SpirePulsar Series

Wireless Automatic Metering System

Submetering is the most accurate method of recovering variable utility costs in the multifamily housing market. By measuring each individual resident's utility consumption, and then billing them directly for their use, multifamily properties, apartment buildings and commercial facilities benefit from reduced variable utility costs, improved net operating income, and increased property value.

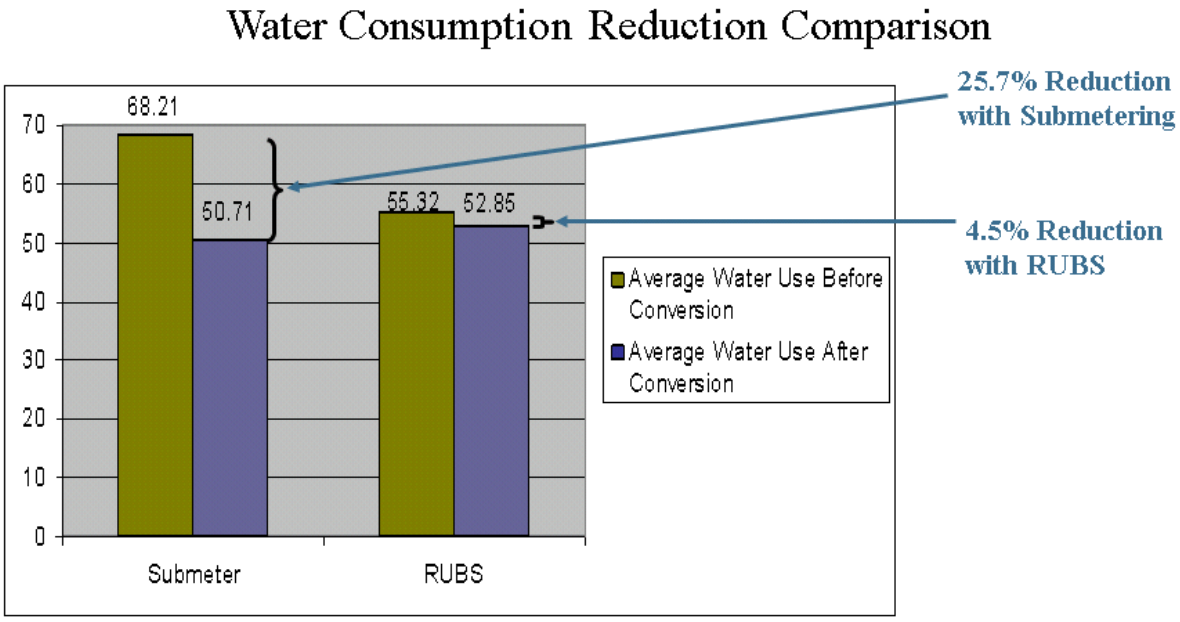
Unlike ratio utility billing systems (RUBS), a submetering system tracks each resident's monthly utility use, and a billing company provides a bill to each resident based on their personal usage. Submetering not only reduces a property's operating expenses, but also encourages utility conservation among residents.

Submetering not only saves money, but it also improves the marketability of a property. Since residents are responsible for their own utilities, properties can offer more competitive rents, attracting more prospective residents. Since wireless submetering systems are compatible with water, electric, and gas meters, properties can recover virtually all utility expenses associated with individual apartment units. A property's operating budget is no longer affected by utility rate increases or spikes in resident usage.

SpirePulsar is a wireless automatic meter reading (AMR) system which is designed for submetering applications. It has numerous benefits:

- Decreases operating costs and increases property values
- Installs easily
- Uses proven wireless technology
- Reduces utility consumption
- Allows for future property growth
- Regulatory requirements. Some states do not allow RUBS.

One example of using submetering to reduce water consumption is illustrated in the following figure.



Data from: Environmental Protection Agency Study: August 2004

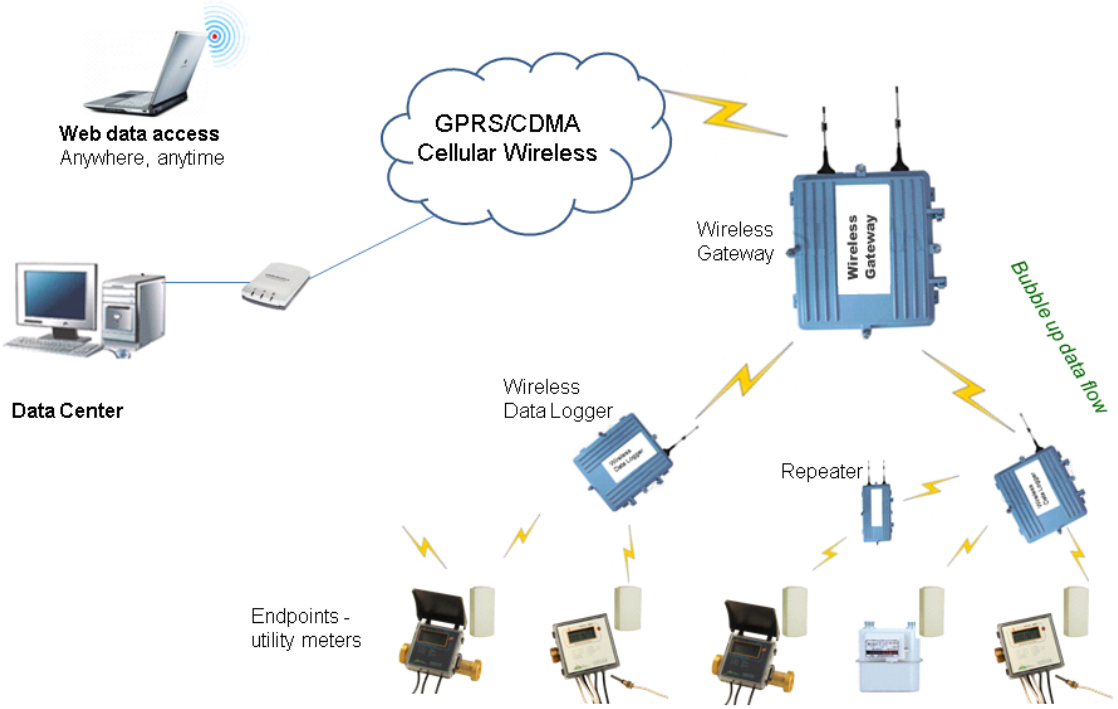
(www.aquacraft.com/Projects/submeter.htm)

How Does the SpirePulsar AMR System Work

The SpirePulsar AMR system utilizes pulse transmitters to count the number of pulses from utility meters and transmit the accumulated pulses to remote concentrators or wireless meter readers using RF wireless.

There are two types of SpirePulsar systems: fixed wireless system and mobile reading system. In a fixed wireless system, all the network components are installed in fixed locations. The utility meter data are sent to a remote data center automatically. This document will be focused on the fixed SpirePulsar only.

A fixed SpirePulsar AMR system is normally consisted of a number of utility meters, such as ultrasonic water meters, pulse transmitters, repeaters, data loggers, wireless gateway and a data center. The figure below illustrates a typical SpirePulsar AMR system. The meter reading process is initiated by the Wireless Data Logger (WDLR). At a preset schedule, the WDLR sends meter read command to remote endpoint (pulse transmitter). The endpoint is awaked, then, it responses the WDLR with its pulse counter data which represents the most recent utility meter reading.

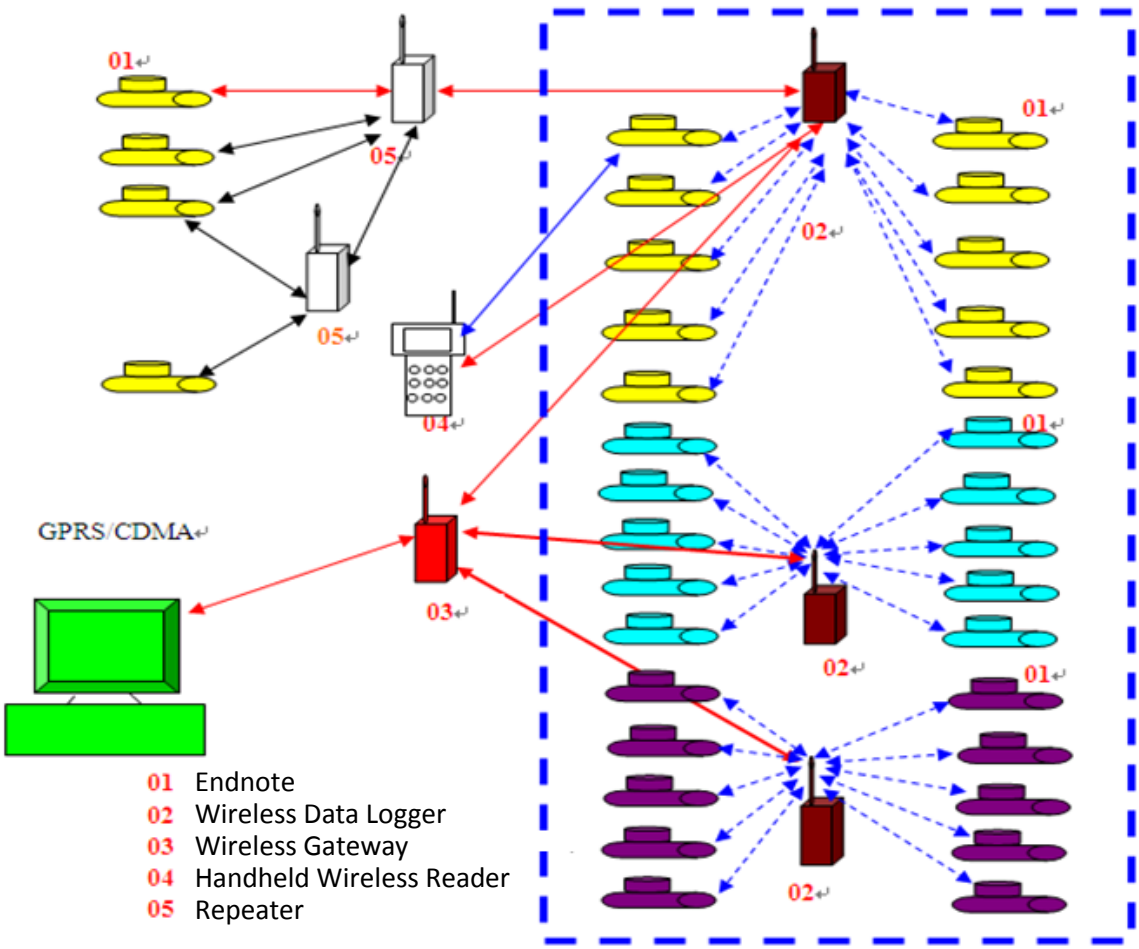


Work Flow at a Glance:

	Each utility (water, gas, heat, and electricity) meter in a building is connected to a wireless pulse transmitter. It sends a pulse to the transmitter for each certain quantity of utility usage. The pulse transmitter totalizes the number of pulses received from the utility meter. It transmits the totalize reading wirelessly at a preset schedule.
	Repeaters, placed at strategic locations across the site, receive and verify signals from the transmitters and amplify the signals for transmission to the receiver
	Wireless Data Logger (WDLR) receives transmissions from repeaters or pulse transmitters and stores the data in its large memory. The data can be retrieval by PC software through RS232 or be sent to data center through a wireless gateway.

	Wireless Gateway uses GPRS cellular service to send the data logger data to Spire's server which has fixed IP address in the Internet.
	Web-based data management: Data are presented on the Website. Clients can log into their account to manage their data anywhere, any time.

It is quite common that some of the utility meters are located in an area that mobile wireless reading instead of fixed wireless system reading makes more economical senses. In this case, Spire Metering provides integrated mobile reading solution which allows a user to use a handheld wireless reader to read the meter data near the utility meter. The data can be downloaded to a computer and integrated into the database of the fixed wireless system. This provides a uniform data interface for billing system.
The figure below illustrates a mix wireless AMR system.



System Components

1. **Utility meter**

A utility meter is a device used to measure utility consumption. It could be water meter, heat meter, gas meter, electricity meter and more.
To be compatible with SpirePulsar AMR system, the utility meter must provide a pulse output. Each pulse represents a certain amount of utility usage. For example, for 280W-DN20 water meter, each pulse represents $1m^3$ of water.

2. **Pulse Transmitter**

A pulse transmitter does two things: counts the number of pulses received from a utility meter; transmit the data to a repeater or a data logger through its RF wireless port.
The frequency of the transmitter is 470MHz in a free frequency band. This transmitter has integrated functions such as automatic frequency hopping, secondary routing, automatic wake-up and periodic data uploading, which have solved frequency interference problem and increased transmission distance.
From network point of view, each RF transmitter is an endnote (or end point). It has a unique 10 digits ID.
The transmitter could be either a separate device or integrated into the utility meter.
The transmitter is powered by a 3.6V lithium battery for 6 years operation. It is normally in sleep mode. To read the data, a WDLR has to send a command to the transmitter to wake it up. After waking up, the transmitter sends the data in its pulse counter back to the WDLR. This automatic wake-up function can greatly reduce the power consumption to save battery life.

Item#	Name	Parameter
1	Modulation Method	FSK
2	Transmission Power	17 dBm
3	Frequency	470MHz
4	Transmission Current	85±10mA
5	Receiving Current	20±5mA
6	Receiving Sensitivity	-110dBm
7	Wake Time	<3s
8	Sleep Current	30uA
9	Average Power Consumption	<40uA
10	Power Supply	3.6V Lithium Battery
11	Battery Life	>6 years
12	Temperature	-20℃~65℃
13	Humidity	10%~90%
14	Baud Rate	9600bps
15	Channel	01 (default)
16	Open Air Distance	>300m

17	Other Main Features	Pulse Count Wireless Awake Bi-directional Low-battery Alarm Transmit data upward on schedule and on usage quantity

3. Repeater

The repeater is an intelligent transceiver that identifies signals from endnote transmitter and rebroadcasts those signals. The repeater transmits at a higher power than the endnote, so the endnote radio transmissions need only reach the repeater, not the WDLR. This extends the life of the battery in the endnote and creates an accurate, reliable, and cost-effective wireless system.

The transmission between a repeater and an endnote uses 9600 Baud rate. The transmission between two repeaters or between a repeater and a WDLR uses 100k Baud rate. The repeater network uses tree-topology. Each repeater has a farther note and a son node. Each node has a unique 10 digits ID.

The repeater is a high power repeater with transformer intelligently amplifies transmission from endnote transmitter while ignoring background noise. The repeater is perfect for large facilities such as multi-floor buildings, multi-building sites, shopping malls, campuses and other open-air installations. Virtually any number of repeaters can be added to a system, scaling the system size as needed.

4. Wireless Data Logger

The Wireless Data Logger (WDLR) interfaces to the wireless network for collection of utility consumption data, stores the collected data, and transfers the data to a remote data server or data management or bill generation.

The WDLR can be equiped with two wireless interfaces, both are 470MHz. One interface communicates with endnotes or repeaters, another interface communicates with Wireless Gateway.

The WDLR data can be read with a handheld wireless reader. It also has a serial port which can be connected to a PC to download the data.

WDLR Features:

1. Wireless module is with low transmit power, and the largest transmit power is 500mW with secondary routing function.
2. Work frequency is leisure band without applying frequency point. High anti-interference capability: based on FSK modulation, use high-efficiency FEC channel

coding technology to improve data's resistance to burst interference and random interference.
3. Interface Baud Rate is 9600bps,8-e-1.
4. Can set maximum 10 of each special repeater addresses or endnote (water, gas) addresses, automatically configuring the optimal meter reading path.
5. Integrates functions such as real time, periodic and freezing meter reading data.
6. High reliability and beautiful layout.
7. Can manage maximum 200 of water or gas meters.

5. Wireless Gateway:

The Wireless Gateway is an important device of the SpirePulsar wireless AMR system. SpirePulsar system achieves low construction cost and low maintenance cost. It is particularly suitable for new urban development zone, old urban renewal, small town development and other projects. The Wireless Gateway is a relay station for data center server and WDLR.

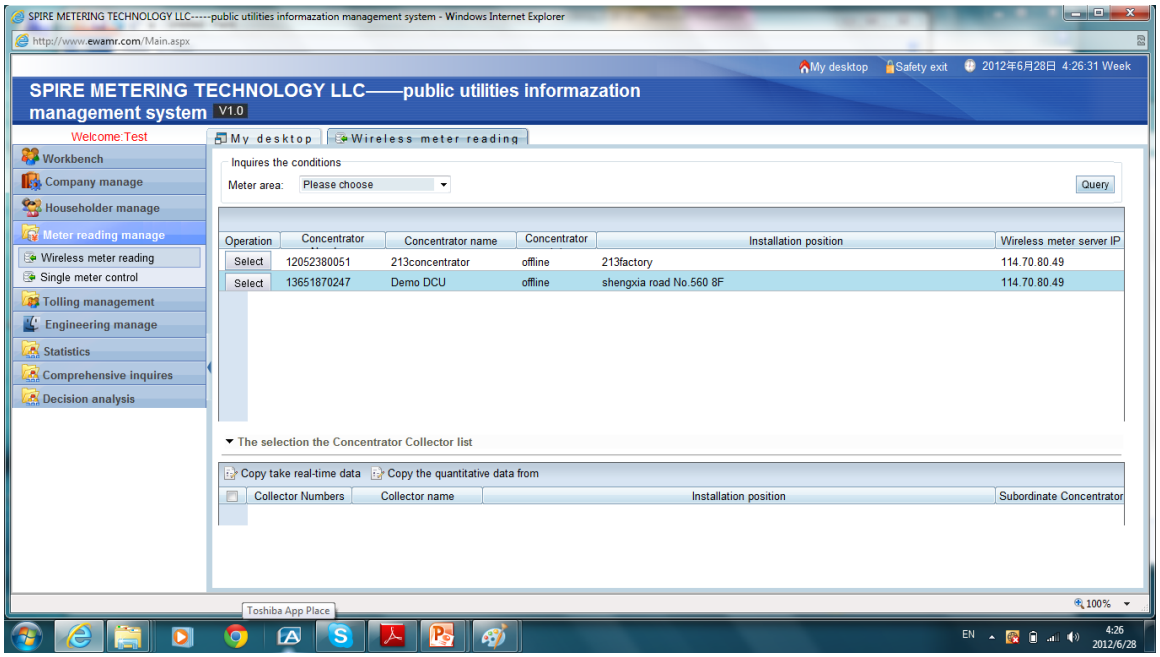
The Wireless Gateway has two wireless modems, one is GPRS modem which communicates with data center through GPRS cellular network, the other is RF wireless modem which communicates with WDLR through 470MHz radio wireless. It has a voltage stabilized switching power supply, which ensures its reliable operation in complicate power supply environment.

The working flow is as following:
After the system starts to work, Wireless Gateway is the first to get the orders from data center. It first verifies whether the orders are correct or not to avoid outside interference, then, checks the command frames. If it is a valid command, Wireless Gateway will then forward the command to the corresponding WDLR.

Upon receiving the command, WDLR analyzes the command. If it is a real-time meter reading command, WDLR will read the real-time data from the corresponding pulse transmitter directly or through repeaters. After receiving the real-time data, the WDLR sends it back to the Wireless Gateway which then forwards it to the data center.
If the command is for standard meter reading, the WDLR will get the meter data from its logger memory and response to Wireless Gateway directly.

6. Web-based Data Management

Spire Metering provides a server which receives the data from the Wireless Gateway. This server has a static IP address. It can be accessed by a registered client from anywhere anytime. Please visit the following site for the demo: www.ewamr.com
The user interface is self-explanatory. It allows you to manage your meters as well as your customers easy and quick.



7. Billing software

Spire Metering also provides its own billing software. The billing software reads meter data exported from the AMR database. It provides an easy to use tool for customer account management, secure online bill presentment and payment, integration with 3rd party systems, and a low cost print and mail solution.

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