Location Intelligence™

Presented by:

wave market

November 2002

---

wave market

55% of all mobile calls and SMS ask "WHERE ARE YOU?"

LBS Application Matrix

wave market

Performance issues: Key LBS Apps	Overloads network	Does not scale	Costly Throughput	Needs more intelligence
Enterprise				
Semantic Routing		✓	✓	
Real-time Re-routing	✓	✓	✓	✓
Intelligent Location Profiling/Geofencing				✓
Asset Tracking	✓	✓	✓	
Consumer				
Safety Tracking	✓	✓	✓	
Merchant Finder		✓	✓	
Wireless Advertising	✓	✓	✓	✓
Buddy Finder	✓	✓	✓	✓
Calendar Reminders	✓	✓	✓	
Privacy	✓	✓	✓	
Data Sales				
Road Speed	✓		✓	✓
Retailer – Market Research			✓	✓

Investors

wave market

- Nokia Venture Partners
- Saturn Ventures
- Granite Ventures/ British Telecom Venture
- Intel Capital
- iPacific Partners (Korean Venture Firm)
- Caisse de Depot ($2 Billion Private Equity)
- Pete Higgins
  - Ex #3 at Microsoft

Location Intelligence

Permission Configurator
Polling Server
Prediction
XML
Computational Geometry
Combinatorial Optimization
Java API
Alerts & Triggers
Location Intelligence
Interpolation
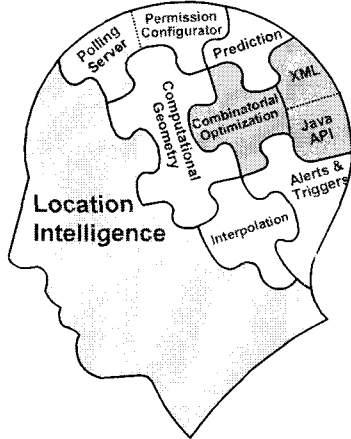
- 12 yrs of research by MIT & Berkeley Professors and PhDs
- 2.5 years of Stealth Development
- Team members spearheaded large-scale software systems such as Oracle and SGI Irix OS
- Team combines top algorithmic expertise with leading experienced software development
- 10+ patents files
  - Computational geometry
  - Least-cost routing
  - Compression

Engineering Team

- **125+ years of development experience**
- **40+ years of software management experience**
- **Custom hired for location intelligence**
- **Managers have 6-9 years experience leading software development teams**

Phil Klein, Ph.D. – Chief Scientist
- MIT CS PhD. Full Professor, tenured at 32. Fellow at Harvard, Princeton.
  - Experience with Xerox PARC, NEC, BBN, AT&T Labs, Nortel.
- Optimization guru; 25 years of computer science and development.

Compression	Prediction	Combinatorial Optimization	Efficient Algorithms	Computational Geometry

Scott Hotes, Ph.D. – VP Engineering
- Silicon Graphics – built IRIX OS network management & security.
  - National Security Agency – built pattern recognition software.
- 10 years leading software teams, dozens of developers. Berkeley Ph.D.

Machine Learning	Event-driven Computing	Compression Algorithms

Saurabh Sethia, Ph.D. – Algorithms Scientist
- PhD in Computational Geometry & CS, Ranked 5th in India.
- Increased Voronoi diagram computation speed by 20-30x.

Computational Geometry

David Blackston, Ph.D – Compression
- Ph.D in Computer Science from Berkeley CS
- Graduated 1st in class from MIT Mathematics
- Ranked 11th on worldwide Putnam Math Olympics

Todd Hodes Ph.D – Wireless Handset Perfomance and Trigger Services
- Ph.D in Computer Science from Berkeley
- Developed dynamic location trigger-based technology

Selected Development Team

Jef Poskanzer
- built world's fastest web server
- 4th largest web-server

Keshav Byri
- Top 0.5% in India CS
- 4 years GIS experience

Tomi Vrljicak
- Highest distinction from McGill (#1 school in Canada)
- Dual Honors in CS and Math (3.9 GPA)

Joel Susal
- UPenn CS Summa Cum Laude (3.8 GPA)
- #1 in Penn Engineering contest for wireless wishlist software

Jesse Myers
- #1 CS grad from Brown (3.95 GPA)

Engineering Team

• *In addition to the science/algorithmic expertise, WaveMarket team includes some of the leading core developers in Silicon Valley*

Jeff Pozkanzer
• Built the world's fastest web server and 4th largest in terms of market share
• Worked on the kernel of SUN Solaris OS – the most scalable software
• Open source legend who has won many development awards. 20 years of development experience in Silicon Valley

Scott Hotes
• 10+ years as one of key developers and leads of SGI kernel IRIX OS
• Built software scalable to 300M for machine learning with the US Department of Defense

Ron Gutman
• Individually built the Informix Spatial product which has been been one of their most successful products -- installed in over 1000 customers including leading wireless operators like DoCoMo, ATT
• Built the entire Airflash location middleware which has been installed in operators such as Singapore Tel, France Telecom/Orange, T-Mobile
•Has been published in Dr. Dobbs as the leading authority on Location-based services

Richard Fromm
• Was the key developer of Inktomi's search engine along side CTO Paul Gautier (they were classmates at Berkeley)
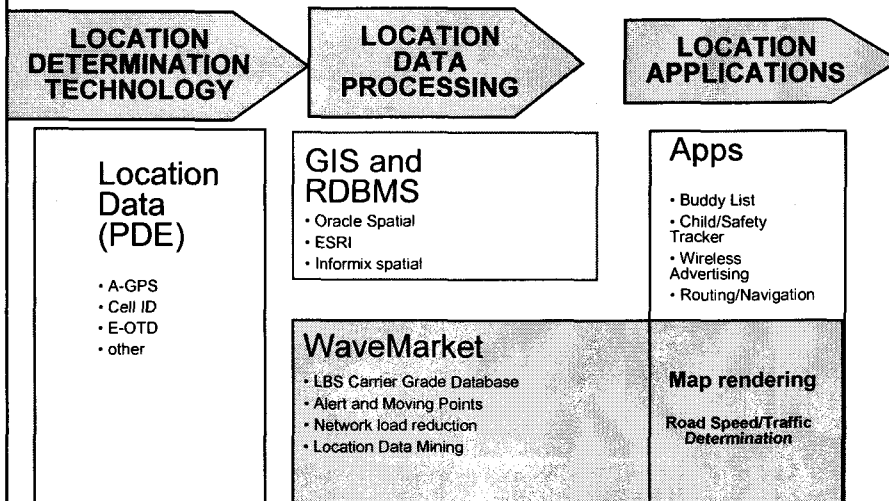
Andrew Cohen
• For 8 years, One of the lead developers of the core of Oracle RDBMS. Spearheaded CISCO e-commerce rollout.

•Ron Lawrence
• Installed Signalsoft location suite services and infrastructure for T-Mobile, Compaq, Sprint PCS, Orange
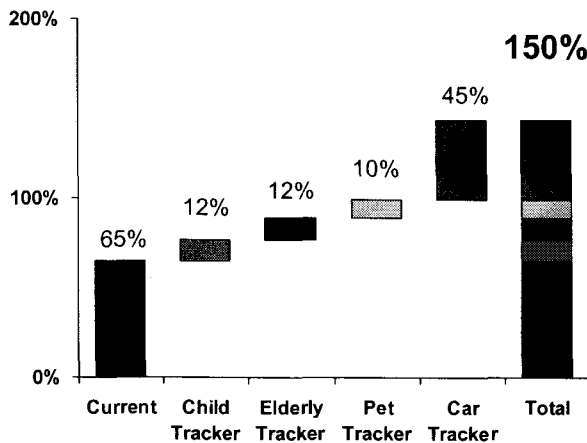

Where we fit in with LBS

LOCATION DETERMINATION TECHNOLOGY	LOCATION DATA PROCESSING	LOCATION APPLICATIONS

Location Data (PDE)
• A-GPS
• Cell ID
• E-OTD
• other

GIS and RDBMS
• Oracle Spatial
• ESRI
• Informix spatial

Apps
• Buddy List
• Child/Safety Tracker
• Wireless Advertising
• Routing/Navigation

WaveMarket
• LBS Carrier Grade Database
• Alert and Moving Points
• Network load reduction
• Location Data Mining

Map rendering

Road Speed/Traffic Determination

wave:market

"Location" is the only means of communication to drive penetration rates – New applications and devices

150%

45%

10%

12%   12%

65%

| Current | Child Tracker | Elderly Tracker | Pet Tracker | Car Tracker | Total |

Advanced European Nations have 65% wireless penetration rates.

Location services push penetration rates to 150%+ by introducing innovative applications capturing the power of "where"

---

wave:market

Alert Services provides time-sensitive and actionable information for things you care about

Child/Elderly Tracker	➤ When child/elderly are entering danger
Car theft system	➤ To be awoken at night when car is traveling away from the house
Buddy List	➤ Know your friend is close by
Emergency Alert	➤ Know when an emergency event (bomb/fire) is happening near by
Traffic Alerts	➤ When traveling towards a heavy-traffic zone
Enterprise Fleet Services	➤ When fleet driver has spend too much time at the customer site or is traveling in the wrong direction
Wireless Advertising	➤ Get a meaningful coupon from a local retailer

Polling Server

Polling Server
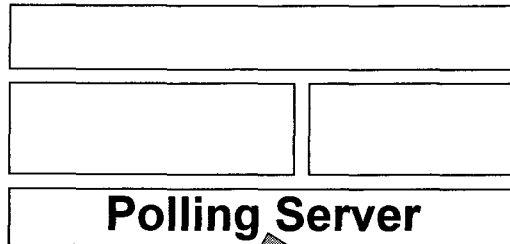
Reduces Network Load 90%+

Too Much Load

|	
1 Alert Application	update every 5 minutes = 12 pings/hour
	288 Pings per day
x End Users	10 Million subscribers
Total Pings	1.0 Trillion /year
Peak Load	4 Million /min

wave ̤market

- Polling Server Functionality
  - Load Reduction
    » Reduces location requests through intelligent algorithms

  - Constraint-based Optimization
    » Will maximize value for given load constraint, for example location server max of 150 requests/sec.

  - Location Request prioritization
    » For example, e911 or safety requests will get priority over less critical such as wireless ad.

wave ̤market

Alerts Engine

Alerts Engine

Moving Point Triggers

wave••market
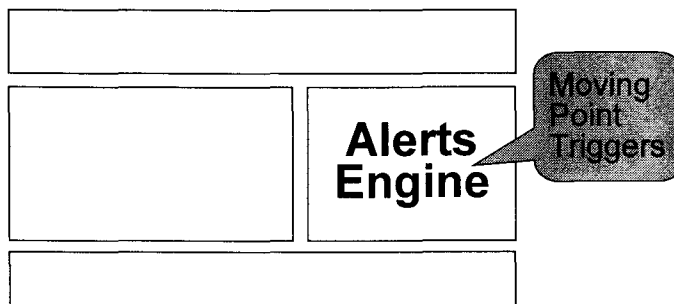
City Map
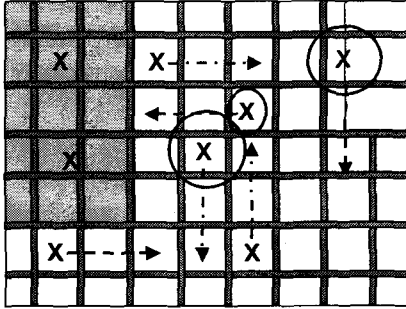
▨ **Dangerous Area**

☐ **Downtown Area**

Situation in dealing with many moving points/subscribers

• Continuous tracking of moving (dynamic) points
• Points moving along spatial plane and street grid
• Moving points that are related to each other and have dynamic triggers (eg. buddy lists) and static triggers – eg. Send an ad if near coffee shop x.
• Moving points have Moving points have criteria they must match – eg. Looking for Chinese Restaurant close to park

• Processing requirement grows exponentially with number of subscribers

• Impossible to manage all applications!