Can Wireless Control Systems Save Energy?
The Answer is Yes, The Question is When & How Much!

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Johnson Controls

Looking For Clues

Defining the Unknowns

The wireless questions you may not have known to ask

- What are the benefits of wireless control and sensing?
- Where does wireless apply in a commercial BAS?
- What types of wireless technologies are available for a commercial BAS?
- Are there any silver bullets for successful wireless layout & installation?
- What do I need to know about wireless interference and security?
- Can I use wireless on all my BAS equipment?
- Anyone using this stuff?

Wireless Controls - Benefits

Installation Savings and Flexibility Today

Economy

- Superior alternative to conventional hardwiring for cost prohibitive applications, or applications that require aesthetic or historic preservation
  - Applications with decorative surfaces, such as museums, historic buildings, and convention centers
  - Applications where hazardous materials, such as asbestos, present installation roadblocks
  - Where initial cost of wiring is high due to distance, rates, practices or codes

Flexibility *and* ***Mobility*** *for installation and relocation.*

- Applications with frequent changes or tenant turnover, such as office buildings, commercial real estate buildings, and retail malls

Simplicity *for moves, adds, and changes*

- Offers quick expansion of control capabilities in existing installations
- Minimizes disruption to building occupants

User Benefits

Installation savings should be based on TCO

TCO = TIC + TOC

- Total Cost of Ownership is the real cost saving opportunity
- Total Installed Cost
  - For wired = engineering + material + installation + termination + commissioning
  - For wireless = engineering + infrastructure + commissioning
- Total Operations Cost
  - For wired = changes (material + installation+ terminations + commissioning) + maintenance
  - For wireless = changes (commissioning) + maintenance

The moral of the story is:
The greater the distance, the greater the cost of copper, the greater the cost of labor, the more restrictions or requirements placed on wired installation, the greater the number of moves adds and changes, the more likely it is that wireless controls will save money. That means the more likely that energy savings will be enabled now and moving forward

User Benefits

Wired Communication Headaches … A Thing of the Past

Wired RS485 networks can be difficult to diagnose & troubleshoot

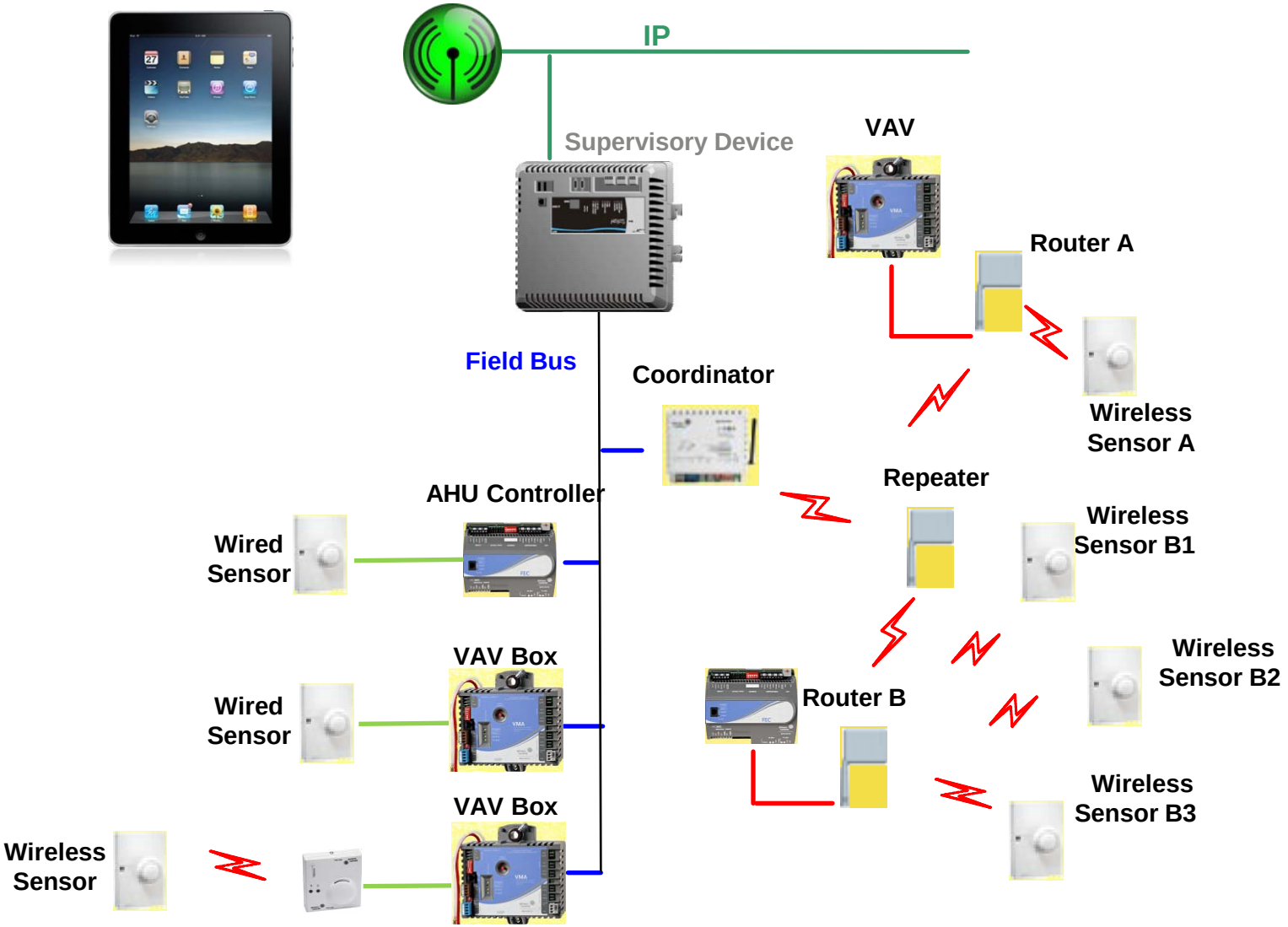
- Short detection
- Ground loops
- Lightening strikes, transients
- EOL location determination
- Locating problematic nodes

Wireless systems have fewer hassles

- **Quicker installs** with fewer punch list items
- **No software tools required** for initial installation
- In many systems each node displays it's own **bus health** using an LED
- Tools available to installing contractors, **pinpoint problematic nodes**
- **No special training** required for wireless tools, easier long term support

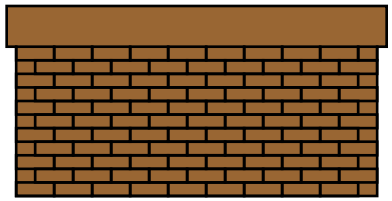
Looking For Clues

Where Can I Use Wireless in My BAS?



Looking For Clues

Key Points for Successful BAS Wireless Installation – Silver Bullets



Wireless Physical Knowns

Wireless signals are greatly effected by the mediums through which they travel

Wireless system devices have finite communication distances and hop counts between wireless nodes

Wireless devices often times have to share the same air space with other devices

Be aware of wireless restrictions in ALL areas of your wireless system

Specific Target Applications and Best Practices

Where to Use

- Structures with **excessive brick or concrete walls**
  - Schools, correctional facilities
- Buildings with **decorative surfaces** such as marble, granite, glass, wood, mirrors or historic building **sites requiring the preservation of architectural details**
  - Museums, convention centers, civic treasures
- Locations with **large, open spaces**
  - Atriums, stadiums, arenas, gymnasiums, convention centers, airports, auditoriums
- Buildings with **frequent tenant turnover** or changes in use
  - Office buildings, malls, retail stores
- Buildings with **occupants sensitive to disruptions** to business
- Buildings that contain **asbestos and other materials that cannot be disturbed**
- Regions with there is a **shortage of skilled workers** for installation and termination

Target Applications

Where to Avoid (Perhaps)

- Validated Environments
- UL864 **Smoke Control** applications
- Applications that cannot tolerate intermittent interference in wireless conditions, including applications in which:
  - Critical control features would impact **life safety** or result in large monetary loss
  - Data centers, production lines, or critical areas would be shut down
  - Operation of exhaust fans or air handling units would impair a purge or pressurization mode
  - **Security** points are monitored
- Applications that also restrict use of cellular telephones or WiFi
  - For example, avoid **operating rooms**, **radiation therapy** rooms
- Where **metal obstructions** hinder the direct, line-of-sight transmission path between wireless devices

Looking For Clues

3 Popular Wireless Technologies

WiFi

- 2.4 GHz, 11 Channels
- High Band Width
- High Power Consumption

ZigBee

- 2.4 GHz, 16 Channels
- Low Band Width
- Low Power Consumption

Enocean

- 868 MHz Europe, 315 MHz USA
- Ultra Low Band Width
- Ultra Low Power Consumption

Why ZigBee?

Standards Based, Reliability, Low Cost

ZigBee is a committee regulated, international protocol

"The ZigBee Alliance is a global ecosystem of companies creating wireless solutions for use in home, commercial and industrial applications. It is the only global wireless communications standard enabling the development of easily deployable, low-cost, low-power, monitoring and control products."

Membership: The Power of Many

ZigBee Alliance members come from a broad spectrum of industries

Alliance has more than **200 member companies**.

Standards-Based

The ZigBee Alliance standardized its specification on top of the Physical **(PHY)** and Medium Access Control **(MAC)** layers of the **IEEE 802.15.4** global standard; adding the application profile layers, security and network layers to create ZigBee. The intent is that vendor-independent product solutions will be interoperable. the stack is continually evolving just as BACnet implementation was in the 90s.

Mesh Network Features

The continuous flow of communication exacted by a mesh network topology provides the **reliability** required for wireless-based connectivity of remote monitoring and sensing controls.

Served Markets

ZigBee is a standards-based technology designed to address the unique needs of **low-cost**, low-power, wireless sensor networks for **remote monitoring**, **home control**, and building automation network applications.

Why ZigBee?

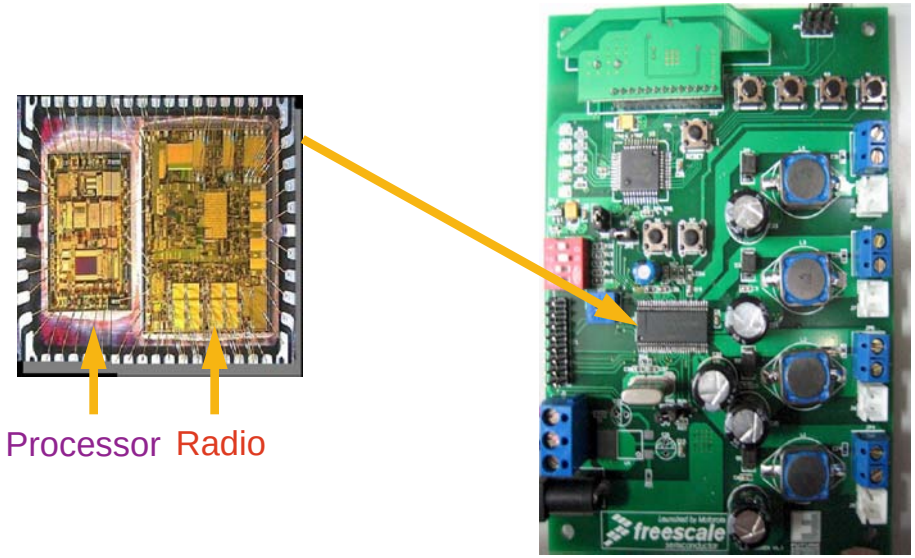
Rapidly Adopting Customer Base, Multi-sourced Chip Providers

Quickly becoming industry standard for wireless peripheral communication

- Southern California Edison will have in place 5 million ZigBee wireless nodes for electric, gas, and water utility meter reading in homes
- ZigBee is used extensively in home automation

ZigBee radios and integrated microprocessors are available from **multiple** vendors

- Texas Instruments™
- Oki™ Semiconductor
- Ember™
- Freescale™ Semiconductor



Approx. size of a business card

ZigBee and BACnet

The Partnership Solidifies ZigBee in the Commercial Building Industry

"BACnet is partnering with ZigBee because we see a number of strengths by working together and creating a mutually beneficial relationship by marrying our technologies. Our teams are dedicated to working very closely to deliver long-term value for the commercial building industry."

Bill Swan, BACnet Committee chair

BACnet (ANSI/ASHRAE Std.135 add. Q) has added ZigBee as it's FIRST wireless data link!

BACnet → Over → ZigBee™

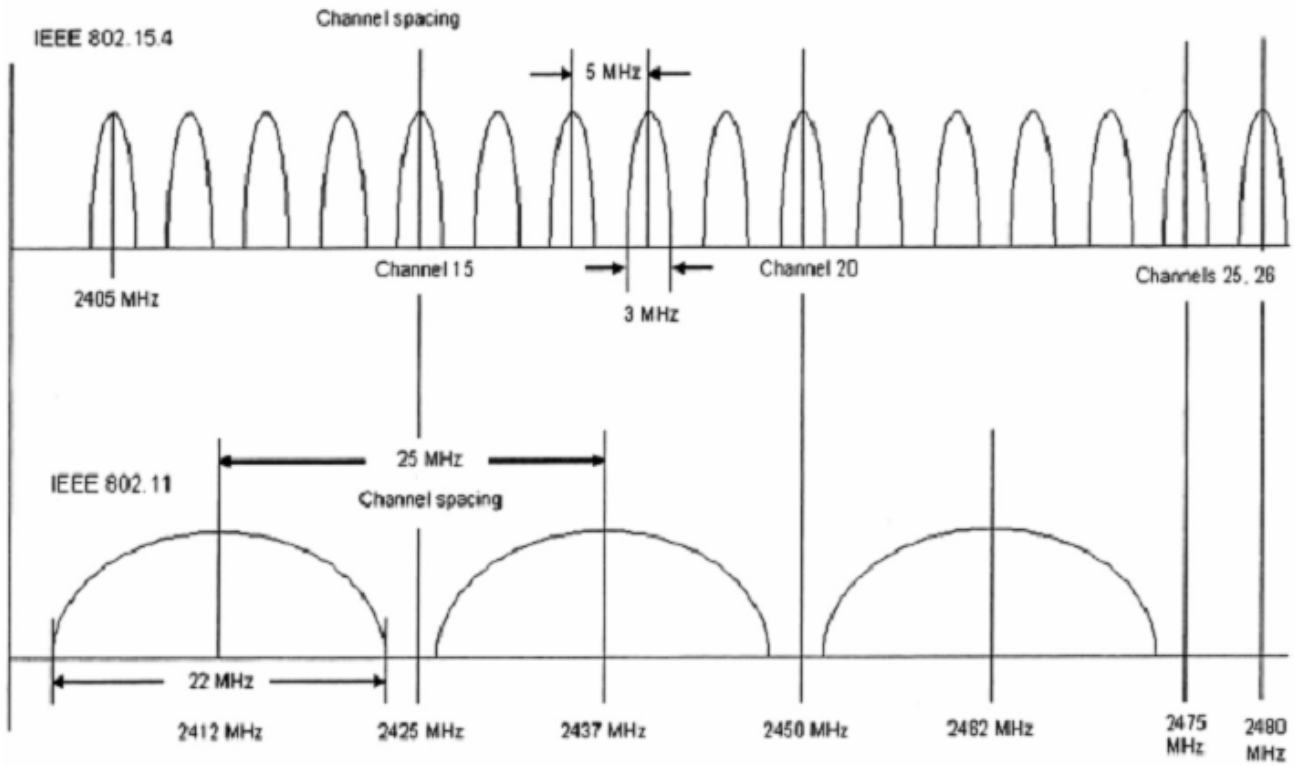
Overview of ZigBee Technology

Based Upon IEEE 802.15.4

Up to 16 different channels on the 2.4 GHz band to secure **non-interference** with other wireless devices

Yes, it does operate on the on the 2.4G Hz radio frequency band yet…

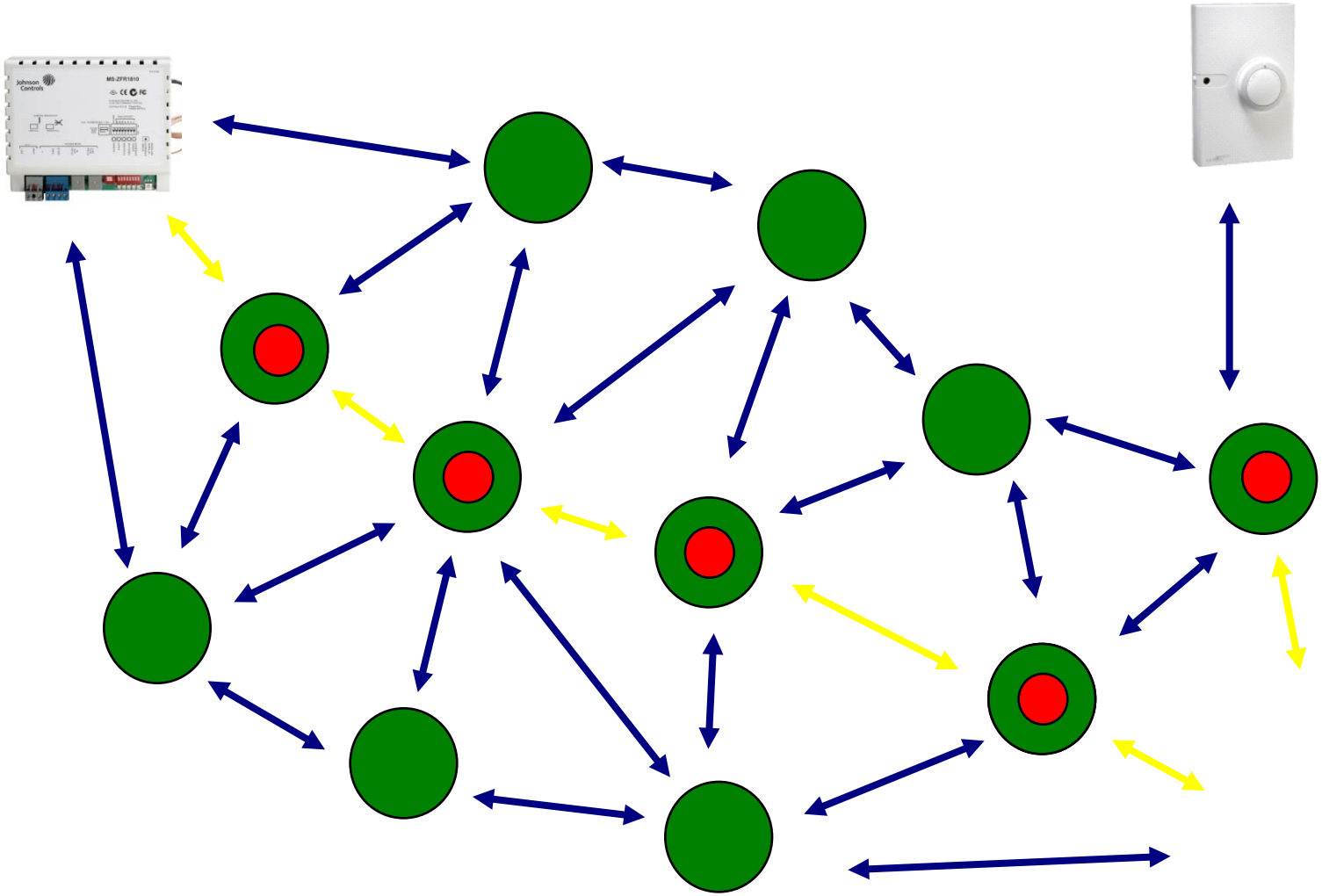
- No common frequencies between **cell phones** bands and 2.4G Hz band where ZFR System operates
- Same frequency band as IEEE 802.11 **WiFi**, but uses different sized channels
- Automatically selects non-overlapping, "quiet" channels (e.g. 15, 20, 25). *Operates in the WiFi valleys*



Overview of ZigBee Technology

Mesh Network Topology

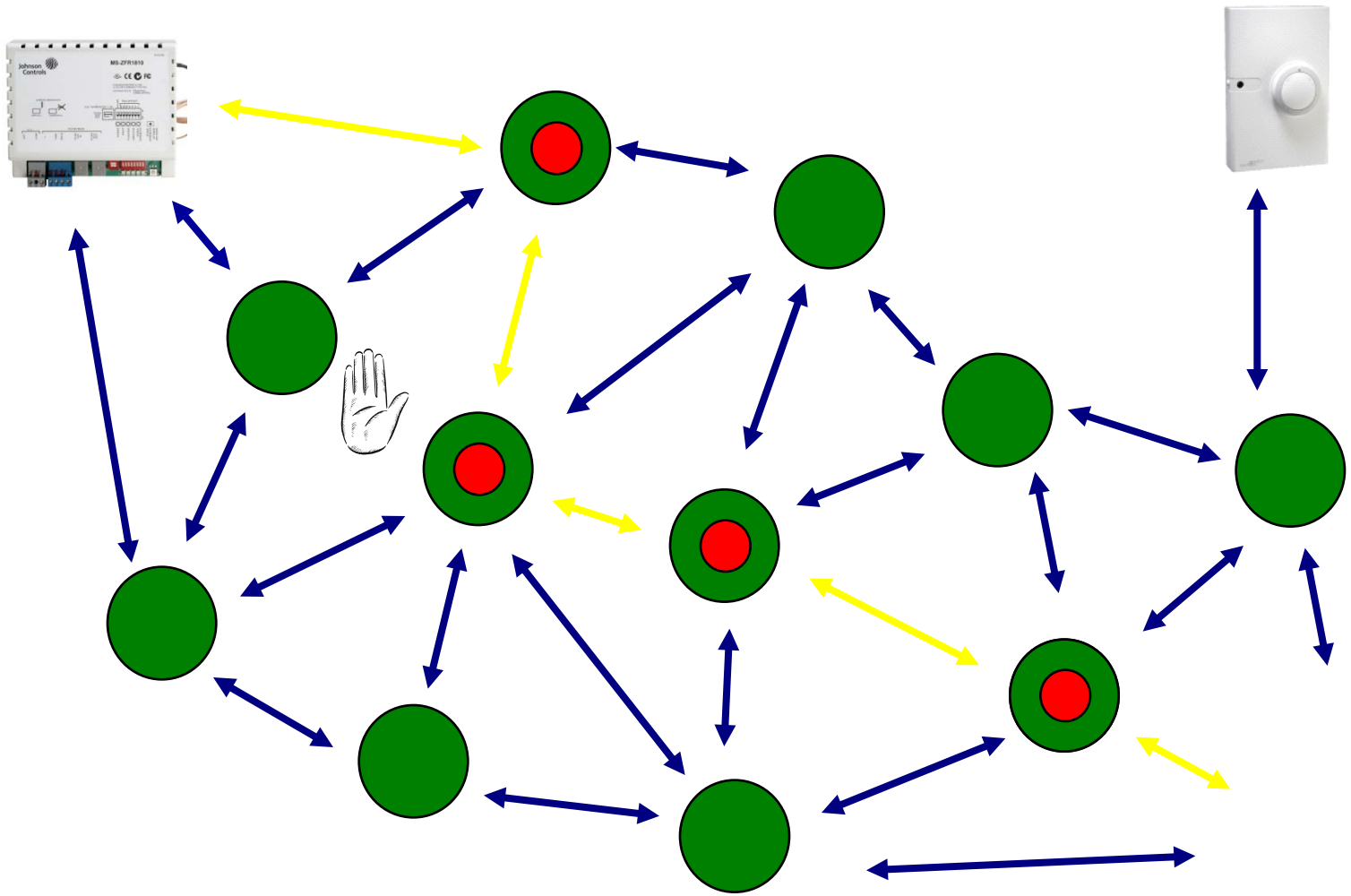
- ZigBee nodes in a mesh network seek the BEST path from source to destination



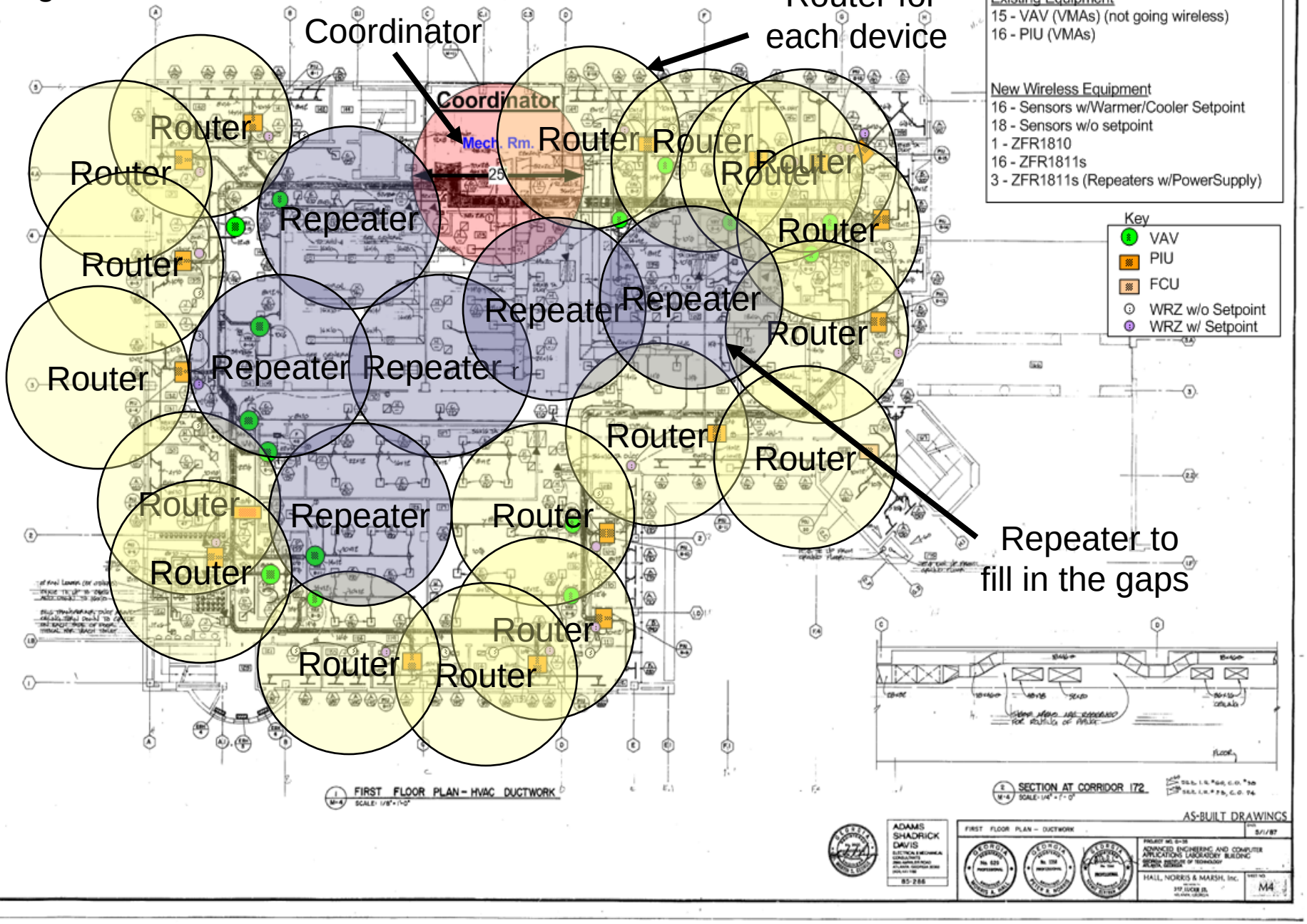
Overview of ZigBee Technology

Mesh Network Topology

- ZigBee Meshes **Self Heal** if a path is blocked



ZigBee Wireless Communications!



Looking For Clues

Putting It All the Clues Together… Early Considerations

All installations begin in the engineering office

- Utilize mechanical drawings
- Utilize knowledge of tenant usage

Retrofits can benefit from site inspections

- Site survey tools
- Walk thru

Up front considerations

- Battery usage, replacement, recycling, harvesting
- Battery types.. alkaline, lithium
- Consider life cycle changes in the building – avoid between floor repeaters, ect

Cost savings analysis for wireless mesh network

These examples are typical:

	Devices	Wireless	Infrastruct	Repeaters	Wire savir	NET		
Job 1	20					20		
	20	5	2	1	-10	18	-10%	
	20	5	2	0	-10	17	-15%	
Job 2	10					10		
	10	2.5	2	0.5	-5	10		
	10	2.5	2	0	-5	9.5	-10%	
Assumption is that								
		the premium for a wireless device or additional hardware is 25%						
		the cost of a reciever mounted near the supervisory controller is 200%						
		The cost of a necessary repeater is half the cost of the device						
		The average wiring savings for the device is half the cost of the device						

How do we Maximize Effectiveness and Minimize Cost of the Infrastructure?

The answer is more devices in the mesh (easy with ZigBee)

Lighting

- Fixture control
- Blind controls

Energy monitoring

Water monitoring

HVAC

- Increased zoning
- Window monitoring and control
- Air Quality

RF audio messaging

RF video control

Occupancy sensing

Summary

Wireless delivers savings

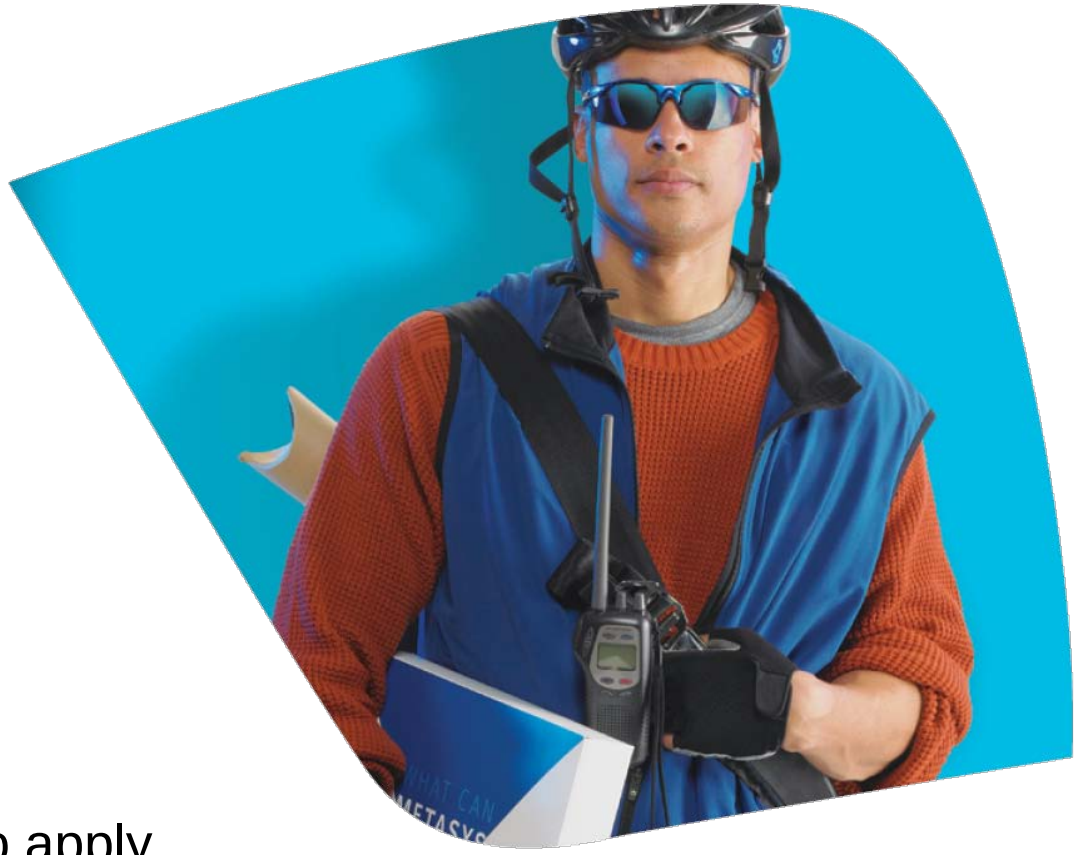
Wireless is here

- Available
- Proven

Harmonized standards

- ZigBee Alliance
- EnOcean Alliance
- Wifi
- Emerge Alliance

Success is in knowing how to apply



Vision

A more comfortable, safe and sustainable world.