Infodraw Wireless Sensor Devices System

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Abstract

Infodraw Wireless Sensor Devices System (WSDS) is a system of wireless sensors that communicate using the Zigbee protocol. These sensors can be set up to indicate an acceleration event and/or an input port contact alarm, and deliver output port dry contact and relay a UART conversation. The Zigbee communications system defines three types of roles for a device that communicates this protocol: coordinator, router and end-device.

Coordinator

The coordinator node sets up the Zigbee network and there must be exactly one of it in a network. Every other node (router, end-device) connects to a network already set up by the coordinator. When the Zigbee network is used with MRS devices, the coordinator will be the node inside the PMRS box, on the electronic balcony with the cellular module and/or WiFi module. It will exchange that between the PMRS device and all other nodes in the network. The coordinator is a super-router that has to be online all the time for network management and cannot be battery powered for a long time.

Router

The routers relay messages inside the network. In this way a message can travel a long way without using high transmission power – simply by routers that repeat the message forward until it reaches its destination. A router connects to a network set up by the coordinator. The router has to be online all the time for passing random messages so it cannot be battery powered for a long time.

End-Device

The end device is the node which can be placed in power savings mode for running a long time with battery power. The end-device connects to a network set up by the coordinator. It does not have to be online all the time: every pre-configured time it asks the nearby router (or coordinator) if there are any messages for itself. It only sends messages that it generated by itself. Note that when sending a message to an end-device, it may take some time until the end-device receives the message (when it wakes up to check up on messages) and acts accordingly.

Features

The WSDS devices delivered by Infodraw can be in one of two forms: The first is the built-in chip inside the PMRS box. This device has no additional features than the basic communication feature of passing network messages. The other is the external sensor that has the following features other than being part of the Zigbee network.

USB Configuration and Charging

The device can be configured and charged via a USB cable to the PC. The **WSDS_WinConfig** application is used to configure the device. In order to configure the device you must connect it to the PC with the standard USB cable, install the driver (if not already installed) and run the application. The driver can be found in the **Wireless Sensor USB driver** package. While the device is connected to the PC, the batteries will be charged. In the configuration utility click the “Config” button. You should then see a web page that lists the available devices. If your device is currently a coordinator and there are other devices connected to its network, you'll be able to configure them too through this USB connection, otherwise you will only be able to configure the attached device. In order to configure the internal device inside the PMRS box, you should double click the “WSDS” tree item inside the PMRS device section in the MRS Monitor Client Application.

Accelerometer

The external devices come with a built-in accelerometer for movement detection of the device. If configured so in the WSDS Configuration Web Pages, then when the device moves and/or stops moving, it sends a message to the coordinator about it. The coordinator inside the PMRS box will relay this information through the MRS network to the Monitor Client Application generating responses such as beeps, display of video/audio and/or recordings.

Input Ports

The external devices come with dry contacts that detect whether they are connected to the ground (closed circuit) or not (open circuit). If configured so in the WSDS Configuration Web Pages, then when the connection changes, the device will send a message to the coordinator about it. The coordinator inside the PMRS box will relay this information through the MRS network to the Monitor Client Application generating responses such as beeps, display of video/audio and/or recordings.

Output Ports

The external devices come with dry contacts that can either close or open a circuit to the ground when they get a message to do so. They can be controlled by the MRS Monitor Client Application and also by the WSDS Configuration Web Pages.

UART

The external devices come with UART ability to send and receive serial data. The serial data can be sent and received using the WSDS Configuration Web Pages. It can also be exchanged if a TCP port is configured there – by accessing this port on the PC hosting the connection to Wireless Sensor device, the PC running the WSDS_WinConfig application or the PMRS with the WSDS coordinator inside.

General Configuration Page

This page can be entered from the main devices list page by pressing on the “General” link in the row that matches the device of choice. After changing one or more of the parameters inside, it is recommended to restart the device.

Address

This is the short address of the device in the network. Coordinators typically are addressed 0. Others get random device numbers when joining the network. This address cannot be changed by the user. This address is a number between 0 and 65530.

Hardware Identifier

This is a unique identifier assigned for each Zigbee device. It cannot be changed.

Time Alive

This is the time since the device was powered on or restarted.

Software Version

This is the software version of the device.

Role

Change this role to switch between a coordinator, a router and an end-device.

Network PAN ID

A network PAN identifier distinguishes between different networks. Select 65535 to setup/join any network, or between 0 and 65534 for a specific network.

Network (Group) [1-65534]

A zigbee group can limit communication between devices of the same group. Do not change this number unless you want to create different groups and broadcast device messages to the device's group.

Endpoing [1-253]

The endpoint defines the type of communications used in the network. Do not change this number unless you wish to prevent certain devices in the system from communicating with each other.

Presence message frequency [1-65]

The time between messages sent that declare the availability of the device. A small number means that the device will be detected more quickly in the network, but it will also consume more power for sending more messages. An end-device, then, needs a larger number to consume less battery-power. Recommendation: 20 seconds.

USB Timeout [20-65]

The idle time without USB messages that should trigger a port toggle. When the device is connected with the USB cable, it will detect an idle time when no message are passed in order to reconnect and re-trigger a conversation with the USB host machine. Recommendation: 30 seconds.

Network timeout [6-65]

This is the idle time without network messages that should trigger a device restart. It is relevant for routers and end-devices that are supposed to be online passing messages to the coordinator node. In case there is a network failure, the devices must be able to restart, which may fix the problem. Recommendation: 60 seconds.

Last restart reason

This field indicates the reason why the device has been last restarted.

Transmit Power

This field sets the transmission power. Do not change this field unless lower or high power is suspected to cause network difficulties.

Network messages target

This field sets the target of a message sent through the network. If set to “automatic” or “unicast”, then messages from routers and end-devices will be sent directly to the coordinator. If set to “group” then messages will be sent to all nodes of the same group. If set to “broadcast” then messages will be sent to all nodes of the same network. Recommendation: Automatic.

Has Accelerometer

This option defines whether or not the device has an accelerometer hardware. Uncheck this option for the built-in device inside the PMRS box. Check this option for standalone WSDS devices.

Has UART

This option defines whether or not the device has a UART capacity. Uncheck this option for the built-in device inside the PMRS box. Check this option for standalone WSDS devices.

Flash Periodic LED

This option defines whether or not the device should flash a LED indicating network connection. Uncheck this option for the built-in device inside the PMRS box. Check this option for standalone WSDS devices that do not rely on battery-power.

Debug Messages

This option is reserved for future use. Do not check this option for now.

Use Watchdog

A watchdog is used to reset a non responsive system. Do not use this option for a battery powered device. Check this option for the coordinator and router devices.

Rely on USB

Check this option if the device passes messages to/from its USB connector all the time and must maintain this connection, such as the internal coordinator built inside a P/MRS capture device box. It will make the CPU restart in case the USB connection is lost for the timeout period.

Secure

This option is used to secure the network messages between the devices. It is reserved for future use, so do not use this option for now.

Battery Powered

Use this option for battery powered end devices to save power. An end-device that has this feature turned on will enter sleep mode and turn off its radio in order to save power.

Has RF Front-End

Check this option for external Zigbee WSDS devices. They have RF power amplifiers for long range messages. Uncheck this option for the internal coordinator built inside the PMRS box.

Automatic RF Front-End Control

Check this option for external Zigbee WSDS devices. They have RF power amplifiers for long range messages. This option is used by battery-powered end-devices for automatically turning off the radio when entering sleep mode. Uncheck this option for the internal coordinator built inside the PMRS box.

Logical Ports Configuration

Output Port 1/2

The output port entries affect the dry contact ports accessible by the wire connected to the external WSDS devices. Do not use these entries with the internal device built inside the PMRS box. Setting "Connected" will make the entry appear in the MRS Monitor Client Application as an output port which can be set or unset by either the check-box in the Monitor Application or in the configuration web page.

Input Port 1/2

The input port entries affect the dry contact ports accessible by the wire connected to the external WSDS devices. Do not use these entries with the internal device built inside the PMRS box. Setting "Connected" will make the entry appear in the MRS Monitor Client Application as an input port. The configuration web page enables setting the polarity of the port: either normally open or normally close. Normally open means that a short-circuit of the port wire to the ground will cause a contact alarm. Normally close means that cutting the circuit of the port wire to the ground will cause a contact alarm.

Polling time

The best option to alert that an input port has changed its state is using an interrupt. However, due to hardware limitations, when using more than one input port at the same time or an input port and an accelerometer, an interrupt cannot be used for this matter, so polling is used instead. The polling time is the time between two polls of the input. A small value means more polls and more power consumption over a long time, so polling is not recommended for devices with battery-power.

Accelerometer Configuration

Axis

This field defines the axis for acceleration detection. It can be X,Y,Z or all axes. Recommendation: for battery-powered end-devices use one axis, not all axes, and do not connect any input ports.

Threshold [1-128]

This field defines the alert threshold of change. The lower the threshold, the more sensitive will be the detection, the higher the threshold, the less sensitive will be the detection. Recommendation: 5.

Time between polls [1-65000]

The accelerometer can detect motion automatically on one axis using an interrupt. The best option to alert that an accelerometer has changed its state is using an interrupt. However, due to hardware limitations, when using an input port with the accelerometer, or choosing all axes instead of one axis, an interrupt cannot be used for this matter. A small value means more polls and more power consumption over a long time, so polling is not recommended for devices with battery-power.

Output Port 1/2

These options enable to set the output port as a response to an acceleration detection. The polarity is set by the "**Automatic output polarity**" field. If "**Network accelerometers**" option is checked, then the output port will be set as a response to an accelerometer alarm of any other device as well.

Automatic output polarity

This field defines whether or not the selected output ports above will close or open a circuit to the ground when an acceleration alarm is set or unset. Choosing "Normally Open" means that an acceleration alarm will close the circuit of port 1 and/or 2 to the ground. Choosing "Normally Close" means that an acceleration alarm will open the circuit of port 1 and/or port 2 to the ground.

Green LED

This option defines whether or not the acceleration alarm will light the green LED located on the external WSDS device.

Output port minimal time [0-65000]

This field defines the minimal time for the output port to remain in its alarm state before switching back to its normal state.

Network accelerometers

This option defines if the output ports and green LED options defined in this acceleration page should response only to alarms from the built-in accelerometer in the specific device (unchecked), or also to alarms from all devices that their acceleration alarm message were received (checked).

Run Accelerometer

This option turns on or off the accelerometer for generating alarms. Acceleration alarms will show as input port alarms in the MRS Monitor Client Application.

UART Communications

Pressing the UART link for a specific device entry in the main devices list web page (Internet Explorer) will open a page with output and input boxes for direct sending and receiving over the web page. Write text in the output box and click “Send” to send it. Look at the incoming text at the input box and click “Clear” to erase it. Click “Parameters” to modify the following UART parameters:

Baud Rate

This field defines the baud-rate which is the UART connection speed for the UART port. It can be one of: 9600, 19200, 38400, 57600 or 115200 bps.

TCP Port

This fields enables direct communications with the peer connected by UART to the device by accessing the coordinator's host TCP port specified by this field. Port 0 disables this option. Any other port causes the coordinator's host to listen on the specified port and pass messages back and forth with the device's UART port.

Signal Strength Management

It is possible to get a measurement of the device's received signal strength. It is done by sending a message from the coordinator to the device asking the device to reply with a message that includes the RSSI of the original message. Pressing the Signal link for a specific device entry in the main devices list web page will open a page with the following items:

Last measured RSSI

Displays the last measured RSSI value on the device. Click “Measure” to acquire a new measurement.

Minimal RSSI [-128 - 127]

This field defines the minimal RSSI value for defining that the signal is strong enough to be OK. It is used when generating an alarm when the signal drops below this value. It is also used for a reference when doing a standalone signal test against another device. If the signal returned by the target device is lower than this value, then system will set output ports and/or the green LED according to the configuration below.

Generate an alarm when the signal drops below minimum

This option turns on or off the alarm based on the RSSI value. It causes the coordinator to send

messages to the device with frequency the network timeout value and a minimum time of 5 seconds. Every time the acquired RSSI drops below the minimal RSSI defined above, an alarm is generated and will show as input port alarms in the MRS Monitor Client Application.

Standalone signal test

This option enables the standalone signal test. This test should be done in a network of two devices, one is the coordinator, which is the device to be configured. The other can be a router or an end-device. Configure the coordinator for a standalone test against the other device when the coordinator is not connected to a host (works standalone) like a PMRS or a PC. If enabled, the coordinator will query the other device for its RSSI and compare it to its minimal RSSI value (the one configured in the coordinator, not the other device). The frequency of the queries depends on the network polling time defined for the coordinator.

Standalone signal test target device

Select the target device for the standalone signal test. The coordinator will query this device for its RSSI.

Last measured RSSI for target

Displays the last measured RSSI value of the signal test target device. Click “Measure” to acquire a new measurement.

Output Port 1/2

These options enable to set the output port as a response to a low signal detection. The polarity is set by the “**Automatic output polarity**” field.

Automatic output polarity

This field defines whether or not the selected output ports above will close or open a circuit to the ground when a low signal is detected. Choosing “Normally Open” means that a low signal will close the circuit of port 1 and/or 2 to the ground. Choosing “Normally Close” means that a low signal will open the circuit of port 1 and/or port 2 to the ground.

Green LED

This option defines whether or not the low signal will light the green LED located on the external WSDS device.