WiMAX E2E Architecture - A Solution Overview

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Cisco Expo
Cairo. January 2009
Agenda

- WiMAX Market Overview
- Cisco WiMAX Solution Overview
- Cisco BTS Overview
- Cisco ASN/CSN Overview
- Cisco WiMAX Services
- Q&A
Agenda

- WiMAX Market Overview
- Cisco WiMAX Solution Overview
- Cisco BTS Overview
- Cisco ASN/CSN Overview
- Cisco WiMAX Services
- Q&A
Cisco’s Mobility Vision
‘Any Play Services’

“Any Play” Services

Across Devices
Across Segments
Across Technologies

IP NGN

Commercial
Enterprise
Consumer

Cable/DSL
WiMAX
WiFi/FemtoCell/MOCA..
3G/4G

Unified Comm
Digital Video
Routing & Switching
Service Exchange
WHY WiMAX?

Following the same adoption curve ...

The Path to Volume Economics

- Standard, Certification and multi vendor interoperability drive exponential revenue growth and reduction in system cost
- Strong Ecosystem: more than 400 members of WiMAX Forum (>125 Service Providers)
- Large Estimated Market Size
  - $7B Fixed/Stationary by 2010
  - $20 – 30B Portable/Mobile by 2015

*Other names and brands may be claimed as the property of others.
Reaching Critical Mass

2.7B people covered by WiMAX spectrum licenses today, estimated 4B as a result of ITU IMT-2000 inclusion
The Real Opportunity
Country Transformation and ‘Digital Inclusion’

Broadband Penetration—2006

Source: EIU, Telegeography, Point Topic, Cisco Analysis
The Broadband Wireless Market

Why is WiMAX Important?

- WiMAX Leverages IP technologies throughout; a natural fit for Cisco
- WiMAX Enhances Cisco’s existing market-leading WiFi and WiFi mesh solutions

WiMAX (802.16e-2005) enables a wide range of fixed and mobile ‘any play’ services to deliver the Connected Life experience

- Service Providers: Improved cost effectiveness with significant reductions in capital and operational expenditures
  Faster time-to-market; no wires
  Complements and extends existing cellular / broadband offerings

- Governments: An efficient means to enable ‘Digital Inclusion’
Agenda

- WiMAX Market Overview
- Cisco WiMAX Solution Overview
- Cisco BTS Overview
- Cisco ASN/CSN Overview
- Cisco WiMAX Services
- Q&A
# Cisco IP Next Generation Networks

*IP Forms the Foundation for True Mobility for WiMAX*

<table>
<thead>
<tr>
<th>Subscriber</th>
<th>Radio Networks</th>
<th>Mobile Service Exchange</th>
<th>Multiservice IP/MPLS Core</th>
<th>Internal Services and Operations</th>
<th>External Services</th>
</tr>
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<tr>
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<td>Packet Gateways</td>
<td>IP Anchor Point</td>
<td>IP Service Control</td>
<td></td>
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<td>GGSN</td>
<td>PDSN</td>
<td>Multi-service IP/MPLS Core</td>
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<tr>
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<td></td>
<td>Mobile IP Home Agent</td>
<td>Service Control</td>
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<td></td>
<td>Wireless Mesh</td>
<td>ASN-GW</td>
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<tr>
<td></td>
<td></td>
<td>WiFi</td>
<td>Wireless LAN Controller</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Persistent Roaming Across Wireless Access Networks
- Subscriber-Differentiated IP Service Delivery

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**Cisco IP Next Generation Networks**

**IP Forms the Foundation for True Mobility for WiMAX**

- UMTS / HSPA
- WiMAX
- CDMA
- WiFi
- Persistent Roaming Across Wireless Access Networks
- Subscriber-Differentiated IP Service Delivery

**Radio Networks**

- UMTS / HSPA
- WiMAX
- CDMA
- WiFi

**Mobile Service Exchange**

- GGSN
- PDSN
- ASN-GW
- Wireless LAN Controller

**Multiservice IP/MPLS Core**

- Content Services Gateway
- Session Border Controller
- IP Transfer Point

**Internal Services and Operations**

- News Portals
- VoD
- Location Services
- Broadcast
- VoIP
- Music
- Billing
- AAA
- DNS
- Policies
- Subscriber Profiles
- Logging

**External Services**

- Corporate VPNs
- Internet
- Roaming Exchanges
- Application Partners
- IP Media Partners
- Signaling Networks

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Cisco Broadband Wireless Strategy Overview

WiMAX is one of the Access Choices & Options Available...
**WiMAX End to End Network Reference Model**

- **MSS** – Mobile Subscriber Station
- **NAP** – Network Access Provider
- **NSP** – Network Service Provider

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### ACCESS SERVICE NETWORK (ASN)
- **Access gateway (ASN GW)** – provides the micro-mobility anchor point and supports bearer services. Also supports the Foreign Agent.
- **Base station (BS)** – provides the radio dependent functions and has limited IP functionality

### CORE SERVICES NETWORK (CSN)
- **Home agent (HA)** – provides the macro-mobility anchor point and supports bearer services, if roaming/mobility is desired.
- Other Network Elements such as AAA, DHCP servers and more are also in the CSN.

---

R1: 802.16e (MSS-ASN)
R2: MSS – CSN
R3: ASN GW – HA
R4: Inter-ASN
R5: CSN-CSN
R6: BS - ASNGW
R8: Inter BS
ASN Profiles

- Three ASN Profiles have been specified in WiMAX as a tool to manage diversity in ASN node usage and implementation
  - Release 1 of NWG Specifications on WiMAX supports 3 ASN

- Profiles:
  - **Profile A:**
    - Centralized ASN Model with BS and ASN GW in separate platforms through R6 interface
    - Split RRM: RRA in BS and RRC in ASN-GW
    - Open interfaces for Profile A: R1, R6, R4, and R3
  - **Profile B:**
    - Distributed ASN solution with the BS and ASN GW functionalities implemented in a single platform
    - Open interfaces Profile B: R4 and R3
  - **Profile C:**
    - Similar to Profile A, except for RRM being non-split and located in BS.
    - A big departure from the way things used to be done in the mobile radio world.
WiMAX End-to-End System
Profile-C: Fixed and Nomadic Wireless Access
ASN-gw: Termination of CPE’s
Simultaneous IP-CS and E-CS support

- Users are connected into groups – regardless of Eth-CS or IP-CS.
- Address Allocation: Can support a single common subnet for a large residential market
- Split Architecture for E-CS (business Customers) being developed
- Highly scalable – and works regardless of CS mode
**WiMAX Solution**

**Packet Flow & QoS Model**

The 802.16 Convergence Sublayer (CS) provides tunneling over the air. Tunnels are identified by the CID (Connection Identifier). Assignment of CIDs is performed in the BS. Plain IP packets can be forwarded over CS.

**Diagram Details**

- **Control (UDP 2231/R6)**
  - MAC
  - PHY

- **IP-CS Data Path**
  - IP
  - IP-CS
  - GRE
  - MAC
  - PHY

- **IP-CS Data Path (Pmip)**
  - IP
  - IP-CS
  - GRE
  - Micro Mobility
  - GRE
  - MIP
  - Macro Mobility
  - MIP

- **ETH-CS Data Path**
  - ETH
  - ETH-CS
  - GRE
  - GRE
  - PHY

**Network Nodes**

- **BRAS**
- **ISP**
- **3G**
- **Internet**
- **H-CSN**
- **BS**
- **ASNgw**
- **V-CSN**
- **HA, AAA, DHCP/DNS**
- **R1, R6, R3, R5**
- **ISP**
- **3G**
- **Internet**
- **H-CSN**

**Key Points**

- The 802.16e Path
- Session
- Flows
- The 802.16e Control Plane
- The 802.16e Data Plane

**Legend**

- 802.16e Ctrl
- IP-CS Ctrl
- CSNctrl
- ASNctrl
- 16eCtrl
- PHY
- LNK
- IP
- GRE
- ETH-CS

**Network Flow**

- Traffic flows from the user to the BS, then to the ASNgw, and finally to the Internet or 3G network.
Cisco WiMAX Solution QOS
Architecture using IP-NGN

Consumer and Business Traffic Utilize Per-Subscriber or Per Service QoS Model in Access, Aggregation and Core

<table>
<thead>
<tr>
<th>Traffic Class</th>
<th>Core /Edge/ Aggregation</th>
<th>Access</th>
<th>UNI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Core / Edge/ Aggregation</td>
<td>Access</td>
<td>UNI</td>
</tr>
<tr>
<td></td>
<td>MPLS/IP</td>
<td>Ethernet</td>
<td>DSL, ETTX</td>
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<tr>
<td>PHB</td>
<td>DSCP</td>
<td>MPLS EXP</td>
<td>802.1P</td>
</tr>
<tr>
<td>Control Protocols Network Management</td>
<td>AF</td>
<td>48</td>
<td>6</td>
</tr>
<tr>
<td>Residential Voice</td>
<td>EF</td>
<td>46</td>
<td>5</td>
</tr>
<tr>
<td>Business Real-time</td>
<td>EF</td>
<td>56</td>
<td>7</td>
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<tr>
<td>Residential TV and VoD</td>
<td>AF</td>
<td>32</td>
<td>4</td>
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<tr>
<td>Residential D-Server Video</td>
<td>AF</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>Business Critical In Contract Business Critical Out of Contract</td>
<td>AF</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Residential HSI Business Best Effort</td>
<td>BE</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>
## WiMAX QoS & Scheduling Schemes
### Specifications & Applications…

**Service Flows:**
Mechanism defined in Mobile WiMAX to provide QoS
Uni-directional flow of packets associated with certain defined QoS parameters for traffic

**Connections:**
Unidirectional logical link between BS and CPE
Each connection is associated with a service flow delivering the necessary QoS over the air interface

**Packet Classifiers:**
Each service flow also has packet classifiers associated with it to determine criteria used by the MAC layer to associate packets into service flows

**Mobile WiMAX scheduling based on QoS service Flows associated with each packet**

<table>
<thead>
<tr>
<th>QoS Category</th>
<th>Applications</th>
<th>QoS Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>UGS</td>
<td>VoIP</td>
<td>• Maximum Sustained Rate&lt;br&gt;• Maximum Latency&lt;br&gt;• Jitter Tolerance</td>
</tr>
<tr>
<td>Unsolicited Grant Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rtVR</td>
<td>Streaming Audio or Video</td>
<td>• Minimum Reserved Rate&lt;br&gt;• Maximum Sustained Rate&lt;br&gt;• Maximum Latency&lt;br&gt;• Traffic Priority</td>
</tr>
<tr>
<td>Real-Time Variable Rate Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ErtVR</td>
<td>Voice with Activity Detection (VoIP)</td>
<td>• Minimum Reserved Rate&lt;br&gt;• Maximum Sustained Rate&lt;br&gt;• Maximum Latency&lt;br&gt;• Jitter Tolerance&lt;br&gt;• Traffic Priority</td>
</tr>
<tr>
<td>Extended Real-Time Variable Rate Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nrtVR</td>
<td>FTP File Transfer Protocol</td>
<td>• Minimum Reserved Rate&lt;br&gt;• Maximum Sustained Rate&lt;br&gt;• Traffic Priority</td>
</tr>
<tr>
<td>Non-Real-Time Variable Rate Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>Data, Web Browsing, etc.</td>
<td>• Maximum Sustained Rate&lt;br&gt;• Traffic Priority</td>
</tr>
<tr>
<td>Best-Effort Service</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WiMAX End-to-End System
Profile-C Fixed, Nomadic, and Mobile
Agenda

▪ WiMAX Market Overview
▪ Cisco WiMAX Solution Overview
▪ Cisco BTS Overview
  Beamforming
  MIMO
▪ Cisco ASN/CSN Overview
▪ Cisco WiMAX Services
▪ Q&A
Broadband Wireless Access (BWX) Products

Former Navini Nomenclature

- **P3 or BTS-MX8**
- **BWX 8305 Basestation**
- **BTS-MX2**
- **BWX 2305 Basestation**
- **Combiner**
- **BWX 8326 Basestation Combiner**
- **External GPS Unit (EGU-3)**

**Broadband Wireless Access (BWX) Products**

- **BWX 8303 Basestation Timing System**
- **RFS8 Sector**
- **BWX 8305 Basestation Antenna**
- **BWX 320**
- **Desktop + VoIP modem**
- **BWX 350 USB modem**
- **BWX 360 Outdoor modem**
- **SURFER 1000**
- **BWX 210 Desktop modem**
- **LMX**
- **BWX 110 Desktop modem**
- **PMX**
- **BWX 120 PCMCIA modem**
Typical BaseStation Configuration

120-degree sectors

- **Hardware Maturity (3rd Generation)**
- **Software upgradeable to 802.16e**
- **5MHz, TDD**
- **Configurable DL/ UL duplex**
- **Simplified Installation**
- **EMS remote operation**
- **Security**
- **Software programmable radio**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Power</td>
<td>31 dBm @ antenna port +27-+46 dBm EIRP</td>
</tr>
<tr>
<td>Operational Temperature</td>
<td>+0 to +50 degrees C</td>
</tr>
<tr>
<td>Mechanical Dimensions</td>
<td>5.25hx19wx12.9d inches for standard rack application</td>
</tr>
<tr>
<td>Power Supply</td>
<td>+24VDC, -48VDC, 110/240 AC</td>
</tr>
</tbody>
</table>
Cisco AAS Technology

Not all AAS approaches are equal...

Switched Lobe Smart Antenna (Vendor X)
Cheap, but inflexible. Uses multiple small, immobile “sub sectors”. Base Station selects which sub sector to use based on strongest signal received. Suffers from limited gain.

Dynamically Phased Array/Beam Steering (Vendor Y)
Uses multiple small, immobile “sub sectors”. Base Station selects which sub sector to use based on angle of arrival, and steers beam. Suffers from multipath interference.

Adaptive Antenna Array - Cisco
Best performance. System measures angle, phase and strength of arrival from uplink sounding. Uses results to send downlink using all available multipaths to add constructively at the source.
Cisco WiMAX RF Technical Leadership
The Only Commercially Deployed Smart Beam-Forming

Pioneering the Combination of Smart Beam-Forming with MIMO:
- Requires up to 50% fewer sites than competition
- Yields up to 50% savings in both OpEx and CapEx
- Enables the use of low powered consumer broadband devices (up to 4 times power reduction)
- Two to three times the network capacity
- Higher signal strength to both stationary and mobile users
- Enhanced indoor coverage / performance
- Improved roaming capabilities; fewer dropped signals
Cisco RF Adaptive Beamforming

Using DSP Signal Processing…

Downlink Beamforming:
“remember” the individual “vector” paths of each element in the Rx direction

Uplink Beamforming:
Use each Tx and combine each vector so that resultant signal is boosted.
MIMO vs (Beamforming + MIMO)

Summary Animation

MIMO-only

Beamforming + MIMO

Closer data packets indicating higher order modulation = higher data rates

Larger Screen due to higher data rates

Less MIMO-B beam overlap = less noise, more decorrelation, higher data rate

Stronger green halo reflecting stronger signal even behind buildings

Greater coverage perimeter

Animation found on BWBU PLM share Cisco server (36 Megs):
\Rch-filer03awq-blbwbu_product_management_wimax\Published\PRESENTATIONS\DEMO
Agenda

- Cisco WiMAX Solution Overview
- Cisco BTS Overview
- Cisco ASN/CSN Overview
- Cisco WiMAX Services
- Q&A
WiMAX End-to-End System
Carrier Ethernet based Solution

Access Devices | Intelligent Aggregation | Carrier Ethernet | WiMAX Edge | Mobile Edge
---|---|---|---|---
WiMAX CPE | WiMAX Basestation | Logical Data Flow - Mobile | Integrated Services Gateway | Service Control
Premise Routing with Voice | Ethernet Access Node | | | Mobile IP Home Agent
WiMAX Enabled Laptop | Microwave Link | Aggregation Node | | |
WiMAX Enabled Mobile Device | Aggregation Node | IP / MPLS Aggregation Network | | Corporate VPNs
Premise Routing | Distribution Node | | | Internet

Services and Operations

Cisco Access Registrar | Cisco Network Registrar | Service Management | Billing and Accounting | VoIP | Network Management
Cisco ASN Gateway service module

- ASN-GW software will run on a service module in the 7600 Series Router
- Allows the system to rapidly scale by adding more service modules to meet traffic loads
- 7600 offers a variety of chassis configurations for different deployment scenarios
- A very robust and proven approach that has been used to support a variety of different applications in the mobile space
- A smaller “standalone”, 1RU high appliance based ASN-gw based on C7301 is available for Field/Demo trials
Cisco ASNgw Overview

Main Features
• Authentication/Security
• QoS
• Mobility (micro)
• IP address allocation
• Initial Network Entry of a user
• Service Flow creation for a user (with only pre-provisioned service flows)
• De-registration of a MS
• Support for unpredicted Hard Handoff
• Support for IP Convergence sublayer (CS) only

Carrier Class Features
• ASNgw Clustering using ASNgw-SLB
• Geographic Load Balancing & Scaling
• Stateful 1:1 Redundancy
• Deep Packet Inspection & Accounting
• Carrier-grade billing support using CSG2 (pre & postpaid)

Software

Carrier Class Performance
• 8 Gbps per card using IMIX packet
• 100K Subscribers, 30% active, 70% idle
• Unlimited # of sessions per Subscribers

Carrier Class Performance
• 8 Gbps per card using IMIX packet
• 100K Subscribers, 30% active, 70% idle
• Unlimited # of sessions per Subscribers
## Cisco Broadband Wireless Gateway

<table>
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<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards Compliance</td>
<td>Assure interoperability and enabling faster time to market. Compliant with WiMAX NWG 1.1.2 Standards and Profile C, open R6 Interoperability demonstrated with multiple Radio vendors</td>
</tr>
<tr>
<td>Stateful Redundancy</td>
<td>Stateful intra- and inter-chassis redundancy</td>
</tr>
<tr>
<td>Extensions</td>
<td>Co-existing Simple IP and Mobile IP, full mobility support [idle mode, paging]</td>
</tr>
<tr>
<td></td>
<td>Intelligent BWG Load balancing [ASN-SLB]</td>
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<tr>
<td></td>
<td>Enterprise and residential markets [Multi-host, NAP sharing, VPN, etc.]</td>
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<tr>
<td></td>
<td>Enhanced Charging and Policy enforcement [Interworking with CSG2]</td>
</tr>
<tr>
<td></td>
<td>Managed Voice [Lawful Intercept, RoHC, PHS]</td>
</tr>
<tr>
<td>Power of IOS</td>
<td>Cisco Systems’ BWG solution can leverage the proven features of the Cisco IOS: Ex. QoS, ACL, NAT, security, VPNs, High Speed Forwarding, Redundancy.</td>
</tr>
</tbody>
</table>

- Scales by adding BWG Feature Modules in the chassis. Up to 6 Modules per 7609S
- Redundancy scheme provides High Availability
- BWG Feature Module Performance*  
  - 500 Base Stations  
  - 100,000 active users  
  - 5Gbps of full-duplex bandwidth
Cisco Home Agent

<table>
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<tr>
<td>Extensions</td>
<td>Proxy Mobile IP</td>
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<tr>
<td></td>
<td>Intelligent Home-Agent Load balancing (HA-SLB)</td>
</tr>
<tr>
<td></td>
<td>NAT-traversal</td>
</tr>
<tr>
<td></td>
<td>Home-Agent virtualization (HA VRF)</td>
</tr>
<tr>
<td>Power of IOS</td>
<td>Cisco Systems' HA solution can leverage the proven features of the Cisco IOS:</td>
</tr>
<tr>
<td></td>
<td>Ex. QoS, ACL, NAT, security, VPNs, and integrated voice/data.</td>
</tr>
</tbody>
</table>

- Scales by adding Home Agent Feature Modules in the chassis. Up to 6 Modules per 7609S
- Redundancy scheme provides High Availability
- HA Feature Module Performance*
  - 500,000 simultaneous bindings
  - 16,000 tunnels
  - 5Gbps of full-duplex bandwidth
Services and Application Module for IP

The only product in the industry that is LTE Ready TODAY!

- 10 Gbps line rate throughput (IP)
- IOS and Linux
- FCS Aug 07
- 6 Gbyte & 12 Gbyte memory options
- Supports a wide variety of apps (GGSN, PDSN, CSG2, HA, ISG, ITP and eventually LTE)
- Have shipped well over 700 modules

SAMI

We developed solutions that allowed operators to stay ahead of the Internet tidal wave…. we will do the same for the Mobile Internet
Based on the SAMI module

Addresses the mobile data pain point that operators are experiencing
Current Analysis / Iometrix / Cisco SAMI/CSG2 performance testing

- Third Party test validated by Current Analysis & Iometrix – Jan 08
- Cisco 7613 with nine Service Application Module for IP (SAMI)
- Spirent Avalanche 2900 test sets used to generate traffic (4 client/server sets total)
- Two separate tests executed
  - Basic packet switching and throughput of base SAMI platform
  - CSG2 Layer 4 inspection throughput

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## WiMAX Services

### Residential Services
- Internet Access
- Parental Control
- Residential Voice
- Walled Garden

### Business Services
- Managed Services
- L2 VPN
- L3 VPN (MPLS)
- Internet access and presence
- Backhaul of Hotspots

### Wholesale Services
- Internet Access
- Voice Services

### Consumer Services
- Internet Access
- Voice Services
Mobile WiMAX Foundation Services
Business Voice

Call Control
Flows to Enterprise call manager (CCM) and to PSTN if required. VOIP end-point.

Call bearers
Are switched in the ASNGW
Mobile WiMAX Foundation Services
Business HSIA and Voice using 802.16e Ethernet-CS

- Switched Access
- Signaling through ASN-GW
- Bearer through Carrier-Ethernet

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Diagram: Mobile WiMAX Foundation Services

- MS (Mobile Station)
- BS (Base Station)
- ASNGw (Aggregation Gateway)
- CSN (Carrier Service Node)

- Control Plane
- Data Plane

- BS local switching
Managed router service allows remote configuration

SP enables Site-to-Site MPLS or IPSec VPN features in Cisco Router

Extend support for VPN Acceleration from SP to customer premise through AES wide-key support in both

Provide Managed Site-to-Site VPN Service without truck-roll

Obtain new service revenue from already deployed and managed CPE
Service Provider enables security features on a managed router without a truck roll

- Basic security allows split tunneling and dynamic site-to-site connections
- Advanced security allows application and content filtering
- Enables new service revenue from existing managed CPE
Mobile WiMAX Foundation Services
SMB Solution Bundles

**Foundation**
Retail Branch Basic

- Retail Servers
- Product Inventory
- POS Registers
- IP VPN
- WiMAX

Option:
- Managed store connectivity (upgradeable)

**Growth**
Retail Branch Enhanced

- Retail Servers
- Product Inventory
- IP VPN + CoS
- POS Registers
- Back Office PCs / eLearning
- Employee Portals
- Mobile Checkout Kiosks
- WiMAX

Option:
- Add security (FW, IDS, NAC)
- Add store mobility—WLAN

**Optimize**
Retail Branch Premium

- Retail Servers
- Product Inventory
- IP VPN + VoIP
- CoS
- Mobile Checkout Kiosks
- POS Registers
- Back Office PCs / eLearning
- Employee Portals
- WiMAX

Option:
- Add security (FW, IPS, NAC)
- Add store mobility—WLAN
- Add managed IP communications
- XML applications (Product Lookup, workforce automation…)
- Add Instore media/content dist.
- Add IP Contact Center integration
Mobile WiMAX Foundation Services
Residential High-Speed Internet Access

The R6 Control Plane
Handles user authentication and QoS/Service Flow assignment

The R6 Bearer plane
Residential Services uses both the R6 control and bearer plane.
Mobile WiMAX Foundation Services
Residential / Business HSIA using 802.16e IP-CS

- Bearer- and Signaling-Paths through ASN-GW
Mobile WiMAX Foundation Services
Residential / Business HSIA using 802.16e Ethernet-CS

- Routed Access via Home Router
- Bearer- and Signaling-Paths through ASN-GW

Diagram showing the network architecture with various components and protocols.
Mobile WiMAX Foundation Services
Residential Voice

Call Control
Flows to BTS10xxx call control engine and PSTN if required. POTS end-point.

Call bearers
Are switched in the ASNGW
Mobile WiMAX Foundation Services
Residential Video-on-Demand

SEF allows access to VoD service (e.g. boost BW temporarily). Set-top box (STB) allows user to select video programming.

VoD can be delivered as streaming content or background download depending on BW needs. IP MCAST reduces BW required.
Agenda

- Cisco WiMAX Solution Overview
- Cisco BTS Overview
- Cisco ASN/CSN Overview
- Cisco WiMAX Services
- Summary / Q&A
Cisco Broadband Wireless
Cisco Offers an End-to-End Solution

- Cisco’s Mobile WiMAX solution is a fully tested, fully integrated end-to-end IP NGN service delivery architecture
- Cisco Broadband Wireless enables operators to evolve from access providers to highly-relevant experience providers
- Cisco Broadband Wireless enables the Connected Life, expands the Human Network
Cisco Broadband Wireless

Broadband Wireless Access

Cisco’s Mobile WiMAX Adaptive Beamforming consistently delivers excellent downlink gain (12dB) and uplink sensitivity (6dB), resulting in:

- Greater coverage, range, and capacity
- Higher service bandwidth (16 / 64QAM versus QPSK)
- Excellent Non Line-of-Site (NLOS) performance and indoor penetration
- Efficient spectrum utilization (N=3 frequency reuse, low inter-cell interference)
- 30 to 50% fewer cell-sites and basestations for decreased Capex / Opex
- Rapid service deployment and return on investment
Cisco Broadband Wireless

Carrier Ethernet

Cisco Carrier Ethernet solutions provide the foundation for efficient converged IP NGNs

- Access technology agnostic enables efficient infrastructure utilization for broad sets of customers and services
- Cisco offers the broadest portfolio of routing, switching, and optical Carrier Ethernet solutions for unparalleled architectural flexibility
- Rich QoS, security, and resiliency features deliver class-leading protection of voice, video, and data services

Access and service convergence using Cisco Carrier Ethernet leads to dramatic CAPEX and OPEX reductions
3-Oct-2008: Re:TV is now broadcasted for IPTV.bg customers:
From the 3th of October 2008 Re:TV is broadcasted in IPTV.bg networks as a free channel to all of our partners and clients. Re:TV is a public and journalistic project supported by the Public Media foundation. Its purpose is to present objective, authentic and current information, rich commentaries and competent analyses of public events and processes.

View Now: http://www.retv.bg/

http://iptv.bg/

3 October 2008
Re:TV is now broadcasted for the IPTV.bg customers. More information.
Reference Deployment – MaxTelecom, Bulgaria

Executive Summary

Max Telecom
- Industry: Telecommunications
- Location: Bulgaria
- Number of Employees: 125

Business Challenges
- Rapidly and cost-effectively expand service coverage to all of Bulgaria
- Elastic capacity for "triple-play" services (data, voice, and video)
- Stand out from the competition with WiMAX innovations for anytime, anywhere services

Network Solutions
- Navini Smart WiMAX base stations and antennas
- Cisco aggregation solution, making use of third-party transport (Cisco ONS 15450 Metro Ethernet switches at base stations, Cisco 7609 Series at headquarters)
- Architectures integrating 3G, 4G solutions for maximum mobility indoors and outside

Business Results
- Increased capacity by 2 Gbps in early 2008, with the ability to support up to 100,000 subscribers by early 2009
- Added new revenue streams from enabled "triple-play" services
- Expanded "triple-play" services portfolio, including IPTV over WiMAX, to sustain subscriber growth and reduce churn

Bulgarian Telco Pioneers Mobile “Triple-Play” Services over WiMAX

Max Telecom uses Navini Smart WiMAX and Cisco Carrier Ethernet solutions to deliver nationwide mobile services.

Business Challenges

Max Telecom entered the telecommunications market in Bulgaria just two and a half years ago and quickly established itself as a new-generation operator by adopting the latest network and business innovations and giving subscribers industry-leading services and capabilities. The "greenfield" company is garnering international attention with its nationwide network based on mobile WiMAX™ technology. The ambition of Max Telecom is to extend its modern, highly efficient network to the entire population of the country within the next few years. The aggressive build-out has challenged the company to select technology partners that can deliver the required hand-held devices as well as help Max Telecom deliver its vision of mobile access for all services.

The company currently offers Internet access, VPNs, voice services, video, and IPTV.

Having already selected Cisco® for the core network, Max Telecom evaluated radio vendors to determine the best possible foundation to meet its goal of delivering all services using mobile WiMAX. The company simultaneously evaluated all alternatives for an efficient access/aggregation solution. To shorten time to market and keep costs low, Max Telecom decided to lease parts of the network. A third-party provider Ethernet to the home (ETTH) for access to base stations in various cities, and Metropolitan Area Network (MAN) lines to connect its headquarters with the smaller cities. To build out the mobile access network, Max Telecom looked for base station equipment and an overall architecture that could scale aggressively and help ensure security within its leased transport environment. The company aims to cover 90 percent of the 7.5 million residents of Bulgaria by the end of this year.

The major requirements for the base station selection and overall design included:
Breakout Session Evaluation Form

Your session feedback is valuable

Please take the time to complete the breakout evaluation form and hand it to the member of staff by the door on your way out

Thank you!
WiMAX 802.16 Service Flow
Model Definitions

• Packets are associated with a service flow, which is the central concept of the MAC protocol

• **Service flow** = an unidirectional flow of packets with a particular QoS

• Service flow has parameters like bandwidth, latency, jitter and other QoS-related variables

• When data comes to MAC layer, the convergence sublayer gives it an connection ID (CID)

• The service flow is mapped to this ID \{CID, SFID\}

• The Service Flow ID is fixed across Base-Stations. Each Base-Station maps a SFID to a new CID.

  - Created on-demand or pre-provisioned
    - On-demand SF creation subject to authorization against permitted QoS parameters