Wireless Seminar:

Testing Mobile WiMAX

Agilent E6474A NiXT Drive Test
Agenda

Overview of Mobile WiMAX

- Mobile WiMAX Charts and Views in E6474A
- Assessing 4G Services with Video Mos Tests
- W1314A Receiver WiMAX measurements
- Supplement: List of WiMAX measurements
Mobile WiMAX (IEEE 802.16e-2005)

• New technology based on OFDMA (expected to be used for all 4G)
• TDD operation - TX and RX using one RF Carrier
• Standard calls for up to 70 Mbps at up to 120Kmph
• 10 Mbps devices currently available today
• Facilitates new services (two-way video file-sharing, two-way VoIP) with integrated QOS (not implemented yet)
• Approved as a IMT-2000 “3G” technology by ITU - this opens up existing Cellular and PCS Frequencies for use
• First commercial deployments in 2008
WiMAX Network Reference Architecture

AP – Access Point (Base Station)
MS – Mobile Station
GW – GateWay
ASN – Access Service Network
CSN – Connectivity Service Network
NAP – Network Access Provider
NSP – Network Service Provider

R2 = Logical Interface – Authentication and Configuration Management

See next slide for details.
WiMAX Network Reference Architecture

Flat ALL IP Architecture

- NAP
- ASN
- ASN GW (FA)
- R1
- R6
- AP
- MS
- VT
- VOIP
- Video
- PS
- SMS
- SMSC
- Internet
- PSTN
- CS
- VOIP
- Video
- VT

CS – Circuit Switch Services
VOIP – VoIP Services
VS – Video Services
PS – Packet Switch Services
SMS – Short Message Services
E6474A WiMAX - Basics

Every Sector has:

• A Center Frequency
• A Common Bandwidth
• A Preamble Index offset
• A BSID
• An associated group of Neighbor Sectors with this same information
Each Sector also has a set of Key PHY Parameters:

- RSSI (Server and Neighbors)
- CINR (Server and Neighbors)
- TX Power (Server only)

For the Server the complete MAC Messaging Dialog is captured and displayed in real-time
Summary of WiMAX – R1 Link

Mobile WiMAX  
802.16e-2005 -- OFDMA

- **RF Bands**
  - 2.3-2.4GHz (Asia)
  - 2.5-2.7GHz (US, Japan, some ROW)
  - 3.4-3.8 GHz (LAR , EMEA, Asia)
  - 2.3-2.4 uses 7 Mhz and 8.75Mhz BW
  - 2.5-2.7 uses 5 MHz and 10MHz BW
  - 3.4-3.8 uses 7 Mhz and 8.75Mhz BW
  - 1.25 MHz and 20MHz BW allowed
- **OFDMA** with 128, 512, 1024, or 2048 carriers in respective allocated BWs
- Multiple Modulation Coding Schemes are used concurrently
- **HARQ Processes**

(Wave 1)

Today

(Wave 2)

2008

- **MIMO** (Multiple Input Multiple Output)
  - 2x2 initially evolving to 4x4
- **STC** (Space Time Coding)
- **Adaptive Antennas**
  - Beam Forming
- **Wave 2 Enhancements** Focused on Capacity improvements and Throughput performance

Bottom Line: 802.16e-2005 is significantly more complex than WLAN or Fixed WiMAX or Today’s 3G
NiXT Architecture Overview
RF Coverage, Quality and Capacity measurements

Single Platform air-interface measurement system for:
• GSM/GPRS/EDGE/UMTS/HSxPA
• CDMA/cdma2000/1xEVDO
• WiMAX, iDEN, TD-SCDMA

Platform features include:
• Database logging and Playback
• Integral GPS/Real time mapping
• Alerts/alarms/Events
• Flexible time chart
• Protocol message decode
• File export
• Link phone & receiver

Post Processing
• Fast fault analysis
• Summary KPI reports
• Flexible export
• Open interface

Phones Support:
• Key network measurements
• Protocol capture/decode
• Multi-vendor support
• Cover multiple chipsets

Data Services testing:
• Data service testing (e.g. FTP, HTTP, Email, Video Telephony, Video Streaming /w MOS etc), MMS, SMS, WAP. Including commercial mobile interface and with content validation

Network Independent Receiver functionality:
• BCH/SC/Pilot analyzer
• Interference analyzer
• Spectrum & CW analyzer
• Cover multiple technologies
• Uplink and downlink
• Integral GPS & USB Hub

Data testing:
• End to End, client-server ‘pipe’ testing – UDP or TCP data geometry

Voice Quality testing:
• ITU P.862.1 PESQ-LQO Support
• Uplink and downlink

NiXT Architecture Overview
Network Independent Receiver functionality:
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• Interference analyzer
• Spectrum & CW analyzer
• Cover multiple technologies
• Uplink and downlink
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E6474A-656 WiMAX Phone Measurements

- **E6474A-656** option providing WiMAX phone measurements.
- Currently supports Beceem chipset devices.
  - MS120 PC Cards (Wave 1)
  - BCS200 PC Cards (Wave 2)
- New! Intel Baxter Peak and Echo Peak Chipsets support (11.3 – May 08)
- Roadmap to Add Runcom RNA200 Chipset support (11.4 – in Aug 08)
- Roadmap to add Ethernet and USB support (11.4 – in Aug 08) Beceem 120/200
- Others TBD on Business Case
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Assessing 4G Services with Video Mos Tests

W1314A Receiver WiMAX measurements

Supplement: List of WiMAX measurements
Default Views – Server and Neighbors

Displays the current call processing status of the WiMAX PC Card

- Serving Channel and Preamble Index to identify the serving sector
- The Serving RSSI to show signal coverage
- Serving CINR value to determine signal quality
- TX Power to assess power control performance

Neighbor Information: Preamble Index and associated RSSI and CINR values

- UL and DL MAC Throughput Rates in Kbps to show current traffic flow

CQICH TX gives indication of uplink power control messaging volume
Default Views – MAC Protocol Decoder

Displays the current MAC Protocol dialog between the PC Card and the Access Point.

Like L3 Protocol in 3G technologies this provides a top level message flow display, the ability to notify on a filtered set of specific messages as well as complete decode of each individual message.

Messages are color coded to help highlight different network transactions:

- **Downlink** – Navy
- **Uplink** - Light Blue
- **DL or UL** – Purple
- **Authentication** – Yellow
- **Handover Request** – Red
- **HO Response** – Gold
- **HO Indication** - Magenta
Default Views - Map

Visualize in Real-Time:
- Handover performance
- Coverage (RSSI)
- Interference (CINR)
- MAC Throughput
- User Experience (VMOS)
  - Video and Audio MOS
- Application Throughput
  - Video Streaming, FTP, PUT/GET, HTTP Downloads etc.
Agenda

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Video Streams with MOS
(Assess Users actual 4G multimedia experience)

• Understand how customers see the WiMAX Service
• Content can be on Internal or Public Video Server
• Supports the following Formats:
  Windows Media, Real Player, Quick Time, Mpeg4, 3GPP
• Measure every 300ms - correlate to RF conditions
  Audio MOS, Video MOS, %Jerkiness, %Bluriness, %Blockiness
Streaming Video with MOS

- Integrated Test
- Automates traffic generation
- Easy to Configure
- Can be used with other application data tests

- Video and Audio can be replayed with collected data
WiMAX Drive Test with Video MOS
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E6474A-655 WiMAX Receiver Measurements

- **E6474A-655** option providing WiMAX Receiver measurements.

- Currently supports:
  - Preamble RSSI/CINR measurements
  - Preamble Decodes
  - CW, Spectrum Analysis
W1314A Models that support WiMAX Bands

W1314A-600 Supports WiMAX 2.5GHZ  
(includes 850 and 1900 MHz downlink band support)

W1314A-603 Supports WiMAX 2.5GHZ

W1314A-623 Supports WiMAX 2.3 Ghz  
(includes 2.1GHZ downlink band support)

W1314A-E01 Supports WiMAX 2.3/2.5/3.5 GHz
W1314A Models that support WiMAX Bands

W1314A-E02  Supports WiMAX 2.5GHZ  
(includes 850/1900/2100/iden 800/ iden900 MHz downlink band support)  

W1314A-E03  Supports WiMAX 2.5GHZ  
(includes 850/1900/2100* MHz Up and downlink band support)  

W1314A-E04  Supports WiMAX 3.5GHZ  
(includes 900/1800/2100 MHz downlink band support)  

W1314A-E05  Supports WiMAX 3.5GHZ  
(includes 850/900/1800/1900 MHz downlink band support)  

W1314A-E06  Supports WiMAX 2.5GHZ  
(includes 800/900/1700/2100 MHz downlink band support)  

* 2100 uplink is 1700Mhz AWS band support for US only
W1314A Receiver Performance Enhancements – Individual Technology

<table>
<thead>
<tr>
<th>Mobile WiMAX</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Scan (preamble-RSSI)</td>
<td>7 channels / sec (10 MHz BW)</td>
</tr>
<tr>
<td>Power Scan (preamble-RSSI)</td>
<td>15 channels / sec (5 MHz BW)</td>
</tr>
<tr>
<td>Preamble decode</td>
<td>Minimum 7 up to 15 decodes / sec&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Can be multiple preamble decodes for each RF carrier.
Agenda

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<table>
<thead>
<tr>
<th>Agilent Restricted</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Device Configuration</th>
<th>Power work mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>RSSI deviation</td>
</tr>
<tr>
<td>ESN</td>
<td>Num of BRTH</td>
</tr>
<tr>
<td>RF Log Intvl Distance</td>
<td>Connection index</td>
</tr>
<tr>
<td>RF Log Intvl Time</td>
<td>Transport CD</td>
</tr>
<tr>
<td>Call Duration</td>
<td>Wimax Sync Status</td>
</tr>
<tr>
<td>Noisy Call Threshold</td>
<td>Phys Sync Status</td>
</tr>
<tr>
<td>Device Mode</td>
<td>Base Station ID</td>
</tr>
<tr>
<td>Device Type</td>
<td>Presamble ID</td>
</tr>
<tr>
<td>Label</td>
<td>Mean CINR</td>
</tr>
<tr>
<td>Device Description</td>
<td>CINR Deviation</td>
</tr>
<tr>
<td>Software Version</td>
<td>Mean RSSI</td>
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<tr>
<td>IMEI</td>
<td>RSSI Deviation</td>
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<td></td>
<td>Modern Center Freq</td>
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<td></td>
<td>Modern BW</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Wimax SS Statistics</th>
<th>Wimax Link State Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS Stats Size</td>
<td>Avg CINR</td>
</tr>
<tr>
<td>Num of Frames Rcvd</td>
<td>Std CINR Deviation</td>
</tr>
<tr>
<td>Num of PDUs Rcvd Per MCS</td>
<td>Max Tx Power</td>
</tr>
<tr>
<td>Num of PDUs Sent Per MCS</td>
<td>Freamble Index</td>
</tr>
<tr>
<td>Modern State</td>
<td>DL ID Cell</td>
</tr>
<tr>
<td>Centre Frequency</td>
<td>UL Cell ID</td>
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<tr>
<td>Frame Number</td>
<td>IR Code End Value</td>
</tr>
<tr>
<td>DL Rate</td>
<td>IR Code Start Value</td>
</tr>
<tr>
<td>UL Rate</td>
<td>Current Tx Power</td>
</tr>
<tr>
<td>Current Offset BS</td>
<td>Tx Headroom</td>
</tr>
<tr>
<td>Phys Sync Failures</td>
<td>BF End Value</td>
</tr>
<tr>
<td>Network Entry Failures</td>
<td>BF Start Value</td>
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<tr>
<td></td>
<td>FR End Value</td>
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<tr>
<td></td>
<td>FR Start Value</td>
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<td>HR End Value</td>
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<td>HR Start Value</td>
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<td>Base Station ID</td>
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</tbody>
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<tr>
<th>Wimax CP Stats</th>
<th>Wimax DP Stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Num UL Chnl marked unusable</td>
<td>Num of SDU rcvd</td>
</tr>
<tr>
<td>Num DL Chnl marked unusable</td>
<td>Num of SDU sent</td>
</tr>
<tr>
<td>Num of Sync Failures</td>
<td>Num of non-data SDU rcvd</td>
</tr>
<tr>
<td>BW Flst from MS</td>
<td>Num of non-data SDU sent</td>
</tr>
<tr>
<td>DL CH chg changes</td>
<td>Num of PDU rcvd</td>
</tr>
<tr>
<td>UL CH chg changes</td>
<td>Num of PDU sent</td>
</tr>
<tr>
<td>LCD Rx count</td>
<td>Num of PDU rcd</td>
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<tr>
<td>DCD Rx count</td>
<td>Num of Mgmt Plks sent</td>
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<tr>
<td>Invalid SBC Rcvd</td>
<td>Num of SDU rejected</td>
</tr>
<tr>
<td>Auth Failures</td>
<td>Total Bytes rcvd</td>
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<td></td>
<td>Total Bytes sent</td>
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<td>Total num of UL conn</td>
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<td>Total num of DL conn</td>
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<tr>
<th>Wimax Device Config</th>
<th>Wimax Physical State Info</th>
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<tbody>
<tr>
<td>MAC Address</td>
<td>DLMAP FEC Scheme</td>
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<tr>
<td>Library Version</td>
<td>UL burst data (FEC)</td>
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<tr>
<td>Firmware Version</td>
<td>DL burst data zone</td>
</tr>
<tr>
<td>Driver Version</td>
<td>UL burst data zone</td>
</tr>
<tr>
<td>Baseband Chip Version</td>
<td>Frame number</td>
</tr>
<tr>
<td>RF Chip Version</td>
<td>Local frame number</td>
</tr>
<tr>
<td>Calibration Status</td>
<td>UL burst duration</td>
</tr>
<tr>
<td>Antenna Calibration</td>
<td>DL burst duration</td>
</tr>
<tr>
<td>Antenna Gain Offset</td>
<td>UL burst size</td>
</tr>
<tr>
<td>Tx Power Offset</td>
<td>DL burst size</td>
</tr>
<tr>
<td>Wimax Modern State Info</td>
<td>UL ranging speed</td>
</tr>
<tr>
<td>Network Entry Status</td>
<td>UL burst data CID</td>
</tr>
<tr>
<td>Base Station ID</td>
<td>DL burst data CID</td>
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|                               | UL burst data UUIC         |
Video Streaming MOS test