Application Note: ModHopper ® Makes Submetering Easy

"If you can't measure it, you can't manage it." This statement is true for most processes and operations, but nowhere is it more applicable than in the field of energy management. Many owners of commercial, industrial and retail facilities are faced with the challenge of measuring energy usage as the first step in managing their energy budgets, but are confronted with costs to add metering that are prohibitive. Two of the largest components of any project to add meters and other sensors are: 1) the cost of installing wiring to connect meters in various locations to a central data acquisition device; and 2) the cost of getting data from the central data acquisition device to a server for analysis and display.

This paper focuses on new technologies that allow meters and sensors to be installed throughout a facility and communicate with a central host using radio communications. The key to realizing cost effective and timely communication lies in radio transceivers that combine plug and play connectivity for a variety of meters with "mesh" technology radios.

What's a ModHopper? The ModHopper® (Models R9120-3, R9120-5) from Obvius is a wireless Modbus/pulse transceiver designed specifically to provide seamless integration of Modbus devices into a wireless mesh network. The ModHopper allows the installation of electrical meters and other devices into new or existing networks without the need for costly wiring runs or software configuration.

What are wireless mesh communications? Mesh wireless radio systems are based on the principle that the system will determine the optimal path for transmission of data and that the data will be routed through one or more other nodes on the network before reaching its final destination (see Figure 1). The primary advantages to a mesh network topology are that each node can have multiple potential paths and that each node is continually evaluating the success of its transmissions and can change paths dynamically in the event an existing path is interrupted or new nodes are added.

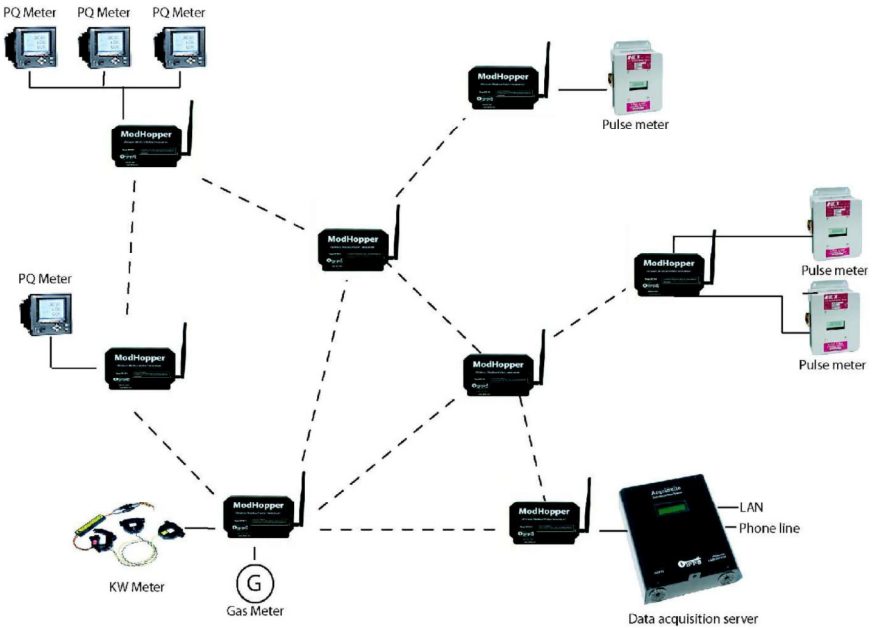

Figure 1 – Mesh network topology

As Figure 1 illustrates, each node in this network can have one or more meters connected to it. When a request is received from the AcquiSuite DAS (see below) or other Modbus master for data from one of the ModHopper nodes, the node attached to the AcquiSuite determines the optimal path for routing this request to the appropriate ModHopper node on the network. As this illustration shows, several of the ModHopper nodes have communication links with multiple other nodes and thus have several options for routing the data request and the reply to the AcquiSuite. In the event one of the nodes is occupied or off-line, the ModHopper can automatically route the data to a different node for forwarding to the requesting device.

The following example demonstrates how the mesh topology works in practice. In this case, we assume that the AcquiSuite DAS (node 1) needs to get information from one of the PQ meters attached to node 4. The red arrows show the path of the request as it is passed from node 1 to node 2, node 2 to 3 and finally node 3 to 4 where it is then passed through to the meter.

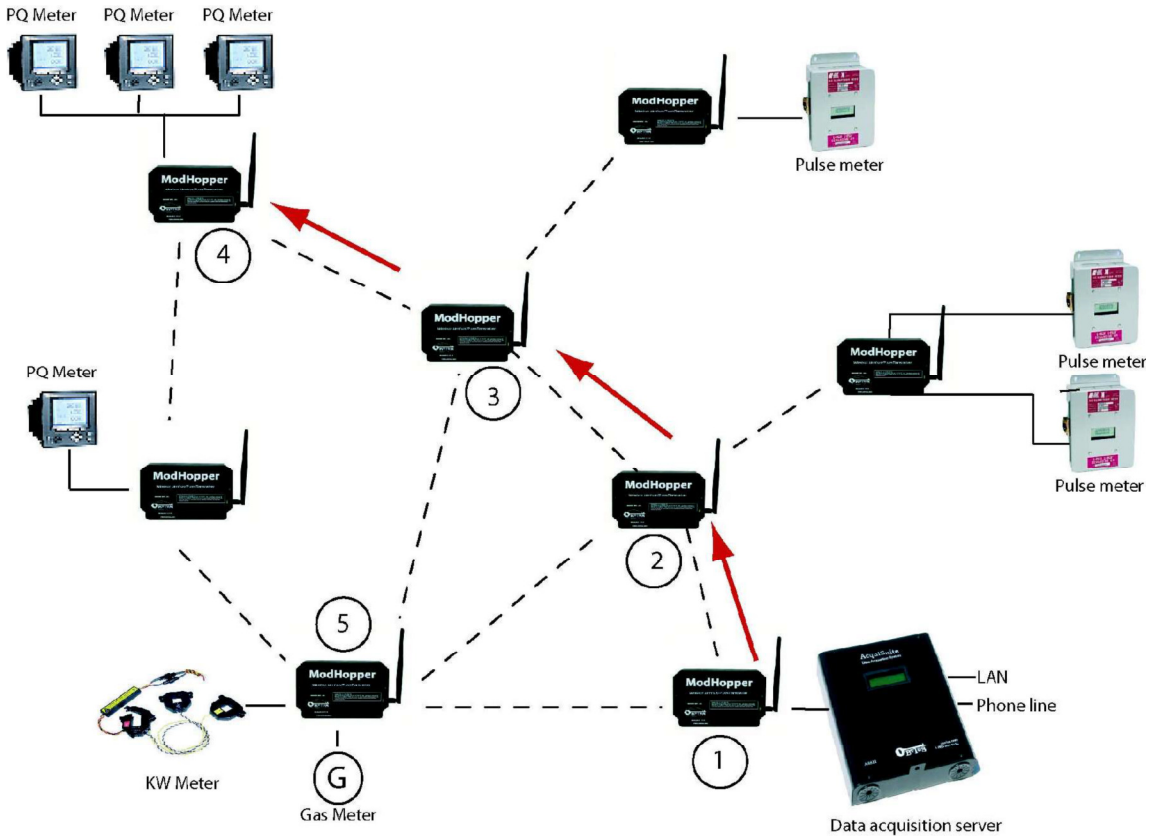

Figure 2 – Modbus request path

When node 4 returns the requested information from the meter to the AcquiSuite, it would be logical to assume that the data would follow the same path in reverse (i.e., from node 4 to 3 to 2 to 1). If we assume, however, that node 2 is off-line or unavailable for some reason, the network will reroute the data to a different path to bypass node 2. Figure 3 shows the path (green arrows) that the data follows (in this case, node 4 – 3 – 5 –1) in getting from the meter to the AcquiSuite.

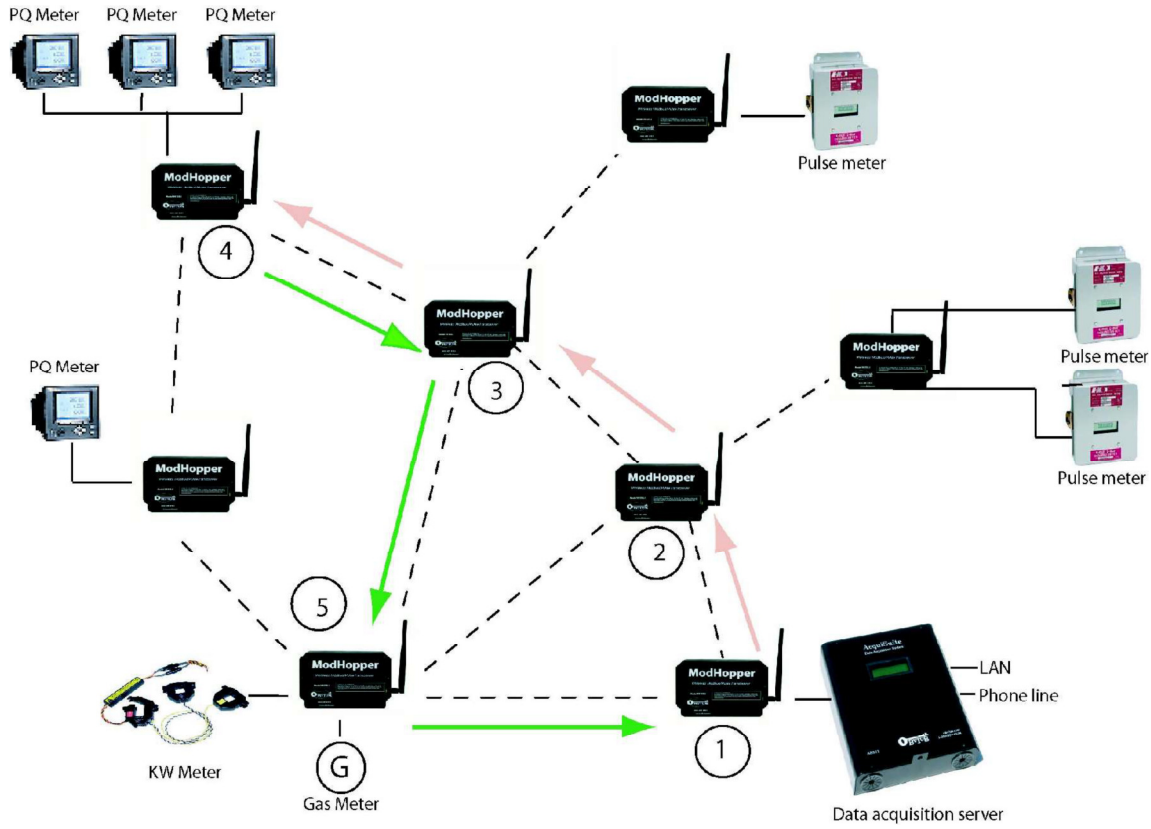

Figure 3 – Return path for data request

What does the ModHopper do? The ModHopper from Obvius is the first mesh technology transceiver optimized for Modbus communications. The ModHopper provides several key functions in a wireless submetering network:

- **Plug and play connectivity to Modbus meters** – The ModHopper allows connection of Modbus meters and sensors without the need for costly software for integration. Simply set the Modbus address for each meter, connect the meters to the RS485 port on the ModHopper and ModHopper does the rest
- **Wireless connectivity for new or existing pulse output meters** - Two pulse connections allow the ModHopper to gather pulse data from gas, water, steam, electricity and BTU meters in addition to Modbus devices. Pulse counts from new or existing meters can be communicated to a remote device.
- **Intelligent mesh networking without software or a central PC** – Many wireless networks require the installation of a central PC and software to manage the mesh network configuration and operation, but the ModHopper needs only two or more nodes to form a fully functioning mesh network system.
- Dynamic network configuration – ModHopper makes adding devices "on-the-fly" simple and cost-effective. Adding new devices to existing nodes or adding nodes is as easy as setting the Modbus address. ModHopper takes care of the rest, by optimizing network paths to reflect the new devices/nodes
- **Elimination of "dead zones"** - Many wireless networks suffer from "dead zones" or areas in the facility where radio communication is difficult due to interference or distance limitations. Adding a ModHopper (with or without connected Modbus or pulse devices) provides a path for communication through or around dead zones at a very low cost.

What Modbus devices does the ModHopper network support? The ModHopper network is specifically designed for supporting Modbus devices and will provide connectivity to any Modbus RTU device. As with any Modbus network, successful communication between the slave device and the master is dependent on the master recognizing the Modbus slave device.

If the ModHopper network is connected to the AcquiSuite® DAS from Obvius, the AcquiSuite provides plug and play connectivity to a variety of meters and Modbus devices. If any of these meters are connected to the AcquiSuite (either via ModHopper or hard-wired), the AcquiSuite will automatically load drivers for the meters and will log and store interval data (see below for more information).

What pulse devices can be connected to the ModHopper? Any pulse output device can be connected to the ModHopper (up to 2 pulse inputs per node). The ModHopper accumulates the pulses and forwards the counts to a master device such as the AcquiSuite. Typical flow devices connected to the ModHopper network include:

- Gas meters
- Water meters
- Electricity meters
- BTU meters
- Other flow meters

How does the ModHopper handle pulse inputs? The ModHopper functions as a pulse accumulator and a pulse to Modbus converter. For each single pulse input, the ModHopper provides five different Modbus values:

- Total pulses accumulated
- Pulse rate
- Minimum
- Maximum
- Average

What is the AcquiSuite and what does it do? The AcquiSuite (Models A8812, A8812-GSM) and AcquiSuite EMB (Model A8810) are both data acquisition servers (DAS) from Obvius that provide plug and play connectivity for a variety of Modbus meters and devices. When a supported meter is connected to the AcquiSuite, it automatically detects the meter type and loads the appropriate driver. The AcquiSuite then logs interval data (on user selected intervals from 1 to 60 minutes) and stores the information in non-volatile memory. Data can then be uploaded from the AcquiSuite to a remote server (for example, http://www.obvius.com) for viewing and report generation.

The AcquiSuite provides connectivity using either a LAN or phone modem connection. All of the user interface with the AcquiSuite is done with any Web browser, making setup and monitoring simple and cost effective. For more information and data sheets on the AcquiSuite, go to http://www.obvius.com/documentation/products.html.

Does the system require an AcquiSuite to operate? No. The AcquiSuite is one option for a master Modbus device on the network, but any Modbus RS485 master can be used to collect data from the slave devices on the ModHopper network. For example, the Modbus master connected to the ModHopper network could be a PLC with Modbus ports or a BAS controller with Modbus.

How does the system get configured? The best part of the ModHopper mesh network is that the system does the configuration with minimal effort from the installer.

A typical submetering installation has the following steps:

1. Install the Modbus meters to be served by one ModHopper (each meter gets a unique Modbus address)
2. Daisy chain a twisted pair of wires to each of the meters
3. Connect the RS485 wire to the serial port on the ModHopper
4. Set the Modbus address of the ModHopper to a unique address
5. Provide power to the ModHopper
6. Repeat as necessary

As soon as two or more ModHoppers are connected and powered up, the network nodes will determine optimal routing paths. As new ModHoppers are added, they will be recognized by the network and routing paths will be modified or added by the network as needed to optimize data transfers.

What is the maximum distance between nodes? There are two versions of the ModHopper: one for short distances (1500ft indoor / 7 miles LOS) and one for longer distances (3000ft indoor / 14 miles LOS). As with any radio system, the actual distance which can be effectively managed will depend on a variety of factors, such as the physical construction of the building, distances to be covered and equipment that interferes with the radio signals. The ModHopper uses a radio module designed to maximize efficiency in building environments at a very low cost.

What is the maximum number of devices that the network will support? The network has a practical limitation of approximately 250 Modbus devices. As outlined earlier in this paper, each ModHopper is a Modbus device, so the total of 250 devices must include each ModHopper. It is important to note that overall system performance will depend on the configuration of the network, i.e., the time for any given data transfer will be more dependent on the number of "hops" the data must make before reaching the final destination than the total number of nodes.

Where is there more information? More information is available on our website:
http://www.obvius.com or by calling (866) 204-8134.