

In Building Wireless: Planning and Pitfalls

EduComm Conference

June 9, 2004

Presented by Elert & Associates

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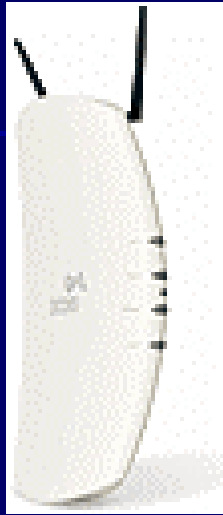
Agenda

- Wireless Terminology
- The First Questions
- In-building Wireless Technologies
- Applications & Spectrum Review
- Wi-Fi, Cellular/PCS/Paging & Public Safety
- Planning Steps & Pitfalls
- Q & A

Terms



- WLAN
- 802.11 ("b" "a" and "g")
- Wi-Fi (Laptop/PDA Networking)
- Bluetooth (Printer/Headset Connections)
- AP (Access Point)
- Interface (WLAN to Wired)
- Client (PC, PDA, etc.)
- Public Safety (Police, Fire & EMS)
- DAS (In-building repeater)

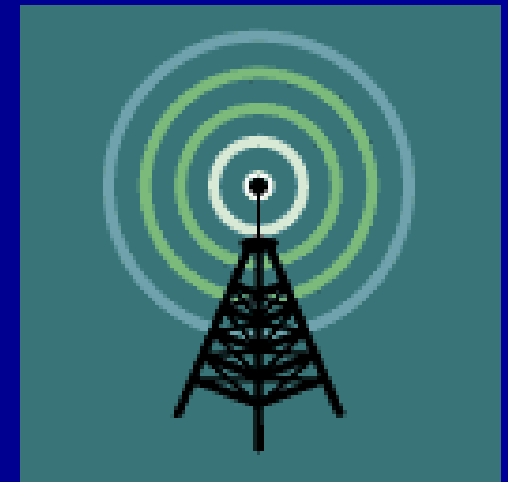


Early Questions

- Will wireless replace wired communications (completely)?
- Can wireless ever reach wired throughput and security?
- Where does wireless make sense?
- Are wireless "faults" just accepted?

In-building wireless technologies to consider

- Wi-Fi WLAN
- Bluetooth/Short Range Devices
- Paging
- Wireless phones
- Cellular/PCS voice/data/video
- Public Safety communications
- Two-way radio (internal)
- Portable control/audio/video devices



Application 1: Skyline Exhibits

- Tradeshow & Event Exhibits
- Mobility of Staff
- 280,000 ft²



Mobile Phones

■ Procurement Process

- Used consultant expertise
- Industry standard platform
- Vendor accountability
- Deployed in phases

■ Installation Results

- Technology met expectations
- Tuning period lasted about 1 month
- Started with 100 phones, increased to 125



Application 2: Minnesota State Crime Lab

- Interactions between labs
- Interactions with evidence reception
- Interactions with law enforcement
- Multiple labs and offices
- Interactions with county attorneys

Wireless in the Lab

- Wireless handsets
- Bar code readers
- PDAs
- Radios
- Pagers
- Ovens!



The Wireless Spectrum

Infrared Light

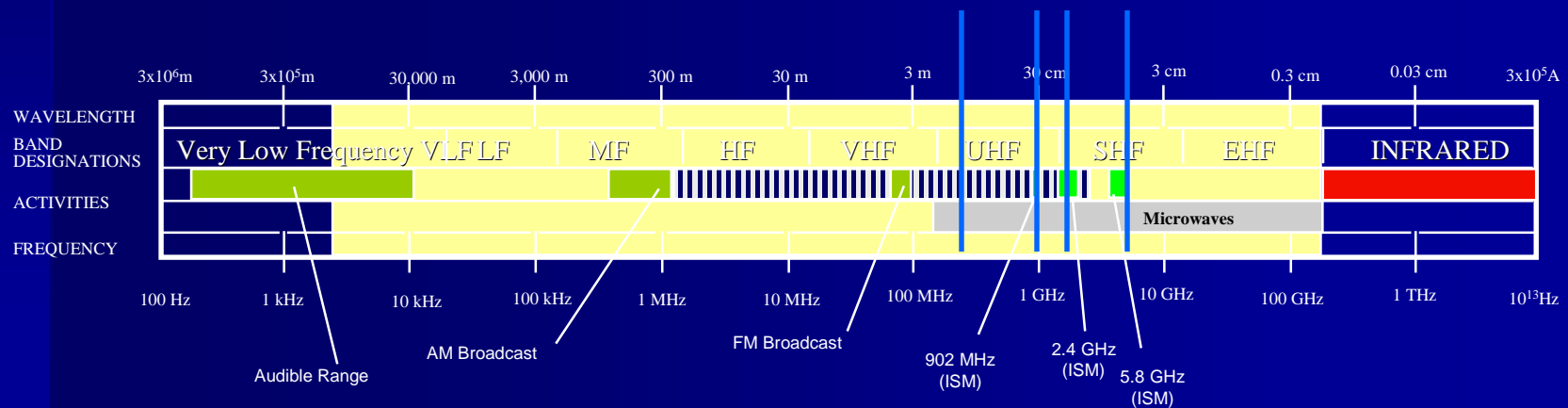
Narrowband

Spread Spectrum

- Typically Line-of-site
- Short Range Connectivity
- In Room Application
- High Data Rate Potential

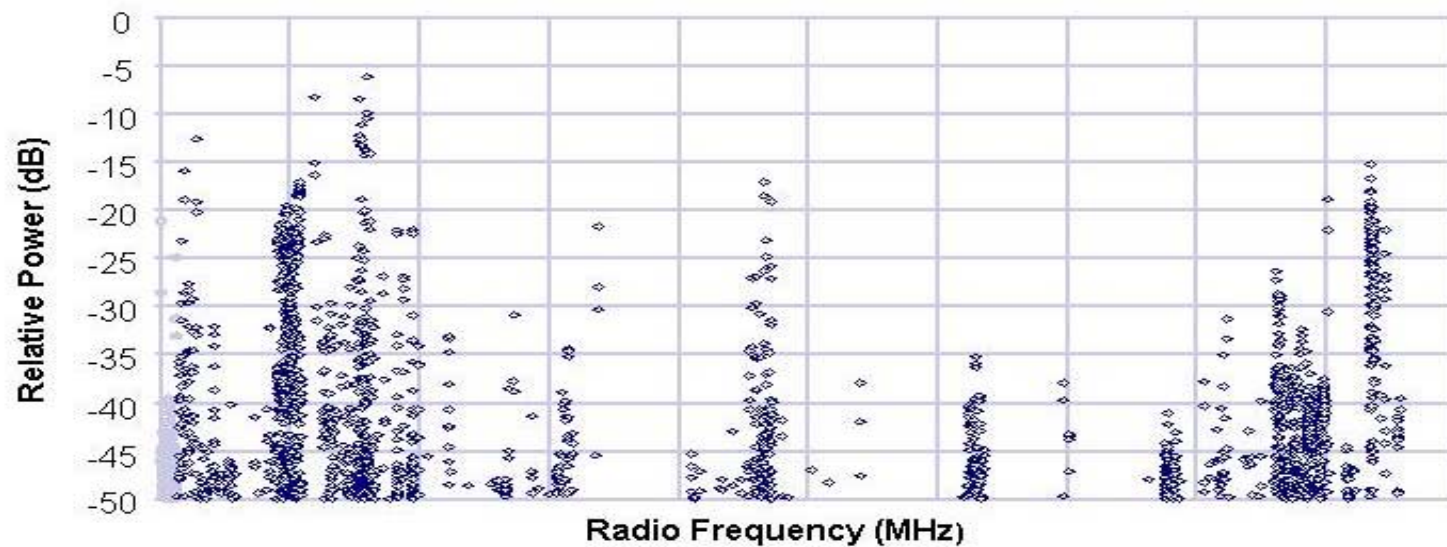
- Specific Frequencies
- Individual User License
- Low Data Rates

- Interference Resistance
- Secure
- License Free Use



Spectrum Utilization

The Real World



Spectrum: The Facts

- Refarming
- Higher and higher utilization ratios
- Federal protection for some users
- The demand keeps growing
- Users want spectrum when they want it
- Quickly owing to digital

The FCC Approach

- Commons-based: Unlicensed
 - ISM: 900 MHz, 2.4 GHz and 5.2/5.8 GHz
 - 802.11 a, b/g
 - FCC Part 15 (low power handheld control, security and audio devices)
- Property-based: Licensed
 - VHF/UHF/Broadcast Television/Radio/Satellite
 - Public Safety - 700/800 MHz
 - Cellular/PCS/Paging – 800/900/1900/2100 MHz

Unlicensed Frequencies

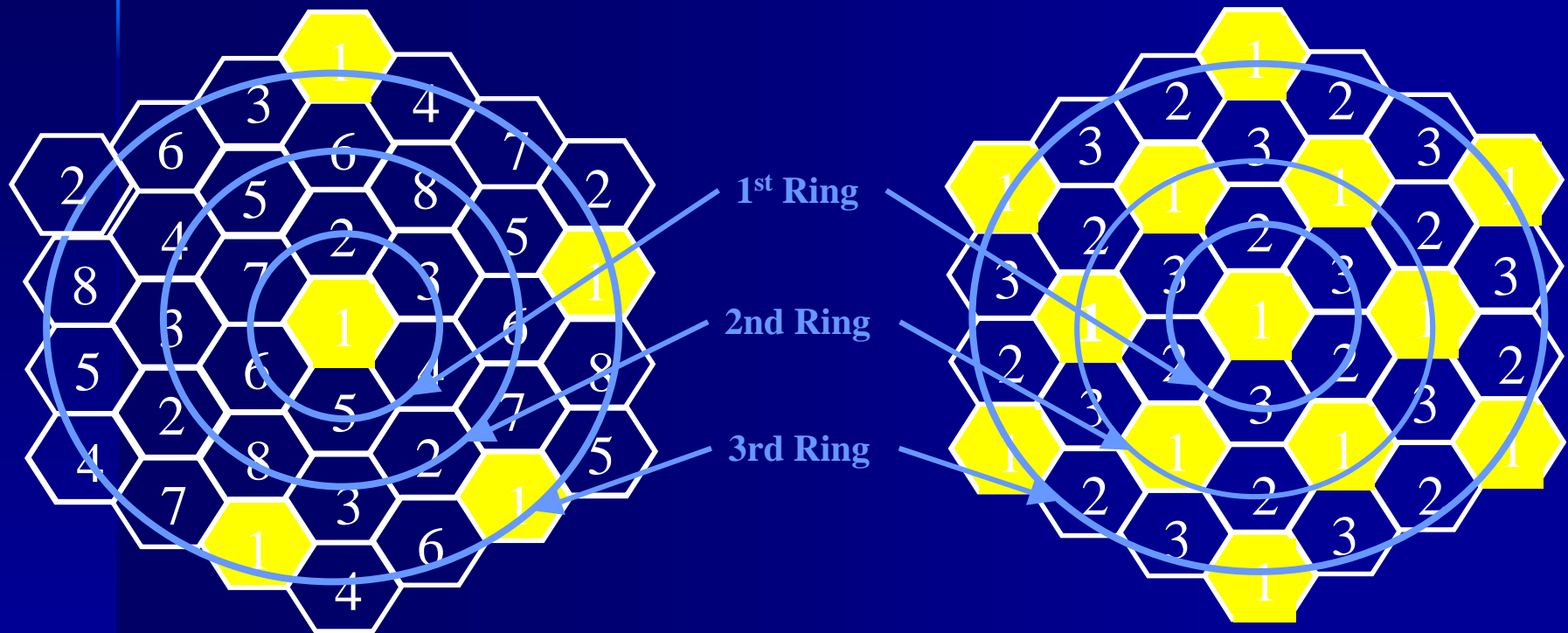
- 2.4 & 5.8 GHz "License to Interfere Bands"
- Wi-Fi is smart: "Listens before Talking"
- Early Bluetooth: "Just talks" (2.4 GHz)
- Handheld control devices (IR & UHF)
- Wireless audio (VHF, UHF, & 900 MHz)
- Video security cameras (900 & 2.4 GHz)
- RFID (UHF w/higher power just authorized)

Wi-Fi IEEE 802.11b, a & g

- Shared medium & frequencies
- Throughput (speed)
- Frequencies
 - Interference
 - Multiple modes
- Coverage area
- Home vs. enterprise products



WLAN Frequency Reuse Plan



802.11a

802.11b

WLAN Selection Review

- 802.11b (2.4 GHz)
 - Loading
 - Frequency Reuse
 - Lowest cost
- 802.11g (2.4 GHz)
 - Auto downgrade to “b”
 - More channels
- 802.11a (5 GHz)
 - More channels
 - Lower interference potential

Cellular/PCS/Paging

- 800, 900, 1900, 2100 MHz frequencies
- FDMA (AMPS), TDMA, CDMA and GSM
- Exterior systems – base stations
- In-building access methods
 - System loading
 - Licensing and contractual issues
 - Enhanced 911

Distributed Antenna System (DAS)

- Access to Cellular/SMR/Paging
 - Donor antenna
 - Base Station on site
- Bi-Directional Amplifier(s)
- System Management
- Antenna Distribution
 - Coax
 - Fiber optics
 - Shielded Cat. 5

Building/Structural Issues

- Shielding
- Signal absorption
- Multipath
- Site survey
- Antenna locations/visibility

Shielding & Absorption

- Steel, concrete, and solar glass
- Underground areas
- Moveable walls & dividers
- Moving furniture
- Free space (distance)
- People!

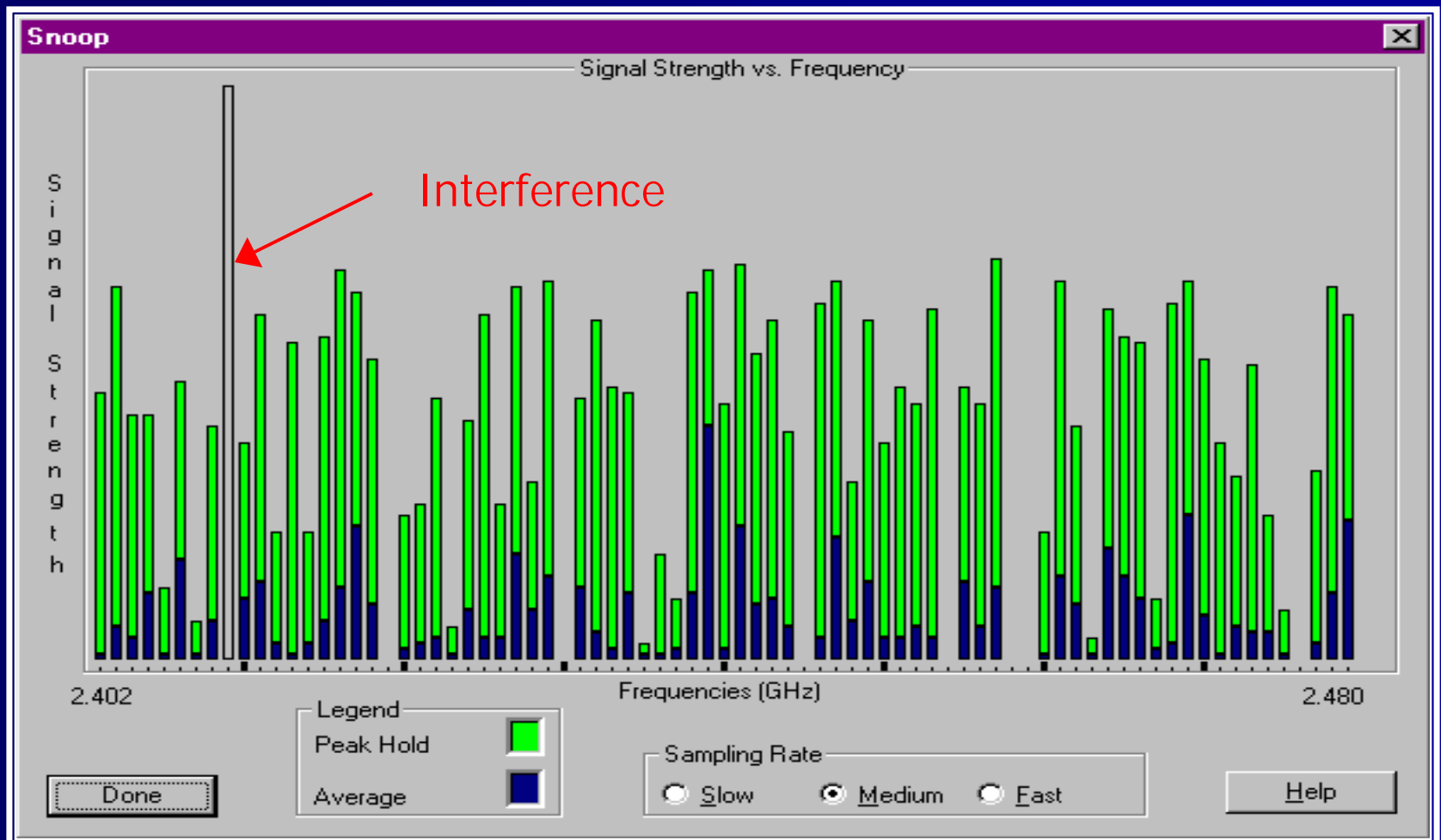
Multipath

- Reflections
- Peaks and valleys
- Frequency dependent

Equipment Locations

- Inside antennas
- Access Points & Antennas
- Common hardware
- Outside antennas

Interference



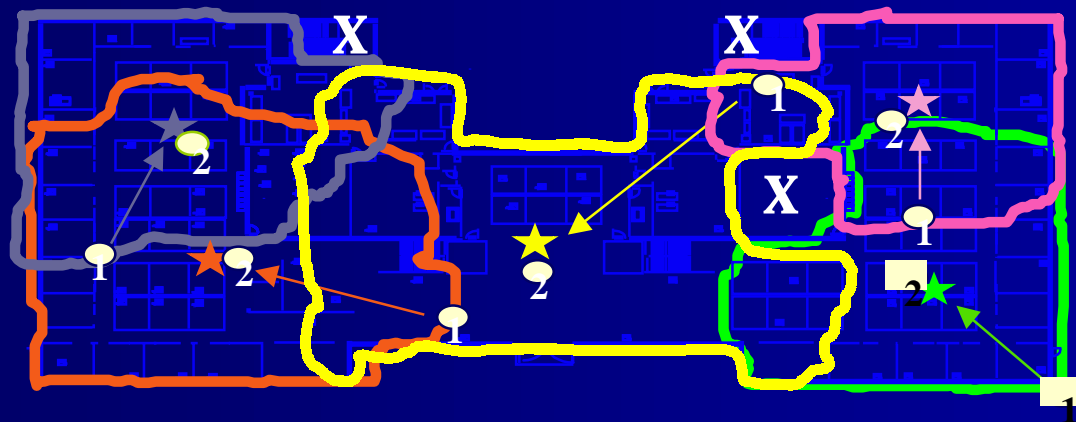
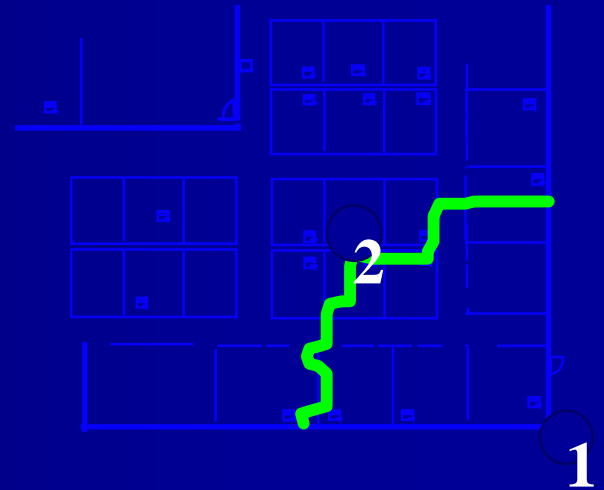
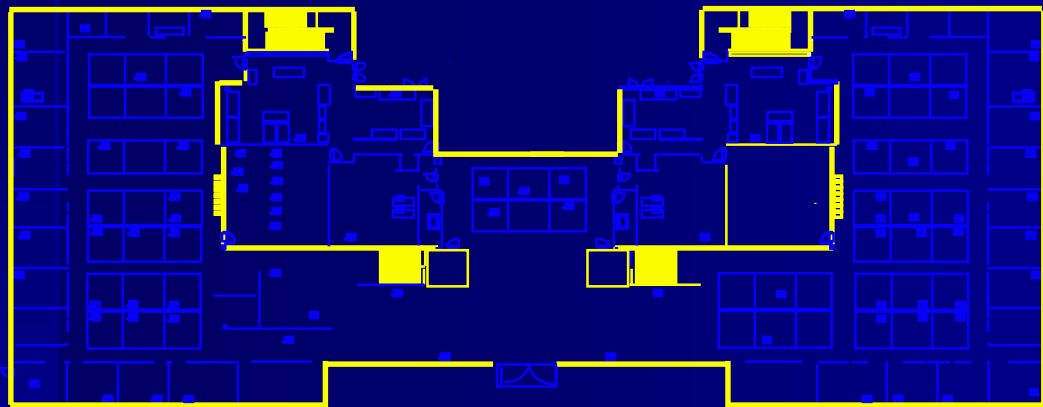
Interference

- Other Devices
 - Anything with a microprocessor
 - Receivers
 - Microwave ovens
- Intermodulation
- Signal mixing
- Receiver desensing
- The neighbor's AP

Wireless Planning Steps

- Select initial inside antenna locations
- Test and redesign per signal strength
- *Test and redesign per signal strength*
- Create a “real-world” coverage map
- Determine how many APs (channels)
- Assign frequencies to APs
- Audit: APs, frequency, location and coverage

Site Survey & AP Placement



Other WLAN Design Issues

- Overall system loading
 - Voice/Data mix & expectations (QoS)
 - Number of simultaneous conversations
- Supporting network systems
 - Quality of Service
 - VLAN deployment
- Network management tools
- Utilization of Virtual APs
- Rogue and Neighboring APs

WLAN Planning Pitfalls

- Access Point quantities & placement
- AC Power availability
- Channel capacity vs. system growth
- Interference (known and unknown)
- Data & Voice issues
- Security concerns (802.1x)
- Signal Strength vs. Noise
- Redesign with addition of a new AP

Solutions/Issues?

- System Integration
 - Total design vs. “Peace-meal” approach
- Neutral Host Service for DAS
 - Carrier shared cost
 - External management
 - Public buildings
- Building Manager/Owner
 - Partially owned system
 - Responsibility

Wireless Lessons Learned

"The User Perspective"

- Make use of existing expertise
- Ask a lot of questions, then ask more
- Don't expect to over deploy
- Test, Test, Test
- Explicit performance guarantees
- Phase in the wireless deployment
- Tie payment milestones to performance

Future Considerations

- Technology changing & improving
 - Hardware vs. Software Defined
 - Cognitive Control
- Jurisdictional codes
- Sensor technology (RFID & crumbs?)
- Interference keeps increasing

Questions ???

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