Basic ModHopper Functionality

The ModHopper transceiver from Obvius combines two components:

- Frequency Hopping Spread Spectrum (FHSS) radio modules; and
- An Obvius board that manages the communications traffic using the patent pending Obvius Wireless Routing Protocol (OWRP)

Frequency bands

The ModHopper uses off-the-shelf radio modules licensed by the FCC in the ISM (Instrumentation, Scientific and Medical) bands. Use of these radios means that no site license needs to be secured for installation and that the devices containing the radio modules (the ModHoppers) can operate with other radio devices with minimal interference.

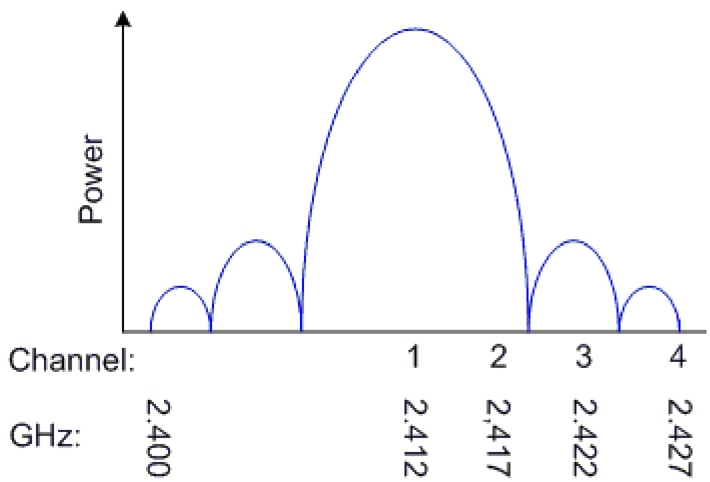
ISM bands include 400 Mhz (US), 900 Mhz (US/CA), 2.4 Ghz (Worldwide) and 5.0 Ghz (US/CA). Under FCC and international rules, any of these frequency bands can be utilized without site licenses. Choosing the best frequency for a particular application involves balancing the need for high link quality and appropriate data rates. The short version is that the lower frequencies (i.e., 400 Mhz) generally provide the best link quality as low frequency radio waves are best at penetrating walls and standard obstructions, but the lower frequency means that data rates are less than high frequecny signals. Higher frequencies (i.e., 2.4 Ghz) provide the highest data rates, but are less reliable in penetrating walls and other obstructions.

Since both signal quality and data rates affect the overall data throughput, the ModHopper uses 900 Mhz radios to provide the best balance of signal quality and data rates (and, hence the best overall throughput). This 900 Mhz band is, of course shared with other radio devices and these other devices (particularly high power devices such as cellular phone repeaters) need to be considered in installing wireless metering systems using ModHoppers.

Spread spectrum radios

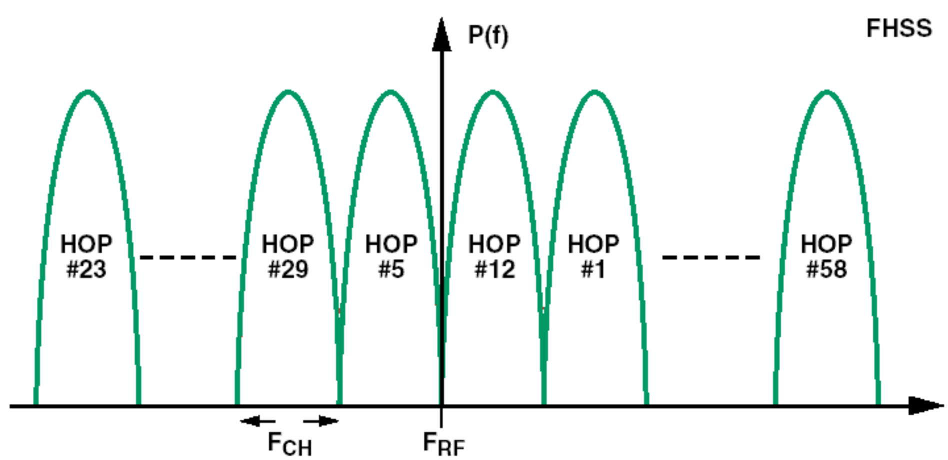
Spread spectrum radios are designed to allow the use of a much broader range of the allowed spectrum than fixed frequency radios. Using a broader band allows for the transmission of more data with a greatly reduced risk of interference that could be expected with radios communicating on a single frequency. There are two types of spread spectrum radios which commonly employed in wireless submetering applications, Direct Sequence Spread Spectrum and Frequency Hopping Spread Spectrum, The primary characteristics of the two are:

- Direct Sequence Spread Spectrum (DSSS) – in a DSSS spread spectrum radio network, the data transmission is based around a fixed frequency and the data is transmitted based on modulation of the signal from that frequency. Each radio manages the transmission through a series of algorithms. The primary advantage to a DSSS radio network is that it reduces the latency that is introduced when two radios have to "find" each other as in FHSS.



The disadvantage to DSSS is that transmissions may fail since multiple radios that cannot "hear" each other may transmit simultaneously on the same frequency.

- Frequency Hopping Spread Spectrum (FHSS) – In FHSS, the transmission of data is spread across a much wider frequency range based upon a predetermined hopping sequence that is programmed into each of the radios. The advantage to FHSS is that the likelihood of interference on any given frequency is mitigated by the use of multiple frequencies, making the odds of a successful transmission significantly higher. The disadvantage to FHSS is that it adds latency to the transmission since each of the radios has to "search" for other radios using the predetermined sequence.



Radio power

Radios are rated in terms of output power, which has a significant impact on the distance a signal can be transmitted and the likelihood that the signal can penetrate walls or other obstructions. It is important to note, however, that radio output power is only one factor that determines the ultimate signal quality of a given transmission so increasing the power of the radio may or may not provide significant improvement in any given situation. The best way to think of power is to view a radio transmission as a conversation between two individuals in a noisy room full of people. The success of their conversation is dependent on a number of factors, including the volume of the speaker, the hearing ability of the listener and the amount of extraneous noise being introduced by other nearby speakers in the same frequency range.

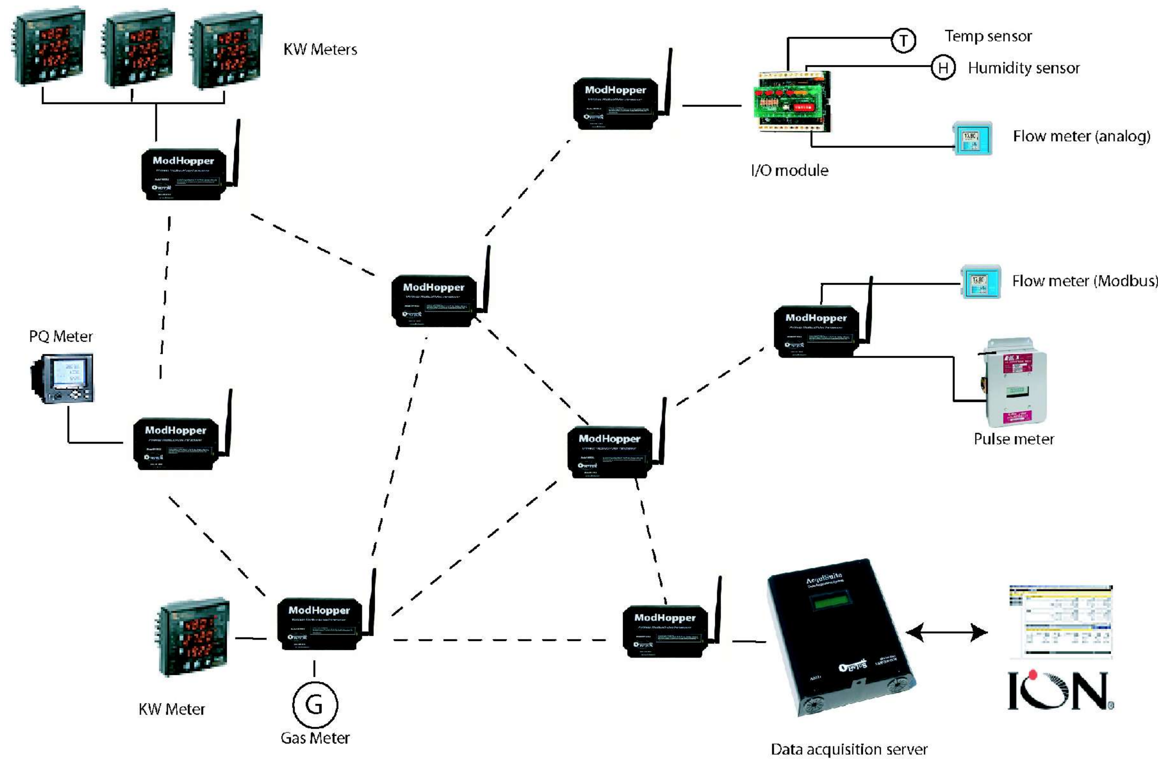
If the listener is having trouble hearing the speaker, the simple solution is for the speaker to simply raise the volume of his or her voice to "blast" through the noise. The overall success of this change in volume (power) is difficult to determine, since it is not known what other effects may be impacting this conversation. For example, if the listener is very hard of hearing or is highly sensitive to particular frequencies from surrounding conversations, raising the volume may have little impact on the overall success of the transmission. At the same time, raising the volume of this particular conversation will almost certainly have an adverse impact on other conversations occurring nearby and will interfere with them.

In the same way, higher power radios can have both negative and positive impacts on the overall success of the transmission of data. To be successful, the receiving (listening) radio must have good attenuation characteristics to be able to hear the signal clearly and minimize the impact of surrounding noise. In an ideal network, the output power of the radio is sufficient to cover the distance and obstructions present without adversely impacting other radio transmissions nearby. This is particularly true for mesh networks (see below).

The ModHopper is available in two power ranges (1 mW and 100 mW) that are rated for 300 feet and 1500 feet indoors, respectively. These ranges can be considerably longer (up to 7 miles) in outdoor line of sight applications.

Mesh radio network

Each ModHopper functions as a node on a larger, self-configuring mesh network of radio transceivers. Basically, the mesh network design allows each radio to be aware of a number of other nodes on the network and to relay data from one node through one or more other nodes to reach its destination. The ModHopper network is uniquely designed to bring the flexibility of mesh network characteristics to an RS 485 communications network, allowing typical wired serial networks to work seamlessly with wireless nodes. Each ModHopper stores all of the routing information for all the devices on the network, allowing the system to optimally route requests for data.



As the illustration above shows, each of the ModHoppers detects other ModHoppers that are within range and determines the optimal routing path for requests from the AcquiSuite master to each of the connected devices (meters and sensors). If new Modbus devices are added to the network, each of the ModHoppers will add the device to its routing table to provide one or more data paths.