Wireless Network Discovery

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Disclaimer

Certain commercial equipment, instruments, or materials are identified in this presentation to specify adequately the experimental procedure. In no case does such identification imply recommendation or endorsement by the National Telecommunications and Information Administration, nor does it imply that the material or equipment identified is necessarily the best available for the purpose.
Network Discovery

- Connection Topology
- Temporal Parameters
- Topography (for mobile networks)
Outline of Talk

- Motivation for work
- Test Instruments
- Projects
Growth in Wireless Data Usage

U.S. Wireless Data Subscriber Forecast

Units in millions

Source: Cahners In-Stat Group
Interference Issues

Wireless tower boom creating local static

Antennas unregulated

By Stacie Oulton

Denver Post Staff Writer

Sunday, April 08, 2001
Priority Access Issues

Priority Wireless Access Urged for Rescuers During Crises

By Robert O'Harrow Jr.
Washington Post Staff Writer
Friday, October 12, 2001; Page E11
Test Instruments

- Field Test Mode on Phones
- Drive Test Tools
- Spectrum Analyzers
Wireless Handset as a Network Measurement Instrument

**TDMA (5160)**
- RSSI = -85 dBm
- DVCC = 7
- Slot = 1
- DCCH = CAMPING
  (Dedicated Control Channel)

**CDMA (6185)**
- CSST = IDLE
- Channel = 750
- SP = 1900 MHz
- Rx = -78 dBm
- Tx = -75 dBm
- Ec/Io = 14

**GSM (5190)**
- DVCC = 622
- RSSI = -73 dBm
- CCCH = Common Control Channel
Drive Test Tools
PN Code Scanner
Walsh Code Scanner
Projects

• Wireless Data Throughput

• Propagation Mapping

• Base Station Location

• Congestion Studies
Measurement Set up

Internet

Mobile Computing Platform

Linux Server

Modem

PSTN or Internet

PSTN

Wireless Data Device

Base Station
<table>
<thead>
<tr>
<th>Medium</th>
<th>MODE</th>
<th>File Size (kB)</th>
<th>Throughput (kbps)</th>
<th>Std Dev. (kbps)</th>
<th>95% Confidence Interval (kbps)</th>
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<tr>
<td><strong>Wireless PDA</strong></td>
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<td>10</td>
<td>1.4</td>
<td>0.01</td>
<td>0.01</td>
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<td></td>
<td>100</td>
<td>1.4</td>
<td>0.01</td>
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<tr>
<td><strong>Cellular Digital Packet Data</strong></td>
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<td>1.5</td>
<td>0.54</td>
<td>0.33</td>
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<td>0.20</td>
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<td><strong>IS-95</strong></td>
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<td>100</td>
<td>97.8</td>
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<td><strong>9.6 kbps Wireline Modem</strong></td>
<td>Stationary</td>
<td>Mixed</td>
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<td>0.32</td>
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**IP Data Channel Throughput**
TCP Congestion Behavior

Time (round trips)

Congestion window (segments)

ssthresh = 8

ssthresh = 10

cwnd = 20

After timeout

Nitin Vaidya Associate Professor, Department of Electrical and Computer Engineering University of Illinois at Urbana-Champaign
CDMA 100 kB File Transfer

11.3 kbps
Propagation Mapping
Base Station Location

- **CDMA**
  - Optional field in access parameters message provides GPS coordinates of base station
  - Time difference of arrival information is also known
CDMA Base Stations
Base Station Location

• GSM
  – Timing advance parameter gives distance to base station in 550 meter (1800 ft) increments
  – Phone must be in operation for timing advance to become available
Base Station Location

• Other Cases
• Power Models
  – Power exponent variable
• Trilateration
  – Time of Arrival (TOA)
  – Time Difference of Arrival (TDOA)
• Triangulation
  – Angle of Arrival (AOA)
Congestion Studies
Future Projects

• PCS Interference

• 802.11b Wi-Fi

• Bluetooth