BAPI 900 MHz Wireless System - Communication Overview and Optimization

Application Note

Communication Overview

The sensors and gateways in BAPI's 900 MHz Wireless System are transceivers, meaning that they both transmit and receive RF data. All sensors and gateways that are within range of each other and transmitting on the same RF frequency or channel will receive transmissions from each other, even if they are on different wireless networks.

As with all wireless technologies, there is a limit to how many sensors and gateways can be within range of each other and transmitting on the same channel and still provide effective communication. A large number of sensors and gateways communicating on the same channel leads to data collisions. A collision occurs when two devices transmit at the same time and one or both of the transmissions are lost. When too many collisions occur, communication becomes ineffective.

The BAPI system uses smart logic to analyze channel noise and cycle through the available channels to select one with a minimal level of noise. Each of the sensors and gateways uses this technology to assure that communication is achieved in the most reliable manner. Up to four channels are available on each device, and any combination of these four channels can be selected for communication via the device configuration software (as described in the gateway operation/installation manual). By default, each device will communicate on the channel that it has selected through smart logic plus one additional channel (if more than one channel has been selected in the configuration). This will allow a transmission to be received even when there is a temporary interference in the other channel.

Factors that Impact Communication Effectiveness

There are several factors that affect how many gateways and sensors can be installed in a system and still maintain effective communication. These include:

- **Number of Sensors and Gateways**
  Determines the number of devices that are transmitting.
- **Sensor and Gateway Transmission Power**
  Determines the transmission distance and therefore how many sensors and gateways are within range of each other.
- **Sensor Transmission Interval**
  Determines how often each sensor transmits its data.
- **Sensor Sample Interval**
  Determines how often the sensor takes a measurement. The sample interval can be used in conjuction with the "Delta" setting to add transmissions when there is a change in the temperature but not when the temperature is stable. For example, if the sensor transmission interval is set to five minutes and the sample interval is set to one minute, the sensor will take a reading every minute but only transmit the most recent reading every five minutes. However, if the delta is set to .25°F, then a .25°F change in temperature between a one minute sample and the next one minute sample will cause a transmission at that point, rather than waiting for the full five minute transmission interval.
- **Number of Channels that are Selected for Communication**
  The system utilizes smart logic to analyze channel noise and cycle through the four available channels to select one with a minimal level of RF noise. Reducing the number of channels available for each device (via the configuration software) reduces the chances of finding a channel with a minimal level of noise.

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Optimizing Communication Effectiveness

A BAPI wireless system with a single gateway and all four channels active can effectively communicate with up to 25 sensors within range of each other at a transmission rate of 30 seconds. If additional gateways or sensors are added within range of the initial 25 sensors and gateway, there is a possibility of excessive RF traffic, which could lead to the following issues:

- Sensor data not being received by the gateway
- Sensors losing connectivity to the network
- Sensors or gateways “locking up”
- LED on the sensor or gateway constantly remaining lit

There are several steps that can be taken to improve the effectiveness of communication and increase the number of sensors and gateways that can operate within range of each other. These include:

- **Decrease Transmission Interval**
  Reducing the Transmission Interval from once every 30 seconds to once every 3 minutes reduces RF traffic and potential data collisions by 83%.

- **Decrease Transmission Power**
  If your system contains multiple gateways and networks, then the Transmission Power can be reduced at both the sensors and gateway to reduce the transmission distance and limit the crosstalk between sensors and gateways on different networks. Note: Make sure that reducing the Transmission Power does not affect the communication between the sensors and gateways within the same network.

- **Channelize Wireless Networks**
  If you have multiple gateways and networks, then channelizing the different wireless networks will prevent crosstalk and wireless collisions between the networks. For example, setting Network A to communicate only on channels 1 and 3, while setting Network B to communicate only on channels 2 and 4, will allow some frequency agility for each network while segregating RF traffic between the networks. If there are more than two networks, then each of the networks may need to be set to a single channel, for example Network A on channel 1, Network B on channel 2, and Network C on channel 3.

  Note: In systems with more than one network, a unique address is assigned to each network. Having a different network address, however, does not stop devices from interfering with each other. If devices from different networks are operating within range of each other and on the same channel, then they can cause collisions. Channelizing (as described above) is the best way to prevent interference between devices from different networks that are located in close proximity to each other.

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