

Part 1 Sample System Overview Specification

1.01 System Description

1. Furnish and install a complete Wireless Submetering and Monitoring System (WSMMS) as detailed on the drawings and as described in the specification. The system shall be designed to include wireless devices for water metering, electric metering, thermostat metering, BTU metering and gas metering. The system should include a wireless coordinator and gateway hardware connected to the Internet.
2. The WSMMS shall utilize 2.4 GHz wireless to connect the coordinator with the metering devices.
3. The WSMMS must utilize 2.4 GHz frequency band (2.400 to 2.483.5). In order to provide maximum reliability and interference immunity transmitters/receivers should use Direct Sequence Spread Spectrum (DSSS) in conjunction with the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) technique. The radios must be certified by the Federal Communications Commission (FCC). The transmitters/receivers must meet the FCC established technical standards and allow the submetering system to operate throughout the United States without the user, supplier or operator obtaining any type of radio license.
4. WSMMS software shall be provided as described in Article 2.03 of this specification.
5. The WSMMS shall be supplied by H2O Degree.

1.02 References

1. All high flow water meters (greater than 8 gallons per minute flow rate) shall conform to meet or exceed AWWA specifications or NIST Standards and be NSF 61 Certified.
2. All low flow water meters (less than 8 gallons per minute flow rate) shall conform to meet or exceed AWWA specification or NIST Standards and be NSF 61 Certified.

1.03 Submittals

1. Indicate electrical and mechanical characteristics and connection requirements. WSMMS components shall be installed by other; the drawings shall clearly identify the components with the internal connections, and all contractor connections.
2. Provide catalog sheets and technical data sheets to indicate product specifications and characteristics.

Part 2 Sample Water Meter Specification

2.01 M54120 Water Meter

1. The M54120 shall be provided for each tenant location on the incoming cold and/or hot water supply.
2. The M54120 shall meet or exceed AWWA specification and be NSF 61 Certified.
3. The M54120 shall have an integrated radio and on-board processor to provide flow time, flow events, temperature and a gallon register over the 2.4 GHz frequency band utilized by the WSMMS.
4. The M54120 shall have a 3.6V D Cell Lithium battery to provide a 5 year life expectancy of the meter.
5. The M54120 must interface with the PLM10100 Flow Sensor to detect water flow that will be installed in-line on a water supply.
6. The M54120 must be able to be installed on Point-Of-Use (POU) and Point-Of-Entry (POE) plumbing configurations.
7. The M54120 shall utilize two-way communication over the 2.4 GHz frequency band utilized by the WSMMS.
8. The Wireless Submetering and Monitoring System provider shall provide and certify the water metering system by way of H2O Degree.

2.02 WM1000C Water Meter

1. The WM1000C shall be provided for each tenant location on the incoming cold water supply.
2. The WM1000C shall be of multi-jet design housed in polymer reinforced plastic.
3. The WM1000C shall conform to AWWA specification or NISH Handbook 44 standards and NSF 61 Certified.
4. The WM1000C shall be NTEP and CTEP Certified.
5. The WM1000C shall be a 5/8" x 3/4" meter which shall also meet specified applicable pressure loss and maximum GPM flow rate.
6. The WM1000C shall be equipped with a measuring chamber capable to rotate independently of the flow tube on an axis to ensure the measuring chamber can always be positioned horizontally.
7. Registers on the WM1000C shall be permanently sealed, IP-68 rated, dust and water proof with tamper proof features and incorporates a six wheel odometer totalizer.
8. Registers on the WM1000C shall be available in U.S. Gallons.
9. Registers on the WM1000C shall have an output contact for field interface to WSMMS. The output contact shall correspond to 1 pulse per 1 U.S. Gallon. Contacts should be rated 12 VDC @ minimum of 6 mA.
10. The Wireless Submetering and Monitoring System provider shall provide and certify the water metering system by way of H2O Degree.

Part 3 Sample Communication Specification

3.01 Battery Powered Pulse Counter - Indoor (M54230)

1. The M54230 shall utilize 2.4 GHz frequency band (2.400 to 2.483.5) and be compatible with the H2O Degree WSMMS.
2. The M54230 shall be equipped with two channel inputs to interface with up to two meters equipped with pulse output.
3. The M54230 shall be able to provide two communications on the WSMMS.
4. THE M54230 shall be able to provide local device LED sequence indication for successful commissioning to WSMMS when installer uses a magnet to force device to join network.
5. The M54230 shall be able to provide data transmission of recorded consumption every 60 minutes.
6. The M54230 shall be rated for a 10 year battery life expectancy.
7. The M54230 shall be equipped with a tamper switch and be able to send a data transmission immediately once triggered.
8. The M54230 shall be equipped with a replaceable lithium battery.

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Part 3 Sample Communication Specification (Continued)

3.02 Wireless Mesh Transceiver - Indoor (M54200)

1. The M54200 shall utilize 2.4 GHz frequency band (2.400 to 2.483.5) and be compatible with the H2O Degree WSMMS.
2. The M54200 shall be able to extend the range of devices installed throughout the WSMMS.
3. The M54200 shall be able to provide two communications on the WSMMS.
4. The M54200 shall be able to provide local device LED sequence indication for successful commissioning to WSMMS when installer uses a magnet to force device to join network.
5. The M54200 shall be able to provide a network health packet every 120 minutes.
6. The M54200 shall be line powered with a power supply output rated at 9-12 VDC.
7. The M54200 shall be able to support extending the range of up to 32 devices at any given time.
8. The M54200 shall be able to store up to 16 neighbors to create multiple data pathways to the Coordinator.

3.03 Ethernet Gateway - Enhanced (IT1000)

1. The Gateway shall feature one 10/100base TX Ethernet port, 1 GHz processor, Real-Time Clock with battery, 512 MB RAM and 3 USB 2.0 ports, power 120 VAC less than 2 amps.
2. The Gateway shall be configured to use DHCP (Dynamic) to automatically get an IP Address.
3. The Gateway shall have a FLASH memory for non-volatile storage to store real-time metering data and to store up to 200,000 records. Once FLASH memory storage is full, the Gateway will flush the records according to a first in, first out principal.
4. The Gateway shall support the following protocols: Ethernet - Modbus/TCP and HTTP.
5. The Gateway shall be compliant to industrial temperature. It shall withstand an operating temperature range of 0 Degrees C to 50 Degrees C.
6. All Ethernet cabling shall be installed by a qualified data communications cable installer or the electrical contractor qualified to install data communications equipment. All communications cabling shall be PATCH Category 5 rated for 100baseT.
7. The Gateway shall be "Plug and Play" with no configuration required.
8. The Gateway software shall be able to be upgraded remotely.
9. Each Gateway must use a USB port to communicate with the Coordinator. The Coordinator has two-way communications with all of the wireless devices utilizing a 2.4 GHz frequency band (2.400 to 2.483.5). In order to provide maximum reliability and interference immunity, transmitters/receivers should use Direct Sequence Spread Spectrum (DSSS) in conjunction with the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) technique. The radios must meet the FCC established technical standards and allow the submetering system to operate throughout the United States without the user, supplier or operator obtaining any type of radio license.

3.04 Coordinator (M54700, M53700)

1. The Coordinator shall interface with either the IT1000 Gateway or the IT1002 Gateway via USB allowing the gateway to receive data from the wireless devices installed on the network.
2. The Coordinator shall be "Plug and Play" with no configuration required.
3. The Coordinator must form, monitor and control devices over the wireless network.

3.05 Internet Connection Options

1. Connection to the Internet using DSL, Cable or FIOS - Both the enhanced IT1000 and the standard IT1002 gateways have an Ethernet port which can be used to connect the Gateway to the Internet. The customer must supply an Internet router in order to provide a firewall to protect the Local Area Network (LAN) that the Gateway is connected to. If an Internet router is already in place the Gateway can be connected using an existing LAN. The Gateway should not be connected directly to a DSL Modem, Cable Modem or FIOS modem.
2. Connection to the Internet using Cellular Modems (IT2000, IT2001, IT2002) - Optional cellular modems can be used to connect the Gateway (either the enhanced IT1000 or standard IT1002) to the Internet when sufficient 3G coverage is available and Ethernet is not a viable solution. Modem hardware shall be provided by the WSMMS vendor and installed by the system installer where specified. Use of modems shall be transparent to the WSMMS software and monitoring devices. The end user is responsible for all recurring charges or fees associated with the operation of cellular modems.

Part 4 Sample WSMMS Software Specification

3.01 WSMMS Software

1. The WSMMS software shall be a web based program.
2. The WSMMS software can push the consumption data in any accepted format (i.e. csv, ftp, etc.) to a billing company to obtain meter readings from the data collection device (gateway).
3. Each transmitter/receiver (wireless) device shall have a unique user defined meter serial number.
4. The WSMMS software shall provide the following functions:
 - a. Record and display general information.
 - b. Show meters by building and apartment.
 - c. Show daily historical data for each meter.
 - d. Show hourly historical data for each meter.
 - e. Show total consumption for each apartment by date range (ranked by apartment).
 - f. Show total daily consumption for the entire property by date range.
 - g. Provide an automated daily leak report for each apartment that has leaks, or over consumption that is past the set threshold.
 - h. Show all water meters that have no water consumption.
 - i. Ability to support any number of properties each with associated buildings, apartments and water meters.
 - j. Provide tenant level access to show daily and monthly consumption and automated leak reports.

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1.1 Unit & Common Space Water Meters, Data Collection System

A. Unit water meters and the data collection system shall be supplied, programmed and warranted by one manufacturer. The following specification is based on H2O Degree or approved equal.

B. Residential Water Meters

1. Cold Water

1. Provide 1 (one) H2O Degree WM1200C*** Multi-Jet cold water meter per unit.
2. Provide Brass Union Coupler comprising of 2 union nuts, 2 washers, 2 male adapters x" threaded.

2. Hot Water

1. Provide 1 (one) H2O Degree WM1200H*** Multi-Jet water meter per unit.
2. Provide Brass Union Coupler comprising of 2 union nuts, 2 washers, 2 male adapters x" threaded.

3. Operation

- a. The impeller movement shall be transferred by a magnetic coupling to a hermetically vacuum sealed register.

4. Construction

- a. The meter consists of the main case and a register pulser assembly.
- b. The main case is cast brass with raised characters showing direction of flow.
- c. Display in "gallons".

5. Wireless Pulse Radio

a. General

1. Provide 1 (one) H2O Degree model number L54230 10-year battery life radio per each pair of hot and cold water meter or in each residential unit.

b. Description

1. Collects and transmits information from most North American Utility meters (including multi-utility collection - water, gas and electric within the same system network).
2. Stand-alone unit with internal power source (10 year expected battery life).
3. Radio is equipped with two dry contact pulse inputs.
4. Easily replaceable, readily available battery (H2O Degree part number BT1000-3.6V 19 ah).
5. High reliability (indoor applications).
6. Easy and quick installation - no need for extensive infrastructure.

c. Features

1. Easy push wire connector that accepts input from any dry contact pulsed output meter.
2. Cumulative information stored and transmitted hourly.
3. LoRaWAN Open Protocol.

6. Gateway

a. General

1. Provide 1 (one) H2O Degree LIT1005-xxx-KIT LoRa Gateway.

b. Description

1. Commodity information is received from L54230 radios within a reception radius of up to 1,000 feet. *Distances can be increased with additional equipment, such as an increased dB antenna on the LIT1005-xxx-KIT LoRa Gateway.
2. Cloud server process verifies collected data validity and any diagnostic messages.
3. Cloud server provides health network, battery voltage, transmit counter, etc. to detail site reliability.
4. Requires 110VAC power outlet, and (1) Ethernet DHCP based internet connection.

7. Features

- a. The data is backhauled on a real-time basis via the public/private network to the cloud server.
- b. The gateway can be retrofitted in a NEMA 4X enclosure for outdoor use.
- c. Open wireless protocol allows interface to virtually any other LoRaWAN node.

8. Installation

a. Water Meters

1. The water meters must be installed in a clean pipeline, free from any foreign materials.
2. The water meters shall be installed with the direction of flow as indicated by the arrow on the meter case.
3. The water meters may be installed in a horizontal position with the register facing upward.
4. The water meter is for use in cold water up to 105 degrees F and working pressure up to 150 psi.
5. The Hot water meter is for use in water up to 194 degrees F and working pressure up to 150 psi.
Couplings should not be "over tightened" hand tight plus 1/4 turn max. Mechanical end of coupler should not have pipe tape or sealant applied.
6. No water meter adjustments need to be made before installation.
7. The plumbing contractor shall provide temporary spool pieces between each meter couplings until the building domestic water system has been completely installed and thoroughly flushed of all construction debris prior to installing the water meters.

b. Wireless Pulse Radio

1. The plumbing contractor shall install wireless pulse radios utilizing the push wire connector. Wireless radios do not need any additional programming or preassignment. The contractor will be responsible for recording the serial number/QR Code of the installed radio to the corresponding apartment using the provided serial number/QR Code pull tag. Serial Numbers/QR Codes will be scanned and uploaded to devicemanager@h2odegree.com for database commissioning.

c. Gateways

1. The plumbing contractor shall be responsible for pre-coordination and space allocation with the electrical and telecommunication contractors. H2O Degree shall designate a suitable location for gateway to maximize RF.

d. Read, Bill and Collection Services

1. H2O Degree does not contract with billing companies or provide billing services. The billing data is owned by the building owner, and can be provided by any qualified third party billing service provider free of charge. Plumbing contractor shall coordinate through the general contractor and owners who the elected third party billing service provider is. Once established H2O Degree will work with elected service provider on data integration of billing data.

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H2O Degree has many different methods for reading and writing Modbus data. This overview discusses the three basic methods to access Modbus data.

Access Modbus Data Using an H2O Degree Radio as a Modbus Master

In this application, the H2O Degree radio has an RS-485 serial port that can communicate using a two conductor cable with one or more devices that support Modbus RS-485 RTU. One example would be the H2O Degree model M54550, which is designed to poll one or more EM-2000 electric meters. The EM-2000 has a ModBus RTU bi-directional serial interface. In addition to reading just a single submetering value such as kilowatt-hours, the radio can also read other ModBus registers.

Access Modbus Data Using an H2O Degree Gateway as a Modbus Master.

In this application, the H2O Degree gateway has an Ethernet port connected to the local area network (LAN). Also on the LAN is a third-party wireless gateway which can read proprietary electric meters wirelessly. The third-party buffers the kilowatt hour readings from the wireless electric meters. The H2O Degree gateway connects to the third-party gateway over the Ethernet LAN. The H2O Degree acts as a Modbus master and uses Modbus TCP/IP to read the data packets that arrive over the third-party wireless network to the third-party gateway. Typically the H2O Degree gateway reads data from the third-party gateway every 2 seconds and then sends the data to the H2O Degree server. Each electric meter has a unique serial number, and this number is passed along with the data to identify which device provided the data. The database on the H2O Degree server maintains a correlation between each unique address and the apartment associated with this particular electric meter. The H2O Degree radio can interface to other third-party devices that support Modbus serial RTU. Contact the factory for a quote on custom devices.

Access Data Collected by the H2O Degree Gateway (The H2O Degree Gateway Acts as a Slave)

In this application, the H2O Degree gateway exposes all of the data collected from the wireless network and from any Modbus slaves on the LAN to one or more Modbus masters. The H2O Degree gateway uses Modbus RTU over Ethernet. Since different wireless networks have different Modbus maps, the user is required to run a report that automatically creates a Modbus register map. The Modbus register assigns a unique register address for each data point that the gateway collects from the wireless network. The H2O Degree server automatically downloads the configuration file to the gateway so that the gateway knows the Modbus register to data point assignment.

Typically, the Modbus master is a Building Automation component such as a Jace or Tridium box. The output of the Modbus register map program is a spreadsheet that can be used to configure the Building Automation component. Alternately, the user can log into the web server on the gateway to inspect the Modbus registers and data values as a web page. The Building Automation System can only read most of the Modbus registers. The Building Automation System can write to other registers. One example of write registers would be thermostat heating and cooling set-points.

Diagram 3: Sample Modbus Register Map

Modbus Register Map for: Property One
 Gateway Hostname: property_one
 Gateway IP Address: 192.168.0.101
 Updated Oct 29 2016 6:28AM
 Gateway Version: 0.111

Counter	Description	Blgd. / Floor	Apartment	Location	Modbus Code	Base Address	Registers	EUI	Attached To
1	Aqura Water Meter	Property One	First floor	basement	4	11081	15	000D6F00015827FC	Main Feed Single
2	Aqura Water Meter	Property One	Second Floor	basement	4	11096	15	000D6F0000567538	Main Feed Single
3	BTU Meter	Property One	First floor	basement	3	164	21	000D6F0001D84C15	Coil
4	BTU Meter	Property One	Second Floor	basement	3	185	21	000D6F0001D8461A	Coil
5	Gateway	Property One	Basement	Basement	4	51	12	FFFF002531032122	None

Short Explanation of this Modbus Register Map

This property has two water meters, two BTU meters and the gateway.

Each water meter has 15 registers that describe the data coming from the water meter. The base address 11081 is for the first-floor water meter. The base address 11096 represents the second-floor water meter. Some of the registers for the water meter include gallons, temperature, events and flow time.

Each BTU meter has 21 registers that describe the data coming from the BTU meter. The base address 164 is for the second-floor BTU meter. Some of the registers for the BTU meter include gallons, pulses, inlet temperature, outlet temperature, temperature difference and therms.

Finally, the gateway has 12 registers based on address 51. The Modbus register map documentation describes all of the registers for each device type.

Diagram 4: Sample Modbus System Configuration Diagram

