



900 MHz WAM Connect Wireless Gateway

Installation and User Guide





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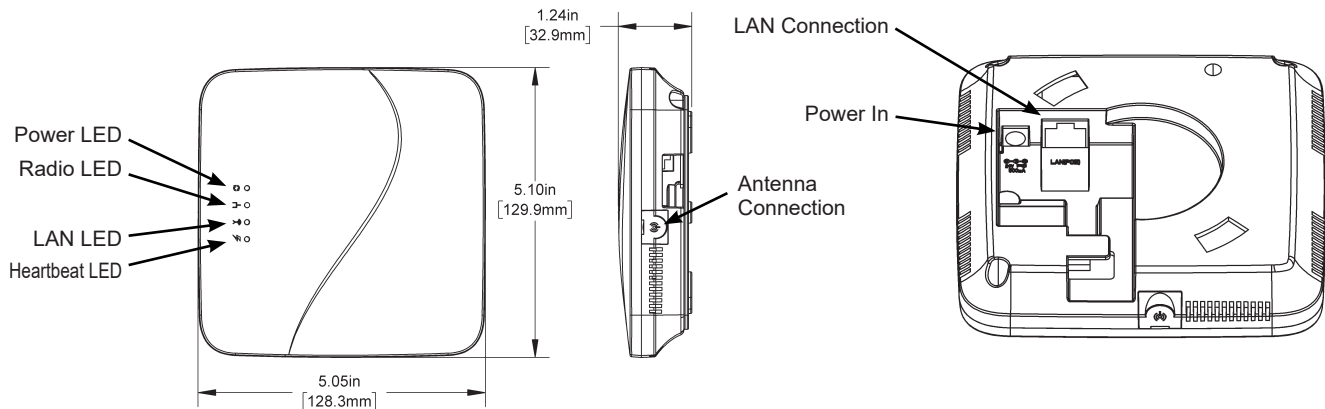
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Mounting and Termination**Fig. 11: Gateway Mounting and Termination**


Remove the gateway from the box and attach the antenna. Remove the gateway mounting plate by twisting 1/4 turn counterclockwise. Plug in the network cable. Connect the Ethernet cable into the gateway and then into the wall outlet. Secure the mounting plate to the preferred mounting surface after fishing the wires through the center wireway hole or the wireway hole next to the antenna connection. Hold the gateway up to the plate and secure by twisting 1/4 turn clockwise.

POWER OPTIONS:

Direct 24VAC/VDC, Power Supply Included
Power Over Ethernet (PoE) on board device

LED INDICATORS

Heartbeat: Blinks to show gateway is “alive” 

Radio: Green when radio is found 

LAN: Green when network is configured 

Power: Green on 24V power supply / Red on PoE 

WAM DESIGN - FEATURES:

Gateways discoverable via TCP/IP with USB dongle
Configuration via TCP/IP with USB dongle
Supports EDE (Engineering Data Exchange) via standardized CSV or Excel File

NETWORK:

DHCP/static IP
Class A,B,C network support
Updates available via user initiated update

NOTE: Range can vary greatly based on building materials, device positioning, interference, etc. Contact a BAPI representative for a site consult prior to purchase.

Overview

The BAPI wireless gateway is a device that allows for the receiving of up to 50 BAPI 900MHz wireless sensing devices and outputs that received information in one of two formats: BACnet IP for your typical Building Automation system and MQTT for BAPI WAM (Wireless Asset Monitoring).

The BAPI gateway can be powered from the supplied plug-in power supply or Power over Ethernet (PoE) if your network supports that feature. The wireless network setup application (WAM Design) lets you assign your wireless devices to the appropriate gateway while also allowing you to note sensor names, location, settings, etc.

You will need to have a BAPI Wireless USB Dongle (WAM Link) to commission the system. This dongle acts as a default radio module which you will need to discover the wireless sensors that are in the factory default mode. With this tool and the application on your computer you will be able to "hand off" the sensors to the appropriate gateway.

- Multiple communication options including BACnet IP and MQTT.
- Each gateway supports up to 50 sensors that can be configured remotely via the gateway.
- The system uses "smart logic" to find and secure a clean frequency channel rather than "frequency hopping".
- Easily configure wireless sensors to be presented to BACnet network via a flat mode for single gateway device with sensors as associated objects.



Fig. 1:
900MHz
BACnet
Gateway

Customer Provided Equipment and Materials

The user must provide an active local network for this gateway. The user's Windows 7 or higher computer must have the WAM Link connected via a USB port and WAM Design installed on their PC.

At locations where there is a secure network and foreign equipment is not allowed, it may be necessary to provide a separate router and network switch. This decision depends on the number of connections needed, which will allow the installer to set up an isolated network for the gateway network connections.



Fig. 2: USB
Configuration Tool
Dongle

Placement Recommendations and Building Material Attenuation Losses

- 275 feet line of sight (LOS) is the maximum range that can be expected. Actual range will vary based on the environment.
- All materials that block the path of transmission between a sensor and gateway contribute to signal loss. See chart to the right for some common materials and expected signal loss.
- The gateway should be mounted as far away from metal obstacles as possible to avoid RF reflections or blockages.
- Mounting to drywall between studs, ceiling tiles, brick, glass or concrete is very common. Mounting to ceiling T-Bar is common but will affect distance due to the metal in the T-Bar and the horizontal orientation.

BAPI recommends conducting a bench test before permanently mounting the gateway to assure strong communication between the gateway and sensors. Once bench testing is complete, temporarily place the gateway and sensors in their desired locations.

900 MHz Wireless System	
Material	Attenuation Loss
Brick 3.5" (89 mm)	3.5 dB
Brick 7" (178 mm)	5 dB
Brick 10.5" (276 mm)	7 dB
Concrete 4" (102 mm)	12 dB
Concrete 8" (204 mm)	23 dB
Concrete 12" (305 mm)	35 dB
Glass 0.25" (6.5 mm)	0.8 dB
Glass 0.5" (12.7 mm)	2 dB
Lumber 3" (76 mm)	2.8 dB
Masonry Block 8" (204 mm)	12 dB
Masonry Block 16" (406 mm)	17 dB
Masonry Block 24" (610 mm)	28 dB
Open Air 33' (10 m)	72.5 dB
Open Air 329' (100 m)	92.5 dB
Open Air 3290' (1000 m)	112.5 dB
Reinforced Concrete 3.5" (89 mm)	27 dB

Setup

Note: BAPI's 900 MHz System has many available features and options, so patience is key while configuring the gateway and sensors. Please read all the steps prior to starting which will help with the process. If you have questions after reading all the steps, call BAPI for assistance and one of our wireless tech will walk you through this process.

1. Choose a convenient location for a “bench setup” of your system prior to installing it in the final location.

Choose a “bench setup” location with the sensors, gateway and computer within easy reach. Remove the gateway from the box and attach the antenna. Connect the supplied ethernet cable to the gateway and the network. Connect the supplied power cord to the gateway and then into the wall outlet if you are not able to use PoE.



2. Download and open the BAPI WAM Design Application

Download the WAM Design from this address (Contact BAPI for link address.) Plug WAM Link into an available USB port on your computer. Open the Design Application. Make sure your WAM Link Dongle displays in the pull down box of the initial screen (Fig 3). If it does not, click the red “retry” arrows to the right of the box. The WAM Link dongle should automatically identify itself to WAM Design software.

3. Run the WAM Design Application

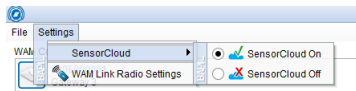
Click start. A dialog box will show up asking for a password. If you wish, assign a password to the gateway. If not, press “Yes” to continue. This will open the Configuration Screen shown in Fig 4. The left column lists the available gateways that are on the same network as your computer. Click on the gateway that you plan to configure and “hand off” the sensors to.

The center column tabs show the selectable options for the gateway.

- **Network:** This is the network setting for your LAN should you decide to change any of them.
- **Settings:** This is where you can make changes to the gateway such as its name.
- **WAM:** This is where you select the end destination path for all MQTT settings.
- **Sensors:** This is where you “hand off” sensors to the gateway.
- **FDR:** This is the Foreign Device Registry BACnet tool.
- **Backup:** This is where you can back up your settings or recover a stored backup. See the “Backup and Restore Gateway” section for more information.

There are also some additional options on the Settings dropdown in the upper left menu:

Sensor Cloud On/Off:



“On” – saves the names of the sensor and gateway to a secure BAPI cloud location for retrieval at a later time.

“Off” – Sensor and gateway names are not saved to the cloud.



Fig. 3: BAPI Design Application Initial Screen

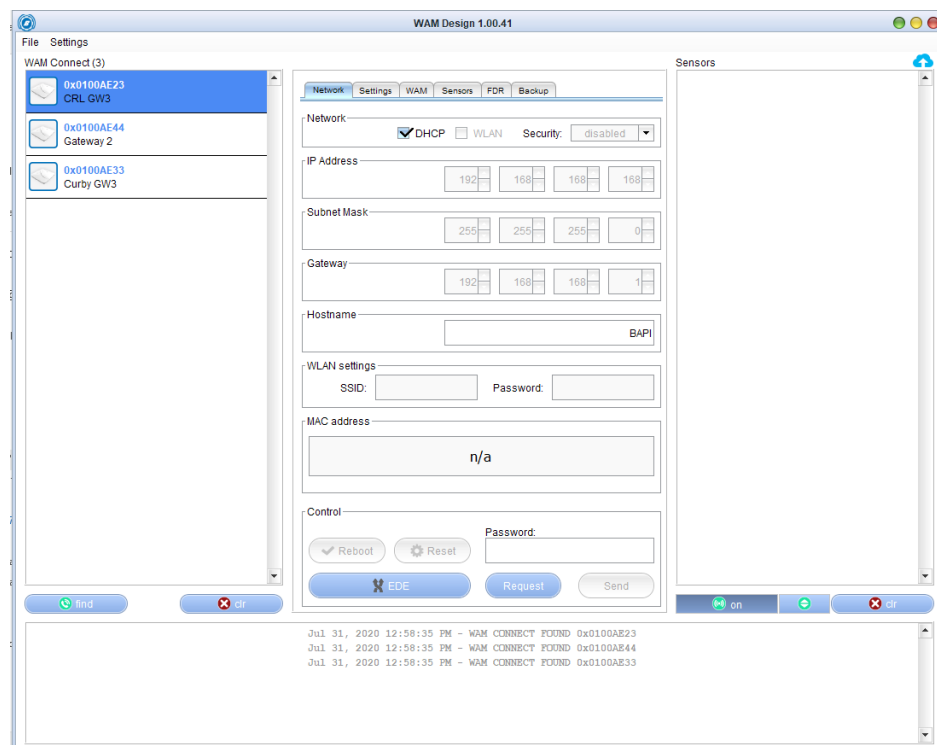
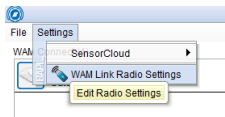


Fig. 4: Network Tab on the Design Application Configuration Screen

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Setup continued...

WAM Link Radio Settings:



Adjusts the radio setting on the WAM Link 900 MHz USB Dongle

4. Configure the “Network Tab”

Under the “WAM Connect” column you will find a list of all the gateways that are present on the LAN (Local Area Network) that you are on. Select one of the gateways and then configure the options on the center column “Network Tab” (Fig. 4) as needed. Removing the check mark next to “DHCP” will switch your Gateway from DHCP to Static IP Address. IP Address, Subnet Mask, and Gateway will be editable. The gateway will attempt 10 times to get an IP from a DHCP. If that fails, it will set itself to a fall back IP of 192.168.100.100.

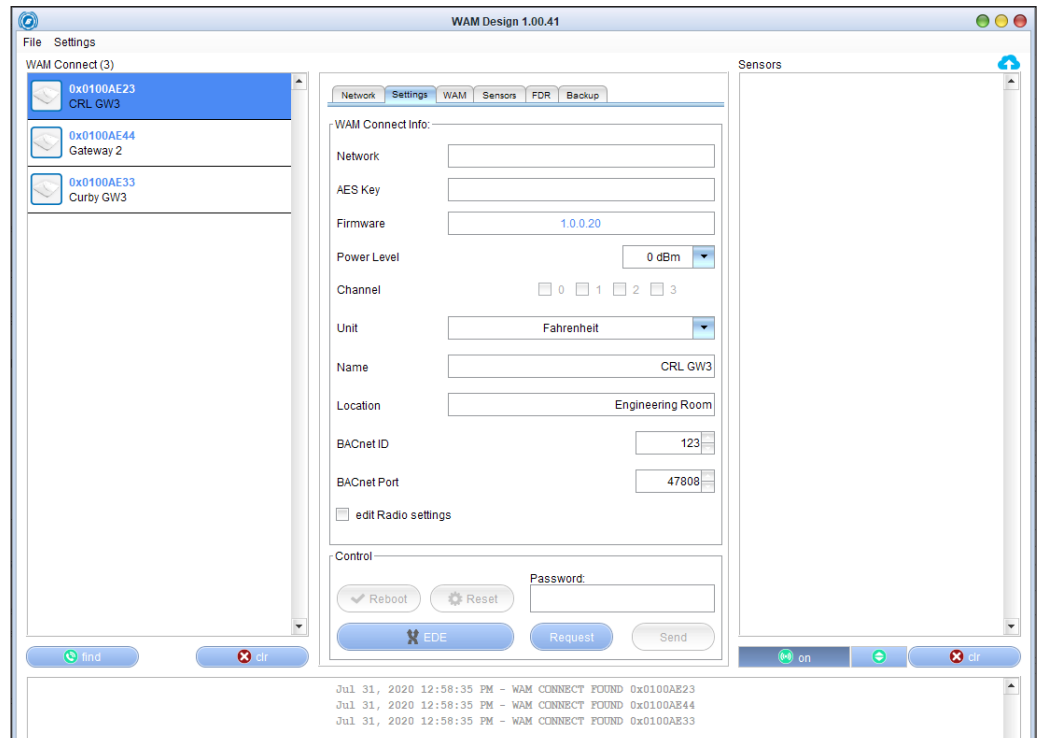


Fig. 5: Settings Tab on the Design Application Configuration Screen

5. Configure the “Settings Tab”

Configure the options on the “Settings Tab” as needed.

- **Network:** Self assigned by gateway, not adjustable.
- **AES Key:** Self assigned by gateway, not adjustable.
- **Firmware:** Current Firmware Version.
- **Power Level:** Adjust the dBm level of the gateway radio.
- **Channel:** The gateway picks the channels to use. There is no need to adjust this.
- **Unit:** Set the unit of measurement displayed in the gateway. Options are Celcius or Fahrenheit.
- **Name:** This editable field allows you to assign a gateway name. See Step 8 “Configuring the Sensor” for more info.
- **Location:** This editable field allows you to assign a gateway location. See Step 8 “Configuring the Sensor” for more info.
- **BACnet ID:** This is assigned by the gateway and how it will appear on your network. Note: If you have more than one gateway on the same BACnet network, be sure to change the BACnet ID of the gateway from the default number.
- **BACnet Port:** This is the port the gateway will be on in the Bacnet IP network. Default Port is 47808.
- **Reboot:** Allows you to remotely restart the gateway.
- **Reset:** Allows you to reset the gateway.
- **EDE:** Export Devices names and BACnet IDs.
- **Request:** You can request data from the gateway.
- **Send:** This is what sends all your configuration data to the gateway. Think of it as a “save settings button”.

NOTE: You must click the “Send” button after handing off the sensors to the gateway to save the sensor setup in the gateway!

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Setup continued...

• **Bottom Dialogue Box:** The dialog box at the bottom of this window displays the communication between the gateway and any sensors that are communicating with that gateway.

Bottom Buttons: (not required to change for setup)

The “CLR” buttons clear the list should you need to clean it up for training purposes.

The “Find” button below the left column is used to search for gateways and sensors if they have not already populated in the list.

The column on the right allows you to turn off the sensor discovery application.

6. Configure the “WAM Tab”

Configure the options on the “WAM Tab” as needed.

Off: Turns off the MQTT output.

WAM: Sends the MQTT output to the BAPI WAM System or your own MQTT Broker.

Local: Sends the information to an MQTT broker that sits on the LAN.

URL: Location of the MQTT Broker.

User: Username for the MQTT Broker.

Password: Your Password for the MQTT Broker.

7. “Handing off” Sensors to the Gateway

Sensors will appear in the right column once the battery is installed and WAM Link receives a transmission from the sensor (or the unit is powered for non-battery powered units). To assign or “hand off” a sensor to the gateway, click on the desired gateway from the left column of the Configuration Screen (Fig. 7). Then click the center “Sensors” tab. Now drag one of the available sensors from the right column to the center “sensors” column.

The “Link Sensor” dialog box will

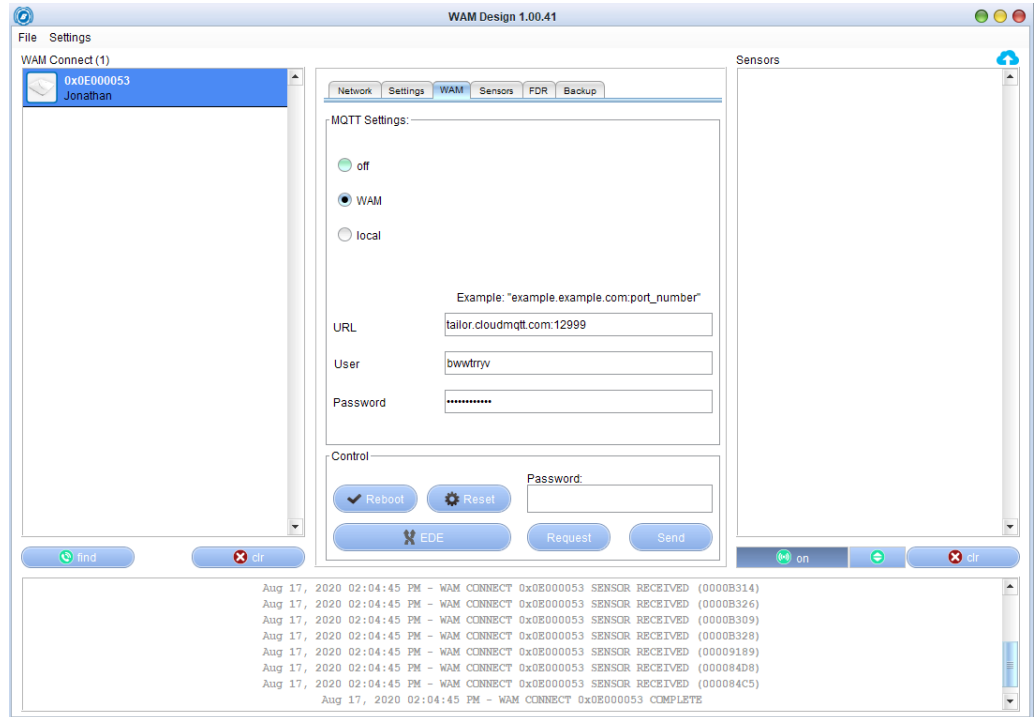


Fig. 6: Settings Tab on the Design Application Configuration Screen

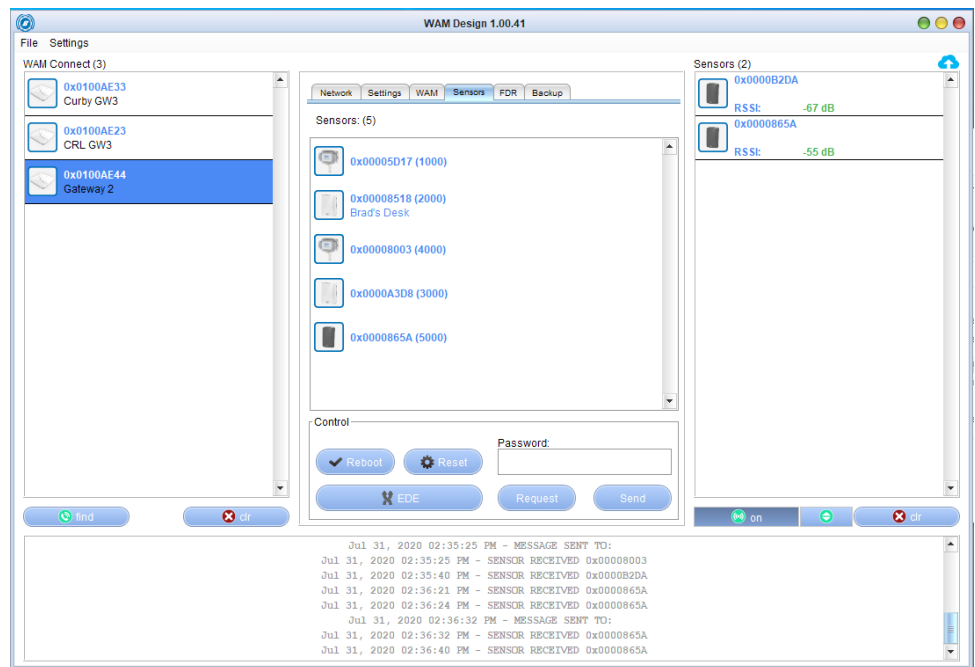


Fig. 7: Configuration Screen showing a completed sensor setup

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Specifications subject to change without notice.

Setup continued...

appear (Fig. 9). Enter the sensor name and BACnet ID if using BACnet. See Step 8 “Configuring the Sensors” for more info.

When prompted, press the ping/train button on the sensor. This “hands off” the sensor to the gateway from the USB dongle. The communication between the sensor and gateway will then appear in the dialog box at the bottom of this window. This is a good way to confirm your sensor has accepted the “handoff”.

If after a “handoff” process the sensor still appears in the right sensor column and turns green at the press of the ping/train button, the handoff was unsuccessful. Please repeat the process.

(Note: The sensor may appear in both columns. If this happens, right click on the sensor in the center column and select delete, and then repeat the hand off process.)

The Configuration Screen in Fig 8 shows a successful handoff of sensors to the gateway. Note that all the sensors have been removed from the right column and are now in the center column. These sensors are now “handed off” or assigned to the gateway that is highlighted in the left column.

Note: When all the sensors are “handed off” to the gateway, you must click the “Send” button to upload all the settings changes to the gateway. After clicking the “Send” button, a dialog box will appear asking if you want to reboot the gateway. This is not required.

8. Configuring the Sensors

The sensor can be configured when it is first assigned to the gateway but if changes need to be made, you can get to these settings by right clicking on a sensor in the center column of the Configuration Screen which opens the Edit Link Sensor window (Fig 9).

Note: To properly set up a sensor, the sensor must be handed off and associated with the gateway.

The “Sensor Info” section at the top of the window shows the following:

- **Serial Number:** The serial number of the radio on the sensor.
- **Sensor Type:** The type of sensor.

The “Naming Tab” (Fig 9) lets you edit the following:

- **Name:** The name of the sensor.
- **Location:** The location of the sensor.
- **BACnet ID:** Assigns the BACnet Object Instance ID.

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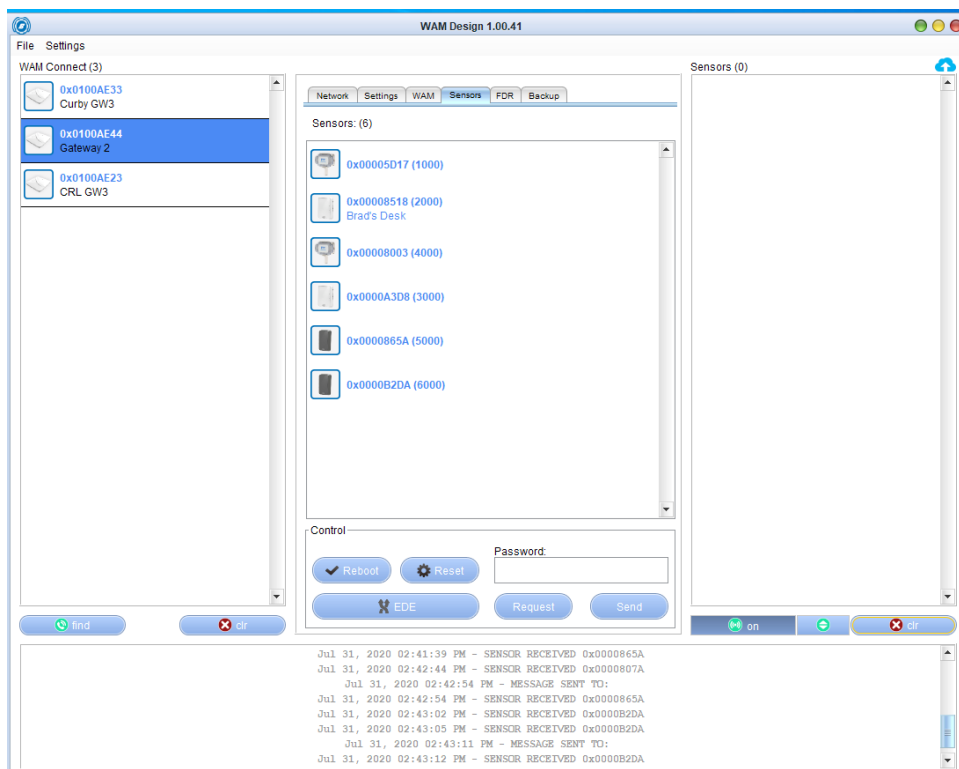


Fig. 8: Configuration Screen showing a completed sensor setup

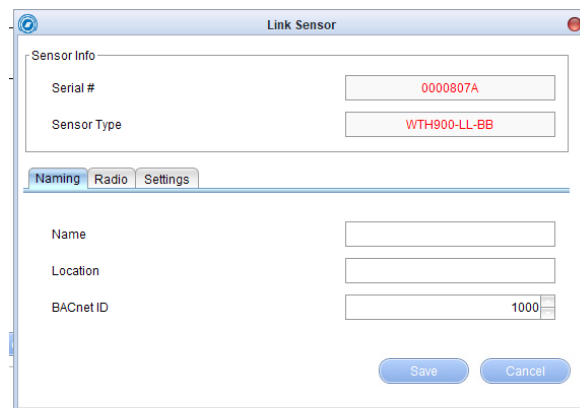


Fig. 9: Naming Tab on the Edit Link Sensor Window

Setup continued...

By default the gateway assigns the BACnet Object Instance ID for the first sensor starting at 1000. It will go up by 1000 for each additional sensor added, so the BACnet Object Instance ID for the second sensor will be 2000. If a sensor is removed, the next sensor added to the system will have the lowest available default number. This is important to know when replacing a sensor.

Notice in Fig. 13 on page 10 that each sensor has multiple objects related to it. For example, room sensor 9544 has a BACnet Object Instance ID of 1000, so all the objects associated with it (temp, humidity, setpoint, etc.) will begin with 1000. As shown in the chart below, the object instance for the temperature value is always “0” so the temperature value for the first sensor is 1000. The object instance for the Humidity value is always “1”, so the humidity value for the first sensor is 1001. For the second sensor (749E), the temperature and humidity values are 2000 and 2001 respectively. Note that the object instance is skipped if that value is not available from that sensor, so there is no 1003 or 2003 for the first two sensors since neither of them has light level sensing.

You can assign your own BACnet Object Instance IDs for the sensors rather than taking the defaults assigned by the gateway. However the IDs must be at least 10 numerals apart from each other. If you do not assigned them at least 10 apart, the system will not recognise them. For example, if you assign BACnet IDs for three sensors as of 6000, 6001 and 6002, the second two sensors will not save on the system because their IDs are already being used as the humidity and setpoint or Barometric pressure values for the first sensor. Instead you must assign numbers that are at least 10 apart from each other, such as 6000, 7000 and 8000 or 6000, 6010 and 6020.

BACnet Object Instance Chart

Object Type Object Instance Object Description

Analog Input	0	Temperature in °C or °F
Analog Input	1	Relative humidity in %RH
Analog Input	2	Setpoint for room sensors / Barometric pressure in kPa for non-room sensors
Analog Input	3	Light level in LUX
Analog Input	4	Battery voltage level in volts
Analog Input	5	Received wireless signal strength in dBm
Binary Input	6	Occupancy override status
Analog Output	9	Heartbeat check (described on page 11)

Note: the object instance is skipped if that variable is available from the sensor, so there would be no “2” value for a sensor without humidity measurement.

The “Radio Tab” (Fig 10) on Edit Link Sensor Window lets you edit the following:

- **Network:** The network address of the sensor assigned by the gateway
- **AES Key:** This is the AES encryption used between the gateway and device assigned by the gateway
- **Channel:** This is the radio channel the sensor is using. Assigned by the gateway
- **Power level:** dBm level of the radio. 0 dBm will yield good battery life. Default = 0 dBm. Adjustment range = -30 to +5 dBm.
- **Interval:** Is the time between transmissions in seconds. 300 sec = 5 min. Default = 5 min. Adjustment range = 30 sec to 15 min.
- **Battery:** The voltage at which the battery is going to stop transmissions due to an expiring battery.

Note: Once the battery drops below 3 volts, the battery is very close to end of life and should be replaced.

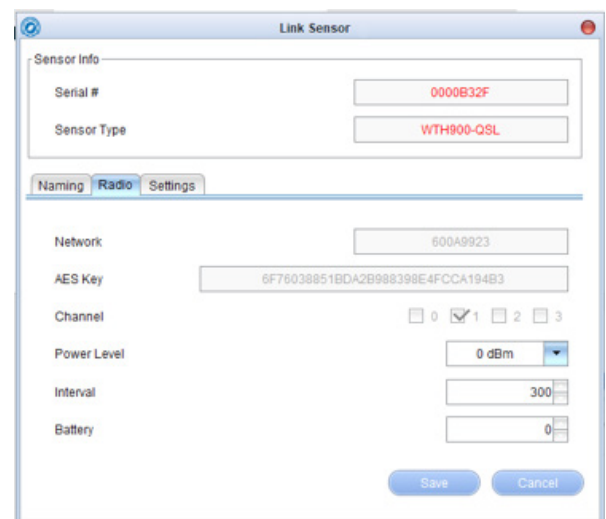


Fig. 10: Radio Tab on Edit Link Sensor Window

Foreign Device Registry (FDR) Information

Fig 12 shows the settings for the BACnet FDR (Foreign Device Registry) tab. If more information is needed for your network FDR settings, please discuss it with the network administrator for the BACnet network in your facility.

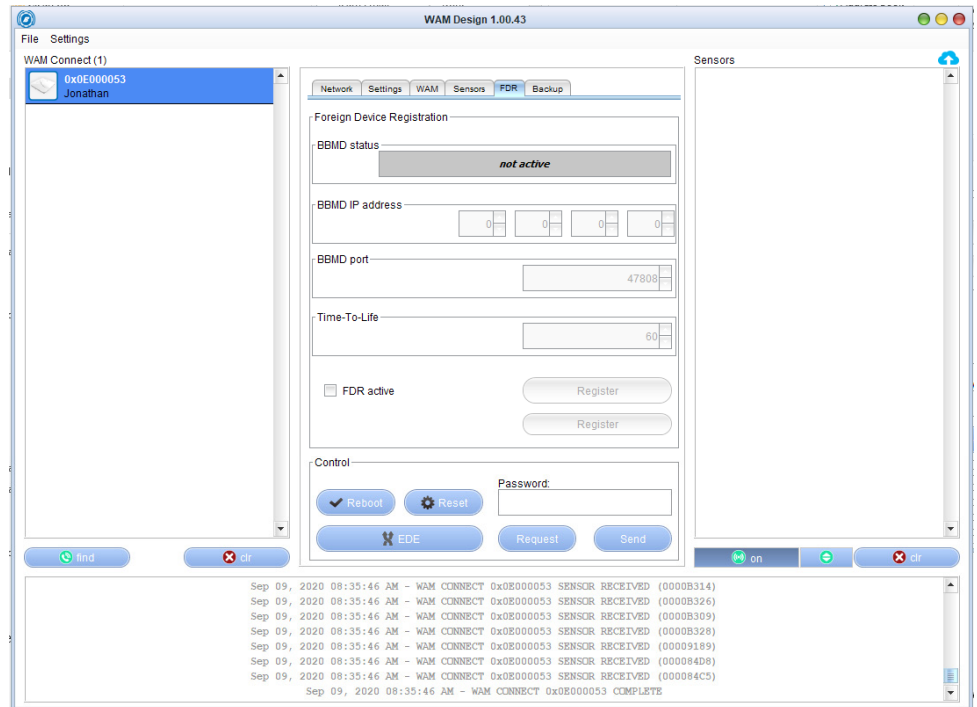


Fig. 12: FDR Tab on the Design Application Configuration Screen

BACnet Information

BAPI BACnet Vendor ID: 1069

BACnet Object Instance

Fig 13 is an example of what the BACnet Objects will look like from the BAPI Gateway using YABE (Yet Another BACnet Explorer). Notice the Object Instance ID changes based on the type of value being transmitted.

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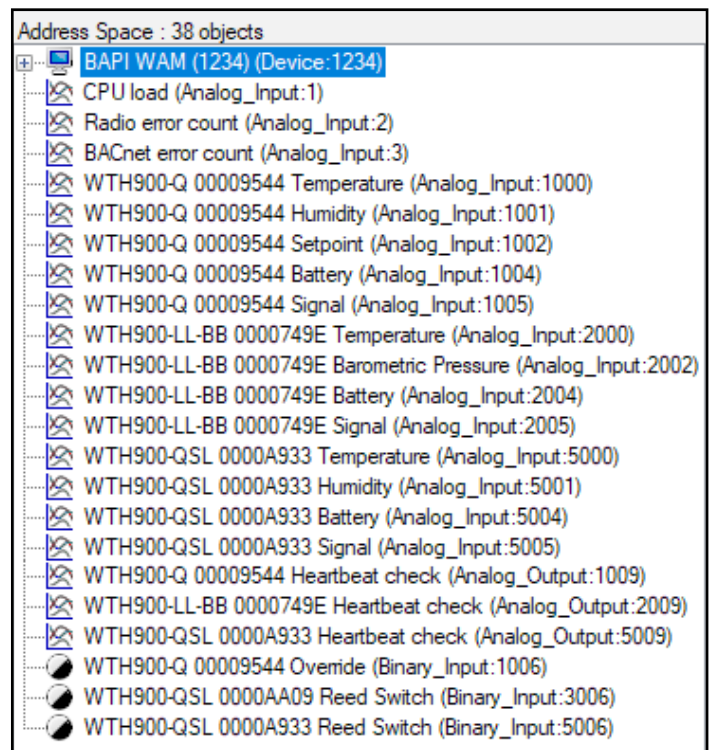


Fig. 13: BACnet Object Instance info using hierarchical topology

Specifications subject to change without notice.

BACnet Information continued...

BACnet Properties without a Fault

Fig 14 shows the BACnet Properties for a temperature sensor without a sensor fault. Notice that the "Reliability" says "0: No Fault Detected".

The "Cov Increment" at the top is a writeable value and the Default value is 1.

BACnet Properties with a Fault

Fig 15 shows the BACnet Properties for a temperature sensor with a sensor fault. Notice that the "Reliability" says "1: No Sensor".

BACnet "Heartbeat Check" Properties

Fig 16 shows the properties for the "Heartbeat Check Object". Notice the "Present Value" is set for 900 which is in seconds and equals 15 minutes. This value is writeable and adjusts the amount of time between a missed transmission before it trips a Reliability flag. Monitoring this "Flag" can be used as an alert for sensor issues

Suggestion: the Heartbeat should be set to 3 times the transmit interval value to prevent a fault on one or two missed transmissions.

Replacing a Sensor

When replacing a BACnet sensor, change the ID to the previous sensor's BACnet ID. This will retain the links from the previous sensor through the network. The procedure is described below:

1. Right click the sensor you want to replace and click "Edit".
2. Make note of current Name and BACnet ID, then click "Cancel".
4. Right click on the sensor, click delete, then "Yes".
6. Insert batteries or pull battery insulators on the NEW sensor.
7. Press the NEW sensor Ping button and the sensor will show up in the right column.
8. Click and drag the sensor from the right column to the center "Sensors" column.
9. Enter the Name and BACnet ID so the new sensor has the same information as the original sensor noted in Step 2 and click "Save".
11. Press the sensor Ping button when prompted.
12. Click "Send" to save settings, and click "Yes" to reboot the gateway or "No" to not reboot the gateway.

BacnetProperty	
Cov Increment	1
Event State	0 : Normal
Interface Value	
Object Identifier	OBJECT_ANALOG_INPUT:1000
Object Name	WTH900-Q 00009544 Temperature
Object Type	0 : Object Analog Input
Out Of Service	False
Present Value	75.74
Reliability	0 : No Fault Detected
Status Flags	0000
Units	64 : Degrees Fahrenheit

Fig. 14: BACnet information for a temperature sensor without a sensor fault

BacnetProperty	
Cov Increment	1
Event State	0 : Normal
Interface Value	
Object Identifier	OBJECT_ANALOG_INPUT:5000
Object Name	WTH900-QSL 0000A933 Temperature
Object Type	0 : Object Analog Input
Out Of Service	False
Present Value	0
Reliability	1 : No Sensor
Status Flags	0100
Units	64 : Degrees Fahrenheit

Fig. 15: BACnet information for a temperature sensor with a sensor fault

BacnetProperty	
Command Time Array	Object[] Array
Cov Increment	1
Current Command Priority	
Event State	0 : Normal
Interface Value	
Last Command Time	8/14/2020 11:37 AM
Object Identifier	OBJECT_ANALOG_OUTPUT:1009
Object Name	WTH900-Q 00009544 Heartbeat check
Object Type	1 : Object Analog Output
Out Of Service	False
Present Value	900
Priority Array	Object[] Array
Property List	Object[] Array
Reliability	0 : No Fault Detected
Relinquish Default	0
Status Flags	0000
Units	73 : Seconds
Value Source	BacnetValue[] Array

Fig. 16: BACnet "Heartbeat Check Object" information for a temperature sensor

Specifications subject to change without notice.

Backup or Restore the Gateway

The BAPI gateway can be backed up and restored locally. This allows you to reset the gateway in the rare instance that it would be locked up. It also allows you to copy the configuration to a new gateway if you chose to replace a gateway, eliminating the need to perform a network setup procedure on the gateway.

BACKUP - LOCAL

1. Create a folder on your computer or server to store and retrieve the backup content.
2. Go to the center “Backup” tab and click the “Local” icon and then click the “Backup” button (Fig 17). This will open the “Select Backup Folder” screen (Fig 18).
3. Select the local folder that you created in Step #1 and click “Open” to save the backup to the folder. You will receive a “Backup Successful” message as shown in Fig 19.

RESTORE - LOCAL

1. Go to the “Backup” tab on the WAM Design Configuration Screen of the gateway that you would like to restore (or the new gateway if replacing the gateway) and click the “Restore” button.
2. Select the backup folder on your local computer or network from in the “Select Folder” Screen (Fig 20) and click “Open”. You will receive a “Restore Successful” confirmation screen (Fig 21) and also a request to reboot the system. Click “yes”.

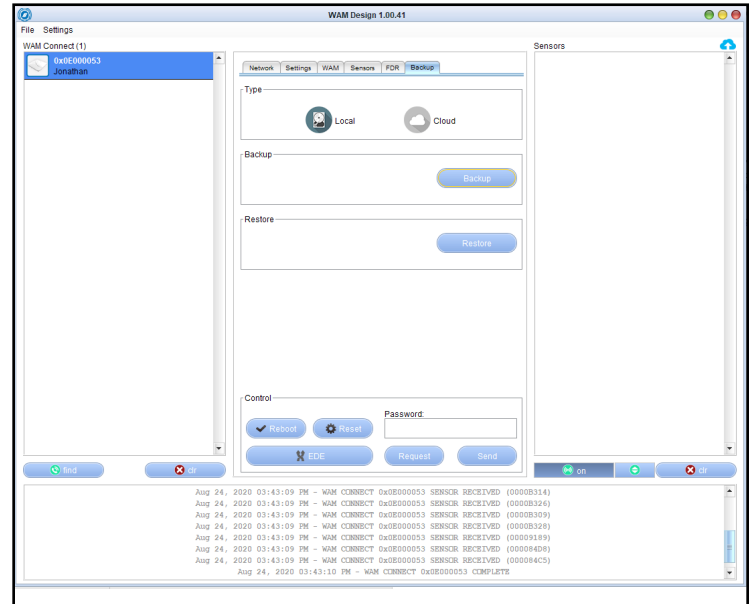


Fig. 17: Backup Tab on the Design Application Configuration Screen

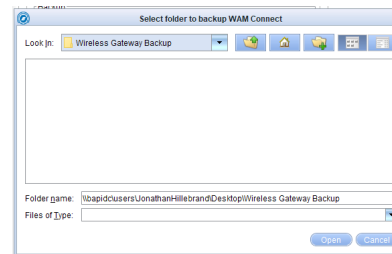


Fig. 18: Select Backup Folder Screen.

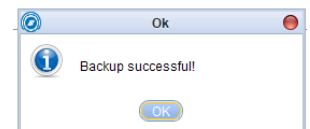


Fig. 19: Backup Successful Message.

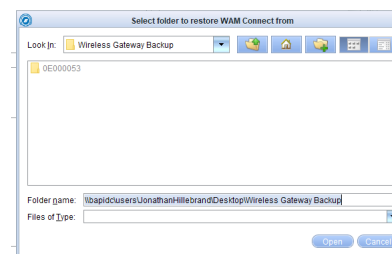


Fig. 20: Select Restore Folder Screen.

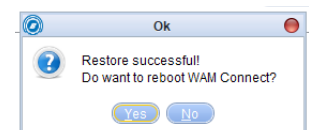


Fig. 21: Restore Successful Message.

Specifications for the 900MHz WAM Connect

Processor: AM3358 1GHz ARM® Cortex-A8 Processor

On-board Flash: 4GB Rated

Voltage: 12 to 42 VDC, 20 to 30 VAC

Rated Power: 12 Watt

RAM: 1 GB Cache 256KB Power over Ethernet (PoE) Power Requirements 3 watts @ 48 volts

Specifications subject to change without notice.