Opportunistic RF Localization for Next Generation Wireless Devices
June 17, 2008
Worcester Polytechnic Institute
Worcester, MA, USA

Agenda

- Introduction
  - A brief summary of TruePosition
- The Challenge
  - A description of current location technology capabilities/limitations
- A Unified Approach
  - A discussion of future location technology plans
TruePosition Company Overview

- TruePosition is one of the largest companies solely dedicated to Location-based technology solutions and services
  - 480+ employees, 200+ field staff and 100 international patents
- TruePosition is a wholly-owned subsidiary of Liberty Media

TruePosition Customers
- AT&T Mobility (formerly Cingular)
- T-Mobile
- Several Tier II and Tier III carriers

TruePosition Uplink Time Difference of Arrival (U-TDOA) Coverage:
- Over 75,000 Base Stations deployed
- More than 270 million POPs covered in the US

TruePosition – U-TDOA Coverage

- Includes:
  - AT&T Mobility
  - T-Mobile
  - Several Tier II and Tier III carriers
  - More than 270 million POPs covered
  - Over 75,000 BTS deployed
U-TDOA - Description

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The Challenge

- Users want a consistent, reliable, and accurate location solution wherever they are at any given time

- They DO NOT want to think about:
  - Who's network am I on?
  - What technology is being used?
  - What is the environment I am in?

No single existing or anticipated solution meets all these needs

Current Solutions

<table>
<thead>
<tr>
<th>Time of Flight</th>
<th>Power Loss</th>
<th>Proximity</th>
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<tbody>
<tr>
<td>GPS</td>
<td>???</td>
<td>N/A</td>
</tr>
<tr>
<td>GLONASS</td>
<td></td>
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<tr>
<td>GALILEO</td>
<td></td>
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<tr>
<td>Weak Signals limit Indoor and Urban Performance</td>
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</table>

Satellite

<table>
<thead>
<tr>
<th>U-TDOA</th>
<th>E-OTD</th>
<th>AFLT</th>
<th>TV Signal</th>
<th>Dedicated Transmitters</th>
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Terrestrial

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<tr>
<th>E-CID</th>
<th>CID</th>
<th>Bluetooth Tags</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Access Points</td>
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</table>

<table>
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<tr>
<th>WIFI</th>
<th>Density of sites limits usefulness and/or accuracy</th>
</tr>
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</table>

| Poor Geometry of Sites Limit Rural Performance | Calibrated E-CID Pattern Matching |
| Local Variability Limits Reproducible Results | |

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What do we have today

• GPS covers the Globe
  
• But leaves lots of holes where people live and work…

What do we have today

• U-TDOA covers the US

• But provides poor accuracy in some (rural) areas
What do we have today

- Cell ID is Ubiquitous where carrier have coverage
- But has low and inconsistent accuracy

Ubiquitous location technology

- OUR GOAL: “Ubiquitous User experience”
- Several factors contribute to user experience
  - High Accuracy
  - High Yield
  - Low Latency
  - Consistency

A new solution is required that combines the strengths of different approaches
Hybrid U-TDOA / AGPS

- Hybrid approach can significantly improve Accuracy and Yield
- Allows high-accuracy location with few or no GPS satellite visibility
- Provides rural accuracy of AGPS with urban and in-building performance of UTDOA

Combining raw measurements from each approach yields better performance than either technique can achieve by itself.