

ZFR1800 Series Wireless Field Bus System

Technical Bulletin

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Refer to the [QuickLIT website](#) for the most up-to-date version of this document.

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ZFR1800 Series Wireless Field Bus System

Technical Bulletin

Document Introduction

This document describes how to commission and configure a ZFR1800 Series Wireless Field Bus System on a Metasys® network. This document also provides a brief technical background on ZigBee® technology and describes how to test and troubleshoot a wireless mesh network.

This document does not describe how to install ZFR1810 Coordinators, ZFR1811 Routers/Repeaters, or WRZ Series Sensors. It also does not describe how to install, commission, configure, operate, or troubleshoot the supported controllers.

Related Documentation

Table 1: ZFR1800 Series Wireless Field Bus System Related Documentation

For Information On	See Document	LIT or Part Number
Applications, Features, and Benefits of the ZFR1800 Series Wireless Field Bus System	<i>ZFR1800 Series Wireless Field Bus System Product Bulletin</i>	<i>LIT-12011336</i>
Locating, Mounting, and Wiring ZFR1810 Coordinators	<i>ZFR1810 Wireless Field Bus Coordinator Installation Instructions</i>	<i>Part No. 24-10325-2</i>
Locating, Mounting, and Wiring ZFR1811 Routers	<i>ZFR1811 Wireless Field Bus Router Installation Instructions</i>	<i>Part No. 24-10325-10</i>
Locating, Mounting, and Wiring WRZ Series Sensors	<i>WRZ Series Wireless Room Sensors Installation Instructions</i>	<i>Part No. 24-10332-2</i>
	<i>WRZ-STR0000-0 Wireless Refrigerator/Freezer Temperature Transmitter and Probe Assembly Installation Instructions</i>	<i>Part No. 24-10332-10</i>
Using the WRZ-SST Series Wireless Sensing System Tool with a WRZ Series Sensor to Perform a Site Survey for Pre-determining Potential Locations for Installation, and to Test Wireless Signal Strength In Advance of ZFR1800 Series System Installation	<i>WRZ-SST-120 Wireless Sensing System Tool Installation Instructions</i>	<i>Part No. 24-10563-12</i>
Configuring, Commissioning, and Loading the ZFR1800 Series Wireless Field Bus System Using the Controller Configuration Tool (CCT)	<i>Controller Tool Help</i>	<i>LIT-12011147¹</i>
ZFR Checkout Tool	<i>Controller Tool Help</i>	<i>LIT-12011147¹</i>
Troubleshooting MS/TP Communications Bus (FC bus) Issues	<i>MS/TP Communications Bus Technical Bulletin</i>	<i>LIT-12011034</i>
Using the MS-BTCVT-1 to Connect to Wireless Enabled Field Controllers (WEFCs)	<i>Wireless Commissioning Converter Installation Instructions</i>	<i>Part No. 24-10108-2</i>

1. This LIT number represents a print-friendly version of *Controller Tool Help*.

Applications

The wireless Metasys products within a Metasys system are ideal for any location where it is cost-prohibitive, difficult, or aesthetically unappealing to hardwire between Metasys products. Examples of these locations include the following:

- hospitals, office buildings, university campuses, educational facilities, correctional facilities, and other commercial structures with brick or solid concrete walls and/or ceilings that impede hard-wired applications
- office buildings, retail stores, and other commercial real estate where tenant turnover is frequent and temporary walls and ceilings are common
- museums, historical buildings, atriums, and other sites where building aesthetics and historical preservation are important
- stadiums, arenas, gymnasiums, convention centers, airports, zoos, and other locations with large, open spaces
- buildings with marble, granite, glass, mirrored, wood veneer, or other decorative surfaces that present challenges to hard-wiring
- buildings with asbestos or other hazardous materials that must not be disturbed
- buildings with occupants sensitive to disruptions to business
- regions with high labor costs
- refrigerator/freezer storage containers

Applications to Avoid

Locations or applications that prohibit cellular telephones or Wireless Fidelity (WiFi) systems are unsuitable for the wireless Metasys products. Examples include:

- operating rooms or radiation therapy rooms
- validated environments
- UL 864 applications
- Department of Defense applications requiring Diacap certification (for example, military bases and military hospitals)

Do not use the wireless Metasys products in applications that cannot tolerate intermittent interference, or where:

- critical control features would impact life-safety or result in large monetary loss, including secondary (backup) life-safety applications
- data centers, production lines, or critical areas would be shut down
- loss of critical control would result from loss of data from humidity or temperature sensor communications
- operation of exhaust fans or Air Handling Units (AHUs) would impair a purge or pressurization mode

- missing data would invalidate reporting required by the customer
- security points are monitored

ZFR1800 Series Wireless Field Bus System Overview

The ZFR1800 Series Wireless Field Bus System uses ZigBee technology for wireless monitoring of HVAC equipment using the BACnet® protocol. The system creates a wireless mesh network that enhances reliability and provides a resilient self-healing capability by using automatically forming multiple transmission paths for the data.

The Multidrop Serial Bus/Token-Passing (MS/TP) trunk and device limits for supported Network Automation Engine (NAE) and Network Control Engine (NCE) models are the same for hard-wired products, wireless products, or a combination of hard-wired and wireless products.

The wireless mesh network is independent of any building infrastructure and does not require any preexisting wireless infrastructure.

Any of the following Metasys® field controllers can be wirelessly enabled using a ZFR1811 Wireless Field Bus Router:

- Field Equipment Controllers (FEC) - FEC16 or FEC26
- Advanced Application Field Equipment Controllers (FAC) - FAC26 or FAC36
- Input/Output Module (IOM) - IOM17, IOM27, IOM37, or IOM47
- Variable Air Volume (VAV) Modular Assembly (VMA) - VMA16

The wireless components are transparent to the supervisory controller and require no special setup procedure to discover, map, and integrate the Wireless Enabled Field Controllers (WEFCs).

Note: The devices within the ZFR1800 Series Wireless Field Bus System are designed for indoor, intra-building applications only.

Note: A successful ZFR1800 Series Wireless Field Bus System requires that a minimum wireless signal strength is maintained between system components. Component location is an important part of system design. Distance, metal objects, and other obstructions can reduce or completely block the wireless signal transmissions.

IMPORTANT: A Network Engine reports an offline alarm within a fixed period of time when an associated MS/TP field controller goes offline. For a hard-wired FEC, FAC, IOM, or VMA field controller, this time period is usually 20 seconds. For a wireless-enabled FEC, FAC, IOM, or VMA field controller within the ZFR1800 Wireless Field Bus system, this time period is 5 minutes.

An example of a ZFR1800 Series Wireless Field Bus System is shown in Figure 1.

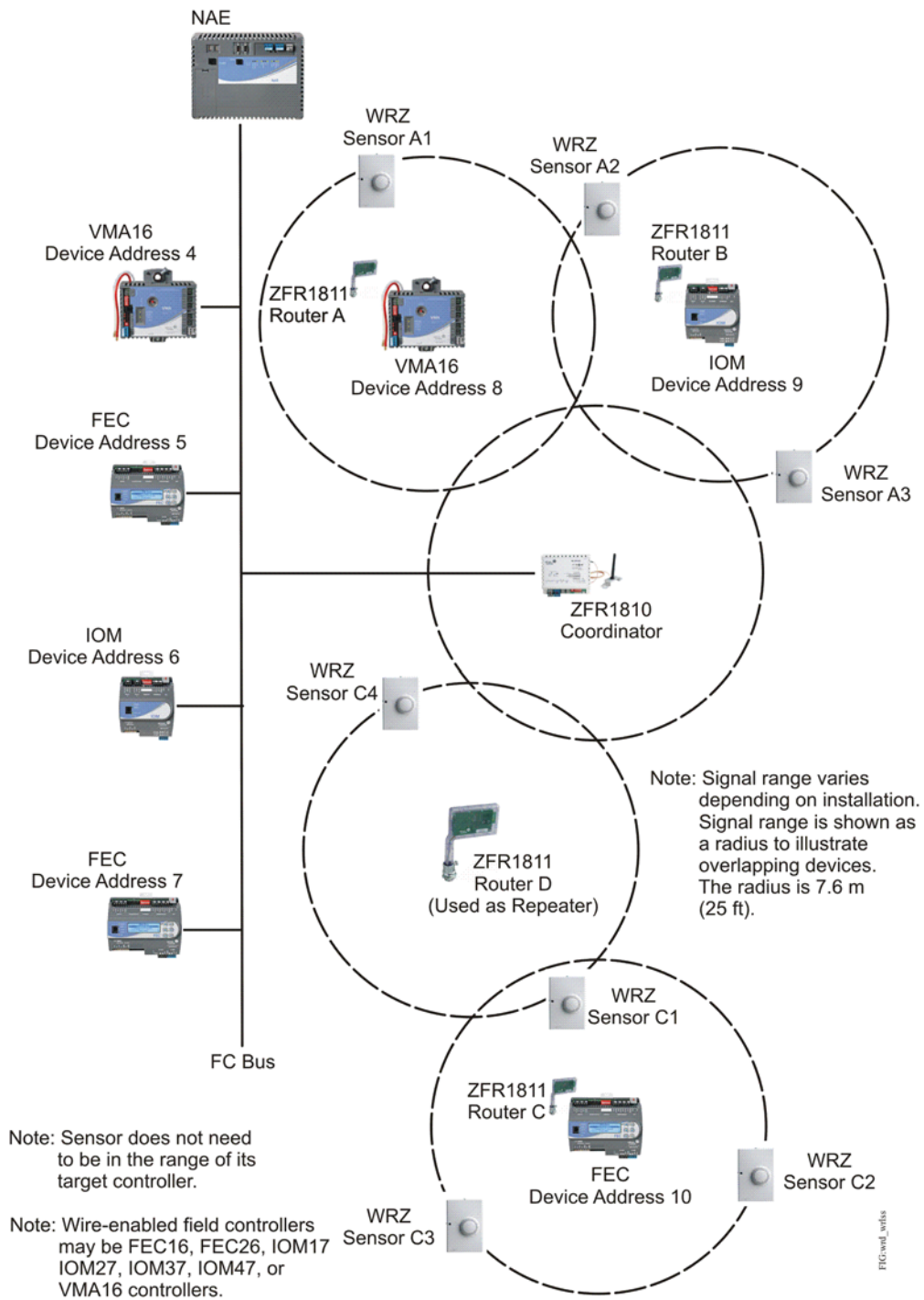


Figure 1: Example Metasys Network with ZFR1800 Wireless Field Bus System

ZFR1800 Series System Components

One ZFR1811 router is required per field controller. This pairing of a router and an FAC, FEC, IOM or VMA16 field controller is a Wireless Enabled Field Controller (WEFC).

A ZFR1800 Series system consists of:

- up to eight ZFR1810 Wireless Field Bus Coordinators per field bus
- up to 35 Wireless Enabled Field Controllers (WEFCs) per coordinator/Personal Area Network (PAN)
- up to 100 WEFCs per field bus, depending on the network engine (32 with NCE, 50 with NAE35)
- up to nine WRZ Sensors per WEFC

Note: Up to 100 total WEFC and WRZ Sensors per PAN

- additional ZFR1811 Wireless Field Bus Routers connected to MS-ZFRRPT-0 Repeater accessories, as required, acting as repeaters.

Note: Repeaters extend the wireless transmission distance of the BACnet data communications, fill in any gaps within the wireless mesh network, and provide multiple wireless data transmission pathways.

NAE and NCE

NAE35/45/55s and NCE25s (NxEs) are Web-enabled, Ethernet-based, supervisory controllers that connect BAS networks to IP networks and the Web. NxEs provide scheduling, alarm and event management, trending, energy management, data exchange, dial-out capability, and password protection. With a computer running Microsoft® Internet Explorer® Version 6.0 (or later), you can browse to a configured NxE, and monitor and control BAS field devices in the Metasys Site Management Portal on the NxE.

ZFR1810 Coordinator

A ZFR1810 Wireless Field Bus Coordinator provides a wireless interface between an NAE35/45/55 or NCE25 supervisory controller on a wired BACnet MS/TP network and wireless-enabled Metasys BACnet FEC/IOM/VMA field controllers.

Each wireless mesh network requires one ZFR1810 Coordinator, which initiates the formation of the network. Each field bus can support up to eight ZFR1810 Coordinators.

A ZFR1810 Coordinator can operate from either of two power sources:

- a 24 VAC, Class 2 power source
- 15 VDC power provided from the FC Bus jack on any Field Equipment or Supervisory Controller that is connected directly to the FC Bus

The ZFR1810 Coordinator features a remote-mount antenna and cable to allow transmission when the ZFR1810 Coordinator is mounted inside a metal panel.

ZFR1811 Router

A ZFR1811 Wireless Field Bus Router is used with any model FEC, IOM, or VMA16 field controller to provide a wireless interface between a field controller and:

- the NAE/NCE supervisory controller (by means of a ZFR1810 Coordinator)
- its associated WRZ Series Sensors

The ZFR1811 Router can also be used as a repeater to extend the range of the data communications within the wireless mesh network, or to fill any gaps within the mesh network, based on the physical layout of the wireless devices, obstacles, and other characteristics of the installation site.

A ZFR1811 Router is powered directly from the connected field controller's 15 VDC output. It can also be powered by the ZFRRPT repeater accessory to serve as a stand-alone repeater, extending the range of the BACnet data communications within the wireless mesh network.

Supported Field Controllers

The ZFR1800 Series Wireless Field Bus System enables wireless BACnet connectivity between FAC, FEC, IOM, or VMA16 controllers and Network Engines, including NAE/35/45/55 and NCEs.

In addition, the wireless field bus system provides wireless communication between FEC, FAC, or VMA16 Controllers and WRZ Series Sensors. Each wireless-enabled FEC, FAC, or VMA16 controller can support up to nine WRZ Series Sensors, for multi-zone or averaging applications, or for high/low temperature or humidity selection within a zone.

Note: The ZFR1811 Routers should be at the same Metasys system release version as the wirelessly enabled FEC, IOM, or VMA16 field controller. If there is a version mismatch, the Controller Configuration Tool (CCT) provides indication of this, and the ZFR1811 Router automatically updates during the main code download to the field controller. For information on uploading or downloading the devices to match, refer to the *Loading Devices* chapter of the *Controller Tool Help (LIT-12011147)*.

Note: Some field controller applications do not support the occupancy/temperature setback function.

Note: Wirelessly enabled FEC, FAC, and VMA16 field controllers can also use hard-wired NS Series network sensors.

WRZ Series Sensors

Depending on the sensor model, the WRZ Series Sensors transmit temperature, setpoint, humidity, occupancy status, and low battery conditions to an associated field controller by means of a ZFR1811 Router. If the field controller is mapped to the NxE, the data sent by the wireless sensor can be displayed.

Some applications that support the temperature or humidity control functions do not support the occupancy/temperature setback function. Refer to a field controller's commissioning and operation literature to determine if the application supports occupancy or temperature setback functions.

Note: Configure the Analog Inputs (AIs) on all WRZ Sensors as SA Bus devices (the same as with hard-wired NS Series Sensors).

Note: The WRZ Series Sensors are designed for indoor, intra-building applications only.

The WRZ Series Sensors require two 1.5 VDC AA alkaline batteries. The WRZ sensors minimize power consumption by transmitting data only once per minute, which yields an expected battery life of approximately 4 to 5 years.

ZFR Checkout Tool (ZCT)

The ZFR Checkout Tool is an optional tool, included with the installation of the Controller Configuration Tool (CCT), that allows you to validate the wireless connectivity and health of wireless devices within a ZFR1800 Series Wireless Field Bus system, helping ensure a reliable mesh network is in place. You can use the information provided by the ZCT to analyze and troubleshoot the wireless mesh network created by a ZFR1800 Series System.

The ZCT gathers information by discovering the wireless field controllers and wireless sensors on your network and analyzing their status and wireless communication paths. The ZCT provides a simple report of wireless network performance, including online status verification and wireless signal strength information. The ZCT also provides wireless device lists, signal strength information, and diagnostic measurements of the wireless mesh network.

Refer to the *Using the ZFR Checkout Tool (ZCT)* chapter of the Controller Tool Help (LIT-12011147) for more information on the ZCT.

The ZCT requires a Universal Serial Bus (USB) adapter with ZigBee driver. For information on this adapter and how to order it, see [WRZ-SST-120 Wireless Sensing System Tool](#).

Note: You must connect the adapter to the computer running CCT/ZCT before attempting to scan the network.

ZFR Wireless USB Dongle

The ZFR Wireless USB Dongle allows a computer to connect to a ZFR wireless Field Bus for commissioning and downloading applications to wirelessly enabled field controllers. The ZFR Wireless USB Dongle is also used with the ZFR Checkout Tool for the purpose of analyzing a ZFR wireless mesh. The ZFR Wireless USB Dongle requires a USB software driver, which is installed automatically with CCT Release 5.3 or later. No user configuration is required.

WRZ-SST-120 Wireless Sensing System Tool

Use the optional, battery-operated WRZ-SST-120 Wireless Sensing System Tool with any model WRZ Series Sensor as a site survey tool. Position the battery-operated WRZ-SST-120 Tool and the WRZ Series test sensor in potential locations of ZFR1800 system devices to survey your application, test the wireless signal strength between potential device locations, and adjust ZFR1800 device locations before installing the devices. Refer to the *WRZ-SST-120 Wireless Sensing System Tool Installation Instructions (Part No. 24-10563-12)* for more information on the tool.

Location and Estimating Guidelines

This section of the document provides general information, guidelines, and a procedure for determining the optimum location for wireless Metasys systems.

Positioning the wireless Metasys products in the optimum locations with direct, unobstructed, line-of-sight signal paths enhances the wireless signal strengths between associated products and typically reduces the number of wireless products required for your application. Figure 2 shows an example of a line-of-sight path for a ZFR1800 Series Wireless Field Bus System.

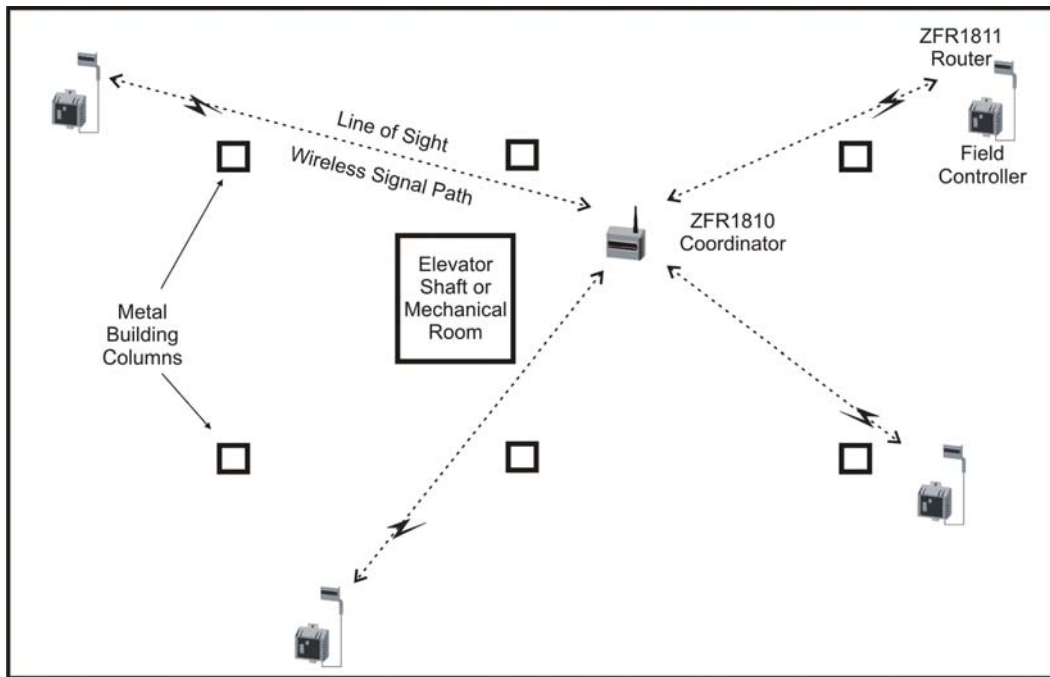


Figure 2: Line of Sight

IMPORTANT: For special precautions regarding installing of a ZFR1800 Series system in a hallway, see [Appendix C: Restricted Hallway Scenario](#).

Required Materials

To perform the procedures for locating the components of your wireless Metasys systems, you need the following:

- a detailed copy of the job site floor plans for the proposed application site with the wall locations, column locations, mechanical rooms, elevator shafts, stairwells, metal duct work, chases and risers, and other large metal obstructions shown. The plans should also include the proposed mechanical/HVAC zone layout and wireless device locations.
- a copy of the job site architectural and mechanical specifications with the construction materials defined
- information on the dimensions, materials, and the general location of the furnishings and other mobile content that is or will be installed in the occupied application space (for example, file cabinets, shelving units, partitions, displays, and other large metal items that can obstruct wireless signals)
- several different colored pens or markers for identifying zone and area boundaries, wireless Metasys product locations, and signal obstructions. Examples of major obstructions (MOs) include:
 - interior building features such as elevator shafts, stairwells, mechanical or electrical equipment rooms, equipment chases for HVAC, plumbing and electrical risers, metal reinforced walls, concrete walls, cinder blocks, glass walls with metal coating, and large metal-reinforced columns and pillars
 - office equipment and furnishings such as computer racks, many rows of tall file cabinets and book shelves, metal partitions, and displays

Examples of minor obstructions include several rows of cabinets or shelves, metal light fixtures, multiple small pillars, sheetrock walls with metal or wood studs, and glass walls without metal coating. For estimating purposes, several small or minor obstructions can be grouped and considered a single MO.

General Guidelines for Locating Wireless Devices

Follow these general guidelines when locating your wireless products:

- Locate the wireless Metasys products so they are easily accessible.
- Locate the wireless products in direct, line of sight to as many other wireless products within the same wireless network. The best distance is calculated by locating the device on the same plane; however, it is possible to locate the devices in an atrium as long as you maintain proper line of sight.
- Avoid metal, concrete, and brick obstructions (including equipment rooms and elevator shafts) between the wireless products.
- Locate the ZFR1810 Coordinators in an elevated position in the space, above furniture, cabinets, shelves, and other obstructions.

- All ZFR1811 Routers/Repeaters should be located in the same plane. For example, if you are mounting the routers/repeaters above a dropped ceiling, all routers/repeaters must be mounted above the dropped ceiling.
- Avoid configurations where a microwave oven is located between two wireless devices. Avoid locating the ZFR1810 Coordinator near areas that may contain a microwave oven, such as an employee break area or cafeteria. At a minimum, ensure that no microwave ovens are within 6 m (20 ft) of a ZFR1810 Coordinator.
- For best signal transmission on ZFR1810 Coordinators, which have an external antenna, vertically orient the external antenna with at least 50 mm (2 in.) exposed below and clear of any pipes, duct work, or other metal obstructions.
- For best signal transmission on ZFR1811 Routers and WRZ sensors, which have internal antennas, vertically mount these products.
- Do not mount the wireless Metasys product in recessed areas, metal enclosures, or shelving units unless the antenna can be positioned outside of the recessed area or enclosure.
- Locate the wireless Metasys products that are within a wireless network on the same floor or building level as the associated wireless products in the same wireless network. For example, locate ZFR1810 Coordinators, ZFR1811 routers, and WRZ sensors on the same floor.

Guidelines for Locating Thermostats and Wireless Sensors

For best temperature sensing and control, follow the same best practices used to locate a hard-wired temperature control, sensor, or thermostat when locating wireless sensors:

- Avoid enclosed or recessed locations and locations behind curtains, doors, or other obstructions to the controlled space.
- Avoid locations near entry foyers, doors, windows, supply air ducts, and pipes.
- Avoid locations that are exposed to drafts, direct sunlight, and other sources of heat or cooling.
- Avoid locations where the wireless products could be exposed to excessive vibration.
- Locate the wireless products on an interior wall where it is easily accessible, at least 1.4 m (54 in.) above the floor, in an area where the temperature is representative of the entire zone.

Guidelines for Locating ZFR1800 Series System Components

Use information in this section to determine the optimum location for the ZFR1810 Coordinator, ZFR1811 Routers, and WRZ Sensors in your ZFR1800 Series system applications and to estimate the number of additional repeaters required.

- ZFR1811 Router locations are determined by the locations of the equipment that are being controlled, the locations of the associated field controllers and WRZ sensors, the physical characteristics of the applications space, and the obstructions in the application space.
- Every WRZ Sensor should be within 15 m (50 ft) (recommended) of at least two ZFR1811 Routers. (WRZ Sensors communicate only with routers.)
- Every ZFR1811 Router should be within 15 m (50 ft) (recommended) of at least two other ZFR1811 Routers.
- The ZFR1810 Coordinator should be within 15 m (50 ft) (recommended) of at least two ZFR1811 Routers.
- The ZFR1810 Coordinator should be at the center of the mesh network.
- The maximum distance between the ZFR1810 Coordinator and the farthest ZFR1811 Router should be less than 76.2 m (250 ft).

IMPORTANT: If any WRZ Sensor, ZFR1811 Router, or ZFR1810 Coordinator is not within 15 m (50 ft) (recommended) of at least two other ZFR1811 Routers, then use ZFR1811 Routers and ZFRRPT Repeater accessories to function as repeaters to provide multiple wireless data pathways.

Wireless Signal Transmission Range

The effective transmission range/distance for indoor applications varies because of wireless signal absorption and reflection due to metal obstructions, walls (or floors), and furniture found in typical building interiors.

Transmission ranges between ZFR1800 Series products can be less than the maximum distances shown in Table 3.

Table 2: Indoor Line-of-Sight Transmission Ranges

Range Type	Transmission Distance	
	ZFR1810 Coordinator, ZFR1811 Router/Repeater	WRZ Series Sensor
Recommended	15.2 m (50 ft)	15.2 m (50 ft)
Maximum, Line of Sight	76.2 m (250 ft)	30 m (100 ft)

Selecting a PAN OFFSET for a Wireless Network

When selecting a PAN OFFSET for a wireless network, keep these points in mind:

- All devices within one wireless mesh network must be set to the same PAN OFFSET.
- Select PAN OFFSETs that are unique for the site.
- Select PAN OFFSETs that result in unique MS/TP addresses for each ZFR1810 Coordinator on a trunk.

IMPORTANT: To avoid interference, assign a unique PAN OFFSET to each wireless network in a building. Using a unique PAN OFFSET is particularly important if you have PANs on adjacent floors of a building. **Do not use the same PAN OFFSET on multiple wireless networks in a building, even if the PANs do not overlap.**

Detailed Procedures

Designing and Planning the ZFR1800 Series Wireless Field Bus System

To ensure that the system is well-designed with good line-of-sight communication paths and distances, see [Location and Estimating Guidelines](#) for planning guidelines and restrictions **before** designing the system.

IMPORTANT: For special precautions regarding installing of a ZFR1800 Series system in a hallway, see [Appendix C: Restricted Hallway Scenario](#).

In designing and planning the system, pay special attention to these points:

- Every WRZ Sensor should be within 15 m (50 ft) (recommended) of at least two ZFR1811 Routers.
- Every ZFR1811 Router should be within 15 m (50 ft) (recommended) of at least two other ZFR1811 Routers.
- The ZFR1810 Coordinator should be within 15 m (50 ft) (recommended) of at least two ZFR1811 Routers.
- If any WRZ Sensor, ZFR1811 Router, or ZFR1810 Coordinator is not within 15 m (50 ft) (recommended) of at least two other ZFR1811 Routers, then use ZFR1811 Routers and ZFRRPT Repeater accessories to function as repeaters to serve this purpose of providing multiple wireless data pathways.

Note: WRZ sensors **do not** act as repeaters in the ZFR1800 Series Wireless Field Bus System.

- The maximum distance between the ZFR1810 Coordinator and the farthest ZFR1811 Router/Repeater should be less than 76.2 m (250 ft).
- Transmissions may use up to ten hops to transmit the signal to the coordinator; transmissions that require more than ten hops can not reach the coordinator due to network restrictions. A hop is any time a signal (information packet) moves from one wireless device in the network to another wireless device in the network.

- When a wireless mesh network forms, it uses up to five address depths in assigning addresses for network communication. Refer to Figure 3. For more information, see [Appendix C: Restricted Hallway Scenario](#).

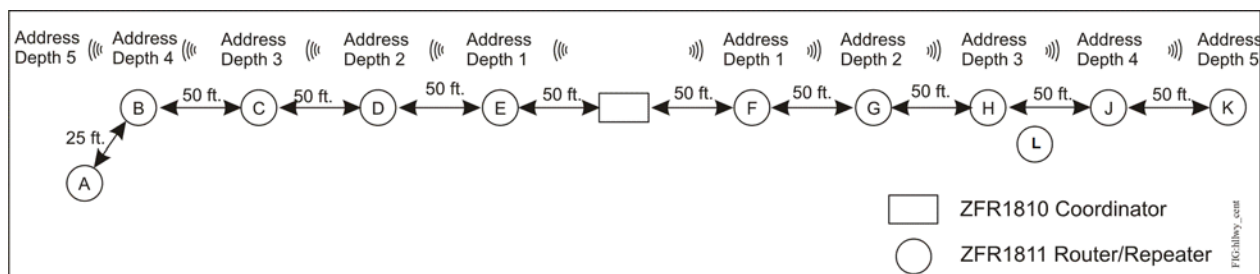


Figure 3: Address Depths

Note: Sensor devices cannot communicate directly with routers at depth 5. They must be able to join the mesh at depth 4 or lower. For example, suppose a WRZ sensor is physically located in the same room as its VMA with Address K at depth 5. Since Address K cannot support any sensors directly, the sensor must be within range of Device J at depth 4 and send its data to Device J, which then forwards it to Address K.

Note: When a router joins the mesh, it does so based on the availability and signal quality of other devices around it at that point in time. For example, although Device L is physically located in the proximity of Device H, it may get its address from Device J when it joins, making it a depth 5 device and effectively limiting the growth of the mesh from that point.

Table 3 shows recommended and maximum indoor transmission ranges between ZFR1800 Series products.

Table 3: Indoor Transmission Ranges

Range Type	Transmission Distance	
	ZFR1810 Coordinator, ZFR1811 Router/Repeater	WRZ Series Sensor
Recommended	15.2 m (50 ft)	15.2 m (50 ft)
Maximum, Line of Sight	76.2 m (250 ft)	30 m (100 ft)

Indoor line-of-sight transmission ranges between products can be less than shown in Table 3. The effective transmission distances and signal quality can vary per application because of wireless signal absorption and reflection due to metal obstructions, walls, ceilings, floors, and furniture found in typical building interiors.

Note: Use the optional, battery-operated WRZ-SST-120 Wireless Sensing System Tool with any model WRZ Series Sensor as a site survey tool to determine the wireless signal strength between potential locations of ZFR1800 system devices to survey your application and adjust ZFR1800 device locations before permanently installing the devices. Refer to the *WRZ-SST-120 Wireless Sensing System Tool Installation Instructions (Part No. 24-10563-12)* for more information on the tool.

To locate the products on a copy of the job site building and HVAC plans:

1. Inspect the building plans floor by floor (section by section on each floor if necessary), and locate your field controller and the intended locations of all WRZ sensors. See Figure 4.

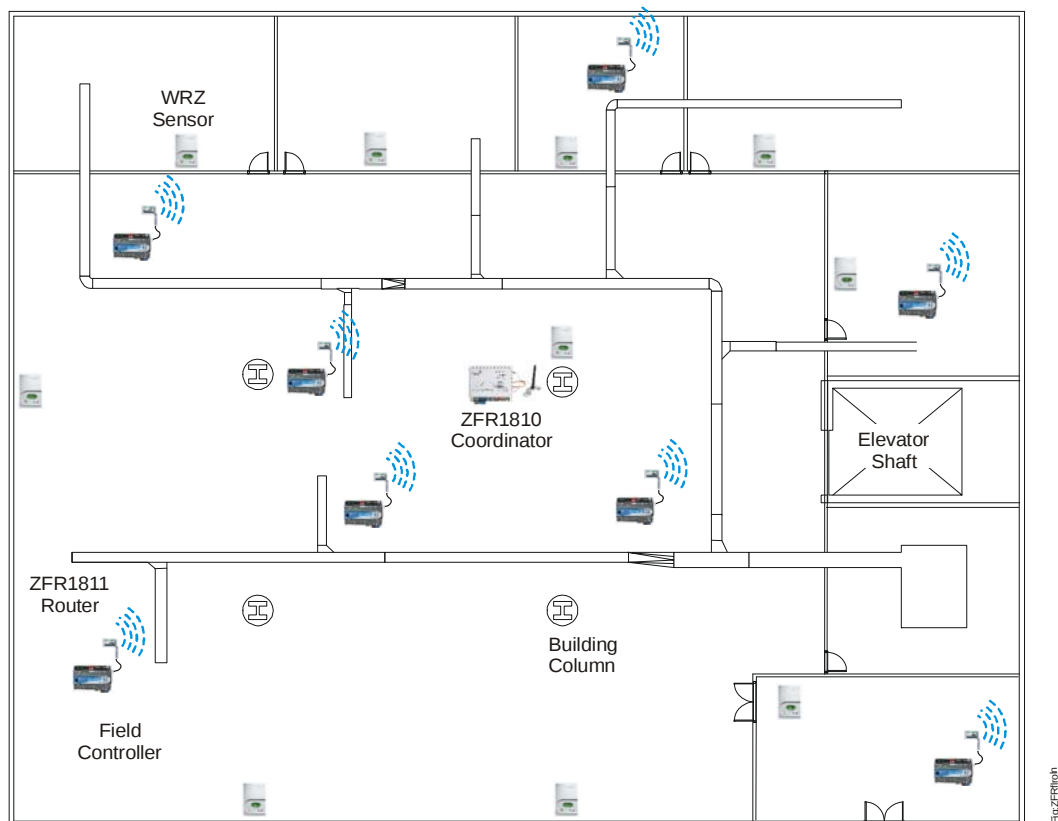


Figure 4: Building Floor Plan with ZFR1800 Series System

2. Locate the ZFR1811 Routers near their respective field controllers.
3. Highlight all of the obstructions on the building floor plans; for example, elevator shafts, metal equipment, equipment rooms, and duct work. See Figure 4.
4. Locate the ZFR1810 Coordinator near the center of the space. See Figure 4.

You must locate the ZFR1810 Coordinator on the same floor or building level as the associated ZFR1811 Routers. The ZFR1810 Coordinator's antenna should be in direct, unobstructed line-of-sight with a minimum of two ZFR1811 Routers.

5. On your floor plans, draw a 15 m (50 ft) diameter (7.5 m [25 ft] radius) circle around each ZFR1800 Coordinator (purple circle), ZFR1811 Router (orange circle), and WRZ Sensor (green circle), to help determine wireless signal range. See Figure 5.

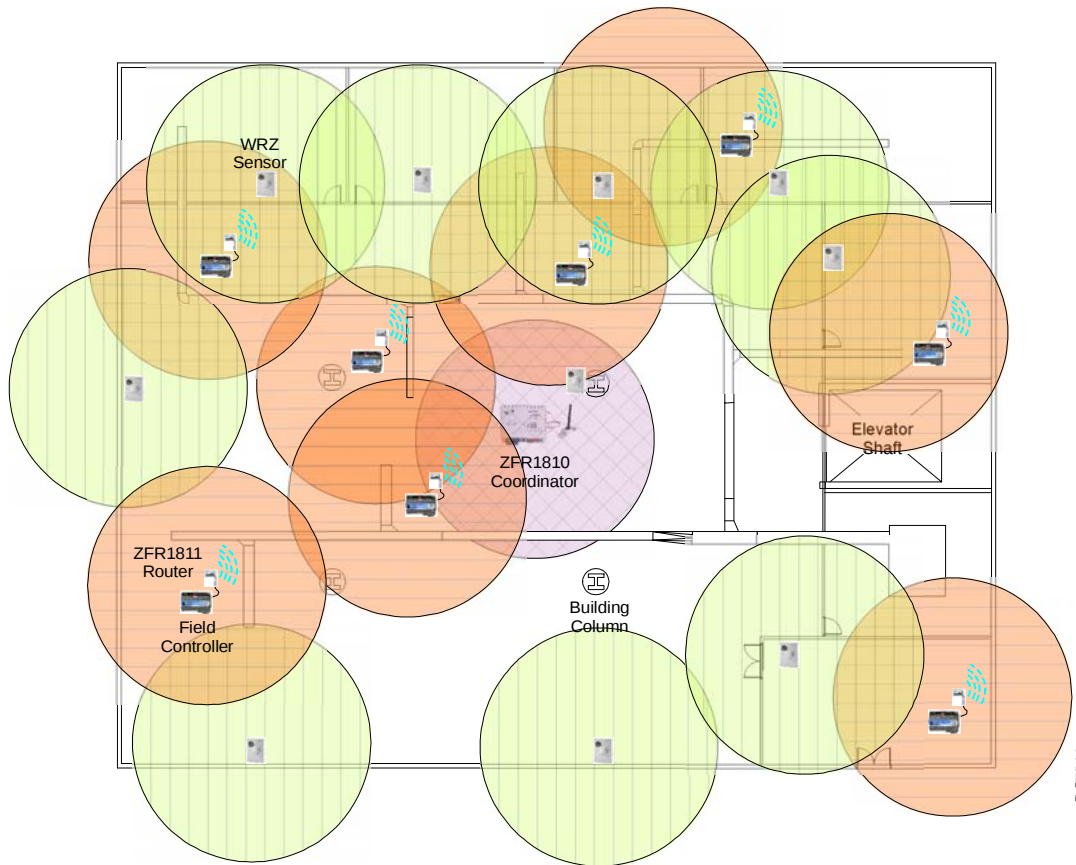


Figure 5: Building Floor Plan with ZFR1800 System and with Circles Representing Wireless Signal Range

6. Add ZFR1811 Routers and ZFRRPT Repeater accessories to serve as repeaters in order to fill in gaps and provide multiple wireless transmission paths between products. See Figure 6.

Note: On your floor plan, if you have 15-m (50-ft) diameter (7.5-m [25-ft] radius) circles that do not overlap with each other, add ZFR1811 Routers (yellow circle) to serve as repeaters to fill in the gaps so that every 15-m (50-ft) diameter (7.5-m [25-ft] radius) circle overlaps with at least two other 15-m (50-ft) diameter (7.5-m [25-ft] radius) circles.

Note: Typical job sites include a number of major and minor obstructions in the final occupied space. The router quantity and locations are directly affected by the number and location of obstructions.

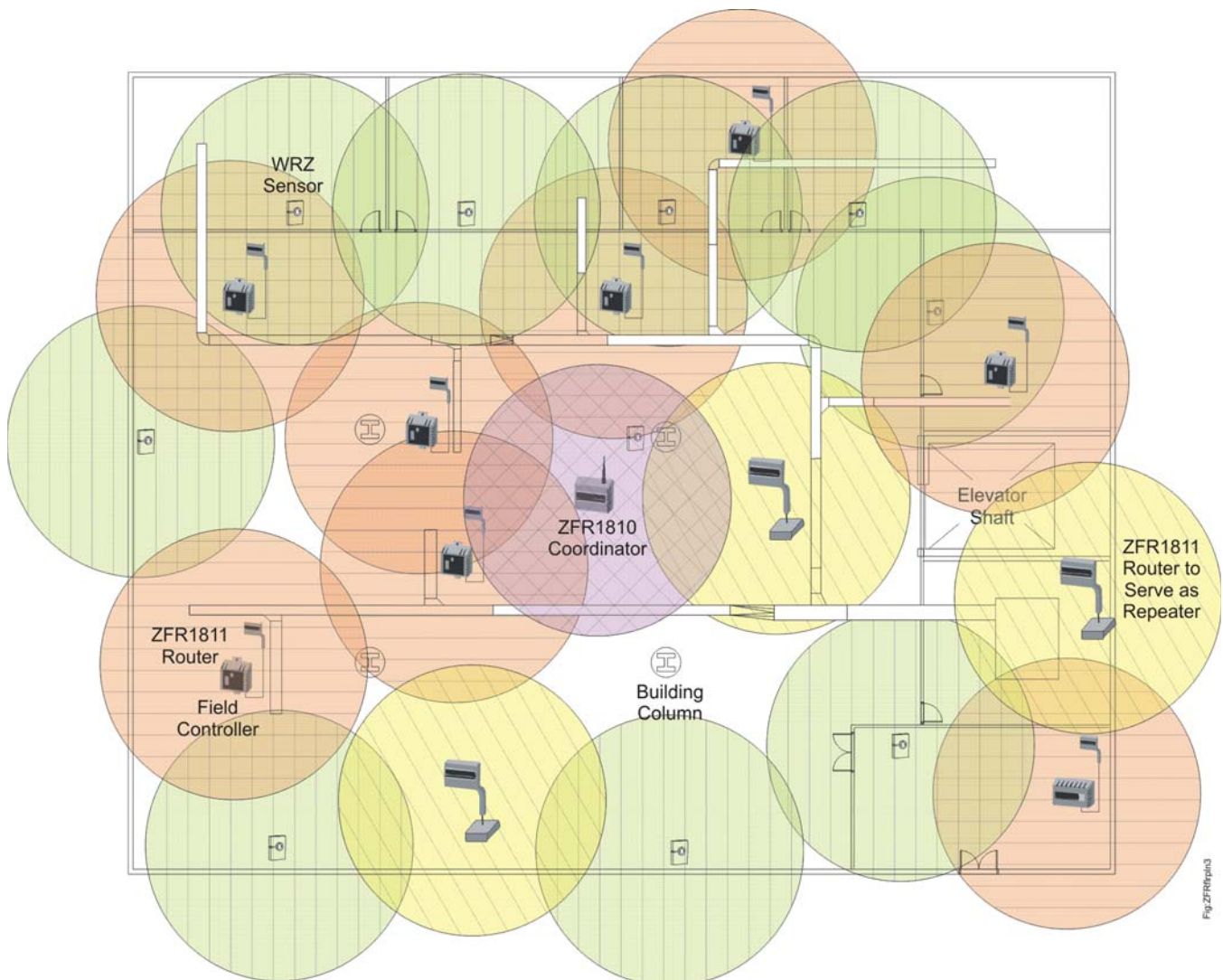


Figure 6: Building Floor Plan with ZFR1800 System Including Repeaters

Installing the ZFR1800 Series Wireless Field Bus System

Ensure that the physical installation of the ZFR1810 Coordinator and all the ZFR1811 Routers/Repeaters have good line-of-sight communication paths, good wired connections, and correct DIP switch settings per the guidelines in the following documents:

- *ZFR1810 Wireless Field Bus Coordinator Installation Instructions*
(Part No. 24-10325-2)
- *ZFR1811 Wireless Field Bus Router Installation Instructions*
(Part No. 24-10325-10)

Pay special attention to these points:

- Mount all ZFR1811 Routers/Repeaters and the antenna of the ZFR1810 Coordinator in the same horizontal plane where possible, preferably just above the ceiling panels. See Figure 7.

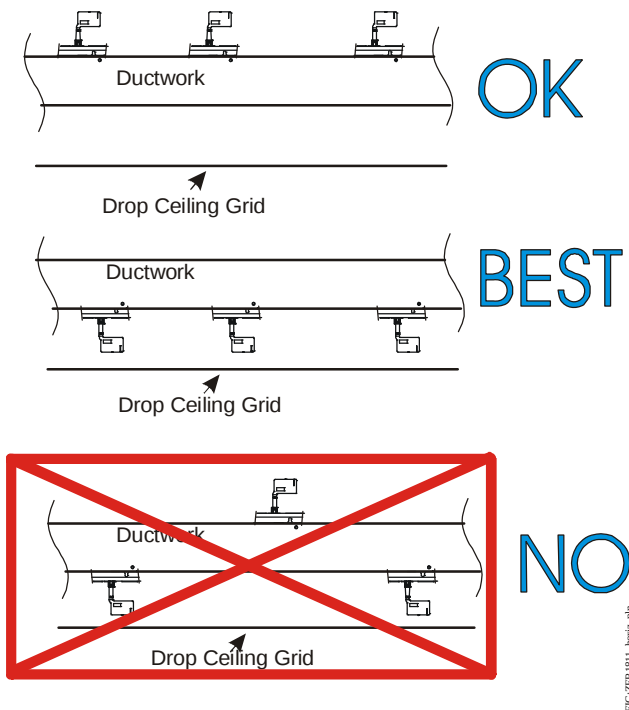


Figure 7: Mount ZFR1811 Routers/Repeaters in the Same Horizontal Plane Below Pipes, Duct Work, or Metal Obstructions

- For best signal transmission, vertically orient the ZFR1811 Router/Repeater or the ZFR1810 Coordinator's antenna with at least 50 mm (2 in.) exposed below (and clear of) any pipes, duct work, or other metal obstructions.

Do not mount a ZFR1811 Router/Repeater or the ZFR1810 Coordinator's antenna in a horizontal orientation.

When mounting the ZFR1811 Router/Repeater or the ZFR1810 Coordinator's antenna to an enclosure, mount it to the top, bottom, or side of the enclosure. See Figure 8.

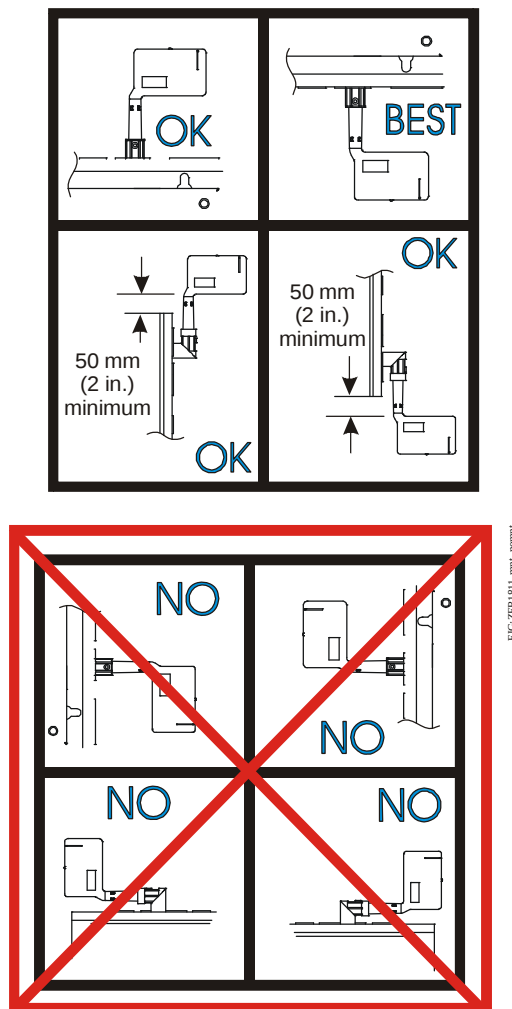


Figure 8: Proper and Improper Mounting Orientations

- Do not mount the ZFR1810 Coordinator's antenna or the ZFR1811 Router/Repeater in recessed areas, metal enclosures, or shelving units.
- Locate the ZFR1810 Coordinator's antenna and the ZFR1811 Router/Repeater in line-of-sight with as many ZFR1811 Routers/Repeaters and WRZ Sensors as possible. Ensure that the line-of-sight is clear of metal studs or ductwork.
- Locate the ZFR1810 Coordinator on the same floor as the associated ZFR1811 Routers/Repeaters and WRZ Sensors.

- Connect the ZFR1811 Router to the correct jack on the field controller. Refer to the *ZFR1811 Wireless Field Bus Router Installation Instructions (Part No. 24-10325-10)*.
- Select PAN Addresses that are unique within the site.
- Select PAN Addresses that result in unique MS/TP addresses for each ZFR1810 Coordinator on a trunk. We recommend that you set the PAN addresses of multiple ZFR1810 coordinators on the same trunk sequentially to guarantee that each ZFR1810 has a unique MSTP Address on the bus. Refer to the *ZFR1810 Wireless Field Bus Coordinator Installation Instructions (Part No. 24-10325-2)*.

Note: Once the PAN has been selected and other devices start to join the network, do not change the PAN switches to another value and then back again. Changing the PAN switches causes that device to clear its network information, resulting in abandoned children. This can lead to duplicate network (short) addresses and controller online/offline toggling.

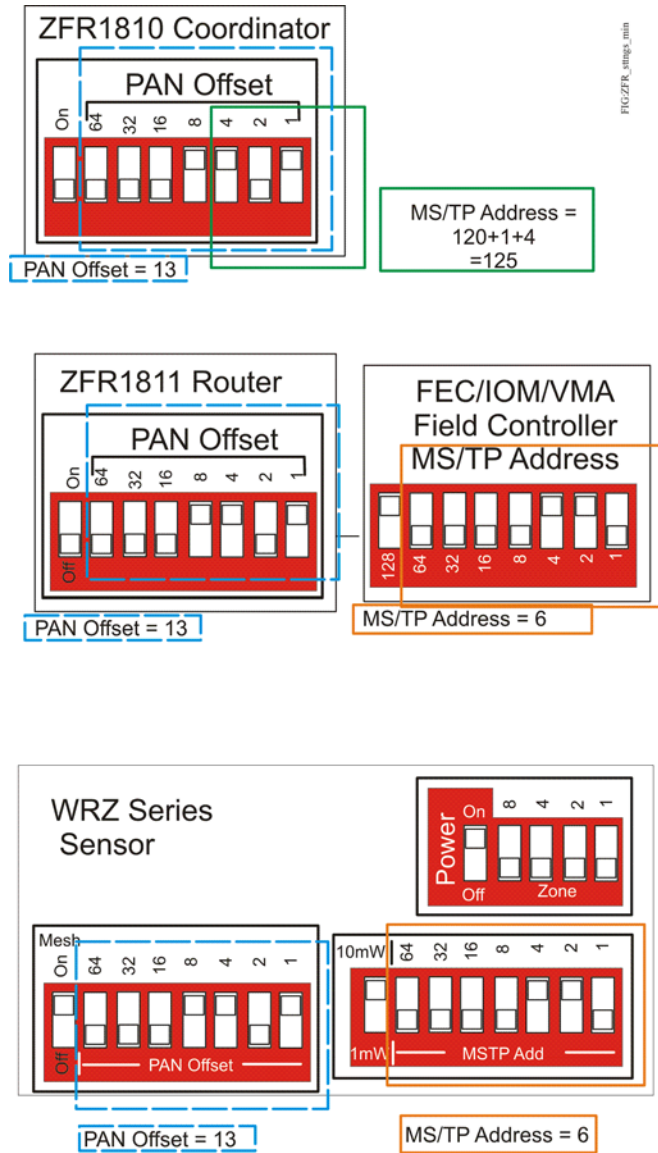


Figure 9: Sample DIP Switch Settings

Installing the ZFR1810 Coordinator

To install the ZFR1810 Coordinator:

1. Select mounting locations for the ZFR1810 Coordinator and its external antenna. See *Location and Estimating Guidelines* and *Designing and Planning the ZFR1800 Series Wireless Field Bus System*.
2. Mount the ZFR1810 Coordinator and its external antenna. Refer to the *ZFR1810 Wireless Field Bus Coordinator Installation Instructions (Part No. 24-10325-2)*.

Note: The connection from the antenna cable to the ZFR1810 is intended to be made only once. Avoid any repeat removals and reinsertions that may affect wireless connection integrity and unit performance.

Note: Remove the ZFR1810 Coordinator from its mounting base before connecting the antenna cable to the ZFR1810 Coordinator.

3. Set the ZFR1810 Coordinator's End-of-Line (EOL) switch based on MS/TP network installation guidelines. Refer to the *ZFR1810 Wireless Field Bus Coordinator Installation Instructions (Part No. 24-10325-2)*.
4. Set the ZFR1810 Coordinator's PAN OFFSET Switch per the job drawings (for example, Floor 1 = 1, Floor 2 = 2, and so forth). The MS/TP address of the ZFR1810 Coordinator is **120 plus the sum of the first three values** of the PAN OFFSET DIP switch, giving an MS/TP address range of 120 to 127. Only the values associated with the first three switch positions (right to left) affect the MS/TP address. In Figure 9, for example, the PAN OFFSET is configured to 13 with values 1, 4, and 8 set to the **ON** position. The sum of these values is 5, and the MS/TP address of the ZFR1810 Coordinator would then be 120 + 5, which equals 125.

IMPORTANT: The PAN OFFSET switch setting must be the same for all the ZFR1800 Series and WRZ devices on the same wireless mesh network.

IMPORTANT: To avoid MS/TP address conflicts, **do not** connect the ZFR1810 Coordinator to the field bus before setting the PAN OFFSET switches.

IMPORTANT: To avoid interference, assign a unique PAN OFFSET to each wireless network in a building. Using a unique PAN OFFSET is particularly important if you have PANs on adjacent floors of a building. **Do not use the same PAN OFFSET on multiple wireless networks in a building, even if the PANs do not overlap.**

IMPORTANT: For multiple ZFR1810 Coordinators on a field bus, use sequential PAN OFFSETs to ensure unique MSTP addresses.

5. Wire the MS/TP FC Bus between the ZFR1810 Coordinator and the NAE or NCE. Refer to the *ZFR1810 Wireless Field Bus Coordinator Installation Instructions (Part No. 24-10325-2)*.
6. Connect the power supply to the ZFR1810 Coordinator, but **do not** apply power.

Installing the ZFR1811 Router Used with a Field Controller

The ZFR1811 Router connects to each FEC/IOM/VMA field controller as specified in Table 4. For additional information on the appropriate connection point, refer to the *ZFR1811 Wireless Field Bus Router Installation Instructions (Part No. 24-10325-10)* and the appropriate installation instructions of each controller.

IMPORTANT: Switch 128 on the FC Bus address switch block enables the FEC/FAC/IOM/VMA field controller to operate in a wireless mode using the ZFR1800 Series Wireless Field Bus system. **Set the field controller's Switch 128 to the ON position for wireless operation.** Set the field controller's Switch 128 to the OFF position for hard-wired operation.

To install the ZFR1811 Router used with a field controller:

1. Select mounting locations for the ZFR1811 Router. Refer to the job plans and see *Location and Estimating Guidelines* and *Designing and Planning the ZFR1800 Series Wireless Field Bus System*.
2. Set the ZFR1811 Router PAN OFFSET Switch to match the ZFR1810 Coordinator PAN OFFSET according to the job plans (for example, Floor 1 = 1, Floor 2 = 2, and so forth).

IMPORTANT: The PAN OFFSET switch setting must be the same for all the ZFR1800 Series and WRZ devices on the same wireless mesh network.

IMPORTANT: **Do not** connect the ZFR1811 Router to the field controller before setting the PAN OFFSET switches.

IMPORTANT: To avoid interference, assign a unique PAN Offset to each wireless network in a building. Using a unique PAN OFFSET is particularly important if you have PANs on adjacent floors of a building. **Do not use the same PAN Offset on multiple wireless networks in a building, even if the PANs do not overlap.**

3. Mount the ZFR1811 Router. Refer to the *ZFR1811 Wireless Field Bus Router Installation Instructions (Part No. 24-10325-10)*.
4. At each FEC/FAC/IOM/VMA16 WEFC, set the MS/TP Address switch per the job plans. Set the MS/TP Address switch 128 to the ON position. This procedure enables the field controller's wireless mode and allows it to work with a ZFR1811 Router.

5. Connect the ZFR1811 Router to the field controller as shown in Table 4.

Table 4: Connecting the ZFR1811 Router to a Field Controller

Field Controller Model	Plug the ZFR1811 Router Connector Cable into the following Jack on the Field Controller:	Connection Points for Bluetooth CVT Commissioning Interface and Other SA Bus Products ¹	Use This Communications Port between WEFC and Wired IOMs, WRS Sensors, or VFDs
FAC26, FAC36	FC Bus RJ-12 Jack	SA Bus RJ-12 Jack	SA Bus Terminals
FEC16	FC Bus RJ-12 Jack	SA Bus RJ-12 Jack	SA Bus Terminals
FEC26	FC Bus RJ-12 Jack	SA Bus RJ-12 Jack	SA Bus Terminals
IOM17^{2,3}	SA/FC Bus RJ-12 Jack	Not available in wireless mode. Use CCT with ZFR Dongle.	N/A
IOM27^{2,3}	SA/FC Bus RJ-12 Jack	Not available in wireless mode. Use CCT with ZFR Dongle.	N/A
IOM37^{2,3}	SA/FC Bus RJ-12 Jack	Not available in wireless mode. Use CCT with ZFR Dongle.	N/A
IOM47^{2,3}	SA/FC Bus RJ-12 Jack	Not available in wireless mode. Use CCT with ZFR Dongle.	N/A
VMA1610/1620⁴	SA Bus RJ-12 Jack	Use ZFRCBL Cable.	FC Bus Terminals
VMA1615/1630	FC Bus RJ-12 Jack	SA Bus RJ-12 Jack	SA Bus Terminals

1. SA Bus products include the DIS1710 Local Controller Display, the BTCVT Wireless Commissioning Converter, and the NS Series (RJ-12 connection) Network Sensors, and Balancing Sensors.
2. IOMs cannot be used in wireless mode to extend the IO of a field controller. You must always hardwire IOMs to their host field controller.
3. Do not connect any device to the SA Bus/FC Bus terminal block when using the IOM with a ZFR1811.
4. On the VMA1610/1620 models, when the 128 bit switch on the address DIP switch is turned on (to enable wireless operation), the FC and SA Bus are swapped internally. All connections that were SA Bus (RJ-12 and terminal blocks) are now FC Bus connections. The terminal block connections marked for the FC Bus are now connected internally to the SA Bus.

Using the ZFRCBL Wire Harness

The ZFRCBL Cable is the MS-ZFRCBL-0 wire harness (Figure 10). The wire harness is a sealed, pre-wired unit that is plugged into the SA Bus and FC Bus terminal blocks as shown in Figure 10.

RS-485 (RJ-12) Jack

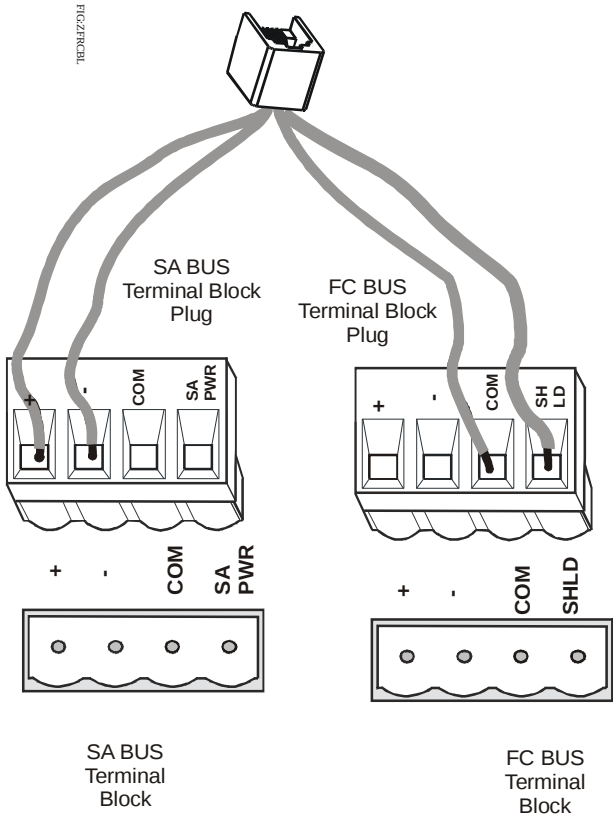


Figure 10: Installing a ZFRCBL Wire Harness

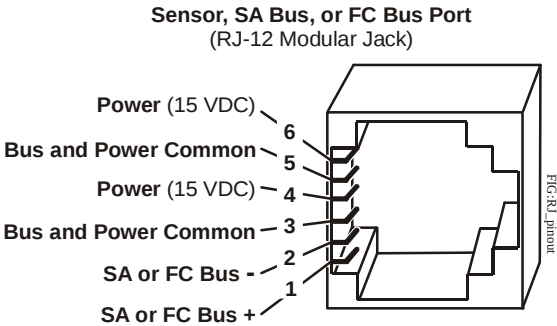


Figure 11: Pin Number Assignments for RJ-12 Jack

Port Swap on Wireless-Enabled VMAs

On the VMA1610/1620 models, when the 128 bit switch on the address DIP switch is turned on (to enable wireless operation), the FC and SA Bus are swapped internally. All connections that were SA Bus (RJ-12 and terminal blocks) are now FC Bus connections. The terminal block connections marked for the FC Bus are now connected internally to the SA Bus.

If you have an installation that calls for a wired IOM connected to the SA Bus of a wireless-enabled VMA1610/1620 field controller, connect the IOM to the FC Bus Terminals (which are really the SA Bus terminals on a VMA1610/1620 field controller in wireless mode) as indicated in Figure 12 and Figure 13.

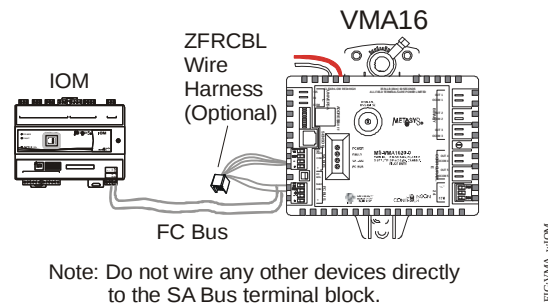


Figure 12: Connecting IOM to Wireless-Enabled VMA1610/1620 Field Controller

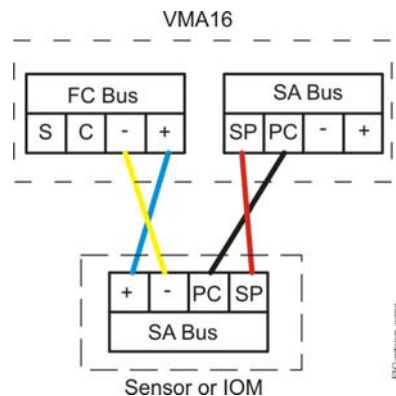


Figure 13: Wiring a Discharge Air Netsensor, Zone Netsensor with Terminal Block, or IOM to a Wireless-Enabled VMA1610/1620 Field Controller

Note: The VMA1615/1630 controller have RJ-12 connectors on the FC bus and SA bus. These controllers do not require port swapping when in wireless mode.

Installing the ZFR1811 Router as a Repeater

To install the ZFR1811 Router as a repeater:

1. Select a mounting location for each ZFR1811 Router that is to be used as a repeater. Refer to the job plans and see *Location and Estimating Guidelines* and *Designing and Planning the ZFR1800 Series Wireless Field Bus System*.
2. Set the ZFR1811 Router PAN OFFSET Switch to match the ZFR1810 Coordinator PAN OFFSET according to the job plans (for example, Floor 1 = 1, Floor 2 = 2, and so forth).

IMPORTANT: The PAN OFFSET switch setting must be the same for all the ZFR1800 Series and WRZ devices on the same wireless mesh network.

IMPORTANT: To avoid interference, assign a unique PAN Offset to each wireless network in a building. Using a unique PAN OFFSET is particularly important if you have PANs on adjacent floors of a building. **Do not use the same PAN Offset on multiple wireless networks in a building, even if the PANs do not overlap.**

3. Mount each ZFR1811 Router to its power supply within the MS-ZFRRPT-0 accessory. Refer to the *ZFR1811 Wireless Field Bus Router Installation Instructions (Part No. 24-10325-10)*.

IMPORTANT: **Do not** connect the ZFR1811 Router to the power supply before setting the PAN OFFSET switches.

4. Connect the ZFR1811 Router to the power supply, but do not apply power.

Installing a WRZ Series Sensor

To install a WRZ Series Sensor:

1. Select a mounting location for the sensor. Refer to the job plans, the *WRZ Series Wireless Room Temperature Sensors Installation Instructions (Part No. 24-10332-2)*, and see *Location and Estimating Guidelines* and *Designing and Planning the ZFR1800 Series Wireless Field Bus System*.
2. Place the Mesh application DIP switch overlay over the DIP switches. Refer to the *WRZ Series Wireless Room Sensors Installation Instructions (Part No. 24-10332-2)*.

3. Set the WRZ Sensor DIP switches as shown in Table 5.

Table 5: Configuring WRZ Sensor DIP Switches

DIP Switch	Setting
Mode	Mesh
Zone	Set according to application requirements.
Transmit Level	10 mW
MS/TP Address	Match the MS/TP address of associated field controller (FEC/IOM/VMA16).
PAN OFFSET	Match the PAN OFFSET of associated ZFR1810 Coordinator and ZFR1811 Routers.
Power	OFF

IMPORTANT: The PAN OFFSET switch setting must be the same for all the ZFR1800 Series and WRZ devices on the same wireless mesh network.

IMPORTANT: To avoid interference, assign a unique PAN Offset to each wireless network in a building. This is particularly important if you have PANs on adjacent floors of a building. **Do not use the same PAN Offset on multiple wireless networks in a building, even if the PANs do not overlap.**

4. Verify that the factory calibration jumper is installed. If the jumper is missing, temperature readings report as unreliable values.
5. Install two AA alkaline batteries (supplied) into the battery compartment on the back of the sensor. Ensure that you install the batteries in the proper polarity.
6. Secure the sensor to its mounting base. Repeat these steps for each additional zone.

Commissioning the ZFR1800 Series Wireless Field Bus System

Once a ZFR1800 Series System has been planned and installed according to the guidelines in *Designing and Planning the ZFR1800 Series Wireless Field Bus System* and *Installing the ZFR1800 Series Wireless Field Bus System*, use these steps to commission the system.

1. Power the system and verify communications in the ZFR1800 Series Wireless Field Bus System using the Signal Strength (ZFR1810 Coordinator) or Status (ZFR1811 Router/Repeater) LEDs.
 - a. Remove the ZFR1810 Coordinator from the field bus before starting the wireless network and verifying wireless communications.
 - b. Power up the ZFR1810 Coordinator. See *Powering the ZFR1810 Coordinator*.
 - c. Power up the ZFR1811 Routers/Repeaters. See *Powering the ZFR1811 Router and WEFC* and *Powering the ZFR1811 Repeater*.
 - d. **Do not** power up the WRZ sensors.

Note: Turning on the WRZ sensors before the wireless mesh is formed and operating depletes the battery prematurely as the WRZ sensor tries to find the mesh network.

- e. Wait 5 to 15 minutes for the mesh network to form. After the network forms, the Signal Strength (ZFR1810 Coordinator) or Status (ZFR1811 Router/Repeater) LEDs should show the three-flash pattern indicating good signal strength.

Table 6: ZFR1810 Coordinator Status LEDs

Name	Color	Normal	Descriptions
Wireless	Green	flash	flash - 2 Hz = Normal operation (ZFR1810 Coordinator is receiving BACnet frames over the wire). Off Steady = Not receiving BACnet frames. On Steady = Stopped receiving BACnet frames.
Signal Strength	Green	Signal Strength¹ Indication: 3 Flashes - Excellent 2 Flashes - Good 1 Flash - Weak OFF for 3 seconds - None	OFF Steady = Not able to start a network. ON Steady with Signal Strength displayed once every 10 seconds = Normal operation (ZFR1810 Coordinator is a member of a wireless network).

1. Signal Strength appears once every 10 seconds or when the Network Optimize/Reform button on the ZFR1810 Coordinator is depressed momentarily (less than 5 seconds).

Table 7: ZFR1811 Router Status LED

Name	Color	Signal Strength Indication ¹	Descriptions
Signal Strength	Green	3 Flashes - Excellent 2 Flashes - Good 1 Flash - Weak OFF for 3 seconds - None	OFF Steady = No power (or normal operation for more than 2 hours). OFF Steady with 1 Flash every 10 seconds = ZFR1811 Router is not a member of a wireless network, invalid PAN OFFSET setting, no ZFR1810 Coordinators or ZFR1811 Routers in area. ON Steady with Signal Strength displayed once every 10 seconds = ZFR1811 Router is a member of a wireless network. OFF Steady with Signal Strength displayed once every 10 seconds = Wireless network is actively communicating, but ZFR1810 Coordinator cannot be reached (for example, coordinator lost power). Rapid Flashes for 5 minutes - rapid flashes occur for up to 5 minutes: - When the Reform Network option is initiated to the network, the ZFR1811 router disconnects itself from the network - When the PAN OFFSET is changed on the ZFR1811 router - When the PAN OFFSET is changed on the ZFR1811 router after it has already joined another PAN - when you change the channel mask using CCT. For example, you might change the channel mask to force the network to a specific channel. It would be better to force the channel change through the engineering view of the coordinator at the NAE. However, it can take up to an hour for all the devices in the PAN to locate the coordinator on the new channel.

1. The Signal Strength LEDs on all the ZFR1811 routers in a network extinguish after approximately 2 hours of normal operation, making the ZFR1811 less distracting when installed in an open area. To re-enable the ZFR1811 LEDs for troubleshooting purposes, perform a scan using the ZCT or push the Network Optimize Push Button on the ZFR1810 coordinator for 2-3 seconds.

- If a ZFR1810 Coordinator shows poor signal strength, you may improve the signal strength by moving the device's antenna a couple of inches in either horizontal direction.

If you cannot complete Step 1, review the information in [Location and Estimating Guidelines](#) and [Designing and Planning the ZFR1800 Series Wireless Field Bus System](#).

For more information, refer to the following documents:

- *ZFR1810 Wireless Field Bus Coordinator Installation Instructions (Part No. 24-10325-2)*
- *ZFR1811 Wireless Field Bus Router Installation Instructions, (Part No. 24-10325-10)*

2. Use the ZFR Checkout Tool (ZCT) to perform a scan of the mesh.
 - a. Ensure all controllers and repeaters are communicating on the ZFR system mesh.
 - b. Select the Status Tab and ensure everything in the Device Status column is green.
 - c. Select the Routing Tab and verify there are no controllers requiring more than 5 hops to communicate with the ZFR1810 coordinator.
 - d. If new devices are failing to join the network, or if the ZCT indicates abandoned children or duplicate short addresses, you may benefit from reforming the network using the Commands > Reform Network menu item. Devices should come online in 5 to 15 minutes. **Be careful** with network reforms. If all the devices are not online, a reform can make things worse, particularly if done too frequently. A good practice during startup commissioning is to reform nightly as you leave the site, which allows the mesh to stabilize by morning.

Note: Disconnect the NAE from the MSTP network before initiating a reform. The extra communication traffic that the NAE attempts while the ZFR PAN is in this mode can be very disruptive, causing the reform to take longer or fail.

Note: The Signal Strength LED on the ZFR1811 Routers flashes rapidly for 5 minutes when the Network Reform command is received. See Table 7.

For more information on the ZCT, refer to the *Using the ZFR Checkout Tool (ZCT)* chapter of the *Controller Tool Help (LIT-12011147)*.

3. Use the Controller Configuration Tool (CCT) to check addressing and versions of all wirelessly enabled devices on the trunk.
 - a. Use the MS-BTCVT-0 Wireless Commissioning Converter at the FC/SA Out Bus connection of the coordinator.

Note: Use a six-wire phone extension cable (less than 100 ft long) to place the Wireless Commissioning Converter in a convenient location.

- b. In CCT 10.0 and earlier, use Tools> Controller Information to ensure that the radio firmware on each ZFR1811 Router and the boot firmware and main firmware on each associated field controller is at the same version on each WEFC in the mesh network. Note the devices that are not compliant; this information is required in Step 4. **This is no longer a requirement at CCT 10.1, WEFC firmware version 6.2, and above.**

Note: The ZFR1811 router Radio Firmware updates with the main code download. Ensure that the ZFR1811 router is connected to the associated controller during the main code download so that the radio firmware updates.

- c. Remember that the MS/TP trunk can support a mix of wireless controller and wired controller versions.
- d. Ensure that the ZFR1810 Coordinator version is equal to or higher than the version of each WEFC.
- e. Ensure that the Supervisory Controller (NxE) version is equal to or higher than the ZFR1810 Coordinator version in order to take advantage of all features in a controller.

For more information on CCT, refer to the Controller Tool *Help (LIT-12011147)*. For information on uploading or downloading devices firmware, refer to the *Loading Devices* chapter of the Controller Tool *Help (LIT-12011147)*.

4. Use Point Schedule to mass-download controllers.

Note: You can also use CCT to download controllers individually or use CCT Trunk utilities to mass-download controllers. See .

- a. Ensure all ZFR1810 Coordinators are connected to the Field Bus to allow for mass download of all controllers (wired and wireless) of one model type (FEC, IOM, or VMA).

Note: Prior to Release 5.1, download only one controller type at a time.

- b. Plug the MS-BTCVT-0 Wireless Commissioning Converter into the ZFR1810 Coordinator at the FC or SA Out Bus connection.
- c. Download the boot firmware for each controller with Point Schedule, based on the findings of Step 3 (mismatched versions).

Note: Ensure that all controllers have downloaded the boot firmware successfully before downloading the main and application firmware.

- d. Download the main and application firmware for each controller with Point Schedule, based on the findings of Step 3 (mismatched versions).

Note: During a mass download of controllers, you may experience an occasional download failure. Retry the download of those failed controllers before using the troubleshooting process.

Note: The controller Fault LED may have a fast flash if the SA bus device is offline. This fast flashing is normal as the WRZ sensors are defined in the application, but are not yet powered and communicating.

Note: A Main code download may take more than 2 hours, based on the number of controllers.

For more information on using Point Schedule to download controllers, refer to the *Controller Tool Help (LIT-12011147)*.

For information on alternate methods of downloading the controllers, see *Commissioning the ZFR1800 Series Wireless Field Bus System*.

For more information on improvements in using Point Schedule at Release 5.0 and later, see *Appendix B: Upgrading Controller Firmware Using Point Schedule*.

5. Turn on WRZ Sensors using the DIP switch (see Figure 9). The sensors locate the nearest parent device on the wireless mesh within 15 minutes.

For more information on WRZ sensors, refer to the *WRZ Series Wireless Room Sensors Installation Instructions (Part No. 24-10332-2)*.

6. Use ZCT to perform a scan of the mesh network to ensure all sensors are online.

- a. Check the Sensor Status column to ensure all devices are online and are green.

- b. If any sensors have not come online, initiate a signal strength test with the associated ZFR1811 Router. Press and hold the manual occupancy override button on the WRZ Series Sensor for 5 seconds or more, then release the button. After you release the button, the signal strength code displays.

Table 8: WRZ Sensor to ZFR1811 Router Wireless Signal Strength

Flashes	Signal Strength
3	Excellent/Sensor has joined network
2	Good/Sensor has joined network
1	Weak/Sensor has joined network
0	None/Sensor has not joined network
Fast Flash Rate (8)	Unable to locate associated wireless enabled field controller

On LCD models, the signal strength is shown on the display on the face of the sensor (callout in Figure 14).

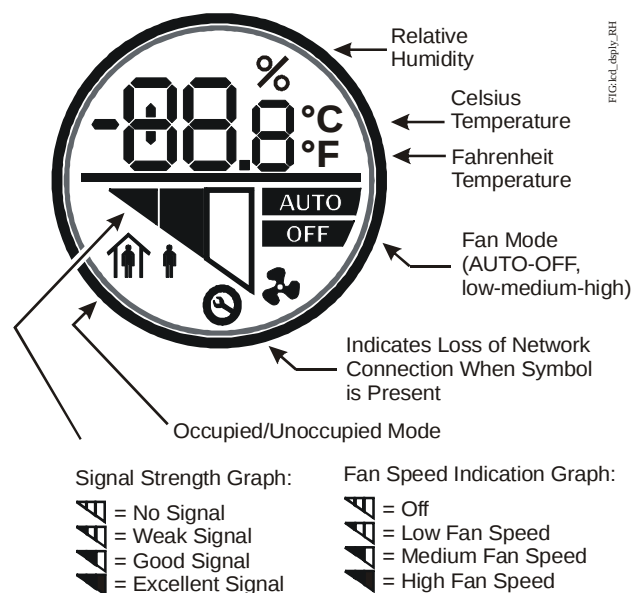


Figure 14: Sensor LCD (WRZ-MTB, WRZ-STR, WRZ-THB, WRZ-TTB, and WRZ-TTD Models)

For more information on the ZCT, refer to the *Using the ZFR Checkout Tool (ZCT)* chapter of the *Controller Tool Help (LIT-12011147)*.

7. Verify the MS/TP wired trunk communications.
 - a. Connect all of the ZFR1810 coordinators and other devices to the MS/TP wired trunk.
 - b. If an NAE is available, log on to the NAE and check that all controllers and sensors are online and updating. If no NAE is available, use the Point Schedule utility.

Also see *Verifying Wireless Operation*.

8. Continue with your normal system commissioning procedure. Also see *Commissioning the WEFCs*.

Powering the ZFR1810 Coordinator

The ZFR1810 Coordinator is required to start the ZFR network.

The ZFR1810 Coordinator needs to be powered, but does not need to be connected to an NAE/NCE. In fact, the NAE/NCE does not need to be present or online when you install any ZFR1800 Series component but is needed to complete system commissioning.

1. Apply power to the ZFR1810 Coordinator.
2. Verify that the ZFR1810 Coordinator Signal Strength LED Goes ON. If not, see [*Troubleshooting*](#).
3. Verify that the ZFR1810 Coordinator Fault LED Goes OFF. If not, see [*Troubleshooting*](#).

Powering the ZFR1811 Router and WEFC

1. Apply power to each WEFC.
2. Verify that if the WEFC has an application downloaded, its Fault LED goes off. If the Fault LED is on steady, and the WEFC has an application, a firmware mismatch may exist between the WEFC and the ZFR1811 Router. Connect to the WEFC with CCT, and correct the firmware mismatch.
3. Verify that the ZFR1811 Router LED is on. If the LED is off, the Router is not joining the network; see [*Troubleshooting*](#).
4. Verify that the ZFR1811 Router LED flashes a good or average Signal Strength indication after 10 seconds (see Table 19 on page 63). If the LED shows poor signal strength or is not flashing, see [*Troubleshooting*](#).
5. Verify that the WEFC's FC/SA Bus LED flashes to show communications (if the supervisory controller is connected to the ZFR1810 Coordinator). If the LED is off or on steady, see [*Troubleshooting*](#).

Powering the ZFR1811 Repeater

1. Apply power.
2. Verify that the ZFR1811 Router LED lights ON. If not, see [*Troubleshooting*](#).
3. Verify that the ZFR1811 Router LED flashes a Signal Strength Code after 10 seconds. If not, see [*Troubleshooting*](#).

Using the ZFR Wireless USB Dongle

An LED on the ZFR USB Dongle is used to indicate connection status to a ZigBee wireless mesh network and wireless communication activity by flashing while wireless communication packets are transferring from the dongle to a ZigBee wireless mesh. There is also a small pinhole button on the ZFR USB dongle that is reserved for future features.

Setting ZFR Wireless USB Dongle Parameters in CCT

Use the Load Device dialog box in CCT to set ZigBee connection parameters.

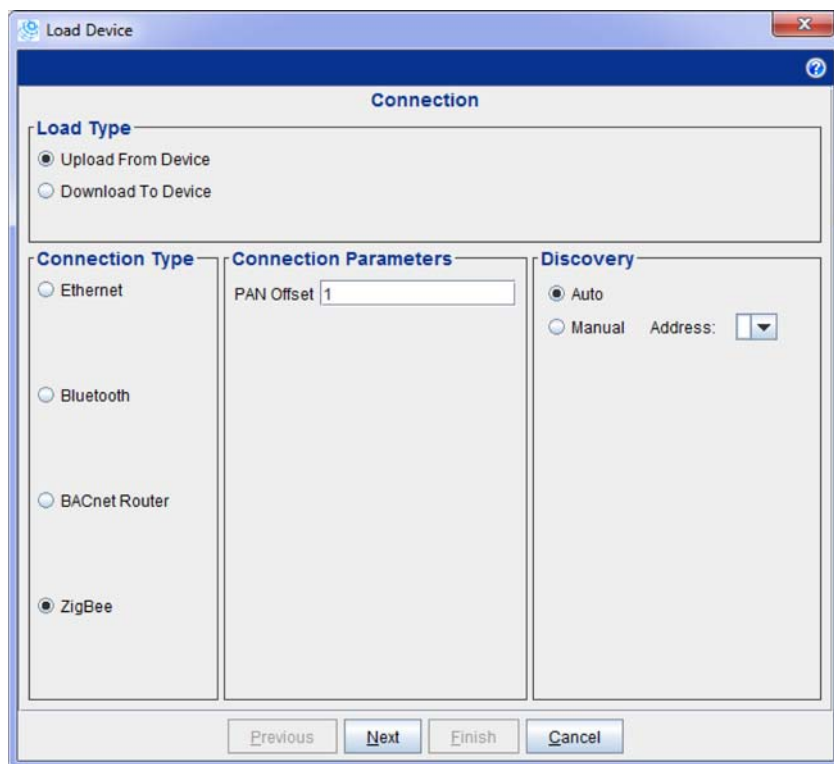


Figure 15: CCT Load Device Screen

1. Insert the ZFR USB dongle in an available USB port.
2. Because the dongle does not connect to the mesh at the ZFR1810 Coordinator, you should locate the laptop near a router or repeater with an available address. Depending on the mesh, you may need to relocate the laptop to another location to connect to the mesh.
3. Select the ZigBee connection type.
4. Enter the PAN ID of the wireless mesh you want to join.
5. Click Next.

The ZFR USB dongle LED flashes rapidly (approximately three times a second) until it successfully joins the mesh. The LED illuminates solid after successfully joining the mesh. The LED flashes during communication with wirelessly enabled field controllers.

If the ZFR USB dongle cannot join the mesh after 1 minute, the LED turns off. See [ZFR USB Dongle Troubleshooting](#) to diagnose why the ZFR dongle could not join the wireless mesh.

Setting ZFR Wireless USB Dongle Parameters in ZCT

Use the main screen of ZCT to set wireless connection parameters..

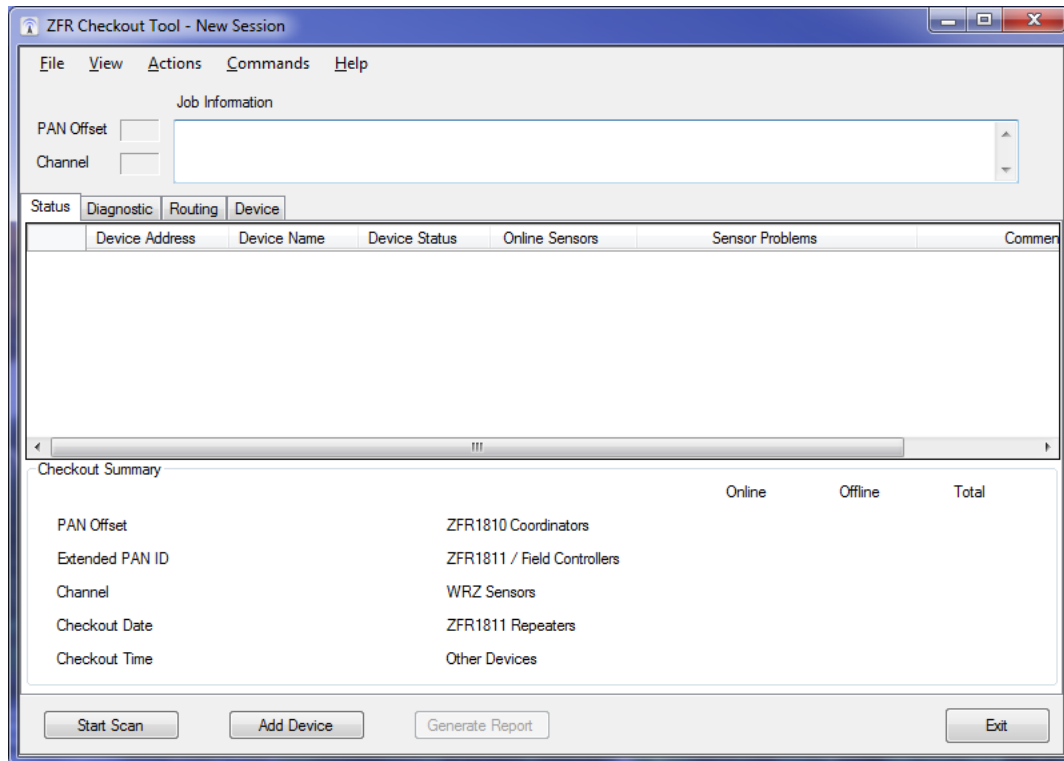


Figure 16: ZCT Load Device Screen

1. Insert the ZFR USB dongle in an available USB port.
 2. Because the dongle does not connect to the mesh at the ZFR1810 Coordinator, you should locate the laptop near a router or repeater with an available address. Depending on the mesh, you may need to relocate the laptop to another location to connect to the mesh.
 3. Click Start Scan. The Scan Configuration dialog box appears.
- Note:** Refer to the ZCT section of the Controller Tool Help (LIT-12011147) for further information about the options available in the Scan Configuration dialog box.
4. Enter the PAN ID of the wireless mesh you want to join.
 5. Select the ZFR system mesh channel number if it is known. Otherwise, leave this parameter set to Auto.

Entering a known channel number can decrease the amount of time it takes to connect to the wireless mesh.

6. Click Scan to connect to the mesh. The ZFR USB dongle LED flashes rapidly (approximately three times a second) until it successfully joins the mesh. The LED illuminates solid after successfully joining the mesh. The LED flashes during communication with wirelessly enabled field controllers.

If the ZFR USB dongle cannot join the mesh after 1 minute, the LED turns off. See [ZFR USB Dongle Troubleshooting](#) to diagnose why the ZFR dongle could not join the wireless mesh.

Connecting to and Downloading the FEC/FAC/IOM/VMA Field Controllers

To connect to and download the FEC/FAC/IOM/VMA Field Controllers:

1. Start CCT on your computer and connect to the ZFR1800 Series Wireless Field Bus System by one of the methods shown in Table 9.

Table 9: Connection Points for Configuring Wireless-Enabled FEC/IOM/VMA16 Field Controllers

	MS-BTCVT-1 at Hard-wired FC Bus ¹	MS-BTCVT-1 at Wireless FEC/IOM/VMA ¹	ZigBee Wireless Connection in CCT ²
Downloading Application (via CCT or Point Schedule)	X ³	X	X
Downloading Boot and Main Firmware (via CCT or Point Schedule)	X ³	X	
Downloading Parameters (via Point Schedule)	X	X	X

1. For information on using the MS-BTCVT-1 to connect to FEC/IOM/VMA16 field controllers, including when to use the MS-ZFRCBL-0 wire harness, see Figure 10 and Figure 12 and refer to the *Wireless Commissioning Converter Installation Instructions (Part No. 24-10108-2)*.
 2. At Release 4.0, the ZigBee connection type within CCT requires the CCT patch that is available on the Release 4.0 Branch Purchase Package, and the USB adapter with ZigBee driver. At Release 4.1 or later, the ZigBee connection type within CCT requires the USB adapter with ZigBee driver. See *WRZ-SST-120 Wireless Sensing System Tool*.
 3. This action via CCT is accomplished through CCT connected directly to the hard-wired FC Bus or through NAE passthrough.
2. Scan the FC Bus for WEFCs using CCT.
 3. Identify the WEFCs to configure and download using CCT or the Point Schedule.
 4. Download the Controller Application File (CAF) for each WEFC controller using CCT or the Point Schedule.
 5. Write additional configuration parameters to the FEC/IOM/VMA field controllers using CCT or the Point Schedule Parameter Sheet.

Verifying Wireless Operation

To verify wireless operation:

1. Open Microsoft® Internet Explorer® Web browser and log on to the NAE/NCE using the Metasys Site Management Portal.
2. From the Metasys Site Management Portal, perform a discovery of the MS/TP trunk.
3. Verify that all the FEC/IOM/VMA field controllers (wired and wireless) have been discovered.

Note: When you first power up the wireless network, there is a potential for a few field controllers to toggle online and offline for a short period until the entire trunk has finished its startup procedure. This is a normal operation.

4. Verify that a ZFR1810 Coordinator has been discovered.
5. Select the ZFR1810 Coordinator in the All Items view.
6. Open the Engineering view of the ZFR1810 Coordinator. Watch the statistics and ensure that no duplicate ZigBee network addresses exist on the network.
7. To check the performance of the wireless mesh network, including online status and wireless signal strength, you can use the ZFR Checkout Tool (ZCT) within CCT.

Note: ZCT requires the use of a USB adapter with ZigBee driver. The ZFR USB dongle is available within AOMS. To purchase the ZFR USB dongle, use product code ZFR-USBHA-0.

Commissioning the WEFCs

To commission the WEFCs:

1. Start CCT on your computer and connect to the ZFR1800 Series wireless network by selecting one of the methods shown in Table 10.

Table 10: Connection Points for Commissioning WEFCs

	MS-BTCVT-1 at Hard-wired FC Bus ¹	MS-BTCVT-1 at WEFC ¹	ZigBee Wireless Connection in CCT ²
General Checkout or Commissioning (via CCT)	X ³	X	X ⁴
Box Flow Tests (via CCT)	X	X	X
Balancing (via CCT)	X	X	X
Balancing (via Handheld VAV Balancing Tool [MS-ATV7003-0])		X ⁵	
Uploading (via CCT or Point Schedule)	X	X	X

1. For information on using the MS-BTCVT-1 to connect to FEC/IOM/VMA field controllers, including when to use the MS-ZFRCBL-0 wire harness, see Figure 10 and Figure 12 and refer to the *Wireless Commissioning Converter Installation Instructions (Part No. 24-10108-2)*.
2. At Release 4.0, the ZigBee connection type within CCT requires the CCT patch that is available on the Release 4.0 Branch Purchase Package, and the USB adapter with ZigBee driver. At Release 4.1 or later, the ZigBee connection type within CCT requires the USB adapter with ZigBee driver. See *WRZ-SST-120 Wireless Sensing System Tool*.
3. This action via CCT is accomplished through CCT connected directly to the hard-wired FC Bus or through NAE passthrough.
4. This action is also accomplished via the Point Schedule.
5. The Handheld VAV Balancing Tool (MS-ATV7003-0) connects in place of the MS-BTCVT-1.

2. Perform general equipment checkout as required.
3. (VMA16 only) Invoke the Box Flow Test on the VMA16 Controller using one of the connection options in Table 10.
4. (VMA16 only) Locally balance the wireless enabled VMA16 Controller using one of the connection options in Table 10.
5. After balancing is complete, upload parameters and/or CAF Files using CCT or the Point Schedule using one of the connection options in Table 10.

Network Maintenance

Use this section when you need to upgrade an existing ZFR1810 Coordinator, replace an existing wireless component, or change the ZigBee channel.

Note: The default selection for the ZigBee channel is **Automatic**; however, the ZigBee channel can be manually adjusted as described in this section.

Upgrading an Existing ZFR1810 Coordinator

You can upgrade the ZFR1810 Coordinator by using CCT to download the MS-ZFR1810 Boot and Main code. Use the Wireless Commissioning Converter (MS-BTCVT-1) while directly connected to the **Bus Out** port on the ZFR1810 Coordinator.

Note: You cannot use the **Bus In** port on the ZFR1810 Coordinator with the Wireless Commissioning Converter because this port does not provide power to the converter.

To upgrade an existing ZFR1810 Coordinator:

1. Identify the current version of the ZFR1810 Coordinator using one of the following methods:
 - Log on to the NAE/NCE supervisory engine, and view the focus window of the MS-ZFR1810 object.
 - In CCT, go to Tools > Controller Information, and select the MS-ZFR1810 from the list.
 - In CCT (no application open), select Load and choose the Download To Device option on the Connection screen of the Load wizard. Click Next. After discovery finishes, select the MS-ZFR1810 to download from the list on the Device Selection screen (this is the only device in the list), and click Next. The Load Summary screen indicates the Model, Bootcode Version, and Maincode Version of the MS-ZFR1810 device.
2. Upgrade the Boot and Main Code of the ZFR1810 Coordinator as follows:
 - a. In CCT (no application open), select Load. The Load wizard appears with the Connection screen active.
 - b. Select the Download To Device option on the Connection screen of the Load wizard and click Next.
 - c. After discovery finishes, select the MS-ZFR1810 to download from the list on the Device Selection screen and click Next.
 - d. Select Boot and Main code on the Load Summary screen and click Finish.

Note: When upgrading from Release 4.0 to Release 4.1 using the Wireless Commissioning Converter (MS-BTCVT-1) or passthrough, and downloading both boot and main code, follow these steps if the main code download fails:

- (1) Start the main code download using the manual address 2. Only the main code downloads because the download type is set to DownloadMainCode, not DownMaincodeWithFile.
- (2) When this download completes, perform the Boot and Main code download again.

Replacing an Existing ZFR1810 Coordinator

To replace an existing ZFR1810 Coordinator:

1. Prepare the new ZFR1810 Coordinator by setting its PAN OFFSET Switch per the job drawings.

IMPORTANT: The PAN OFFSET switch setting must be the same for all the ZFR1800 Series and WRZ devices on the same wireless mesh network.

IMPORTANT: Do not connect the new ZFR1810 Coordinator to the power supply before setting the PAN OFFSET switches.

IMPORTANT: Make sure all devices are online to the network before initiating this procedure. You can do this from the NAE/NCE supervisory engine or by using the optional ZFR Checkout Tool (ZCT) in CCT.

2. Turn off power to the ZFR1810 Coordinator that you wish to replace.
3. Remove this ZFR1810 Coordinator.
4. Install the new ZFR1810 Coordinator. Turn on its power.
5. Perform a Network Reform. See [Using the ZFR1810 Coordinator's Network Optimize/Reform Button](#) or [Optimizing/Reforming a Network](#).
6. Allow up to 15 minutes for the WEFCs to rejoin the network. Sensors may take an additional 45 minutes to rejoin the network.
7. Use the Metasys Site Management Portal to verify that all devices on the wireless network report online to the NAE/NCE. If one or more devices are not online, see [Troubleshooting](#).

Replacing an Existing ZFR1811 Router

To replace an existing ZFR1811 Router:

1. Prepare the new ZFR1811 Router by setting its PAN OFFSET Switch per the job drawings.

IMPORTANT: Do not connect the new ZFR1811 Router to the FEC, IOM, or VMA field controller before setting the PAN OFFSET switches.

2. Unplug the ZFR1811 Router from the field controller and remove the router.
3. Install the new ZFR1811 Router and connect the field controller to the router. The ZFR1811 Router joins the network as indicated by its Signal Strength LED.
4. Allow up to 15 minutes for the system to recognize that the ZFR1811 Router has been replaced.
5. Verify that the ZFR1811 Router reports online to the NAE/NCE. If this device is not online, see *Troubleshooting*.

Replacing a WRZ Series Sensor

To replace a WRZ Sensor:

1. Prepare the new WRZ Sensor by applying its Mesh application overlay and setting its DIP switches as shown in Table 5 on page 33.

IMPORTANT: The PAN OFFSET switch setting must be the same for all the ZFR1800 Series and WRZ devices on the same wireless mesh network.

2. Turn off power to the WRZ Sensor that you wish to replace.
3. Remove this WRZ Sensor.
4. Install the two AA alkaline batteries (supplied) in the new WRZ Sensor.
5. Move the POWER switch to the ON position.
6. Mount the new WRZ Sensor.
7. Wait 1 to 3 minutes for the sensor to find the network. Press and release the **Occ** Button. Wait for the flash reply. Ensure that there is at least one flash. If not, see *Troubleshooting*.
8. Secure the sensor to its mounting base.

Changing the Wireless Active Channel

To change the Wireless active channel:

1. Open Internet Explorer Web browser and log on to the NAE/NCE using the Metasys Site Management Portal.
2. From the Metasys Site Management Portal, open the Focus window for the Field Bus.

3. Click the Engineering tab.
4. Expand the Field Bus and the MS-ZFR1810-0 Coordinator items as shown in Figure 17. Open the details window for the **ZIGBEE** item.

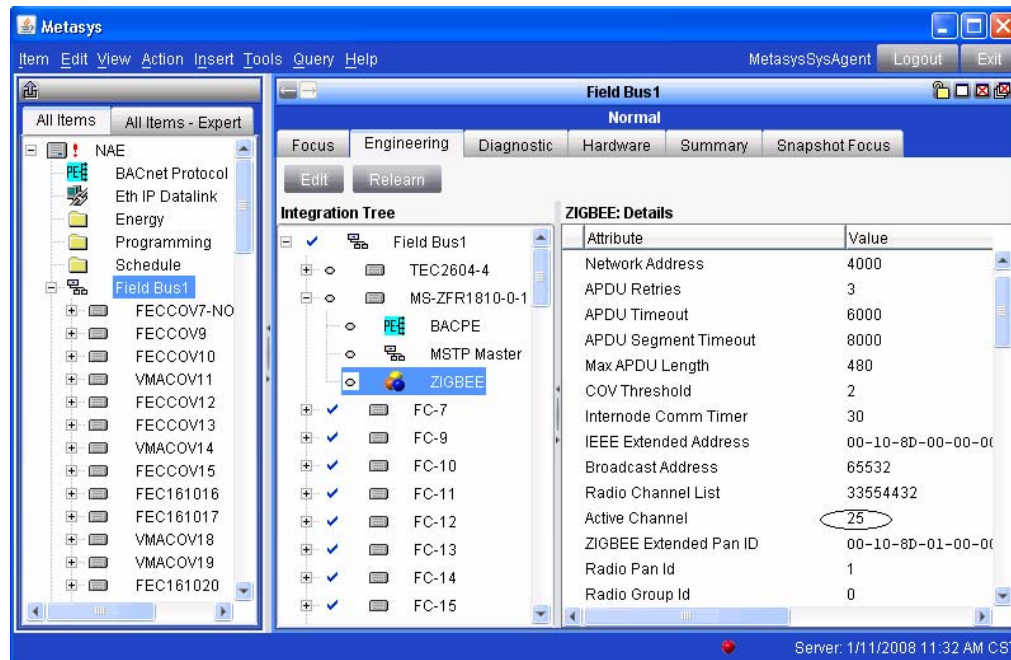


Figure 17: Changing Wireless Active Channel

5. Click Edit and change the Active Channel field. Possible values include 15, 20, and 25.
6. Click Save. All devices on the wireless network go offline.
7. Allow up to 15 minutes for the WEFCs to rejoin the network. Sensors may take an additional 45 minutes to rejoin the network.
8. Verify that all devices on the wireless network report online to the NAE/NCE. If one or more devices are not online, see [Troubleshooting](#).

Optimizing/Reforming a Network

You can reform or optimize a network using the ZFR1810 Coordinator's Network Optimize/Reform Button or the Metasys Site Management Portal.

Optimizing the Network

When you optimize the network, the ZFR1810 Coordinator:

- clears its internal (persisted) routing tables
- clears its statistics
- initiates a relearn sequence to all ZFR1811 Routers

During this relearn sequence, the ZFR1811 Routers also clear their routing tables and attempt to find better signal paths to the ZFR1810 Coordinator.

For more details, see [*Optimizing the Network*](#) and [*Optimizing/Reforming a Network from the Metasys Site Management Portal*](#).

Reforming the Network

You can also initiate a network reform function, which affects the ZFR1810 Coordinator and all of the ZFR1811 Routers operating on the PAN.

IMPORTANT: When you initiate the network reform function, the wireless network reforms, and field controllers may go offline for approximately 15 minutes. If a ZFR1811 Router does not come back online after a network reform, set all PAN OFFSET switches on the ZFR1811 Router to ON, cycle power, then set the switches back to their original settings. For details on the manual reset, see [*Troubleshooting*](#).

Using the ZFR1810 Coordinator's Network Optimize/Reform Button

The ZFR1810 Coordinator has a Network Optimize/Reform button that allows you to optimize network communications and routing paths between the ZFR1810 Coordinator and each ZFR1811 Router and WRZ Sensor on its wireless network. Figure 18 shows the location of the Network Optimize/Reform button.

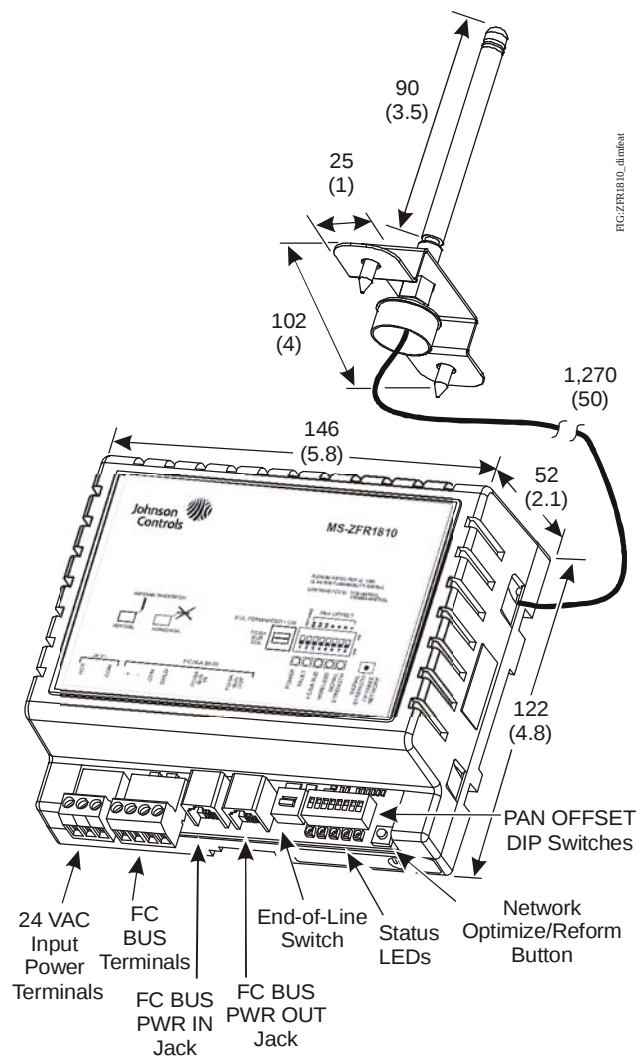


Figure 18: ZFR1810 Coordinator

Press this button after you complete a full wireless system installation. Table 11 shows the Network Optimize/Reform button functions.

Table 11: Network Optimize/Reform Button

User Action	Duration (in Seconds)	ZFR1810 Coordinator Function
Press and Hold Down Network Optimize/Reform Button	0-5	Flashes latest signal strength code
	5-10 ¹	Optimizes Network
	more than 10 ²	Performs Network Reform ³

1. Once the Network Optimize/Reform Button begins flashing rapidly, release the button (between 5 and 10 seconds).
2. Once the Network Optimize/Reform Button stops flashing rapidly and stays ON, release the button (approximately 10 seconds).
3. Read this entire section for important details before using the Network Reform function.

Optimizing/Reforming a Network from the Metasys Site Management Portal

To optimize the network from the Metasys Site Management Portal:

1. Open Internet Explorer Web browser and log on to the NAE/NCE using the Metasys Site Management Portal.
2. From the Metasys Site Management Portal, open the Focus window for the Field Bus.
3. Click the Engineering tab.

- Expand the Field Bus and the MS-ZFR1810-0 Coordinator items as shown in Figure 19. Open the details window for the **ZIGBEE** item.

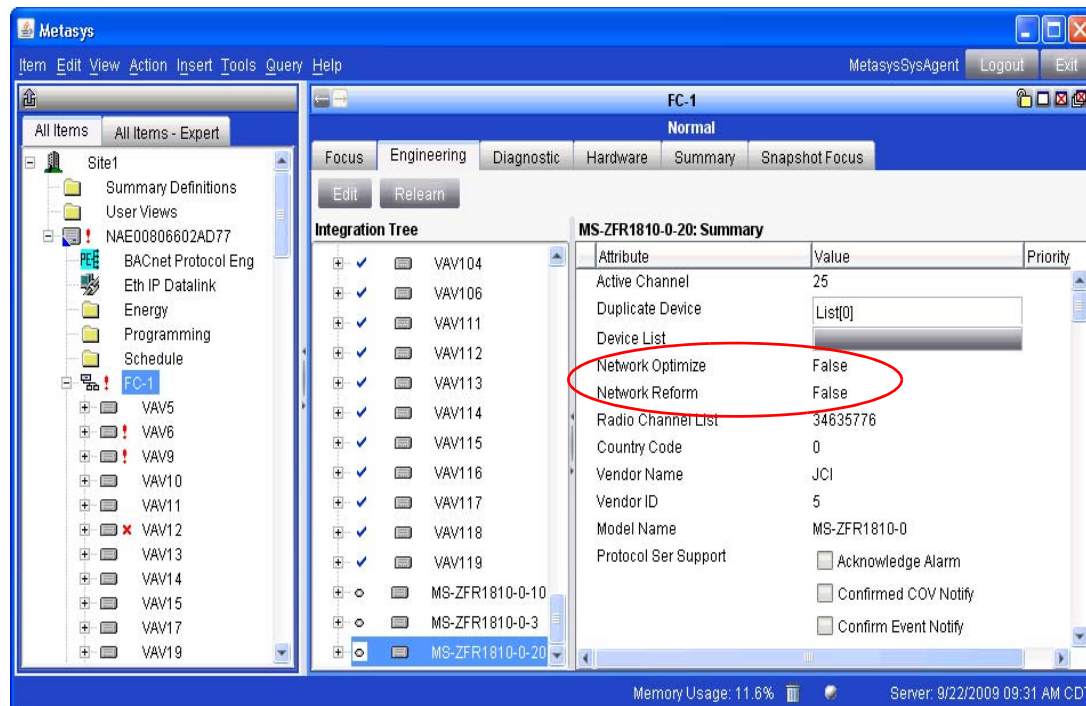


Figure 19: Optimizing/Reforming a Network from the Metasys Site Management Portal

- Click Edit and change the **Network Optimize** or **Network Reform** field to TRUE.

Note: In Release 4.1, the **Network Optimize** field is labeled **Route Repair** and the **Network Reform** field is labeled **Text Not Found**.
- Click Relearn. All devices on the wireless network go offline.
- Allow up to 15 minutes for the WEFCs to rejoin the network. Sensors may take an additional 45 minutes to rejoin the network.
- Verify that all devices on the wireless network report online to the NAE/NCE. If one or more devices are not online, see [Troubleshooting](#).

Troubleshooting

Troubleshooting tables are divided into categories related to hardware, and the possible cause codes are structured as shown in Table 12.

Table 12: Possible Cause Codes

First Letter	System Component	Second Letter	Category
C	ZFR1810 Coordinator	H	Hardware
R	ZFR1811 Router/WEFC	M	MS/TP Network
S	WRZ Sensor	W	Wireless Communication

ZFR1810 Coordinator

Use Table 13 to identify symptoms and possible causes. Use Table 14 to identify the possible causes and steps to remedy the causes.

Table 13: Identifying Symptoms and Possible Causes

Symptom	Identification	Possible Cause Code
The ZFR1810 Coordinator does not start the network.	All ZFR1810 Coordinator LEDs are OFF.	CH1, CH2, CH3
	The SIGNAL STRENGTH LED remains OFF.	CW1, CW2
The ZFR1810 Coordinator does not have a wireless signal.	The SIGNAL STRENGTH LED is ON, but shows no flashes every 10 seconds.	CW3, CW4, CW5, CW6
The NAE/NCE cannot discover the ZFR1810 Coordinator on the MS/TP trunk.	The Power LED on the ZFR1810 Coordinator is OFF.	CH1, CH2, CH3
	The FAULT LED on the ZFR1810 Coordinator is ON.	CH3, CH4
	The FC BUS LED on the ZFR1810 Coordinator is not flashing.	CH5, CH6, CM1
A ZFR1810 Coordinator is toggling offline to the Metasys system.	The Metasys Event Log indicates one or more offline events for the ZFR1810 Coordinator.	CH6, CH7, CH8
	The FC BUS LED on the ZFR1810 Coordinator is Off or On Steady.	CH6, CH7, CH8
	The ZFR1810 Coordinator's POWER LED is Off or flickering.	CH9
The user cannot automatically discover the ZFR1810 Coordinator in the Metasys Site Management Portal or CCT.	The ZFR1810 Coordinator's FAULT LED is on solid.	CH10
	The ZFR1810 Coordinator has no LEDs On.	CM1
A main code download failure occurs on the ZFR1810 Coordinator	Communication errors occur between the CCT and the ZFR1810 Coordinator.	CM2, CM3

Table 14: Taking Corrective Action (Part 1 of 3)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
CH1	The ZFR1810 Coordinator is unpowered - power supplied by a 24 VAC transformer.	• If the 24 V~ connector block is not plugged into the ZFR1810 Coordinator, plug the 24 V~ connector block into the ZFR1810 Coordinator. • If 24 VAC power is not connected to the HOT and COM terminals of the 24 V~ connector block, connect 24 VAC power to the HOT and COM terminals of 24 V~ connector block. • If 24 VAC power cannot be measured across the HOT and COM terminals of the 24 V~ connector block, replace the 24 VAC transformer.
CH2	The ZFR1810 Coordinator is unpowered - power supplied from the FC BUS jack on an NAE35/45 or NCE25.	If the cable from an NAE35/45xx or NCE25xx is connected to the ZFR1810 Coordinator's FC BUS OUT port, connect the plug to the FC BUS IN port of the ZFR1810 Coordinator.
CH3	ZFR1810 Coordinator is defective.	Replace the ZFR1810 Coordinator.
CH4	ZFR1810 Coordinator needs a software download.	Download the ZFR1810 Coordinator software using CCT.
CH5	ZFR1810 Coordinator is not wired properly to the NAE/NCE.	Connect the FC bus terminals to the corresponding terminals on all devices on the FC bus.
CH6	FC Bus cable is incorrectly terminated.	Connect the FC bus terminals to the corresponding terminals on all devices on the FC bus.
CH7	The FC Bus cable between the ZFR1810 Coordinator and the NAE/NCE is loosely connected or incorrectly terminated.	Securely connect wires to the correct FC bus terminals on all devices on the FC bus.
CH8	Problem is intermittent MS/TP Communications.	Refer to the <i>MS/TP Communications Bus Technical Bulletin (LIT-12011034)</i> .
CH9	The ZFR1810 Coordinator has a loose power connection.	Securely connect the wires to the 24 V~ connector block.

Table 14: Taking Corrective Action (Part 2 of 3)

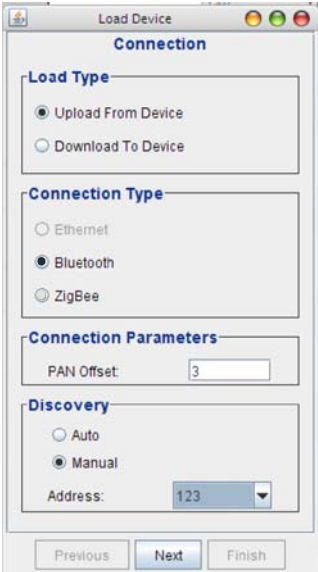
Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
CH10	The ZFR1810 Coordinator is running in Boot Mode.	If the red Fault LED is illuminated on the ZFR1810 Coordinator and the device is operating in Boot mode, restart the upgrade by closing and reopening the CCT Load Device dialog box. In the Load Device option of CCT, select Manual in the Discovery field, and use the known MS/TP address of the target device in the Address drop-down box. Use the values associated with the PAN Offset switch to determine the MS/TP address of the ZFR1810 Coordinator. 
CM1	An MS/TP address conflict exists in which there are two ZFR1810 Coordinators on the same trunk with the same MS/TP address.	Verify that the MS/TP addresses of the coordinators are unique as determined by the first three DIP Switches of the PAN OFFSET.
CM2	Installer is attempting to downgrade the ZFR1810 Coordinator to Release 4.0.	A ZFR1810 Coordinator can communicate with earlier release versions of ZFR1811 Router. There is no need to downgrade the ZFR1810 Coordinator.
CM3	The Bluetooth® wireless connection failed.	Reinitiate the download.
CW1	Another ZFR1810 Coordinator with the same PAN OFFSET is (or was) within radio range.	1. Find any ZFR1810 Coordinator that is within a 100 ft radius of (or one floor above and below) any ZFR device in the network. 2. Verify that the PAN OFFSET is unique for each ZFR1810 Coordinator and all of the ZFR devices in their respective wireless networks. 3. Change the PAN OFFSET of all the devices in one of the wireless networks. 4. If WEFCs in an existing network go offline, use the Reform Network function to repair the network.
CW2	A wireless interference source (such as microwave oven or 2.4 GHz cordless phone) is installed near the toggling ZFR1811 router or the ZFR1810 Coordinator.	Identify sources of wireless interferences. These can include, radio antennas, microwave ovens, Wireless TEC devices, wireless security devices, wireless LAN access points, paging systems, and cordless phones. Locate the ZFR1800 Series System device 3 m (10 ft) nominally from wireless devices operating at 2.4 GHz. Avoid locations where a microwave oven is located between two wireless devices.

Table 14: Taking Corrective Action (Part 3 of 3)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
CW3	No powered ZFR1811 Routers are in range of the ZFR1810 Coordinator.	1. Check the job plan drawing to ensure that a ZFR1810 Coordinator is within 50 ft of a ZFR1811 Router/Repeater. If necessary, add a ZFR1811 Repeater between the ZFR1810 Coordinator and the outlying ZFR1811 Router/Repeater. 2. Check to see if any ZFR1811 Router/Repeater within 50 ft of the ZFR1810 Coordinator is powered, if the ZFR1811 Router/Repeater is unpowered, apply power. 3. Check that any ZFR1811 Router/Repeater within 50 ft of the ZFR1810 Coordinator is configured with the correct PAN OFFSET. If necessary, change the PAN OFFSET switches to match the ZFR1810 Coordinator's PAN OFFSET. 4. Use the Reform Network command. Wait up to 15 minutes for the mesh network to reform.
CW4	The ZFR1810 Coordinator's antenna is not connected or is connected improperly.	Securely and properly connect the ZFR1810 Coordinator's antenna cable. Note: The connection from the antenna cable to the ZFR1810 Coordinator is intended to be made only once. Do not remove it once you have inserted it into the jack. If you must remove the antenna, disassemble the case of the ZFR1810 Coordinator and remove the antenna from the jack by pulling on the knurled end of the antenna's connector only. Pulling on the antenna cable from anywhere else can result in damage to the antenna. Avoid any repeat removals and re-insertions as this may impact wireless connection integrity and unit performance.
CW5	A mismatch exists between the PAN OFFSET settings on the ZFR1810 Coordinator and the ZFR1811 Routers associated with the WEFCs.	1. Ensure that the PAN OFFSET switches on the ZFR1811 Routers match the PAN OFFSET switches on the ZFR1810 Coordinator. 2. Ensure that the PAN OFFSET switches on the WRZ Sensors match the PAN OFFSET switches on the ZFR1810 Coordinator.
CW6	The ZFR1810 Coordinator is installed inside a metal enclosure and the antenna is not external to the enclosure.	Install the antenna external to the enclosure.

ZFR1811 Router and WEFCs

Use Table 15 to identify symptoms and possible causes. Use Table 16 to identify the possible causes and steps to remedy the causes.

Table 15: Identifying Symptoms and Possible Causes

Symptom	Identification	Possible Cause Code
All WEFCs toggle offline to the Metasys system.	The Metasys Event Log indicates one or more offline events for all of the WEFCs.	RW1, RW2, RW3
A single WEFC is toggling offline to the Metasys system.	The Metasys Event Log indicates one or more offline events for the WEFC.	RM1, RW4, RW5, RW6
	The SIGNAL STRENGTH LED on WEFC's ZFR1811 Router (or any router in the path of the coordinator) indicates a weak signal (one flash) or no signal (no flashes).	RW5, RW8, RW9, RW10, RW11
The NAE/NCE cannot discover the WEFC on the MS/TP trunk.	Metasys system cannot discover the WEFC.	RH1, RM1, RM2, RM3, RM4, RM5, RW6, RW12
WEFCs do not come online.	ZFR1811 Router LED is steady OFF.	RH1, RH2, RH3, RM2
The ZFR1810 Coordinator Wireless LED shows ON steady or OFF steady.	The SIGNAL STRENGTH LED on WEFC's ZFR1811 Router is OFF steady.	RM6
	The SIGNAL STRENGTH LED on WEFC's ZFR1811 Router is ON steady.	RW11
The ZFR1811 Router does not join the wireless network.	The ZFR1811 Router LED flashes once every 5 seconds.	RW12, RM3, RW10
The ZFR1811 Router signal quality is weak.	The SIGNAL STRENGTH LED indicates a weak signal (one flash) or no signal (no flashes).	RW4, RW7, RW10
All WEFCs in an existing, running network suddenly go offline.	- All WEFCs report OFFLINE at the NAE/NCE. - Affected ZFR1811 Router's Signal Strength LEDs indicate not a member of a network (off steady with 1 flash every 10 seconds) - WEFCs lose control of temperature in controlled space.	RW13, RW14
The WEFC's FC/SA BUS LED flashes and then stays OFF.	The WEFC's FC/SA BUS LED flashes and then stays OFF.	RH1, RH2, RH3, RH4, RM8
The WEFC's FC/SA BUS LED is steady ON.	The WEFC's FC/SA BUS LED is steady ON.	RH4, RM8

Table 16: Taking Corrective Action (Part 1 of 3)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
RH1	The ZFR1811 Router is unplugged from (or has a poor connection to) the WEFC.	1. Check the drawing to see if devices near each other are all offline. 2. Start at device closest to ZFR1810 Coordinator and determine if that ZFR1811 Router is unpowered. 3. Wait up to 15 minutes for the mesh network to reform without an unpowered router. 4. Install a ZFR1811 Router in the area to increase mesh density.
RH2	The WEFC is not powered.	Apply 24V power to the 24V power terminals on the WEFC.
RH3	The ZFR1811 Router is defective.	Replace the unit.
RM1	ZFR1811 Router has a duplicate ZigBee network address.	Locate the device with the duplicate ZigBee network address, which is the one that is likely to be offline. 1. Set all PAN OFFSET switches to ON. Wait 10 seconds. 2. Change PAN OFFSET to original number. Wait 10 seconds. 3. Ensure ZFR1811 Router's LED shows adequate signal strength.
		Reform the wireless mesh network. Perform Network Reform on the ZFR1810 Coordinator.
RM2	Duplicate address ranges between multiple coordinators or MS/TP field devices installed on the trunk have duplicate MS/TP trunk addresses. Note: An address conflict can exist between a coordinator and field controllers within the address range of 120 through 127.	Each field controller and coordinator on the FC bus must have a unique MS/TP address. Cycle power to the controller to force the controller to start communicating with its unique address.
RM3	There is a mismatch of PAN OFFSET settings.	1. Ensure that the PAN OFFSET switches on the ZFR1811 Routers match the PAN OFFSET switches on the ZFR1810 Coordinator. 2. Ensure that the PAN OFFSET switches on the WRZ Sensors match the PAN OFFSET switches on the ZFR1810 Coordinator.
RM4	In CCT, the controller information (or device discovery dialogue) shows an incorrect MS/TP address for a controller.	Use the Network Reform command. Or 1. Locate the devices with duplicate addresses. 2. On one of the devices, change the PAN OFFSET setting to another setting. 3. Wait for 10 seconds. 4. Change the PAN OFFSET setting to the former setting.

Table 16: Taking Corrective Action (Part 2 of 3)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
RM5	WEFC does not have Address Switch 128 set to ON.	1. Ensure that the firmware revision of the WEFC is at Release 4.0 or later. If necessary, download new code to the WEFC over a wired or Bluetooth connection. 2. Check that the last switch on the Address DIP switch block (Switch 128) is set to ON. If necessary, set Switch 128 to ON.
RM6	The Metasys System has not mapped any WEFCs.	Map the WEFCs in the Metasys Site Management Portal.
RM7	The NAE/NCE is offline.	FC Bus communication issue - wired or wireless. FC Bus wiring, duplicate address, non Johnson Controls device on trunk causing problems. Refer to <i>MS/TP Communications Bus Technical Bulletin (LIT-12011034)</i> .
RW1	Wireless mesh is reconfiguring to optimize routes.	Wait for 15 minutes.
RW2	Another ZFR1811 Router has been disconnected or failed, forcing wireless mesh to reconfigure.	Wait for 15 minutes.
RW3	Newly commissioned wireless network is still in the configuration process.	Wait up to 45 minutes.
RW4	The ZFR1811 Router is not installed following recommended System Location Guidelines.	Compare installation of affected router with guidelines in <u>Location and Estimating Guidelines</u> .
RW5	A wireless interference source (such as microwave oven or 2.4 GHz cordless phone) is installed near the toggling ZFR1811 router or the ZFR1810 Coordinator.	• Identify sources of wireless interferences. These can include, radio antennas, microwave ovens, Wireless TEC devices, wireless security devices, wireless LAN access points, paging systems, and cordless phones. • Locate the ZFR1800 Series System device 3 m (10 ft) nominally from wireless devices operating at 2.4 GHz. • Avoid locations where a microwave oven is located between two wireless devices.
RW6	Too many WEFCs are installed as part of this system.	1. Identify all devices associated with this wireless network. 2. If more than 35 WEFCs are installed, remove the ZFR1811 Router from the field controller that is farthest from the ZFR1810 Coordinator. 3. Repeat removing ZFR1811 Routers until the system is stable. Note: Each ZFR1810 Coordinator can support up to 35 WEFCs.
RW7	The ZFR1811 Router is oriented incorrectly, limiting the effectiveness of its antenna.	Orient router correctly. See <u>Location and Estimating Guidelines</u> .
RW8	The ZFR1811 Router is too far from the other ZFR1811 Routers.	See <u>Location and Estimating Guidelines</u> .

Table 16: Taking Corrective Action (Part 3 of 3)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
RW9	The ZFR1810 Coordinator is not installed following recommended System Location Guidelines.	See <u>Location and Estimating Guidelines</u> .
RW10	One or more ZFR1811 Routers are too far from the ZFR1810 Coordinator or another ZFR1811 Router.	See <u>Location and Estimating Guidelines</u> and follow these steps. 1. Check the job plan drawing to ensure that a ZFR1810 Coordinator is within 50 ft of a ZFR1811 Router/Repeater. If necessary, add a ZFR1811 Repeater between the ZFR1810 Coordinator and ZFR1811 Router/Repeater. 2. Check to see if any ZFR1811 Router/Repeater within 50 ft of the ZFR1810 Coordinator is unpowered. If necessary, power the ZFR1811 Router/Repeater. 3. Check that any ZFR1811 Router/Repeater within 50 ft of the ZFR1810 Coordinator is configured with the correct PAN OFFSET. If necessary, change the PAN OFFSET switches to match the ZFR1810 Coordinator's PAN OFFSET.
RW11	The ZFR1810 Coordinator has lost communication with all WEFCs.	Reform the wireless network.
RW12	ZFR1811 Router's Signal Strength is Weak.	1. Check the ZFR1811 Router's LED for poor or no signal strength. 2. Add another ZFR1811 Router between the existing ZFR1811 Router and the next closest ZFR1811 Router. Note: Additional repeaters may be needed if ZFR1811 Routers are still 50 ft apart or more.
RW13	ZFR1810 Coordinator was already started somewhere out of range (like in a training/sales demonstration unit, or when the existing network was powered off) with the same channel and have the same PAN setting, and then brought into range of an existing, functioning network.	Use the Network Reform button on the ZFR1810 Coordinator or the Network Reform function in the Metasys Site Management Portal.
RW14	Another ZFR1810 Coordinator is started out-of-the-box with same channel and PAN settings as (and in radio range of) an existing, functioning network.	Use the Network Reform button on the ZFR1810 Coordinator or the Network Reform function in the Metasys Site Management Portal.

WRZ Sensor

Use Table 17 to identify symptoms and possible causes. Use Table 18 to identify the possible causes and steps to remedy the causes.

Table 17: Identifying Symptoms and Possible Causes

Symptom	Identification	Possible Cause Code
Wireless signal strength is not indicated after a WEFC's associated WRZ Sensor's Occ Button is pressed.	ZFR1811 Router's Signal Strength LED does not flash after the sensor's Occ button is pressed.	SH1, SM1, SW1
The WRZ Sensor cannot find a wireless network or has not yet joined the network.	The WRZ Sensor LED turns off after the Occ button is pressed.	SH1, SH2, SW2, SW3
The WRZ Sensor cannot find its associated WEFC.	The WRZ Sensor LED flashes eight times rapidly.	SH3, SM1
The WRZ Sensor signal quality is weak.	The WRZ Sensor LED flashes once after the Occ button is pressed.	SW1, SW3
The WRZ Sensor values are unreliable.	Metasys Site Management Portal indicates an unreliable value.	SH4, SH5, SH6, SW1
The WRZ Sensor LED does not light when the Occ Button is pressed.	The WRZ Sensor LED does not turn on.	SH7, SH8, SH9, SH10

Table 18: Taking Corrective Action (Part 1 of 2)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
SH1	A WRS Series Sensor is installed instead of a WRZ Sensor.	1. Remove the cover of the sensor. 2. On the inside of the plastic cover, read the product code. If it does not start with WRZ, the sensor does not work in this system. 3. Replace sensor with an equivalent WRZ model.
SH2	The PAN OFFSET switch of the WRZ Sensor does not match the PAN OFFSET switch of a ZFR1811 Router.	1. Ensure that the PAN OFFSET switches on the ZFR1811 Routers match the PAN OFFSET switches on the ZFR1810 Coordinator. 2. Ensure that the PAN OFFSET switches on the WRZ Sensors match the PAN OFFSET switches on the ZFR1810 Coordinator.
SH3	The ZFR1811 Router on the associated WEFC is not installed, powered, or on the PAN.	1. Check the MS/TP device address on the sensor, and the WEFC match. 2. Check that the router is installed/connected. 3. Check that the router and WEFC are powered.
SH4	The WRZ Sensor battery power is low and its batteries need to be replaced.	Replace the batteries.
SH5	The WRZ Sensor is not installed.	Install the sensor and ensure settings are correct.
SH6	The factory calibration jumper (J5) is not installed.	Ensure jumper is installed correctly on both pins.

Table 18: Taking Corrective Action (Part 2 of 2)

Possible Cause Code	Possible Cause	Troubleshooting Step and Remedy
SH7	The WRZ Sensor batteries are not installed.	Install the batteries.
SH8	The WRZ Sensor batteries are dead.	Replace the batteries.
SH9	The WRZ Sensor is defective.	Replace the WRZ sensor.
SH10	The power switch on the WRZ Sensor is off.	Turn the power switch ON.
SM1	The MS/TP address of WRZ Sensor does not match the MS/TP address of the WEFC.	1. Ensure that the MS/TP address of the WRZ Sensor matches the MS/TP address of the WEFC. 2. Change the MS/TP address switches on the WEFC and associated sensors to match. 3. Ensure all DIP switch settings (PAN settings, MS/TP address settings) are correct on the WRZ sensor, the ZFR1811 Router, and the WEFC.
SW1	The WRZ Sensor is not in range of any ZFR1811 Router.	See <u>Location and Estimating Guidelines</u> .
SW2	The wireless network is not started.	Start the wireless network.
SW3	The WRZ Sensor is not installed following the recommended System Location Guidelines.	See <u>Location and Estimating Guidelines</u> .

Testing Wireless Signal Strength between WRZ Series Sensor and ZFR1811 Router

To test the wireless signal strength between a WRZ Series Sensor and ZFR1811 Router, ensure that the sensor and router are powered on and communicating by momentarily pressing and releasing the sensor occupancy override button. If the sensor occupancy LED flashes after the button is released, the sensor and router are communicating. See Table 19 for what each LED flash rate indicates.

Note: If the LED does not flash, you must determine why the sensor and router are not communicating. See *Troubleshooting*.

Table 19: WRZ Sensor/ZFR1811 Router Wireless Signal Strength

Flashes	Signal Strength
3	Excellent/Sensor has joined network
2	Good/Sensor has joined network
1	Weak/Sensor has joined network
0	None/Sensor has not joined network
Fast Flash Rate (8)	Unable to locate associated wireless enabled field controller

On LCD models, the signal strength is shown on the display on the face of the sensor (callout in Figure 20).

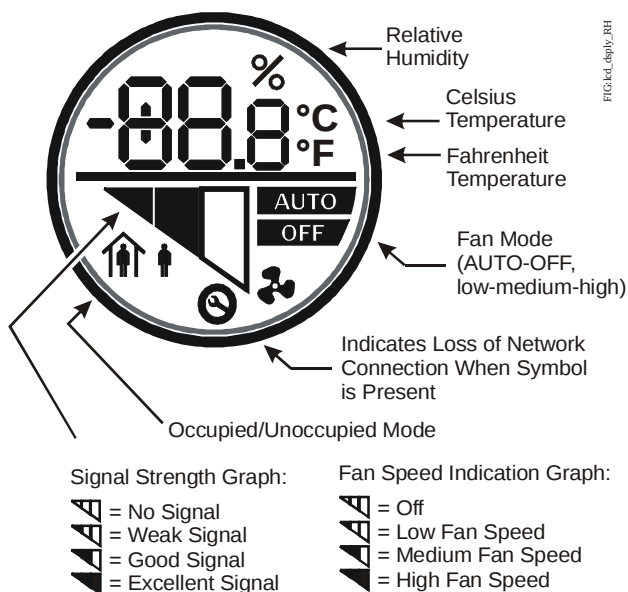


Figure 20: Sensor LCD (WRZ-MTB, WRZ-STR, WRZ-THB, WRZ-TTB, and WRZ-TTD Models)

For information on using the optional ZFR Checkout Tool (ZCT) to see the wireless signal strength of all of the various ZFR1800 Series System devices, refer to the *Using the ZFR Checkout Tool (ZCT)* chapter of the *Controller Tool Help (LIT-12011147)*. For information on using the optional WRZ-SST-120 Wireless Sensing System Tool and any WRZ Series Sensor to test wireless signal strength, refer to the *WRZ-SST-120 Wireless Sensing System Tool Installation Instructions (Part No. 24-10563-12)*.

ZFR USB Dongle Troubleshooting

Use Table 20 to identify possible causes if you cannot connect to a ZigBee wireless mesh.

Table 20: ZFR USB Dongle

Symptom	Cause	Solution
LED on ZFR Dongle never illuminates.	Incorrect USB driver installed on computer	Verify CCT Release 5.3 or higher is installed on computer.
	Two or more USB ZFR Dongles plugged into the same computer.	Unplug all extra USB ZFR dongles from laptop USB ports and restart CCT and or ZCT software applications.
	Defective USB Dongle	Replace the defective ZFR USB dongle.
LED on ZFR USB Dongle flashes rapidly (three times a second) for 1 minute then extinguishes.	Incorrect PAN ID entered from CCT or ZCT ZigBee wireless connection dialog boxes.	Verify the PAN ID entered within CCT or ZCT matches the PAN ID of the ZFR system mesh you are attempting to join.
	Incorrect wireless channel number entered from ZCT main screen.	Verify the channel number entered within ZCT matches the wireless channel of the ZFR system mesh you are attempting to join. If you do not know the correct channel number, select Auto for the channel number within the ZCT.
	Attempting to connect to the wireless mesh through the ZFR1810 Coordinator.	Move to the nearest wireless-enabled field controller ZigBee repeater of the mesh you want to join. The ZFR USB dongle does not connect to a wireless mesh through the Coordinator.
	Too far away from the wireless mesh you are attempting to join.	Move closer to the wireless mesh you are attempting to join.
LED on ZFR USB dongle flashes slowly (once a second) continuously.	ZFR USB dongle is in boot mode.	If the pinhole button is pressed on the ZFR USB dongle while it is plugged into a USB slot, the USB module enters factory boot mode. If this happens, reinsert the dongle in the USB slot without pressing the button. Note: This is an unusual circumstance as the button is recessed in the surface of the ZFR USB dongle package.

Appendix A: ZigBee Overview

The ZigBee network is a global open networking standard that defines a low-cost, low-power, two-way wireless communication system. Its development comes from the ZigBee Alliance, an organization of manufacturers devoted to providing a cost-effective wireless networking technology for use in commercial and residential applications. The primary advantages that ZigBee technology brings to the marketplace include the following:

- high reliability and security
- low power with multi-year battery life
- low complexity at an economic cost

ZigBee Communications Technology

The ZigBee network is a Personal Area Network (PAN) based on the Institute of Electrical and Electronic Engineers (IEEE) 802.15.4 standard for low power, low duty-cycle wireless transmitting systems. Devices on the network use Direct Sequence Spread Spectrum (DSSS) wireless technology and operate on the 2.4 GHz Industrial, Science, Medical (ISM) band.

Devices on the ZigBee network are different from Bluetooth® devices and wireless Universal System Bus (USB) devices in that they form a mesh network between nodes. Mesh networks are a type of daisy chaining from one device to another. This technique expands the typically short range of an individual node into a much larger, widespread network consisting of multiple nodes.

The Media Access Control (MAC) layer uses a Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) mechanism. This layer transmits beacon requests, synchronizations, and message retries. The physical layer of the ZigBee network uses the 2.4 GHz radio band. Channels 11 to 26 are available in this band. Figure 23 illustrates the details and provides a comparison of ZigBee and Wireless Fidelity (WiFi) network channel spacing.

ZigBee Device Types

The ZigBee specification defines three kinds of devices that can be part of a ZigBee network: a coordinator, one or more routers, and one or more end devices.

Coordinator

A coordinator is a required network component. Up to eight coordinators are permitted on each wireless network. The coordinator acts as a parent device, initiating network formation, which involves channel selection and network identification. Each Wireless PAN contains one and only one network coordinator.

Router

A router is an optional network component. One or more routers are permitted on each wireless network. Routers act as parent devices, participating in multi-hop message routing; they relay messages between nodes and allow child nodes to connect to them. Routers can talk to other routers and to end devices.

End Device

An end device is an optional network component. One or more end devices are permitted on each wireless network. End devices may be low-power, child devices that are typically battery powered. They do not communicate directly to other devices but rely on their parent to forward and buffer messages for them.

ZigBee Network Topologies

A ZigBee network can adopt one of three topologies: star, tree, or mesh (Figure 21). The topology defines how a message is routed from one node to another. A star network has a central node through which all messages pass. A tree network has a top node with a branch and leaf structure below in which messages travel up and down the tree as necessary. A mesh network is a modified tree network in which some leaves are linked, enabling messages to travel across the tree when a suitable route is available. The ZFR1800 Series Wireless Field Bus system uses a mesh network.

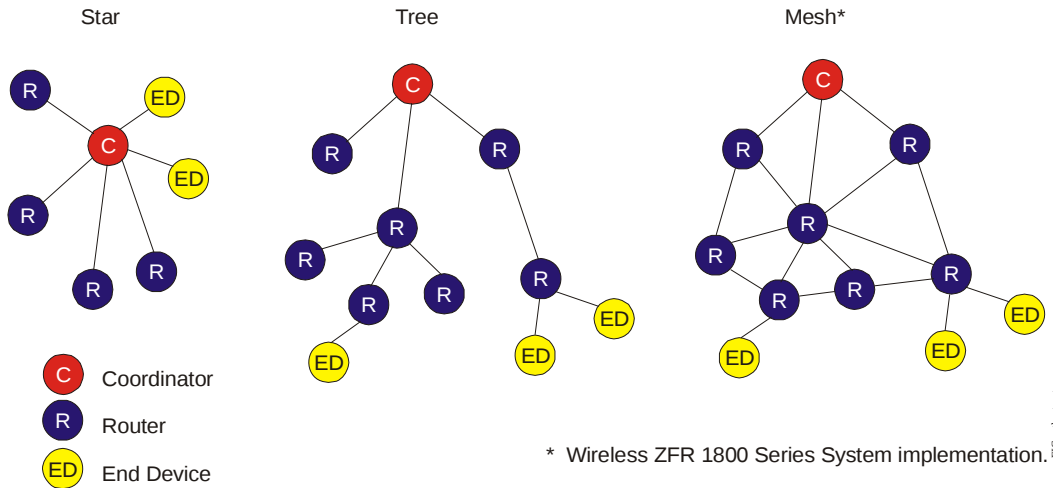


Figure 21: Topologies for Wireless Network

Parent and Child Devices

In a wireless ZigBee network, a parent is a device that assigns unique network addresses to other child nodes as they join the network. Any coordinator or router can be a parent to other routers and end devices, but the coordinator is always a parent device. When a router or end device joins the network, it selects a parent from a group of routers or the coordinator. The selected parent may not always be the closest node because the router or end device selects a parent based on signal strength and its proximity to the coordinator. Once the router joins the network, it no longer relies on its parent for communication; however, once an end device joins, it continues to rely on its parent for all two-way communication.

In a ZigBee network, each coordinator and router has six addresses to give other routers that want to join the network and 14 addresses for end devices. Once a device has given out all of its available addresses, the device cannot give out more addresses to add other devices to the network.

Note: This address limitation is based on the ZigBee Home Automation Profile.

Self-Healing, Multi-Hop Network

The ZigBee network is further characterized as a self-healing, multi-hop network. If a wireless communication path experiences interference or drops out, the network automatically reroutes the message through an alternate path to form a new wireless communication path. Each message is received, then retransmitted as it hops along from node to node until it reaches its final destination. Within a ZigBee network, a single message is allowed to hop 10 times between the source and destination node.

End Devices, Parent and Target Routers

An end device communicates through its parent router. This parent may also be the target of the data. To illustrate, consider the partial wireless system shown in Figure 22. The following parent and target relationships exist:

- For WRZ Sensor A1 and A2, Router A is both the parent and target node.
- For WRZ Sensor A3, Router A is its target node and Router D is its parent node.
- For WRZ Sensor A4, Router B is its parent node and Router A is its target node. If Router B becomes unreachable, Sensor A4 automatically finds a new parent, which is Router C in this example. It then forwards its data through its new parent, Router C, on to Router D, then finally to its target, Router A.

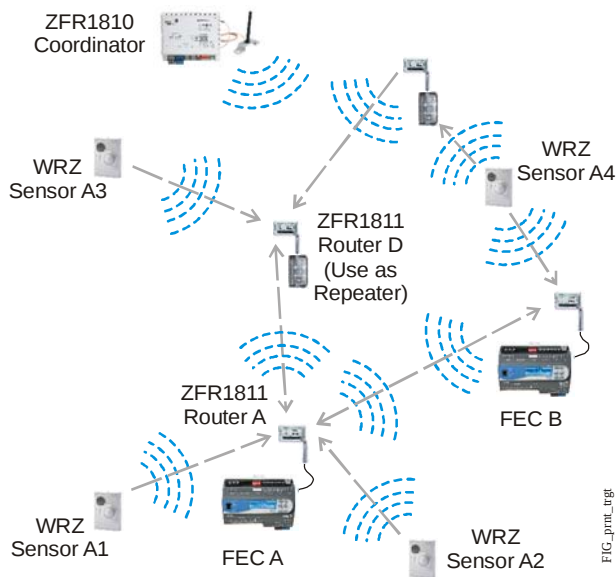


Figure 22: Illustrating Parent and Target Routers

ZFR1800 System Implementation of ZigBee Technology

The ZFR1800 Series Wireless Field Bus system implements ZigBee technology as follows:

- The ZFR1810 Coordinator is the ZigBee coordinator, which does not accept end devices as child nodes. The ZFR1810 Coordinator is a parent to ZFR1811 Routers.
- The ZFR1811 Router is the ZigBee router. The ZFR1811 Router can serve as a child to a ZFR1810 Coordinator or other ZFR1811 Routers, and a parent to other ZFR1810 Routers and WRZ Sensors.
- The WRZ Series Sensors are the ZigBee end devices. The WRZ Sensors are battery-operated devices that serve as children to ZFR1811 Routers but are never also children of the ZFR1810 Coordinator.
- The system uses the ZigBee Home Automation Profile.

ZigBee Channels

The ZFR1800 Series System operates on an Institute of Electrical and Electronic Engineers (IEEE) 802.15.4 ZigBee network.

This ZigBee network has 16 channels available for use (Channels 11 through 26, shown in Figure 23). In North America, the ZFR1800 Series System uses channels 11 through 25. By default, the ZFR1810 coordinator is configured for use in North America, and uses channels 15, 20, and 25.

These channels were selected for the ZFR1800 Series System because they do not overlap with channels used on an IEEE 802.11 WiFi network. To illustrate, Figure 23 compares the channel spacing of the ZigBee and WiFi networks. Notice that the IEEE 802.15.4 channels of operation used by the wireless Metasys systems do not overlap and, therefore, avoid interference with the WiFi network.

Use CCT to select a different subset that has been preselected based on the country or region of use. These channel subsets were selected because they do not overlap or interfere with channels used on WiFi channels used in those regions. To illustrate, Figure 23 is a diagram showing the channel spacing of the ZigBee and WiFi networks for North America.

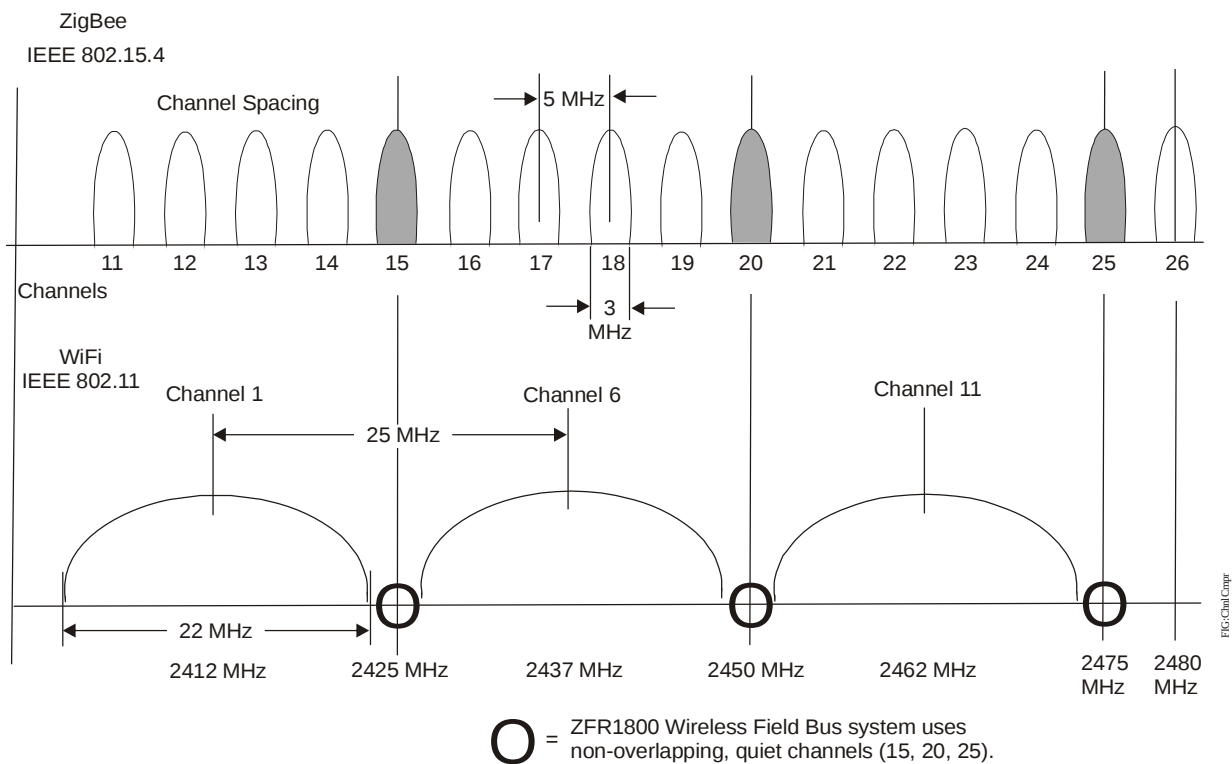


Figure 23: Comparing Channel Spacing of the ZigBee and WiFi Networks

Wireless Interference

The ZFR1800 Series Wireless Field Bus System is designed to minimize the potential for wireless interference with other wireless applications. In most commercial environments, the ZFR1800 Series System does not encounter or generate wireless interference, even in environments with cell phones and competing WiFi applications.

ZFR1800 Series Wireless transmissions use different modulation schemes than WiFi applications and use frequencies between popular WiFi bands, enabling WiFi and ZFR1800 Series Wireless networks to exist in the same areas.

The system should not interfere with other wireless systems for the following reasons:

- No common frequencies exist between the cell phone bands and the 2.4 GHz Industrial, Scientific, and Medical (ISM) band where the wireless system operates; therefore, interference should not occur with cell phone transmissions.
- The 802.11 WiFi standard and the 802.15.4 standard used by the wireless Metasys systems both use Direct Sequence Spread Spectrum (DSSS) wireless technology and are specified and required by the Federal Communications Commission (FCC) to be simple noise sources to each other. These standards are major advantages for DSSS technology, as each system's transmissions typically result in only a slight increase in background noise. The message is spread across multiple frequencies and the noise allows reconstruction of the entire message where the noise is virtually undetectable.
- The ZFR1800 Series Wireless Field Bus System operates on the same frequency band as IEEE 802.11 WiFi networks, but uses different channels. The ZFR1800 Series System automatically selects non-overlapping, quiet channels (for example, 15, 20, and 25). See Figure 23.
- The ZFR1800 Series Wireless Field Bus System uses clear channel assessment to listen to the channel before transmitting on it. This detail means that before transmitting wireless data on the channel, the device first listens to determine whether any another device is already transmitting on the channel. Various wireless technologies also use clear channel assessment, which further helps to minimize the potential for interference.
- ZFR1800 Series Wireless Field Bus System devices transmit at a low transmission power of 10 mW. 802.11 WiFi devices typically transmit at 40 to 100 mW. As a result, when both a 802.11 WiFi device and a ZFR1800 Series System device transmit simultaneously, the ZFR1800 Series System device only appears as low-level noise to the WiFi device.

- The ZFR1800 Series Wireless Field Bus devices transmit data using several short messages that are collected and reconstructed at the destination. These smaller messages can transmit between the larger WiFi messages. The short messages have less chance of colliding with other messages and a better chance of transmitting successfully. If a piece of the ZigBee wireless message is transmitted at the same time as a WiFi message, it retries until it can transmit at the next available gap (Figure 24).

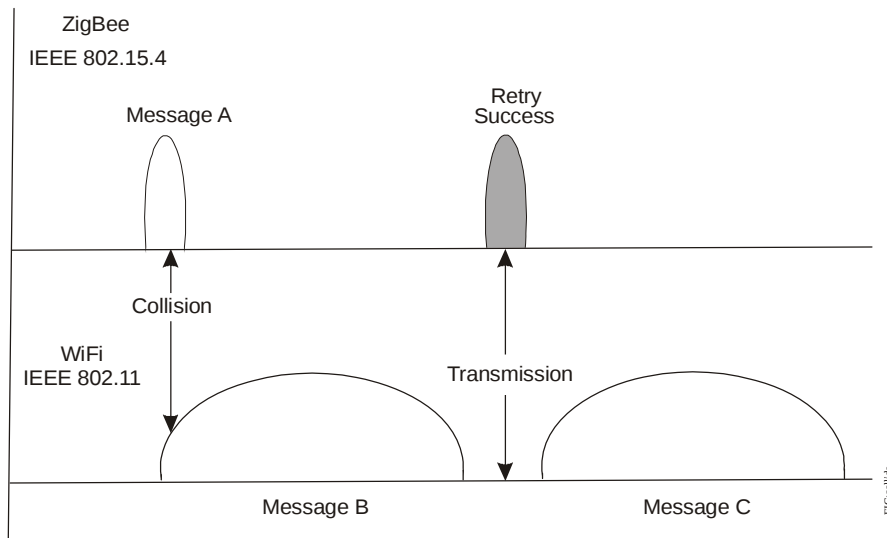


Figure 24: Message Transmission

Other wireless systems should not interfere with the ZFR1800 wireless system for the following reasons:

- Cell phones do not operate on the 2.4 GHz ISM band; therefore, cell phone transmissions should not interfere with the wireless Metasys systems.
- When a wireless system encounters WiFi transmissions in the 2.4 GHz ISM band, most of the transmissions appear merely as noise, with insignificant or no impact on wireless system communication.
- Wireless interference and transmission failures are minimized by maintaining an adequate distance between wireless transmitting devices. If a wireless device operating at 2.4 GHz (for example, a WiFi access point) with a standard antenna is located at least 3 m (10 ft) from the ZFR1800 components, there should not be any interference. Likewise, if a wireless device with a high-gain antenna is located at least 6 m (20 ft) from a wireless Metasys system, there should not be any interference.
- Tests indicate that WiFi channel 11 transmissions should not significantly interfere with a wireless system unless the WiFi access points are within 3 m (10 ft) of the wireless Metasys products, and the access points are transmitting at full power almost continuously.

- Although the compatibility of WiFi and ZigBee products is based on standards and good design, other sources can interfere with both WiFi and the wireless system by overloading the bands with continuous transmissions at very high levels. Many consumer 2.4 GHz wireless products, such as cordless phones and some older phone headsets, can cause wireless interference and should not be used anywhere near a wireless system or other WiFi applications. Additionally, some camera and sound systems are continuous frequency modulation transmitters, and they must be kept out of the WiFi environment to ensure optimal operation.
- The wireless Metasys systems automatically choose the best channel of operation at initialization. This channel can be overridden with a manual command.

Wireless Security

The ZFR1800 Series Wireless Field Bus System is secure for the following reasons:

- ZFR1800 Series Wireless Field Bus System devices transmit at a low transmission power of 10 mW preventing outside sources from accessing the system. You must be physically within the building to access and transmit on the system.
- The ZFR1800 Series Wireless Field Bus devices transmit data using several short messages that are collected and reconstructed at the destination. If a piece of the message is intercepted, it is indecipherable to the outside source.

Appendix B: Upgrading Controller Firmware Using Point Schedule

At Release 5.0 and above, wireless download behavior has been changed when upgrading controller firmware.

Within the point schedule (automatic process), a firmware upgrade is initiated by first simultaneously downloading two controllers within each wireless mesh. After the first two controllers finish upgrading, the firmware upgrade propagates from those two controllers to the rest of the mesh automatically. The point schedule, at this time, is merely polling the devices for download status.

IMPORTANT: Even if the point schedule is removed from the network after initiating an upgrade, the upgrade continues throughout the mesh network until every controller in the network completes the firmware upgrade.

We now suggest doing a Network Reform before performing a firmware upgrade due to the new firmware upgrade behavior, because the new download scheme relies on an even distribution of the ZigBee short addresses, which is best achieved by a Network Reform with all the nodes communicating. This Network Reform only needs to be done the first time the mesh network's controllers are upgraded.

The network chooses two of the first depth-level controllers that are closest to the coordinator. Those controllers are upgraded first, then the siblings at that same depth level. The point schedule instructs each node in the mesh network when to begin their download from their parent device. As each parent device finishes upgrading, the child devices of that device begin their own upgrades, reading the main code from the parent device.

If you have multiple coordinators (mesh networks) on a trunk, the point schedule downloads a pair of controllers on each wireless mesh at a time. For example, if your trunk has three ZFR1810 coordinators with the same model controllers in each mesh, six downloads occur simultaneously.

Appendix C: Restricted Hallway Scenario

Using a linear or daisy-chain arrangement instead of a mesh is not recommended because it can create a scenario where a single point of failure results in disrupted network communications. Some installations require this linear configuration, such as in a building wing or long hallway where signals need to cover long distances, but building restrictions (architectural, appearance, owner preference) restrict use of (or prevent installing) repeaters in hallways. This scenario often requires extra repeaters, resulting in excessive address depths and an increased number of signal hops.

Figure 25 shows this sort of scenario. If you plan the wireless system only on the basis of transmission distances and transmission hops, you might think that this scenario should work, because there is no more than 50 ft between each device and its neighbor and because the WRZ sensor associated with the ZFR1811 Router labelled **K** uses 10 hops to transmit the signal to the coordinator. However, only part of this system works because this network design ignores the limit of the five-depth short address assignment. When a wireless mesh network forms, it uses up to five layers in assigning short addresses required for network communication.

In Figure 25, the ZFR1811 Router labelled **E** is at Address Depth 4, and is the last device that can assign a subaddress to an associated WRZ sensor. The ZFR1811 Router labelled **F** is at Address Layer 5; and although it can join the network, it cannot assign an address to a WRZ sensor. The ZFR1811 Routers labelled **G** through **K** do not get short addresses, and cannot join the mesh network.

The WRZ sensor associated with the ZFR1811 router labelled **D** can use four hops to send the signal to the ZFR1810 coordinator. The ZCT scan may show five hops because the network may route the signal through the ZFR1811 router labelled **A**.

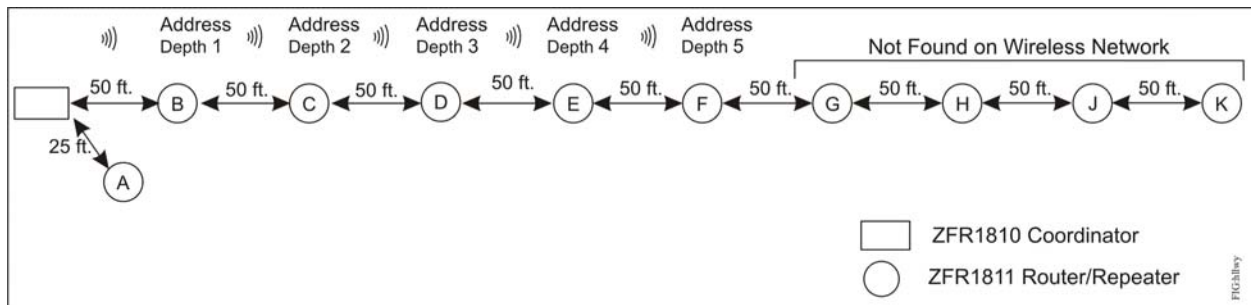


Figure 25: Hallway Scenario

Invalid Solutions

Improper application of the partial network setup procedure (sometimes called the candle method) has shown the partial network setup procedure to be inadvisable in a variety of settings, particularly in hallways. Figure 26 and Figure 27 show misapplications using a partial network setup.

IMPORTANT: Using a Network Reform command through any method (ZFR1810 button, ZFR Checkout Tool, or Metasys Site Management Portal) results in the improperly created address depths dropping out of the network. To avoid this problem, use one of the recommended valid solutions (see [Valid Solutions](#)).

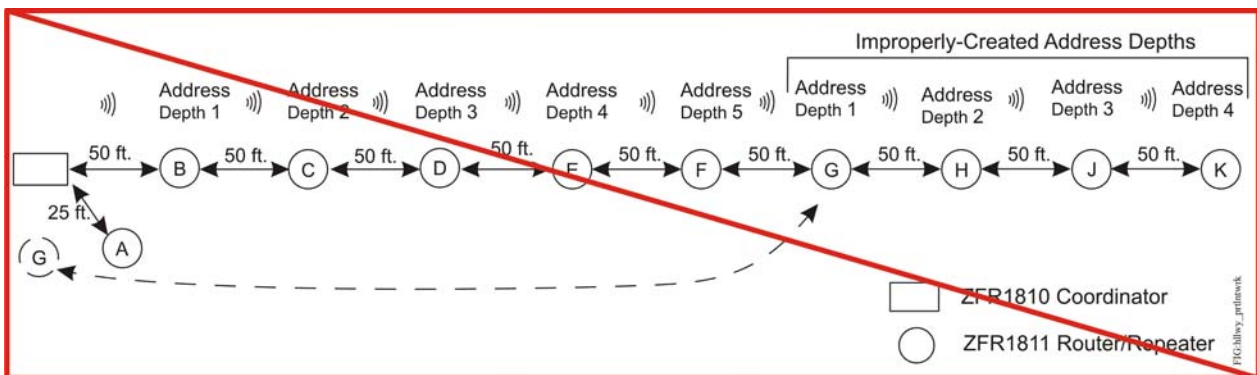


Figure 26: Hallway Scenario - Invalid Solution 1

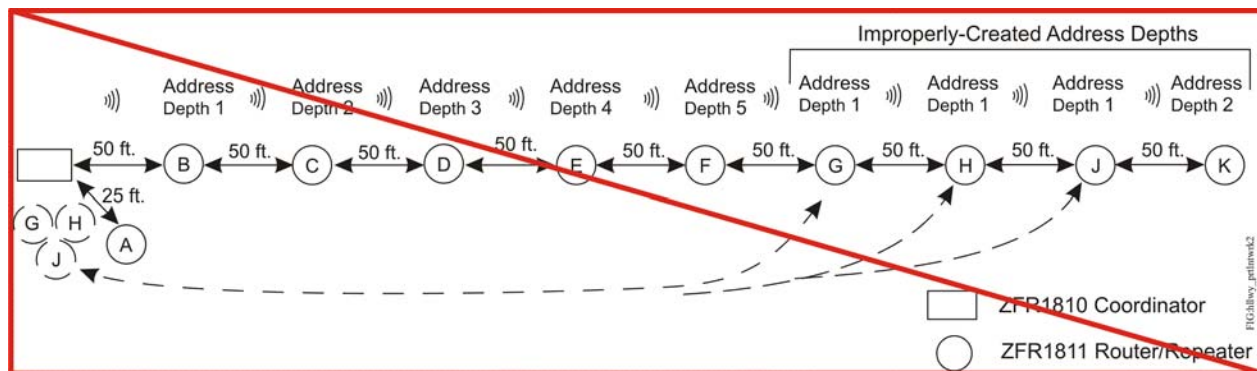


Figure 27: Hallway Scenario - Invalid Solution 2

Valid Solutions

There are two solutions to the problems presented by a hallway:

- centrally locate the coordinator in the hallway to avoid exceeding the maximum five-depth addressing limit (Figure 28)
- locate a coordinator at each end of the hallway, using two separate wireless networks with separate PAN OFFSET instead of one wireless network with a single PAN OFFSET (Figure 29)

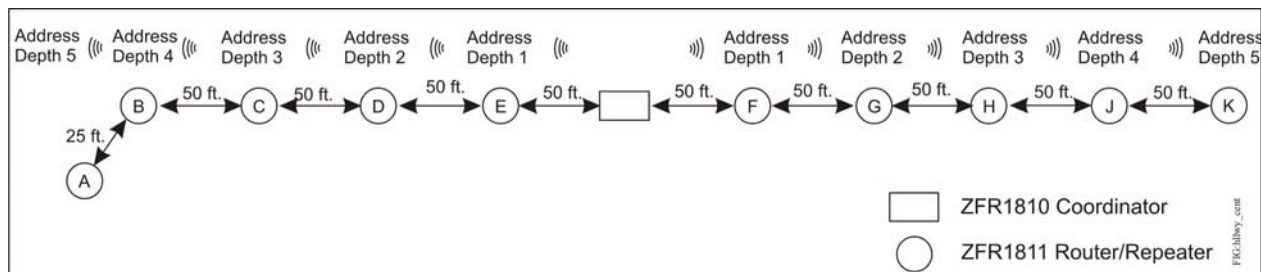


Figure 28: Hallway Scenario - Valid Solution 1



Figure 29: Hallway Scenario - Valid Solution 2



Building Efficiency
507 E. Michigan Street, Milwaukee, WI 53202

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