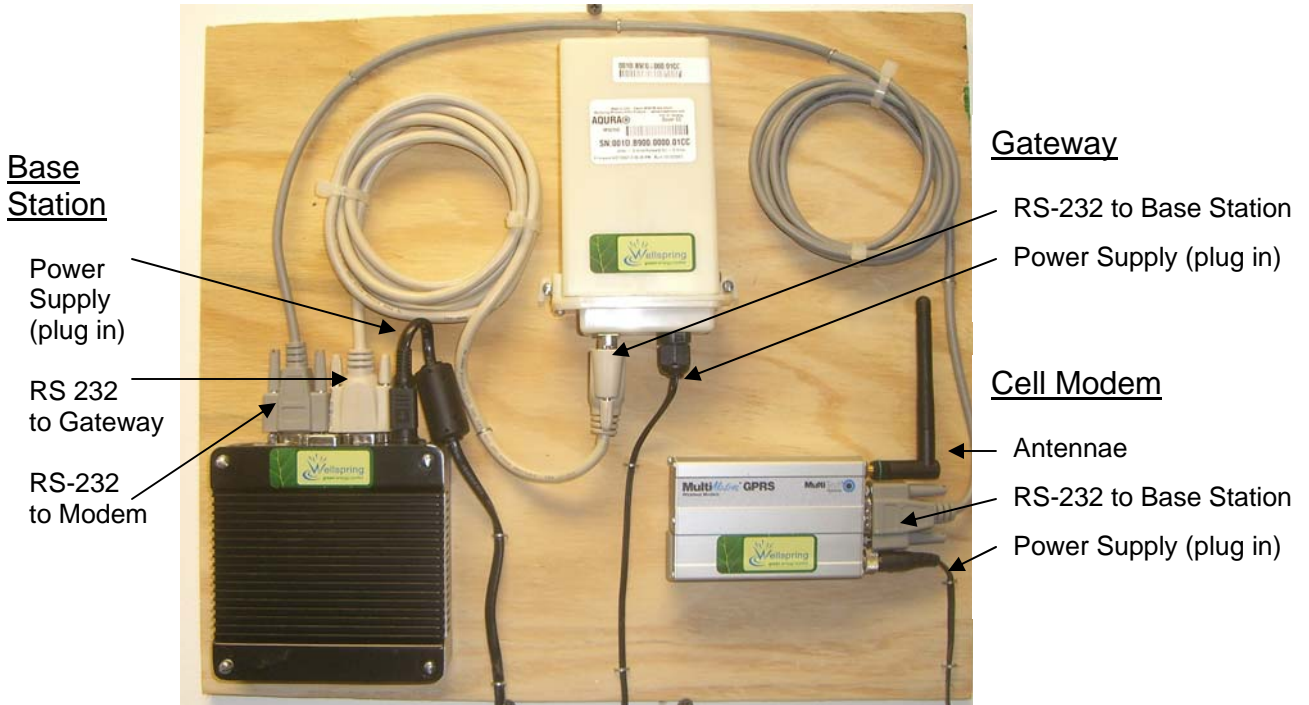




Router, Gateway, Base Station, Cell Modem Specification and Submittal



General

Wellspring designs and manufactures a family of submetering and control products which employ an open protocol 2-way radio that complies with IEEE 802.15.4 and ZigBee radio standards.

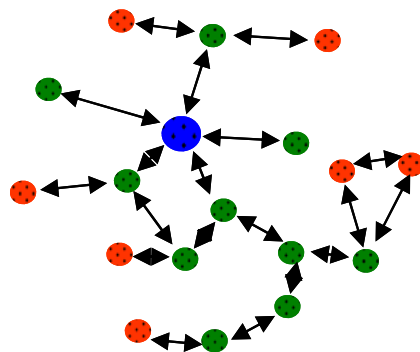
ZigBee Radio Network

All Wellspring products use the same radio architecture, in which data is passed back and forth between remote devices with wired inputs and outputs (in orange below) and a central point in the network called a gateway (in blue). Data passes to and from the Gateway through a ZigBee compliant mesh of Routers (in green). The network operates on one of 16 channels between 2.405 and 2.485 GHz.

The network is managed by Wellspring's network application software (WS-NAS), which is self configuring and self healing. One Gateway within the community or neighborhood acts as network coordinator, which automatically selects the network channel frequency where interference is lowest.

Mesh Routers and End Nodes (including thermostats) scan all 16 channels looking for the one selected by the gateway, and join the network when they receive an acknowledgment, choosing the most efficient route to the gateway. It is possible to then "dial down" their transmit power from 100 mW to as low as 1 mW to minimize the interference footprint of any node.

Typical ZigBee Mesh



For more information, contact Wellspring at 215-788-8485, or e-mail us at greenetwork@wellspringwireless.com
Wellspring has a policy of continuous product improvement and reserves the right to change design and specifications without notice.



If the chosen route ever fails to produce a return message acknowledgment, the sending node cures the failure by switching routes. and (if required) scanning other frequencies until an acknowledgment is received. Since this is a ZigBee compliant network, other ZigBee compliant devices may join Wellspring's network, provided they have the correct security code.

Green means “Good to go”

All Wellspring nodes can be tested with a magnet (see page 4,5), which forces communication with the gateway. Green flashes means success – red indicates failure. Feedback happens at the time of installation, saving time and money.

Gateway, Base, Modem bridge to Internet

Attached to the ZigBee Gateway is the Base Station, which is a fully functional Linux computer. Software in the Base Station receives data from the gateway in real time, and sends control or program instructions through the gateway to various routers and end nodes connected to the ZigBee network. The Base Station supports several communication protocols. Wellspring uses 2 RS-232 ports – COM 1 to the Gateway, and COM 2 to the modem. In addition, the Base station has connectors for a monitor, Ethernet and 2 USB ports – these connectors are not generally used in Wellspring systems. Finally, the Base Station is connected to a cellular modem. The modem attaches to a public cellular network just like any cell phone, and provides TCP/IP communication from the carrier to the Base Station. Thereafter, the Base Station can be accessed via the cellular carrier network.

Routers, Gateway, Base & Modem - Power

These devices require a constant uninterrupted 115 volt power source, into which their “power cube” transformers are plugged. It is obvious but often overlooked – the system will not function if it is not plugged in to a live outlet that is uninterrupted. So too, Routers which form the mesh (green nodes in the diagram above) are constantly listening for data

from end nodes, and maintaining the mesh so that data transfer failures are minimized. Therefore, they too require a continuous power source which is normally a 115 volt plug and a power cube. The output of the power cube is 6 volts DC – and so, any clean 6 volt DC source with no less than 0.2 amps of capacity will power a router.

Green Thermostats can Function as Routers

When a complete 24 volts AC circuit is available at Wellspring's Green Thermostat (both supply and common), both the thermostat and the Wellspring radio operate from line power. In this case, each Green Thermostat radio also acts as a router (a green node in the diagram above),

If a 24 volt common wire is unavailable at the thermostat location, the Green Thermostat operates on batteries. In this instance, the Thermostat radio acts as an end node (in orange above) and attaches to an external router in order to send and receive data to and from the network gateway. If communication with the router is not answered, a curing algorithm is used, changing route first & then scanning for a new channel frequency.

Aqura Water Meters & Energy Monitors

Aqura Water Meters and Energy Monitors may be line powered or battery operated. These devices always function as End Nodes (orange in the diagram above) and they do not route data. All battery operated devices are, of necessity, end nodes, and can never be routers.

Data Recovery & Reporting

Wellspring retrieves data from every base station every day and issues a data report to its customers. The nature of these reports, and means of data access vary by application and customer. Many customers choose to route their data to a third party billing company – and in some cases, billing companies use Wellspring's host software to read Base Stations directly and issue their own reports to building managers.

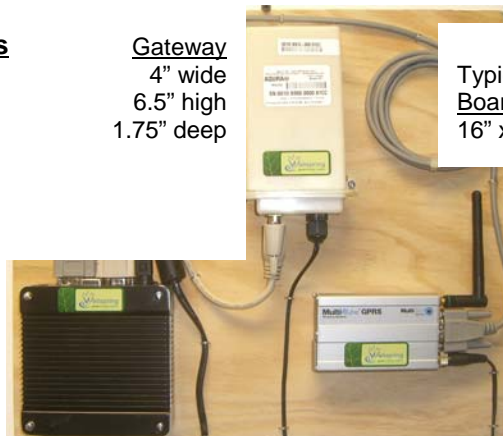


Router
4” wide
6.5” high
1.75” deep

Dimensions

Base Station
4.5” wide
4.75” high
1.5” deep

Gateway
4” wide
6.5” high
1.75” deep



Typical Mounting Board (by others)
16” x 16”

Cell Modem
4.0” wide
2.25” high
1.0” deep



Router, Gateway, Base Station, Cell Modem Installation & Operating Instructions



Install the Gateway, Base Station & Cell Modem FIRST

Locate a central point in the building that provides the maximum opportunity for coverage. Ensure the availability or install 115 VAC electric service for the Gateway and Linux Computer. Surge protection or a UPS should be installed, with outlets to power the Base Station, the Gateway and the Cellular modem.

WARNING: In order to test other network components when they are installed, the Gateway **MUST** be operating. It is always best to start with the central Gateway, Base Station and Cellular modem, and the work outward to install routers, making sure the network forms as it is installed.

NOTE: When choosing existing electric service, remember that if other users unplug the Gateway, the loss of power resets the Gateway memory. It may require 48 hours for the network to re-form, and for the full complement of meters to report in their current data. It is generally recommended that dedicated electrical service be installed, and that the Gateway, Base Station and Cell Modem be located in an area where they will not be bothered or unplugged.

Choose a location for the Gateway that is high in the room and away from casual reach. If necessary, separate it from the Base Station and Cell Modem – perhaps installing the Gateway in the attic just above the Base Station and Cell Modem. Use of a portable ladder makes this easier to accomplish.

The Gateway enclosure is installed with at least two #6 round-head sheet metal screws high on the sidewall, taking care to insure the unit is mounted vertically so its antenna is ideally situated. The use of drywall inserts is recommended for drywall installations.

The Base Station (Linux Computer) may also be wall (or desk) mounted using the four fasteners provided. It should be plugged in, and connected to the Gateway using the RS 232 cable provided. Peripherals such as a key-board and display are normally not included, but may be provided and connected to the jacks available in the Linux Computer. The Base Station has a steady green indication when operating properly.

Finally, the cellular modem should be mounted at a location that provides reliable cellular coverage, where the antennae will not be disturbed. The antennae should be pointing sky-ward. The connection from Linux to the cellular modem should be installed, using RS 232 cable. The Cell Modem displays a periodic red LED flash when it is powered, and flashes rapidly when communicating.

Choosing Router Locations

Choosing router locations must respond to two constraints:

1. The radio transmission distance anticipated between end nodes and routers for the environment encountered, so that each end node can reach at least two routers, and
2. The availability of power, since every router must be line powered.

End nodes are manufactured with 100 mW of radio capacity. Distance varies with location and materials of construction. It is unwise to base router locations on the best distance you anticipate from your end-nodes – rather you should choose Router locations based on the shortest distance that you can reliably count on, making certain that each end node can reach 2 or more routers.

Inside a residential building, you can count on a 100 mW transmitter to reliably cover between 150 and 200 feet inside, and 600 to 1000 feet outside. All routers and gateways are 100 mW.

Router should be mounted as high in the building, or the room as possible. This allows them to escape the attenuation impact of furniture and people.

Green Thermostat Routers

If Green Thermostats are used and powered by a 24 volt source, then each thermostat also acts as a 100 mW router. In this case, no other routers are needed, unless the distance between buildings dictates the use of a bridge (or bridges, to be redundant) in the form of external routers. The density of the 100 mW Green Thermostats may be too great – which may require some routers to be operated at a reduced output power.

Router Installation

1. Choose locations according to the guidance above.
2. Begin installing Routers closest to the gateway, and work toward locations that are further – this allows routers to join the gateway as they are installed.
3. Assure that the power supply can be secured to the outlet, or is not generally available to the public. In some cases, it may be wise to cover the outlet and power cube with a “clamshell” secured with a fastener.
4. Attach the Router to the wall, in the vertical position, so that the internal antennae is pointing up, as shown in the photo below.
5. Route the power cord and plug in the router. The router then will enter a “jitter” period when it is idle. The jitter value is printed on the Router label, and varies from unit to unit, so that all units start at different times in the event of a power outage and restoration.

Testing the Router and Forcing Communication

Place a large permanent magnet along side the electronics package on the front side opposite the antenna for 2 seconds, as shown in the photo below. Then remove the magnet so it does not distort the radio signal. Flashing red and green LED's will appear from inside the housing that tell you how the test is going (see box below). The circuit looks for your magnet every 2 seconds, so be patient. The circuit does not respond to your magnet at all if it is in jitter mode or in-process of joining on its own (takes 60 seconds), if it is

transmitting data, or if it is executing a test you initiated with a magnet. A successful test requires between 30 and 60 seconds. A failure may involve a re-try, and take longer.

Once a meter has joined the network, its initial response to a magnet is two green flashes, which means it has joined – then after a pause, it should flash 4 green times indicating an acknowledgment was received. If the test ends with alternating red and green flashes (4 times), it indicates that no acknowledgment was received, and the test has ended. Every test ends either with 4 greens, or 4 alternating red and green.

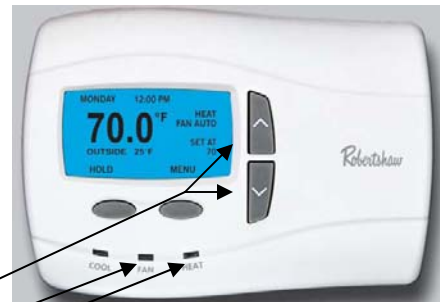


LED Indications – GREEN is GOOD

1. All LED's light briefly when power is applied.
2. Test starts, one red then one green flash indicates that sensor board is not properly installed.
3. Two Red (FAN on thermostats) flashes means that the unit is not attached to any network, and it tries to join. The join attempt lights both LED's.
4. Two Green (HEAT on thermostat) flashes mean that the unit is now attached to a network.
5. Two more Green flashes mean that the message acknowledgement is received. (process ends)
6. One Red flash followed by 1 Green flash (4 times) means that the unit failed to join a network (end).

Testing the Thermostat Router

The thermostat LED response is identical to any other router, but it utilizes the middle (FAN) indicator light for the “red” and the right (HEAT) indicator light instead of “green”. Rather than place a magnet to trigger a test, one simply presses both arrow keys at the same time. The sequence above is then followed, using the FAN and HEAT lights for feedback.



Trigger Test with both Arrow Keys
FAN Light substitutes for “red”
HEAT Light substitutes for “green”



For more information, contact Wellspring at 215-788-8485, or e-mail us at greenetwork@wellspringwireless.com
Wellspring has a policy of continuous product improvement and reserves the right to change design and specifications without notice.