Academy of Telecommunications Technology
 - Adopted as part of the global 3G/UMTS standard
 - Max data speed 384kbps



4G Developments

- ◆ Concept: universal high speed network which seamlessly interfaces with wireline backbone
- ◆ Will be digital packet data networks utilising IP v6.0 with converged voice and data capabilities and integrated support for WLAN, Bluetooth etc.
- ◆ Data speeds 20-100 Mbps
- ◆ Frequency bands 2-8 GHz and utilising Orthogonal Frequency Division Multiplexing and Multi Carrier CDMA
- ◆ NTT DoCoMo develops Variable Spreading Factor Orthogonal and Code Division Multiplexing (VSF-OFCDM)
- ◆ NTT DoCoMo stated to launch 4G in 2006



Mobile Subscribers

Millions	2002	2007
North America	153	245
South America	107	255
Asia/Pacific	456	1 138
Europe	415	599
Africa/Middle East	60	197
Total	1 190	2,434



Mobile Subscribers

✦ Japan

- 2002: Penetration rate 56%, Subscribers 70,7 million
 - NTT DoCoMo: 41,2 million (58%)
 - KDDI 16,45 million
 - J-Phone 12,55 million
- 2007: 3G subscribers 89,8 million
- NTT DoCoMo's 3G service FOMA 110 000 subscribers by 06/2002
 - 69% corporate users
- KPN Netherlands, E-Plus Germany and AT&T USA launched i-mode
KPN Orange (Belgium) to launch

✦ Asia/Pacific (excl. Japan and China)

- Fastest growing market (Korea, China and Taiwan)
- 70 % GSM, 30% CDMA
- Korea 3G network CDMA2000 1X (153kbps)



Mobile Subscribers

◆ China

- In 2001 Chinese mobile market world's largest
- Forecast 220,9 million subscribers by end 2002
- Urban areas remain the focus
- China Mobile launched GPRS in May 2002, China Unicom has delayed the launch
- Voice will still dominate next five years
- Siemens predicts 40 million subscribers for TD-SCDMA by 2005

◆ North America

- Relatively low penetration compared to Europe
 - USA 33,9%, Canada 45,8%
- Mobile data services behind Europe and Japan; voice dominates
- 6 operators cover 81% of subscribers in USA
- 4 operators cover 95% of subscribers in Canada



Mobile Subscribers

◆ USA

- Major issue is the lack of bandwidth to provide mobile data
- Cingular Wireless announced to migrate only as far as EDGE
- Verizon's upgrade to CDMA 1X has provided sufficient spectrum until end 2003
- Market consolidation to increase as major operators look to increase their available bandwidth
 - Cingular Wireless and VoiceStream likely to join forces
- Market for mobile services highly fragmented also within operators
- Digital networks mostly CDMA (41%) or TDMA (33,1); GSM 9,6%, AMPS 15,2%
- Sprint PCS to launch CDMA 1X in 08/2001 (nationwide) and plans CDMA 1X EV-DV in 2004



Mobile Subscribers

✦ Canada

- AMPS most widely used technology, CDMA second TDMA third
- TDMA/AMPS operators likely to choose GSM

✦ Latin America

- TDMA (57,1%) and AMPS (17,1%) dominate; (GSM 5,3%)
- Growth of CDMA (20,5%) will be steady for next five years
 - Centennial (Puerto Rico) launched CDMA2000 1XRTT
- Much of GSM rise due to European operators (Telefonica Moviles, TIM and Portugal Telecom)
- Entel PCS (Chile) was Latin America's first GPRS operator



Mobile Subscribers

◆ Western Europe

- GPRS has been widely launched commercially
 - It is anticipated to be the thrust behind the success of UMTS
- EDGE not anticipated to be widely deployed
- ARC Group believes that by the end of 2004 3G services will have total of 20 million subscribers

◆ Eastern Europe

- Mainly GSM, some TDMA and CDMA networks
- CDMA based 1XRTT 2,5G services launched in Romania
- Wider GPRS and WCDMA deployment long way off

◆ Africa / Middle East

- Cellular market poorly developed but rapidly growing
- VAST majority GSM 900 digital systems
- Roll-out of 2,5G or 3G long way of (excluding South Africa)
- Middle East fairly underdeveloped infrastructure (excl. Israel)



Wireless Internet Market Development

◆ Mobile Internet Services

- As network and device capabilities improve personal information management (PIM), directories and simple personalisation (ring tones and logos) will be offered
- Main mobile service categories:
 - Communications (voice, SMS, MMS, e-mail, etc)
 - Information (push SMS, multimedia PIM apps, web browsing)
 - Content (games, music, video)
 - Transactions (micropayments, macropayments)



Wireless Internet Market Development

◆ Mobile Services Operator Revenues

- Voice services will continue to provide majority of revenues, but mobile data services will grow at faster rate to \$250 billion globally by 2007
 - Data services to account for 30% of total operator revenues by 2007
 - North America and Europe even higher (35%)

◆ Mobile Data Traffic

- Global mobile data traffic will increase from 159 billion (2002) events to 1 273 billion (2007)



LBS Market

- ◆ Value of LBS comes from the use of location with user profile data to act as content filters
- ◆ Minimum accuracy requirements vary for different services
 - Emergency <100m
 - Navigation/Tracking 100m
 - Guidance/Location <500 m
 - Billing or Information >1 km
- ◆ Benefits of deploying LBS solutions for service providers
 - Stronger customer loyalty
 - Additional revenue from the LBS and location-specific advertising
 - Location-dependant tariffs
 - Locatable trouble detection



Tough economic conditions

- ◆ Operators cautious to invest
 - Slower deployment and adoption of LBS
 - Many companies adapted their business models
- ◆ Some mergers to stay competitive
 - e.g. Webraska and Airflash
- ◆ Other companies stop selling to operators directly
 - e.g. CPS with Ericsson and Siemens
- ◆ Partnerships have taken place
 - e.g. SignalSoft has a long list of partners
- ◆ Acquisitions have happened
- ◆ In any case consumer services slowly deployed
 - Especially European and Asian operators
- ◆ E911 most widely deployed LBS in USA



LBS Forecasts

- ◆ Location will be an inherent feature of many mobile services
- ◆ LBS are a subset of mobile internet services
- ◆ Service categories:
 - Person-to-person messaging
 - m-Commerce
 - Infotainment
 - Entertainment
 - Intranet (including ERM, employee relationship management)
 - Navigation
 - Personal Tracking
 - Web access / internet browsing
 - Advertising
 - Field force (e.g. workforce scheduling and management)
 - In-vehicle services
 - Logistics and ERP



LBS Traffic

- ◆ LBS services 3,9% of mobile data traffic in 2002
 - In 2007 it will count for nearly 30%
- ◆ Consumer LBS volumes worldwide (billions of events):

	2002	2007
Person-to-person messaging	30,5 %	5,5
m-Commerce	0 %	2,0
Infotainment	53,5%	63,6
Entertainment	4,7%	4,4
Navigation	3,8%	10,7
Tracking	1,8%	6,3
Web access	4,2%	2,9
Advertising	0%	3,1
In-vehicle services	1,5%	1,4
Of total	5,48 billion	325,47 billion



◆ Business LBS usage worldwide (billions of events)

	2002	2007
Intranet	32,5%	26,3%
Field force	10,9%	10,5%
Logistics & ERP	56,7%	63,1%
Of total	0,705 billion	40,642 billion

◆ LBS operator revenues (\$bn)

	2002	2007
Worldwide	\$1,295	\$99,810



◆ Consumer LBS revenues (\$m)

	2002	2007
Person-to-person messaging	17,1 %	5,5
m-Commerce	0 %	2,0
Infotainment	35,6%	63,6
Entertainment	5,4%	4,4
Navigation	15,5%	10,7
Tracking	15,8%	6,3
Web access	4,8%	2,9
Advertising	0%	3,1
In-vehicle services	5,9%	1,4
Of total	\$976,9 million	\$84 409,3million



◆ Business LBS revenues (\$m)

	2002	2007
Intranet	14,4%	13,9%
Field force	13,6%	11,1%
Logistics & ERP	72,0%	75,0%
Of total	\$317,8 million	\$15 401,1million

◆ LBS revenue and usage of total mobile data services

	2002	2007
LBS Revenue	3,9%	40,5%
LBS Usage	3,9%	28,8%



3. Wireless LBS Solution



Key technology elements

- ◆ Location positioning technologies
 - Such as Cell-ID, E-OTD and A-GPS
- ◆ Mobile positioning systems
 - Including location gateways and servers, that extract the location information and make it available to applications
- ◆ Location middleware
 - Application management platforms that provide interface to third party applications. Key features are privacy, authentication, billing, alarm/alerts, user statistics, handling scalability and load balancing.
- ◆ Applications

The boundaries of these layers are often blurred.



Positioning technologies

◆ Cell Identity (Cell-ID)

- Identity number associated with a cell
- Operator knows the coordinates of each cell site
- Accuracy of terminal dependant on cell size (100 m – 30 km)
- Potentially available in all networks, requires developmental work
- Most widely available LBS architecture

◆ Cell-ID and Timing Advance (TA)

- TA information can improve the accuracy of Cell-ID in urban areas

◆ Enhanced Cell-ID (E-CGI)

- Accuracy of Cell-ID improved by using measurements of field strength
- Commercial deployment widely anticipated during 2003
- Seen as a possible solution for Automatic Vehicle Location (AVL) requirements



✦ Uplink Time of Arrival (TOA)

- Hybrid network-based triangulation method
 - Computations use GPS time clocks to calculate TOA differences
- Uses time of arrival of data from terminal to nearby base stations
- Does not require modifications to the handsets
- Expensive for the operators
- Accuracy 100-250 m, thus generally better than Cell-ID

✦ Angle of Arrival (AOA) and Time Difference of Arrival (TDOA)

- Similar to TOA
- LMU measures either the angle or time difference of arrival of signals from three base stations
- Combination of these provides accurate location information
- High network installation costs, terminal modifications not required



◆ Enhanced Observed Time Difference (E-OTD)

- Hybrid solution combining elements of network and handset based technologies
 - Terminal measures arrival time of signals from >3 cell sites
 - The network measures the transmission time of these signals
- Requires handset modifications
- Requires LMUs throughout the network
- Not suitable for rural areas as the visibility of at least 3 stations required
- CPS anticipates being able to provide 10-20m accuracy for WCDMA
- For 3G networks E-OTD is known as Observed Time Difference of Arrival (OTDOA)
- Nokia provides its own E-OTD solution and plans to include it in all future Nokia GSM handsets



◆ Matrix E-OTD (ME-OTD)

- Enhanced version of E-OTD developed by CPS
- Provides equivalent accuracy as E-OTD
- Aim to reduce deployment costs by reducing number of LMUs
 - Only one LMU required per 20-30 base stations

◆ Global Positioning System (GPS)

- Based upon triangulation between signals dispatched from an orbital array of 24 satellites
- General accuracy 5-40m, with a clear sky view
- Commercial providers of GPS solutions for handhelds:
 - Blue Impact AG, Conexant, DeLorme, EMTAC Technology, Geodiscovery, Magellan, Nexian, Nimble Microsystems, Pharos, Rand McNally and Trimble
- May be turned off and reception problematic in urban and indoors



✦ Assisted GPS (A-GPS)

- GPS provides exceptional accuracy, but can suffer from reception difficulties and reduced accuracy in built-up areas and indoors
- To address these problems assistance data may be provided via cellular network
- Assistance may be of different levels
- A-GPS has been chosen by all CDMA operators in US



Positioning technology vendors

◆ Cambridge Positioning Systems (CPS)

- E-OTD system called Cursor
- Licensed technology to Ericsson, Nortel, Siemens, Infineon, Lucent, Mitsubishi, Philips and Intel; collaborates with Webraska and SignalSoft
- Major GSM operators (originally) selected E-OTD

◆ SnapTrack (subsidiary of Qualcomm)

- A-GPS system
- Commercial agreements with NEC, Motorola, Intel and TI
- Sprint PCS first to sell phones with SnapTrack technology in US
- KDDI's GPS Keitai and Movie Keitai phones use it
- How it works:
 - Network sends approximate location of terminal to location server
 - Location server tells the terminal which satellites are relevant.
 - The terminal collects the GPS signal and calculates the distances to the satellites
 - Terminal sends them to location server, which in turn calculates the final location.



(cont.)

✦ TruePosition

- TruePosition's Wireless Location Platform collects and processes location data
- LMUs installed in base stations collect the raw cell data when a call is made
- SMLC then triangulates the position using TDOA and AOA
- Agreement with Cingular (on TDMA/AMPS network)
- MoviStar in Puerto Rico announced to deploy it

✦ Cell-Loc

- SuperResolution TDOA location technology provider
- Cellocate is a family of location products enabling LBS
- Joint venture in China manufacturing Cellocate CDMA technology



(cont.)

◆ SiRF

- Three types of architectures for GPS-enabled phones
 - SingleSat enables SiRF-guided in-vehicle systems to navigate with only one satellite
 - SiRFstar I is a minimal GPS architecture for consumer products
 - SiRFstar II additional technology built on previous
- Partnership with CellPoint, SiRF's A-GPS integrated with CellPoint's E-Cell-ID location platform technology

◆ Grayson Wireless (division of Allen Telecom)

- Geometrix is a TDOA and AOA overlay technology
- Verizon Wireless has deployed it in two counties, technology used as an interim step before A-GPS
- AT&T Wireless will install Geometrix in its TDMA and AMPS networks

◆ Other vendors:

- Airbiguity (GPS accessory), Cellguide (A-GPS), Celltrax (TDOA), Digital Earth System (patented algorithm), Global Locate (A-GPS), Global Telematics (GPS), Radix Technologies (AOA/TDOA), SigmaOne (AOA/TDOA), Symmetricom (GPS for E-OTD and TDOA), Tendler Cellular (GPS)



Mobile Positioning Systems

- ✦ MPS serve as an interface for the retrieval, forwarding, storage and position control of location data
 - Interfaces with positioning technologies and transfer the location to a Service Control Point (SCP), where the data is routed to application for spatial processing
 - Known as Mobile Positioning Centre (MPC) for CDMA/TDMA world and as Gateway Mobile Location Centre (GMLC) in GSM
 - MPS features can include: automatic provisioning of location info, integration with other service enabling platforms, variety of delivery options for the location information
- ✦ MPS vendors:
 - Cellpoint, Ericsson, Lucent, Nokia, Redknee, Siemens, Signalsoft, TCS, Trueposition, TSI



Location Middleware

- ◆ Location middleware is required to avoid the problems related to having external applications direct access to location servers:
 - Duplication of functions across applications
 - Excessive hits on the positioning server
 - Application developers having to support variety of communication protocols and different network functions
- ◆ Middleware provides a standard interface for applications and protects operator's core network
- ◆ Some middleware platforms have map-engines and/or geo-toolboxes that perform tasks such as:
 - Geocoding, location refinement, map rendering, reverse geocoding, route directions and spatial searches.



◆ Middleware vendors:

- Mobilaris
 - Middleware called Pacific Ocean provided to Telia (Sweden), Telenor (Norway) and Vodafone (Ireland)
 - Strategic partners Ericsson, Sun Microsystems, Webraska, Compaq and Oracle as well as with It's Alive!, UwiredFactory and PocketIT
 - Two interfaces: Java-based API for operator's internal services and XML-based for external applications
- CT Motion
 - Middleware called Celebrity, which integrates with other network platforms
 - Acts as an single API for multiple applications enabling interaction
 - Applications: m-Commerce, Mobile Yellow Pages, m-Coupons and Mobile Workforce Management (called FieldView)
 - FieldView offered by Partner Communications (Orange Israel) in Israel
 - Service cost: monthly subscription fee \$6 and usage based charges
 - Experiences: menu browsing is key, accuracy not critical



✦ (vendors cont.)

- Mahindra British Telecom (MBT)
 - Product called Location Services Manager (LSM)
 - Provides a set of APIs, and tracking and zone-centric services
- LocationNet
 - Product called LocationNet Platform comprises of:
 - A real-time service delivery engine serving as middleware
 - LBS applications
 - An open API and Software Development Kit (SDK)
 - A mapping engine
 - Korean Neo Telecom to use the platform
- Other vendors:
 - Airflash, Autodesk, Cellpoint, Cellvision, CMG, GeoTouch, IntelliWhere, Kivera, LPG Innovation, Lucent, Nortel, Openwave, Opteway, Redknee, Signalsoft, Telcontar, TeleCommunication Systems (TCS), Webraska, WhereOnEarth, Xmarc



Applications

◆ Examples of location-based applications include:

- Navigation and routing, traffic information, fleet and resource mgmt, people and vehicle tracking, friend finder, emergency services
- Friend finder and infotainment are currently most common
- Games, advertising and messaging-based apps have future potential

◆ Application providers:

- 10Best, Adversoft, A-INFO Science and technology, Air2Web, Apama, Arcus Software, Autodesk, Batmap, Bluefactory, Cellpoint, CitiWiz, Clickmarks, Etak, GlobalDining, Go2, INFOiSLIVE, InirU, It's Alive!, MapInfo, MapQuest, Mobile Commerce, Mobile News Channel, NextBus Information Systems, Pocket IT, Quadriga, Tele Atlas, Trackwell, TrafficStation, UnwiredFactory, Wcities, Webraska, Whereonearth.com



4. LBS Value Chain & Business Models



LBS Value Chain

- ◆ Old value chain of operator and end user to include others
 - Due to arrival of mobile data, operators will face competition from other players
- ◆ Core LBS value chain includes:
 - Operators
 - Operator portals
 - Independent portals
 - ASPs
 - Content providers
 - Application developers



Mobile operators

- ◆ New business opportunities in content and application delivery
- ◆ Operators will increasingly often offer third party wholesale of location information (like Vodafone and Telia)
- ◆ Mass markets require the availability of non-operator VASs
- ◆ Operator's role remains central due to privacy requirements and billing capabilities
 - Operators will get the biggest share of the revenues
- ◆ Different business models for operators
 - Outsourcing of content and application development
 - Buy in / license content from providers and brand it themselves
 - Produce content themselves



Mobile portals

- ◆ Portals can be divided into horizontal and vertical portals (for both consumer and business user)
 - Horizontal portals divided into consumer and business sectors containing content for: customised infotainment, mobile intranet/extranet access, MMS and LBS.
- ◆ Most successful portals provide multi-platform delivery of content
- ◆ Branding, trust and security essential elements
- ◆ Fixed-internet portal providers e.g. Yahoo, Netscape, Excite, AOL and Microsoft are determined to succeed
- ◆ Device enhancements will encourage portal access



ASPs

- ◆ Standard ASP services include mobile integration with back-office SW (e.g. e-mail, PIM applications) and access to a variety of content services
- ◆ Also unified messaging and LBS can be offered
- ◆ ASP outsourcing one mean to bring expensive IT solutions in-house
- ◆ Many companies still concerned about security and privacy
- ◆ ASPs have two business models:
 - Make services directly available to users
 - Act as an application provider for companies



Content providers

- ◆ Operators can choose to work with content aggregators or name-brand content providers
- ◆ In the early phases it may be good strategy for content provider to provide via operator's portal ("walled garden") until market settles down and revenue models become clearer
- ◆ In more mature phases subscribers likely to demand access to the specific services they want to use



Application developers

- ◆ Develop and provide applications to be used in a mobile device or allow delivery of content in a way providing added value for end user
- ◆ Need relationships with ASPs, device manufacturers, content providers, portals and operators
- ◆ Early successor is MapInfo through deal with Vodafone



Relationships in the value chain

- ◆ Simplest relationship is the customer-supplier
- ◆ Technology vendors compete by trying to provide compelling benefit to their customer's own customers
 - E.g. Cellpoint's partnership with Benefon
- ◆ Variation of customer-supplier model is the royalty model
 - Becoming increasingly common with handset vendors such as Motorola and Sony Ericsson and e.g. CPS
- ◆ A closer relationship is a partnership agreement
 - E.g. SignalSoft has formed partnerships with over 330 companies, including location technology, content, application and service providers as well as channel partners.
- ◆ Joint ventures (e.g. Sony Ericsson)
- ◆ Consolidation expected to be increasingly common



Business Models

- ◆ The report distinguished two main types of business models: B2C and B2B
- ◆ Issues to be considered:
 - Time to market
 - Market size (subscribers and revenues)
 - Exclusivity arrangements
 - Customer care responsibilities
 - Schemes for service trials
 - Branding and marketing responsibilities
 - Control of content
 - Revenue models
 - Technical support
 - Network support
 - Control of customer data



- ◆ Rapid time to market provides first mover advantages
 - Operators can reduce time to market with ASPs and alliances
 - Device manufacturers, system developers and OEMs can reduce it by adopting industry standards and using open architecture
- ◆ Quality of products and services will be judged according to the quality of customer services
- ◆ Mobile service providers have a choice of allowing open and direct access to all content or limit it to their portals (walled garden)
 - Walled garden approach frees user from set-up arrangements, customer services can be assured, billing is simpler
 - Walled garden is not likely to last due to inherent restrictions
 - i-mode's strategy an option: access to non-approved sites possible, but without support
 - European and NA users may be frustrated if access to familiar sites in fixed internet not allowed, thus open access will eventually be demanded



- ◆ Ensuring good marketing campaigns essential
 - Current market awareness is low
 - Operators need to understand target markets, the needs, preferences and willingness to pay
- ◆ Creating and retaining revenue streams is key in developing mobile services
 - Subscriptions likely in the medium term
 - Flat fees may be a good way to introduce new services and may be easiest for packet-based services
 - Per-use charge may be best in encouraging to try new services
 - Hybrid pricing allows the provision of branded services and access to non-branded content
 - m-commerce anticipated as one of most promising revenue generator
 - Advertising expected to be an important revenue generator



- ◆ Revenue sharing will become more important as the content and service provision becomes broader
 - The proportion of revenues retained by operator depends e.g. on the added value of the content itself for the user and e.g. on the strength of operator's brand
 - T-Mobile has announced plans to share 50% of subscription charges
 - Telia has announced plans to implement revenue sharing
 - i-mode's move into Europe will have an impact in these markets
 - In current market conditions its unlikely that content providers could be charged for being included in mobile portals
- ◆ End users unlikely welcome numerous bills from different providers
- ◆ Different charging policies stimulate the market over time



Selected Business Models

NTT DoCoMo

- ◆ The simple and effective business model behind i-mode has been stated as the principal reason for its success
 - i-mode was constructed on top of a packet-based network
 - It uses c-HTML, making Internet content usable
 - It was designed with user friendliness in mind
 - It has a straightforward business model
- ◆ I-mode has 31,25 million subscribers (Jan-2002)
- ◆ Offers range of content and applications, supporting Java and colour screens
- ◆ Content development outsourced, available free of charge or low monthly subscriptions
- ◆ Simple payment mechanism
- ◆ I-area was not launched to increase subscriber numbers (although it did) but to provide more convenience for current users



KDDI / Au

- ✦ In November 2001 KDDI launched three new cdmaOne handsets with Qualcomm GPS chip
- ✦ Until March 2002 a promotional campaign gave users access to GPS-based services 'ezwebmulti' for only monthly fee (\$2,57); now charge is \$5,13 per month
- ✦ Third parties used for content and application development
- ✦ KDDI's revenues from a percentage of content charges, from monthly subscription fees to its services and from data transmissions (\$0,002 per 128b)



Telia

- ◆ Plans to implement a new revenue sharing model to encourage third party development of mobile applications
 - Developers will be provided a direct channel to Telia's customers and access to Telia's billing system
 - Telia will take 20% of content developer's revenue and also charge for providing network access to any service
 - Currently 30% of total accesses to Telia's portal account for LBS



Orange UK

- ◆ Road map for applications and services includes partnerships with Microsoft and Wildfire (voice-recognition technology developer)
- ◆ Next generation data services to be based on news, instant messaging, games and mobile commerce
 - Orange plans to be a key player in wireless gaming, controlling all aspects of the delivery chain
 - Currently gaming accounts for 50% of all WAP page impressions
 - Orange wants to get customers used to use the mobile terminals as payment devices



T-Mobile

- ◆ T-Mobile online (the portal) was introduced in Aug-2001
 - New business model based on charging for premium services and sharing revenues with content providers (up to 50%, excl. airtime or access fees)
 - Plans to introduce the service in UK and Austria. Users will pay monthly subscription charge (\$8,70) to access 25 services
 - T-Mobile online controls the pricing of services, although the service and content providers decide whether their services are categorised as premium services



Future Business Strategies

- ◆ Successful players in the future will need to provide/have:
 - Access to valuable and suitable content
 - Ability to quickly move into new technologies
 - Required expertise to develop new systems
 - End user friendly pricing strategies
 - Rapid development of new infrastructures
 - Adequate security to support m-commerce
- ◆ Other important issues
 - Branding
 - Diverse service offerings
 - Outsourcing and partnerships
 - Consumer segment offers huge potential, but business and specialist areas are important as well



5. Consumer & Business Location-Based Services



Examples of LBS

- ◆ Dating – alert when the right person is near
- ◆ Fleet and asset mgmt – to improve customer service
- ◆ Friend finder – alert when friends are near
- ◆ Games – playing of games based on location
- ◆ Personal tracking – locate family to increase security
- ◆ Proximity services – finding closest services
- ◆ Traffic information and navigation – avoid jams
- ◆ Vehicle breakdown recovery – inform the breakdown services of your location



Consumer LBS

Consumer benefits

- ◆ LB voice and data services can provide customised, personalized messaging, navigation, content and m-commerce according to their location
- ◆ Success depends on easy access, and on variety, breadth and quality of content and services
 - Must meet actual consumer needs:
 - Safety, operational (e.g. navigation, travel services), social, entertainment and m-commerce
- ◆ According to industry poll messaging would be main driver for operator revenues, followed by games and personalised content – many of which will be location-enabled by 2007
 - An location-enabled service will attract a premium over those without location



Operator deployment

- ◆ Current service provision often quite limited
- ◆ Some examples:

E-Plus	Proximity & content, friend find	O2	Proximity & content
Max.mobil	Friend finder	EraGSM	Directory
Netcom	Information & navigation, games & community, friend finder	Telenor	Information & Navigation, Games, Proximity & community
Optimus	Friend finder	Orange UK	Directory, Proximity & Navigation
Orange Denmark	Games & Entertainment	DNA Finland	Game
Orange Israel	Games, Friend finder, advertising, taxi	D2 Vodafone	Nightguide
Sonera	Proximity & content	Sunrise	Information & Yellow pages
Telia Mobile	Community, Friend finder, Games	Telestet	Smart tourist guide
TIM	Navigation, Concierge & Enterprise	Vodafone UK	Proximity & content
T-Mobil	Proximity & Content	Viag Intercom	Home & directory
Vizzavi	Friend finder, traffic information	Swisscom	Friend finder, Entertainment
Vodafone Ireland	Games	AT&T Wireless	Proximity & content



Mobile Games

- ◆ Greater processing power, better displays, and increased bandwidth will increase and broaden the market
- ◆ Games need to be available across networks, otherwise takeoff can be seriously affected
- ◆ Example game providers:
 - It's Alive: Botfighters, X-Fire, Supafly
 - Bigwheel Creative: Ticqle
 - BlueFactory: Pocket Lover
 - Ruksun Software Technologies: Monopoly, Treasure hunt
 - Trackwell: Mobile Warrior
 - Unwiredfactory: Girlfriends, Treasure Machine, Battlemachine



Community LBS

- ◆ Formed around communities of users that have common interests
 - E.g. YachtPosition provided by Telia Mobile
- ◆ Most interest in Friend finder –applications
 - In UK 65,9% interested in friend finding
 - Family finders e.g. Trackwell's Child Tracker
 - Examples of providers: Ahead Mobile, Autodesk, Bigwheel Creative, BlueFactory, Cellpoint, Cellvision, Cyantel, ImaHima, LocationNet, Mobilaris, OnMobile, Q-Labs Software Engineering, Ruksun Software Technologies, Signalsoft, Trackwell, Valis, Webraska, Zonith



Proximity and Content-based services

✦ Currently most widely deployed LBS

- Mobile Commerce's solution deployed by T-Mobile (in UK) and O2; PocketThis "find my nearest" is also based on their technol.
- Webraska's solutions selected by Orange UK, E-Plus (i-mode)
- Other service providers: Cybrid, AU-System, ImaHima, Mapflow, Geodan Mobile Solutions, Pocket IT, 10Best, FindMe, E-street.com, Local-serve.com, Wcities



Personal tracking

- ◆ Personal safety and security needs
 - Positional accuracy important
- ◆ NTT DoCoMo's DokoNavi uses A-GPS –enabled Naviewn PDA
- ◆ Largest Japanese security company Secom has launched Koko Secom using KDDI's CDMA network and gpsOne technology (Monthly charges per person: \$4, per vehicle \$9)
- ◆ Digital Angel is a GPS based people tracking system. Devices (watch-like or pager-sized) cost \$399, monthly fees \$19.95-\$49.95 (basic, silver, platinum services)
- ◆ Wherify Wireless system is a GPS embedded in a wristwatch
- ◆ Siemens offers a service based on GPS equipped GSM handset
- ◆ Arbonaut participates in EU project LOVEUS, one of planned applications is a VIP monitoring service for the Olympics in Athens
- ◆ Trackwell's Child Tracker
- ◆ Security service provider Orbis formed alliances with Vodafone and Benefon



Personal navigation

- ◆ Colour graphical displays best suited, as maps play a central role
- ◆ Due to complicated address system and availability of colour screens, Japanese operators launched navigation services as their first LBS
 - DoCoMo: pedestrian navigation service Jan-2000
 - J-Phone: J-Navi in May-2000
 - KDDI: Eznavigation in Jul-2000
 - Toshiba plans to upgrade EZ-ekitan to provide door-to-door directions
- ◆ In Europe and US, navigation services have been mainly for cars
 - NavTechs real-time map service is available
 - D2-NightGuide service uses MapInfo's miAware
 - In US, Portable Internet provides sw for GPS based navigation and cityguides
- ◆ Other providers:
 - Autodesk, FindMe, Neumobility, PowerLOC, Spatial Dimension, Webraska, Geodan, LaNetro, Mulimap.com, Kivera, Maptuit, CT Motion, Mapflow, Quadriga, Pocket IT, Zonith, Estimotion, GeoGuide



Advertising

- ◆ Two types of LBS content: push and pull
- ◆ Two marketing principles
 - Dynamic – location and time used as filters
 - Traditional – sponsorship, promotion
- ◆ Spamming an issue
- ◆ LB advertising may be costly
- ◆ Example providers:
 - Adversoft, Aeritas, Apama, Brainstorm Marketing, CT Motion, Cyantel, Flytxt, InirU, Portable Internet, Quadriga, Zonith



Emergency services

◆ Wireless E911 phases

- Phase 0 – call routed to a PSAP
- Phase 1 – user's number (and Cell ID) provided to PSAP
- Phase 2 – user's number and location (lat & lon) to PSAP

◆ In Oct-2001 FCC revised requirements for 5/6 nationwide carriers

◆ Enhanced 112

- Common emergency call number for EU since 1999
- Location information was planned to be provided by Jan-2003
 - Not implemented, CGALIES was formed
 - CGALIES reports that strained public budgets will have problems financing required equipment
 - New directive: operators should provide access to what is feasible



Business LBS

◆ Industry opinion on business monthly ARPU in 2007

- Messaging
- Intranet access
- Field force automation, fleet mgmt
- Enterprise systems
- Logistics systems
- Telematics
- Supply chain mgmt
- Other



Highest proportion of
Business monthly ARPU

Many of these will be location-enabled by 2007



Business user preferences

- ◆ Businesses will be motivated by proven financial benefits
- ◆ Locating customers in regards to assets, services and networks
- ◆ Already used in fleet and freight vehicles
- ◆ Tailoring often required to incorporate company systems
- ◆ Logistic companies have introduced LBS as tracking systems
- ◆ Public transport and public safety organisations are beginning to implement
- ◆ Operators offering fleet and resource mgmt services:
 - Radiomobil, Tele 2, Europolitan Vodafone, Orange Israel



Sales and field force automation

- ◆ Applications providing:
 - Messaging, synchronisation and data transfer with data bases, access to client/customer data, instant access to field workers
- ◆ Location systems enable a work force to be tracked and co-ordinated



Fleet management

- ◆ Delivery tracking
- ◆ Traffic monitoring and control
- ◆ Two-way communication
- ◆ Computer aided dispatch information
- ◆ Real-time information on parking e.g.
- ◆ Remote vehicle fault diagnostics
- ◆ Sample launches:
 - Eircell, Vodafone UK
- ◆ Example providers:
 - @Road, @Track, AccuTrack USA, AirIQ, AirLink, Cheng Holin Int., Cyantel, ID Systems, Magellan, Mentor Engineering, Nextcell, Nexterna, Oztrack, Qualcomm, Roadnet Techn., Satsafe MLS, SPS technologies, TeleType, Trackwell, Trimble, Volvo Trucks, Webraska



Asset tracking

- ◆ Embedding cellular or cellular/GPS modules into valuable items (objects or animals)
- ◆ Separated from fleet mgmt by security issues
- ◆ iNet-Blue has announced X-all Falcon for vehicles and Tra-X-all BlackHawk Systems for valuable/dangerous cargo
- ◆ Intuicom's solution is used to manage the buses for the University of Colorado
- ◆ Nexterna's OptiTrack 4.0 allows definition of zones
- ◆ Orbitrac-100 is used by Southeastern Michigan Snow and Ice Management to manage its vehicles



6. Operator Case Studies



Case: NTT DoCoMo

- ◆ i-mode reached 30 mio subscribers, after 3 years of launch (Dec-2001), 59% of Japanese mobile users
 - Two success factors: Java-compatible phones (Jan-2001) and i-area (Jul-2001)
 - Earlier LBS launched:
 - Ima-DoCo, May-1998, for PHS network
 - DoCoNavi, Jan-2000, PDC network, A-GPS plug-in device for \$500
 - Mopera, Feb-2001, content-based location service offering, PHS
 - i-area was the first LBS for mass markets
 - Accessed through i-mode portal
 - PDC-P network and Cell-ID technology
 - Currently i-area subscribers do not pay additional for the location
 - Service categories: food, weather, city info, maps, travel, accommodation, travel
 - DoCoMo Location Platform (DLP)
 - Joint Venture of NTT, NEC and Seiko Epsom called Location Agent distributes
 - In future NTT aims to offer businesses priority access to i-mode and DLP



Case: KDDI

- ◆ KDDI's mobile communications:
 - au, the cdmaOne service by KDDI
 - PDC service – by TU-KA Group in Tokyo, Nagoya and Osaka
 - PHS service by DDI Pocket
- ◆ KDDI's strategy to first introduce services that drive 3G has been successful (regained second position in Japan)
 - Packet usage of GPS handsets 3-4 times higher than non-GPS handsets
- ◆ eznavigation in Dec-2001:
 - Available to all KDDI Ezweb users
 - GPS based (Snaptrack) – KDDI feels Cell ID is not enough
 - 20 services, offerings expand:
 - Personal navigation, communication services, maps, gourmet town guides, traffic info, weather, security services, information, games entertainment
 - Eznavi, the navigation service is the most popular GPS LBS on offer



- ◆ First GPS Keitai phones (gpsOne from Qualcomm)
 - C3001H from Hitachi
 - C3002K from Kyocera
 - C5001T from Toshiba – supports also ezmovie
 - Sold dec2001-march2002: 654 700 units
- ◆ Later other handsets available:
 - A3011SA, A3012CA, A3013T, A1011ST, A1012K
- ◆ In March 2002 C3003P from Matsushita launched
 - Includes **electronic compass**
- ◆ KDDI followed the i-mode business model
 - Monthly subscription fees, content fees, user's packets, airtime
 - Service fee for eznavigation \$6,02 in addition to regular monthly service charge, packet fee \$0,002/packet
 - New services at 64Kbps
 - For corporate users GPS MAP
 - Location information management service



Case: J-Phone

- ◆ J-Phone gained the second place for a short period until KDDI's 3G services were launched
- ◆ J-Phone has heavily relied on shamail photo messaging service
 - Now facing fierce competition from KDDI and DoCoMo camera-phone services, provided over faster 3G networks
- ◆ LBS offerings: J-Navi and J-Skystation
 - J-Navi, May-2000, first mass-market LBS in Japan
 - Map service integrated with business and landmark info
 - Cell-ID since Sept-2000, also self positioning still used (“future position”)
 - All J-Phone models support J-Navi
 - 2 million handsets sold in first 2 months, 5 million in first 6 months
 - 3 days after launch, service generates 1,6 million hits (100 000 expected)
 - Charged per download (\$0,17) and network-usage charge (\$0,03)
 - J-Skystation, Oct-2000
 - Cell-broadcast service, provides info on subscribed topics e.g. games, horoscopes, entertainment and news updates



Case: AT&T Wireless

- ◆ Like other US GSM operators AT&T opted for GPRS, to be followed by EDGE and WCDMA
- ◆ LBS Services
 - Like other US operators initial focus on E911
 - Plans to deploy E-OTD, but FCC requirements yet to fulfil
 - For TDMA/AMPS networks TDOA and AOA tested
 - As DoCoMo's partner, i-mode based m-mode launched Apr-02
 - Find It service includes e.g.:
 - 10 Best Dining, Cellmania (“best content and apps available”), FedEx (track FedEx shipments), Switchboard Travel (locate businesses and get driving directions), Vicinity ATM Finder, White Pages, Yellow Pages



Case: Telia Mobile

- ◆ Only Swedish operator providing LBS
- ◆ LBS offered:
 - Community: YachtPosition, BikePosition, FriendFinder
 - Games: Botfighter
 - Info: House Near You, Yellow Pages Near You, Right Way Near You, Weather Near You, Post Office Near You
- All available as premium services, \$0,42-0,56/SMS (WAP ~same)
- At first marketing was modest, but when Friend Finder (Nov-01) was launched broad marketing campaign (web, TV, poster ads)
 - Launch exceeded target by 400%



Case: Vodafone

- ◆ Signed a deal with Siemens and MapInfo
 - Siemens location-enabling server and MapInfo geo-toolbox part of Vodafone's global LBS solution
 - Key feature the support for roaming when travelling
 - LBS to be offered to over 50 million subscribers by Autumn-02
 - Initial rollouts in UK and Germany, other European markets in following months
- ◆ Enables developers to access location functionality using LIF's API2
 - Third parties able to benefit the range of geo-toolbox facilities
 - e.g. Maps, addresses, routing information



Case: Orange Switzerland

- ◆ Mobile Location Services launched Dec-2000
 - WAP call to select POIs, routing, traffic and cinema
- ◆ Webraska's real-time Navigation Platform deployed
 - Provides access to map facilities
- ◆ Traffic information from Touring Club Suisse
- ◆ Cell-ID used to provide a list of streets to choose from
- ◆ Routing supports: pedestrians, bus, tram or by car
- ◆ Usage:
 - Routing 42% (88% car, 12% pedestrians), POIs 33%, Traffic 21%, Cinema 4%
- ◆ Only airtime charged
- ◆ Market needs further education



Case: Iceland Telecom

- ◆ My Super Offer
 - Instant access to bargains, dependant on location and selected category
 - Features sponsored SMS and advertising subscription
- ◆ My Buddy Tracker (Trackwell)
- ◆ Treasure Hunt (Unwiredfactory)
- ◆ Mobile Warrior



Case: Telenor and Netcom

- ◆ Norway first country to provide LBS from 3rd parties (Pocket IT) for 100% of country's subscriber base (incl. Prepaid/postpaid)
 - Both operators also provide their own LBS
 - Pocket IT offerings: FindMe, FindNearby, RouteMe, MapMe, HowFar, WhereIs, Weather, TreasureHunt, LocalChat, LocalDate, FriendFinder
 - Revenue sharing with Pocket IT (excluding airtime)
 - Approximate example, end-user price 100:

VAT	20	Media channel	25
Telco billing	25	Content provider	10
Telco position	5	Application provider	15



Case: Optimus

- ◆ Opted for Cell-ID + TA
 - May evolve to e.g. GPS
- ◆ Optimus has integrated content, maps, middleware, location gateway, applications into location platform
 - Plans to launch LBS Q3 2002, initially with Friend finder
- ◆ Optimus research on friend finder; users want:
 - Total control
 - Personalisation
 - More than just locating friends
 - LB dating
 - LB chat
 - SMS, not WAP



7. Strategic Issues & Conclusions



Location Privacy and Data Protection

- ◆ The growth of LBS market is facing several hurdles
 - e.g. privacy and security of consumer location information
 - Device vendors and LBS providers are building privacy and security safeguards
 - Operators are increasingly using middleware platforms
 - Legislative measures are being prepared
 - Serious threats in criminals using stolen location data
 - Location details must be under user control
 - Opt-in approach for LBS (excl. emergency and law enforcement)



Interoperability

- ◆ LBS architecture complex: network, location servers, middleware, geo-spatial info, applications, content, terminals
 - Conventional communication between these bears disadvantages
- ◆ Various groups with different needs and objectives creates interoperability problems
- ◆ Interoperability issues have been tackled by LIF
 - Mobile Location Protocol
 - Cooperation with Open GIS Consortium
- ◆ Open Mobile Alliance
 - Consolidation of LIF, MMS-IOP, SyncML, WAP Forum
- ◆ Truly global coverage of services requires roaming agreements



Unsolicited Spam

- ◆ Push advertising may result in discouraging use of new services
- ◆ Lack of appropriate safeguards can potentially undermine revenues and the LBS market as a whole
- ◆ The only workable control method is provided by opt-in
- ◆ Making unsolicited wireless advertising illegal has been the goal of two bills introduced in US Congress
 - So far other factors have prevented them becoming a law
- ◆ In Europe EU and ETSI are investigating similar regulation



m-Commerce Security

- ◆ Concerns regarding the security of issuing credit card details across wireless links
- ◆ Confidence required for the vendor to know the user is who they say they are, as well for the customer to obtain similar confidence in the vendor
- ◆ Transactional security must fulfil
 - Confidentiality, authentication, integrity and non-repudation
- ◆ Data encryption offers solution for data confidentiality and integrity
- ◆ Digital certificates and signatures to confirm user's identity
- ◆ Example wireless data security solution vendors:
 - Covado, Diversinet, Schlumberger, Buytel, VeriSign, Valicert, eMobile



Payments

- ◆ Operators need to be able to separate new types of services from traditional to charge appropriately
- ◆ Micropayments can provide alternative revenue sources for content providers
 - Reverse billing one method
 - Goal is to minimise the cost overhead of a single transaction
- ◆ Macropayments (>\$10) from virtual wallets or via credit card payments



Partnering

- ◆ Partnerships and alliances key elements for success of LBS
- ◆ Alliances are often trade-offs between desire for control and the need for expertise and speed to market



Emerging Enabling Technologies

- ◆ **Bluetooth** is important for LBS as an alternative application facilitator and positioning technology
- ◆ **Java** provides enhanced user experience by increasing scope and variety of applications for mobile handsets
- ◆ **XML** provides a flexible and common information format
- ◆ **Spatial databases** enable storing and management of geographic information
 - Concerns of current databases and tools to support high-volume location polling
 - WaveMarket claims its product executes mobile location queries 20 to 400 times faster than existing GIS and relational database



Positioning Technology

- ◆ Most current commercial LBS based on Cell-ID
 - Several operators planning enhancements via TA or NMR
- ◆ Medium to long term plans yet unclear
 - In the long term more accurate solutions will dominate
- ◆ Much debate about the best solution
 - Some operators opted for A-GPS
 - Vodafone's roadmap: Cell-ID, E-CGI and A-GPS
 - Providers serving enterprise and vertical sectors opt for A-GPS
 - For the consumer market the development of low cost, small footprint, single-chip solution required
- ◆ Example GPS OEM module vendors for mobiles:
 - μ -blox AG, Ace Asia, Conexant, Garmin, GEC Plessey, Globalsat Technology Corp., Infineon, Leica, Magellan, Marconi Canada, Motorola, Navitec, Novatel GPS, Philips, Qualcomm, Rockwell Semiconductor, SiRF, STMicroelectronics, Thuderous Sounders Electronics, Trimble, Won Ik Telecon
- ◆ E-OTD will likely be deployed in Europe in urban areas



Location Servers

- ◆ Location servers are currently being deployed
 - Essential to choose a solution that offers migration path towards 3G and high-accuracy positioning and supports roaming
- ◆ Vendors have different strategies
 - Ericsson offer their servers independently, end-to-end solutions through partnerships
 - Siemens and Cellpoint offer location servers, middleware solutions and applications
- ◆ Lines between location servers and middleware to blur with the introduction of 3G



Middleware Platforms

- ◆ Middleware's integration with network support systems enables re-use of legacy systems
 - It also offers billing mediation functionality
- ◆ Should support LBS applications from all sources
- ◆ Main benefits of location middleware:
 - Operator can integrate new applications
 - Open APIs allow flexible third-party integration
 - Secure access to external applications
 - Anonymous service access
 - Privacy management
- ◆ Extremely competitive sector – partnerships fundamental
 - Gaining market momentum is difficult
 - Consolidation expected in the middleware sector



Revenue Streams & Opportunities

- ◆ Encouraging application development:
 - Vodafone provides an X,Y wholesale tariff with volume discounts
 - Vodafone platform's geo-toolbox functionality lowers the barrier to entry
 - Telia aims to educate the market and start wholesale of location
- ◆ Deployed LBS must meet changing user needs
- ◆ Important device features:
 - positioning technologies, colour displays, data entry, open operating platforms
- ◆ Messaging is a key driver
 - MMS will enhance LBS with zoomable and animated colour map images



Expanding Value Chain

- ◆ Different applications require different location services and there is an array of positioning technologies
 - Opportunities for middleware providers to act as location brokers
- ◆ Operators move to portal role
- ◆ Device manufacturers move to service-provider role
 - Nokia's Club Nokia, Ericsson's WISE, Lucent's Zingo
- ◆ Mobile Virtual Network Operators

- ◆ All above changes the value chain into value web