In-Building Wireless Solutions

Bob Matthews • Technical Manager • March 30, 2011
In-Building Wireless - Market Drivers

• Commercial
  – Ubiquitous cellular coverage is now a basic expectation in-building
  – ≈ 75% of mobile calls are originating or terminating indoors (Verizon 2009)
  – Higher frequency 3G/4G services make in-building coverage more critical

• Public Safety
  – In-building coverage taking on greater importance
  – Migration to 700/800 MHz means less signal penetration
  – Portable radios should support first-responders within buildings
  – New ordinances and building codes mandating coverage
Problem Buildings - Commercial

- Corporate Offices (Fortune 1000)
- Universities
- Hospitals
- Multi-tenant High-Rise Office Buildings
  - Typically >15th floor
- Manufacturing Facilities
- Hotels, Casinos
- Stadiums
- Fed/Local Government Facilities

Coverage

Deep Cavernous Buildings

Parking

Below Grade

Low-E Glass (LEED)
Why Is Indoor Coverage Poor?

• The building is acting as an RF shield.
  – Fortified Construction; Hospitals, Government buildings, etc...
  – Highly tinted windows; Energy efficient, green building efforts.
  – Lack of coverage in below grade floors.
  – Elevators, and center areas of the building

• High Rise buildings (typically over 25 floors)
  – Above cell site tower coverage footprint.
  – Bottom and below grade floors often shadowed and need a DAS.
  – No dominant mobile control channels on upper floors

• The building is blocked from the tower by other buildings.

• The WSP Network Cell Site Tower is too far away.
  – Some WSP tower locations may be closer than others.
Is a Coverage System Required

- Wireless Service Provider (WSP) Commercial Services
- Is there less than 3 “BARS” on a phone?
- Do people complain about poor cellular coverage indoors?
- Do people need to stand next to a window to make a call?
- Does the owner want to guarantee full coverage?

- Public Safety Services (police, fire, rescue)
- Does the city have a first-responder in-building coverage ordinance?
- Do first responders complain about poor 2-way radio coverage?
- Is there coverage in the stairwells and elevators?
- Do you have liability concerns?
In-Building Wireless – A Complete Solution

- Neutral Host System
  - Supports all W-WAN systems
    - Public Safety and commercial operators
  - Negotiate wireless service from any operator

- Improve business level QoS – more bars

- Reduce liability risk through improved public safety

- Increase efficiency of mobile employees, customers, vendors

- A future-proof solution that will migrate as wireless technology evolves
DAS System Configurations

- **Passive DAS** - Coax used to distribute RF signals
  - Only active component
  - Ideal solution for smaller venues <150K ft²
  - Limited growth or expansion capability
  - Parallel systems required for carrier and public safety

- **Active DAS** - Adds RF↔FO conversion, fiber, and distributed amplifiers
  - Scalable – Single to multi-band/operator installations
  - Cost effective multi carrier coverage over 150,000 sq. ft.
  - Flexible for growth and expansion
  - One system for both Cellular Carriers and 700/800/900 Public Safety
PASSIVE DAS
Passive System Design – Small Venues

- 3 components in Passive system
  - Outdoor Antenna
  - Indoor Antenna
  - Small Bi-Directional Amplifier
- Ideal for spaces up to 50K sq. ft.
- Generally, good for a Single Service Provider
- Typically, Dual Band (Cell and PCS) support
Key Functions

- Variable bandwidth (up to 25 MHz)
- Auto Gain functionality
- Automatic Level Control (ALC)
- Display for RSSI and status indication
- Easy commissioning via web-based GUI
- Connection to LAN
- Optional remote access and alarm forwarding via SMS
- Multi-Band / Multi-Segment Configurations
- Meeting all regulatory standards (GSM05.05, FCC, 3GPP etc.)
- Network migration to 3G, 4G and beyond without hardware upgrades
### MRx18 Combinations

- Almost all combinations of all prevalent frequency standards possible
- Mainly requested combinations are the following:

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1) up to 3 segments
2) either combination with 2 fixed segments in 850MHz and 2 variable segments in 1900MHz or 1 variable segment in 850MHz and 2 variable segments in 1900MHz
3) 2 fixed segments in 850 MHz
Passive Solution Design – Larger Venues

- Ideal for spaces up to 150K sq. ft.
- 3 components in Passive system
  - Outdoor Antenna
  - Indoor Antenna
  - Larger Bi-Directional Amplifier
- Able to support Multiple Service Providers
- Typically, Multi-Band (Cell and PCS, AWS, PS UHF) support
Bi-Directional Amplifiers (BDA) / Repeaters

- **Scalable:** Upgradable to meet the continual evolution of new wireless standards & technologies
- **Selective:** Utilization of the latest advancements in technology to ensure independence from other radio transmission sites
- **Intelligent:** Reconfigurable to meet the dynamic needs of the ever changing wireless landscape
- **Efficient:** The industry’s most compact and energy efficient off-air, Multi-Band repeater
## Node A RF Modules for Commercial Spectrum

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Module</th>
<th>Wattage</th>
<th>Frequency Range</th>
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<tr>
<td>700 MHz</td>
<td>AF 727</td>
<td>½ watt</td>
<td>698 – 716 &amp; 776 – 787 / 728 – 757 MHz</td>
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<td>AF 737</td>
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<td>800 MHz</td>
<td>AF 8037</td>
<td>5 watt</td>
<td>806 – 824 / 851 – 869 MHz</td>
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<tr>
<td>850 MHz</td>
<td>AF 8527</td>
<td>½ watt</td>
<td>824 – 849 / 869 – 894 MHz</td>
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<td></td>
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<tr>
<td>900 MHz</td>
<td>AF 9037</td>
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<td>896 – 902 / 935 – 941 MHz</td>
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<td>1900 MHz</td>
<td>AF 1927</td>
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<td>1850 – 1915 / 1930 – 1995 MHz</td>
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<td>AF 1937</td>
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<tr>
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<td>1710 – 1755 / 2110 – 2155 MHz</td>
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<tr>
<td></td>
<td>AF 1737</td>
<td>5 watt</td>
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ACTIVE DAS
Active DAS RF Path

Floor 4
Cellmax 1  Cellmax 2  Heliax Cable  Heliax Cable  Cellmax 3  Cellmax 4
ION Remote

Floor 3
Cellmax 1  Cellmax 2  ION Remote  Cellmax 3  Cellmax 4
Single Mode Fiber

Floor 2
Cellmax 1  Cellmax 2  Mode Fiber  Cellmax 3  Cellmax 4
ION Remote

Floor 1
Cellmax 1  Cellmax 2  ION Remote  Cellmax 3  Cellmax 4

O-DAS ION Master Unit

AIMOS Operations and Maintenance Center

Base Station

Node-A Repeater

Cellmax Donor Antenna
In-Building Wireless Solution

- Passive distribution on each floor with coax & antennas
- Active equipment amplifies and conditions all carrier and public safety signals
- Utilizes Coax ↔ FO conversion and fiber backbone distribution system
- Dynamic system provides future-proofing as frequency allocations change
Passive Components

- 50Ω ½” Coax
- N-Type Connectors
  - Plenum – Corrugated + Positive Stop
  - LSZH – Smooth wall + EZFit
- RF Splitters/Combiners
- Directional couplers / Taps
- Antennas
  - 15-20Kft² typical per antenna
Thank You