City of Naperville: Water AMI Project

Exhibit A

Statement of Work: Core & Main/Sensus

Exhibit A

Statement of Work

(SOW)

1. **Project Definitions:**

   1.1. Listed in Attachment 1

2. **Project Name:**

   2.1. Naperville Sensus FlexNet Water AMI Communication Network Implementation (AMI Implementation).

3. **Project Scope:**

   3.1. The project scope for the AMI implementation includes: professional services (project management, coordination), RNI Headend software installation and integration into City's existing MDMS via BizTalk, read delivery via MV90 format, Base Station installation, work order software integration, and CIS Integration, MIU field programming hardware/software solution, MIU installation, product training and system acceptance testing.

4. **Project Goals:**

   The AMI implementation is intended to enable the City to accomplish the following goals:

   4.1. City water meters are to be read wirelessly with a high degree of accuracy to generate timely water bills; and

   4.2. City staff will have access to alarms on potential customer side water leaks based on Sensus IPerl Meters and based on resolution of existing meter inventory; and

   4.3. City staff will have access to standard water meter alarms that will assist in optimizing system operations based on Sensus IPerl meters and based on resolution of existing meter inventory; and

   4.4. City Staff will have the capability to monitor water usage at each water meter in hourly intervals for enhanced analytics for reduction of non-revenue water, improved hydraulic modeling, and other water distribution system optimization based on Sensus Iperl meters and based on resolution of existing meter inventory; and

4.5. City will have customer water usage interval and register data reliably delivered in a format that can be later used in its online customer portal; and

4.6. City will have a fully integrated hardware and software solution for future water meter and MIU installations.

5. <u>Project Outcomes:</u>

Successful outcomes of the AMI implementation can be generally summarized as follows:

5.1. Successful installation of approximately 43,500 MIUs with minimal disruption to water customers; and

5.2. Accurate interval water consumption, standard meter and MIU alarms collected on an hourly basis and transmitted consistently via wireless technology once every 4 hours from the MIUs to the Base Stations which will then transport the data over a backhaul network, owned by City, to the RNI Headend located on-premise on City owned servers.; and

5.3. The RNI Software will create and transmit a scheduled output file, on approved intervals, to BizTalk which shall permit the City to translate that data into a form usable by the Meter Data Management Software (MDMS) owned by the City. That data will be sent by the City from the MDMS to the City's utility billing system, through BizTalk so that the City can issue utility bills in a timely manner to its customers. Additionally, a process by which the RNI Headend Software will process MV90 Read Request Files and produce MV90 response files will be deployed (See Attachment 15 – File Formats).

5.4. The RNI Headend Software will be available for use by City staff to monitor system performance, water meter and consumption alarms. City staff will receive enough training on all hardware/software components, and relevant system processes to allow for effective management, trouble shooting, and general use during system deployment and post project implementation.

5.5. Read Success Rates with MIUs, Base Stations and RNI Headend components operating normally as follows:

5.5.1. 99.5% of all available meters as defined in the Sensus AMI System Performance warranty accurately read every 72 hours.

5.6. A fully integrated process of MIU installations shall be developed and all hardware and software configured appropriately to facilitate the installation of new and re-used MIU devices. This includes integration with the City's CIS system using BizTalk.

5.7. All equipment and software deployed (including integrations) shall meet federal, state and local cyber and physical security standards.

6. <u>Project Design Criteria:</u>

6.1. Contractor agrees that the AMI system components and associated functionality meets the required design criteria referenced in Attachment 13 (AMI Requirements Matrix).

6.2. Contractor agrees that the AMI system is compatible with the meter inventory currently in use by the City (Meter Inventory Attachment 14).

7. <u>Project Responsibilities Summary:</u>

7.1. Core & Main (Contractor):

7.1.1. Provide a project manager to coordinate all AMI installation activities with the City, Sensus, and all sub-contractors.

7.1.2. Provide to the City a Sensus certified propagation study that determines the locations best suited for installation of the Base Stations to ensure proper communication between MIUs and the Headend.

7.1.3. Work with Sensus to commission the Headend software installation and necessary integration into City' systems including the completion of all software acceptance plans.

7.1.4. Schedule and implement a training program to familiarize City personnel with all AMI hardware and software components.

7.1.5. Hire a certified contractor to install base station components and MIU installation.

7.1.6. In coordination with Sensus, assist the City with all project closeout activities including identifying the applicable performance test standards for AMI System acceptance.

7.2. City of Naperville (City):

7.2.1. Provide a key point of contact, contact information, for project management activities to work with Contractor to help and facilitate AMI implementation.

7.2.2. Provide and maintain a backhaul network for communication between Base Stations and Headend.

7.2.3. Purchase required hardware, software, and services for AMI implementation as outlined in this Agreement.

7.2.3.1. Hardware and software components (make and model) to be purchased under this agreement are specified in Attachment 12.

7.2.4. Installation of MIUs in meter pits.

7.2.5. Installation of MIUs inside the residence or property.

8. Project Phases:

Component Installation	• Base Station Site Preparation • Base Station Installation • RNI Software Installation/Setup
Commissioning of the System	• Base Station commissioning • RNI Software Commissioning • Commissioning of the Communication link between the base stations and the RNI Software
System Setup and Deployment	• Configuration of RNI Software and User Accounts Access and all necessary software integrations • Conduct field training for installers and/or City Personnel of the MIUs • Schedule and Coordinate network software training with manufacturer • Installation of Pilot Location MIUs

	• Test data transfer between RNI software and City systems • Monitor System Read Performance • Pilot Phase System Acceptance • Mass Deployment of MIUs
Final System Acceptance	• City Acceptance Testing of AMI System • City Signoff of System Acceptance

9. AMI Software Installation:

9.1. Defined in Attachment 2.

10. AMI Software Integration:

10.1. Defined in Attachment 3.

10.2. Output file formats shall be in conformance with those identified in Attachment 15.

10.3. System Schematic: Figure 1 on following page

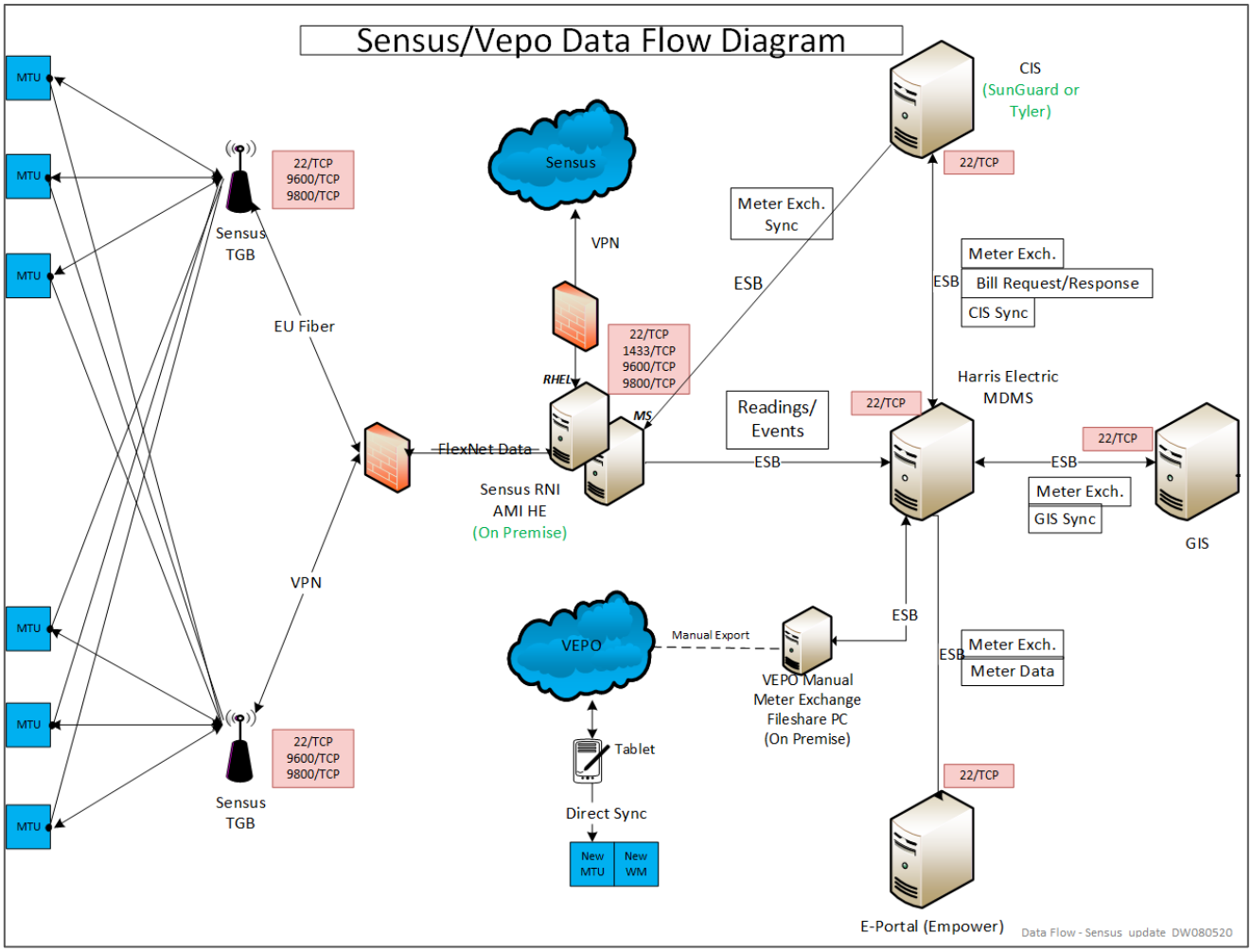


Figure 1: System Schematic

11. Base Station Installation:

11.1. Contractor Responsibilities:

11.1.1. Furnish and install three (3) Base Stations, model: M400B2.

11.1.2. Instruct City on issues concerning infrastructure prior to site preparation work and verify work is done correctly.

11.1.3. Coordinate the installation and commission of AMI related components for proper operation.

11.1.4. Hire a competent contractor to install antenna and related components.

11.1.5. Provide the necessary antennas, mounts, cable and other antenna components for Base Stations.

11.1.6. Install the Base Station Cabinet.

11.2. City Responsibilities:

11.2.1. Purchase the required number of Base Stations recommended in the propagation study.

11.2.2. Provide facilities and access for Base Station installations.

11.2.3. Provide required power, computer network access and associated cabling for Base Stations.

11.2.4. Connect Base Stations to computer network, power source and backhaul network.

11.2.5. Provide security for Base Stations.

11.2.6. Install necessary grounding material at Base Station locations.

11.2.7. Provide network connectivity information to Sensus (IP Address, default gateway, sub-net mask, etc.)

12. <u>Project Schedule:</u>

12.1. In coordination with the City the Contractor will submit a project schedule for review and approval of the City. The project schedule is included in the SOW as Attachment 4.

13. <u>Pilot Deployment:</u>

13.1. The City and Contractor will utilize a Pilot Deployment to test the functionality of the software, all integrations, base station and MIUs.

13.2. The Pilot area will be Billing Cycle #45 and Route 1.

13.3. Two successful monthly billing cycles will need to be demonstrated during the Pilot before mass deployment of the MIUs will commence.

13.4. Read Success Rates of 99.5% of the (available meter) as defined in the Sensus AMI System Performance warranty MIUs in the Pilot Area for the billing cycle is the metric for a successful Pilot Deployment.

14. <u>Training:</u>

14.1. Contractor shall provide training on all AMI software and hardware components provided under this Agreement in conformance with Attachment 5.

15. <u>MIU Installation - General Requirements</u>:

15.1. Contractor shall furnish and install approximately 43,500 MIUs, model: Sensus 510M Smartpoint Module.

15.2. Contractor shall install all MIUs in conformance with the manufacturer's specifications and guidelines as detailed in Attachment 6

15.3. Contractor will assign a main point-of-contact as well as an onsite, full-time project manager. A chain of escalation shall be defined for critical or unresolved issues.

15.4. Contractor will provide a dashboard that provides a daily snapshot of project progress, network installation.

15.5. Contractor must receive approval from the City to any changes in the project manager and other key project team roles.

15.6. City may, at its sole discretion, request a change in project manager or other key project team roles.

15.7. Contractor will participate in weekly project status meetings and periodic AMI Committee meetings (e.g., monthly).

15.8. Contractor shall maintain a documented safety and customer service program.

15.9. Contractor shall complete the installation of assigned MIU devices in the City service territory, as outlined in the mutually agreed upon deployment plan and schedule.

15.10. Contractor shall follow the deployment plan provided by City with a forward-looking view of at least ninety (90) days.

15.11. Contractor shall provide a single point of contact for all interfaces with the City AMI project team and City technology group.

15.12. Contractor will provide sufficient field and warehouse personnel including supervision to provide the services outlined in this Agreement.

15.13. Contractor shall provide enough back-office personnel necessary to provide the services outlined in this Agreement.

15.14. Contractor shall provide personnel with the requisite knowledge and skillsets to perform register replacements and/or MIU installations. Specifically:

15.14.1. Conducting an initial site safety inspection.

15.14.2. Noting any infrastructure facing imminent failure (including leaks), which will be immediately referred to City.

15.14.3. Locating touchpads, meters, or meter boxes (including digging, as required)

15.14.4. Installing an MIU.

15.14.5. Programming an MIU.

15.15. Contractor shall provide all tools necessary to successfully install AMI within City's service territory, including:

15.15.1. Wi-Fi/cellular data-equipped Toughbook or mobile devices that are compatible with the preferred workorder management system.

15.15.2. Personal protective equipment: Uniforms, including Contractor's name and logo.

15.15.3. Transportation and vehicle: Tools and equipment: Communications equipment (e.g., cell phones, MIUs).

15.16. Contractor will provide AMI programming devices as required.

15.17. Contractor shall provide all computer equipment and office facilities, warehousing and material handling facilities, equipment staging areas, security services, maintenance and repair facilities, etc. required to perform the services outlined in this SOW.

15.18. Contractor shall provide sufficient storage capacity to accommodate inventory of and other materials as required to support the services outlined in the Agreement.

15.19. Contractor shall handle scheduling all customer appointments as required. Note process for scheduling, confirming, and working customer appointments, including if a customer appointment is in jeopardy of being missed.

15.20. Contractor shall utilize a workorder management system and inventory control system, both of which support daily reconciliation with City's workorder system and/or CIS.

15.21. Contractor shall report all customer defective equipment, emergency breaks, suspected theft of water, and unsafe conditions to City.

15.22. The Contractor installation vehicles shall contain City-approved branding. Note the anticipated vehicle make and if all installers will have a vehicle and/or supporting wagons. Provide photos of typical vehicles and markings. City reserves the right to reject vehicles for reasons of appearance, state of repair, or other concerns.

15.23. The Contractor field personnel shall have highly visible identification badges with photos and City approved branding.

15.24. Contractor shall adhere to City's customer refusal/ delay list process that is managed by the AMI project team. The process specifies the actions that shall be performed by the installers when a customer refusal is received at the customer premises. Additionally, AMI installation orders are required to be cancelled/added even upon short notice (including on the day the MIU installation is planned) based on a customer's decision to refuse/accept a MIU device.

15.25. Contractor will be provided City field cards containing talking points for use by installers when interacting with customers. City will train Contractor management and installers on the use and content of the field cards prior to AMI installation beginning. The materials will be updated by City as required to support the program and provided to the Contractor. It shall be the Contractor's responsibility to train new personnel that join the project after the initial City-led training is conducted as well as when new field card materials are issued (e.g. tailgates, classroom, etc.).

15.26. Contractor shall immediately notify City of any material changes to the AMI deployment schedule, particularly changes that impact that start and end dates for AMI installations.

15.27. Contractor shall provide City with mobile phone numbers of field supervisor personnel to allow for real-time communications regarding deployment/customer issues with City work planning, call center or other personnel.

15.28. Contractor will refer any media, police, or safety inquiries related to the project to City AMI Project Manager.

16. <u>MIU Installation - Field Deployment:</u>

16.1. Contractor shall install all necessary MIU devices on the outside of the property, residence or building.

16.2. Contractor shall perform all work during the hours of 8AM – 5PM Central Time, Monday through Friday or as otherwise mutually agreed to by Contractor and City. Contractor will adhere to City's holiday schedule, which recognizes 14 holidays per year. The holiday schedule will be determined and announced by City annually.

16.3. Contractor shall complete service orders as outlined in the AMI deployment schedule.

16.4. Contractor shall develop resident/customer communication materials (i.e. handouts, door hangers, flyers, call center scripts, website, etc.) for use during deployment. These materials shall be reviewed and approved by the City.

16.5. Contractor will not install MIUs during the meter reading blackout window (2-days before and up to 6-days after scheduled meter reading date) based on the meter reading schedule provided by City.

16.6. Contractor shall meet all customer appointments per the service level agreement outlined in Section 22.

16.7. If meter or touchpad access is not obtained, Contractor shall return to the premises and re-attempt the install; Contractor should schedule appointments as appropriate.

16.8. Contractor shall leave a door hanger provided by City upon attempt/completion of the AMI installation (separate door card for successful and unsuccessful attempts shall be utilized).

16.9. Contractor shall use its most efficient and safe MIU change-out and AMI installation process.

16.10. Contractor shall comply with all environmental controls during any phase of the deployment as directed by City.

16.11. City's standard installation is as follows:

16.11.1. Locate touchpad, meter or meter box and dig if necessary

16.11.2. Take pre-installation photos, including a photo clearly displaying the meter number and the outgoing register read.

16.11.3. Document register out read.

16.11.4. Complete MIU replacement in adherence to manufacturer instructions.

16.11.5. Attach MIU via approved connector.

16.11.6. Program MIU.

16.11.7. Replace pit lid (if required).

16.11.8. Reinstall any locks.

16.11.9. Complete visual inspection of installation

16.11.10. Remove materials/debris/trash to leave the customer site in equal or better condition than received.

16.11.10.1. Waste will be off-hauled and disposed of by Contractor to a local landfill.

16.11.11. Take post-installation photos, including a photo clearly displaying the meter serial number and the ingoing register read.

16.11.12. Leave City approved door hanger identifying work performed and/or incomplete; Close the service order and document any relevant notes/customer interactions.

16.11.13. Disassemble MIU (if required) and dispose/recycle parts per specifications.

16.11.14. All photographs shall include a date and time stamp.

16.12. Contractor shall upload all Meter/MIU marriage files to City's CIS daily during installation periods.

16.13. Contractor shall develop and keep current a schedule of installations by route and cycle. City will use this information to provide information on timing and activities to its customers and employees.

16.14. Improperly installed AMI endpoints: Contractor shall follow installation procedures according to the manufacturer's specifications or City's standards. Contractor shall assume and accept the financial responsibility for replacement of damaged equipment or lost revenue due to incorrectly installed AMI endpoint.

16.15. Repairs to metering-related equipment: Contractor may encounter situations where repairs to metering-related equipment are required to complete an installation, including service-side and customer-side issues. Contractor shall perform minor repairs

such as securing loose metering equipment. Contractor shall report all equipment needing major repair or plumbing intervention by notation on the workorder management system, including notes on the current accessible conditions and anticipated repair needs. In the event of an emergency, Contractor will immediately call City dispatch. Repairs returned to the utility must include photos and comments on work required. If City accepts these repairs as required these scenarios will not count against Contractor's RTU metric.

17. <u>Quality Assurance:</u>

17.1. Contractor will implement a field deployment quality assurance (QA) program to ensure that deployment services are provided in accordance with the service level agreement. Contractor will share the results of the quality assurance program with City on a weekly basis.

17.2. Contractor shall provide its quality assurance program to City for review and approval. At a minimum the quality assurance program should include aspects related to workmanship, customer interaction, and safety.

17.3. Contractor shall have a resource that is accountable to perform QA Inspector responsibilities.

17.4. Contractor shall inspect one hundred percent (100%) of all work completed by new hires for a period of five (5) working days from the date the installer begins work in the field (the "Initial Period").

17.4.1. Audit of deployments by new hires should occur within twenty-four (24) hours of the deployment.

17.4.2. Contractor shall track and provide a listing of new hires, and include hire date, and first date that such employees begin field installations.

17.5. After the Initial Period, five percent (5%) of each installer's daily totals will be randomly audited. These audits shall be performed within forty-eight (48) hours of the installations.

17.6. Installers who are retrained and returned to the field shall have one hundred percent (100%) of their work audited for five (5) consecutive working days. Any error in that

five (5) day period will result in the installer being permanently removed from the field.

17.7. Contractor UTC - When the Contractor is unable to complete (UTC) an installation due to access, the Contractor shall make three field visit attempts (inclusive of the first installation attempt) to gain access and install the AMI endpoint within 21 days. City will make at least two more attempts to contact the customer during the 21-day period. After three field attempts by the contractor with the support of two phone call attempts by City, the order shall be returned to the utility (RTU).

17.8. Return to Utility (RTU) would include irregular or unsafe conditions preventing MIU installation, the parameters of which will be agreed upon between Contractor and City. All such activity shall be documented as a note within the workorder management system and provided to City to support the Contractor's case that the account is UTC.

18. <u>Facilities and Warehousing:</u>

18.1. Contractor shall be responsible for establishment and operation of any warehouse facilities necessary to perform the services covered under this Agreement. Contractor functions will include:

18.1.1. Receive and visually inspect new material shipments from Sensus or manufacturers' facilities.

18.1.2. Notify City of damaged shipments.

18.1.3. Work with City personnel to order MIUs/lids and other materials shipped directly to warehouse(s).

18.1.4. Establish, track, manage and maintain inventory to ensure adequate supplies of all products that Contractor needs to complete the services under this Agreement.

18.1.5. Perform daily installer inventory reconciliation of installed versus removed hardware.

18.1.6. Perform routine warehouse and vehicle inspections to validate inventory accuracy.

18.1.7. Load and unload delivery and service trucks including the use of equipment such as forklifts.

18.1.8. Coordinate disposal/disposition of removed MIUs, and other assets, including breaking down devices and sorting into appropriate bins.

18.1.9. Maintain proper security to protect City assets and be responsible for replacement of any damaged or lost materials while in the Contractor's care, custody and control.

19. <u>Staffing and Recruiting:</u>

19.1. Contractor shall be responsible for all recruitment and staffing of the project to support the deployment schedule.

19.2. Contractor shall be familiar with and observe established and accepted labor practices, procedures, and project agreements.

19.3. Contractor shall have full responsibility for the conduct of all employees employed on or in connection with the Services (including the employees of any subcontractor) and will ensure that there is adequate, daily supervision of all services.

19.4. Contractor shall be responsible for training. Training shall include but is not limited to:

19.4.1. Safety and customer service, which includes appropriately updating customers on work to be performed and/or work completed and handling difficult customer situations.

19.4.2. Identification of meter types, service and register sizes, curb stop, valves, and Nicor connectors; Correctly entering, updating, and closing service orders, including corresponding notes, photos, and documentation.

19.4.3. Accurate reading of meter registers.

19.4.4. Proper MIU installation and programming.

19.4.5. Identification and proper response to emergency and/or unsafe situations.

19.4.6. Identification and reporting of abnormal operating conditions, including infrastructure facing imminent failure, damaged services, theft, and/or tampering.

19.5. Contractor shall be responsible for ensuring all personnel maintain any professional qualifications, licenses, permits, certifications and skills appropriate for the services to be performed.

19.6. Contractor shall be responsible for conducting pre- employment drug and alcohol testing on all personnel. Certification of this test must be provided to Naperville on Contractor letterhead for each employee. Contractor shall comply with the federal Drug-Free Workplace Act of 1988 and maintain a substance abuse program. Contractor shall test its employees as appropriate throughout the performance of services in accordance with its substance abuse program.

19.7. Contractor shall provide all field and warehouse workers employed to provide the services listed in this SOW with Naperville approved personal protective equipment, uniforms, and badges approved by Naperville. Following design approval, the Contractor shall be responsible for acquiring and deploying the approved branding.

19.8. Contractor shall provide field personnel with vehicles displaying the appropriate labeling/logo.

20. <u>Status Reporting:</u>

20.1. Contractor shall submit a weekly status report per the AMI status reporting process and attend the weekly AMI status meeting.

20.2. Contractor shall provide all data/materials as requested by City personnel in preparation for the AMI status meeting and then provide a summary read-out of the prior week's productivity, human performance errors, safety incidents, customer refusals, and other notable deployment activities. Contractor shall adhere to all Naperville policies and processes as it relates to providing condition reports and corrective action plans for certain operational events (e.g. human error, injury, etc.).

20.3. Contractor shall provide the following performance metric information to a designated project team member on a weekly, monthly, and cumulative basis:

20.3.1. List of routes completed during the previous week and a list of routes to be worked in the coming week.

20.3.2. MIUs installed.

20.3.3. MIU installs with appointments, including quantity and percentage of missed appointments.

20.3.4. Installations per installer per day.

20.3.5. Deployment report that details the number of AMI devices installed compared to the expected amount.

20.3.6. Installation report that itemizes MIUs installed by date and cycle/route.

20.3.7. Repairs required (box, meter, register, lid, service lines, valves, customer-side, other).

20.3.8. Switched or crossed meters.

20.3.9. Customer refusals.

20.3.10. New inflow of UTC locations

20.3.11. Unworked UTC locations.

20.3.12. Completed UTC locations.

20.3.13. UTC cause codes by status; UTC percentage: number of jobs assigned, number of jobs completed and number of jobs UTC.

20.3.14. RTU percentage: number of jobs assigned, number of jobs completed and number of jobs RTU.

20.3.15. Quality assurance inspections and results.

20.3.16. Safety incidents.

20.3.17. Access issues (obstruction, animal, customer denied access, customer requests appointments, restricted/locked access, safety, vacant/boarded up, service removed, other).

20.3.18. MIU shipments received; Number of MIUs returned and any other pertinent inventory (i.e. Naperville provided parts or property necessary to the deployment services.).

20.3.19. Claims summary report.

20.3.20. Month-end accounting requests for unbilled services to support Naperville's accrual process.

20.3.21. Monthly reporting of diverse spend against commitments made toward diverse business enterprises

20.4. Contractor shall notify City designated representative immediately after any safety incident or event which may result or which results from, but not limited to, the following:

20.4.1. Injury.

20.4.2. Employee reports to a hospital.

20.4.3. Property damage.

20.4.4. Theft.

20.4.5. Media related incident.

20.4.6. Police report.

21. <u>Account Management:</u>

21.1. Contractor agrees to assign and maintain a designated representative to the Naperville account.

21.2. Contractor agrees that the presence of the account manager is a material factor in Naperville's decision to work with Contractor.

21.3. Responsibilities include but may not be limited to:

21.3.1. Manage contract, pricing, activities, reporting, issue-resolution, and deliverables.

21.3.2. Manage escalated issues.

21.3.3. Coordinate daily operations.

21.3.4. Complete daily, weekly, monthly, quarterly, and/or annual status reporting as required.

22. <u>MIU Inventory:</u>

22.1. Contractor shall be required to maintain adequate inventory levels to meet the project schedule and service level requirements, and to accept and account for hardware inventory.

22.2. Contractor will be responsible:

22.2.1. For maintaining sufficient inventory as required to support the services and the deployment schedule and to support reorder points as mutually agreed upon by City.

22.2.2. For all costs associated with the expediting or premium charges associated with orders, from the low stock, or no stock process resulting from Contractor not fulfilling its obligations under this Agreement.

22.3. If Contractor is affected due to lack of materials supplied by Naperville, as caused by Naperville, Naperville shall compensate Contractor for any actual and reasonable costs incurred as a result of the lack of material provided to Contractor. Contractor shall use its best efforts to keep the costs as low as possible.

22.4. Contractor is responsible for maintaining all Naperville materials in secured facilities.

22.5. Contractor is responsible for replacement of any damaged or lost materials while in Contractor's care, custody, and control.

23. <u>Service Level Agreements</u>

23.1. The Contractor agrees to perform all work under this Agreement in conformance with the following service levels:

23.1.1. Safety violation: 0 violations allowed.

23.1.2. Successful field audits: 97% passed

23.1.3. Register reads: 99.5% accuracy required

23.1.4. Meter mix-ups: 99.7% accuracy required

23.1.5. Defective installation: 99.7% accuracy required.

23.1.6. Return to Utility (RTU): <1% (excludes inside installations)

23.1.7. Customer appointments missed: <1% (excludes inside installations)

23.1.8. Black-out Period violations: 0 violations allowed

23.1.9. 24-hour response time to address any and all unsafe conditions as a result of the Contractor during the performance of the work.

23.1.10. Five (5) business days to respond, investigate, and if necessary, correct any issues related to damage from MIU installation to customer or resident property

23.2. The City reserves the right to impose a penalty of $25 for each instance where the Contractor has failed to properly notify the Customer at least 24 hours in advance of a scheduled appointment time for the need to reschedule the appointment for another day.

23.3. The City reserves the right to impose a $50 penalty for each instance where the Contractor has failed to notify the Customer of a late arrival for an appointment time.

23.4. The City reserves the right to impose a $100 penalty for each instance where the Contractor completely fails to show up for an appointment.

24. <u>Project Milestones:</u>

24.1. Project Management Fee milestone payment schedule.

	Milestone	**Milestone %**	**Payment %**
1	Contract Execution	10%	$2,500
2	Project Kickoff Meeting Complete	10%	$2,500
3	Install RNI Software	20%	$5,000
4	Base Stations Deployed	20%	$5,000
5	Interfaces/Integrations Installed	10%	$2,500
6	Conduct Product Training	10%	$2,500
7	System Acceptance Testing Certificate Signed	5%	$1,250
8	Project Final Completion	15%	$3,750
	TOTAL Project Management Fee	**100%**	**$25,000**

24.2. MIU Installation:

Billing Cycle	**Route**	**MTUs to be Installed**	**Notes**
#39			Schools
	1	21	
	20	28	ERTs
#40			
	1	232	
	2	261	

	3	369	
	4	210	
	5	135	
	6	109	
	7	168	
	20	874	ERTs
#41			
	1	232	
	2	202	
	3	329	
	4	206	
	5	274	
	6	244	
	7	117	
	20	120	ERTs
#42			
	1	232	
	2	72	
	3	252	
	4	231	
	5	237	
	6	169	
	7	109	
	8	327	
	20	53	ERTs
#43			
	1	269	
	2	232	
	3	164	
	4	262	
	5	252	
	6	227	
	7	252	
	20	61	ERTs
#44			
	1	331	
	2	207	
	3	313	
	4	106	
	5	198	
	6	163	
	7	194	
	20	344	ERTs
#45			
	1	263	Preferred Pilot Area
	2	264	

	3	193	
	4	247	
	5	258	
	6	118	
	7	229	
	20	64	ERTs
#46			
	1	213	
	2	303	
	3	267	
	4	354	
	5	281	
	6	338	
	7	120	
	8	110	
	20	192	ERTs
#47			
	1	287	
	2	337	
	3	203	
	4	199	
	5	201	
	6	234	
	7	300	
	20	35	ERTs
#48			
	1	268	
	2	256	
	3	224	
	4	242	
	5	243	
	6	371	
	20	205	ERTs
#49			
	1	244	
	2	211	
	3	230	
	4	249	
	5	248	
	6	237	
	7	230	
	20	35	ERTs
#50			
	1	330	
	2	254	
	3	294	

	4	309	
	5	367	
	6	250	
	7	229	
	20	27	ERTs
#51			
	1	241	
	2	232	
	3	311	
	4	273	
	5	252	
	6	279	
	7	317	
	8	280	
	20	25	ERTs
#52			
	1	382	
	2	257	
	3	285	
	4	149	
	5	309	
	6	262	
	7	325	
	8	272	
	20	28	ERTs
#53			
	1	308	
	2	302	
	3	275	
	4	265	
	5	265	
	6	320	
	7	278	
	8	287	
	20	39	ERTs
#54			
	1	281	
	2	322	
	3	263	
	4	269	
	5	232	
	6	316	
	7	308	
	8	192	
	20	42	ERTs
#55			

	1	346	
	2	615	
	3	292	
	4	371	
	5	296	
	6	249	
	7	369	
	8	338	
	9	296	
	20	97	ERTs
#56			
	1	304	
	2	280	
	3	265	
	4	316	
	5	284	
	6	289	
	7	393	
	8	598	
	9	497	
	10	362	
	11	349	
	12	788	
	20	76	ERTs
#57			
	1	445	
	2	366	
	3	522	
	4	324	
	5	353	
	6	340	
	7	419	
	8	261	
	9	282	
	20	104	ERTs
#58			
	1	421	
	2	270	
	3	320	
	4	259	
	5	298	
	6	289	
	7	340	
	8	389	
	9	468	
	10	714	

	11	351	
	20	43	ERTs

24.3. Billing Cycle order to be determined mutually by City and Contractor.

24.4. No more than 5 billing cycles to be open at one time for MIU installation.

25. <u>Change Orders:</u>

25.1. Work requested by the City of the Contractor outside the scope of this Agreement must be approved in writing by both parties prior to the commencement of the work.

25.2. Work performed by Contractor without written authorization is not an obligation of the City.

25.3. Change orders will use a consistent form during the Project, Attachment 7, which shall include a general description of the work to be provided and the value of the work, and signature blocks for City and Contractor personnel.

26. <u>Payment:</u>

26.1. AMI Professional Services will be paid to the Contractor in conformance with the Milestone Completion table outlined in Section 23.1.

26.2. MIU installations will be paid to Contractor, minus retainage, on a Route completion basis as outlined in Section 23.2 and Exhibit B, Schedule of Prices.

26.2.1. A Route is considered complete when 99% of all the meters in that cycle have their associated MIUs installed or designated as RTU.

26.2.1.1. MIUs need to be communication all required meter and MIU alarm information to RNI Headend for 10 consecutive days in order to be considered installed.

27. <u>Project Completion:</u>

27.1. The Project is considered substantially complete when the City and Contractor mutually agree that:

27.1.1. All AMI hardware and software has been installed and working properly.

27.1.2. All acceptance plans have been approved by the City.

27.1.3. Achievement of Satisfactory MIU Performance:

27.1.3.1. One read per day has been achieved from 99.5% of installed MIUs during a mutually-agreed to billing window

27.2. The Project is considered to have achieved final completion when the City and Contractor mutually agree that:

27.2.1.1. Substantial Completion has been achieved and;

27.2.1.2. All identified warranty work has been completed.

27.2.1.3. All known claims pursuant to the claims management provisions of the PSA have been paid, settled, or otherwise resolved.

27.2.1.4. All areas disturbed by the Contractor during the performance of their work under this agreement have been restored to their original condition or better.

27.3. Contractor shall notify the City in writing when it believes Project Completion has been achieved.

28. <u>Return Merchandise Authorization (RMA):</u>

28.1. Merchandise refers to all the hardware provided to City by Contractor covered by Warranties outlined in this Agreement.

28.2. Merchandise returned to Contractor by City will be in accordance with the return merchandise authorization procedure referenced in Attachment 8

28.3. City will pay all freight charges on shipping merchandise to Contractor.

28.3.1. In lieu of shipping, Contractor may, from time-to-time and at no cost to the City, pick-up materials located at the City property

28.4. Contractor is responsible for:

28.4.1. Secure storage in a segregated facility, handling, processing and return of merchandise and packaged units incorporating merchandise;

28.4.2. The return (or certified destruction) of all scrap or rejects to City.

28.4.3. The return, including cost of freight or shipping, of all replacement items to City.

28.5. Contractor will be liable for any loss of merchandise received by Contractor pursuant to such RMA procedure, including, but not limited to, theft, destruction, and deterioration.

29. Additional Services to be Provided:

29.1. Base Station Maintenance Services

29.1.1. Defined in Attachment 9

29.2. Meter/MIU Exchange Software & Field Hardware

29.2.1. Defined in Attachment 10

29.3. Purchase of 250 MIUs to accommodate new construction during the deployment period. These MIUs will be installed by City personnel.

29.4. Purchase of 36 MIU devices and associated peripheral materials designed for meter pit installation. These MIUs will be installed by City personnel.

30. Order of Precedence:

30.1. If there is any conflict, apparent conflict or ambiguity in or between any sections and attachments of Exhibit A, the sections and attachments will be applied in the following order of precedence with the items higher in the order of precedence prevailing.

30.1.1. SOW Sections 1-22
30.1.2. SOW Attachment 2 – Sensus Software Installation SOW
30.1.3. SOW Attachment 3 – Sensus Software Integration SOW
30.1.4. SOW Attachment 13 – AMI Requirements Matrix
30.1.5. SOW Attachment 10 – Meter/MIU Exchange Software & Field Hardware
30.1.6. SOW Attachment 11 – MIU Installer Specifications
30.1.7. SOW Attachment 1 – Project Definitions
30.1.8. SOW Attachment 4 – Project Schedule
30.1.9. SOW Attachment 5 – Training Schedule
30.1.10. SOW Attachment 6 – MIU Installations Specifications & Guidelines
30.1.11. SOW Attachment 7 – Change Order Form
30.1.12. SOW Attachment 8 – RMA Process
30.1.13. SOW Attachment 9 – Base Station Maintenance Agreement

Attachment #1

to

Statement of Work

Project Definitions:

AMI - Advanced Metering Infrastructure. Refers to the Sensus FlexNet system as proposed, including all hardware and software

AMI Professional Services - Software Installation, Software Integration, Training, Base Station Deployment, Base Station Testing, Software Acceptance Testing.

Billing Cycle - Group of meters that are to be read and billed during a defined period.

Black Out Period - Period in which MIUs are not to be installed. Two days before and six days after specified date. Used to allow billing of accounts to coordinate with installation of MIUs.

City - City of Naperville, IL

Contractor - Core and Main

Deployment Schedule - The mutually agreed upon schedule developed by Contractor and City to support the scope set forth in this Statement of Work

Headend - Refers to the Sensus RNI (Regional Network Interface)

MDMS - Meter Data Management System (owned by City)

Biztalk –Microsoft Biztalk Server is a system used for sharing information or events between applications or systems that are needed to work together in a business process.

MIU - Meter Interface Unit or Sensus SmartPoint or radio endpoint

PSA - Provider Services Agreement

Read Success Rate - Term used to indicate overall AMI performance by showing the percentages of MIUs returning accurate data to Sensus RNI on water meters and MIU alarms over a prescribed interval (25 hours, 72 hours, etc)

RNI - Sensus Regional Network Interface or Headend servers

Route - Grouping of water meters, typically in a similar geographical location, to aid in meter reading and for billing. Billing cycles have more than one route.

RTU - Return to Utility. Accounts where an installation was unable to be completed by contractor and turned over to City for installation.

SOW - Statement of Work

UTC - Unable to Complete. Installations that the contractor cannot perform. These are reviewed by the City to determine if they are RTU or given back to Contractor.

639 Davis Drive
Morrisville, NC 27560 USA
www.sensus.com

SCOPE OF WORK

Naperville, IL for Core & Main

PM Services for Virtual RNI Setup and Integration Work

1. Scope of Work Number [_1__]:

Sensus has been asked to assist with the deployment of a Virtual RNI at a customer site and to perform integration work to ensure that the RNI will communicate information between the Sensus RNI and the customers MDM and Billing Systems. Deployment of the RF Network Base Stations and the Endpoints within the system will be the responsibility of Core & Main (CUSTOMER) and are not a part of this SOW.

This Scope of Work (SOW) will provide a quote for Sensus personnel to deploy the Virtual RNI at the end customer's Data Center, Application Engineering Services to setup the RNI and ensure communications with the base stations and Project Management Service to coordinate all activity between the Sensus personnel, Core & Main and their end customer (Naperville).

2. Commencement and completion dates for provision of Services:

Start Date will be based on the mutually agreed upon Sensus Project Plan between the City of Naperville and Sensus. The project plan must indicate when the work begins and that it is shown completed within or at the end of 12-month period.

End Date will be the first of 12-months after Start Date or the completion of the work outlined in the Sensus Professional Services Statement of Work.

3. Description of Services to be performed by Provider:

Sensus will provide the following services under this Scope of Work:

- Project Management Services (PM) –
  - Assign a Sensus Project Manager, working on a part-time basis, to assist and guide CUSTOMER with execution of this SOW and completion of their FlexNet RNI deployment and system integrations.
  - Project Management tasks include:
    - Lead weekly project status meetings with the CUSTOMER team
    - Project communications management, including generation and distribution the weekly 3P project status report

- Coordination of Sensus OPS Team to site for RNI installation, setup and commissioning
- Tracking of action items and resolving system issues

- Application Engineer Services (AE) –
  - Assign a Sensus Applications Engineer, working on a part-time basis, to assist and guide CUSTOMER with execution of this SOW and completion of their FlexNet RNI deployment and setup.

- Sensus Operations Team (Ops Team) -
  - Sensus Project Manager will work with Core & Main and the Sensus Ops Team to schedule and complete the Virtual RNI deployment.
  - Sensus Operations Team will perform the Virtual RNI deployment (Production, Test, and Backup) at the customer's site with the assistance of the customer's IT team and the Core & Main project team.
    - Note that the customer is responsible for all hardware and licensing required for installing and operating the Virtual RNIs in their data center. See paragraph 3.
    - RNI Images will be shipped to the customer minus the licenses identified in paragraph 3. Sensus will require at least 2 days to create the build prior to shipping.
    - Sensus Operations will need 8 days to either work onsite to complete the RNI application and setup or can be discussed to do it remotely. TBD
  - Ops Team will test the virtual RNIs to ensure that it is operational in the customer's data center and that all communications/connections are operational.

- Network Deployment Assistance –
  - The PM will coordinate with CUSTOMER to ensure that the RF network equipment is installed, commissioned, certified and fully operational in the RNI
  - Sensus AE will ensure that each base station deployed is activated in the RNI to ensure proper communications, configuration and activation.
  - Sensus RF Engineer will perform Base Station certification of each new base station that is deployed.

- DR Strategy -
  - In order to minimize any downtime, Sensus proposes that Naperville rely upon virtualization technologies such as those provided by VMware (vMotion) to ensure application resiliency. This will support any necessary failover operations required in the event that of a move, scheduled maintenance, or natural disaster. It is critical to note that the virtual infrastructure maintains IP and DNS context during any downtime so that any TGB connections go unnoticed. In the event that Naperville requires guidance in this specific area, Sensus' project team can provide setup assistance as a separate line item through our Professional Services team

- In order to assist Naperville in supporting this strategy, Sensus will provide an architectural overview document as a resource for this secondary environment; we propose a discussion with Naperville in order to align on the overall system configuration and its capabilities. Technical support will be addressed through an amendment to our standard support and maintenance agreement

Working in a collaborative effort, Sensus and CUSTOMER will review the status of the FlexNet Virtual RNIs deployment and system integration work each week and work to resolve all data, configuration and hardware issues within the system. The PM will also review progress with execution of this SOW.

3. Description of Customer Provided Hardware and Software and Licenses for Onsite Deployment:

- Regional Network Hardware and Software Requirements / Licenses located at customer data center to run the FlexNet Head End System:

Purpose: **Head End Services**	
CPU Specification:	2 cores with >3.0 GHz processor
RAM Specification:	20 GB RAM
Disk Specification:	2 x 600 GB SAS @ 15 K rpm, RAID 1
OS Version:	Red Hat 7.8
Additional Software:	None
Purpose: **MS SQL**	
CPU Specification:	4 cores with >3.0 GHz processor
RAM Specification:	12 GB RAM
Disk Specification:	2 x 600 GB SAS @ 15 K rpm, RAID 1
OS Version:	Windows Server 2016
Additional Software:	Microsoft SQL Server 2016 Standard Edition Service Pack 1 or Higher .NET framework 3.5 Cygwin 2.85 Oracle JDK 1.8
Database Storage:	SAN or Direct Attach
Storage Specification:	1 TB (RAID 5)
SAN IOPs	7k Steady, 15k Peak

- Customer to provide VM Ware version available at Customer Data Center

4. Performance of Services: The following table indicates the percentage of time each Sensus resource will spend working under this SOW. Once CUSTOMER issues a purchase order for this Scope of Work, Sensus will allocate resources to perform the work.

Sensus Resource	Utilization
Sensus Operations Engineer	Time on site to complete Virtual RNI setup
Project Manager	10 hours per month
Application Engineer	10 hours per month

5. Compensation: The proposed cost for this SOW is presented in the following table.

Line Item	Sensus Resource	Rate	Frequency	Amount
1.	RNI Deployment & Setup (Ops Team)	One-time Fee	One-time Fee	$11,750
2.	Project Manager *note – for integration support	One-time Fee	One-time Fee	$13,750
3.	PM Travel			3 trips with total combined costs not to exceed $5000
4.	Applications Engineer *note – for integration support	One-time Fee	One-time Fee	$13,750
5.	AE Travel (maximum trips 3)			3 trips with total combined costs not to exceed $5000

639 Davis Drive
Morrisville, NC 27560 USA
www.sensus.com

6.	Applications Engineer *note – for 12 month duration after integration completed	One-time Fee	One-time Fee	$13,750
7.	AE Travel			3 trips with total combined costs not to exceed $5000

Line item 1 will be charged when Sensus has completed the work.

* Line item #2 and #4 will be charged when Line item 1 is completed.

Line items #3 and #5 will be billed to the customer at the end of the month of the travel occurrence.

* Line item #6 will be charged IF the City of Naperville desires to have continued Application Engineering support.

Line item #7 will be billed to the customer at the end of the month of the travel occurrence and IF the City of Naperville has elected to proceed with continued Application Engineering support per Line item #6.

6. Monitoring Project Performance – The City of Naperville and Sensus will hold a monthly check in to assess work performed and work remaining.

7. **Renewal:** At the end of this SOW, CUSTOMER and Sensus will evaluate the progress of the system deployment and operation. Based on that evaluation The PM and AE Services described in this SOW can be extended for an additional period (3-month minimum) with a signed change order extending this SOW.

639 Davis Drive
Morrisville, NC 27560 USA
www.sensus.com

The Parties have caused this Scope of Work to be executed and delivered by their respective, duly authorized representatives.

SENSUS USA, INC.

BY: _____ DATE:_____

NAME: _____

TITLE: _____

CORE & MAIN

BY: _____ DATE:_____

NAME: _____

TITLE: _____

639 Davis Drive
Morrisville, NC USA
www.sensus.com

Integration Statement of Work for Naperville

Created by Sensus Professional Services

Document Version: 0.9

Date: 4 -August-2020

Overview

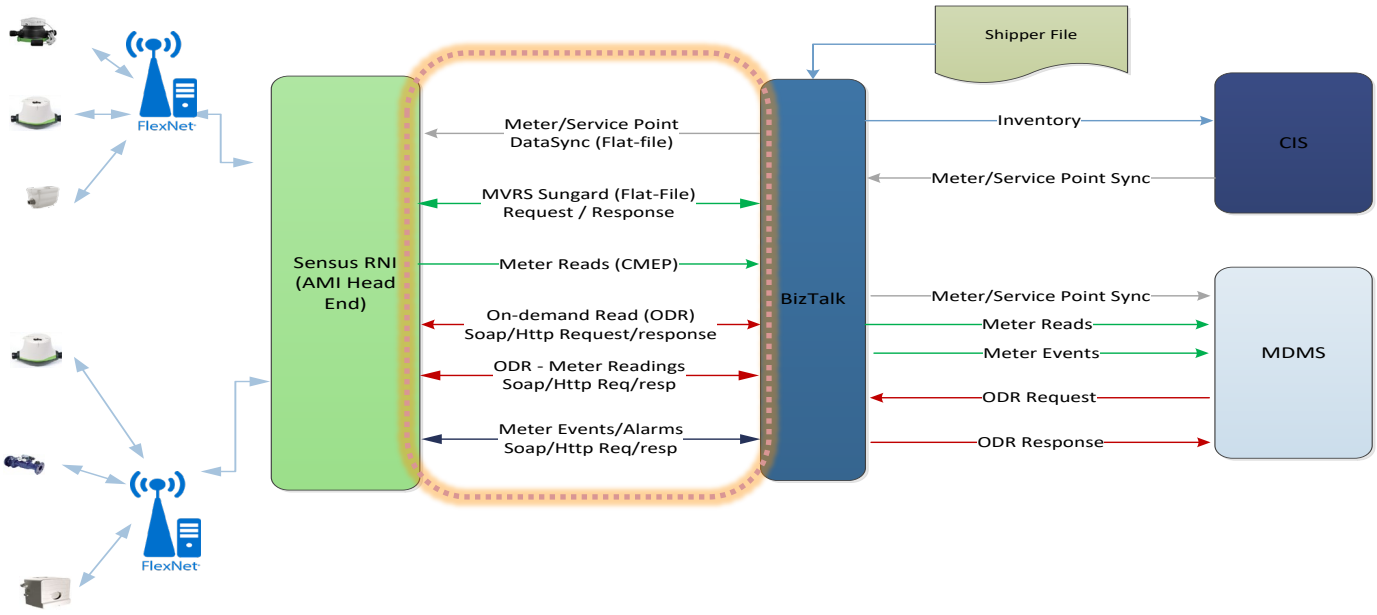
City of Naperville is requesting a statement of work detailing the integration of Sensus AMI (RNI) to their Billing and MDM systems via BizTalk Service Bus The city is looking into two phases for the implementation with the initial phase for SunGard CIS/Billing system and a later phase involving a MDM system along with a new CIS/Billing system. Both phases will be using the ESB to integrate with the Sensus interfaces and exports.

Scope

The scope of integrations required for City of Naperville will include

- MVRS like request/response interface for SunGard CIS/Billing
- Register and Interval Reads in CMEP format
- Flat-file CSV based DataSync Adapter for Life-Cycle synchronization
- Web Services MultiSpeak based Interfaces for on-demand Reads
- CMEP based Alarm Reports
- Auto-pushed to Alarm Notifications to ESB MultiSpeak Web Services endpoint
- Integration test the outlined interfaces with City of Naperville ESB in a RNI dev/test environment
- Deployment of the interfaces in the production RNI
- All interfaces to be routed via BizTalk ESB

The File Exchanges will require a file share server which the City will host and provide access to all necessary applications while adhering to all cyber security best practices. The scope included in this SOW is highlighted below in the solution design.



Out of Scope

- Currently the City is looking to route all interfaces via its existing BizTalk ESB and direct integrations with the CIS, MDM or other systems are not in scope of this SOW

Custom Billing Interface with SunGard (MV90)

The SunGard CIS/Billing is currently in place and using the following request (download) and response (upload) file layouts and both files include one Header record and detail records, one per Meter. A custom solution will be created to handle the request/response model and the layouts detailed in the sections below. File formats can be found as Attachment 15 in the general Statement of Work

Request/Download Header

From	To	Value/Description
1	1	"H"
2	3	cycle
4	4	0
5	6	route
7	9	blanks
10	14	count
15	576	blanks
577	577	"*"

Request/Download Detail - * Need customer to Highlight Key attributes and also mark any attributes to be transferred to the upload file as-is

From	To	Value/Description	Comments*
1	1	"A"	
2	3	cycle	
4	4	0	
5	6	route	
7	15	customer ID	
16	24	location ID	
25	26	service type	
27	29	000	
30	41	meter number (left justified)	
42	42	number of registers	
43	47	sequence number	
48	51	meter size	
52	52	number of dials	
53	60	high range consumption	
61	68	low range consumption	

69	76	spaces	
77	84	previous read	
85	92	"xxxxxxxx"	
93	178	blanks	
179	208	customer name	
209	256	customer address	
257	257	account status	
258	283	blanks	
284	285	meter location	
286	310	description of meter location	
311	312	hazard code	
313	337	description of hazard code	
338	451	blanks	
452	456	00000	
470	474	multiplier	
475	478	0000	
497	576	comments	
577	577	*	

Response / Upload Header

From	To	Value/Description
1	1	"H"
2	3	cycle
4	4	0
5	6	route
27	50	meter reader name
51	62	blanks
63	64	Read MM
65	66	Read DD
67	68	Read YY

Response / Upload Detail

From	To	Value/Description	Comments
1	1	"A"	
2	3	cycle	
4	4	0	
5	6	route	
7	15	customer ID	
16	24	location ID	
25	26	service type	
27	29	000	
30	41	meter number (left justify)	
42	42	number of registers	
43	47	sequence number	
48	51	meter size	
52	52	number of dials	
53	60	high range of consumption	
61	68	low range of consumption	

69	76	actual consumption (NOT dial meters)	
77	84	previous reading	
85	92	current reading	
93	93	high-low fail (status of the reading)	
94	94	number of re-tries entering the read	
95	110	blanks	
111	118	dial reading	
119	126	blanks	
127	134	dial reading	
135	135	high-low fail (status of the reading) for DIAL meters	
136	136	number of re-tries entering the read for DIAL meters	
137	178	blanks	
179	208	customer name	
209	256	address	
257	257	account status	
258	283	blanks	
284	285	meter location	
286	310	description of meter location	
311	312	hazard code	
313	337	description of hazard code	
338	377	blanks	
378	389	time stamp (MMDDYYHHMMSS)	
390	410	blanks	
411	451	remarks	
452	456	00000	
457	457	C (?)	
458	469	blanks	
470	478	multiplier	
479	496	blanks	
497	576	meter comments	
577	577	*	

CMEP Register and Interval Reads Export

The City requires an interface for Meter Readings from the RNI to the MDM via BizTalk ESB. This interface will be one-way export from the RNI to the file share server hosted by the City. The process will be scheduled to export a file a minimum of four times per day and will be setup per the City's business requirements. The data will be in a CMEP format.

The **RNI Extended CMEP Specifications Reference Manual** (Attachment 18) describes the layout of the Reports. MEPMD01 and MEPMD02 record layouts will be used for Interval and register exports respectively. The MEPMD01 record can include book-end registers along with interval data.

Custom DataSync Adapter to MultiSpeak

The City requires meter attributes to be delivered from the CIS/Billing system to the to the RNI via a CSV file export from the ESB. RNI supports a MultiSpeak based Web Services interfaces for meter life cycle and a custom adapter will be required to process a CSV export as input and to invoke the appropriate MultiSpeak Web Services interfaces to sync up the RNI. The Custom adapter will be provided as part of the solution

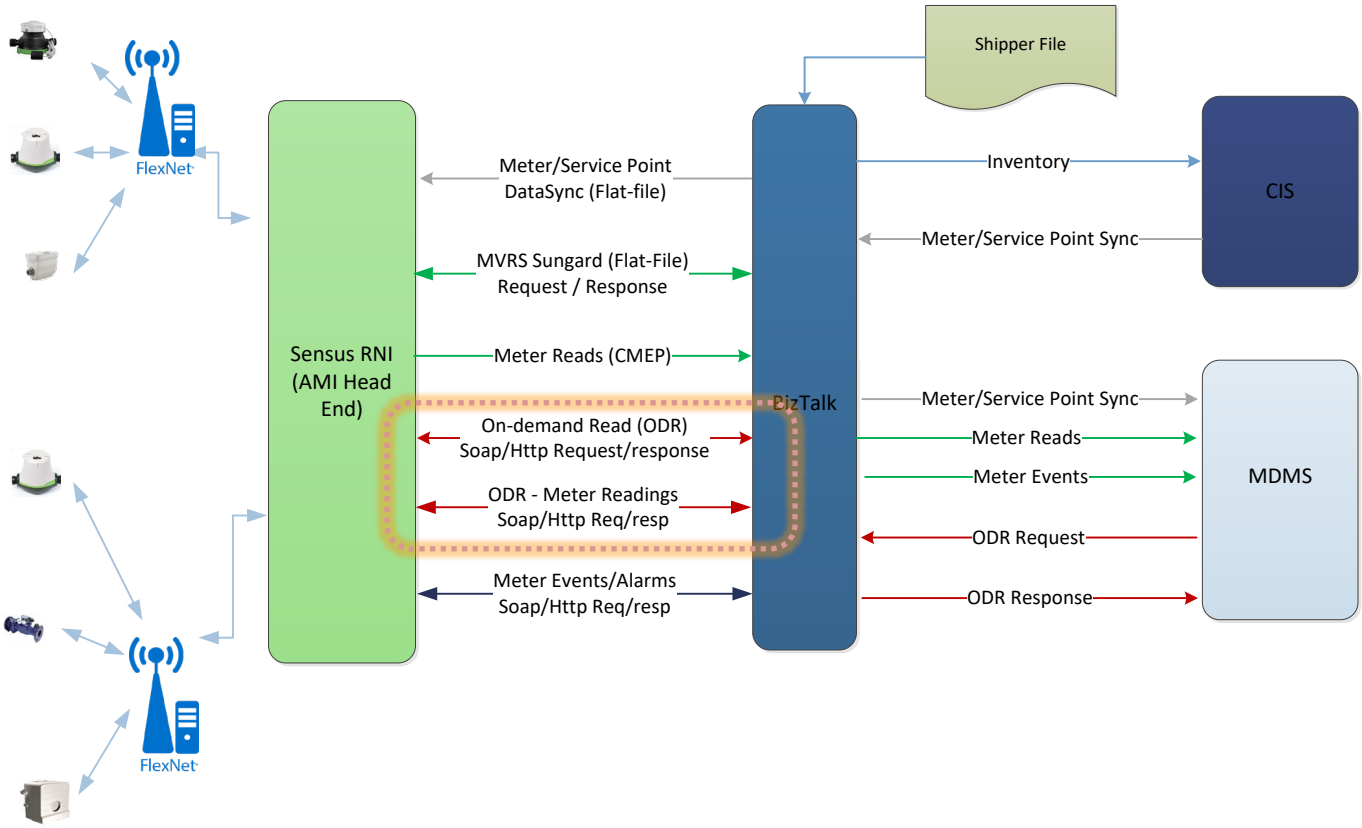
The CSV export file from the ESB is expected to include the following list of attributes

Field Name	Field Description	Required	Type	Max Size
Record Type	Add, Remove, Update	Yes	Char	10
Meter Identifier	The primary unique meter identifier used by the utility (typically the meter serial number). This must be the ID that meter data (reads and alarms) will be associated to in the Sensus head-end (RNI	Yes	Alphanumeric	25
Alternate Meter Identifier	FlexNet ID (Transmitter/MXU)	Yes	Numeric	10
Meter Manufacturer Code	A code used to identify the manufacturer of a meter/device.	No	Alphanumeric	1
Commodity Type	An indicator for water, gas or electric (W, G, E)	Yes	Alphabetic	1
Lifecycle State	Expected Lifecycle State of the meter. For example, Inventory or Installed	Yes	Alphabetic	15
Billing Cycle	Billing Cycle Id	No	Numeric	3
Rate Code	Rate code if applicable	No	Numeric	
Service Point ID/ Location Number	Unique location#, premise#, or service point# which does not change when a new resident moves in. A unique numeric Location Number is preferred.	Yes	Alphanumeric	20
Street Name	Customer (or service) street name including Street Number, Direction, Unit/Apartment Number, et cetera.	Yes	Alphanumeric	20
City	Customer (or Service or Premise) City.	Yes	Alphanumeric	30
State	Customer (or Service or Premise) State.	Yes	Alphanumeric	12
Postal Code	Customer (or Service or Premise) US ZIP Code.	Yes	Alphanumeric	15

Meter Install Date	Date the meter was installed at *premise/location* [When removing a meter, this date is required, and must match what was previously provided as the Meter Install Date.]	Yes	Date Format: MMDDYYYY	8
Meter Remove Date	Date the meter was removed from the premise/location (for return to inventory, scrap, etc). If not provided, the meter should still be installed.	No	Date Format: MMDDYYYY	8
Latitude	The Latitude component of the service location's GPS coordinate (alternatively, this can be provided directly from the Sensus Head-end RNI system).	No	Decimal	14
Longitude	The Longitude component of the service location's GPS coordinates (alternatively, this can be provided directly by the Sensus Head-end RNI system).	No	Decimal	14
Project Area	Location Description	No	Alphanumeric	15

MultiSpeak Web Services based interfaces for on-demand reads

The RNI supports MultiSpeak interface for retrieving reads from the meter and will require a request interface, InitiateMeterReadingsByMeterID to send the request from the ESB to RNI which will be processed and forwarded to the meter. This Web Service will acknowledge with a Success/failure based on the validations. And when the meter responds with a reading, the readings will be published from the RNI to ESB via another Web service requested initiated from the RNI, ReadingChangedNotification to an endpoint on the ESB. The interfaces related to On-demand reads are highlighted below in the solution diagram.



The details related to these interfaces have been provided as part of the MultiSpeak specification documentation.

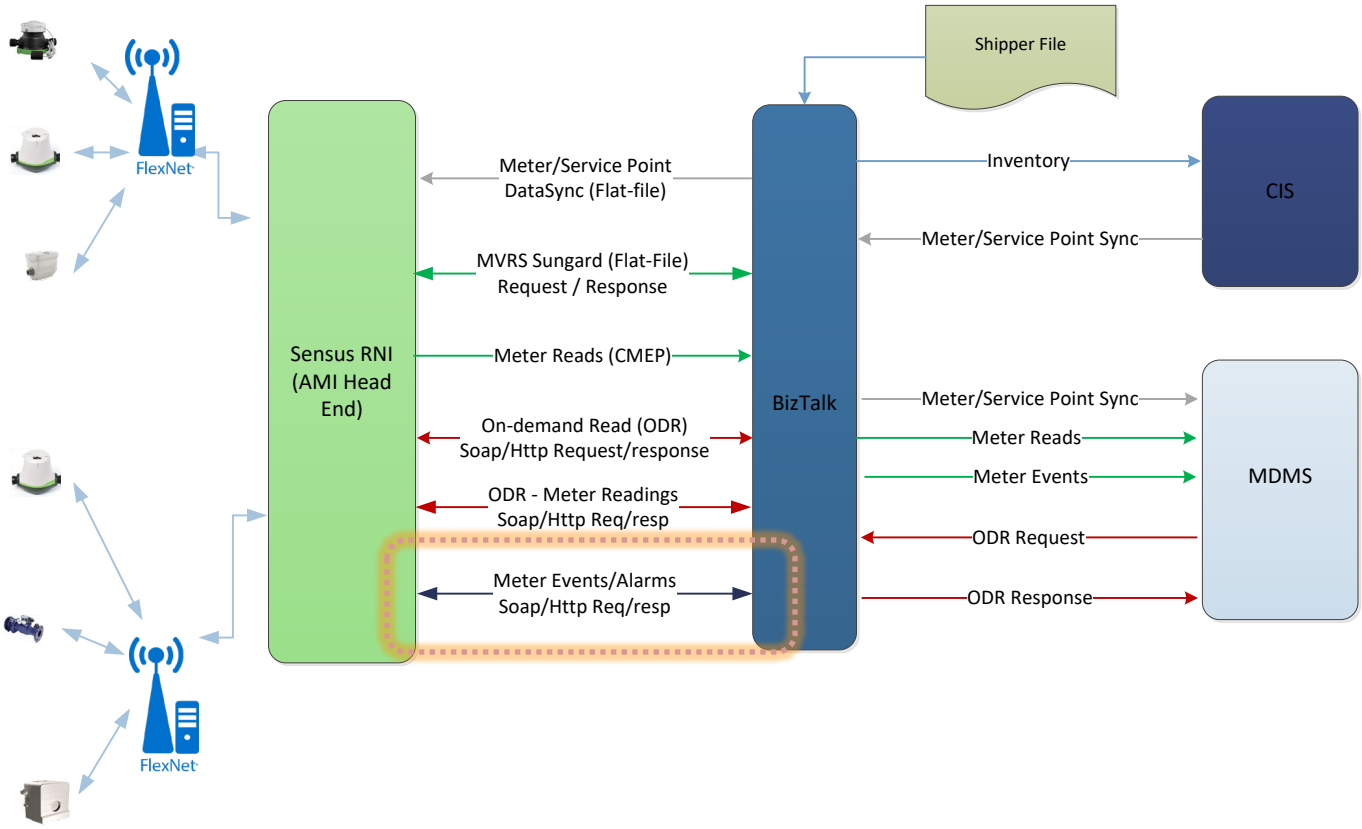
CMEP based Alarm Reports

The Alarms reported from the Sensus Smartpoints will be captured and stored within the RNI FlexNet Database. These alarms can be periodically exported via a flat-file interface and it will be in a CMEP based record format. This process shall be run a minimum of twice per day and the file delivered to the file share server hosted by the City.

The CMEP specification document provides details on the MLA record for exporting the Alarms.

Auto-pushed Alarm notifications to ESB MultiSpeak Web Services endpoint

The Alarms reported from the Sensus Smartpoints to the RNI can be published to a consuming Web Services endpoint running at the ESB and this will be MultiSpeak based MeterEventNotification. The details of the interface will be available via the specification documents. The interface specification related to the MeterEventNotification is described in the MultiSpeak integration documentation (Attachment 17). The diagram below highlights the Alarm notification interfaces.



Effort

The scope of work includes custom development, unit testing and integration testing of the various interfaces outlined in the scope as well as the deployment into a production environment. The effort will include both phases City of Naperville is planning to implement for their CIS and MDM systems.

Naperville AMI Project

Core & Main
Steve Bruntlett

Project Start: Tue, 9/1/2020

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Phase 1 - Project Initialization				
Award Purchase Order	Jim Alworth	0%	9/1/20	10/15/20
Initiate Purchase Process	Jim Alworth	0%	10/15/20	10/17/20
Contract Negotiation	Jim Alworth	0%	9/1/20	10/15/20
Completion of Sensus Agreements	Jim Alworth	0%	10/15/20	10/20/20
Completion of C & M Master Project Agreement	Jim Alworth	0%	10/22/20	10/23/20
Completion of Infrastructure Agreements	Jim Alworth		10/16/20	10/18/20
Phase 2 - Infrastructure Deployment				
Verify with Installation team and Systems Group that antenna height is what was used for propagation study	Jim Alworth	0%	11/1/20	11/3/20
Review data backhaul requirements	Jim Alworth	0%	11/3/20	11/5/20
Meet with Customer Support, Operations and Purchasing to review requirements, roles & responsibilities	Jim Alworth		11/5/20	11/8/20
Order TGB ancillory equipment	Jim Alworth		11/5/20	11/5/20
Update Team on notes and actions from customer meeting (WebEx and conference call) Go-No Go Meeting, Set install date.	Jim Alworth		11/5/20	11/5/20
Pre-TGB Installation Activities				
IP network diagram completed	Jim Alworth		9/16/20	9/21/20
Backhaul Circuits build-out and functional	Jim Alworth		9/22/20	9/26/20
TGB pre-install activities (Customer)	Jim Alworth		9/27/20	10/2/20
Install circuit breaker panel and receptacle (30 Amp breaker)	Jim Alworth		10/3/20	10/7/20

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Run power from source to circuit breaker panel (120 VAC)	Jim Alworth		9/27/20	10/1/20
Install TGB mounting hardware				
Install coax cable from antenna to TGB	Jim Alworth		12/1/20	112/15/2020
Install poly-phases at each end of coax with appropriate ground connection	Jim Alworth		12/1/20	112/15/2020
Install TGB at specified location	Jim Alworth		12/1/20	112/15/2020
Electrical Work	Jim Alworth		12/1/20	112/15/2020
Certify available ground field or install new ground field	Jim Alworth		12/1/20	112/15/2020
Install ground strap between TGB and ground field	Jim Alworth		12/15/20	1/1/21
Connect TGB to available power	Jim Alworth		12/15/20	1/1/21
Connect data cable to TGB	Jim Alworth		12/15/20	1/1/21
TGB Configuration	Jim Alworth		12/15/20	1/1/21
Power up & Connect TGB to Backhaul	Jim Alworth		12/15/20	1/1/21
Test remote access to TGB	Jim Alworth		12/15/20	1/1/21
Configure BTS	Jim Alworth		12/15/20	1/1/21
Test TGB receive & transmit functionality	Jim Alworth		12/15/20	1/1/21
Test remote access to TGB	Jim Alworth		12/15/20	1/1/21
Document Network IP addresses and send to Sensus IT	Jim Alworth		12/15/20	1/1/21
Backhaul Communications	Jim Alworth		12/15/20	1/1/21
Connect and verify communications to customer LAN (end to end test)	Jim Alworth		12/15/20	1/1/21
Sensus RF Tech certifications	Jim Alworth		12/15/20	1/1/21
Setup user accounts	Jim Alworth		12/15/20	1/1/21

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Setup data exchange between RNI and customer billing system	Jim Alworth		12/15/20	1/1/21
Provide familiarization to Customer	Jim Alworth		12/15/20	1/1/21
SA Deployment	Jim Alworth		12/15/20	1/1/21
Define SA requirements (MTS/Sales)	Jim Alworth		12/15/20	1/1/21
Integrate SA	Jim Alworth		12/15/20	1/1/21
	Jim Alworth		12/15/20	1/1/21
Phase 3 - Endpoint Deployment				
Kickoff Meeting	Steve Bruntlett		1/5/21	1/5/21
Develop acceptable work schedule for endpoint installation	Steve Bruntlett		1/5/21	1/5/21
Establish inventory control procedure and product pickup from utility	Steve Bruntlett		1/5/21	1/5/21
Establish data upload schedule	Steve Bruntlett		1/5/21	1/5/21
Establish RTU Protocol	Steve Bruntlett		1/5/21	1/5/21
Create weekly (or bi-weekly) production update call	Steve Bruntlett		1/5/21	1/5/21
Commence Pilot Meter Installation	Steve Bruntlett		1/5/21	1/15/21
Confirm data uploads to billing system	Steve Bruntlett		1/15/21	1/15/21
Deploy Remaining Endpoints	Steve Bruntlett		2/1/21	10/15/21
On-going training and project monitoring with designated AMI leader for utility	Steve Bruntlett		1/12/21	3/1/21
Clean up RTU's and/or transfer remaining unresolvable accounts to utility	Steve Bruntlett		10/8/21	10/8/21
Customer Acceptance Test	Steve Bruntlett		10/15/21	10/15/21
Customer Accepts system	Steve Bruntlett		11/1/21	11/1/21
Project Close-out				

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Gather all project information	Steve Bruntlett		11/1/21	11/8/21
Hold close-out meeting with customer	Steve Bruntlett		11/15/21	11/15/21
Hold meeting with Technical Services to transfer system to Customer	Jim Alworth		11/22/21	11/22/21
Notify project team that project has completed and celebrate	Steve Bruntlett		11/22/21	11/22/21

FlexNet® for Operators (Water)

RNI 4.5 RELEASE

FlexNet

METHOD

- Instructor-led class (customer's site)
- eLearning

PREREQUISITES

- FlexNet Introductory Series

AUDIENCE

- FlexNet Operators

DURATION

- 1 day

RESOURCES

- sensus-training.com
- My Sensus
- 1-800-638-3748

WHAT'S NEXT

- FlexNet for Administrators
- Sensus Analytics

OVERVIEW

Provides guidance and instruction to new customers in the operator role of water utilities, on performing daily monitoring and maintenance tasks for a FlexNet® communication network, including meters, base stations, and RNI system components, when used in an Advanced Metering Infrastructure (AMI) environment.

CONTENT SUMMARY:

Monitoring Overview

- List the three key areas of the monitoring process in the recommended order of performance.
- Describe the kinds of tasks performed during each of the three key areas of the monitoring process.

Monitoring Network Performance

Billing Read Performance

- Monitor the daily billing read success rate to determine if endpoints are sending reads as expected.
- Monitor the monthly billing read success rate to determine if endpoints are communicating reads successfully over the previous rolling 30 day period.
- Differentiate between a successful and unsuccessful performance score.
- Describe the process to follow when performance is poor.

Read Interval Performance

- Monitor the daily success rate of read interval performance to determine how well the network is receiving read intervals from endpoints.
- Monitor the monthly success rate of read interval performance to determine how well the network is receiving read intervals from endpoints over the previous 30 day period.

CONTENT SUMMARY CONTINUED

Read Interval Performance continued

- Differentiate between a successful and unsuccessful performance score.
- Describe the process to follow when performance is poor.

Network Performance

- Monitor the daily success rate of read throughput to determine how successful the network is at passing read messages from endpoints to the Regional Network Interface (RNI).
- Monitor the monthly success rate of read throughput to determine how successful the network is at passing read messages from endpoints to the RNI over the previous 30 day period.
- Differentiate between a successful and unsuccessful performance score.
- Describe the process to follow when performance is poor.

Network Device Performance

- Monitor the communication between the base stations and the RNI.
- Monitor base stations and collectors for transmission latency.
- Monitor the online status of base stations and collectors.
- Describe the process to follow for poor operational status.

Monitoring RNI Operation

- Verify scheduled jobs are running as expected.

Monitoring Meter Operation

Monitoring Meter Status

- Determine the endpoint state of a meter / SmartPoint module
- Determine if a meter has missing or incorrect configuration or manufacturing information.
- Determine if a meter is in the RMA process.
- Determine which meters are missing reads.
- Identify potential causes of missed reads.

Monitoring Meter Alerts

- Identify where to find alert information in Device Manager.
- Use DM to find alerts related to battery power issues, meter operation, or resource usage.
- Access the Leak Report to identify meters experiencing leak alerts.

FlexNet® for Administrators

RNI 4.5 RELEASE

The FlexNet Administrator class provides guidance and instruction to new customers in the administrator role in water, gas, and/or electric service utilities, on performing daily monitoring and maintenance tasks for a FlexNet® communication network, including those for securing the FlexNet network, and configuring and managing RNI system operation and FlexNet components.

METHOD

- Instructor-led class (customer's site)
- eLearning

PREREQUISITES

- FlexNet Introductory Series

AUDIENCE

- FlexNet Administrators

DURATION

- 1/2 day

RESOURCES

- sensus-training.com
- My Sensus
- 1-800-638-3748

WHAT'S NEXT

- FlexNet for Operators
- Sensus Analytics

CONTENT SUMMARY:

Module 1: RNI Component Review

- Describe the primary functions of the software application servers.
- Identify third-party software that the utility obtains and maintains.
- State the purpose of the MultiSpeak interfaces in the RNI.
- Describe the type and format of reports available from the Reporting Component.
- Describe the high-level flow of data through the RNI.

Module 2: Monitoring Overview

- List the three key areas of the monitoring process in the recommended order of performance.
- Describe the kinds of tasks performed during each of the three key areas of the monitoring process.

Module 3: Security: User Access Control

- Identify the process for creating secure user accounts.
- Create a new role and RNI user account.
- Delete a role and user.
- Specify a password policy.
- Apply one or more roles to a user.

Module 4: Security: System Access Control

- Recall actions taken by Sensus to secure RNI servers prior to shipment to utility.
- Describe why using commercial Secure Socket Layer (SSL) certificates are important.

Module 5: Security: Data Access Control

Sensus Encryption Solution Overview

- List the primary methods used to protect sensitive data.
- Identify at least three key characteristics of the Sensus data encryption solution.
- Describe the overall encryption process for existing and new endpoints.
- Describe the five stages of key management.
- Identify at least three characteristics of the Hardware Security Module.

Planning for Encryption

- Name the three stages of encryption planning.
- Identify the major components of each planning stage.

Configuring Encryption Settings in the RNI

- Identify the types of settings required to prepare the RNI for encryption.
- List the settings used to prepare the RNI for encryption implementation.
- Recall the steps to enable encryption on an installed device in Device Manager.

Module 6: System Operation

Introduction to the RNI Reporting Component

- Describe the role of the RNI reporting component.
- Identify the output file formats.
- List three read reports created by the reporting component.
- List two reports that output non-read data.
- Locate additional information about the individual reports and the reporting component operation.

Managing Scheduled Jobs

- Identify the tools used to manage scheduled jobs.
- Verify reports are being generated in a timely fashion.
- Describe the procedure used to investigate failed jobs.

Module 7: Electric Firmware Downloads

Firmware Download Overview

- Explain why to use the meter firmware download process.
- List the components that can be upgraded.

FlexNet V1

- Identify which protocol version is used based on meter type and firmware version.
- Describe the functions of the various download steps.
- List the order in which the steps are performed.
- Describe the difference between protocol version 1 and protocol version 2.

FlexNet V2

- Identify the meter types which use the FlexNet Version 2 file transfer protocol.
- Describe the functions of the various download steps.
- List the order in which the steps are performed.

Firmware Download Considerations

- Identify network bandwidth and other issues to consider before performing a firmware download.

Performing Electric Meter Firmware Downloads

- Describe the preparations for and initiation of an electric meter firmware download.
- Indicate where to follow the download process as it runs.
- Determine which meters have failed to update their firmware.

Module 8: Water / Gas Firmware Downloads

Firmware Download Overview

- Explain why to use the meter firmware download process.
- List the components that can be upgraded.

Firmware Download Process

- Describe the overall download process.
- Identify network bandwidth and other issues to consider before performing a firmware download.

Performing Water/Gas Firmware Downloads

- Describe the preparations for and initiation of a water or gas meter firmware download.
- Indicate where to follow the download process as it runs.
- Determine which meters have failed to update their firmware..

SmartPoint™ Model 510M - Non-Pit Module Installation Instructions

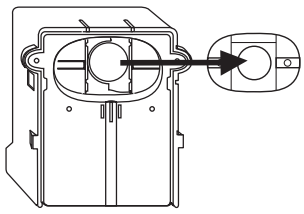
GENERAL INFORMATION

The Model 510M SmartPoint is designed for non-pit, nonsubmersible applications and is available for both single and dual port operation. The Model 510M should be mounted outdoors where it is not subject to submergence to maximize performance in fixed base applications. The Model 510M is not intended for outdoor meter pits or vaults. The module can be installed with either a TouchCoupler connection or wire connection. Please refer to the FieldLogic documentation for programming instructions.

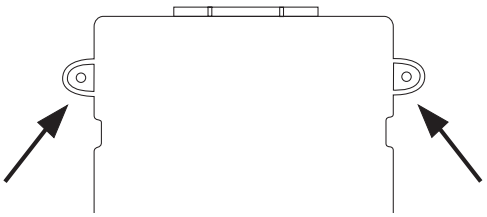
NOTE: *This installation sheet is only for installation of the Sensus Model 510M. For instructions on installing other AMI devices, please refer to the individual installation instruction for those devices.*

SINGLE PORT – TOUCHCOUPLER INSTALLATION

1. Perform a TouchRead on TouchPad(s) to ensure TouchRead to the encoder works.
2. Taking a completely assembled Model 510M SmartPoint and TouchCoupler Spacer with TouchPad Cover, align the TouchPad Cover over an installed Sensus TouchPad.
3. Place the unit over the TouchPad and press firmly until secure.



4. For additional support (optional), remove the front cover and pre-drill the holes designed to fasten the module to the wall. (Holes indicated in diagram below.) Secure the module to the wall with screws. Once secured, replace front cover of module.

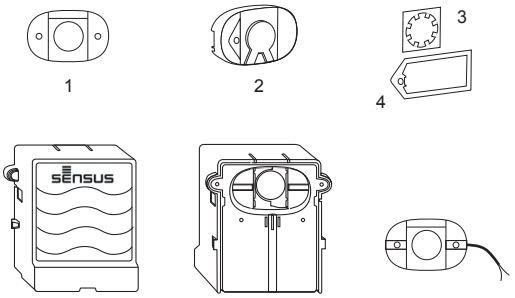


5. Once the module is closed and secured, begin the activation process. (Refer to FieldLogic documentation for programming instructions).
6. For security (optional), a seal wire may be used on the top and bottom of the module for tamper evidence.
7. Coil excess wire and secure to the body of the meter or service line in a presentable manner.

Recommended Tools & Materials

- Wire stripping tool
- Screwdriver, small standard head for terminal connections
- Power drill and bit (1/4”)
- 8x1” sheet metal screws
- TouchPad extension cable
- Seal wires (optional)

Definitions



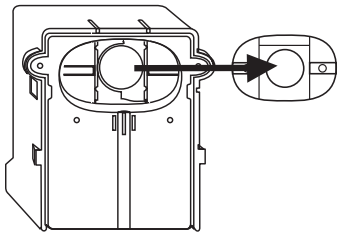
1) Sensus TouchPad
2) TouchPad Cover Assembly Complete
3) TouchPad Fastener
4) TouchPad Cover Locking Clip
5) Model 510 Radio (Front View)
6) Model 510 Radio Touch-Coupler Enabled
7) TouchPad Extension Assembly

WIG-10001-02

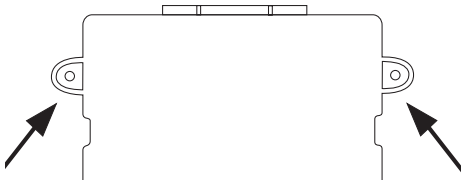
SINGLE PORT – REMOTE TOUCHCOUPLER INSTALLATION

Remote TouchCoupler installations are an option when a direct TouchCoupler (Sensus only) connection cannot be completed due to physical limitations. Before proceeding with the installation of a remote TouchCoupler application, be sure to find a location free from obstacles that would interfere with the connection from the TouchPad Cover to the transmitter.

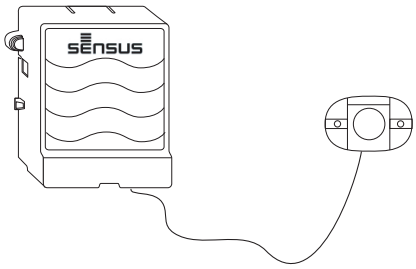
1. Perform a TouchRead on TouchPad to ensure TouchRead to the encoder works.
2. Remove current TouchPad.
3. Replace current TouchPad with TouchPad extension assembly.



4. Connect the current TouchPad to wires extending from the TouchPad extension assembly.
5. Mount current TouchPad in a location free from obstruction for SmartPoint to be mounted over it.
6. Perform TouchRead to verify integrity of wiring.
7. Taking a completely assembled 510M TouchCoupler SmartPoint, place over the Sensus TouchPad and press firmly to secure.
8. For additional support (optional), remove the front cover and predrill the holes designated to fasten to the wall (Holes shown in diagram below.) Secure the module to the wall with screws and snap on the front cover.



9. Once all the connections are complete, snap on the front cover and for tamper prevention place a seal wire on the top and bottom of the module.
10. Once the unit is secured, begin the activation process. (Refer to FieldLogic documentation for programming instructions).

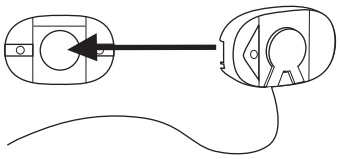


DUAL PORT – TOUCHCOUPLER INSTALLATION

1. Perform a TouchRead on TouchPad(s) to ensure TouchRead to the encoder works.
2. For new installations of dual ports, find a suitable location for an installation where two TouchPads can be installed that will be free from interference. The optimum distance should be less than 12”; otherwise wires may require field splicing. (For existing TouchPad connections when a second port is added, select a location for the second TouchPad installation that will be free from interference).
3. Determine which of the two TouchPads will use the TouchPad Cover only and which will use the TouchCoupler unit as the primary connection.

NOTE: *If TouchPad is not already installed, install TouchPad allowing enough room for the TouchPad Cover to be securely placed over the installed TouchPad.*

4. Place the remote TouchPad Cover firmly over the Sensus TouchPad until secured.

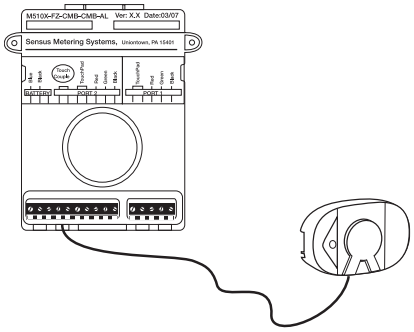


5. Place the SmartPoint over the second TouchPad location and press firmly until the unit is secured to the TouchPad. For additional support (optional), pre-drill the holes designed to fasten the module to the wall. Secure the module to the wall with screws.

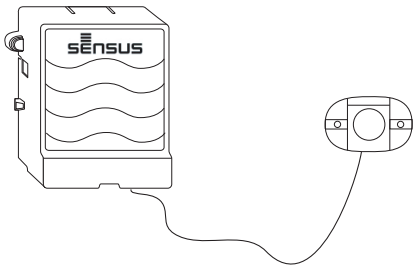
NOTE: *If not already installed, install the second TouchPad allowing enough room to connect the transmitter to the TouchPad.*

6. Strip wires prior to inserting into terminal strip.
7. Connect the wires from the TouchPad Cover to the coordinating port terminals in the SmartPoint labeled TouchCoupled.

NOTE: *Red and black wires are non-polarized.*

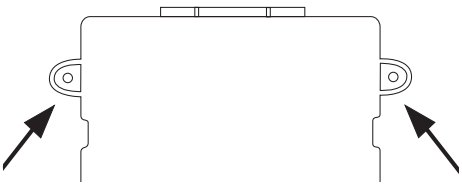


8. Once all the connections are complete, snap on the front cover and for tamper prevention place seal wire on top and bottom of module.
9. Once the module is closed and secured, begin the activation process. (Refer to FieldLogic documentation for programming instructions.)

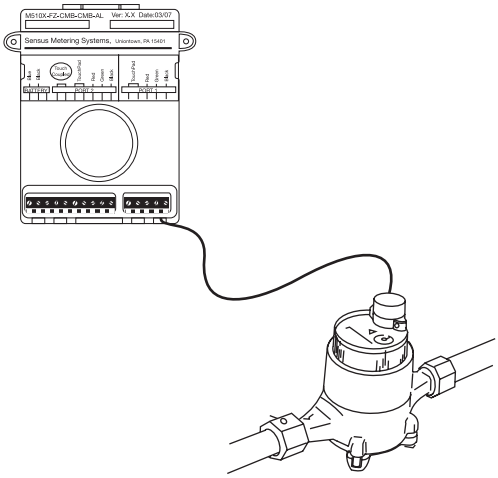


SINGLE AND DUAL PORT – WIRED INSTALLATION

1. Place the SmartPoint at the location for installation. With the front cover removed, mark the location to pre-drill the holes designed to fasten the module to the wall. (Holes shown in figure below).



2. Remove the SmartPoint from the wall and use a 1/4” drill bit to pre-drill the fastener holes.
3. Place the module on the wall and align the pre-drilled holes with the fastener locations.
4. Secure the module to the wall with screws.
5. Strip wires prior to inserting into terminal strip.
6. Connect the wires from the register to the coordinating port terminals in the SmartPoint.



NOTE: *See the encoder wiring reference chart for proper color-coded wiring connections. Badger, Neptune and Elster registers must be wired directly to a 510M port.*

Encoder wiring reference:

SmartPoint Terminal	Sensus Register	Badger ADE	Neptune ProRead	Elster Encoder
Black	Black	Black	Green	Black
Red	Red	Red	Black	Green
Green	Green	Green	Red	Red

7. Once all terminal connections are complete, snap on the front cover and for tamper prevention place seal wire on top and bottom of module.
8. Once the module is closed and secured, begin the activation process. (Refer to FieldLogic documentation for programming instructions.)

COMPLIANCE STATEMENTS

Warning!
The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

Attention!
For Class B - Unintentional Radiators:
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Attention!
Any modifications made to this device that are not approved by Sensus may void the authority granted to the user by the FCC to operate equipment.

Attention!
ICES-003 Class B Notice—Avis NMB-003, Class B
This Class B digital apparatus complies with Canadian ICES-003.

Warning!
DO NOT INCINERATE or subject battery cells to temperatures in excess of 212°F. Such treatment can cause cell rupture.

Warning!
There is danger of explosion if batteries are mishandled or incorrectly replaced. On systems with replaceable batteries, replace only with the same manufacturer and type or equivalent type recommended per the instructions provided in the product service manual.
Do not disassemble batteries or attempt to recharge them outside the system. Do not dispose of batteries in fire.
Dispose of batteries properly in accordance with the manufacturer's instructions and local regulations.

Warning!
If you are not sure of the rated power of your radio, contact your Sensus representative or dealer and supply the product model number found on the product label. If you cannot determine the rated power out, then assure 20cm separation from the body to the device.

Warning!
TO REDUCE THE RISK OF ELECTRIC SHOCK DO NOT REMOVE COVER (OR BACK). NO USER SERVICEABLE PARTS INSIDE. REFER TO QUALIFIED SERVICE PERSONNEL.

Attention!
Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different form that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Radiation Hazard!
In order to satisfy the FCC RF exposure limit of 0.60 mW/cm^2 for transmitting devices, a separation distance of 20cm (7.8 inches) or more should be maintained while operating the Sensus WFL2. To ensure compliance, operations at closer than this distance are not recommended. This minimum safe distance is required between personnel and this antenna of this device.

Attention!
This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Attention!
This radio transmitter the Sensus WFL2 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.
Le présent émetteur radio (Sensus WFL2) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

- Omni ~2dBi

Attention!
Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.
Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Attachment 7

to

Statement of Work

Change Order Procedure

Any change to a Statement of Work must be agreed upon in writing by both parties. The following procedure (whether requested by the Client or Core & Main) will be used to control all changes. All Requests for Change ("RFC") to the applicable Statement of Work must be made in writing and shall be submitted by the appropriate Project Manager. Each request should contain the following information:

1. The requested change;
2. The impact, if any, on the existing work product;
3. Estimated impact, if any, on Project schedule; and
4. Estimated change, if any, in Services fee

The Project Manager shall review and accept or reject the RFC. If rejected, the RFC shall be returned to the submitting party with written reasons for rejection and, as appropriate, any alternatives. All approved RFC's will be incorporated into the Change Order to this Statement of Work. Core & Main will not perform any Services outside of the Statement of Work until the RFC has been signed by both parties.

1. Describe the requested change:_____

_____

2. Define the impact, if any, on existing work product: _____

_____

3. Define additional work product required as a result of the requested change, if any:_____

_____

4. Define the impact, if any, to the existing Project schedule. Provide an updated Project schedule, if appropriate.

_____

_____

_____

5. Provide an updated work product and payment schedule, if appropriate. _____

_____

Accepted By:

Core & Main

By: SAMPLE

Print name: SAMPLE

Title: SAMPLE

Date: SAMPLE

Accepted By:

City of Naperville, IL (Client)

By: SAMPLE

Print name: SAMPLE

Title: SAMPLE

Date: SAMPLE

BASE STATION MAINTENANCE AND BILLING AGREEMENT

This Base Station Maintenance and Billing Agreement (the "Base Station Maintenance and Billing Agreement") is entered into on the _____ day of _____, 2020, between the City of Naperville, an Illinois municipal corporation and home rule unit of government, with offices at 400 South Eagle Street, Naperville, Illinois 60540 ("City"), and Core & Main LP, with offices at 220 S. Westgate Drive, Carol Stream, IL 60188, a Florida limited partnership authorized to do business in the State of Illinois ("Provider").

WHEREAS, simultaneous with the execution of this Base Station Maintenance and Billing Agreement, Provider and the City will enter into that certain Provider Services Agreement (the "Provider Services Agreement") for the purchase of a Water Advanced Metering Infrastructure Project (the "Project"); and

WHEREAS, Core & Main is the authorized distributor for Sensus USA, Inc. ("Sensus"), the manufacturer of meters and equipment to be purchased by the City from Provider under the Provider Services Agreement; and

WHEREAS, the terms and conditions under which Sensus provides base station maintenance services to customers through its authorized distributors are set forth in the Sensus Base Station Protection Plan attached hereto as Exhibit A (the "Base Station Protection Plan"); and

WHEREAS, Provider desires to sell and the City desires to purchase base station maintenance services provided by Sensus and as set out in the Base Station Protection Plan at the prices set forth in Exhibit B of the Provider Services Agreement; and

WHEREAS, the purpose of this Base Station Maintenance and Billing Agreement is to establish the terms and conditions under which the base station maintenance services as set out in the Base Station Protection Plan will be provided by Sensus through Provider, its authorized distributor, and billed to the City by Provider; and

WHEREAS, the City will accept and be bound to the Base Station Protection Plan in order to receive the base station maintenance services provided by Sensus.

NOW, THEREFORE, for and in consideration of the mutual promises contained herein and other good and valuable consideration, the receipt and sufficiency of which is acknowledged, the parties agree as follows:

1. The fees for the base station maintenance will be a fixed price of $2,200.00 per base station per year for year one (the "Annual Base Station Maintenance Fees") as more fully described in Exhibit A, attached hereto.

2. The fees for the base station maintenance for years two through five will not exceed 3% increase per year.

3. The base station annual billing date will be established as the date the base stations are shipped by Sensus (the "Base Station Maintenance Annual Billing Date"). The first Base Station Maintenance Annual Billing Date occurs twelve months after the date of shipment.

4. Provider will invoice the City for years one through five of the Annual Base Station Maintenance Fees thirty (30) days prior to each Base Station Maintenance Annual Billing Date. Unless

otherwise directed in writing by both Sensus and Provider, the City will remit its payments directly to Provider on or before the Base Station Maintenance Annual Billing Date.

5. Following the conclusion of year five, if the City chooses to terminate the Base Station Protection Plan with Sensus, the City may also terminate this Base Station Maintenance and Billing Agreement for any reason upon providing Provider with written notice sixty (60) days in advance of the Base Station Maintenance Annual Billing Date.

6. Governing Law/Venue. This Base Station Maintenance and Billing Agreement shall be governed by the laws of the State of Illinois as to both interpretation and performance. Venue for any action taken by either Party, whether in law or in equity, to enforce the terms of this Base Station Maintenance and Billing Agreement shall be in the Circuit Court of the Eighteenth Judicial Circuit, DuPage County Illinois.

7. Severability. In the event, any provision of this Base Station Maintenance and Billing Agreement is held to be unenforceable or invalid for any reason, the enforceability thereof shall not affect the remainder of the Base Station Maintenance and Billing Agreement. The remainder of this Base Station Maintenance and Billing Agreement shall be construed as if not containing the particular provision and shall continue in full force, effect, and enforceability, in accordance with its terms.

IN WITNESS WHEREOF, the parties hereto have caused this Base Station Maintenance and Billing Agreement to be executed effective as of the date first written above.

City of Naperville		Core & Main LP	
Signature:	_____	Signature:	_____
Print Name:	_____	Print Name:	_____
Title:	_____	Title:	_____
Date:	_____	Date:	_____

Sensus Base Station Protection Plan

The following information describes the features of the base station protection plan provided to FlexNet® communication network customers. The base station protection plan was created to provide customers assurance that their base stations are covered regardless of whether it is a maintenance issue or the need to be upgraded to meet minimum software and hardware operating requirements for Sensus products.

Participation and Coverage

Participation in the base station protection plan is strongly recommended. This recommendation is made so that all participating customers can benefit from this cost effective plan to meet support needs.

All customers are required to declare participation in this program at the time of the initial base station order. Customers will be required to purchase the base station protection plan in five (5) year increments. Customers will be issued a renewal notice approximately sixty (60) days prior to the expiration date for them to renew for a new five (5) year term. Invoices must be paid no later than thirty (30) days following the system anniversary date or the protection plan will be terminated. Customers who do not choose to renew during the renewal period cannot elect to participate once the renewal period has expired.

Coverage Terms

- Sensus will repair or replace defective parts
- Base stations will be upgraded to meet minimum requirements for operating Sensus products
- Protection plan includes labor in the repair, replacement or upgrades of base stations
- Access to technical support 24/7
- Defective parts will be repaired or replaced within five (5) business days once Technical Service has determined that the base station is unusable and that no workaround is available
- Upgrades to base stations will be completed by Sensus or their representatives once it has been determined that the hardware or operating software requires an upgrade to meet minimum operating requirements for Sensus products
- Includes base station re-certification, if required

Alternate Option

Because participation in this protection plan is not mandatory, there is an alternate option for customers who choose to not participate. The customer will be charged for any and all repair, replacement or upgrade related to hardware, software and labor. Standard rates for all hardware and services at the time of service will apply.

Further Information

If you would like further help or information concerning the protection plan, please contact your local Sensus representative, authorized distributor, or call 1-800 METER-IT (1-800-638-3748)

Notes

- Customers are responsible for monitoring hardware and software components of their FlexNet system and contacting Sensus when support is needed. The base station protection plan does not cover system monitoring on a continuous or ongoing basis
- Customer acknowledges that Sensus reserves the right to repair or replace malfunctioning equipment at its discretion and at Sensus choice of location – either at the customer site, Sensus manufacturing facility or other appropriate site determined by Sensus
- If Sensus becomes unable, either wholly or in part, by an event of Force Majeure, to fulfill its obligations under this agreement, the obligations affected by the event of the Force Majeure will be suspended during the continuance of that inability. The term " Force Majeure" means events beyond the reasonable control of Sensus, including, but not limited to, acts of God, hurricane, flood, volcano, tsunami, tornado, storm, tempest, vandalism, illegal radio frequency interference, strikes, lockouts, or other industrial disturbances, unavailability of component parts of any goods provide hereunder, acts of public enemies, wars, blockades, insurrections, riots, epidemics, earthquakes, fires, restraints or prohibition by any court, board, department, commission or agency of the United Sates or any States, any arrests and restraints, civil disturbances and explosions. Furthermore, the above services and support do not apply to products or software which have been: installed improperly or in non-recommended installations. Tampered with; modified or repaired with parts or assemblies not certified in writing by Sensus, including without limitation, communications parts and assemblies; converted; altered; damaged; read by equipment not approved by Sensus; subject to misuse, improper storage, care, maintenance (including expired hardware and/or software maintenance) or improper periodic testing (collectively, "Exceptions".) If the applicable product satisfies any of the above Exceptions, the customer shall pay for and/or reimburse Sensus for all expenses incurred by Sensus in the examination and/or repair or replacement of such products
- Does not include antenna, antenna cables or base station batteries
- Does not include costs associated with tower rental, electrical fees or site maintenance
- Does not include costs associated with purchase, maintenance or support of ancillary network equipment or network backhaul connection
- Does not include adding additional base stations to assure network coverage and/or capacity
- Does not include upgrades for network capacity due to increased field devices or traffic requirements in the service territory

Terms and Trademarks

- **"FlexNet base station"** identifies the Sensus manufactured device consisting of one transceiver that receives readings from the SmartPoint® modules (either directly or via a repeater) by radio frequency and passes those reading to the RNI by TCP/IP backhaul communications. For clarity, FlexNet base stations include M400B2, M400DS, M400D and R100NA
- **"SmartPoint"** modules identifies the Sensus transmission devices installed on devices such as meters, distribution automation equipment and demand response devices located at end user premises that take the readings of the meters and transmit those readings by radio frequency to the relevant FlexNet base stations
- **"RNI"** identifies the regional network interfaces consisting of hardware and software used to gather, store and report data collected by the FlexNet bse station from the SmartPoint modules
- **"Field Devices"** refers to the SmartPoint modules
- **"FlexWare Software"** or **"Sensus Software"** identifies the Sensus RNI software or FlexNet base station software
- **"Updates"** means releases of the software or hardware that constitute a minor improvement in functionality
- **"Upgrades"** means release of the software or hardware which constitute a significant improvements in functionality or architecture of the software or hardware
- **"Release"** means both updates or upgrades
- **"AMI System"** identifies the Sensus FlexNet Advanced Metering Infrastructure (AMI) system comprised of the SmartPoint modules, RF equipment, server hardware, software licenses, FCC licenses and other equipment provided to the customer hereunder. The AMI system included the foregoing, as provided by Sensus. The AMI system does not include goods, equipment, software, licenses or rights provided by a third party or parties to this agreement.

This base station protection plan is supplemental to Sensus' published warranties available at www.sensus.com/tc. The goods and services outlined herein are valid upon Sensus' receipt of payments within the specified timeline as defined within Sensus payment terms and conditions.

All products purchased and service performed are subject to Sensus' terms of sale, available at either www.sensus.com/tc or 1-800-METER-IT. Sensus reserves the right to modify these terms and conditions in its own discretion without notice to the customer.

For additional information concerning you base station protection plan, please contact your local Sensus representative, authorized distributor, or call: 1-800-METER-IT (1-800-638-3748).

SENSUS
a xylem brand

637 Davis Drive
Morrisville, NC 27560
+1-919-845-4000
sensus.com

BILLING AGREEMENT

This Billing Agreement (the "Billing Agreement") is entered into on the _____ day of _____, 2020, between the City of Naperville, an Illinois municipal corporation and home rule unit of government, with offices at 400 South Eagle Street, Naperville, Illinois 60540 ("City"), and Core & Main LP, with offices at 220 S. Westgate Drive, Carol Stream, IL 60188, a Florida limited partnership authorized to do business in the State of Illinois ("Provider")

WHEREAS, the City and Provider entered into a Provider Services Agreement (the "Provider Services Agreement"), for the purchase of a Water Advanced Metering Infrastructure Project (the "Project"); and

WHEREAS, as a supplement to the Project, the City has chosen VPIE cloud-based software owned by Vepo Analytix LLC ("Vepo"); and,

WHEREAS, Vepo has agreed to grant the Provider access to utilize the VPIE software through an agreement with Provider, and Vepo has further authorized Provider to grant access to the City to utilize the VPIE software; and

WHEREAS, the City and Core & Main desire to enter into an agreement wherein Provider will invoice the City for the monthly fees for access to and use of the VPIE software for years one through five.

NOW, THEREFORE, for and in consideration of the mutual promises contained herein and other good and valuable consideration, the receipt and sufficiency of which is acknowledged, the parties agree as follows:

1. The monthly fees for use of the VPIE software (the "Monthly Software Fees") will be a fixed price of $995.00 per month for up to 10 users for years one and two. The Monthly Software Fees for additional users will be $125.00 per month for years one and two.

2. Year one of the Monthly Software Fees will commence upon Project Completion as defined in the Provider Services Agreement.

3. The Monthly Software Fees for years three through five will not exceed 3% increase per year.

4. Core & Main will invoice the City on a [monthly/annual] basis for the Monthly Software Fees for years one through five thirty (30) days prior to the due date. Unless otherwise directed in writing by both Vepo and Core & Main, the City will remit its payments directly to Core & Main on or before the due date.

5. If the City chooses to terminate its use of the VPIE software, the City may terminate this Billing Agreement upon providing Core & Main with written notice ninety (90) days in advance of the date of termination.

6. Governing Law/Venue. This Billing Agreement shall be governed by the laws of the State of Illinois as to both interpretation and performance. Venue for any action taken by either Party, whether in law or in equity, to enforce the terms of this Billing Agreement shall be in the Circuit Court of the Eighteenth Judicial Circuit, DuPage County Illinois.

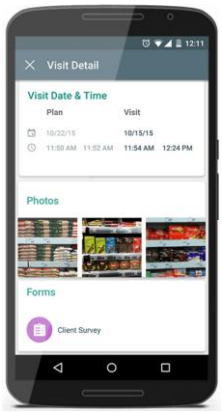
7. Severability. In the event, any provision of this Billing Agreement is held to be unenforceable or invalid for any reason, the enforceability thereof shall not affect the remainder of the Billing Agreement. The remainder of this Billing Agreement shall be construed as if not containing the particular provision and shall continue in full force, effect, and enforceability, in accordance with its terms.

IN WITNESS WHEREOF, the parties hereto have caused this Billing Agreement to be executed effective as of the date first written above.

City of Naperville		Core & Main LP	
Signature:	_____	Signature:	_____
Print Name:	_____	Print Name:	_____
Title:	_____	Title:	_____
Date:	_____	Date:	_____

Field Service Management Software for Naperville

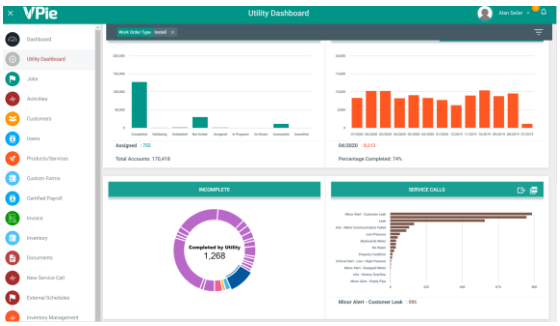
MOBILE APP



- Work Order Pictures
  - Before and After installation pictures
  - Require certain pictures to be taken otherwise cannot close work order
- Bar Code Scanning
  - Increase data accuracy of new Meter and Radio ID serial numbers
  - Eliminate human error, difficult handwriting and wet paperwork
- Data Collection On-line or Off-line
  - Store installation data without data connection
  - Native App synchronizes when data connection becomes available
- Customize Forms and Fields
  - Create required fields to capture install data
  - Create customized work orders to do other field work
- Assign Tasks to Technicians
  - Easily assign work and maximize routes for technicians
- Track Efficiency
  - Record date, technician, time started and finished installation
- GIS Data
  - Capture latitude and longitude for locations of meter/radios installed
  - Sub-meter and sub-foot accuracy
- Available on iOS and Android Devices

Field Service Management Software for Naperville

CLOUD-BASED SOFTWARE



- **Digital Work Orders**
  - All field installation data populated on PDF with pictures
  - History of work orders tracked
- **Electronic Service Calls**
  - Track all service and maintenance calls
  - Individual Work orders created for each stop made
- **Multi-Communication Platform**
  - Communicate with customers via email, text, or voice blast
  - Track all communication history with customer including date, time, subject and message sent
- **Inventory Management**
  - Track where your meters/radios are located ie: warehouse, technician's truck, or installed
  - Updated daily inventory report based on installations completed from the day before
- **Integration to CIS and Billing Software**
  - All data collected can be exported through csv files, xlsx, and APIs can be developed
  - Billing File can be mapped to CIS or billing software
- **Key Performance Indicators (KPIs)**
  - Real-time Dashboard tracking statuses of all meter/radios to be installed
- **Work Order History Management**
  - Track all work orders performed at each individual address
- **Appointment Installation Notifications**
  - Three different emails or texts messages sent to customer creating efficiency and safety
    - Confirmation email/text after appointment is made
    - 24 Hour reminder day before appointment
    - Technician on his way to property with picture

Detailed Endpoint Installation

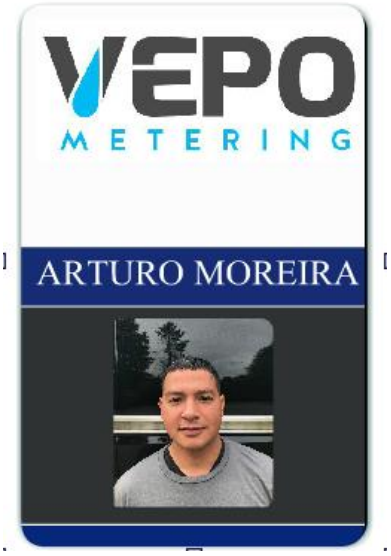
Under this specification VEPO METERING shall supply all equipment and labor necessary to install Water Meters, and/or Advanced Metering Infrastructure (AMI) system endpoints. While the primary function shall be to provide labor for the installation of meters and endpoints, VEPO METERING will also provide project management, data integration services, and a field service software with a Utility Portal (with unlimited licenses to the City of Naperville) allowing electronic data transfers to billing software, and full transparency of project progress as described herein.

1.0 TECHNICIANS

A. VEPO METERING shall employ competent, efficient employees skilled in the work assigned to them. VEPO METERING will provide the City of Naperville with a list of names, photo identification, background checks, vehicle information and other required information for the employees performing work.

B. VEPO METERING technicians will always display in a clear manner, photo identifications. Each photo identification shall have VEPO METERING and employee's name. See Figure 1 below.

FIGURE 1:

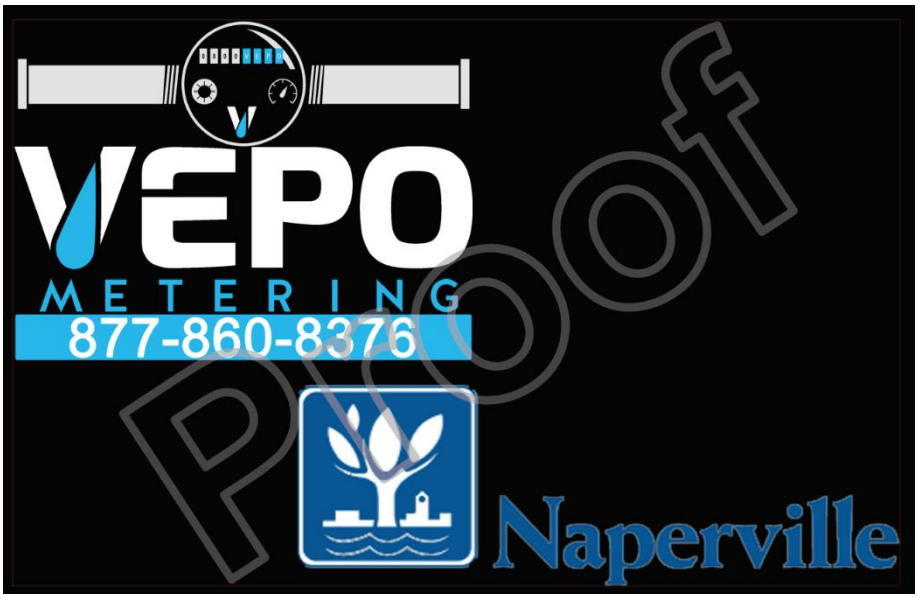


C. All service staff, technicians, drivers and field supervisors will be equipped with smart phones and/or tablets. Electronic and Wireless Communication, through a cellular network, will be utilized by the installation team.

D. All VEPO METERING employees shall be neat and presentable always to present a professional appearance. All technicians shall have the same color uniforms including shirts, pants, and jackets. VEPO METERING logo shall be permanently attached to shirts and jackets.

E. VEPO METERING vehicles used shall have company logos prominently displayed and shall have license plates registered with the City of Naperville. See Figure 2 below.

FIGURE 2



F. All work shall be performed by competent, skilled personnel, to be conducted in accordance with good trade practices and all applicable codes.

G. VEPO METERING is skilled in handling both small and large water meters, both indoors and outdoors, including confined space meter vaults, ranging in size from 5/8" to 12"

H. VEPO METERING shall be responsible for the proper care and protection of the work site, for all materials and articles delivered to the site where VEPO METERING will perform the work, until completion and final acceptance of the work. VEPO METERING shall exercise proper precautions and safety measures in performing the work, which shall be in accordance with all applicable laws, rules and regulations. VEPO METERING shall be responsible for the protection of all persons and/or property at the location in which the work will take place.

I. VEPO METERING shall keep the work site free from unnecessary accumulations of waste materials. Upon the completion of all work, VEPO METERING installers will be instructed to remove all tools, equipment and surplus materials, as well as all rubbish and waste resulting from the work. Upon the completion of the work, the work area shall be left "broom clean" or its equivalent, to the reasonable satisfaction of the City of Naperville.

2.0 FIELD TOOLS

A. All VEPO METERING technicians will be equipped with tablets/mobile devices that communicate through a cellular network providing a real time paperless solution in the field for every installation.

B. Tablets/mobile devices with a mobile app will be used for capturing before and after pictures, meter data, endpoint data, customer information, bar code data, and any other required information using the field service software mobile app.

C. The mobile app will provide the technicians to access all information including installers schedule, office calendar, existing meter and radio data, all account information, and material inventory.

D. VEPO METERING technicians will be equipped with all equipment and software required by Sensus to program the radio endpoints.

4.0 FIELD SERVICE SOFTWARE

A. The Field Service Software will provide the capability to record, manage, store, retrieve, and access all relevant data for each customer location, including customer signatures.

B. The Field Service Software will allow for scheduling of all appointments if required, logging all customer interactions, and handling of service requests.

C. **Notifications:** The Field Service Software will automatically send a confirmation email to the customer when an appointment is scheduled as shown below in Figure 3. A second email shall be sent to the customer the day before the appointment as a reminder as shown below in Figure 4. Finally, a third email will be sent to customer the day of the appointment, when technician is in-route to the location. Additionally, the third email will contain a picture of the technician for safety and security reasons as shown below in Figure 5.

FIGURE 3

Your Appointment is Confirmed

Dear Richard Whitman Jr,

VEPO METERING thanks you for taking the time to schedule an appointment for the Meter Change-out Program.

You will be receiving a reminder email 24 hours in advance of this scheduled appointment.

Additionally, the day of the appointment, you will receive an email when the technician is on their way to your location with their picture.

We also recommend you watch our Intro Video for more information. VEPO METERING Intro Video

If you have any additional questions regarding this upgrade, you may contact us by calling 877-860-VEPO METERING (8376) or replying to this email.

Please confirm that the information below is accurate and if any changes are required, please let us know.

Appointment Details

Water Utility: Tupper Lake, NY

Customer Name: Richard Whitman Jr

Account #: 11445300

Address: 10 WEBB RD - Tupper Lake, NY - 12986

Time: Friday, October 18, 2019, 8:00 AM - 12:00 PM

Mobile #: 518-806-1108

Home #: 518-359-3861

Additional Notes:

Regards,
VEPO Metering
www.VEPOMetering.com

FIGURE 4

Dear Robert Lapierre,

Please use this email from VEPO METERING as a reminder for your scheduled appointment tomorrow 10-04-19 between 12:00 PM - 4:00 PM at “8 LAFAYETTE ST”.

You will be receiving another notification tomorrow when your technician is on his way with his picture attached to the email for your safety and security reasons.

Thanks in advance for your time and attention to this important project.

There is no need to reply this mail.

Have a great day.

Customer Service
VEPO Metering
877-860-VEPO (8376)

FIGURE 5

Dear Robert,

This email is to notify you that Chelton Forbes your technician is on their way to your scheduled appointment. For your security and convenience, please take note of their picture attached to this mail.

Thank you for your time and attention to this important project.

There is no need to reply this mail.

Have a great day.

Customer Service

VEPO Metering

877-860-8376

D. VEPO METERING will provide the ability for City of Naperville customers to schedule appointments online at their convenience. Once the appointment is scheduled, the customer shall receive an email confirmation of their appointment. The email confirmation shall contain an informational video explaining the installation process.

E. All account management is to be completed through the Field Service Software. All relevant customer account information and new product data collected after installation will be accessible by all Utility personnel, and project management through the Utility Portal.

5.0 UTILITY PORTAL

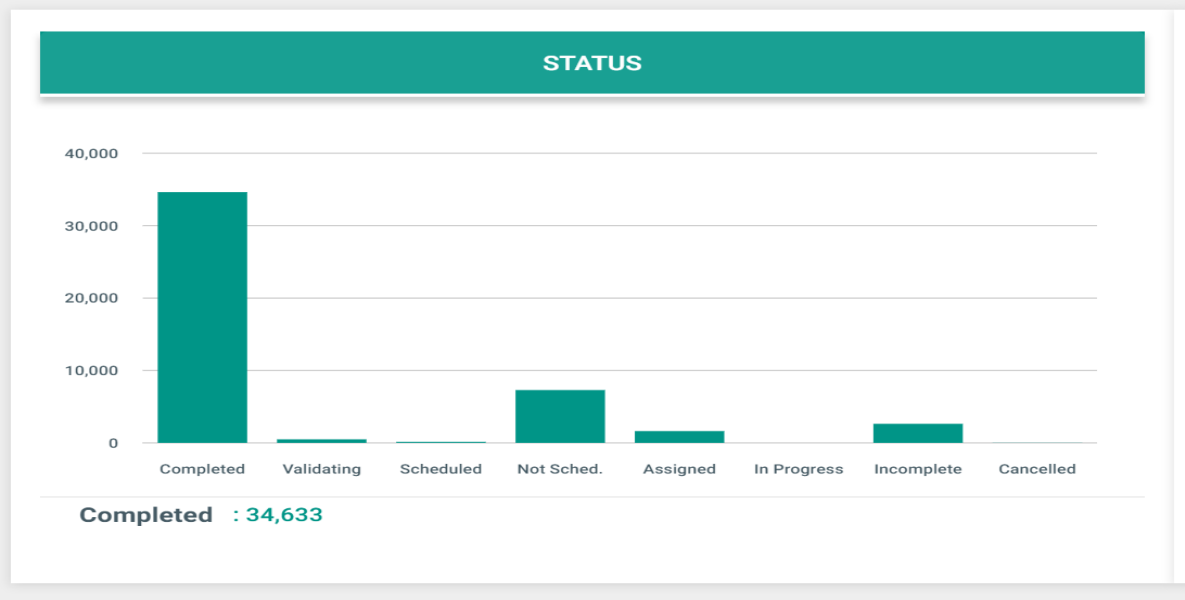
A. VEPO METERING has a cloud-based Utility Portal by secure invitation only, for the City of Naperville – with unlimited licenses - to monitor in real time the complete installation process.

B. Field Service Software mobile app utilized by the technicians will be completely integrated with the Utility Portal to provide the City of Naperville real-time updates on the progress of installations.

C. There will be five statuses available on the Utility Portal for all users to quickly review the status of entire installation project, as shown below in Figure 6:

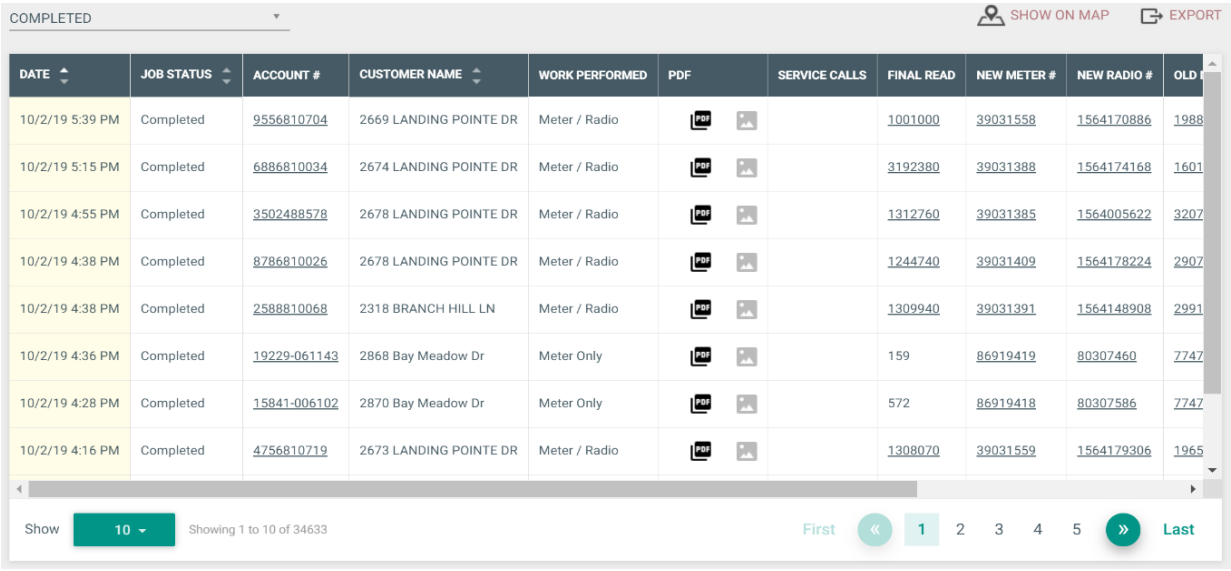
- Completed- Job Done
- Validating - Job done awaiting data validation process
- Scheduled - Job scheduled in the future
- Not Scheduled - Jobs not scheduled
- Assigned – Assigned to a technician
- In progress – Technician working on meter installation
- Incomplete - Jobs that cannot be completed
- Cancelled – Was scheduled but customer canceled

FIGURE 6



D. The Utility Portal will have built in search/filter capabilities to provide a status of each individual account as shown below in Figure 7. The Utility Portal will be able to filter account statuses by day, week, month, etc. to monitor the project

FIGURE 7



E. The Utility Portal will be able to provide a list of accounts that are incomplete and indicate the reasons why they cannot be completed as shown below in Figure 8. The reasons for an account being incomplete shall include:

Denial of Access

Meter not Accessible

Meter not Found

Plumbing Conditions

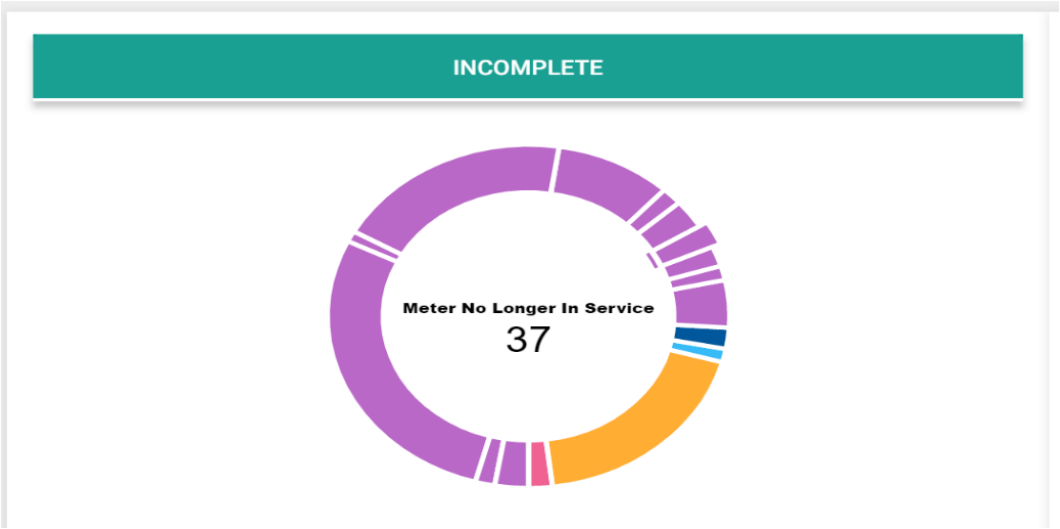
Vacant Property

Change Order

No Show

Miscellaneous

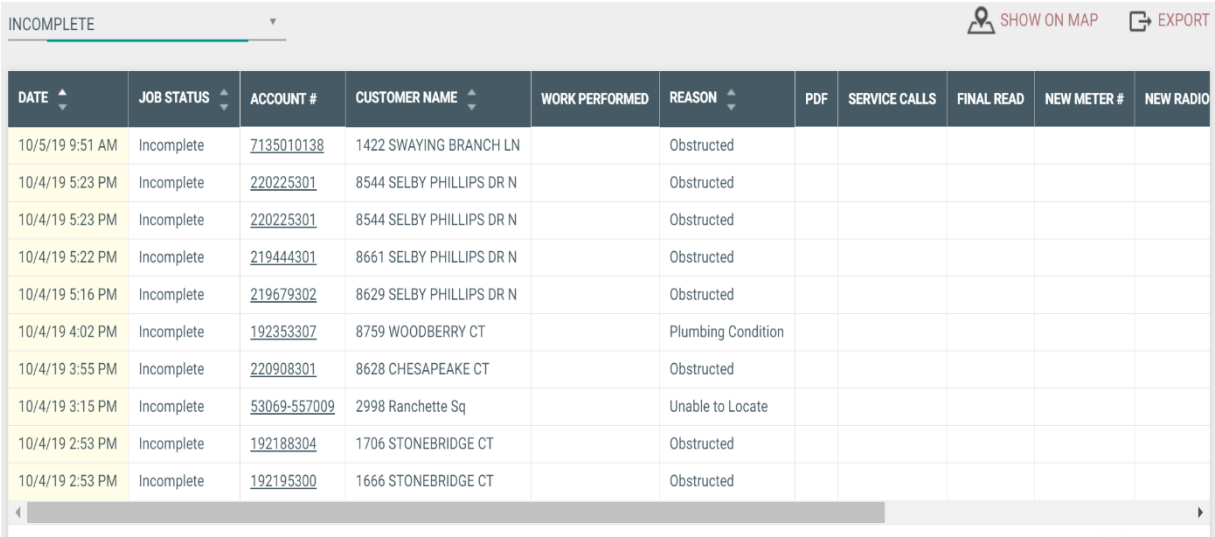
FIGURE 8



Field technicians will have the capability to enter the reason for an account being on hold through the mobile application of the field service software.

All incomplete devices, along with the reason they are incomplete shall be listed within the grid data as shown below in Figure 9.

FIGURE 9



DATE	JOB STATUS	ACCOUNT #	CUSTOMER NAME	WORK PERFORMED	REASON	PDF	SERVICE CALLS	FINAL READ	NEW METER #	NEW RADIO
10/5/19 9:51 AM	Incomplete	7135010138	1422 SWAYING BRANCH LN		Obstructed					
10/4/19 5:23 PM	Incomplete	220225301	8544 SELBY PHILLIPS DR N		Obstructed					
10/4/19 5:23 PM	Incomplete	220225301	8544 SELBY PHILLIPS DR N		Obstructed					
10/4/19 5:22 PM	Incomplete	219444301	8661 SELBY PHILLIPS DR N		Obstructed					
10/4/19 5:16 PM	Incomplete	219679302	8629 SELBY PHILLIPS DR N		Obstructed					
10/4/19 4:02 PM	Incomplete	192353307	8759 WOODBERRY CT		Plumbing Condition					
10/4/19 3:55 PM	Incomplete	220908301	8628 CHESAPEAKE CT		Obstructed					
10/4/19 3:15 PM	Incomplete	53069-557009	2998 Ranchette Sq		Unable to Locate					
10/4/19 2:53 PM	Incomplete	192188304	1706 STONEBRIDGE CT		Obstructed					
10/4/19 2:53 PM	Incomplete	192195300	1666 STONEBRIDGE CT		Obstructed					

F. When an installation is completed, an electronic work order will be created and added to the Utility Portal with old and new data, before and after pictures, and a customer signature as shown below in Figure 10.

FIGURE 10

VEPO METERING

Work Order# 334690

Replacement Program

Carolina Water Service of North Carolina™

Service Address
Lefft,Benita E
2674 Landing Pointe Dr
Lake Wylie, SC 29710

Account Number - 6886810034
Technician - Fitzroy Forrest
Date - 10/2/19
Time Started - 5:15 PM
Time Ended - 5:25 PM

Work Performed
✓ Replaced Meter ✓ Installed Radio

Existing Information	
LOCATION	
Lat	35.12254531964205
Long	-81.07858163312177
METER	
Number	16013584
Number Found	16013584
Inside Final Read	3192380
Size	5/8"
RADIO	
Outside Read	
ID Number	

Replacement Information	
LOCATION	
Meter	Outside - Pit
Radio	Pit
METER	
Manufacturer	Neptune
Number	39031388
Register ID Number	
Size	5/8" x 3/4"
Initial Reading	000000
RADIO	
ID Number	1564174168

Additional Comments

Existing

Meter Tag

Meter #

Meter Set

Meter Read (HI)

Remote

New

Meter # (HI)

Meter Read (HI)

Meter Set

Remote ID (HI)

Handheld Programming Success

Handheld SNR / Base Station

Remote

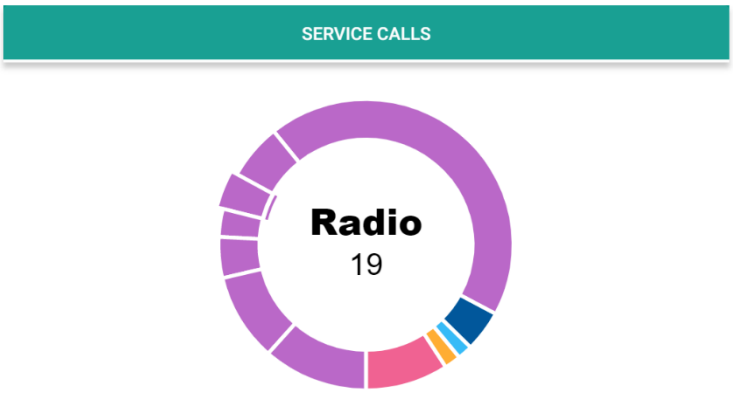
6.0 SERVICE CALLS

A. The Utility Portal shall have the ability to track all service calls required when adjustments need to be made to completed installations, as shown below in Figure 11. Reasons for service calls shall include:

- Leaks – Meter is leaking after complete installation
- Backwards Meter – Meter installed backwards
- Endpoint – Radio needs troubleshooting
- Property Condition
- Low Pressure was reported by customer

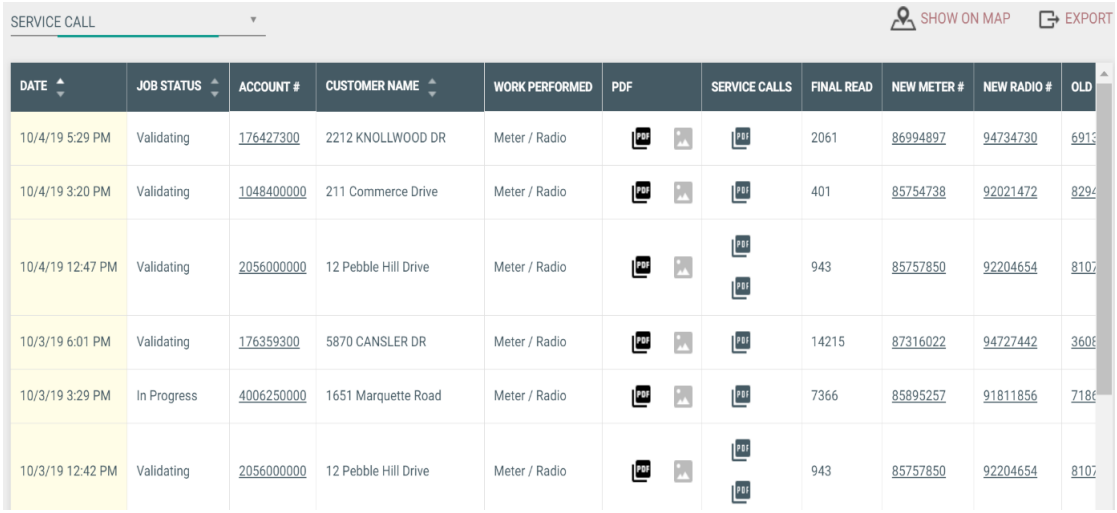
- Mismatched Data
- Meter box
- No Water – Water service not returned
- Programming
- Other

FIGURE 11



All service calls, along with the reason for the service call shall be listed within the grid data as shown below in Figure 12. An electronic workorder for each service call shall be generated, with associated pictures, and accessible through the grid data. An example of the work order is shown in Figure 13 below along with pictures. All pictures are expandable by clicking on the image within the utility portal.

FIGURE 12

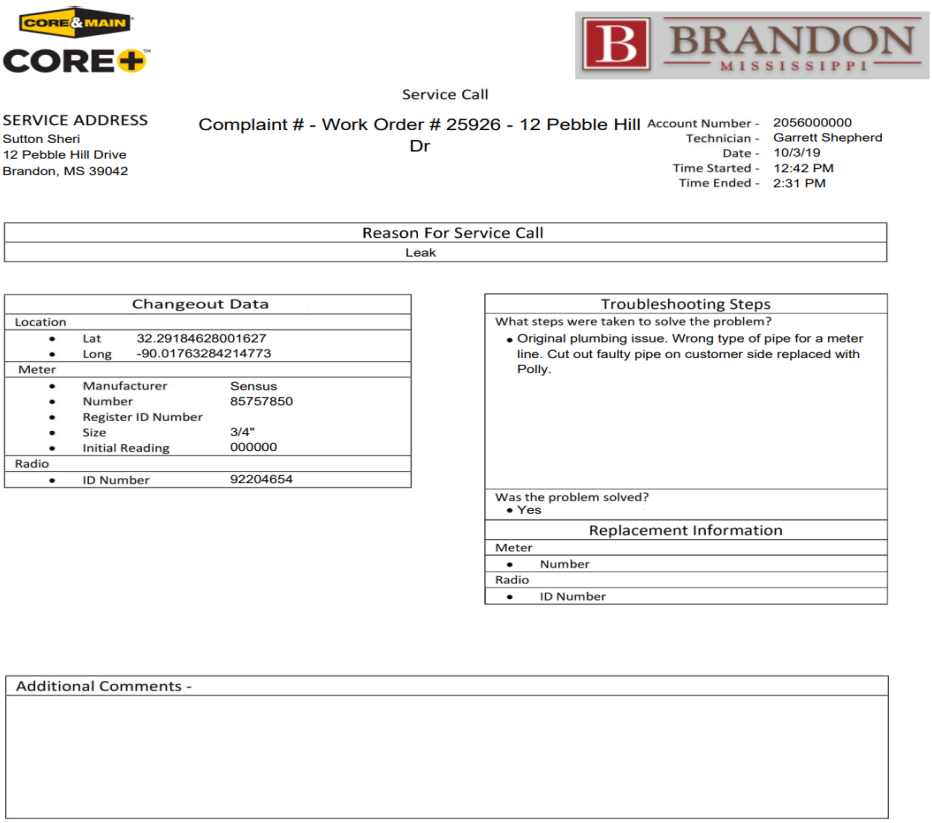


SERVICE CALL

SHOW ON MAP EXPORT

DATE	JOB STATUS	ACCOUNT #	CUSTOMER NAME	WORK PERFORMED	PDF	SERVICE CALLS	FINAL READ	NEW METER #	NEW RADIO #	OLD
10/4/19 5:29 PM	Validating	176427300	2212 KNOLLWOOD DR	Meter / Radio			2061	86994897	94734730	6913
10/4/19 3:20 PM	Validating	1048400000	211 Commerce Drive	Meter / Radio			401	85754738	92021472	8294
10/4/19 12:47 PM	Validating	2056000000	12 Pebble Hill Drive	Meter / Radio			943	85757850	92204654	8107
10/3/19 6:01 PM	Validating	176359300	5870 CANSLER DR	Meter / Radio			14215	87316022	94727442	3608
10/3/19 3:29 PM	In Progress	4006250000	1651 Marquette Road	Meter / Radio			7366	85895257	91811856	7186
10/3/19 12:42 PM	Validating	2056000000	12 Pebble Hill Drive	Meter / Radio			943	85757850	92204654	8107

FIGURE 13



CORE & MAIN CORE+

BRANDON MISSISSIPPI

Service Call

SERVICE ADDRESS
Sutton Sheri
12 Pebble Hill Drive
Brandon, MS 39042

Complaint # - Work Order # 25926 - 12 Pebble Hill Dr

Account Number - 2056000000
Technician - Garrett Shepherd
Date - 10/3/19
Time Started - 12:42 PM
Time Ended - 2:31 PM

Reason For Service Call
Leak

Changeout Data	
Location	
• Lat	32.29184628001627
• Long	-90.01763284214773
Meter	
• Manufacturer	Sensus
• Number	85757850
• Register ID Number	
• Size	3/4"
• Initial Reading	000000
Radio	
• ID Number	92204654

Troubleshooting Steps
What steps were taken to solve the problem?
• Original plumbing issue. Wrong type of pipe for a meter line. Cut out faulty pipe on customer side replaced with Polly.
Was the problem solved?
• Yes

Replacement Information
Meter
• Number
Radio
• ID Number

Additional Comments -

Photos

Before Surroundings Photo

After Surroundings Photo

After Surroundings Photo

After Surroundings Photo

After Surroundings Photo

After Surroundings Photo

After Surroundings Photo

After Surroundings Photo

B. The Utility Portal can create a CSV file with all data to be exported to the City of Naperville's billing software. VEPO METERING shall work with the City of Naperville's billing software company to ensure the format of the export file from the Utility Portal is compatible with the billing software. This shall allow for the electronic transfer of all new meter data, collected in the field and uploaded to the Utility Portal, to the billing software.

C. Utility Portal will provide a view to the City of Naperville of the product inventory throughout the project. Water meter and endpoint quantities shall be monitored by the City of Naperville in real-time through the Utility Portal.

D. The Utility Portal will provide a location for, and City of Naperville access to project documents such as contracts, Invoices, prevailing wage payroll, and any other documents required by the City of Naperville.

7.0 PROJECT MANAGEMENT

A. VEPO METERING shall provide inventory management through the Field Service Software in conjunction with the Utility Portal, as shown below in Figure 14. Field Technicians shall use bar code scanning technology to enter meter and radio endpoint data into the Field Service Software. As meters and endpoints are marked installed through the field technician's mobile app, they shall be deducted from the inventory levels.

FIGURE 14

Radio	Received	Remaining
Radio	1940	1940

Meter	Received	Remaining
5/8"	1559	1559
3/4"	35	35
1"	4	4

B. VEPO METERING shall be responsible for receiving material deliveries from Core and Main and Sensus.

C. Routing of all installation shall be coordinated with City of Naperville to avoid interruption of billing cycles, schedules, and blackout dates.

D. VEPO METERING will always attempt to complete a full cycle or route prior to starting another one for efficiency and quality purposes.

E. Video conferencing on tablets/mobile device shall be available to field technicians for onsite communication and troubleshooting to ensure quality.

F. VEPO METERING will have a dedicated call center (not outsourced) to be able to schedule appointments. Call center shall be responsible for contacting customers that the City of Naperville is able to provide phone numbers.

G. VEPO METERING can assist the City of Naperville in drafting or providing sample letters to introduce the Water Utilities Advanced Metering Infrastructure project. Additionally, VEPO METERING will utilize door hangers, text, email, and voice blasts to notify residents and schedule appointments. See Figure 15 below.

FIGURE 15

H. Regular project progress meetings shall be conducted by VEPO METERING with all project constituents to update everyone on project status.

8.0 DATA INTEGRATION

A. VEPO METERING is responsible for providing billing file to transfer all field data captured by the technicians, electronically to the City of Naperville billing software. No manual data entry by City of Naperville personnel will be required.

B. VEPO METERING Utility Portal shall provide email notifications to the City of Naperville indicating when the billing file is ready for upload to the billing system. All billing file data will be validated by VEPO METERING team and confirmed to be correct before notification is sent to City of Naperville.

C. Installation VEPO METERING is responsible for uploading existing City of Naperville customer file into the project Field Service Software.

D. Electronic Work Orders are generated and displayed on the Utility Portal. All work orders shall contain existing account information from the City of Naperville data base, new meter and endpoint data, before and after pictures, and any other pertinent account data. Electronic Work Orders shall be available on Utility Portal for an agreed upon period after project completion.

9.0 QUALITY ASSURANCE

A. VEPO METERING will provide a data validation team responsible for confirming information from the City of Naperville data base matches the information field technician finds on location. This is accomplished by data validation team comparing data in field pictures to the data entered by the field technician. See Figure 16 below.

FIGURE 16

RNI Meter Match	RNI MXU Match	Municipality	Status	Record Date	Account	Meter Serial # (Old)	Meter Number Match?	Meter Number Found	Meter ID	Addre	Read Provided	Final Read	Size (Old)	Size (New)	Transmitter Serial # (New	Transmitte r Type (New)	Meter Changed?	Meter Serial # (New)
86923666	80307132	Gulf Breeze, FL	Validating	10/3/2019		77476266	Yes		86923666	830 Bay (	431	456	5/8x3/4"	3/4"	80307132	Single Port	Meter Only	86923666
86920960	80236730	Gulf Breeze, FL	Validating	10/3/2019		77477810	Yes		86920960	1257 Aut	106	1090	5/8x3/4"	3/4"	80236730	Single Port	Meter Only	86920960
86920910	80247424	Gulf Breeze, FL	Validating	10/3/2019		72817173	Yes		86920910	2615 Edn	1260	2190	5/8x3/4"	3/4"	80247424	Single Port	Meter Only	86920910
ERROR	80297742	Gulf Breeze, FL	Validating	10/3/2019		77479160	Yes		86919243	2960 Cor	454	494	5/8x3/4"	3/4"	86919243	Single Port	Meter Only	86919243
86920924	80305944	Gulf Breeze, FL	Validating	10/3/2019		77478630	Yes		86920924	2866 Bay	155	161	5/8x3/4"	3/4"	80305944	Single Port	Meter Only	80305944
86919243	80297742	Gulf Breeze, FL	Validating	10/3/2019		77479165	Yes		86919243	2958 Cor	586	620	5/8x3/4"	3/4"	80297742	Single Port	Meter Only	86919243
86919420	80297282	Gulf Breeze, FL	Validating	10/3/2019		77479159	Yes		86919420	2964 Cor	287	130	5/8x3/4"	1"	80297282	Single Port	Meter Only	86919420
86919422	80297932	Gulf Breeze, FL	Validating	10/3/2019		77479163	Yes		86919422	2968 Cor	321	523	5/8x3/4"	3/4"	80297932	Single Port	Meter Only	86919422
86919421	80297498	Gulf Breeze, FL	Validating	10/3/2019		77479197	Yes		86919421	2970 Cor	484	47	5/8x3/4"	3/4"	80297498	Single Port	Meter Only	86919421

B. VEPO METERING shall be responsible for confirming AMI endpoints successfully communicate back to the head end of the AMI system.

C. VEPO METERING will conduct mandatory monthly workshops incorporating revised safety procedures, municipality updates, reinforcing Occupational Safety Health Administrative (OSHA) standards in the field and confined space rules and regulations

D. Field Technician will spend 40 hours in the field and home office including the call center to be crossed trained in all functional areas of the business

E. Field Supervisors will have 30 hours of Occupational Safety Health Administration (OSHA) training and 8 hours specifically in confined space entry training

F. Field technicians will have minimally 10 hours of Occupational Safety Health Administration (OSHA) training and 8 hours specifically in confined space entry training

G. To assure quality, VEPO METERING will randomly call customers and conduct field inspections on completed installations

Exhibit B - Preconstruction Meeting Agenda

Base Station Site

Installation

- Contractor site visit review
- Identified location for base station
- Base station mounting discussion
- Breaker panel for base station discussion
- A/C power availability
- Is permitting required?

Data Back Haul

- Data back haul method

Utility / Billing Information

- Utility to identify Project Manager / Single point of Contact
  - All communication will be coordinated through this person
- Utility to provide CIS contact
  - Work with manufacturer to develop import file and Billing Export file
    - Import file pulls data from CIS system into analytics software
    - Billing Export file pulls reads from MDM and uploads into CIS system

Field Installation

- Meter Installation Contractor Discussion
  - Contractor to identify Field Manager to coordinate daily activities
- Utility and Core & Main to designate the installation information to collect
  - Old Meter ID Number
  - Old Meter Read
  - New Meter ID Number
  - New Meter Size
  - New Smart Point Number
  - GPS coordinates

Field Installation (cont.)

- How will installation information be entered into CIS system?
  - Manual
  - Electronic
- Utility to provide C & M the billing file containing customer information

- Location for storing meters
- What happens to old meters?
- Process to sign out material for control purposes
- How to handle existing conditions
  - Leaks
  - Old Valves
  - Damaged pits
- Discuss Utility's position on non-compliant residents
- Acceptable hours of work
  - Start time
  - End time
  - Weekends acceptable?

Training

RNI Training

- To be scheduled with Utility
- 2 Day onsite training performed by Contractor
- Utility to provide name and email address for those who will need to access the RNI

Tentative Project Schedule (Varies by project)

- Week 1 – Base station delivered to local Core & Main branch
- Week 2 – Base station installed
- Week 3 – Manufacturer commissions base station and put on line
- Week 4 – Test meters installed to confirm integrity of the system
- Week 5 – Installations begin

SmartPoint 510M

Non-Pit Set Module

The SmartPoint® 510M Non-Pit Set Module is a radio transceiver that provides water utilities inbound and outbound access to water measurement and ancillary device diagnostics via radio signal. The SmartPoint 510M Module is designed for non-submersible/non-pit installations.

BENEFITS:

- Easily receives input from either walk-by/drive-by or fixed-base collection device
- Controls both deployment and lifetime operation costs
- Compact installation that saves time, space and money - without reducing system performance
- Delivers a fast, efficient, reliable connection at minimal cost
- Minimizes new infrastructure investment
- Enables effective leak detection

TouchCoupler Design

The SmartPoint 510M Module utilizes TouchCoupler, the patented Sensus inductive coupling communication platform, to interface with the encoded meter. With TouchCoupler, the SmartPoint 510M Module can connect to the meter using existing two-wire AMR installations instead of requiring utilities to access the home to install a new three-wire system. This results in a fast, efficient and reliable connection at minimal cost.

Operation

With its migratable, two-way communication ability, the M-Series SmartPoint functions as a walk-by/drive-by endpoint, fixed-base endpoint, or combination of the two. This flexibility increases utility data collection capabilities and streamlines operations. The SmartPoint 510M Module receives input from the meter register and remotely sends data to a walk-by/drive-by or fixed-base collection device. The SmartPoint 510M Module easily migrates from walk-by/drive-by to fixed base by simply installing a Base Station.

In walk-by/drive-by mode, the SmartPoint 510M Module collects data and awaits an activation signal from the Vehicle Gateway Basestation (VGB) or Hand-Held Device (HHD). Upon signal receipt, it transmits readings, the meter identification number and any alarms.

As a fixed-base endpoint, the SmartPoint 510M Module interacts with one or more strategically placed Base Stations located in the utility service area. Top of the hour readings and other diagnostics are instantly forwarded to the Regional Network Interface (RNI)™ at time of transmission. The FlexNet® communication network provides unmatched reliability by using expansive tower receiver coverage of metering end points, data/message redundancy, failover backup provisions and operation on FCC primary use (unshared) RF spectrum.

sensus
a xylem brand

SmartPoint 510M

Non-Pit Set Module

Powerful Transmission, Flexible Platform

The SmartPoint® 510M Non-Pit Set Module offers several advantages that control both deployment and lifetime operation costs. Its powerful, industry leading two watt transmitter broadcasts over large distances and minimizes collection infrastructure. And after the SmartPoint 510M Module is installed, its migratable, two-way system platform can be updated without requiring personnel to visit each meter and/or inconveniencing customers.

Additional SmartPoint 510M Module Features

The SmartPoint 510M Module obtains hourly readings and can monitor continuous flow over a programmable period of time, alerting the utility to leak conditions. In addition, the SmartPoint 510M Module stores up to 840 consumption intervals (35 days of hourly consumption), providing the utility with the ability to extract detailed usage profiles for consumer information and dispute resolution. The SmartPoint 510M Module also incorporates a two-port design, allowing the utility to connect multiple registers and ancillary devices (such as acoustic monitoring) to a single SmartPoint. This results in a compact installation that saves time, space and money – without reducing system performance.

Specifications

Service	Wall mounted (non-pit/non-submersible) installation interfacing the utility meter to the Sensus FlexNet system.
Physical characteristics	Width: 5 9/16" x Height: 5 1/2" x Depth: 3"
Weight	1.13 lbs/18.08 oz
Color	Tan
Frequency range	900 – 950 MHz, 8000 channels X 6.25 kHz steps
Modulation	Proprietary Narrow Band
Memory	Non-Volatile
Power	Lithium Thionyl Chloride batteries
Approvals	US: FCC CFR 47: Part 24D, Part 101C, Part 15 Licensed operation Canada: Industry Canada (IC) RSS-134, RSS-119
Operating temperature	- 22° F to +185° F - 30° C to + 85° C
Options	Dual or single port availability; TouchCoupler only, wired only
Installation environment	The 510M is designed for side-of-home applications where it is not subject to submergence.
Compatibility	TouchCoupler and Wired Version: Sensus Encoder Registers, Badger ADE water registers, Master Meter AccuLinx, and Hersey Translator (approved TR/PL Lead) Wired Version Only: Elster Encoder (Sensus protocol), Neptune ARB VI (ProRead), Hersey Translator, Zenner PMN Nitro 01, McCrometer flowcom FC100-00M, and Kamstrup flowIQ 2100 Refer to the 510M/520M SmartPoint® Module Water Meter and Ancillaries Compatibility Quick Guide for the latest compatibility information.
Warranty	20 years – Based on six transmissions per day. Refer to Sensus G-500 for warranty.

SENSUS
a xylem brand

637 Davis Drive
Morrisville, NC 27560
1-800-638-3748
sensus.com

SmartPoint 520M

Pit Set Module

The SmartPoint® 520M Pit Set Module is a radio transceiver that provides water utilities inbound and outbound access to water measurement and ancillary device diagnostics via radio signal. The SmartPoint 520M is designed for submersible, pit-set environments.

BENEFITS:

- Easily receives input from either walk-by/drive-by or fixed-base collection device
- Controls both deployment and lifetime operation costs
- Compact installation that saves time, space and money - without reducing system performance
- Delivers a fast, efficient and reliable connection at minimal cost
- Minimizes new infrastructure investment
- Enables effective leak detection

TouchCoupler Design

The SmartPoint 520M Module utilizes TouchCoupler, the patented Sensus inductive coupling communication platform, to interface with the encoded meter. With TouchCoupler, the SmartPoint 520M Module can connect to the meter using existing two wire AMR installations instead of requiring utilities to access the meter to install a new three-wire connection. This results in a fast, efficient and reliable connection at minimal cost.

Operation

With its migratable, two-way communication ability, the M-Series SmartPoint functions as a walk-by/drive-by endpoint, fixed-base endpoint, or combination of the two. This flexibility increases utility data collection capabilities and streamlines operations. The SmartPoint 520M Module receives input from the meter register and remotely sends data to a walk-by/drive-by or fixed-base collection device. The SmartPoint 520M Module easily migrates from walk-by/drive-by to fixed base by simply installing a Base Station.

In walk-by/drive-by mode, the SmartPoint 520M Module collects data and awaits an activation signal from the Vehicle Gateway Basestation (VGB) or Hand-Held Device (HHD). Upon signal receipt, it transmits readings, the meter identification number and any alarms.

As a fixed-base endpoint, the SmartPoint 520M Module interacts with one or more strategically placed Base Stations located in the utility service area. Top of the hour readings and other diagnostics are instantly forwarded to the Regional Network Interface (RNI)™ at time of transmission. The FlexNet® communication network provides unmatched reliability by using expansive tower receiver coverage of metering end points, data/message redundancy, failover backup provisions and operation on FCC primary use (unshared) RF spectrum.

sensus
a xylem brand

SmartPoint 520M

Pit Set Module

Powerful Transmission, Flexible Platform

The SmartPoint® 520M Pit Set Module offers several advantages that control both deployment and lifetime operation costs. Its powerful, industry-leading two watt transmitter broadcasts over large distances and minimizes collection infrastructure. And after the SmartPoint is installed, its migratable, two-way system platform can be updated without requiring personnel to visit each meter and/or inconveniencing customers.

Additional Smartpoint 520M Module Features

The SmartPoint 520M Module obtains hourly readings and can monitor continuous flow over a programmable period of time, alerting the utility to leak conditions. In addition, the SmartPoint stores up to 840 consumption intervals (35 days of hourly consumption), providing the utility with the ability to extract detailed usage profiles for consumer information and dispute resolution. The SmartPoint also incorporates a two-port design, allowing the utility to connect multiple registers and ancillary devices (such as acoustic monitoring) to a single SmartPoint. This results in a compact installation that saves time, space and money - without reducing system performance.

Specifications

Service	Pit set installation interfacing the utility meter to the Sensus FlexNet communication network. Unit requires 1.75" diameter hole in pit lid; fits pit lid thicknesses up to 1.75"
Physical characteristics	Width: 4.43" x Height: 5.09" x Depth: 3"
Weight	1.0 lbs/16.0 oz
Color	Black
Frequency range	900 – 950 MHz, 8000 channels X 6.25 kHz steps
Modulation	Proprietary Narrow Band
Memory	Non-Volatile
Power	Lithium Thionyl Chloride batteries
Approvals	US: FCC CFR 47: Part 24D, Part 101C, Part 15 Licensed operation Canada: Industry Canada (IC) RSS-134, RSS-119
Operating temperature	- 22° F to +185° F - 30° C to + 85° C
Options	Dual or single port availability; TouchCoupler only, wired only
Installation environment	100% condensing, water submersible
Compatibility	TouchCoupler and Wired Version: Sensus Encoder Registers, Badger ADE water registers, Master Meter AccuLinx, and Hersey Translator (approved TR/PL Lead) Wired Version Only: Elster Encoder (Sensus protocol), Neptune ARB VI (ProRead), Hersey Translator, Zenner PMN Nitro 01, McCrometer flowcom FC100-00M, and Kamstrup flowIQ 2100 Refer to the 510M/520M SmartPoint® Module Water Meter and Ancillaries Compatibility Quick Guide for the latest compatibility information.
Warranty	20 years – Based on six transmissions per day. Refer to Sensus G-500 for warranty.

sensus
a xylem brand

637 Davis Drive
Morrisville, NC 27560
1-800-638-3748
sensus.com

FlexNet M400B2 Base Station

Compact Point-to-Multipoint Base Station

The Sensus FlexNet® M400B2 Base Station offers a strategic communications option for public service providers with endpoints deployed in remote or densely populated areas.

FEATURES

- GPS receiver for time synchronization
- Duplexer for single antenna
- IP-addressable power supply with hot-swap capability
- 8-hour battery backup
- Alarms and reporting capability
- Backhaul via Ethernet/IP
- Heated battery for cold weather environments
- Modular construction for easy serviceability

APPLICATIONS

- Two-way Advanced Meter Infrastructure (AMI)
- Distribution Automation (DA)
- Demand Response (DR)
- Home Area Networks (HAN)
- Sensus VantagePoint® Lighting Control

The efficient transceiver can transmit and receive in a 200kHz band of spectrum. 200kHz enables more dedicated channels, resulting in higher network capacity, allowing more granular data and more channels of data. And the Sensus FlexNet communication network delivers double the transmit power of competitive systems over primary-use licensed spectrum – ensuring reliability for mission critical applications.

The tower-based architecture enables reliable communication of status and usage information with fewer access points than other network architectures. These compact, efficient base stations fit in space-constrained environments and require no air conditioning.

Licensed Radio Spectrum

In North America, FCC/IC protected primary-use spectrum avoids competition with other wireless services, interference from other radio devices and the risk of being taken over by emergency service providers

Fewer Access Points

Our point-to-multipoint architecture directly connects base stations to endpoints over large geographic areas – greatly reducing the number of network backhaul connections as well as O&M costs

Resilient Network Design

Sensus Base Stations continue to provide real time data during outages and emergencies because of eight hour plus battery backup – enabling better workforce management and faster service restoration

Small Footprint

Flexible pole or wall-mounting options enable strategic deployment with a discreet appearance

Industry Leading Security

Sensus has achieved GE/Wurldtech™ Achilles® communications certification for critical infrastructure security against cyber threats

FlexNet® M400B2 Base Station

Compact Point-to-Multipoint Base Station

Properties

Receive bandwidth	200 KHz
Transceivers	Single
Spectrum	Licensed 900 MHz PCS/MAS
Duplexing	Single transmit Sixteen receivers - simultaneous/dedicated
Applications	Single
Expandability	No
Compatibility	SNMP
FlexNet	Requires RNI 3.x or newer

Enclosures - Outdoor - Pole/Wall Mount

Height	22" (55.9 cm)
Width x Depth	22" (55.9 cm) x 10.5" (26.7 cm)
Capacity	One transceiver
Temperature	-40° to +122° F (-40° to +50° C)
Voltage	120 VAC
Battery backup	8 hours
NEMA rating	4
Air conditioned	No

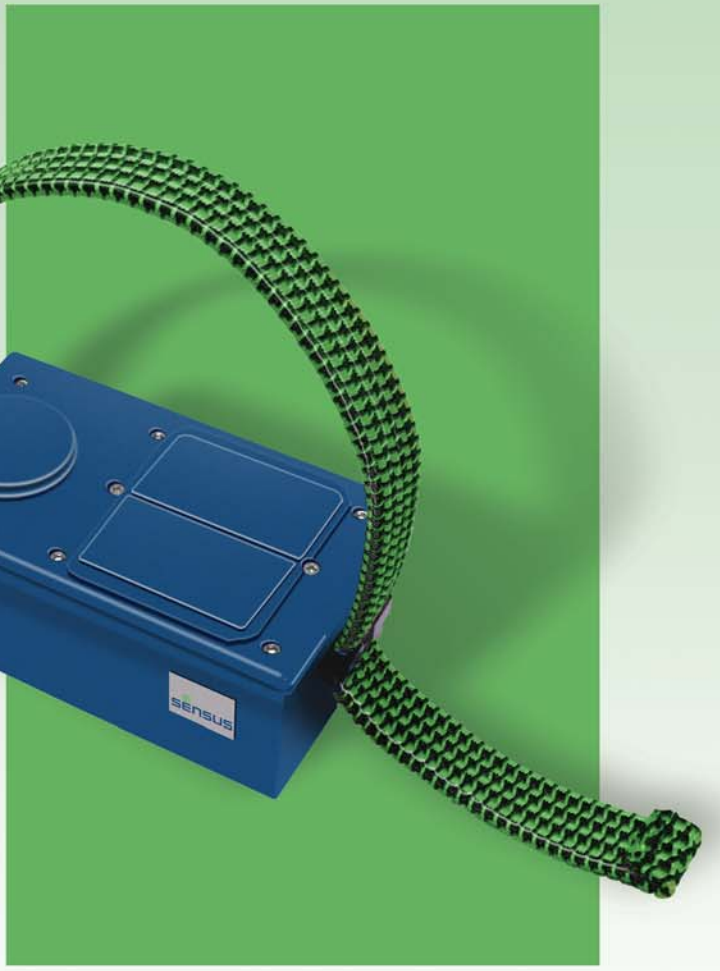
SENSUS
a xylem brand

8601 Six Forks Rd, Ste 700
Raleigh, NC 27615
1-800-638-3748
sensus.com

FLEXNET CommandLink

You're in command.

The FlexNet® CommandLink is a wireless interface that allows utility personnel to access a complete suite of functional controls within a gas, water or electric SmartPoint. The Bluetooth-enabled CommandLink directs the SmartPoint's activation, programming, and diagnostic settings as well as performing on-demand interrogation of the device. CommandLink is capable of communicating with any Hand-Held Device (HHD) enabled with Bluetooth technology, Windows Mobile 6 GPS and 50 MB of available memory as well as laptop computers with Windows XP or Windows Vista, Bluetooth technology and GPS. What's more, this versatile device features rechargeable, field replaceable batteries giving technicians the power to program up to 250 SmartPoints over a two-day period on a single charge. CommandLink System Software includes a simple programmer for ad hoc programming and a route programmer for more structured programming.



Programming:

It couldn't be simpler. Following the physical installation of the SmartPoint, position the CommandLink on the SmartPoint (use the included strap to hold CommandLink in place, if necessary). CommandLink will automatically connect to the HHD or Laptop Computer via Bluetooth wireless technology, allowing personnel to communicate with the SmartPoint and begin the programming process. If programming adjustments are necessary, just follow the simple programming instructions displayed on the HHD or Laptop Computer screen.

Troubleshooting-one-call resolution

CommandLink provides instant access to the SmartPoint's programmed and stored information. With just a few keystrokes, the operator can pull setup information, validate readings, and verify or reprogram settings for optimal performance. You get immediate results. When finished, the CommandLink will initiate communication between the SmartPoint and TGB. Transmit reading, setup, binding or alarm information directly to the database, providing instant confirmation of any changes.

CommandLink

CommandLink Specifications

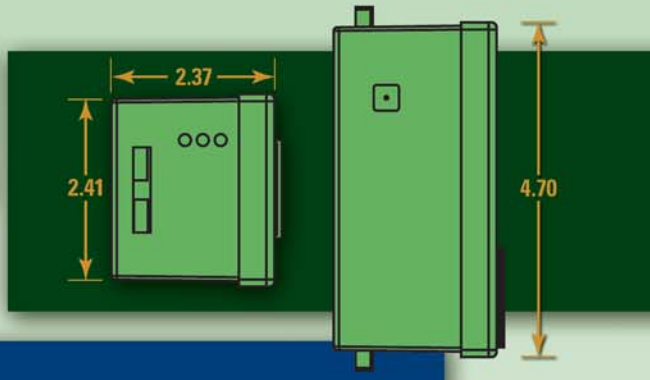
Primary Function

Electronic tool permitting on-site wireless installation, interrogation and programming of FlexNet water and gas SmartPoints.

Physical

Length	Width	Height	Weight
4.7"	2.41"	2.37"	16 oz.

Exterior: high-impact, injection-molded plastic
Strap: elasticized "bungee" material
Accessories: AC/DC charger (included)



Environmental

	MIL-STD 810F			Method
Temperature – shock	-20° – 103° F			503.4
Temperature – storage	-31° – 140° F			501.4
Temperature – operation	-20° – 130° F			501.4
Humidity	90% rel. -29/+54			507.4
Water	Procedure I			512.4
Drop	No.	Ht.	surface	temp.
	6	5 ft.	concrete	-20° F
	5	5 ft.	concrete	70° F
	6	5 ft.	concrete	130° F
				516.5
Sand/Dust	Procedures I, II; IEC-529-IP-X6			510.3

Electrical

Batteries:	Three (3) "AA" rechargeable or Energizer brand disposable NH-15AA
Replaceable:	Yes
AC Charger:	Yes
DC Charger	Yes
Charge Time:	Approximately 4 hours
Indicators:	LED; power, Bluetooth communication, charging
Firmware:	Upgradable via Bluetooth interface

RF Communication

CommandLink complies with FCC Part 15, FCC Part 15 Class B and Canadian ICES-003 requirements.

Bluetooth:	Class 2
Sensus:	Inductive at SmartPoint, TouchRead capable

Hand-Held Compatibility

	Windows Mobile6®	USB Interface	Bluetooth®
Sensus AR5500[1]	X	X	X
Trimble Nomad[1]	X	X	X
Juniper Archer[1]	X	X	X

[1]HHDs listed at left are capable of completing 250 installations over a two day period on a single charge. Other HHDs that meet the Hand-Held Compatibility requirements must have 50 MB of internal memory to operate CommandLink software; however, battery life may not meet the Sensus standard of 250 intallations.

SENSUS

www.sensus.com

FieldLogic

Handheld Software

Description

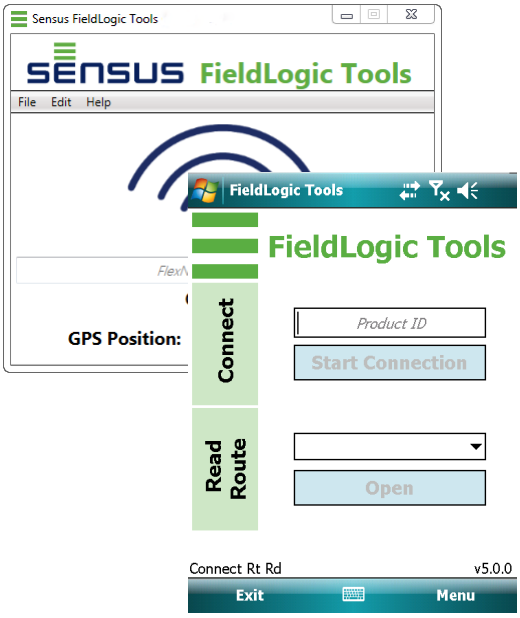
FieldLogic is a suite of tools designed to simplify programming and reading Sensus endpoint devices.

Benefits of FieldLogic include:

- Easy management of multiple handheld devices
- A fast and simple one-step installation process
- Simultaneous RadioRead and SmartPoint device reading
- Improved business process integration with a work order tool interface

FieldLogic Software contains two applications: FieldLogic Hub and FieldLogic Tools.

- FieldLogic Hub is a PC-based application for device configuration and route management setup
- FieldLogic Tools is a handheld or PC-based application for working with SmartPoint® devices and meters and route reading.
- FieldLogic Tools replaces the existing handheld functionality in AutoRead, FlexPro, UniPro and SMSHHApp tools.



Features

FIELDLOGIC HUB

Hub allows utilities to manage multiple handheld devices which in turn configure/read SmartPoint or RadioRead modules. Hub manages devices, configuration bundles, and the import/export of routes.

Configuration bundles are set up prior to fieldwork by the utility to control the handheld functionality and configuration of endpoints. This reduces the time it takes to accomplish tasks in the field such as reading meters, new installation, or meter changes.

Routes can be imported from a billing system, loaded on to a handheld, read, and then exported back through Hub to a billing system.

FIELDLOGIC TOOLS: CONNECT

Connect communicates with and programs Sensus endpoints. Connect uses Bundles to preconfigure the options installers see when setting up Sensus endpoints in the field. This simplifies the installation process, improving the speed at which installers can perform their job while decreasing the opportunity for errors. Connect also is used to deactivate and troubleshoot endpoints.

FIELDLOGIC TOOLS: READ ROUTE

Read Route is used to collect meter reading data from Sensus endpoints. It provides field personnel with route information along with other pertinent information the utility configures. Alarms are provided in the field, allowing problem investigation to occur while field personnel are at the location. The tool supports simultaneous reading of SmartPoint, RadioRead and TouchRead technologies, eliminating the need for field personnel to carry multiple devices.

For more information, visit us at **sensus.com**

8601 Six Forks Road, Suite 700
Raleigh, NC 27615
1-800-638-3748

Regional Network Interface (RNI)™

The nerve center of your FlexNet® communication network

The Regional Network Interface (RNI) is the head end system for the FlexNet communication network. The RNI manages communications by reading and delivering near real-time data, providing a window into the field. Communicating with end points, the RNI continuously gathers and processes device and network data, providing you with status updates and storing or sending data to other systems including your CIS, MDM, OMS and Sensus Analytics. From the data received, you can monitor the operation of meters, base stations, and the various RNI components to ensure timely and accurate billing for services. Priority alarms are delivered immediately, and onboarding diagnostic tools optimize performance by monitoring and managing system health.

RNI COMPONENTS

- **Hardware:** Whether licensed and hosted onsite at your facility, or in one of our data centers through a managed services partnership, servers are part of the RNI, used to host multiple components. Configuration varies with the size, structure and data needs of your network (e.g. number of end points, number of base stations, message duplication rate, base station to meter density).
- **Database:** This is the primary system of record for information consumed and produced by FlexNet. The database contains data such as meter read information and end point configuration information.
- **Software:** a suite of intuitive applications used to manage FlexNet.

RNI software applications

The RNI software applications are used to monitor and maintain the FlexNet AMI communication solution. Core functions include:

- **Configure:** set up of the devices and network settings; manage user access and security settings.
- **Monitor:** observe, detect and record network status using charts and graphs.
- **Tune:** make adjustments for proper system operation.
- **Troubleshoot:** analyze monitoring data and alerts to maintain proper network operation.
- **Optimize:** perform firmware and configuration downloads, and maximize the efficiency and speed of your network.

SENSUS a xylem brand

Regional Network Interface (RNI)

The nerve center of your FlexNet communication network

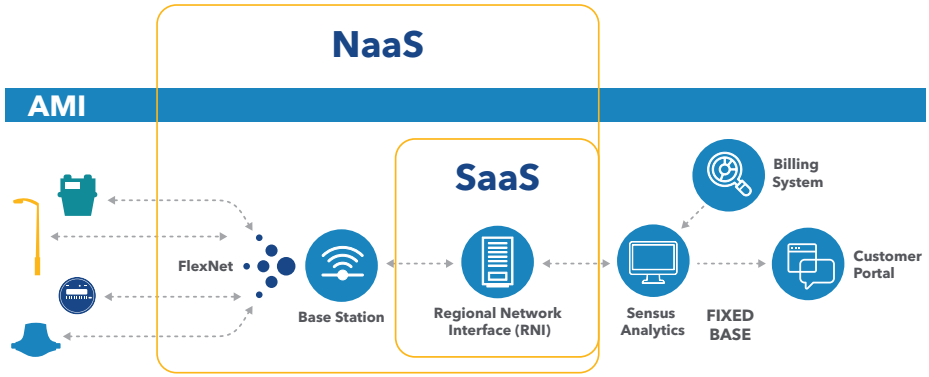
Optional Managed Services

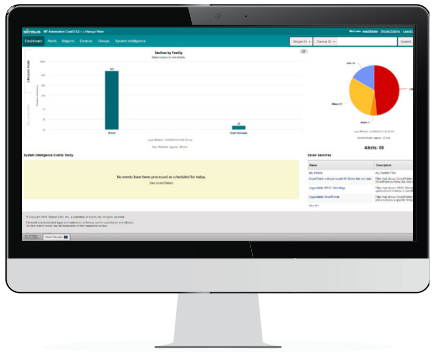
You have choices for hosting and managing the RNI. We can install the RNI at one of your data centers or other climate controlled environment. Or, with our **Software as a Service (SaaS)** offering, Sensus hosts the RNI through a secure cloud-based solution. When you select a SaaS model, we provide all the hardware and software required to operate the RNI through world-class, Tier IV data centers.

To take it a step further, you have the option to own and manage your base stations or allow Sensus to do it for you with our **Network as a Service (NaaS)** offering. With NaaS, all network base stations, firmware RF spectrum and system health are managed and maintained 24/7/365 by our Network Operations Center (NOC) engineers.

RNI BENEFITS

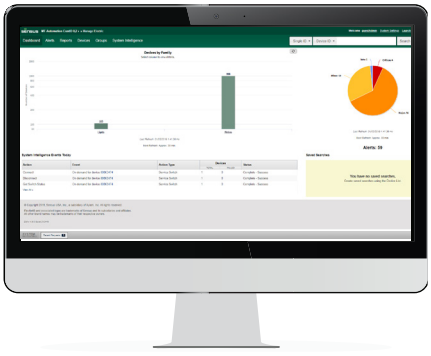
- Receive reliable, accurate device data to support billing and data analytics.
- Configure end points over the air.
- Operate more efficiently.
- Monitor and optimize system performance.
- Manage system security.





Water

Gas



Electric

The RNI Device Manager dashboard view displays meters, alarms and pending jobs.

sensus
a xylem brand

8601 Six Forks Rd, Ste 700
Raleigh, NC 27615
1-800-638-3748
sensus.com

TouchRead® Handheld Device

Model AG6590 AutoGun

The TouchRead® Model AG6590 AutoGun is a multifunction, versatile meter reading device designed to reach hard to read meters. The AutoGun provides on-site electronic meter interrogation from TouchRead® System equipped meters. It can be used as a standalone reading device or can be connected to a Sensus handheld device (FL6500, AR5500) or Trimble Nomad for reading Sensus and other register encoders. The AutoGun can also pull iPERL® interval data when connected to handheld devices.

FEATURES

- Ergonomic design
- Bluetooth® enabled for connectivity with hand-held devices
- LCD Display
- Menu driven
- Rugged outer case

BENEFITS

- Improves meter reading accuracy
- Automates meter reading process
- Enables wire-free meter reading
- Minimizes your exposure to hazardous or challenging environments
- Retrieves iPERL interval data

Design & Construction

The AutoGun's ergonomic design provides a well-balanced, easy to handle unit. The AutoGun is housed in a weather resistant molded case. Surface mounted circuitry in the specially designed watertight case allows the AutoGun to be used in rugged field conditions over a wide range of temperatures.

Communications

The AutoGun uses a Bluetooth® link to communicate to handheld devices. This link transfers meter readings to the device without the use of awkward cables. A communications port is present in the event that Bluetooth communication is interrupted.

Display

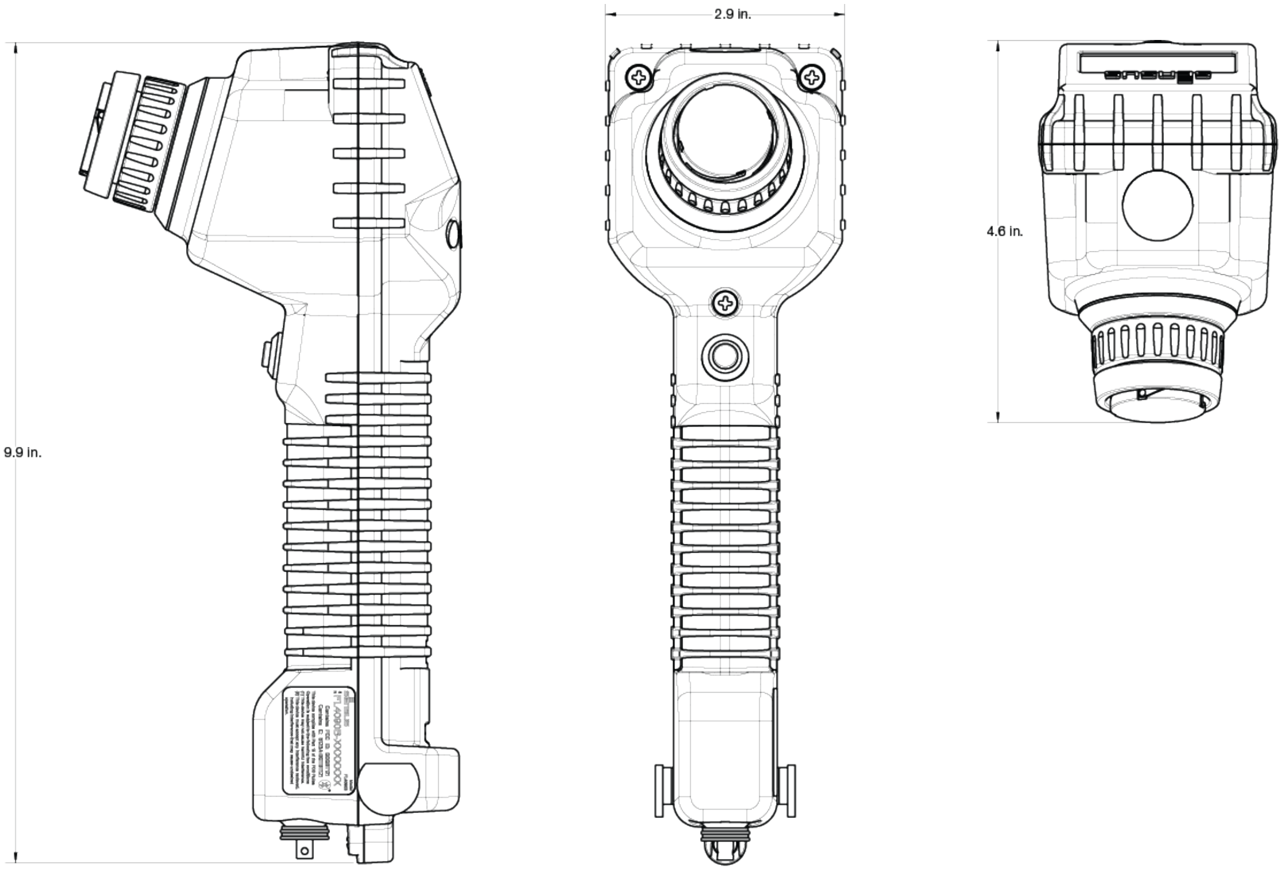
The AutoGun display is a graphical Liquid Crystal Display (LCD) that displays readings, identification numbers, and error messages. For ease of viewing, the contrast value of the LCD automatically adjusts based on the ambient temperature. A battery icon allows the user to see how much battery life remains. The AutoGun is menu driven, enabling it to be configured for individual use. The menu setup allows the user to select communications meter type and reading type.

PitProbe Extension

The AutoGun has a PitProbe extension accessory that allows the user to read meters in underground pits and vaults while avoiding back or leg strain.

TouchRead® Handheld Device

Model AG6590 AutoGun



General

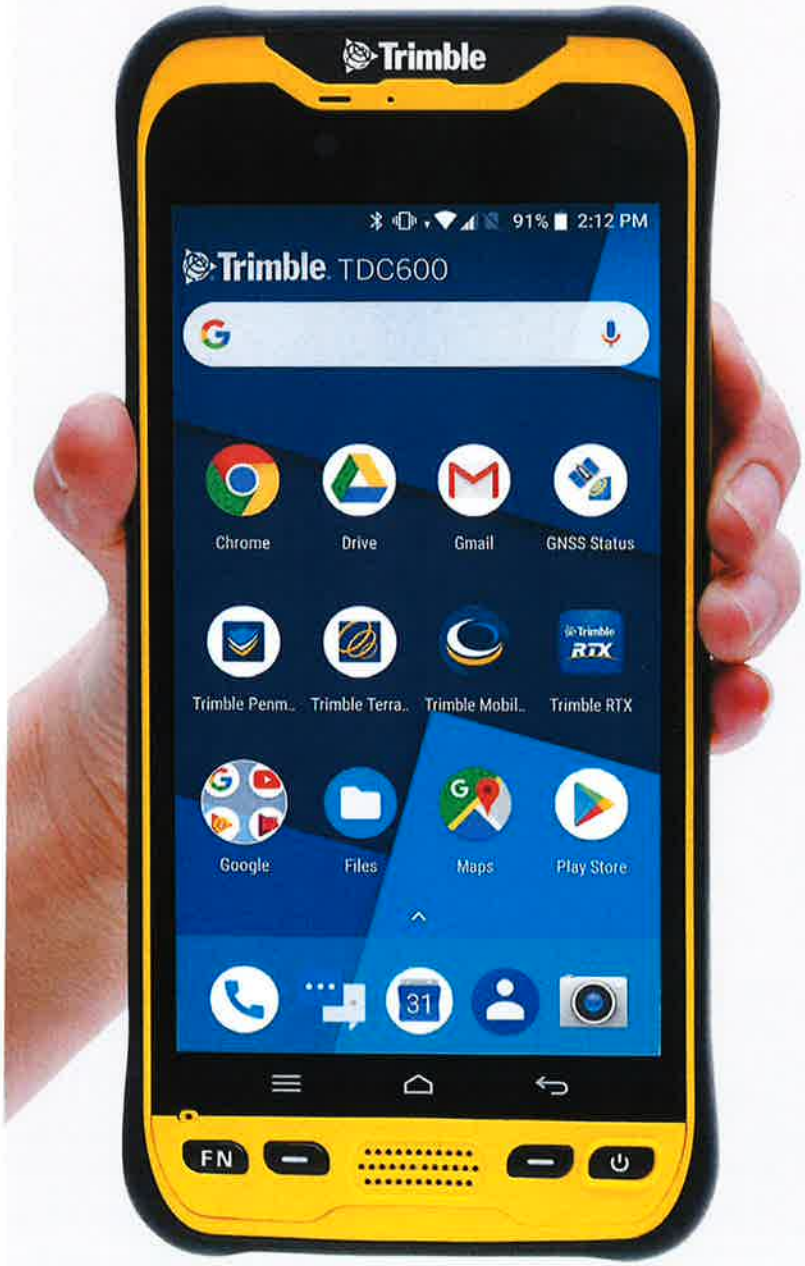
Service	The AutoGun can be used as a standalone unit to read and store up to 99 electronic readings, or as a mated device that interrogates, encodes and sends data to a handheld device which collects and stores it in memory.
Physical Characteristics	Ergonomically molded gray case with slip-resistant grip.
Dimensions	9.9” (254mm) L x 2.9” (73.66m) H x 4.6” (116.84mm) W
Weight	AutoGun = 0.85 lb. (386 grams) PitProbe Extension = 0.50 lb. (227 grams)
Display	4 lines x 16 character graphical LCD display
Power Supply	Rechargeable NiCad battery
Housing	Tested to withstand being dropped on any surface from a four foot height without damage.
Reading Compatibility	Able to read Sensus Encoders and Neptune Proread (ARB VI) encoders. Contact Sensus for additional reading options.
Charging	AR550X, FL650X or Wall Mount Unit

SENSUS

8601 Six Forks Road
Suite 700
Raleigh, NC 27615
1-800-638-3748
sensus.com

Trimble TDC600

HANDHELD



KEY FEATURES

- All-in-one GNSS data collector and smartphone
- Android™ 8.0 operating system
- 6-inch high resolution sunlight-readable display
- Powerful Qualcomm® processor with 4 GB RAM and 64 GB internal storage
- Large capacity, user replaceable all day battery
- Real-time positioning with built-in GNSS receiver
- Google Mobile Services certified with access to Google Play™ store apps
- Ultra-rugged design with MIL-STD-810G certification
- 4G LTE, Wi-Fi, Bluetooth® connectivity options for voice calls and data
- Ergonomic, lightweight and slim form factor
- Front- and rear-facing cameras
- Supports the Trimble® Catalyst™ service and Trimble R Series GNSS receivers
- Runs Trimble TerraFlex™, Trimble Access™, third-party or custom-developed field applications

Learn more:
geospatial.trimble.com/tdc600

Trimble TDC600 HANDHELD

STANDARD FEATURES

SYSTEM

- Integrated 4G cellular data, text and voice capability
- 5 MP front camera and 13 MP rear camera
- Bluetooth v 4.1
- Wi-Fi IEEE 802.11 a/b/g/n/ac, 2.4 GHz / 5 GHz dual-band
- 6.0 inch LED-backlight screen with capacitive multi-touch
- Long-life user replaceable Li-Ion battery
- 2.2 GHz Qualcomm Snapdragon™ 626 processor
- 4 GB RAM
- 64 GB flash memory[1]
- 1 MicroSDHC memory card slot
- Integrated speaker and microphone

OPERATING SYSTEM

- Android 8.0 (Oreo)
- Languages available: Afrikaans, Azebaijani, Bulgarian, Czech, Danish, Dutch, English, Finnish, French, German, Greek, Hindi, Hungarian, Italian, Korean, Lithuanian, Norwegian (Bokmål), Polish, Portuguese (Portugal and Brazil), Romanian, Russian, Serbian (Cyrillic), Simplified Chinese, Spanish, Swedish, Turkish
- Software package includes: Google Mobile Services

COMMUNICATIONS[2]

- Cellular: GSM (850/900/1800/1900), WCDMA (B1/B2/B5/B8), LTE-FDD (B1/B2/B3/B4/B5/B7/B8/B12/B13/B17/B20/B25/B28), LTE-TDD (B38/B39/B40/B41), TD-SCDMA (B34/B39)
- Wi-Fi IEEE 802.11 a/b/g/n/ac
- Bluetooth 4.1
- NanoSIM x 2
- USB 3.0 (Type-C)
- NFC

STANDARD ACCESSORIES

- Hand strap
- A/C charger
- USB cable
- Lanyard

OPTIONAL ACCESSORIES

- External magnetic GPS antenna
- Pole bracket
- Replacement batteries

SOFTWARE COMPATIBILITY

Please refer to the Product Compatibility matrix (www.trimble.com/mappingGIS/productcompatibility)

TECHNICAL SPECIFICATIONS

PHYSICAL

Size	196 mm x 93.4 mm x 17.2 mm (7.7 in x 3.6 in x 0.67 in)
Weight	0.38 kg (0.9 lbs)
Processor	Qualcomm Snapdragon 626, Octa-core, Clock frequency: 2.2 GHz
Memory	4 GB RAM
Storage[1]	64 GB
User Interface Keyboard	2 volume keys, power key 4 programmable keys, standard Android touch panel 3 buttons On screen keyboard
Battery	Li-Ion removable battery Standard capacity 8000 mAh
Battery life	15 hours @ 20° C with GPS on
Charging time	4 hours

ENVIRONMENTAL

Temperature	
Operating	-20 °C to +55 °C (-4 °F to +131 °F)
Storage	-40 °C to 70 °C (-40 °F to 158 °F)
Humidity	95% non-condensing
Water & Dust proof	IP67
Free drop	1.2 m (MIL-STD-810G)

INPUT/OUTPUT

Expansion	MicroSDHC memory card (up to 256 GB)
Display	Gorilla Glass 3, Optically bonded, AF coated, auto rotate
Size	6.0" capacitive multi-touch
Resolution	1920 x 1080
Brightness	500 Cd/m²
Audio	Built-in microphone and speaker Audio jack through USB-C Pogo pin connector
I/O	USB 3.0, external antenna connector
Digital camera	
Rear camera	13 MP with auto-focus and LED flash
Front camera	5 MP with fixed focus
Sensors	Ambient light sensor, digital compass, gyrometer, accelerometer, barometer

GNSS

GNSS Receiver	U-blox Neo-M8T
Internal antenna: 72 channels	GPS L1 C/A, GLONASS, BeiDou, SBAS
Integrated real-time	SBAS (WAAS/EGNOS/MSAS/GAGAN/QZSS)
Tri constellation system	GPS/GAL, GPS/GLO/GAL or GPS/BeiDou/GAL
External antenna connector	Yes
Protocol	Location Services NMEA output (optional)

ACCURACY SPECIFICATIONS (HORIZONTAL RMS)[3]

Real-time SBAS[4]	<1.5 m typical

1 The actual available capacity of the internal memory is less than the specified capacity because the operating system and default applications occupy part of the memory. The available capacity may change when you upgrade applications or the device.

2 Bluetooth, wireless LAN and cellular type approvals are country specific. Trimble TDC600 handheld has Bluetooth, wireless LAN and cellular approval in North America (excluding Verizon) and EU. For other countries, please consult your local Reseller.

3 Horizontal Root Mean Squared accuracy. Requires data to be collected using vertical mounting, minimum of 4 satellites, PDOP mask at 99, SNR mask at 12 dBHz, elevation mask at 5 degrees, and reasonable multipath conditions. Ionospheric conditions, multipath signals or obstruction of the sky by buildings or heavy tree canopy may degrade precision by interfering with signal reception.

4 SBAS (Satellite Based Augmentation System) includes WAAS (Wide Area Augmentation System) available in North America only, EGNOS (European Geostationary Navigation Overlay System) available in Europe only, and MSAS available in Japan only.

Specifications subject to change without notice.

CE Bluetooth®

Contact your local Trimble Authorized Distribution Partner for more information

NORTH AMERICA
Trimble Inc.
10368 Westmoor Dr
Westminster CO 80021
USA

EUROPE
Trimble Germany GmbH
Am Prime Parc 11
65479 Raunheim
GERMANY

ASIA-PACIFIC
Trimble Navigation
Singapore PTE Limited
3 HarbourFront Place
#13-02 HarbourFront Tower Two
Singapore 099254
SINGAPORE

1. Project Management

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
1.01	Vendor will assign a main point-of-contact as well as an onsite, full-time project manager. A chain of escalation shall be defined for critical or unresolved issues.	Y	Agree to Terms. A designated project manager will be identified and a QC process will be available. Reference 1.3 Staffing section of Technical response.	Y
1.02	Vendor will provide a dashboard that provides a weekly snapshot of project progress, network installation counts, and important issues.	Y	Agree to Terms. Installation contractor will have a website available for City to monitor progress. A detailed description will be available in the technical section of the RFP. Reference Appendix_10 Vepo MIU Installer.	Y
1.03	Vendor must receive City of Naperville approval to any changes in the project manager and other key project team roles.	Y	Agree to Terms. No work out of scope will be done without City approval.	Y
1.04	City of Naperville may, at its sole discretion, request a change in project manager or other key project team roles.	Y	Agree to Terms	Y
1.05	Vendor will participate in weekly project status meetings and periodic AMI Committee meetings (e.g., monthly).	Y	Agree to Terms. Weekly/monthly meeting TBD during pre-construction kick-off meeting.	Y

2. System Design

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
2.01	Vendor will provide information on their RF design approach including information on the loss link budget, transmit power, receiver sensitivity, etc.	Y	Sensus takes a superior approach to RF design by using CRC-Predict, the most widely used propagation model in the suite of radio wave prediction algorithms available in Mentum Planet. As a result, predictions of coverage gaps and interference areas are based on your particular terrain and are more likely to be accurate. Traditional approaches to radio-wave propagation that are empirical in nature are limited and cannot account for the infinite variety of landscapes. FlexNet Base Stations transmit up to 20 watts of power. They are also the most sensitive collector of any available on the market today, with the minimum detectable signal approaching theoretical limits. This sensitivity, coupled with overlapping base station coverage for data transmission from the meter, offers unmatched reliability and accessibility in hard-to-reach locations.	Y
2.02	Vendor will provide an RF coverage map detailing collectors necessary to cover 100% of City of Naperville meters, with at least 99.5% of meters having the ability to connect to at least two different collectors. Vendor needs to take into account access to power for collectors at their chosen location.	Y	The Sensus RF propagation model will show two or more basestations communicating with 99.71% of The City of Naperville's MIU's. Please see the notes section of Appendix 13_RF Propagation Study for notation of this requirement.	Y
2.03	Vendor will provide initial system designs for review and approval.	Y	As part of this proposal, we are providing initial system designs for review and approval.	Y
2.04	Once the system is deployed, vendor will provide drawings and other material showing the final system design (as built) for review and approval.	Y	After deployment, we will provide the final system design for review and approval.	Y
2.05	Discuss coverage approach for hard to reach meters. For cellular solutions specifically, identify how Vendor will approach service areas without ubiquitous cellular coverage.	Y	Reaching hard-to-read meters with the FlexNet system has been field-proven in cities across North America for years. In addition to our highly sensitive FlexNet M400B2 Base Stations, our low-cost FlexNet R100NA Collectors assist with communications in extremely challenging locations – for example, geographically hard-to-reach locations (urban or rural), sub-basements, and very deep subterranean locations. The R100NA collector is a low-cost, miniaturized, full-functioned, multichannel RF data collector.	Y
2.06	Vendor will support approximately 43,500 MIUs initially, with network capacity to support up to 60,000 MIUs.	Y	Sensus understands this requirement.	Y

3. Meter Interface Unit (MIU)

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
3.01	Vendors must be willing to sign a non-disclosure agreement with meter manufacturers to develop an integration of the proprietary meter alarms in the proposed AMI system	N	Sensus does not agree to this. A business discussion would be required with Sensus, the meter manufacture, and Naperville.	N
3.02	The MIU shall have the technical ability to wirelessly transmit water reads and other meter-related information to the collector.	Y	The water SmartPoint is capable of true two-way communication with the FlexNet base station. It transmits up to 2 watts of power to the FlexNet Base Stations with state-of-the-art, all digital modulation techniques. Read intervals may be adjusted to greater reading and transmitting frequencies over-the-air, if desired.	Y
3.03	The MIU shall provide secure two-way communication with authorized systems and devices. State the type of RF technology used (i.e., MIU frequency, type of modulation, MIU power, use of cellular, etc.).	Y	The Sensus FlexNet is a utility grade wireless network, that is purpose built for Naperville to enable secured two-way communication to standalone water meters via point-to-multipoint technology. The system uses primary-use, FCC-licensed RF spectrum in the 890-960 MHz range. Inbound messages transmit at up to 2 watts, while outbound messages transmit at up to 20 watts.	Y
3.04	MIU shall be able to accept updates or changes to the configuration via the AMI communications network.	Y	The FlexNet AMI system network supports remote upgrades and configuration for an individual or groups of FlexNet-enabled meters.	Y
3.05	MIU communications to the headend shall be encrypted and the utility shall be able to select the pre-shared key.	Y	Communications for meters on the FlexNet communication network can be encrypted using AES-256 encryption from end to end. Each meter has its own encryption key to prevent access to entire meter population with one key. Part of the security definition is to ensure keys are secure and randomly generated; therefore Sensus generates the keys.	Y
3.06	Describe compatibility with existing City of Naperville meters and proposed meters as well as the proposed AMI backhaul telecommunication system.	Y	Please see the Attachment 2: Compatibility Matrix. The FlexNet Base Stations are designed to be as flexible as possible when dealing with backhaul communications. The base stations support Transmission Control Protocol/Internet Protocol (TCP/IP) via a standard Register Jack 45 (RJ-45) Fast Ethernet connection, permitting a virtually limitless variety of backhaul options. Common backhaul options include Ethernet, Frame Relay, Multiprotocol Label Switching (MPLS), Integrated Services Digital Network (ISDN), Digital Subscriber Line (DSL), Very Small Aperture Terminal (VSAT), 3G/4G cellular, and microwave. The majority of FlexNet installations use DSL, cellular, and direct Ethernet connections for backhaul. It should be noted that any backhaul solution must provide less than 100-ms latency for efficient system operation, and minimum data speeds of 256 kbps. FlexNet Base Stations can be configured with a secondary access Ethernet port by using a Recommended Standard 232 (RS-232) to 10BaseT converter, and then using Serial Line Internet Protocol (SLIP) for the secondary connection. This configuration can be useful in the event that primary communication to the FlexNet Head End System is disrupted. Both primary and backup ports can be connected to existing network backhaul connections. Communications from the FlexNet Base Station to the	Y
3.07	Please indicate MIU interoperability with different types of telecommunication networks and meter brands.	Y	Please see Appendix 17_Water SmartPoint Compatibility Matrix.	Y
3.08	The MIU shall be interoperable with other sensor technology such as leak sensors and irrigation controllers without a major impact on battery life. Provide information on life reduction of the batteries for such applications.	Y	The Smart Gateway empowers Sensus customers to use a wide variety of third-party sensors to monitor water quality, water distribution pressure, stormwater, wastewater, and reclaimed water assets using the same FlexNet infrastructure.	Y

3.09	MIUs shall be compatible with pressure sensor technologies.	Y	The Smart Gateway permits compatibility with pressure sensors.	Y
3.10	All MIUs must have a unique ID (internal serial number and external network address) to be individually addressable. This number shall be visible on a permanently printed label or other means on the MIU.	Y	All SmartPoint MIUs have a unique identifier that can be individually addressed. The number is printed on the SmartPoint MIU.	Y
3.11	MIUs shall have the ability to transmit signals through pit lids. Specify which pit lid materials are compatible and non-compatible with the MIU. Specify which pit lids will require replacement.	Y	Sensus is capable of installing pit-set SmartPoints beneath pit lids. However, Sensus strongly recommends installing SmartPoints through the pit lid for optimal RF configuration. SmartPoints are compatible with all water meter pit lid materials that can be drilled through. The utility may prefer to swap out iron or cement lids for pre-drilled composite lids. The MIU requires a 1.75" diameter hole in the pit lid and fits pit lids with a thickness of up to 1.75".	Y
3.12	In the event pit lids need to be cut or drilled for improved RF propagation, describe method of antenna installation to prevent hazards such as tripping, mowing, and traffic rated where necessary, etc. Clearly indicate which pit lid types will require through the lid mounting vs. which can be under the lid. Provide a standard detail with a section view showing the elevation of the lid with respect to the antenna.	Y	Sensus recommends that the SmartPoint MIU be installed through the pit lid. The MIU is designed to be minimally invasive when installed through the meter pit lid. Newly purchased pit lids can be designed with the SmartPoint recessed into the lid. This design is most effective in this configuration and ensures transmission and reliability within the network. A section view can be found in the Technical Proposal document.	Y
3.13	The MIU shall be designed and built for installation in outdoor water meter boxes as well as above ground mounted discretely on a wall. Provide a photo of both configurations (including brackets if required).	Y	The SmartPoint MIU is available in pit-set and non- pit-set mounts. Configuration options and pictures can be found in the Technical Proposal document.	Y
3.14	The MIU shall be a single package design for rugged, harsh environments and capable of complete submersion in water without damage.	Y	The FlexNet Water SmartPoint is designed to operate without degradation to the battery in temperatures ranging from -22 to 185 degrees Fahrenheit. It is 100% condensing and water submersible. The Sensus TouchCoupler connection is a magnetic induction cable.	Y
3.15	The MIU must not interfere with utility's ability to read the meter display (digital or dial).	Y	The SmartPoint MIU does not interfere with the ability to read the digital display on the meter's register.	Y
3.16	The MIU shall have a minimum service life (including battery), of 20 years and a MIU failure rate (including battery failures) of less than 0.1% per year.	Y	FlexNet communication modules for electric meters have a failure rate of approximately 0.1% per year with an expected life of 20 years.	Y
3.17	Warranty for the MIU must be provided as a 20-year full replacement, including batteries. Vendor shall provide equipment warranties and guarantees with the effective start date for the warranty period shall be acceptance of installed equipment by City of Naperville. Vendors who make provisions for labor costs associated with premature battery failure will be favorably evaluated.	N	They are warranted at full replacement for the first 15 years of the system, and at a prorated rate for the remaining 5 years. The effective start date for the Sensus Limited Warranty is the date of Sensus shipment. Labor charges are not part of the standard warranty. Please see Appendix 6_Sensus Warranties.	N
3.18	The MIU shall provide "wake up" mode operation (or equivalent) to maximize battery life.	Y	The SmartPoint is shipped in a dormant state minimizing battery consumption and reducing RF transmissions when stored in a warehouse. The field tool can take the SmartPoint out of its dormant state. The head end or field tool can put the SmartPoint back into its dormant state. A secondary usage of dormant mode is a consumer opt-out program; the utility can put the meter into a dormant mode (it will not transmit) and not require utility to have to pull the SmartPoint from the residence.	Y
3.19	MIU shall provide battery end-of-life indicator alarm providing a minimum of 1-year notice that battery is nearing the end of its useful life.	Y	If the battery voltage is less than 3.3v, a low battery alarm is triggered at the SmartPoint. It is transmitted to the FlexNet Head End System, where it can trigger a low battery report. 3.3v notification battery longevity is estimated at 6 to 12 months.	Y

3.20	Upon request, Vendor must provide actual field performance data for proposed MIUs and batteries currently installed on operational systems and supply cumulative failure-in-time data for MIUs by manufacturer/model number.	Y	Upon request, Sensus will provide field performance data.	Y
3.21	Upon request, Vendor must provide statistical calculation of projected life including MTBF for proposed MIUs and batteries.	Y	Upon request, Sensus will provide the statistical calculation of projected life.	Y
3.22	The MIU shall store interval meter reads for 90+ days with data integrity until overwritten (i.e., loss of network communications or in the case of disaster). These reading shall be available through the AMI network or by some form of local reading connection.	N	FlexNet water SmartPoint communication modules store up to 35 days of hourly reads in non-volatile memory. Long term storage is best handled by the MDM system.	N
3.23	The MIU shall capture consumption data on an hourly basis, at minimum, without impacting stated battery warranties.	Y	The default MIU configuration captures consumption data every hour and transmits every four hours without impacting the battery warranty.	Y
3.24	The MIU shall be remotely programmable to capture consumption data on a five-minute basis. Note impact to battery life and warranty.	Y	Because of the battery impact it is recommended not to configure below one hour reads. Sensus does provide a MIU part number that enables reads less than one hour. The warrantee for this MIU is limited to one year.	Y
3.25	The MIU shall process notifications such as tamper, leak detection, backflow detection, and other key alarms.	Y	The SmartPoint MIU processes many critical alarms, including tamper and leak detection, low battery, and others.	Y
3.26	The MIU shall have security to prevent tampering as well as alerts to indicate potential tamper events. Tamper events shall be logged and timestamped. The MIU shall communicate tamper events to the AMI system as soon as they occur and trigger an alarm at the AMI head end. Meter tamper events shall be sent with a higher priority than normal status messages. Indications and information about the tamper event shall not be deleted or removed from the MIU until they have successfully transferred to the headend over the AMI network.	Y	The FlexNet system provides several alerts and flags as standard features for SmartPoint communication modules, including tamper alerts. Additionally, transmitting the SmartPoint ID and register IDs over the air prevents tampering or incorrectly recorded information from resulting in the delivery of reads to the wrong account. Many other AMI networks transmit only the register ID, which does not allow their radio and register mismatches to be identified without a site visit. The FlexNet system specifically reports any SmartPoint-register association that does not match what is in the customer's billing system database, and does not apply a reading to an account when the register ID does not match. **Tamper Exception Report**: Generated if tampering is detected at the transmitter or at the wire between the meter and transmitter. The SmartPoint transmits an alarm advising the utility that the connection between the register and the SmartPoint has been disabled. This feature allows the utility to investigate a tamper situation that may be present. The alarm is transmitted during the preprogrammed transmit intervals. **Meter Mismatch and Endpoint Mismatch Reports:** The SmartPoint Mismatch report alerts the utility if the register ID reporting from the field matches what is recorded in the CIS system, but the SmartPoint does	Y
3.27	MIU shall provide automatic alarm for detection of leak (with adjustable trigger parameters). This will include the ability to detect potential on-premises leaks (downstream of meter) making use of low flow meter accuracy with enough reads per day to indicate "no zero flow hours" over a configured period.	Y	The SmartPoint transmits several smart alarms so you can receive alerts and address issues before they become more costly. These alarms include tampering, low battery, customer leak, reverse flow, and high flow. There are a number of key FlexNet elements that support leak detection within the water distribution network. Leak sensors and battery operated pressure monitoring devices can be deployed on distribution mains to help reduce leaks.	Y
3.28	MIU shall have ability to indicate backflow or reverse flow. A timestamped flag or alarm shall indicate that backflow has occurred, even for low-volume events.	Y	The SmartPoint's Backflow alarm indicates that the endpoint detects water flowing in the reverse direction through the meter.	Y
3.29	The MIU shall send an alarm in the event of a meter encoder failure, loss of connectivity with the meter encoder, or persistent errors when trying to read the encoded register.	Y	The SmartPoint detects and reports to the head end under encoder failures and loss of communication with the meter encoder.	Y

3.30	The MIU's clock must be capable of synchronization to the national time standard, without visiting the site, to a tolerance of 5 seconds. Accuracy of better than 30 seconds shall be maintained even if the connection to the AMI network is lost for up to 90 days. Alarms shall be provided should the MIU ever have a time correction exceeding 60 seconds.	Y	The FlexNet exclusive "Middle Of Minute" (MOM) communications keeps the SmartPoint synchronized to within milliseconds of network time. If network is not available the SmartPoint will maintain time with minimal drift. Based on hardware parts selected, Sensus believes it can achieve the requirement.	Y
3.31	Firmware management must meet the following requirements: (1) MIU shall be able to accept and install software/firmware upgrades provided remotely in batch form via the AMI communications network. (2) MIU shall be able to accept and install software/firmware upgrades provided locally. (3) The utility has the ability to update and configure when appropriate. State how many over the air firmware upgrades have been released by Vendor in the past 10 years. State the impact on battery life of firmware upgrades.	Y	The Sensus AMI solution can perform OTA firmware upgrades, and has proven this with both IOU and Municipal customers. Additionally, firmware can be updated locally using FieldLogic Connect. The firmware upgrade process is executed in the background so that it does not interfere with normal data collection operations. The FlexNet system has the ability to perform batch firmware upgrades to utilities with up to 2.5 million SmartPoints. Ten firmware upgrades have been released since the SmartPoint became commercially available 8 years ago. Please note that utilities are not required to accept every version upgrade - it is up to you whether you choose to upgrade or not. As part of the battery life expectancy, Sensus built into the model five firmware downloads over the 20 year life of the SmartPoint.	Y
3.32	MIU shall support diagnostics to self-monitor RAM checksum error, ROM checksum error, hardware failure, memory failure, EPROM error, and battery fault.	Y	These alarms are available with the proposed solution.	Y
3.33	Vendor will have the ability for authorized Naperville technicians to remotely run tests and diagnostics on MIUs.	Y	SmartPoint communication modules continuously run diagnostic tests.	Y
3.34	Describe relevant AWWA/ANSI/FCC certifications for the MIUs.	Y	FCC CFR 47: Part 24D, Part 101C, Part 15. Meters conform to applicable AWWA/ANSI standards.	Y
3.35	MIU cabling shall have a standard minimum length of 18" with the ability to increase cabling length for non-standard installations (e.g., vaults).	Y	Sensus offers varying lengths of connector cable (up to 25 feet) that can be used to ensure that there is adequate cable length for any installation.	Y
3.36	Include the most recent commercially deployed version of Vendor's MIU and cable with Vendor's RFP response. If requested, MIUs will be returned to Vendor at the end of the RFP process.	Y	A sample MIU and cable is included with this RFP response.	Y

4. Collectors and Repeaters

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
4.01	Collectors, as part of the field area network (FAN), will securely and accurately gather reads from AMI meters in their coverage area and transport those reads over a backhaul network to the AMI headend.	Y	Sensus has a point-to-multipoint solution where the SmartPoint MIUs communicate directly with the base station. The base station securely and accurately relays reads to the head end system.	Y
4.02	Provide GIS map and details of any repeater or multi-hop network topology that is used either as part of the base design or that is available to mitigate coverage issues.	N/A	This is not applicable to the Sensus point-to-multipoint system.	N/A
4.03	Provide information on the use of alternative read methods to reach the meters and other devices (Bluetooth, cellular, drive-by, etc.).	Y	FlexNet SmartPoints are backward compatible, therefore, the SmartPoint module can communicate with the Sensus mobile Vehicle Gateway Basestation (VBG) as well as the Sensus handheld device without reprogramming the module. Due to the base station redundancy inherent in the FlexNet system design, data has multiple paths to the head end system. The City of Austin's RF design is such that, on average, each endpoint is covered by multiple FlexNet Base Stations.	Y
4.04	The AMI network will be capable of on-demand reads and status inquiry (pings or health checks) of meter devices. State the impact on battery life of the inquiries.	Y	As part of the battery life expectancy, Sensus accounted one on-demand request per month over the 20 year life of the SmartPoint.	Y

4.05	Network management, monitoring, performance reporting, and diagnostic tools will be provided to Naperville. This includes the ability to pull and review detailed event logs.	Y	This functionality is available and provided through the Sensus head end system.	Y
4.06	The collector shall support remote monitoring. Please describe the monitoring solution.	Y	FlexNet base stations continuously inform the head end of its status. Status information is available through the network monitoring tools. In addition, the head-end will use status information to infer base station health; if a base station is experiencing issues, the head-end can remove the base station from its routing list and use alternative base stations to reach the requested endpoints.	Y
4.07	The collector shall be capable of both local and remote access through SSH or a similar tool. Remote access shall be authenticated through RADIUS or other means.	Y	The utility can access the base station controls on site as well as remotely through secure telnet. For security purposes the user must present the proper authentication to access.	Y
4.08	The FAN and headend systems will meet applicable NIST and other cyber security requirements and be capable of compliance with evolving standards.	Y	The FlexNet Head End System uses NIST standards to achieve confidentiality across the FlexNet communication network. In addition, Sensus uses industry-standard APIs, including CIM flat files, to integrate with third-party applications.	Y
4.09	System shall support remote upgrades of software and firmware in FAN devices from the AMI headend.	Y	All meter and SmartPoint firmware is upgradeable and can be programmed remotely over the air. The FlexNet firmware solution supports the management of firmware versions across the entire deployment.	Y
4.10	System shall be able to integrate GIS data for each metering asset in to the database.	Y	GIS coordinates are transmitted to the FlexNet Head End System from the SmartPoint communication module. The latitude and longitude coordinates stored in the FlexNet Head End System can be provided to external applications through MultiSpeak or CMEP interfaces.	Y
4.11	The collector's clock must be capable of synchronization to the national time standard, without visiting the site, to a tolerance of 1 second. Alarms shall be provided should the collector ever have a time correction exceeding 5 seconds.	Y	FlexNet Base Stations are time-synced continually using GPS as the primary method, with SNTP as a backup.	Y
4.12	The collector shall be installed inside of an enclosure rated at least IP66 (fiberglass or plastic composite) with twist door handle and locking hasps. The enclosure shall have a small thermostatically controlled heater and an interior GFCI rated AC convenience outlet. The collector shall be rated for continuous operation in temperatures between -40 to +70C.	N	Base station enclosures have a hardened locking system with active door alarms that are fed directly to the FlexNet Head End System. The enclosure conforms to IP66 standards, and is rated for temperatures between -40º to +50º C. The base stations are not equipped with AC; the design does not require this.	N
4.13	Vendor shall provide installation warranties and guarantees for collectors with the effective end date of the warranty to be a period that will include one year-end from Naperville acceptance.	Y	Sensus warrants the FlexNet Base Station to be free from material defects or workmanship for a warranty period of 12 months from the date of shipment. Extended warranty periods are available.	Y
4.14	Collectors shall be equipped with a battery backup system that supports 8 hours of continual operation without the primary power source.	Y	If the base station loses power, then battery run time is 20 hours idle on receive only, and eight hours at 17% transmit duty cycle.	Y
4.15	Collectors shall be capable of self-reliant power during a power outage with a combination of a renewable energy source and/or battery. Vendor shall supply this as an option for all communication infrastructure.	Y	FlexNet Base Stations have battery backup in case of power loss. SmartPoint communication modules are battery-powered and thus are not affected by power outages.	Y
4.16	Street light collectors shall use ANSI C136.41, 7-Pin configuration taps. For installations where electrical service to the street light pole must be provided electric utility will provide pricing.	Y	The Sensus lighting VantagePoint module has an ANSI C136.41 NEMA socket interface.	Y

1. Project Management

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
1.01	Vendor will assign a main point-of-contact as well as an onsite, full-time project manager. A chain of escalation shall be defined for critical or unresolved issues.	Y	Agree to Terms. A designated project manager will be identified and a QC process will be available. Reference 1.3 Staffing section of Technical response.	Y
1.02	Vendor will provide a dashboard that provides a weekly snapshot of project progress, network installation counts, and important issues.	Y	Agree to Terms. Installation contractor will have a website available for City to monitor progress. A detailed description will be available in the technical section of the RFP. Reference Appendix_10 Vepo MIU Installer.	Y
1.03	Vendor must receive City of Naperville approval to any changes in the project manager and other key project team roles.	Y	Agree to Terms. No work out of scope will be done without City approval.	Y
1.04	City of Naperville may, at its sole discretion, request a change in project manager or other key project team roles.	Y	Agree to Terms	Y
1.05	Vendor will participate in weekly project status meetings and periodic AMI Committee meetings (e.g., monthly).	Y	Agree to Terms. Weekly/monthly meeting TBD during pre-construction kick-off meeting.	Y

2. System Design

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
2.01	Vendor will provide information on their RF design approach including information on the loss link budget, transmit power, receiver sensitivity, etc.	Y	Sensus takes a superior approach to RF design by using CRC-Predict, the most widely used propagation model in the suite of radio wave prediction algorithms available in Mentum Planet. As a result, predictions of coverage gaps and interference areas are based on your particular terrain and are more likely to be accurate. Traditional approaches to radio-wave propagation that are empirical in nature are limited and cannot account for the infinite variety of landscapes. FlexNet Base Stations transmit up to 20 watts of power. They are also the most sensitive collector of any available on the market today, with the minimum detectable signal approaching theoretical limits. This sensitivity, coupled with overlapping base station coverage for data transmission from the meter, offers unmatched reliability and accessibility in hard-to-reach locations.	Y
2.02	Vendor will provide an RF coverage map detailing collectors necessary to cover 100% of City of Naperville meters, with at least 99.5% of meters having the ability to connect to at least two different collectors. Vendor needs to take into account access to power for collectors at their chosen location.	Y	The Sensus RF propagation model will show two or more basestations communicating with 99.71% of The City of Naperville's MIU's. Please see the notes section of Appendix 13_RF Propagation Study for notation of this requirement.	Y
2.03	Vendor will provide initial system designs for review and approval.	Y	As part of this proposal, we are providing initial system designs for review and approval.	Y
2.04	Once the system is deployed, vendor will provide drawings and other material showing the final system design (as built) for review and approval.	Y	After deployment, we will provide the final system design for review and approval.	Y
2.05	Discuss coverage approach for hard to reach meters. For cellular solutions specifically, identify how Vendor will approach service areas without ubiquitous cellular coverage.	Y	Reaching hard-to-read meters with the FlexNet system has been field-proven in cities across North America for years. In addition to our highly sensitive FlexNet M400B2 Base Stations, our low-cost FlexNet R100NA Collectors assist with communications in extremely challenging locations – for example, geographically hard-to-reach locations (urban or rural), sub-basements, and very deep subterranean locations. The R100NA collector is a low-cost, miniaturized, full-functioned, multichannel RF data collector.	Y
2.06	Vendor will support approximately 43,500 MIUs initially, with network capacity to support up to 60,000 MIUs.	Y	Sensus understands this requirement.	Y

3. Meter Interface Unit (MIU)

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
3.01	Vendors must be willing to sign a non-disclosure agreement with meter manufacturers to develop an integration of the proprietary meter alarms in the proposed AMI system	N	Sensus does not agree to this. A business discussion would be required with Sensus, the meter manufacture, and Naperville.	N
3.02	The MIU shall have the technical ability to wirelessly transmit water reads and other meter-related information to the collector.	Y	The water SmartPoint is capable of true two-way communication with the FlexNet base station. It transmits up to 2 watts of power to the FlexNet Base Stations with state-of-the-art, all digital modulation techniques. Read intervals may be adjusted to greater reading and transmitting frequencies over-the-air, if desired.	Y
3.03	The MIU shall provide secure two-way communication with authorized systems and devices. State the type of RF technology used (i.e., MIU frequency, type of modulation, MIU power, use of cellular, etc.).	Y	The Sensus FlexNet is a utility grade wireless network, that is purpose built for Naperville to enable secured two-way communication to standalone water meters via point-to-multipoint technology. The system uses primary-use, FCC-licensed RF spectrum in the 890-960 MHz range. Inbound messages transmit at up to 2 watts, while outbound messages transmit at up to 20 watts.	Y
3.04	MIU shall be able to accept updates or changes to the configuration via the AMI communications network.	Y	The FlexNet AMI system network supports remote upgrades and configuration for an individual or groups of FlexNet-enabled meters.	Y
3.05	MIU communications to the headend shall be encrypted and the utility shall be able to select the pre-shared key.	Y	Communications for meters on the FlexNet communication network can be encrypted using AES-256 encryption from end to end. Each meter has its own encryption key to prevent access to entire meter population with one key. Part of the security definition is to ensure keys are secure and randomly generated; therefore Sensus generates the keys.	Y
3.06	Describe compatibility with existing City of Naperville meters and proposed meters as well as the proposed AMI backhaul telecommunication system.	Y	Please see the Attachment 2: Compatibility Matrix. The FlexNet Base Stations are designed to be as flexible as possible when dealing with backhaul communications. The base stations support Transmission Control Protocol/Internet Protocol (TCP/IP) via a standard Register Jack 45 (RJ-45) Fast Ethernet connection, permitting a virtually limitless variety of backhaul options. Common backhaul options include Ethernet, Frame Relay, Multiprotocol Label Switching (MPLS), Integrated Services Digital Network (ISDN), Digital Subscriber Line (DSL), Very Small Aperture Terminal (VSAT), 3G/4G cellular, and microwave. The majority of FlexNet installations use DSL, cellular, and direct Ethernet connections for backhaul. It should be noted that any backhaul solution must provide less than 100-ms latency for efficient system operation, and minimum data speeds of 256 kbps. FlexNet Base Stations can be configured with a secondary access Ethernet port by using a Recommended Standard 232 (RS-232) to 10BaseT converter, and then using Serial Line Internet Protocol (SLIP) for the secondary connection. This configuration can be useful in the event that primary communication to the FlexNet Head End System is disrupted. Both primary and backup ports can be connected to existing network backhaul connections. Communications from the FlexNet Base Station to the	Y
3.07	Please indicate MIU interoperability with different types of telecommunication networks and meter brands.	Y	Please see Appendix 17_Water SmartPoint Compatibility Matrix.	Y
3.08	The MIU shall be interoperable with other sensor technology such as leak sensors and irrigation controllers without a major impact on battery life. Provide information on life reduction of the batteries for such applications.	Y	The Smart Gateway empowers Sensus customers to use a wide variety of third-party sensors to monitor water quality, water distribution pressure, stormwater, wastewater, and reclaimed water assets using the same FlexNet infrastructure.	Y

3.09	MIUs shall be compatible with pressure sensor technologies.	Y	The Smart Gateway permits compatibility with pressure sensors.	Y
3.10	All MIUs must have a unique ID (internal serial number and external network address) to be individually addressable. This number shall be visible on a permanently printed label or other means on the MIU.	Y	All SmartPoint MIUs have a unique identifier that can be individually addressed. The number is printed on the SmartPoint MIU.	Y
3.11	MIUs shall have the ability to transmit signals through pit lids. Specify which pit lid materials are compatible and non-compatible with the MIU. Specify which pit lids will require replacement.	Y	Sensus is capable of installing pit-set SmartPoints beneath pit lids. However, Sensus strongly recommends installing SmartPoints through the pit lid for optimal RF configuration. SmartPoints are compatible with all water meter pit lid materials that can be drilled through. The utility may prefer to swap out iron or cement lids for pre-drilled composite lids. The MIU requires a 1.75" diameter hole in the pit lid and fits pit lids with a thickness of up to 1.75".	Y
3.12	In the event pit lids need to be cut or drilled for improved RF propagation, describe method of antenna installation to prevent hazards such as tripping, mowing, and traffic rated where necessary, etc. Clearly indicate which pit lid types will require through the lid mounting vs. which can be under the lid. Provide a standard detail with a section view showing the elevation of the lid with respect to the antenna.	Y	Sensus recommends that the SmartPoint MIU be installed through the pit lid. The MIU is designed to be minimally invasive when installed through the meter pit lid. Newly purchased pit lids can be designed with the SmartPoint recessed into the lid. This design is most effective in this configuration and ensures transmission and reliability within the network. A section view can be found in the Technical Proposal document.	Y
3.13	The MIU shall be designed and built for installation in outdoor water meter boxes as well as above ground mounted discretely on a wall. Provide a photo of both configurations (including brackets if required).	Y	The SmartPoint MIU is available in pit-set and non- pit-set mounts. Configuration options and pictures can be found in the Technical Proposal document.	Y
3.14	The MIU shall be a single package design for rugged, harsh environments and capable of complete submersion in water without damage.	Y	The FlexNet Water SmartPoint is designed to operate without degradation to the battery in temperatures ranging from -22 to 185 degrees Fahrenheit. It is 100% condensing and water submersible. The Sensus TouchCoupler connection is a magnetic induction cable.	Y
3.15	The MIU must not interfere with utility's ability to read the meter display (digital or dial).	Y	The SmartPoint MIU does not interfere with the ability to read the digital display on the meter's register.	Y
3.16	The MIU shall have a minimum service life (including battery), of 20 years and a MIU failure rate (including battery failures) of less than 0.1% per year.	Y	FlexNet communication modules for electric meters have a failure rate of approximately 0.1% per year with an expected life of 20 years.	Y
3.17	Warranty for the MIU must be provided as a 20-year full replacement, including batteries. Vendor shall provide equipment warranties and guarantees with the effective start date for the warranty period shall be acceptance of installed equipment by City of Naperville. Vendors who make provisions for labor costs associated with premature battery failure will be favorably evaluated.	N	They are warranted at full replacement for the first 15 years of the system, and at a prorated rate for the remaining 5 years. The effective start date for the Sensus Limited Warranty is the date of Sensus shipment. Labor charges are not part of the standard warranty. Please see Appendix 6_Sensus Warranties.	N
3.18	The MIU shall provide "wake up" mode operation (or equivalent) to maximize battery life.	Y	The SmartPoint is shipped in a dormant state minimizing battery consumption and reducing RF transmissions when stored in a warehouse. The field tool can take the SmartPoint out of its dormant state. The head end or field tool can put the SmartPoint back into its dormant state. A secondary usage of dormant mode is a consumer opt-out program; the utility can put the meter into a dormant mode (it will not transmit) and not require utility to have to pull the SmartPoint from the residence.	Y
3.19	MIU shall provide battery end-of-life indicator alarm providing a minimum of 1-year notice that battery is nearing the end of its useful life.	Y	If the battery voltage is less than 3.3v, a low battery alarm is triggered at the SmartPoint. It is transmitted to the FlexNet Head End System, where it can trigger a low battery report. 3.3v notification battery longevity is estimated at 6 to 12 months.	Y

3.20	Upon request, Vendor must provide actual field performance data for proposed MIUs and batteries currently installed on operational systems and supply cumulative failure-in-time data for MIUs by manufacturer/model number.	Y	Upon request, Sensus will provide field performance data.	Y
3.21	Upon request, Vendor must provide statistical calculation of projected life including MTBF for proposed MIUs and batteries.	Y	Upon request, Sensus will provide the statistical calculation of projected life.	Y
3.22	The MIU shall store interval meter reads for 90+ days with data integrity until overwritten (i.e., loss of network communications or in the case of disaster). These reading shall be available through the AMI network or by some form of local reading connection.	N	FlexNet water SmartPoint communication modules store up to 35 days of hourly reads in non-volatile memory. Long term storage is best handled by the MDM system.	N
3.23	The MIU shall capture consumption data on an hourly basis, at minimum, without impacting stated battery warranties.	Y	The default MIU configuration captures consumption data every hour and transmits every four hours without impacting the battery warranty.	Y
3.24	The MIU shall be remotely programmable to capture consumption data on a five-minute basis. Note impact to battery life and warranty.	Y	Because of the battery impact it is recommended not to configure below one hour reads. Sensus does provide a MIU part number that enables reads less than one hour. The warrantee for this MIU is limited to one year.	Y
3.25	The MIU shall process notifications such as tamper, leak detection, backflow detection, and other key alarms.	Y	The SmartPoint MIU processes many critical alarms, including tamper and leak detection, low battery, and others.	Y
3.26	The MIU shall have security to prevent tampering as well as alerts to indicate potential tamper events. Tamper events shall be logged and timestamped. The MIU shall communicate tamper events to the AMI system as soon as they occur and trigger an alarm at the AMI head end. Meter tamper events shall be sent with a higher priority than normal status messages. Indications and information about the tamper event shall not be deleted or removed from the MIU until they have successfully transferred to the headend over the AMI network.	Y	The FlexNet system provides several alerts and flags as standard features for SmartPoint communication modules, including tamper alerts. Additionally, transmitting the SmartPoint ID and register IDs over the air prevents tampering or incorrectly recorded information from resulting in the delivery of reads to the wrong account. Many other AMI networks transmit only the register ID, which does not allow their radio and register mismatches to be identified without a site visit. The FlexNet system specifically reports any SmartPoint-register association that does not match what is in the customer's billing system database, and does not apply a reading to an account when the register ID does not match. **Tamper Exception Report**: Generated if tampering is detected at the transmitter or at the wire between the meter and transmitter. The SmartPoint transmits an alarm advising the utility that the connection between the register and the SmartPoint has been disabled. This feature allows the utility to investigate a tamper situation that may be present. The alarm is transmitted during the preprogrammed transmit intervals. **Meter Mismatch and Endpoint Mismatch Reports:** The SmartPoint Mismatch report alerts the utility if the register ID reporting from the field matches what is recorded in the CIS system, but the SmartPoint does	Y
3.27	MIU shall provide automatic alarm for detection of leak (with adjustable trigger parameters). This will include the ability to detect potential on-premises leaks (downstream of meter) making use of low flow meter accuracy with enough reads per day to indicate "no zero flow hours" over a configured period.	Y	The SmartPoint transmits several smart alarms so you can receive alerts and address issues before they become more costly. These alarms include tampering, low battery, customer leak, reverse flow, and high flow. There are a number of key FlexNet elements that support leak detection within the water distribution network. Leak sensors and battery operated pressure monitoring devices can be deployed on distribution mains to help reduce leaks.	Y
3.28	MIU shall have ability to indicate backflow or reverse flow. A timestamped flag or alarm shall indicate that backflow has occurred, even for low-volume events.	Y	The SmartPoint's Backflow alarm indicates that the endpoint detects water flowing in the reverse direction through the meter.	Y
3.29	The MIU shall send an alarm in the event of a meter encoder failure, loss of connectivity with the meter encoder, or persistent errors when trying to read the encoded register.	Y	The SmartPoint detects and reports to the head end under encoder failures and loss of communication with the meter encoder.	Y

3.30	The MIU's clock must be capable of synchronization to the national time standard, without visiting the site, to a tolerance of 5 seconds. Accuracy of better than 30 seconds shall be maintained even if the connection to the AMI network is lost for up to 90 days. Alarms shall be provided should the MIU ever have a time correction exceeding 60 seconds.	Y	The FlexNet exclusive "Middle Of Minute" (MOM) communications keeps the SmartPoint synchronized to within milliseconds of network time. If network is not available the SmartPoint will maintain time with minimal drift. Based on hardware parts selected, Sensus believes it can achieve the requirement.	Y
3.31	Firmware management must meet the following requirements: (1) MIU shall be able to accept and install software/firmware upgrades provided remotely in batch form via the AMI communications network. (2) MIU shall be able to accept and install software/firmware upgrades provided locally. (3) The utility has the ability to update and configure when appropriate. State how many over the air firmware upgrades have been released by Vendor in the past 10 years. State the impact on battery life of firmware upgrades.	Y	The Sensus AMI solution can perform OTA firmware upgrades, and has proven this with both IOU and Municipal customers. Additionally, firmware can be updated locally using FieldLogic Connect. The firmware upgrade process is executed in the background so that it does not interfere with normal data collection operations. The FlexNet system has the ability to perform batch firmware upgrades to utilities with up to 2.5 million SmartPoints. Ten firmware upgrades have been released since the SmartPoint became commercially available 8 years ago. Please note that utilities are not required to accept every version upgrade - it is up to you whether you choose to upgrade or not. As part of the battery life expectancy, Sensus built into the model five firmware downloads over the 20 year life of the SmartPoint.	Y
3.32	MIU shall support diagnostics to self-monitor RAM checksum error, ROM checksum error, hardware failure, memory failure, EPROM error, and battery fault.	Y	These alarms are available with the proposed solution.	Y
3.33	Vendor will have the ability for authorized Naperville technicians to remotely run tests and diagnostics on MIUs.	Y	SmartPoint communication modules continuously run diagnostic tests.	Y
3.34	Describe relevant AWWA/ANSI/FCC certifications for the MIUs.	Y	FCC CFR 47: Part 24D, Part 101C, Part 15. Meters conform to applicable AWWA/ANSI standards.	Y
3.35	MIU cabling shall have a standard minimum length of 18" with the ability to increase cabling length for non-standard installations (e.g., vaults).	Y	Sensus offers varying lengths of connector cable (up to 25 feet) that can be used to ensure that there is adequate cable length for any installation.	Y
3.36	Include the most recent commercially deployed version of Vendor's MIU and cable with Vendor's RFP response. If requested, MIUs will be returned to Vendor at the end of the RFP process.	Y	A sample MIU and cable is included with this RFP response.	Y

4. Collectors and Repeaters

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
4.01	Collectors, as part of the field area network (FAN), will securely and accurately gather reads from AMI meters in their coverage area and transport those reads over a backhaul network to the AMI headend.	Y	Sensus has a point-to-multipoint solution where the SmartPoint MIUs communicate directly with the base station. The base station securely and accurately relays reads to the head end system.	Y
4.02	Provide GIS map and details of any repeater or multi-hop network topology that is used either as part of the base design or that is available to mitigate coverage issues.	N/A	This is not applicable to the Sensus point-to-multipoint system.	N/A
4.03	Provide information on the use of alternative read methods to reach the meters and other devices (Bluetooth, cellular, drive-by, etc.).	Y	FlexNet SmartPoints are backward compatible, therefore, the SmartPoint module can communicate with the Sensus mobile Vehicle Gateway Basestation (VBG) as well as the Sensus handheld device without reprogramming the module. Due to the base station redundancy inherent in the FlexNet system design, data has multiple paths to the head end system. The City of Austin's RF design is such that, on average, each endpoint is covered by multiple FlexNet Base Stations.	Y
4.04	The AMI network will be capable of on-demand reads and status inquiry (pings or health checks) of meter devices. State the impact on battery life of the inquiries.	Y	As part of the battery life expectancy, Sensus accounted one on-demand request per month over the 20 year life of the SmartPoint.	Y

4.05	Network management, monitoring, performance reporting, and diagnostic tools will be provided to Naperville. This includes the ability to pull and review detailed event logs.	Y	This functionality is available and provided through the Sensus head end system.	Y
4.06	The collector shall support remote monitoring. Please describe the monitoring solution.	Y	FlexNet base stations continuously inform the head end of its status. Status information is available through the network monitoring tools. In addition, the head-end will use status information to infer base station health; if a base station is experiencing issues, the head-end can remove the base station from its routing list and use alternative base stations to reach the requested endpoints.	Y
4.07	The collector shall be capable of both local and remote access through SSH or a similar tool. Remote access shall be authenticated through RADIUS or other means.	Y	The utility can access the base station controls on site as well as remotely through secure telnet. For security purposes the user must present the proper authentication to access.	Y
4.08	The FAN and headend systems will meet applicable NIST and other cyber security requirements and be capable of compliance with evolving standards.	Y	The FlexNet Head End System uses NIST standards to achieve confidentiality across the FlexNet communication network. In addition, Sensus uses industry-standard APIs, including CIM flat files, to integrate with third-party applications.	Y
4.09	System shall support remote upgrades of software and firmware in FAN devices from the AMI headend.	Y	All meter and SmartPoint firmware is upgradeable and can be programmed remotely over the air. The FlexNet firmware solution supports the management of firmware versions across the entire deployment.	Y
4.10	System shall be able to integrate GIS data for each metering asset in to the database.	Y	GIS coordinates are transmitted to the FlexNet Head End System from the SmartPoint communication module. The latitude and longitude coordinates stored in the FlexNet Head End System can be provided to external applications through MultiSpeak or CMEP interfaces.	Y
4.11	The collector's clock must be capable of synchronization to the national time standard, without visiting the site, to a tolerance of 1 second. Alarms shall be provided should the collector ever have a time correction exceeding 5 seconds.	Y	FlexNet Base Stations are time-synced continually using GPS as the primary method, with SNTP as a backup.	Y
4.12	The collector shall be installed inside of an enclosure rated at least IP66 (fiberglass or plastic composite) with twist door handle and locking hasps. The enclosure shall have a small thermostatically controlled heater and an interior GFCI rated AC convenience outlet. The collector shall be rated for continuous operation in temperatures between -40 to +70C.	N	Base station enclosures have a hardened locking system with active door alarms that are fed directly to the FlexNet Head End System. The enclosure conforms to IP66 standards, and is rated for temperatures between -40º to +50º C. The base stations are not equipped with AC; the design does not require this.	N
4.13	Vendor shall provide installation warranties and guarantees for collectors with the effective end date of the warranty to be a period that will include one year-end from Naperville acceptance.	Y	Sensus warrants the FlexNet Base Station to be free from material defects or workmanship for a warranty period of 12 months from the date of shipment. Extended warranty periods are available.	Y
4.14	Collectors shall be equipped with a battery backup system that supports 8 hours of continual operation without the primary power source.	Y	If the base station loses power, then battery run time is 20 hours idle on receive only, and eight hours at 17% transmit duty cycle.	Y
4.15	Collectors shall be capable of self-reliant power during a power outage with a combination of a renewable energy source and/or battery. Vendor shall supply this as an option for all communication infrastructure.	Y	FlexNet Base Stations have battery backup in case of power loss. SmartPoint communication modules are battery-powered and thus are not affected by power outages.	Y
4.16	Street light collectors shall use ANSI C136.41, 7-Pin configuration taps. For installations where electrical service to the street light pole must be provided electric utility will provide pricing.	Y	The Sensus lighting VantagePoint module has an ANSI C136.41 NEMA socket interface.	Y

4.17	Batteries shall be of a sealed design without a requirement for venting for hazardous, corrosive, or explosive atmospheres.	Y	The FlexNet M400B2 Base Stations uses 12-volt, 40-amp-hour Enersys XE-40 battery featuring PB/SN chemistry. The battery is AGM-sealed to prevent fumes and hydrogen venting. SmartPoint batteries are also sealed and protected against hazardous conditions.	Y
4.18	Powered field equipment shall be capable of connecting to a main voltage ranging from 120V to 240V.	Y	The FlexNet M400B2 Base Station requires a 120-VAC power supply.	Y
4.19	Collectors shall support prioritization of message and read processing.	Y	The FlexNet communication network supports independent and dedicated RF channels. Standard messages use multiple channels and poll response uses a separate dedicated channel. Additional solutions are delivered on their own channels to prevent interference - an advantage to the Sensus licensed solution.	Y
4.20	Collectors shall be capable of communicating with the headend through firewalls if needed. Provide details on what firewall ports, protocol, and direction would be necessary to support this.	Y	Sensus supports and recommends the use of network firewalls to restrict access to the Sensus systems. Sensus has documented the minimum network ports and services required for the operation of the system. This will be provided as part of standard product documentation for customers to configure their network firewalls.	Y
4.21	Collectors shall support named user logins by default with different permissions for administrator, engineer, user, or guest. Both successful and unsuccessful login attempts shall be logged. Advise if collectors are capable of network based authentication.	Y	Role-Based Access Control (RBAC) is used for base station access. Network based authentication is available.	Y
4.22	Collectors shall use a modular design to permit change of backhaul communications technology if desired.	Y	The FlexNet system will accommodate the City of Naperville's future bandwidth needs upon installation without service interruptions or costly network reconfigurations. As the need for additional network capacity or applications are added to the network, base stations and SmartPoints can be upgraded over the air with new frequency assignments and modulation enhancements. In terms of backhaul, base stations support a wide variety of backhaul methods, including Ethernet, Frame Relay, DSL, VSAT, 3G/4G cellular, and microwave.	Y
4.23	Collectors shall log all access events, identifying user, source IP address, and status of the access attempt.	Y	The FlexNet Base Stations support the ability to log events via standard SNMP-based messaging.	Y
4.24	Vendor will have the ability for authorized Naperville technicians to remotely run tests and diagnostics on collectors.	Y	The Sensus solution complies with this requirement.	Y

6A. Existing Backhaul Network - *if vendor intends to incorporate existing Backhaul Infrastructure*

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
6A.01	The backhaul network shall provide the necessary connectivity from the field collector to the headend systems. Proven record of system performance in dense foliage area is required.	Y	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network where applicable or The City of Naperville provided and approved wireless modem for the three Sensus proposed antenna sites.	Y
6A.02	The backhaul interface shall use a standard approach such as 10/100BaseT Ethernet and be capable of supporting at least 5 Mbps of Ethernet connectivity to each collector site.	Y	The minimum backhaul requirement for FlexNet solution is 256 kbps per site with less than 100 ms latency.	Y
6A.03	The backhaul network shall provide at least 99.9% data link availability in any 24-hour period.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A

4.17	Batteries shall be of a sealed design without a requirement for venting for hazardous, corrosive, or explosive atmospheres.	Y	The FlexNet M400B2 Base Stations uses 12-volt, 40-amp-hour Enersys XE-40 battery featuring PB/SN chemistry. The battery is AGM-sealed to prevent fumes and hydrogen venting. SmartPoint batteries are also sealed and protected against hazardous conditions.	Y
4.18	Powered field equipment shall be capable of connecting to a main voltage ranging from 120V to 240V.	Y	The FlexNet M400B2 Base Station requires a 120-VAC power supply.	Y
4.19	Collectors shall support prioritization of message and read processing.	Y	The FlexNet communication network supports independent and dedicated RF channels. Standard messages use multiple channels and poll response uses a separate dedicated channel. Additional solutions are delivered on their own channels to prevent interference - an advantage to the Sensus licensed solution.	Y
4.20	Collectors shall be capable of communicating with the headend through firewalls if needed. Provide details on what firewall ports, protocol, and direction would be necessary to support this.	Y	Sensus supports and recommends the use of network firewalls to restrict access to the Sensus systems. Sensus has documented the minimum network ports and services required for the operation of the system. This will be provided as part of standard product documentation for customers to configure their network firewalls.	Y
4.21	Collectors shall support named user logins by default with different permissions for administrator, engineer, user, or guest. Both successful and unsuccessful login attempts shall be logged. Advise if collectors are capable of network based authentication.	Y	Role-Based Access Control (RBAC) is used for base station access. Network based authentication is available.	Y
4.22	Collectors shall use a modular design to permit change of backhaul communications technology if desired.	Y	The FlexNet system will accommodate the City of Naperville's future bandwidth needs upon installation without service interruptions or costly network reconfigurations. As the need for additional network capacity or applications are added to the network, base stations and SmartPoints can be upgraded over the air with new frequency assignments and modulation enhancements. In terms of backhaul, base stations support a wide variety of backhaul methods, including Ethernet, Frame Relay, DSL, VSAT, 3G/4G cellular, and microwave.	Y
4.23	Collectors shall log all access events, identifying user, source IP address, and status of the access attempt.	Y	The FlexNet Base Stations support the ability to log events via standard SNMP-based messaging.	Y
4.24	Vendor will have the ability for authorized Naperville technicians to remotely run tests and diagnostics on collectors.	Y	The Sensus solution complies with this requirement.	Y

6A. Existing Backhaul Network - *if vendor intends to incorporate existing Backhaul Infrastructure*

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
6A.01	The backhaul network shall provide the necessary connectivity from the field collector to the headend systems. Proven record of system performance in dense foliage area is required.	Y	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network where applicable or The City of Naperville provided and approved wireless modem for the three Sensus proposed antenna sites.	Y
6A.02	The backhaul interface shall use a standard approach such as 10/100BaseT Ethernet and be capable of supporting at least 5 Mbps of Ethernet connectivity to each collector site.	Y	The minimum backhaul requirement for FlexNet solution is 256 kbps per site with less than 100 ms latency.	Y
6A.03	The backhaul network shall provide at least 99.9% data link availability in any 24-hour period.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A

6A.04	The vendor shall provide a single solution (such as cellular or private point-to-point, or hybrid) for backhaul of AMI communications. Clearly explain the solution.	Y	FlexNet is an purpose built, utility grade wireless communication network built on FCC Primary Licensed Spectrum. Sensus is the single Primary License holder with the FCC. FlexNet supports multiple AMI applications on a single network, as well as other value-add programs, such as smart street lighting and distribution automation (DA). Prioritized channels ensure that multiple applications are supported without impact to the existing water single use network.	Y
6A.05	The vendor shall provide information on the expected life of the proposed solution as well as the upgrade mechanism and estimated costs that would be associated to a technology refresh of the backhaul MIUs.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A
6A.06	The backhaul network shall be capable of handling the expected network traffic from each collector and allow for redundancy to provide coverage in the event other collectors are unreachable and provide for at least 50% growth. Collectors shall be able to store at least 5 days worth of data.	Y	A backhaul with Sensus recommended minimum performance characteristics of a minimum of 256kbps and less than100ms latency will be the ability for the backhaul to serve meter traffic network management traffic, firmware update traffic, and any other transactions required through the backhaul network.	Y
6A.07	The backhaul network shall support at minimum 2 communication paths from the collector to the headend.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A
6A.08	The backhaul network shall report packet and byte throughput and drops by reports or using SNMP trap messages.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A
6A.09	The backhaul equipment shall provide a local status and alarm light (LED) that is visible externally and does not require access to the cabinet.	Y	In outdoor configurations, the backhaul equipment is stored in NEMA 4-rated cabinet and does not have an externally visible LED light. However, the FlexNet system provides diagnostics to aid in investigation of backhaul status. Base stations send a message to the head end system every minute. If no message is received, the head end system will display this status so that the utility can investigate the base station and backhaul connectivity.	Y
6A.10	The backhaul equipment will provide a backup battery with capacity to operate a minimum of 8 hours of continual operation in the event of AC power failure.	Y	Base stations are equipped with battery backup so that your system continues to function normally in the event of a power outage. Battery run time is typically 20 hours idle and 8 hours at 17% transmission. These calculated values have been exceeded in real-world field conditions multiple times, as the FlexNet Base Station transceiver is seldom in a 17% transmit mode.	Y
6A.11	The backhaul equipment shall, as appropriate, have a password protected login with different levels of access for administrator (full) and user (read-only). This equipment shall integrate with Active Directory or RADIUS authentication.	Y	FlexNet Base Stations support local authentication and integration with RADIUS/LDAP for centralized identity management.	Y
6A.12	All separately mounted backhaul equipment shall be installed in an enclosure rated at least IP66 (fiberglass or plastic composite) with a door hasp for the addition of a padlock.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A
6A.13	The backhaul equipment shall be rated for operation from -40 C to +70 C, non-condensing. If necessary, it shall have a thermostatically regulated heater element to reduce condensation and shall not require the use of fans for equipment cooling.	Y	FlexNet Base Stations are available in both indoor and outdoor models that can operate in a variety of environmental conditions. Indoor models are installed in an environmentally-controlled room. Outdoor models are packaged in NEMA 4-rated enclosures.	Y
6A.14	The backhaul shall encrypt all over-the-air data using AES-256 or equivalent utilizing Naperville selected and maintained encryption keys.	Y	In a FlexNet system, the same AES-256 bit encryption scheme is used for all endpoint types and has been engineered to protect the FlexNet system from end to end --- from the endpoint (MIU) to the FlexNet network device (DCU/repeater – a base station in the FlexNet system) to the AMI control computer (FlexNet head end software).	Y

6A.15	If appropriate, the backhaul equipment shall have a local Ethernet port available for device programming and configuration changes.	Y	Sensus can configure its FlexNet Base Stations with a secondary access Ethernet port as a backup connection. The ethernet port is located inside the case, which can be locked. In addition to securing physical access to the port, the proper login credential are also required.	Y
6A.16	The communications network shall have a network latency of less than 100 milliseconds from each collector to the AMI headend.	Y	Maximum efficiency is achieved in the FlexNet system via a network latency of less than 100 milliseconds.	Y
6A.17	Prior to acceptance each link on the communications network from the collector to the headend shall pass a 72-hour traffic stress test at 80% of link capacity at 99.9% packet success rate. The vendor shall provide a detailed report of above results.	Y	Sensus can build these tests into the System Acceptance Test (SAT).	Y
6A.18	All wireless backhaul links from the collectors to the core network shall have at least a 20 dB fade margin between measured RF signal performance and the bandwidth design-goal for each link. They shall strive to utilize paths with an unobstructed line-of-sight. Special attention shall be given to seasonal foliage levels.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A
6A.19	All antenna coaxial connections shall pass through a properly sized and rated coaxial-type surge arrestor (Polyphaser or equivalent) meeting NEC standards (i.e. NEC 800.100).	Y	All FlexNet Base Station/Collector cabinets meet or exceed UL 1449 by design and contain at a minimum UL 1449 compliant surge protection. The M400 Base Station is installed with standard duty AC surge protectors and lightning arrestors on the antenna feed.	Y
6A.20	All antenna coaxial connections shall pass through a properly sized and rated coaxial-type surge arrestor (Polyphaser or equivalent) meeting NEC standards (i.e. NEC 800.100).	Y	All FlexNet Base Station/Collector cabinets meet or exceed UL 1449 by design and contain at a minimum UL 1449 compliant surge protection. The M400 Base Station is installed with standard duty AC surge protectors and lightning arrestors on the antenna feed.	Y
6A.21	All cabling exposed to the outdoor elements shall be electrically shielded and covered with a UV resistant jacket.	Y	All FlexNet Base Station equipment and other associated hardware, such as coax antenna cabling, are shielded and protected from degradation by UV resistant coatings.	Y
6A.22	All outdoor connections shall be weatherproofed to prevent water intrusion or exceeding IP66.	Y	All outdoor connections are weatherproofed and IP66 rated.	Y
6A.23	In cases when any collector or backhaul sites that are to be co-located at the same site or on the same tower with other communications equipment, vendor shall submit an intermodulation study for RF interference mitigation.	Y	Sensus will work with you to determine the best RF Design for your needs,	Y
6A.24	Any communications method that requires FCC licensing of spectrum shall have the costs of frequency coordination and licensing included in the proposal. All licensing shall be in the City's name.	Y	The FCC requires the owner of the primary-use spectrum to charge for usage. To comply with this requirement, Sensus allows our customers to use the spectrum for an annual fee of $1.00.	Y
6A.25	For any communications method on unlicensed RF spectrum, the vendor shall include a site-analysis of the existing noise floor and projections of the impact upon system performance. The design shall have allowances for reasonable increases in the noise floor as additional devices might occupy that same unlicensed spectrum in the future.	Y	The FlexNet system is the only point-to-multipoint network on the market that uses primary-use, FCC-licensed RF spectrum.	Y
6A.26	Ethernet communications shall be in a non-bridged mode to block remote to remote communications unless explicitly granted. (That is, no collector should communicate directly with another collector unless the traffic is "hairpinned" in a router or switch outside the backhaul network itself).	Y	The base station architecture is such that individual transceivers can only communicate with the head end system.	Y
6A.27	Backhaul network components shall comply with FCC regulations (indicated by appropriate documentation) and, where necessary, be FCC certified.	Y	Sensus FlexNet Base Stations comply with FCC regulations. The Sensus FlexNet M400B2 XCVR/PA Base Station is covered under FCC ID SDBM400G2900.	Y

6A.28	Backhaul network devices shall have a failure rate of less than 0.5% per annum over the required operating life of the system (20 years).	Y	SmartPoints are expected to have a useful life of more than 20 years. This longevity is supported in both the empirical data from Sensus' battery calculations, as well as by Sensus' ongoing lab and field testing of lithium thionyl chloride batteries. Our battery testing has been in progress since 1995. The observed failure rate is less than 0.5% per year for the entire 20-year life of the product. FlexNet Base Stations have a useful lifetime exceeding 20 years. The calculated MTBF for the M400B2 base station is in excess of 15 years. Typical base station failure rates of less than 1% have been observed. Sensus Mean Time Before Failure (MTBF) calculations are governed by the guidelines, failure rates, and stress factors from Telcordia SR332, Issue 3, to provide a reliability prediction.	Y
6A.29	Backhaul network shall be fully functional and available 24 hours per day 7 days a week (with an allowance for up to 4 hours a month of scheduled down time for maintenance) with a reliability of 99.9% and no outages extending more than 15 consecutive minutes.	Y	The baseline SaaS offering includes Service Level Agreements (SLAs) for uptime and availability of the RNI application. Sensus is willing to negotiate additional SLA performance guarantees as required by customers.	Y
6A.30	List the anticipated useful life of each network device type. If maintenance or hardware modifications are required to achieve a useful life of 20 years, note what maintenance/modifications must occur.	Y	All proposed network devices have an anticipated useful life of 20 years.	Y
6A.31	Vendor is responsible for the AMI and backhaul network design, selecting data collector site locations (with Naperville input). Note how many data collectors are estimated to be placed on Naperville assets vs. non-Naperville assets.	Y	Sensus is experienced in completed thorough and detailed network designs through superior propagation study software.	Y
6A.32	Vendor is responsible for obtaining agreements to install equipment from property owners. These agreements shall be transferable to Naperville as part of the final agreement and shall be for the 20-year life of the system.	Y	We will work with Naperville to select the most ideal site locations. Sensus will obtain lease agreements as necessary for mounting network hardware and will provide a master lease agreement.	Y
6A.33	Vendor is responsible for all permits, excavation, foundations, fees, below grade material, and above grade structures associated with construction activities to build out of the telecommunication network with agreed-upon warranties.	Y	Sensus is experienced in working with subcontractors and customer personnel to perform this type of work.	Y
6A.34	Vendor's AMI System is likely capable of supporting additional value-added applications beyond metering. If the support of this functionality requires additional network infrastructure, identify the additional architecture and/or costs associated with the additional infrastructure.	Y	Sensus' AMI solution is differentiated from competitive offerings through its unmatched reach, scalability, expandability, security, and ability to support multiple applications on a single network. For instance, FlexNet offers you the flexibility to use the same communication network for AMI, leak detection, pressure monitoring, street lighting control, and other value-enhancing technologies - typically without any additional infrastructure.	Y
6A.35	If a privately owned backhaul network is proposed, details on the bandwidth and latency available and the types of applications (i.e., SCADA communications, video surveillance, etc.) supported shall be provided.	N/A	The Sensus AMI Solution intends to utilize the City of Naperville's existing fiber network. The backhaul will be the responsibility of the City of Naperville to maintain.	N/A

6B. New Backhaul Network - *if vendor intends to create a new backhaul network*

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
6B.01	The backhaul network shall provide the necessary connectivity from the field collector to the headend systems. Proven record of system performance in dense foliage area is required.		This section is not applicable, as we are intending on using The City of Naperville's existing backhaul network.	
6B.02	The backhaul interface shall use a standard approach such as 10/100BaseT Ethernet and be capable of supporting at least 5 Mbps of Ethernet connectivity to each collector site.			
6B.03	The backhaul network shall provide at least 99.9% data link availability in any 24-hour period.			

6B.04	The vendor shall provide a single solution (such as cellular or private point-to-point) for backhaul of AMI communications. If not, clearly explain any deviation from using a single solution.			
6B.05	If a cellular solution is proposed, the vendor shall provide information on the expected life of the proposed solution as well as the upgrade mechanism and estimated costs that would be associated to a technology refresh of the backhaul MIUs.			
6B.06	The backhaul network shall be capable of handling the expected network traffic from each collector and allow for redundancy to provide coverage in the event other collectors are unreachable and provide for at least 50% growth. Collectors shall be able to store at least 5 days worth of data.			
6B.07	The backhaul network shall support at minimum 2 communication paths from the collector to the head end.			
6B.08	The backhaul network shall report signal level (RSSI or RSL), signal to noise ratio (SNR), link quality (BER), and packet and byte throughput and drops by reports or using SNMP trap messages.			
6B.09	The backhaul equipment shall provide a local status and alarm light (LED) that is visible externally and does not require access to the cabinet.			
6B.10	The backhaul equipment will provide a backup battery with capacity to operate a minimum of 8 hours of continual operation in the event of AC power failure.			
6B.11	The backhaul equipment shall, as appropriate, have a password protected login with different levels of access for administrator (full) and user (read-only). Additionally backhaul equipment shall support network based authentication.			
6B.12	All separately mounted backhaul equipment shall be installed in an enclosure rated at least IP66 (fiberglass or plastic composite) with a door hasp for the addition of a padlock.			
6B.13	The backhaul equipment shall be rated for operation from -40 C to +70 C, non-condensing. If necessary, it shall have a thermostatically regulated heater element to reduce condensation and shall not require the use of fans for equipment cooling.			
6B.14	The backhaul shall encrypt all over-the-air data using AES-256 or equivalent.			
6B.15	If appropriate, the backhaul equipment shall have a local Ethernet port available for device programming and configuration changes.			
6B.16	The communications network shall have a network latency of less than 100 milliseconds from each collector to the AMI headend.			
6B.17	Prior to acceptance each link on the communications network from the collector to the headend shall pass a 72-hour traffic stress test at 80% of link capacity at 99.9% packet success rate. The vendor shall provide a detailed report of above results.			
6B.18	All wireless backhaul links from the collectors to the core network shall have at least a 20 dB fade margin between measured RF signal performance and the bandwidth design-goal for each link. They shall strive to utilize paths with an unobstructed line-of-sight. Special attention shall be given to seasonal foliage levels.			
6B.19	All antenna coaxial connections shall pass through a properly sized and rated coaxial-type surge arrestor (Polyphaser or equivalent) meeting NEC standards (i.e. NEC 800.100).			
6B.20	All antenna PoE (Power over Ethernet) or data Ethernet connections shall pass through a surge arrestor (Polyphaser or equivalent) meeting NEC standards (i.e. NEC 800.100).			

6B.21	All cabling exposed to the outdoor elements shall be electrically shielded and covered with a UV resistant jacket.			
6B.22	All outdoor connections shall be weatherproofed to prevent water intrusion.			
6B.23	In cases when any collector or backhaul sites that are to be co-located at the same site or on the same tower with other communication equipment, vendor shall submit an intermodulation study for RF interference mitigation.			
6B.24	Any communications method that requires FCC licensing of spectrum shall have the costs of frequency coordination and licensing included in the proposal. All licensing shall be in the City's Name.			
6B.25	Any communications method on unlicensed RF spectrum, the vendor shall include a site-analysis of the existing noise floor and projections of the impact upon system performance. The design shall have allowances for reasonable increases in the noise floor as additional devices might occupy that same unlicensed spectrum in the future.			
6B.26	Ethernet communications shall be in a non-bridged mode to block remote to remote communications unless explicitly granted. (That is, no collector should communicate directly with another collector unless the traffic is “hairpinned” in a router or switch outside the backhaul network itself).			
6B.27	Backhaul network components shall comply with FCC regulations (indicated by appropriate documentation) and, where necessary, be FCC certified.			
6B.28	Backhaul network devices shall have a failure rate of less than 0.5% per annum over the required operating life of the system (20 years).			
6B.29	Backhaul network shall be fully functional and available 24 hours per day 7 days a week (with an allowance for up to 4 hours a month of scheduled down time for maintenance) with a reliability of 99.9% and no outages extending more than 15 consecutive minutes.			
6B.30	List the anticipated useful life of each network device type. If maintenance or hardware modifications are required to achieve a useful life of 20 years, note what maintenance/modifications must occur.			
6B.31	Vendor is responsible for the AMI and backhaul network design, selecting data collector site locations (with Naperville input). Note how many data collectors are estimated to be placed on Naperville assets vs. non-Naperville assets.			
6B.32	Vendor is responsible for obtaining agreements to install equipment from property owners. These agreements shall be transferable to Naperville as part of the final agreement and shall be for the 20-year life of the system.			
6B.33	Vendor is responsible for all permits, excavation, foundations, fees, below grade material, and above grade structures associated with construction activities to build out of the telecommunication network with agreed-upon warranties.			
6B.34	Vendor's AMI System is likely capable of supporting additional value-added applications beyond metering. If the support of this functionality requires additional network infrastructure, identify the additional architecture and/or costs associated with the additional infrastructure.			
6B.35	If a privately owned backhaul network is proposed, details on the bandwidth and latency available and the types of applications (i.e., SCADA communications, video surveillance, etc.) supported shall be provided.			

7. AMI Headend

The AMI headend refers to the servers and software that collect, analyze and store AMI

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
7.01	The headend and all customer data shall be hosted in the Naperville Smart Grid environment.	Y and N	The Sensus solution can be either hosted in a SaaS environment or on-premise.	Y
7.02	The headend shall be available and fully functional 24 hours a day, 7 days a week.	Y	The headend is available 24/7 except for planned downtime for upgrades or patches.	Y
7.03	The headend shall be capable of requesting on-demand read and status inquiry of individual meter devices or defined groups of meters.	Y	On-demand reads and status inquiries can be made from the head end system of individual meters or of defined groups of meters.	Y
7.04	Headend system will comply the applicable NIST and other cyber security standards and be capable of continuing to meet evolving standards.	Y	The Sensus solution complies with each of the major standards bodies, including NIST, Open-SG, and Zigbee, along with tracking for changes in NERC-CIP.	Y
7.05	The headend shall be able to remotely upgrade meter, MIU, and collector software and firmware.	Y	The headend supports the remote upgrade of SmartPoints, AMI metrology, and HAN firmware.	Y
7.06	The headend shall monitor the performance of the AMI meters, collectors, and network.	Y	The headend provides performance metrics on the health of the AMI network, meters & base stations.	Y
7.07	The headend shall be able to integrate GIS data for each AMI meter and collector into its local database.	Y	The headend stores GIS data transmitted from the meter or base station and can correct inaccurate data.	Y
7.08	The headend shall support mapping capabilities to provide an intuitive view of all event alarms (at the meter, MIU, and collector level).	Y	The FlexNet Head End System software provides dynamic mapping capabilities for endpoints and base stations. Each map can be customized to reflect the user's requirement. Furthermore; the map includes signal, read success, latency, message counts, and communication failures.	Y
7.09	The headend system shall provide for regular time synchronization using the simple network time protocol (SNTP) or other means to keep the system clock accurate to at least 2.5 seconds.	Y	In the FlexNet Head End System, all times have been stored as integers in the database as UTC epoch time. The FlexNet Head End System also stores the time zone region of the endpoints and base stations.	Y
7.1	The headend shall support the ability to gather various status reports, results of diagnostics, and event logs related to various elements of the AMI solution.	Y	The headend system generates standard reports, diagnostics, and event logs.	Y
7.11	The headend system shall be able to detect installation of new meters onto the communications network and shall also detect when existing AMI meters have been removed. This information shall be available as a report that can be periodically produced.	Y	Meters require no pre-configuration to communicate on the FlexNet communication network. The head end system software will recognize and report any network components that are removed from the system after installation and after being authenticated and accepted into the system.	Y
7.12	As meters self-register, the headend system shall initially place them into an unscheduled read group.	Y	Meters do not require configuration upon installation. They may be automatically converted from "inventory" to a state of "installed" upon registering, or may wait for a manual status change. Only meters with a state of "installed" will be reported on from the head end system in daily reports.	Y
7.13	The headend system shall be able to remotely configure the meter's recording interval length (to all interval lengths supported by the meter). Please indicate interval lengths supported and their impact on battery life.	Y	Read interval lengths can be programmed remotely over the air from the FlexNet Head End System software. The head end supports read intervals from 5 minutes to 24 hours. Refer to meter section for details on the meter capability – 3.23 and 3.24.	Y
7.14	The headend system shall be able to issue an on-demand read request initiated from authorized systems.	Y	The system provides true on-demand meter reads via two-way communication from the FlexNet Head End System to the meter's SmartPoint MIU.	Y
7.15	The headend system shall be able to issue and receive results for on-demand read requests from the meter within 1 minute 98% of the time and within 5 minutes 100% of the time. Please note how many on-demand reads can be performed without adversely impacting battery life or voiding the warranty.	Y	A typical on-demand read, or other requested interaction, takes between 30 and 90 seconds. Battery life expectancy was planned with one on-demand read performed per month.	Y

7.16	The headend system shall collect and log all tamper detection events sent by meters (logged with event timestamp, tamper event type, and meter ID).	Y	The FlexNet system can convey meter tamper signals.	Y
7.17	The headend system shall provide comprehensive remote testing and diagnostic capabilities for each system component (meters, MIUs, and backhaul communications) based on a (periodic) schedule or on demand. Remote testing and diagnostic alarm messages are to be considered high priority.	Y	SmartPoint communication modules continuously run diagnostic tests.	Y
7.18	The headend system shall be able to remotely test meters for communications status, battery status, and flow status on-demand.	Y	While the solution continuously monitors all alarm conditions, a user can request alarm status at any time.	Y
7.19	The headend system shall be able to remotely detect network communications problems, including loss of redundant communications pathways, diminishing signal strength, repeated delays in reporting, etc.	Y	The FlexNet Head End System is able to report on the network health through the use of applications such as Network Pulse. In addition, the point-to-multipoint architecture of the FlexNet communication network is designed to provide multiple redundant paths from the meter to the head end system.	Y
7.2	The headend system shall log the results of all remote testing and diagnostics activities and any automatic actions taken based on those results.	Y	Sensus logs all user actions performed on each endpoint, typically for audit trail purposes.	Y
7.21	The headend system shall make the results of all received alerts and remote testing and diagnostic results available to authorized IT systems (e.g., MDMS, Work Order Management, etc.).	Y	Sensus can integrate the FlexNet Head End System software to authorized IT systems, including an MDMS or WOMS, to accomplish this flow of information.	Y
7.22	The headend system shall have configurable alert levels and notifications based on the severity of a problem detected and the number of endpoints affected.	Y	The FlexNet Head End System software may be integrated to a third-party application to develop a suitable solution for Naperville based on its requirements for notification.	Y
7.23	The headend system shall be configurable to allow it to classify specific testing/diagnostic results as either requiring or not requiring human intervention in the determination of issuing trouble reports.	N	The core software does not natively support classify results. Sensus does have a value-add application that, among other things, will enable such classification.	N
7.24	The headend system shall have the ability to identify the probable cause of a communications failure within the AMI system (i.e., bad cable, failed MIU, backhaul issues, etc.).	Y	Network monitoring tools provide this information.	Y
7.25	The headend system shall provide mechanisms for remotely correcting system/component problems, which at a minimum shall include the ability to remotely reset (or restart) a component.	Y	Endpoints and base stations can be configured remotely. In addition, the FlexNet system provides a mechanism for remotely restarting a base station.	Y
7.26	The headend system will detect and, to the extent possible, prevent incompatible hardware/software (firmware) combinations between meters, MIUs, collectors, and the headend itself.	Y	The firmware image contained details that prevent from being loaded onto an incompatible endpoint. In addition, all on-air messages contain the same identifying information, which prevents data packet confusion in the event that two firmware jobs are running concurrently.	Y
7.27	The headend system will collect all interval data and logs from premises and communications network components at a configurable frequency (at least once per day). Provide details on how many times per day reads are transmitted and how many hours of interval data are transmitted per occurrence.	Y	The water SmartPoint communication module defaults to hourly register reads and a transmission once every 4 hours (six times per day). The depth of history is dependent on the consumption volume. As much as 7 days of historical data is sent in each message.	Y
7.28	The headend system shall have the ability to remotely configure (set/update/cancel) each meter's default read schedule for a specified or ongoing duration (for all AMI meters).	Y	The transmit rate for SmartPoint communication modules is set at the factory during manufacturing and can be updated remotely over the air.	Y
7.29	The headend system shall receive and log the meter's acknowledgement of successful default read schedule setup.	Y	The meter confirms all over-the-air changes to the reading schedule and subsequent transmit schedule. Meter programming is pushed to the head end system periodically to confirm the setup.	Y
7.3	The headend system shall have the ability to place meters into read schedule groups.	Y	Endpoints may be grouped in any categories you like; including grouping around read schedules.	Y

7.31	The headend system shall have the ability to identify read groups that (1) consistently fail to meet targeted schedule read times and (2) consistently retrieve all reads within scheduled time parameters.	N/A	The FlexNet system does not require read groups.	N/A
7.32	The headend system shall successfully collect interval and all log data for previous day (midnight to midnight) from at least 99% of meters, each day by 6 a.m. Central Time.	Y	The Sensus solution complies with this requirement.	Y
7.33	The headend system shall be able to issue a re-read request for all meters that have failed to report their default read (i.e. mass on demand read) for up to 10% of total AMI meter population.	Y	Sensus sends approximately 72 hours of reads every 4 hours. The historic or redundant reads backfill any missed reads. Should a user want to fill missed reads before the next read delivery, the user can issue read requests for all meters that have failed to report their default read.	Y
7.34	The headend system shall be able to optimize a mass on-demand read to minimize the impact on system performance.	Y	The FlexNet system will deliver on-demand requests at a rate that will not impact other jobs or cause the network's performance to drop.	Y
7.35	The headend system shall be able to automatically rebalance default meter read schedules on a periodic basis in order to balance/optimize the overall meter read schedule performance. Rebalancing shall be accomplished by automatically selecting meters from “over-committed” groups and reallocating them to one or more “under-committed” groups for maximum default read efficiency.	N/A	The FlexNet system is a supervisory read system, not a polled response system. It does not rely on a scheduling system to collect data, but uses supervisory messages that are sent autonomously by FlexNet-enabled meters at various points throughout the day. For this reason, rebalancing of the system is not necessary.	N/A
7.36	The headend system shall receive acknowledgement of a read schedule setup from the meter within 15 minutes of the setup event being sent.	Y	Changes to the read schedule, read interval rate, and transmission rate are immediately reported by the endpoint. The result is likely to be available within 1 minute of issuing the request.	Y
7.37	The headend system shall record the results of read group analysis and the resulting actions taken.	N/A	The FlexNet system does not require read groups.	N/A
7.38	The headend system scheduled read data shall be able to be transmitted directly to recipients with real-time requirements within 60 seconds of the read being sent from the meter.	Y	The FlexNet system can transmit reads to third-party systems using a real-time MultiSpeak interface.	Y
7.39	The headend system shall have the ability to remotely set a non-default meter read schedule(s) at a configurable frequency of greater than once per day but not more frequently than the meter's recording interval.	Y	Users can set non-default meter read schedules to perform reads as often as needed.	Y
7.4	The headend system shall log details of all non-default meter read schedules including the source (system/party) of each non-default schedule.	Y	This information is set from within the head end system or through a third-party application using a MultiSpeak interface. The ID of the user who initiates the action is saved.	Y
7.41	The headend system shall be able to handle various types of events and device health messages (e.g., low battery, tampering, leak, etc.). Vendor shall provide a list all events/alarms supported for relevant meter manufacturers. Note all available alarms, and which alarms are available based on Naperville’s existing meter population.	Y	The FlexNet system is able to send and receive various types of event messages to and from the SmartPoint communication modules. A list of events and alarms has been provided in Appendix 18_Water Alarms.	Y
7.42	The headend system shall support a cancellation capability for scheduled events.	Y	Batch jobs can be canceled or rescheduled at any time.	Y
7.43	The headend system shall not allow scheduling of conflicting events.	Y	The FlexNet Head End System relies on user confirmation of event jobs.	Y
7.44	For bulk operations, the headend system shall support leveling of event messages to minimize impacts to the system and support personnel.	Y	Actions from the head end system are spread out over time to avoid impact to the FlexNet communication network and to other jobs.	Y
7.45	All network devices shall support SNMP v3 messaging with MIBs provided for integration in to a third-party Network Management System (NMS).	Y	The FlexNet system includes both native tools to manage the FlexNet communication network, and SNMP functionality to ease integration into standard network management systems.	Y
7.46	Incoming data traffic can pass through firewalls protecting the data center. Details on ports, protocol, and direction of communication traffic shall be provided.	Y	Sensus supports and recommends the use of network firewalls to restrict access to the Sensus systems. Sensus has documented the minimum network ports and services required for the operation of the system. This will be provided as part of standard product documentation for customers to configure their network firewalls.	Y

7.47	The headend system shall have an overall architecture and system design that is sufficiently distributed so that no single point of failure causes a system performance degradation so severe that the system no longer serves its intended purpose.	Y	The FlexNet communication network has no inherent single points of failure. As designed, the system is expected to provide redundant communication paths for many meters. The FlexNet system requires no reconfiguration or rerouting. The network is designed to provide an overlap of meter coverage with neighboring FlexNet Base Stations.	Y
7.48	Network devices shall be capable of limiting remote access to SSH or HTTPS connections. Unsecured protocols (such as telnet and HTTP) shall be disabled.	Y	Connections to the base station (and head end system) require secure connectivity.	Y
7.49	Network devices shall support named user logins by default with different permissions for administrator, engineer, user, or guest. *Network based authentication shall be provided.*	Y	The interface provided to access FlexNet Base Stations remotely supports named user logins with permissions.	Y
7.50	The headend system shall be able to provide updated reports available at least once a day as well as on demand that contain key diagnostics and statistics from all AMI meters, devices, and field communication network elements. Reports shall include (at a minimum) meter read status reports, event/transaction status reports, trouble reports, and meter additions/removals.	Y	Sensus provides extensive, customizable reporting capabilities through the FlexNet Head End System. Daily reports are available from all AMI meters and base stations, including the desired reports listed. Some reports are standard within the head end system, including alarms, intervals, reads, and system health, among others. When these reports are generated, they apply input parameters containing values set by the user. This allows for a certain amount of customization by the utility. In addition, Sensus will create custom reports for an additional fee.	Y
7.51	Software releases, firmware releases, security updates, and patches shall be communicated through the official distribution channel from the vendor with release notes indicating the change in functionality and any impact identified in regression testing. Note how frequently releases are provided and the advance notice provided to users.	Y	Notification will be provided in advance of any releases, updates, and patches. More information about a mutually agreed-to notification period will be included in the SLA drawn up between Sensus and Naperville.	Y
7.52	Network devices shall support the upload of new firmware prior to the commitment of firmware upgrade execution (two copies of firmware on the device).	Y	Updating the firmware in the FlexNet Base Station is accomplished using secure protocols via the backhaul connection. With this method, the new firmware is put in place, and then, at an appropriate time, it is switched into operation.	Y
7.53	Network devices shall log all access events, identifying user, source IP address, and status of the access attempt.	Y	The FlexNet Base Stations support the ability to log events via standard SNMP-based messaging.	Y
7.54	The headend system shall fully implement and utilize network based authentication such as RADIUS or Active Directory for all user levels and all user profiles.	Y	The head end system supports local authentication and integration with RADIUS/LDAP for centralized identity management.	Y

8. System Integration

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
8.01	Vendor AMI system head-end software should generate meter reading files on a set schedule, that is configurable by the utility. The naming convention for the output file should also be configurable and consistent, for integration purposes. Vendor shall comply with the requirements outlined in the specification section for Interface to MDMS.	Y	The Sensus solution complies with these requirements.	Y
8.02	Respondents must include a schema for their meter read file format, as well as a small example file.	Y	The Sensus solution complies with these requirements.	Y

8.03	Vendor will enforce appropriate levels of security at the integration layer and will run routine checks for security flaws and other issues that could compromise database integrity.	Y	All solutions are designed and built from the ground up to provide end-to-end security protection. Sensus applies the top information security benchmark model to mitigate risks during the design, development, testing and operations of our solutions. This process is guided by three elements 1) confidentiality, 2) integrity and 3) availability—also known as the CIA Triad. Additional security protection is ensured through: Extensive independent third-party testing and certification Application of industry standard processes and measures including NIST, SDLC and ITIL Maintaining compliance of regulatory requirements Continual threat prevention through patches, anti-viruses, firewalls and layered levels of encryption Scrutinizing and deploying the latest cyber technology measures such as Blockchain 24x7x365 data monitoring at secure Tier IV data centers. 24x7x365 network monitoring at a world-class Network Operations Center (NOC) Sensus leads the industry through the deployment of Pervasive Security, which adds defense in depth through multiple layers of security; and breadth by placing security around each critical system, and across each critical network nexus	Y
8.04	Vendor will run compacting and defragmentation procedures and keep database statistics up to date.	Y	Through SaaS, Sensus will manage the entire system on the utilities behalf.	Y
8.05	Vendor will monitor data and log file size to minimize response time to queries and file requests.	Y	Through SaaS, Sensus will manage the entire system on the utilities behalf.	Y
8.06	Vendor will run security and database procedures on a schedule designed to minimize interference with utility access.	Y	Through SaaS, Sensus will manage the entire system on the utilities behalf.	Y
8.07	Vendor will provide a dedicated technical resource for integrations.	Y	The Sensus Professional Services team has a wealth of experience in integrating our technology to third-parties and can support Naperville as needed.	Y
8.08	Vendor shall provide warranties and guarantees for items in section 8.03 with the effective end date of the warranty to be a period that will include one year-end closing after completion of a successful soft start acceptance test.	Y	Warranty will be dependent on deployment configuration chosen. Sensus will guarantee with NaaS configuration.	N
8.09	Vendor must demonstrate compliance with Naperville Ordinance: Title 8, Chapter 1, Article B – Service Rules and Policies. This Ordinance contains a Customer Bill Of Rights regulating the release of customer data to third parties. For the purpose of this RFP, the Vendor is not permitted to utilize third party hosting, and shall detail the measures and protocols in place that prevent data sharing with third parties.	Y	Data is not shared with 3rd parties. Sensus runs a 2 node Utility Private Cloud where all information is managed, protected, and stored within these facilities with only exception being offsite secure backups. We do not allow the information to leave the U.S., we do not provide customer data to any third party nor does any 3rd party manage the data. We have a dedicated organization that focuses only on our SaaS business, the data is segregated from the corporate systems to allow for least number of resources required for access. Naperville owns the data with our SaaS offering.	Y

9. Security

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
9.01	Vendor must support virtual LANs (VLANs) for network segmentation and security.	Y	The Sensus solution complies with this requirement.	Y
9.02	Vendor must support access control lists on all LANs at each location.	Y	The Sensus solution complies with this requirement.	Y
9.03	Vendor must support point-to-point and point-to-multipoint AES-256 encryption i.e.; VPN tunneling.	Y	FlexNet is a point-to-multipoint network that uses standard AES-256 encryption from end to end.	Y
9.04	Vendor must support secure remote management protocols (i.e., SSH, HTTPS).	Y	The FlexNet Head End System software is a secure, web-based portal to the FlexNet system. The portal is secured using Secure Sockets Layer (SSL) encryption via HTTPS. Data circuits are available through multiple providers and diverse pathways, providing access redundancy.	Y

9.05	Vendor must support the network management protocol SNMP version 3.	Y	The FlexNet system includes both native tools to manage the FlexNet communication network and SNMP functionality to ease integration into standard network management systems.	Y
9.06	Vendor must support logging to a remote log collection server.	Y	The Sensus solution complies with this requirement.	Y
9.07	Vendor must support port mirroring or SPAN network traffic monitoring.	Y	Licensed RF spectrum and multi-channel optimization that let you prioritize time-sensitive applications. Applications are not forced to compete with other network traffic over the same communication channel.	Y
9.08	Vendor must support NetFlow or similar real-time IP traffic monitoring protocol.	Y	The Sensus solution complies with this requirement.	Y
9.09	Vendor must support RADIUS for administrative authentication.	Y	FlexNet Base Stations support local authentication and integration with RADIUS/LDAP for centralized identity management.	Y
9.10	Must perform security assessments, vulnerability scanning, and penetration testing on a routine cadence (minimally on an annual basis).	Y	Sensus conducts the following third-party security assessments: • Periodic penetration testing (such as Rapid7 and Wirehead) • Third-party real-time firewall, logging, and Intrusion Prevention System (IPS) and Intrusion Detection System (IDS) monitoring In addition, Sensus conducts the following internal security assessments: • Dedicated Sensus security team • Responsible for all data center security • Actively participates in and monitors industry regulation and standards regarding security (as described in the preceding section) • Monthly vulnerability scanning • Patch and antivirus management	Y
9.11	Customer data should not be co-mingled.	Y	To control costs, Sensus may use a multitenant system, where utility data can be intermingled. However, no customer has direct access to the database, and all data is managed by unique utility identifiers. The result is that each customer will only have access to their own data. Naperville can be put into their own system for an additional cost. In this scenario, there would be no other customer in the system, and therefore no data would be intermingled.	Y
9.12	Data replication/backups performed at least daily. Data replications/backups to a secure off-site facility should be performed at least weekly.	Y	For the SaaS environment, the configuration for the utility's backup network is a full-scale, replicated system located in a separate facility than its primary data center. Storage level replication between the two locations is to provide rapid recovery in a disaster recovery situation. All existing Sensus SaaS customers currently have real-time replication on multiple live data centers.	Y
9.13	Backup data must be encrypted.	Y	Backup data is encrypted.	Y

9.14	Disaster recovery capabilities must meet industry standards, including secondary sites at geographically dispersed locations. Provide file, log, and activity/traffic monitoring. The City desires that Proposer maintain dual data centers so that one center shall provide secure backup for the other. Indicate the frequency at which Utility data will be synchronized to a disaster recovery database. The recovery time requirement in the event of a system or database failures shall be 4 hours. The recovery point requirement in the event of system or database failure shall not be more than 2 hours.	Y	Sensus currently operates three active and geographically dispersed data centers in North America. The disaster recovery environment will be identical to the City's production environment. For the SaaS environment, the configuration for the utility's backup network is a full-scale, replicated system located in a separate facility than its primary data center. Storage level replication between the two locations is to provide rapid recovery in a disaster recovery situation. All existing Sensus SaaS customers currently have real-time replication on multiple live data centers. For these data centers, the Recovery Time Objective (RTO) is 48 hours. Because of the base station message spooling capability when head-end is off-line, there should be no loss in data as the base station will pushed saved messages to the new system when connection is re-established.	Y
9.15	Backup and DR procedures must be tested; not simply defined. Quarterly tests are preferred. Detail what testing processes took place last quarter and results.	Y	Annual tests are performed across all systems. For a fee, Sensus can set testing more often.	Y
9.16	Provide auditable logging (complete change and activity logs w/data retention in line with Naperville and regulatory/compliance requirements).	Y	Data is stored both in its raw, incoming form and its cleansed, processed form, with an audit trail of any changes. In addition to administering standard security testing procedures, Sensus' certified cybersecurity partners perform quarterly third-party audits and security testing to ensure that all information is safe.	Y
9.17	Vendor should have IDS/IPS enabled and support notification processes. Detail incident response plan and vulnerability management plan.	Y	Sensus recommends the use of network-based intrusion detection/prevention (IDS/IPS) for detection and prevention of network-based attacks against the FlexNet Head End System. This technology, along with the segmentation and separation of components, allows for isolation of critical components (for example, database and key store) behind multiple layers of defense.	Y
9.18	Vendor must include a rollback plan/exit strategy.	Y	Sensus will support your decision to transition from SaaS to a licensed environment (or vice-versa) and will work with you to develop a rollback plan/exit strategy.	Y
9.19	Vendor headend solution must support sign on requirements consistent with other City's smart meters systems.	Y	It is unclear what the other smart meters system sign on requirements actually are. Sensus supports an RBAC; system comes with support for LDAP and AD; and other system through professional services.	Y
9.20	Include the long-term roadmap for security enhancements for the application with the RFP response.	Y	Please see Appendix 19_Sensus Security Roadmap.	Y
9.21	Vendor must support quarterly enhancement releases as well as emergency break/fix.	Y	Sensus software enhancement schedule is approximately every 6 months with fix patches as needed.	Y
9.22	Except for emergency repairs, Vendor shall coordinate with Naperville and provide notifications with release notes prior to all system changes, including repairs and patches.	Y	Sensus will notify the City of any maintenance requirements and confirm acceptance with the City. The FlexNet AMI network infrastructure requires minimal maintenance. Site visits for scheduled maintenance take approximately an hour on average.	Y

10. Acceptance Testing

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?

10.01	Vendor will develop all test plans and submit to Naperville for review and approval.	Y	With over 950 AMI deployments, Sensus understands the importance of a streamlined and methodical testing process. To that end, the System Acceptance Test (SAT) plan consists of a series of tests that build upon each other. We conduct these tests in stages to identify any problems as quickly as possible, and to establish confidence for proceeding with deployment. Initial tests demonstrate that the products meet the major functional specifications in accordance with the agreement. Subsequent tests will help assure the customer that the FlexNet system will perform and scale to meet the specifications in the agreement.	Y
10.02	Vendor will provide any necessary tools and equipment necessary to support testing.	Y	Sensus complies with this requirement.	Y
10.03	All software shall be tested and approved using a user acceptance test. The acceptance test shall validate the meters, MIUs, collectors, backhaul network, software and interfaces are setup correctly and there are no major deficiencies that will result in incorrect information being passed to the Naperville billing system or customers.	Y	Sensus will ensure that system components are tested and approved by Naperville.	Y
10.04	Any tuning or optimization of the network identified during the project or during testing shall be completed before Naperville's acceptance.	Y	Sensus complies with this requirement.	Y
10.05	Naperville will withhold a 10% retainage on all invoiced amounts until successful completion of acceptance testing.	N	Core & Main reserves the right to negotiate provisions including but not limited to retainage. Please see Qualification Exceptions attached to proposal.	N

11. Training

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
11.01	Vendor shall provide training on installation, service, replacement, and repair procedures for equipment provided (e.g. MIUs, network devices).	Y	Sensus is experienced in training installation vendors on the installation, service, replacement, and repair procedures for the FlexNet equipment.	Y
11.02	Vendor shall provide management training for administrative and other personnel who will be responsible for defining and maintaining the system's configurable parameters.	Y	Sensus will provide training to personnel as designated by the City.	Y
11.03	Vendor shall provide training on the headend system and corresponding reports.	Y	Sensus offers two options for training: Solution 1 is a standard curriculum that covers all components of the FlexNet solution; Solution 2 includes everything offered in Solution 1, plus one-on-one instruction and customizable options to meet the City's needs.	Y
11.04	Vendor shall make training material available to Naperville for internal training or retraining of employees. This material shall be kept current as the solution evolves.	Y	Training material is kept current. Much of Sensus training material is online for access at any time.	Y
11.05	Vender shall provide software installation and maintenance documentation, including: product release notes; vendor's third-party software configuration requirements; database install; product installation and configuration steps; transaction entry procedures, batch job setup requirements.	Y	Sensus will provide all documentation needed to operate the system under an NDA upon contract award.	Y
11.06	Vendor shall provide system operations and user manuals. Documentation must explain the following system operations: System Start-Up; System Shutdown; Monitoring; Process Recovery/Re-start; Internal Processing Controls; Archiving.	Y	Sensus will provide all documentation needed to operate the system under an NDA upon contract award.	Y

12. Other

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?

12.01	Software required on-field devices for the installation, testing, and reading of meters and MIUs shall be provided. Describe the make and operating system of these field devices.	Y	The Sensus FieldLogic software and CommandLink and the Juniper Archer 2 hand held device are needed for the installation, testing, and local reading of meters and MUIs in the field. FieldLogic Tools run on Windows 10 or Windows Mobile 6.5.	Y
12.02	It is desired that the proposed solution support various Internet of Things (IoT) and Smart City applications beyond AMI and core utility-focused functionality. Provide details on capabilities, use cases, reference customers, and budgetary pricing.	Y	The emergence of the Internet of Things (IoT), Big Data, and advanced communication networks are about to usher in an era of unprecedented innovation. Municipalities are rethinking the potential for using existing and future investments in technology and infrastructure to improve the lives of residents. The promise of Smart Communities is tantalizingly close. At the same time, the Smart Community promise has also evolved the role of the municipal utility (MU), creating both greater opportunities and equally greater challenges. MUs are under more pressure than ever to provide Smart Community capabilities for their customers today, while preparing to deliver even greater improvements in the future. In order to deliver on this promise, MUs now look to smarter applications and services to make our cities and communities more livable, economically competitive, and sustainable into the future. The benefits of these applications range from their ability to reduce infrastructure and maintenance costs to vastly improving public safety. With the right combination of strategic thinking and technology innovation, Smart Communities can go from vision to reality. **Lighting Leads the Charge**	Y
12.03	Vendor will refer any media, police, or safety inquiries related to the project to Naperville.	Y	Sensus complies with this requirement.	Y
12.04	The vendor will have a support process defined and available 24x7. This will include methods to report issues or receive answers to questions. An escalation process will be defined as appropriate for the severity and impact involved in a particular situation.	Y	Sensus Technical Services provides utility customers with a single point of contact for technical support issues. Requests that require specialized skills are escalated to a senior support engineer or Technical Advisor for further analysis. If Technical Services has exhausted all troubleshooting efforts for the product type, the issue will escalate to the Engineering Support Team. Occasionally, on-site troubleshooting/analysis may be required.	Y
12.05	The design provided shall ensure that at least 99.8% of meters have the ability to connect to at least two different data collectors.	N	As noted in in "Section 2 System Design, ID 2.02", The Sensus RF propagation model will show two or more basestations communicating with 99.71% of The City of Naperville's MIU's. Please see the notes section of Appendix 13_RF Propagation Study for details.	N
12.06	All data such as meter reads, meter locations, etc. belongs solely to Naperville. The vendor shall have systems, policies, and procedures that protect these data.	Y	Utility data is protected. It is not available to any entity outside of San Jose Water and Sensus. Sensus may use the raw data to assist in testing new software versions and developing new applications.	Y
12.07	Vendor's return merchandise authorization (RMA) process provides refund, replacement, or repair of warranty-eligible items within 10 calendar days of receipt. Detail intake and testing criteria to approve/deny warranty eligibility. Note if low-battery MIUs are eligible for full warranty, or if battery must fully fail before hardware is RMA eligible.	N	Sensus evaluates returned material and, if needed, repairs or replaces the materials within 60 days of the receipt date. Please see Appendix 20_Sensus RMA Process.	N

12.08	Describe the failure analysis process that is used when product is returned. On a quarterly basis Proposer will provide a failure analysis report for any and all product returned by Utility to Proposer. For failures of 25 units or more in any quarter, the report should include a diagnosis of the root causes of any failures such as software error, communication error, excessive retries, failed component, water intrusion, etc. The report will include an analysis of similar failures that have occurred on other projects, the cause of such failures, the actions that Proposer is taking to minimize such failures, and an assessment regarding the likelihood of continued	N	Please see Appendix 20_Sensus RMA Process for the failure analysis process that is used when a product is returned. All units which are not under warranty will get an explanation attached to the case with details why it is not covered under warranty. Units which are replaced under warranty do not get a special report but upon request we do often do a periodic review if a customer is seeing higher than anticipated failure rates or a lot of the same failures. All units inspected at Sensus do go into our root cause database regardless of if it is or isn't shared with the customer.	N
12.09	Vendor will pay reasonable shipping fees and in/out charges for hardware returns covered under warranty.	N	According to the Sensus Warranty Agreement, the Customer prepays shipping both to and from the location.	N

13. Service Level Agreement

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
13.01	Utility reserves the right to impose a penalty of $25 for each instance where the Proposer has failed to properly notify the customer at least 24 hours in advance of the appointment time of the need to reschedule for another day. Utility reserves the right to impose a penalty of $50 for each instance where the Proposer has failed to properly notify the customer at least 2 hours in advance of the appointment time of a late arrival. Utility reserves the right to impose a penalty of $100 for each instance where the installer has completely failed to show up for an appointment.	y	MIU Installer agree to all terms.	Y
13.02	Vendor's AMI overall systems and software component availability shall be greater than 99.9% in any 24-hour timeframe.	Y	Sensus' committed uptime is 99.9%.	Y
13.03	Vendor's AMI network (meter to collector) availability shall be greater than 99.9% in any 24-hour timeframe.	Y	The Sensus network is designed for the stated uptime.	Y
13.04	Vendor's AMI backhaul network (collector to headend) availability shall be greater than 99.9% in any 24-hour timeframe.	NA	Sensus intends to use the City of Naperville's owned and operated fiber network for backhaul	NA
13.05	Vendor will be required to provide details on scheduled maintenance requirements and emergency downtime to Naperville. Naperville will be able to declare "critical operations" states where the vendor will not perform work on the system.	Y	This requirement is understood.	Y
13.06	Maintenance windows during which routine maintenance activity may be scheduled will be mutually agreed upon by the vendor and Naperville. Naperville must receive at notification at least three business days in advance of any work performed in these maintenance windows that may impact system performance or availability.	Y	This requirement is understood.	Y
13.07	Vendor shall notify Naperville by e-mail or another mutually agreed upon methods in less than one (1) hour when a collector, backhaul link, or headend device is not fully and reliability functioning.	Y	Under SaaS and NaaS contracts, the request will be met. If Naperville chooses to own their own equipment, the requirements would need to be met by Naperville.	Y
13.08	Vendor is able to provide greater than 99.9% of AMI meter data for billing (on the scheduled bill date), using reads captured within the past 8 hours.	Y	For all available meters, Sensus is confident that FlexNet will ultimately deliver performance at this 99.9+% level but all conditional parameters need to be understood and implemented by Naperville to acheive this.	Y
13.09	Vendor shall identify failed AMI endpoint devices within 1-day of failure. This information shall be available to Naperville in report format.	Y	There are reports within the head end system where failed devices are listed, called stale meters. Utility can reference that report directly. If utility requests in an email form or more direct notification; Sensus professional services team can develop for a charge.	Y

13.10	Vendor will deliver 100% of the previous day's hourly metering data between midnight and 6:00 AM Central Time daily. Note how and when read success rate is calculated.	Y	Sensus is confident that FlexNet will deliver near 100% read perfomance in a 24 hour period in 2 hour increments and is not limited to overnight reads.	Y
13.11	Vendor will deliver greater than 100% of AMI meter data daily no later than 6:00 AM Central Time for presentation to customer portal and use by CSR.	Y	Sensus is confident that FlexNet will deliver near 100% meter data by utilizing 2 hour increments and providing no later than 6:00 AM Central Time for presentation to customer portal and use by CSR.	Y
13.12	Vendor will provide accurate AMI real-time data within 60 seconds of an on-demand read request.	N	A typical on-demand read, or other requested interaction, takes between 30 and 90 seconds.	Y
13.13	Vendor shall resolve failed AMI telecommunication system issues within 3 business days of notification.	Y	Sensus FlexNet NaaS will resolve all failed AMI telecommunicaitons system issues within 3 business days of notificaitons. FlexNet telecommunication issues are extremely rare and can typically be restored within hours of failing by C&M or Sensus technical support. It is often reported that even under disaster conditions such as hurricanes or tornados, FlexNet data is still being communicated and quickly backfills once the utility side of telecommunication is restored.	Y
13.14	Vendor's headend user interface availability shall be greater than 99.9%.	y	Sensus' committed uptime is 99.9%.	N
13.15	In the event that there is downtime in excess of the allowed 0.1%, Proposer shall provide a credit to Utility on an hour-for-hour basis against all of the monthly fees associated with the Software, Hosting and Support for the first ten (10) hours of downtime in the aggregate during the period at issue. For hours 10-20 aggregate hours of downtime, Proposer shall provide two hours of credit per hour of downtime. For any aggregate hours of downtime in a period in excess of 20 hours, Proposer shall provide a credit against all monthly fees on a three hours credit for each hour of downtime basis. Credits shall be applied against the next invoice. In the event a service level default occurs after the Utility has made final payment to Proposer for the managed services and no further invoices shall issue as a result, Proposer shall refund to Utility the amount of the appropriate service level credit due for the period of Default. These credits shall be considered to be liquidated damages and not a penalty. Proposer shall acknowledge that in the event of downtime in breach of the warranty, Utility will incur damages that, while significant, may be difficult to prove with particularity. Proposer acknowledges that the liquidated damages set forth above have been negotiated at arms' length and reflect the parties' reasonable expectation of damages that Utility will likely incur given the circumstances known to the parties at the time this agreement was executed.	Y	Please see Appendix 7_Sample AMI Agreement for remediation if Sensus does not meet its committed uptime.	Y
13.16	Proposer shall provide a written guarantee that no changes in the software, firmware, or hardware design of components of its MIUs, DCUs or Repeaters that it provides to Utility for twenty (20) years from the Commencement Date will be made without prior testing and verification that such changes will result in no loss of functionality for the meters incorporated in Utility's AMI system. In the event of such incompatibility or loss of full functionality, Proposer shall be responsible for repairing or replacing all of its equipment that is not working, including labor. Firmware updates for handheld devices shall be provided by Proposer at no additional cost to Utility for twenty (20) years from the date of delivery of the unit.	N	As an industry leading innovator, Sensus is continually improving hardware and software components. Every effort is made to provide reverse compatibility and our 2-way functionality allows for firmware updates to be performed OTA with little or no cost to our customers. Industry requirements are changing faster today than ever before and that trend will continue. Sensus will keep up or outpace those requirements but cannot possibly guarantee this will not impact the components delivered today all the way out to 2040. We believe our track record of consistency in this area is the best in the industry and owning the spectrum we operate in provides highest level of certainty that your assets will not be stranded.	N

13.17	Proposer warrants that any and all software provided as part of its system to Utility does not contain any program code, virus, worm, trap door, back door, timer, or clock that would erase data or programming or otherwise cause the software to become inoperable, inaccessible, or incapable of being used in accordance with its user manuals, either automatically, upon the occurrence of Proposer-selected conditions, or manually on the command of Proposer, or upon occurrence of user-selected conditions.	N	Sensus tests our firmware and software to ensure that the FlexNet system does not contain any of the listed such as backdoor/trapdoor, or program code that would erase or otherwise cause the system to be inoperable. In addition, Sensus maintains source code in a secure manner to ensure its integrity. Access to the FlexNet head end system is controlled by permissions granted by utility system administrators to ensure that utility personnel only have access to the areas needed to perform their job; likewise, the utility will control Sensus access to your systems too -- for instance, read access can be granted but not write access.	Y
13.18	System data shall be preserved and properly evolved through firmware updates and software upgrades. To demonstrate continuity of functionality, the vendor shall first upgrade or downgrade a single unit before sending updates to the entire system.	Y	Sensus complies with this requirement.	Y
13.19	Should the system be subject to excessive failures of components, Proposer acknowledges that Utility will incur maintenance costs, loss of savings and productivity, loss of credibility and interruptions in cash flow in excess of reasonable expectations. Vendor warrants the MIUs, DCUs and Repeaters against failures that exceed the guaranteed maximum failure rates as defined (by Proposer) in the Pricing Proposal. Should the failure rates exceed these levels, or should the system in its totality substantially fail to perform such that Utility, in its sole and good faith discretion, cannot reliably use the system for billing, or should the occurrence of erroneous or inaccurate meter readings exceed 20 per thousand per year, then the Utility may notify Vendor of this condition, whereupon Vendor shall be responsible for promptly restoring the system to its normal level of reliability and accuracy at its sole cost and expense. Should Proposer be unable to restore the system within a reasonable period of time, Utility may declare the system to be non-functioning, and may exercise its	Y	Sensus provides the most comprehensive "nationally published warranty' in the industry with the Sensus G-500 Warranty. If Naperville would like to enter into a Network wide warranty, Core & Main and Sensus are open to that and would be willing to consider providing one to Naperville's satisfaction.	N
13.20	Vendor shall have the ability to create business performance measurement and reporting per SLA parameters above in a monthly report.	Y	Under SaaS and NaaS contracts, the request will be met. If Naperville chooses to own their own equipment, the requirements would need to be met by Naperville.	Y
13.21	Vendor shall provide standard operating procedures, reports structured to monitor SLA targets, and sample reports.	Y	During contract negotiations, the SLA requirements will be reviewed and reports built in accordance with utility expectations through Sensus professional services organization.	Y
13.22	Vendor will provide support levels and response times based on the severity of the incident. Please see further details in the table below.	N	The Sensus SLA indicates that Severity Level 2 Incidents are responded to within 4 hours. In regards to Severity Level 4 new features or enhancements, Sensus will log these and take them into account but it is not promised accomplish them.	N

Table 1. Incident Severity Log

Severity	Description	Response Target
1	AMI system is down or key applications have failed or critical functionality is not continually available resulting in disruption of work. No work around is available and requires immediate attention.	30 Minutes with work on fix or work around starting immediately and continuing 24/7 until resolved.
2	Failure of major system feature or functionality, or system is unable to export properly formatted files containing meter reads. Operations are restricted. No acceptable work around is available and requires immediate attention.	2 Hours with work on fix or work around starting immediately and continuing 24/7 until resolved.

3	The system is usable and critical operations are not impacted. Operations Naperville considers critical include, at a minimum, any customer-facing experience, reading and billing, and error and exception reporting. Potential increased risk of impact because of lack of redundancy or other issues. Business impact is limited.	1 Business Day with work on a fix or work around being completed within 20 business days.
4	Minor systems issues, question, new features or enhancement requests to be corrected in future version.	2 Business Days with work continuing until resolved within 6 months.

Firm Name: Sensus

Date: 15-Oct-19

1. GENERAL REQUIREMENTS

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
1.01	Vendor will assign a main point-of-contact as well as an onsite, full-time project manager. A chain of escalation shall be defined for critical or unresolved issues.	Y	Agree to Terms. A designated project manager will be identified and a QC process will be available in the technical response section of RFP. Rerference 1.3 Staffing section of Technical response.	Y
1.02	Vendor will provide a dashboard that provides a daily snapshot of project progress, network installation counts, and important issues.	Y	Agree to Terms. Installation contractor will have a website available for City to monitor progress. A detailed description will be available in the technical section of the RFP. Reference Appendix_10 Vepo MIU Installer.	Y
1.03	Vendor must receive approval to any changes in the project manager and other key project team roles.	Y	Agree to Terms. No work out of scope will be done without City approval.	Y
1.04	Naperville may, at its sole discretion, request a change in project manager or other key project team roles.	Y	Agree to Terms	Y
1.05	Vendor will participate in weekly project status meetings and periodic AMI Committee meetings (e.g., monthly).	Y	Agree to Terms. Weekly/monthly meeting TBD during pre-construction kick-off meeting.	Y
1.06	Contractor shall maintain a documented safety and customer service program.	Y	Agree to Terms. Details to be provided in the technical section of RFP. Reference Appendix_10 Vepo MIU Installer.	Y
1.07	Contractor shall complete the installation of assigned registers and MIU devices in the Naperville service territory, as outlined in the mutually agreed upon deployment plan and schedule.	Y	Agree to Terms. Scope of services require installation contractor to Install MIU only and not replace meters or registers as part of this RFP.	Y
1.08	Contractor shall follow the deployment plan provided by Naperville with a forward-looking view of at least ninety (90) days.	Y	Agree to Terms	Y
1.09	Contractor shall provide a single point of contact for all interfaces with the Naperville AMI project team and Naperville technology group.	Y	Agree to Terms. See section 1.01 in AMI and Installation Matrix for response.	Y
1.10	Contractor will provide sufficient field and warehouse personnel including supervision to provide the services outlined in this RFP.	Y	Agree to Terms. There will be sufficient personnel to handle the timelines set forth in RFP.	Y
1.11	Contractor shall provide sufficient back-office personnel necessary to provide the services outlined in this RFP.	y	Agree to Terms. There will be sufficient office personnel to handle back-office personnel to handle timelines set forth in RFP.	Y
1.12	Contractor shall provide personnel with the requisite knowledge and skillsets to perform register replacements and/or MIU installations. Specifically: a) Conducting an initial site safety inspection b) Noting any infrastructure facing imminent failure (including leaks), which will be immediately referred back to Naperville c) Locating meter boxes (including digging, as required) d) Replacing registers e) Installing an MIU f) Programming an MIU	y	Agree to Terms. Personnel skillset will be detailed with customer years of service in industry and past/current projects under contract with similar scope to City requirements set forth in RFP. See technical section of RFP for detailed scope of services provided. Regarding infrastructure leaks, location of meter boxes, replacing registers or meters are not part of scope of RFP. Reference Appendix_10 Vepo MIU Installer.	Y

1.13	Contractor shall provide all tools necessary to successfully install AMI within Naperville's service territory, including: a) Wifi/cellular data-equipped Toughbook or mobile devices that are compatible with the preferred workorder management system b) Personal protective equipment c) Uniforms, including Naperville's name and logo d) Transportation and vehicles e) Tools and equipment f) Communications equipment (e.g., cell phones, MIUs)	y	Agree to Terms. Installation contractor will have necessary equipment and proper wear to program MIU and have sufficient quantities to meet the schedule set forth in the RFP.	Y
1.14	Contractor will provide AMI programming devices as required	y	Agree to Terms. Contractor will have sufficient equipment necessary to meet timelines set forth in RFP.	Y
1.15	Contractor shall provide all computer equipment and office facilities, warehousing and material handling facilities, equipment staging areas, security services, maintenance and repair facilities, etc. required to perform the services outlined in this SOW.	Y	Agree to Terms	Y
1.16	Contractor shall provide sufficient storage capacity to accommodate inventory of new registers, removed registers, and other materials as required to support the Services.	Y	Agree to Terms. Storage will be sufficient to handle timelines set forth in RFP.	Y
1.17	Contractor shall handle scheduling all customer appointments as required. Note process for scheduling, confirming, and working customer appointments, including if a customer appointment is in jeopardy of being missed.	Y	Agree to Terms	Y
1.18	Contractor shall utilize a workorder management system and inventory control system, both of which support daily reconciliation with Naperville's workorder system and/or CIS.	Y	Agree to Terms. Contractor has tracking system that meets or exceeds these requirements.	Y
1.19	Contractor shall report all customer defective equipment, emergency breaks, suspected theft of water, and unsafe conditions to Naperville.	Y	Agree to Terms. Contractor has tracking system that meets or exceeds these requirements.	Y
1.20	The Contractor installation vehicles shall contain Naperville-approved branding. Note the anticipated vehicle make and if all installers will have a vehicle and/or supporting wagons. Provide photos of typical vehicles and markings. Naperville reserves the right to reject vehicles for reasons of appearance, state of repair, or other concerns.	Y	Agree to Terms. Reference Appendix_10 Vepo MIU Installer.	Y
1.21	The Contractor field personnel shall have highly visible identification badges with photos and Naperville-approved branding.	Y	Agree to Terms. Reference Appendix_10 Vepo MIU Installer.	Y
1.22	Contractor shall adhere to Naperville's customer refusal / delay list process that is managed by the AMI project team. The process specifies the actions that shall be performed by the installers when a customer refusal is received at the customer premises. Additionally, AMI installation orders are required to be cancelled/added even upon short notice (including on the day the MIU installation is planned) based on a customer's decision to refuse/accept a smart meter.	Y	Agree to Terms. No meters will be installed as per scope of RFP.	Y

1.23	Contractor will be provided Naperville field cards containing talking points for use by installers when interacting with customers. Naperville will train Contractor management and installers on the use and content of the field cards prior to AMI installation beginning. The materials will be updated by Naperville as required to support the program and provided to the Contractor. It shall be the Contractor's responsibility to train new personnel that join the project after the initial Naperville-led training is conducted as well as when new field card materials are issued (e.g. tailgates, classroom, etc.).	Y	Agree to Terms.	Y
1.24	Contractor shall immediately notify Naperville of any material changes to the AMI deployment schedule, particularly changes that impact that start and end dates for AMI installations within a specific community/town.	Y	Agree to Terms. Weekly/Monthly progress meeting will be sufficient to address any changes to deployment schedules.	Y
1.25	Contractor shall provide Naperville with mobile phone numbers of field supervisor personnel to allow for real-time communications regarding deployment/customer issues with Naperville work planning, call center or other personnel.	Y	Agree to Terms.	Y
1.26	Contractor shall quantify all vehicle mileage to assist Naperville with documenting and reporting on carbon emissions associated with operations and capital projects.	Y	Agree to Terms	Y
1.27	Vendor will refer any media, police, or safety inquiries related to the project to Naperville.	Y	Agree to Terms	Y

2. FIELD DEPLOYMENT

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
2.01	Contractor shall perform all Services during the hours of 8AM – 5PM Central Time, Monday through Friday or as otherwise mutually agreed to by Contractor and Naperville. Contractor will adhere to Naperville's company holiday schedule, which recognizes 14 holidays per year. The holiday schedule will be determined and announced by Naperville annually.	Y	Agree to Terms. Hours of operation, including holoidays and black out periods will be discussed and agreed upon during pre construction kick off meeting.	y
2.02	Contractor shall complete service orders as outlined in the AMI deployment schedule.	Y	Agree to Terms.	y
2.03	Contractor will not install MIUs during the meter reading blackout window (4-days before and 2-days after scheduled meter reading date) based on the meter reading schedule provided by Naperville.	Y	Agree to Terms.	y
2.04	Contractor shall meet all customer appointments per the service level agreement.	Y	Agree to Terms.	y
2.05	If meter access is not obtained, Contractor shall return to the premises and re-attempt the install; Contractor should schedule appointments as appropriate.	Y	Agree to Terms. Acces to meters are not part of RFP scope. Inside MIU installations will be re-scheduled to complete job.	
2.06	Contractor shall leave a door hanger provided by Naperville upon attempt/completion of the AMI installation (separate door card for successful and unsuccessful attempts shall be utilized).	Y	Agree to Terms. Reference Appendix_10 Vepo MIU Installer.	y
2.07	Contractor shall use its most efficient and safe register change-out and AMI installation process.	Y	Agree to Terms. Scope of RFP is to install MIU only either inside/outside residents premises. Reference Appendix_10 Vepo MIU Installer.	y

2.08	Contractor shall comply with all environmental controls during any phase of the deployment as directed by Naperville.	Y	Agree to Terms.	y
2.09	Naperville's standard installation is as follows: a) Locate meter box and dig if necessary b) Take pre-installation photos, including a photo clearly displaying the meter number and the outgoing register read c) Document register out read d) Complete register replacement in adherence to manufacturer instructions e) Enter register in read, and note out read on a sticker placed on the new register f) Attach MIU via Nicor connector g) Program MIU h) Replace pit lid (if required) i) Reinstall any locks j) Complete visual inspection of installation			
2.09 cont.	k) Remove materials/debris/trash to leave the customer site in equal or better condition than received; waste will be off-hauled and disposed of by Contractor to a local landfill l) Take post-installation photos, including a photo clearly displaying the meter serial number and the ingoing register read m) Leave Naperville approved door hanger identifying work performed and/or incomplete n) Close the service order and document any relevant notes/customer interactions o) Disassemble MIU (if required) and dispose/recycle parts per specifications All photographs shall include a date and time stamp.	Y	Agree to Terms. Scope of RFP only to install MIU inside/outside residence. See Technical Response for scope of work provided at resident locations. Reference Appendix_10 Vepo MIU Installer.	y
2.10	Vendor shall develop and keep current a schedule of installations by route. Naperville will use this information to provide information on timing and activities to its customers and employees.	Y	Agree to Terms. See Technical response section for scheduling project by route. Reference Appendix_10 Vepo MIU Installer.	y
2.11	Tampering: Contractor shall inspect existing metering end points and fittings for obvious signs of tampering including, but not limited to bypasses, tampered meters, damage caused by apparent attempts to open the meter, etc. Contractor shall report via the workorder management system. Contractor shall document and digitally capture, store, and make available photographs of such revenue protection/tampering discoveries. All photographs shall include a date and time stamp.	Y	Agree to Terms. See Technical response section for details regarding installation procedures. Reference Appendix_10 Vepo MIU Installer.	y

2.12	Damaged or incorrectly installed meters: Contractor shall report damaged or incorrectly installed meters immediately via notation on the workorder management system. Contractor shall complete register replacement and/or endpoint installation unless prohibited due to unsafe situation.	Y	Agree to Terms. Scope of RFP will not include register or meter changeouts.	y
2.13	Switched/Crossed Meters: Contractor shall communicate all switched meters discovered during installation and shall report these via notation on the workorder management system. Contractor shall not perform work on suspected switched meters without the approval of Naperville.	Y	Agree to Terms.	
2.14	Improperly installed meters/AMI endpoints: Contractor shall follow installation procedures according to the manufacturer's specifications or Naperville's standards. Contractor shall assume and accept the financial responsibility for replacement of damaged equipment or lost revenue due to incorrectly installed register or AMI endpoint.	Y	Agree to Terms.	
2.15	Repairs to metering-related equipment: Contractor may encounter situations where repairs to metering-related equipment are required to complete an installation, including service-side and customer-side issues. Contractor shall perform minor repairs such as securing loose metering equipment. Contractor shall report all equipment needing major repair or plumbing intervention by notation on the workorder management system, including notes on the current meter condition and anticipated repair needs. In the event of an emergency, Contractor will immediately call Naperville dispatch. Repairs returned to the utility must include photos and comments on work required. If Naperville accepts these repairs as required these scenarios will not count against Contractor's RTU metric.	Y	Agree to Terms. Any meter related situations will be discussed with City if necessary but scope of RFP does not include meter installations.	

3. QUALITY ASSURANCE

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
3.01	Contractor will implement a field deployment quality assurance (QA) program to ensure that deployment services are provided in accordance with the service level agreement. Contractor will share the results of the quality assurance program with Naperville on a weekly basis.	Y	Agree to Terms. See Technical response section in RFP for details. See Section 4.4 of Technical Responses for details.	y
3.02	Contractor shall provide its quality assurance program to Naperville for review and approval. At a minimum the quality assurance program should include aspects related to workmanship, customer interaction, and safety.	Y	Agree to Terms. See Technical response 4.4 Technical Responses for details.	y
3.03	Contractor shall have a resource that is accountable to perform QA Inspector responsibilities.	Y	Agree to Terms.	y

3.04	Contractor shall inspect one hundred percent (100%) of all work completed by new hires for a period of five (5) working days from the date the installer begins work in the field (the "Initial Period"). a) Audit of deployments by new hires should occur within twenty-four (24) hours of the deployment. b) Contractor shall track and provide a listing of new hires, and include hire date, and first date that such employees begin field installations.	Y	Agree to Terms.	y
3.05	After the Initial Period, five percent (5%) of each installer's daily totals will be randomly audited. These audits shall be performed within forty-eight (48) hours of the installations.	Y	Agree to Terms.	y
3.06	If after the Initial Period, the installer's quality errors are found to be in excess of one percent (1%) on any given month, the installer shall be removed from the field and retrained.	Y	Agree to Terms.	y
3.07	Installers who are retrained and returned to the field shall have one hundred percent (100%) of their work audited for five (5) consecutive working days. Any error in that five (5) day period will result in the installer being permanently removed from the field.	Y	Agree to Terms.	y
3.08	Contractor UTC - When the Contractor is unable to complete (UTC) an installation due to access, the Contractor shall make three field visit attempts (inclusive of the first installation attempt) to gain access and install the register/AMI endpoint within 21 days. Naperville will make at least two more attempts to contact the customer during the 21-day period. After three field attempts by the contractor with the support of two phone call attempts by Naperville, the order shall be returned to the utility (RTU).	Y	Agree to Terms. Attempts to install will be documented.	y
3.09	Return to Utility (RTU) would include irregular or unsafe conditions preventing MIU installation, the parameters of which will be agreed upon between Contractor and Naperville. All such activity shall be documented as a note within the workorder management system and provided to Naperville to support the Contractor's case that the account is UTC.	Y	Agree to Terms. Issues preventing the installation of MIU will be documented.	y
3.1	Contractor is liable for payment of all claims that are approved via Naperville's existing claims process. Naperville will handle claim processing consistent with today's policies and procedures Claims cost will be deducted from payment to Contractor, unless no further payment is due, in which case Contractor will reimburse Naperville directly. Contractor is liable for damages to landscaping and property such as fences/gates.	Y	Agree to Terms.	y

4. FACILITIES AND WAREHOUSING

Contractor shall be responsible for establishment and operation of any warehouse facilities necessary to perform the Services. Contractor functions will include:

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?

4.01	Receive and visually inspect new material shipments from Naperville's or manufacturers' facilities.	Y	Agree to Terms.	y
4.02	Notify Naperville of damaged shipments.	Y	Agree to Terms.	y
4.03	Work with Naperville personnel to order registers/MIUs/lids and other materials shipped directly to warehouse(s).	Y	Agree to Terms.	y
4.04	Establish, track, manage and maintain inventory to ensure adequate supplies of all products that Contractor needs to complete the Services.	Y	Agree to Terms.	y
4.05	Perform daily installer vehicle inventory reconciliation of installed versus removed hardware.	Y	Agree to Terms.	y
4.06	Perform routine warehouse and vehicle inspections to validate inventory accuracy.	Y	Agree to Terms.	y
4.07	Load and unload delivery and service trucks including the use of equipment such as forklifts.	Y	Agree to Terms.	y
4.08	Coordinate disposal/disposition of removed registers, MIUs, and other assets, including breaking down devices and sorting into appropriate bins.	Y	Agree to Terms.	y
4.09	Maintain proper security to protect Naperville assets and be responsible for replacement of any damaged or lost materials while in the Contractor's care, custody and control.	Y	Agree to Terms.	y

5. STAFFING AND RECRUITING

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
5.01	Contractor shall be responsible for all recruitment and staffing of the project to support the deployment schedule.	Y	Agree to Terms. Contractor has extensive experience in hiring qualified staff.	y
5.02	Contractor shall be familiar with and observe established and accepted labor practices, procedures, and project agreements.	Y	Agree to Terms. Contractor will meet any applicable standards and prevailing wage laws set forth in RFP.	
5.03	Contractor shall have full responsibility for the conduct of all employees employed on or in connection with the Services (including the employees of any subcontractor) and will ensure that there is adequate, daily supervision of all services.	Y	Agree to Terms.	y

5.04	Contractor shall be responsible for training. Training shall include but is not limited to: a) Safety and customer service, which includes appropriately updating customers on work to be performed and/or work completed, and handling difficult customer situations b) Identification of meter types, service and register sizes, curb stop, valves, and Nicor connectors c) Correctly entering, updating, and closing service orders, including corresponding notes, photos, and documentation d) Accurate reading of meter registers e) Proper register installation f) Proper MIU installation and programming g) Identification and proper response to emergency and/or unsafe situations h) Identification and reporting of abnormal operating conditions, including infrastructure facing imminent failure, damaged services, theft, and/or tampering	Y	Agree to Terms. Contractor has extensive experience with the Sensus product and processes necessary to perform scope services set forth in RFP. See references for contractor experience with similar scope of services. Reference Appendix_10 Vepo MIU Installer.	y
5.05	Contractor shall be responsible for ensuring all personnel maintain any professional qualifications, licenses, permits, certifications and skills appropriate for the Services to be performed.	y	Agree to Terms. Contractor will provide all necessary document required to perform scope of services set forth in RFP.	y
5.06	Contractor shall be responsible for conducting pre-employment drug and alcohol testing on all personnel. Certification of this test must be provided to Naperville on Contractor letterhead for each employee. Contractor shall comply with the federal Drug-Free Workplace Act of 1988 and maintain a substance abuse program. Contractor shall test its employees as appropriate throughout the performance of Services in accordance with its substance abuse program.	Y	Agree to Terms. All contractor personnel will be background checked internally prior to any Naperville required background check.	y
5.07	Contractor shall provide all field and warehouse workers employed to provide the services listed in this SOW with Naperville approved personal protective equipment, uniforms, and badges approved by Naperville. Following design approval, the Contractor shall be responsible for acquiring and deploying the approved branding.	Y	Agree to Terms	y
5.08	Contractor shall provide field personnel with vehicles displaying the appropriate labeling/logo.	Y	Agree to Terms. All contactor field personnel vehicles will be properly identified. Reference Appendix_10 Vepo MIU Installer.	y

6. STATUS REPORTING

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
6.01	Contractor shall submit a weekly status report per the AMI status reporting process and attend the weekly AMI status meeting.	Y	Agree to Terms. Contractor customer portal can be accessed at any time for real time installation information. The customer portal can be demonstrated at any time as requested. Reference Appendix_10 Vepo MIU Installer.	y

6.02	Contractor shall provide all data/materials as requested by Naperville personnel in preparation for the AMI status meeting and then provide a summary read-out of the prior week's productivity, human performance errors, safety incidents, customer refusals, and other notable deployment activities. Contractor shall adhere to all Naperville policies and processes as it relates to providing condition reports and corrective action plans for certain operational events (e.g. human error, injury, etc.).	Y	Agree to Terms. See response above.	y
6.03	Contractor shall provide the following performance metric information to a designated project team member on a weekly, monthly, and cumulative basis: a) List of routes completed during the previous week and a list of routes to be worked in the coming week b) Registers/MIUs installed c) Register/MIU installs with appointments, including quantity and percentage of missed appointments d) Installations per installer per day e) Deployment report that details the number of AMI devices installed compared to the expected amount f) Installation report that itemizes registers and MIUs installed by date and cycle/route g) Repairs required (box, meter, register, lid, service lines, valves, customer-side, other) h) Switched or crossed meters i) Customer refusals j) New inflow of UTC locations			
6.03 cont.	k) Unworked UTC locations l) Completed UTC locations m) UTC cause codes by status n) UTC percentage: number of jobs assigned, number of jobs completed and number of jobs UTC o) RTU percentage: number of jobs assigned, number of jobs completed and number of jobs RTU p) Quality assurance inspections and results q) Safety incidents r) Access issues (obstruction, animal, customer denied access, customer requests appointments, restricted/locked access, safety, vacant/boarded up, service removed, other) s) MIU and register shipments received t) Number of MIUs/registers returned and any other pertinent inventory (i.e. Naperville provided parts or property necessary to the deployment services.) u) Claims summary report v) Month-end accounting requests for unbilled services to support Naperville's accrual process. w) Monthly reporting of diverse spend against commitments made toward diverse business enterprises	Y	Agree to Terms. Contractor customer portal can be accessed at any time for real time installation information. The customer portal can be demonstrated at any time as requested.	y

6.04	Contractor shall notify Naperville designated representative immediately after any safety incident or event which may result or which results from, but not limited to, the following: a) Injury b) Employee reports to a hospital c) Property damage d) Theft e) Media related incident f) Police report	y	Agree to Terms.	y

7. ACCOUNT MANAGEMENT

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
7.01	Contractor agrees to assign and maintain a designated representative to the Naperville account. If it is necessary to replace the designated representative account manager, Contractor shall provide Naperville notice of such decision, an opportunity to interview/validate the new designated representative and will ensure a seamless transition between the account managers. Contractor agrees that the presence of the account manager is a material factor in Naperville's decision to work with Contractor. Responsibilities include but may not be limited to: a) Manage contract, pricing, activities, reporting, issue-resolution, and deliverables b) Manage escalated issues c) Coordinate daily operations d) Complete daily, weekly, monthly, quarterly, and/or annual status reporting as required	Y	Agree to Terms. Contratctor will designate a project manager as the first point of contact for any issue that may arise.	y
7.02	Naperville reserves the right to request a new account manager at any time.	Y	Agree to terms.	y

8. REGISTER AND MIU INVENTORY

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
8.01	Contractor shall be required to maintain adequate inventory levels to meet the project schedule and service level requirements, and to accept and account for hardware inventory.	Y	Agree to Terms. Inventory levels will meet the timelines set forth in RFP.	y

8.02	Low Stock or No Stock Process. Contractor will be responsible: a) For maintaining sufficient inventory as required to support the services and the deployment schedule and to support reorder points as mutually agreed upon by Naperville b) For all costs associated with the expediting or premium charges associated with orders, from the low stock, or no stock process resulting from Contractor not fulfilling its obligations under this RFP.	Y	Agree to Terms. Inventory levels will meet the timelines set forth in RFP.	y
8.03	If Contractor is affected due to lack of materials supplied by Naperville, as caused by Naperville, Naperville shall compensate Contractor for any actual and reasonable costs incurred as a result of the lack of material provided to Contractor. Contractor shall use its best efforts to keep the costs as low as possible.	Y	Agree to Terms.	y
8.04	Contractor is responsible for maintaining all Naperville materials in secured facilities.	Y	Agree to Terms.	y
8.05	Contractor is responsible for replacement of any damaged or lost materials while in Contractor's care, custody, and control.	Y	Agree to Terms.	y

9. SERVICE LEVEL AGREEMENTS

ID	Requirement Description	Compliance (Y/N)	Compliance Explanation	Included in Base Price?
9.01	Diverse spend: greater than 21.5%	Y	Agree to Terms. Not required.	y
9.02	Safety violation: 0 violations allowed	Y	Agree to Terms.	y
9.03	Successful field audits: 97% passed	Y	Agree to Terms.	y
9.04	Register reads: 99.7% accuracy required	Y	Agree to Terms. No registers will be replaced as part of RFP scope.	y
9.05	Meter mix-ups: 99.7% accuracy required	Y	Agree to Terms. No registers will be replaced as part of RFP scope.	y
9.06	Defective installation: 99.7% accuracy required	Y	Agree to Terms.	y
9.07	Return to utility: <1%	Y	Agree to Terms.	y
9.08	Customer appointments missed: <1%	Y	Agree to Terms.	y
9.09	Black-out window violations: 0 violations allowed	Y	Agree to Terms.	y

Firm Name: Core & Main
Date: 15-Oct-19

510M/520M SmartPoint® Module

Water Meter and Ancillaries Compatibility Quick Guide

Sensus

Register Type	Model	Meter Type
ICE & ICE Opto	All meters that accept ICE & ICE Opto 3-wire.	Positive Displacement, Multi-jet, Compound, Turbine, Propeller, Fire Service
OMNI™	T2, C2, F2, R2	Floating Ball Technology
accuMAG™	accuMAG	Mag
iPERL®	iPERL	Mag
Permalog	Permalog+	Acoustic Technology
Sensus® Electronic Register+™ and E-Register	accuSTREAM, SR II	Positive Displacement
ally	ally	ally
Hydroverse	Hydroverse	Mag

Badger

Register Type	Model	Meter Type
ADE	All meters that accept ADE 3-wire and TouchCoupler support, Sensus Approved TR/PL lead, up to 8 wheels.	Disc, Turbine, Compound, Fire Service
HR-E LCD	All meters that accept HR-E LCD 3-wire, up to 8 wheels. Must be at least SmartPoint firmware version R1.2.1f or higher.	Disc, Turbo Series, Compound Series, Combo Series, Fire Service
E-SERIES 8 digits	All models with firmware version 1.36. 3-wire**	Ultrasonic

Neptune

Register Type	Model	Meter Type
Proread 4 wheel	All meters that accept Proread registers. 3-wire support	Positive Displacement, Turbine, Compound, Fire Service
E-coder with TouchCoupler 4 wheel	All meters with firmware version 01.02. Manufactured after 1/2016.	Positive Displacement, Turbine, Compound, Fire Service
Proread 6 wheel	All meters that accept Proread registers. 3-wire support	Positive Displacement, Turbine, Compound, Fire Service
E-coder 6 wheel	All meters that accept E-coder registers. 3-wire support (Proread protocol only)	Positive Displacement, Turbine, Compound, Fire Service
E-coder with TouchCoupler 6 wheel	All meters with firmware version 01.02. Manufactured after 1/2016.	Positive Displacement, Turbine, Compound, Fire Service
E-coder 8 wheel	All meters that accept E-coder registers. 3-wire support*	Positive Displacement, Turbine, Compound, Fire Service
E-coder with TouchCoupler 8 wheel	All meters with firmware version 01.02. Manufactured after 1/2016.	Positive Displacement, Turbine, Compound, Fire Service
ProCoder 8 wheel	All meters with firmware version 63.16. Manufactured after 7/2018. TouchCoupler and 3-wire**	Positive Displacement, Turbine, Compound, Fire Service

*SmartPoint firmware version 1.2 and above only
**SmartPoint firmware version 1.7 and above only

sensus a xylem brand

Elster/Amco

Register Type	Model	Meter Type
Scancoder	All meters that accept Scancoder 3-wire support (Sensus protocol only).	Positive Displacement, Turbine, Multi-jet, Bulk combo, Fire service
InVision	All meters that accept InVision 3-wire support (Sensus protocol only).	Positive Displacement, Turbine, Multi-jet, Bulk combo, Fire service

Master Meter

Register Type	Model	Meter Type
AccuLinx V1.19	All meters that accept AccuLinx 3-wire and TouchCoupler, Sensus approved TR/PL lead.	Positive Displacement
Sonata 8 digits	3-wire and TouchCoupler, firmware version 5.01 or greater.**	Ultrasonic
Octave 8 digits	3-wire only.**	Ultrasonic

McCrometer

Register Type	Model	Meter Type
McCrometer flowcom FC100-00M 8 digits	3-wire reading. Firmware 2.4. Manufactured after 4/2015.	Propeller
ML255 battery powered register 8 digits	3-wire reading only. Firmware 5.09 or greater.**	Propeller
ML Series converter, AC powered 8 digits	3-wire reading only. Firmware 3.03 or greater.**	Propeller

Kamstrup

Register Type	Model	Meter Type
flowIQ 2100 4, 6 and 8 wheel	3-wire reading. Version C1.	Ultrasonic
flowIQ 2100 4, 6, and 8 wheel	3-wire and TouchCoupler version H1.**	Ultrasonic

Diehl

Register Type	Model	Meter Type
Hydrus 8 digits	3-wire support only.** Manufactured after 4/2018.	Ultrasonic

Zenner

Register Type	Model	Meter Type
PMN Nitro 01 4 wheel, 6 wheel	3-wire support only. Manufactured after 8/2015.	Multi-jet

Hersey/Mueller Systems

Register Type	Model	Meter Type
Translator	All meters that accept Translator 3-wire and TouchCoupler support, Sensus approved TR/PL lead.	Positive Displacement, Mag

*SmartPoint firmware version 1.2 and above only
**SmartPoint firmware version 1.7 and above only

SENSUS
a xylem brand

637 Davis Drive
Morrisville, NC 27560
1-800-638-3748
sensus.com

Water Meter Inventory

EXISTING WATER UTILITY OVERVIEW

The City of Naperville Water Utilities serves approximately 43,500 customer water meters. There are approximately 2,400 meters read by AMR in the City's unincorporated areas, with the remainder being incorporated and read manually by a contracted outside vendor. The 2,400 unincorporated accounts are water-only customers and are not served by Naperville Electric. A majority of both incorporated and unincorporated locations have the existing reading device mounted on the exterior of the structure. Information regarding the Water Utilities' in-service meters is provided below:

Meter Manufacturer	Count
Hersey	62
ABB	24
Kent	20,843
Neptune	5,419
Rockwell	134
Elster	10
Badger	9,197
Sensus	8,618

SOW Attachment 15
MV90 download format example

```
H40001   00233





                                                                   *
A400010004564770000049 28WT00078617824    10002002006000007580000 0710
00070800XXXXXXXX
                 SCHENCK PROCESS LLC           2151 FISHER DR
          A                             22GARAGE

                                   00000             000010000
60R-SE-22                                                                       *
A40001000154389000004930WT00079378276    10003001506000248000002319
00231100XXXXXXXX
                 MOLEX INC                     1750 COUNTRY FARM DR
          A

                                   00000             000010000
60R-34                                                                          *
A40001000457667000125812WT00011394349    20004502006000077200000740
00073900XXXXXXXX
                 ILLINOIS AUTO ELECTRIC CO.    2115 W DIEHL RD
          A

                                   00000C            000010000
60K-43*32W                                                                      *
```

SOW Attachment 15
MV90 upload format example

```
H40001                    MIKEN




                                                                  *
A40001000456477000004928WT00078617824
1000200200600000758000007100000110000070800071 9    1
                                                    SCHENCK PROCESS LLC
2151 FISHER DR                                  A                          22GARAGE

112719092938                                                              00000
       000010000                  60R-SE-22
                             *
A40001000154389000004930WT00079378276
1000300150600000248000002319000003800002311002349    1
                                                    MOLEX INC
1750 COUNTRY FARM DR                            A

112719093318                                                              00000
       000010000                  60R-34
                             *
A40001000457667000125812WT00011394349
2000450200600000772000007400000110000073900075 0    1
                                                    ILLINOIS AUTO ELECTRIC CO.
2115 W DIEHL RD                                 A

112719093449                                                              00000
       000010000                  60K-43*32W
                             *
```

Quality Control/Quality Assurance Plan

The Installation Contractor will:

- Provide a data validation team responsible for confirming information from the Water Utility data base matches the information field technician finds on location. This is accomplished by data validation team comparing data in field pictures to the data entered by the field technician.
- Be responsible for confirming AMI endpoints successfully communicate back to the head end of the AMI system.
- Conduct mandatory monthly workshops incorporating revised safety procedures, municipality updates, reinforcing Occupational Safety Health Administrative (OSHA) standards in the field and confined space rules and regulations
- Field Technician will spend 40 hours in the field and home office including the call center to be crossed trained in all functional areas of the business
- Field Supervisors will have 30 hours of Occupational Safety Health Administration (OSHA) training and 8 hours specifically in confined space entry training
- Field technicians will have minimally 10 hours of Occupational Safety Health Administration (OSHA) training and 8 hours specifically in confined space entry training
- Randomly call customers and conduct field inspections on completed installations

Sample Test Plans

Base Station / Backhaul Test Plan

- Once the base stations are on line and fully commissioned, 10 - 15 smart points will be installed within proximity of each base station. These smart points will then be located with the Sensus RNI software to insure the smart points are reporting in as anticipated. This will validate the .integrity of the base station infrastructure and the backhaul service.
- If there are any issues, they will be addressed accordingly until the infrastructure in performing as designed.

Harris / Field Installation Integration Test Plan

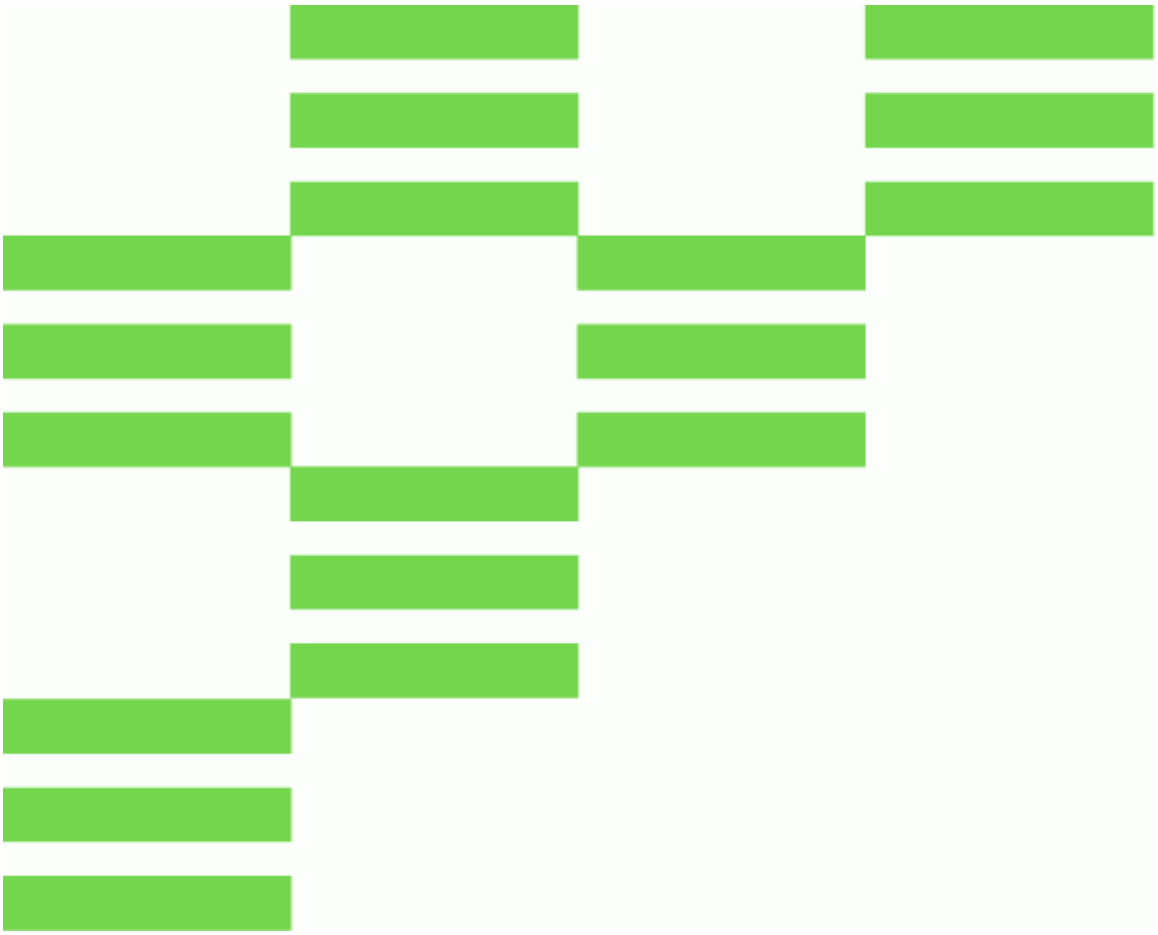
- During the development of the data integration file, sample data will used to validate the file layout and integration process. Prior to full installation deployment, 50 – 100 smart points will be installed and activated the first day of installation. The predefined installation information will be gathered and sent to Naperville staff for integration into the Harris billing system. Any issues will be reported and resolved prior to full installation deployment.

Ongoing Testing Throughout the Project

- Throughout the project, installation data will be sampled from the field installation to insure data is reporting in correctly and timely. Any issues discovered will be investigated and resolved.

MultiSpeak v4.1 Gateway
Section 2: Meter Reading

Integration Guide



Copyright

Sensus
637 Davis Drive
Morrisville, NC 27560
1-800-638-3748
www.sensus.com

Document: MultiSpeak v4.1 Gateway Section 2: Meter Reading

Contents

2 Meter Reading 1

2.1 MR server 1

2.1.1 Overview 1

2.1.2 PingURL 3

2.1.3 GetMethods 3

2.1.4 GetPublishMethods 3

2.1.5 RequestRegistrationID 4

2.1.6 RegisterForService 4

2.1.7 UnregisterForService 4

2.1.8 GetRegistrationInfoByID 4

2.1.9 GetAMRSupportedMeters 4

2.1.10 IsAMRMeter 9

2.1.11 MeterAddNotification 11

2.1.12 MeterChangedNotification 16

2.1.13 MeterRemoveNotification 19

2.1.14 MeterRetireNotification 23

2.1.15 InitiateMeterInstallation 25

2.1.16 InitiateMeterExchange 31

2.1.17 ServiceLocationChangedNotification 34

2.1.18 InitiateMeterReadingsByMeterID 38

2.1.19 GetLatestReadingByMeterID 43

2.1.20 GetReadingsByMeterID 53

2.1.21 GetReadingsByMeterIDAndFieldNameIntervalData 59

2.1.22 GetReadingsByMeterIDListAndFieldNameIntervalDataExt 63

2.1.23 InitiateUsageMonitoring 64

2.1.24 CancelUsageMonitoring 66
2.1.25 InitiateDisconnectedStatus 67
2.1.26 CancelDisconnectedStatus 69
2.1.27 EstablishMeterGroup 70
2.1.28 DeleteMeterGroup 72
2.1.29 InsertMeterInMeterGroup 73
2.1.30 RemoveMetersFromMeterGroup 75
2.1.31 EstablishReadingSchedules 77
2.1.32 InitiateMeterEventsResetExt 78
2.1.33 InitiateEndpointConfigurationChangeExt 78
2.1.34 InitiateDemandReset 78
2.1.35 InitiateDemandResetSchedulingExt 80
2.1.36 GetHistoryLogByMeterID 83
2.1.37 GetHistoryLogsByDate 86
2.1.38 GetHistoryLogsByDateAndEventCode 89
2.1.39 GetHistoryLogsByMeterIDAndEventCode 93
2.1.40 InitiateHistoryLogRequestByMeterIDExt 97
2.1.41 InitiateDiagnosticReportByMeterIDExt 101
2.2 MR Notification client 104
2.2.1 Overview 104
2.2.2 IntervalDataNotification 105
2.2.3 ReadingChangedNotification 113
2.2.4 MeterEventNotification 119
2.2.5 MeterInstalledNotification 137
2.2.6 MeterExchangeNotification 140

2.2.7 HistoryLogChangedNotification 142
2.2.8 DiagnosticReportNotificationExt 148
2.3 CB client 161
2.3.1 Overview 161
2.3.2 GetAllMeters 161
2.3.3 GetAllServiceLocations 165
2.3.4 CB script 168

2 Meter Reading

2.1 MR server

2.1.1 Overview

This is the web service API to the Meter Reading (MR) function in the RNI, as defined in MultiSpeak.

2.1.1.1 References

The complete list of MultiSpeak v4.1.6 MR Server methods are described at
https://multispeakorg.net/content/multispeak/specifications/416/MR_Server.asmx

The subset supported by the RNI gateway, along with Sensus specific extensions are detailed in this chapter.

2.1.1.2 Permissions

In order for a web service method to be executed in the gateway, the UserID in the request must have appropriate permissions in the user store (LDAP/AD). The following table lists the permissions needed for each method.

	Method	Permission
General[1]	PingURL	[none]
	GetMethods	[none]
	GetPublishMethods	[none]
Meter Management	GetAMRSupportedMeters	Get Meter
	MeterAddNotification	Add Meter, Update Meter
	MeterChangedNotification	Update Meter
	ServiceLocationChangedNotification	Update Meter
	MeterRemoveNotification	Update Meter
	MeterRetireNotification	Delete Meter
	IsAMRMeter	Get Meter
	InitiateUsageMonitoring	Add Usage Monitoring
	CancelUsageMonitoring	Delete Usage Monitoring
	InitiateDisconnectedStatus	Add Usage Monitoring
	CancelDisconnectedStatus	Delete Usage Monitoring
Meter Readings	GetLatestReadingByMeterID	Get Meter
	GetReadingsByMeterID	Get Meter
	GetReadingsByMeterIDAndFieldName IntervalData	Get Meter
	GetReadingsByMeterIDListAndFieldName IntervalDataExt	Get Meter
	InitiateMeterReadingsByMeterID	Ping Meter
	InitiateDemandReset	Demand Reset
	InitiateDemandResetSchedulingExt	Demand Reset
	EstablishMeterGroup	Meter Group Management
	GetHistoryLogByMeterID	Get Meter
	GetHistoryLogsByDate	Get Meter

	Method	Permission
	GetHistoryLogsByDateAndEventCode	Get Meter
	GetHistoryLogsByMeterIDAndEventCode	Get Meter
	InitiateMeterExchange	Update Meter
	InitiateMeterInstallation	Update Meter
	InitiateHistoryLogRequestByMeterIDExt	Ping Meter
Meter Groups	DeleteMeterGroup	Meter Group Management
	InsertMeterInMeterGroup	Meter Group Management
	RemoveMetersFromMeterGroup	Meter Group Management
Dynamic Registration[1]	RequestRegistrationID	Dynamic Registration Management
	RegisterForService	Dynamic Registration Management
	UnregisterForService	Dynamic Registration Management
	GetRegistrationInfoByID	Dynamic Registration Management

[1]These methods are described in the overview section of the integration guide.

2.1.1.3 Meter logical states

The **logical** state property complements the **lifecycle** state property, and should be considered in relation to the lifecycle state. The currently supported logical states (*Active*, *Inactive*, *Disconnected*, *Maintenance*, and *Test*) are only relevant for an installed meter (i.e., a meter in the *Install* lifecycle state).

The following figure shows the valid transitions between logical states. In the MultiSpeak domain, the RNI is notified of a *move-out* with `InitiateUsageMonitoring`, a *move-in* with `CancelUsageMonitoring`, a supply side disconnect with an `InitiateDisconnectedStatus`, and a supply side connect with a `CancelDisconnectedStatus`.

The *Maintenance* and *Test* logical states are introduced in RNI version 4.0 to flag devices accordingly.

At present, the logical states are only used for reporting and do not affect any other meter related interactions in the RNI.

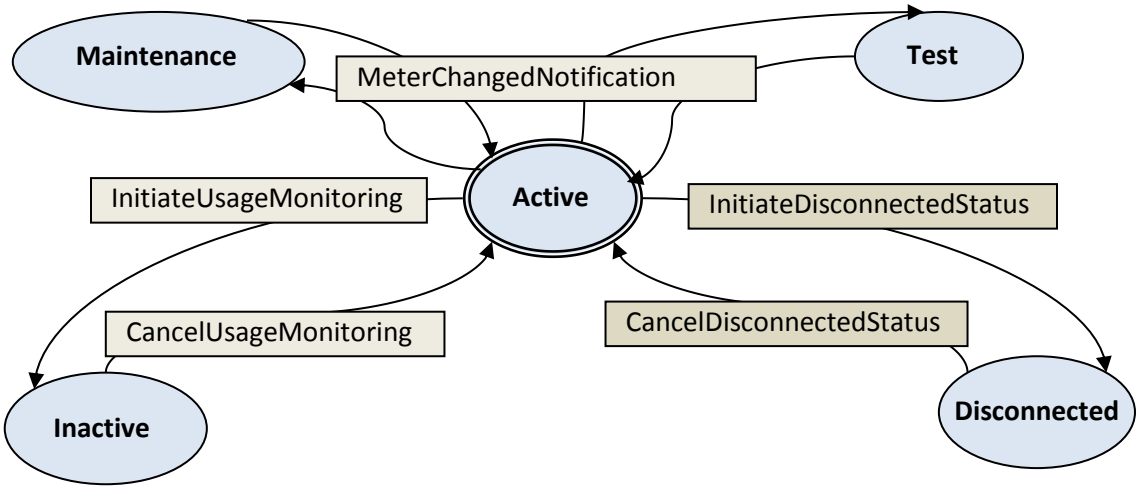


Figure 1: State diagram for meter logical state

The MultiSpeak gateway defaults to strict checking of state transitions and will reject requests that do not adhere to this state diagram (for example, `InitiateUsageMonitoring` for a meter in a `Disconnected` logical state). However this checking can be relaxed via a system configuration.

2.1.1.4 Meter lifecycle states

A meter can have three lifecycle states – *Inventory*, *Installed*, and *RMA*. A meter can be added to the RNI when it is in the *Inventory* or *Installed* state. The Meter Remove process changes a meter from the *Installed* to *Inventory* state. A meter in *Inventory* state can be transitioned to the *Installed* state anytime using the provisioning process. The Meter Retire process deletes the meter from the RNI database by default. However, if the optional meter status is specified with a value of *RMA*, the meter is changed to the *RMA* lifecycle state. The *RMA* state indicates that the meter was removed from the field and sent to the manufacturer for inspection. A meter in the *Inventory* state can directly be retired. A meter in the *Installed* state can also be retired based the custom configuration of the RNI.

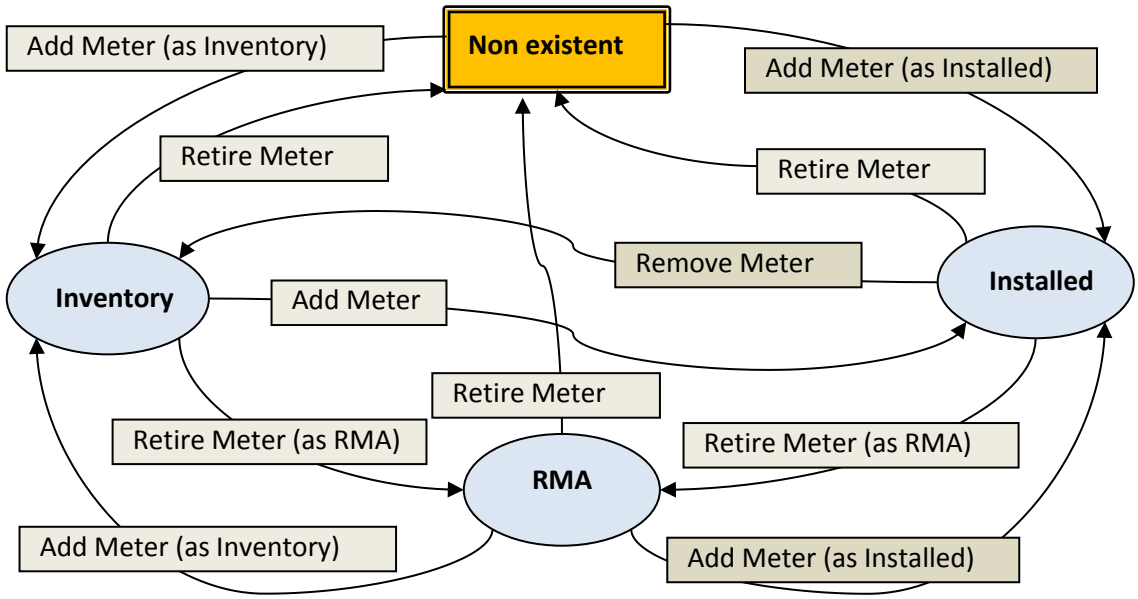


Figure 2: State diagram for meter lifecycles

2.1.2 PingURL

As described in *Section 1 – Overview*.

2.1.3 GetMethods

As described in *Section 1 – Overview*.

2.1.4 GetPublishMethods

As described in *Section 1 – Overview*.

2.1.5 RequestRegistrationID

As described in *Section 1 – Overview*.

2.1.6 RegisterForService

As described in *Section 1 – Overview*.

2.1.7 UnregisterForService

As described in *Section 1 – Overview*.

2.1.8 GetRegistrationInfoByID

As described in *Section 1 – Overview*.

2.1.9 GetAMRSupportedMeters

This method returns the **installed** meters from the RNI database. The number of meters to be returned in the response is configured on the RNI. This is a paged interface and uses the `LastSent` attribute in the response and `lastReceived` element in the request for paging.

Special considerations for a shared RNI

In a multi-tenant RNI, this method translates to get all installed meters *available to the user*. Therefore, even though the request does not specify a utility code, it only returns the meters that the user is allowed to access based on the customer IDs associated with the user in LDAP.

2.1.9.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6"
        Branch="0" BuildString="Release"
        UserID="testUser" Pwd="testPass"
        AppName="MyApp" AppVersion="1.0" Company="MyCo"
        SessionID="779" Context="Testing"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetAMRSupportedMeters>
      <ver:lastReceived>2999</ver:lastReceived>
    </ver:GetAMRSupportedMeters>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.9.2 Sample response

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
         Branch="0"   Build="6" Company="Sensus" LastSent="656872082"
         MajorVersion="4" MinorVersion="1" ObjectsRemaining="10"
xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetAMRSupportedMetersResponse
xmlns:ns2="http://www.multispeak.org/Version_4.1_Release" xmlns:ns3="cpsm_V4.1_Release"
xmlns:ns4="gml_V4.1_Release" xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetAMRSupportedMetersResult>
            <ns2:electricMeters>
               <ns2:electricMeter objectID="1N6033065283" utility="EMCA">
                  <ns2:meterNo>1N6033065283</ns2:meterNo>
                  <ns2:AMRDeviceType>50</ns2:AMRDeviceType>
                  <ns2:AMRVendor>SENS</ns2:AMRVendor>
                  <ns2:meterStatusList>
                     <ns2:meterStatus>Installed</ns2:meterStatus>
                  </ns2:meterStatusList>
                  <ns2:moduleList>
                     <ns2:module objectID="37227477">
                        <ns2:moduleType>FlexNetRadio</ns2:moduleType>
                        <ns2:firmwareVersion>004.007.003.000.0</ns2:firmwareVersion>
                     </ns2:module>
                  </ns2:moduleList>
                  <ns2:utilityInfo>
                     <ns2:gpsPoint>
                        <ns2:latitude>35.8671989440918</ns2:latitude>
                        <ns2:longitude>-78.86119842529297</ns2:longitude>
                     </ns2:gpsPoint>
                  </ns2:utilityInfo>
                  <ns2:electricNameplate/>
               </ns2:electricMeter>
                .....
            </ns2:electricMeters>
            <ns2:waterMeters>
               <ns2:waterMeter objectID="BNHAllyHoth3" utility="ACME">
                  <ns2:meterNo>BNHAllyHoth3</ns2:meterNo>
                  <ns2:AMRDeviceType>47</ns2:AMRDeviceType>
                  <ns2:AMRVendor>SENS</ns2:AMRVendor>
                  <ns2:meterStatusList>
                     <ns2:meterStatus>Installed</ns2:meterStatus>
                  </ns2:meterStatusList>
                  <ns2:moduleList>
                     <ns2:module objectID="656872082">
                        <ns2:moduleType>FlexNetRadio</ns2:moduleType>
                        <ns2:firmwareVersion>001.001.005.000.1</ns2:firmwareVersion>
                     </ns2:module>
                  </ns2:moduleList>
                  <ns2:utilityInfo>
                     <ns2:gpsPoint>
                        <ns2:latitude>38.89767837524414</ns2:latitude>
                        <ns2:longitude>-77.0364990234375</ns2:longitude>
                     </ns2:gpsPoint>
                  </ns2:utilityInfo>
               </ns2:waterMeter>
               .....
            </ns2:waterMeters>
         </ns2:GetAMRSupportedMetersResult>
      </ns2:GetAMRSupportedMetersResponse>
    </soapenv:Body>
   </soapenv:Envelope>
```

2.1.9.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes.*	
BODY	lastReceived	The lastSent value from the previous response. The returned meters will commence with the first ID after the `lastReceived` value.

2.1.9.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
	ObjectsRemaining*	The number of meters remaining in the RNI *at that point in time*. This will be zero if this response contains the last available MeterID. An exact value of remaining meters is returned if there may be meters remaining in the RNI.
	LastSent*	A tag indicating the end of the batch in this response. The remote system should use this as the `lastReceived` value in the subsequent request if the `ObjectsRemaining` is not zero.
BODY	meters/electricMeters/electricMeter	Multiple elements, one per AMR meter that the requesting user is able to view.
	electricMeter@objectID	The object ID for the meter element is the same as the `meter`No.
	electricMeter /meterNo*	The identifier for the meter assigned by the utility (the MeterID). This is unique within the meter population managed by the RNI for a specific utility.
	electricMeter@utility*	The utility owner for this meter (the CustomerID).
	electricMeter/installedDate	Date of meter install.
	electricMeter/AMRVendor	Fixed value of "SENS."
	electricMeter/AMRDeviceType	RNI specific device type e.g., 23 for iConA.
	electricMeter/meterStatusList	Current lifecycle state of the meter. At present this list will have only one entry with a value of `Installed` since this method returns installed meters.
	electricMeter/electricNameplate/dials electricMeter/electricNameplate/form	The dials for the meter. The form factor for the meter.
	electricMeter/moduleList	List of modules.
	moduleList/module@objectID if the moduleType of the module is FlexNetRadio	The identifier for the radio endpoint on the meter (the FlexnetID). This is globally unique identifier within the FlexNet system.

	Attribute/Element	Usage
	moduleList/module/moduleType	Fixed value of FlexNetRadio to identify the FlexNet radio module.
	moduleList/module/firmwareVersion	Module firmware version.
	electricMeter/utilityInfo	
	utilityInfo/serviceLocationID	The identifier for the service location that the meter is associated with.
	utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located.
	utilityInfo/gpsPoint/latitude	Latitude where the meter is physically located.
	meters/waterMeters/waterMeter	Multiple elements, one per AMR meter that the requesting user is able to view.
	waterMeter@objectID	The object ID for the meter element is the same as the `meterNo`.
	waterMeter /meterNo*	The identifier for the meter assigned by the utility (the MeterID). This is unique within the meter population managed by the RNI for a specific utility.
	waterMeter@utility*	The utility owner for this meter (the CustomerID).
	waterMeter/installedDate	Date of meter install.
	waterMeter/AMRVendor	Fixed value of "SENS."
	waterMeter/AMRDeviceType	RNI specific device type e.g., 47 for NA2W Water.
	waterMeter/meterStatusList	Current lifecycle state of the meter. At present this list will have only one entry with a value of `Installed` since this method returns installed meters.
	waterMeter/moduleList	List of modules
	moduleList/module@objectID if the moduleType of the module is FlexNetRadio	The identifier for the radio endpoint on the meter (the FlexnetID). This is globally unique identifier within the FlexNet system.
	moduleList/module/moduleType	Fixed value of FlexNetRadio to identify the FlexNet radio module.
	moduleList/module/firmwareVersion	Module firmware version.
	waterMeter/utilityInfo	
	utilityInfo/serviceLocationID	The identifier for the service location with which the meter is associated.
	utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located.
	utilityInfo/gpsPoint/latitude	Latitude where the meter is physically located.
	meters/gasMeters/gasMeter	Multiple elements, one per AMR meter that the requesting user is able to view.
	gasMeter@objectID	The object ID for the meter element is the same as the `meterNo`.
	gasMeter/meterNo*	The identifier for the meter assigned by the utility (the MeterID). This is unique within the meter population managed by the RNI for a specific utility.

	Attribute/Element	Usage
	gasMeter@utility*	The utility owner for this meter (the CustomerID).
	gasMeter/installedDate	Date of meter install.
	gasMeter/AMRVendor	Fixed value of "SENS."
	gasMeter/AMRDeviceType	RNI specific device type. e.g., 48 for NA2W Gas.
	gasMeter/meterStatusList	Current lifecycle state of the meter. At present this list will have only one entry with a value of `Installed` since this method returns installed meters.
	gasMeter/moduleList	List of modules.
	moduleList/module@objectID if the moduleType of the module is FlexNetRadio	The identifier for the radio endpoint on the meter (the FlexnetID). This is globally unique identifier within the FlexNet system.
	moduleList/module/moduleType	Fixed value of FlexNetRadio to identify the FlexNet radio module.
	moduleList/module/firmwareVersion	Module firmware version.
	gasMeter/utilityInfo	
	utilityInfo/serviceLocationID	The identifier for the service location with which the meter is associated.
	utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located.
	utilityInfo/gpsPoint/latitude	Latitude where the meter is physically located.

2.1.9.5 Error messages

	Error	Reasons
SYSTEM ERRORS	*Common security errors*	
BUSINESS ERRORS	Device not found	Indicates that the lastReceived value could not be correlated to a meter. The most common reason for this is that the lastReceived value is not the same as the LastSent value from the preceding response.

2.1.9.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR. GetAMRSupportedMeters.FetchSize (Customer configuration)	The maximum number of meters returned in a response to `GetAMRSupportedMeters`. Default is 500.
	Lifecycle. IncludeUnknownLifecycle (System configuration)	Boolean property to determine whether to treat the `Unknown`[1] lifecycle state as Installed. If this is set to True then meters which are in an *Unknown* state in the RNI are returned by this method, but the `meterStatus` is not set to `Installed`. Default is True (i.e., include Unknown state as Installed). Set to False if lifecycle is explicitly managed and only Install means installed.
	endpoint_info.MaxRowCount (System configuration)	The maximum number of meters beyond which the **ObjectsRemaining** will be -1 to indicate that there are more results to retrieve. If the remaining meter count is less than or equal to this configuration value then **ObjectsRemaining** will be the actual remaining meter count instead of -1. The default is 100000.
FILE	systemconfig.cacheExpiration (System configuration)	Configuration value cache expiration time in **seconds**. Configuration values that can be changed at run time will be cached for the configured amount of time. The default is 60 seconds.

[1] A meter that has been discovered by the RNI will be in *Unknown* state until it is set to *Installed* or *Inventory*.

2.1.10 IsAMRMeter

This method queries the RNI for whether a meter is known to be **installed**.

2.1.10.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6"
        Branch="0" BuildString="Release"
        UserID="testUser" Pwd="testPass"
        AppName="MyApp" AppVersion="1.0" Company="MyCo"
        SessionID="779" Context="Testing"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:IsAMRMeter>
      <ver:meterID meterNo="10001M" serviceType="Electric"
          objectID="10001M" utility="ACME" />
    </ver:IsAMRMeter>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.10.2 Sample response

This is the sample response for a meter that is installed in the RNI.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:IsAMRMeterResponse>
      <ver:IsAMRMeterResult>true</ver:IsAMRMeterResult>
    </ver:IsAMRMeterResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.10.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**meterID@meterNo***	The identifier for the installed meter assigned by the utility (the MeterID).
	meterID@serviceType*	The service type for the meter (e.g., Electric, Water, Gas).
	meterID@objectID	Same as `meterNo`.
	meterID@utility	The utility owner for this meter (the CustomerID).

2.1.10.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	**IsAMRMeterResult***	Boolean value `true` if the meter is installed, `false` otherwise.

2.1.10.5 Error messages

This response message definition does not have `ErrorObject`. Hence, **any error is returned as a SOAP Fault**. The messages below are in the `faultString` of the SOAP fault.

	Error	Reasons
BUSINESS ERRORS	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request or a value that is not one of the MultiSpeak defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Device not found	The RNI does not contain the specified meter ID.
	Problem accessing database	General database error.
SYSTEM ERRORS	*Common security errors*	

2.1.10.6 Configuration properties

	Property name	Usage
DATABASE	Lifecycle. IncludeUnknownLifecycle (System configuration)	Boolean property to determine whether to include meters with an Unknown lifecycle state in the response. Default is True.

2.1.11 MeterAddNotification

This method notifies the RNI of meters that are added via the utility back office systems. The resulting action is that a meter record is created in the RNI or an inventoried meter is marked as Installed.

Any supported meter properties provided in the `MeterAddNotification` are saved to the RNI database. Note that this method supports *add a meter to inventory* and *add an installed meter* use cases by setting the appropriate `meterStatus` in the request.

2.1.11.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:MeterAddNotification>
      <ver:addedMeters >
        <ver:electricMeters>
          <ver:electricMeter objectID="3000M" verb="Change" utility="ACME">
            <ver:meterNo>3000M</ver:meterNo>
            <ver:moduleList>
              <ver:module objectID="3000">
                <ver:moduleType>FlexNetRadio</ver:moduleType>
              </ver:module>
            </ver:moduleList>
            <ver:electricNameplate>
              <ver:dials>3</ver:dials>
              <ver:form>2S</ver:form>
            </ver:electricNameplate>
          </ver:electricMeter>
          <ver:electricMeter objectID="3001M">
            <ver:meterNo>3001M</ver:meterNo>
            ................
          </ver:electricMeter>
          ..............
        </ver:electricMeters>
      </ver:addedMeters>
    </ver:MeterAddNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.11.2 Sample response

This sample response shows that, of the two meters in the preceding request, one was added successfully while the other resulted in an error because the `FlexNetRadio` module was not provided.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="Release"
        SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:MeterAddNotificationResponse>
      <ns2:MeterAddNotificationResult>
        <ns2:errorObject objectID="3001M"
            errorString="Missing FlexNetRadio module"
            eventTime="2011-11-15T22:20:30.404-05:00"
            nounType="Meter"/>
      </ns2:MeterAddNotificationResult>
    </ns2:MeterAddNotificationResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.11.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	addedMeters	List of newly installed meters.
	addedMeters/electricMeters	List of newly installed electric meters.
	electricMeter/meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeter@objectID	Same as the meterNo.
	electricMeter@utility	The owner for this meter (the CustomerID).
	electricMeter/installedDate	Date that the meter was installed. If not specified then it is assumed to be now.
	electricMeter/AMRDeviceType	RNI specific device type e.g., 23 for iConA.
	electricMeter/meterStatusList	List of meterStatus.
	electricMeter/meterStatusList/meterStatus	Only one meterStatus is currently supported. This is expected to be the target state of the meter when it is added into the RNI. One of {InInventory, Installed}. If not specified, then it is assumed to be *Installed*. Any invalid status is ignored with a warning in the gateway log file.
	electricMeter/electricNameplate/dials	The dials for the meter.
	electricMeter/electricNameplate/form	The form factor for the meter.
	electricMeter/moduleList	List of modules.
	electricMeter/moduleList/module@objectID* (only processed if the moduleType of the module is FlexNetRadio)	The FlexnetID for the meter. This is required **only if** the meter does not already exist in the RNI.
	electricMeter/moduleList/module/moduleType* (only processed if the moduleType of the module is *FlexNetRadio*)	Value is *FlexNetRadio* for a FlexNet transceiver. This is required **only** if the meter does not already exist in the RNI. Any other moduleType is ignored.
	electricMeter/moduleList/module/firmwareVersion (only processed if the moduleType of the module is *FlexNetRadio*)	Firmware version for the FlexNet radio module.
	electricMeter/utilityInfo	Additional utility information related to this meter.

	Attribute/Element	Usage
	electricMeter/utilityInfo/serviceLocationID	Service location where the meter was installed. If the service location identified by *serviceLocationID* does not exist in the RNI, it creates a blank placeholder location. When another ***ServiceLocationChangedNotification*** for this *serviceLocationID* is received (and contains the complete address), the RNI's placeholder is populated with the address.
	electricMeter/utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located. This is used for routing decisions and must be accurate.
	electricMeter/utilityInfo/gpsPoint/latitude	Latitude where the meter is physically located. This will be used for routing decisions and hence must be accurate.
	addedMeters/gasMeters	List of gas meters.
	Properties are same as electricMeter except omit the electricNameplate element.	
	addedMeters/waterMeters	List of water meters.
	Properties are same as electricMeter except omit the electricNameplate element.	

2.1.11.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute an add operation.
	errorObject.objectID*	The MeterID for the meter for which the add notification failed.
	errorObject.eventTime*	Timestamp when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID e.g., `Meter`.

2.1.11.5 Error messages

The response may include one or more of these errors.

	Error	Reasons
BUSINESS ERRORS	Invalid data for meter	One or more of the provided meter properties are not valid according to the validation rules in the RNI.
	Missing meterNo attribute	The `meterNo` is needed to identify the meter being installed.
	Unsupported meterStatus	Supported values are `Installed` or `inInventory`.
	Missing FlexNetRadio module	For a new meter to be added to the RNI, the FlexNetRadio module must be present.
	Missing FlexNetRadioID	For a new meter to be added to the RNI, the FlexNet ID must be provided as the objectID of the FlexNetRadio module. This is required for communication with the meter.
	FlexNetRadio ID is already assigned to a different meter	The FlexNet radio ID in the request is already associated with a different meter.
	Meter already exists	The specified meterID already exists with the requested meter status.
	Invalid lifecycle state in operation	Invalid lifecycle state provided for the request.
	Problem accessing database	General database error.
	Service location [] exceeds maximum length of 25	Provided service location is too long.
SYSTEM ERRORS	*Common security errors*	

2.1.11.6 Configuration properties

	Property name	Usage
DATABASE	Gateway.MaxDials	The maximum value for the dials property for a meter.
	Gateway.MaxRepId	The maximum possible value for the FlexNetRadioID of a meter.
	LifeCycle.AllowBypassInventoryState (System configuration)	Allow a meter to be installed directly in the Install state. Set this to `False` to enforce that the meter must first be added as Inventory and then moved to Install as a separate step. This option is provided for backwards compatibility with the MultiSpeak v3.0 workflow. Default is `True`.

2.1.12 MeterChangedNotification

This method notifies the RNI of changes to the meter properties for an existing meter. The supported properties are updated in the RNI database.

> The lifecycle state of a meter **cannot** be changed through this method. Please use `MeterAddNotification` or `MeterRemoveNotification` to change the state.

For RNI version 4.3 and later, this operation can be used for changing the *Logical State* (*Operational State*) of the meter in the RNI using the *meterStatus* element in the request. Using this feature, the meter can be switched into *Maintenance* or *Test* state indicating that the meter is not in the normal logical/operational state. Switching to *Active* state puts the meter back to the normal operational state. These states are only known to the RNI and not known to the device.

2.1.12.1 Sample request

Following is an example of setting meter properties. In this case, the meter was previously added to the RNI, either through `MeterAddNotification` or some other means.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release" xmlns:cpsm="cpsm" xmlns:gml="gml">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:MeterChangedNotification>
      <ver:changedMeters objectID="UPDT-06062012">
        <ver:electricMeters>
          <ver:electricMeter objectID="3000M" utility="ACME">
            <ver:objectName>ACME.Electric.3000M</ver:objectName>
            <ver:meterNo>3000M</ver:meterNo>
             <ver:meterStatusList>
                 <!-- This may be Active, Maintenance or Test -->
                  <ver:meterStatus>Maintenance</ver:meterStatus >
            </ver:meterStatusList>
            <ver:utilityInfo>
              <ver:serviceLocationID>D4Z3P18</ver:serviceLocationID>
              <ver:gpsPoint>
                <ver:latitude>116.5</ver:latitude>
                <ver:longitude>45.4</ver:longitude>
              </ver:gpsPoint>
            </ver:utilityInfo>
            <ver:electricNameplate>
              <ver:dials>3</ver:dials>
              <ver:form>2S</ver:form>
            </ver:electricNameplate>
          </ver:electricMeter>
          <ver:electricMeter>
            <ver:objectName>ACME.Electric.3001M</ver:objectName>
            <ver:meterNo>3001MX</ver:meterNo>
            <ver:utilityInfo>
              <ver:serviceLocationID>D4Z3P19</ver:serviceLocationID>
              <ver:gpsPoint>
                <ver:latitude>116.5</ver:latitude>
                <ver:longitude>48.1</ver:longitude>
              </ver:gpsPoint>
            </ver:utilityInfo>
          </ver:electricMeter>
```

```
        </ver:electricMeters>
        <ver:comments>Meter updates for 06062012</ver:comments>
      </ver:changedMeters>
    </ver:MeterChangedNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.12.2 Sample response

This sample response shows that, of the two meters in the preceding request, one succeeded and the other resulted in an error because of a typo in the meterNo.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="Release"
        SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:MeterChangedNotificationResponse>
      <ns2:MeterChangedNotificationResult>
        <ns2:errorObject objectID="3001MX"
            errorString="Device not found"
            eventTime="2011-11-15T22:20:30.404-05:00"
            nounType="Meter"/>
      </ns2:MeterChangedNotificationResult>
    </ns2:MeterChangedNotificationResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.12.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	changedMeters	List of newly installed meters.
	changedMeters/electricMeters	List of newly installed electric meters.
	electricMeter/meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeter@objectID	Same as the meterNo.
	electricMeter@utility	The owner for this meter (the CustomerID).
	electricMeter/installedDate	Date that the meter was installed. This will only be updated in the RNI if the meter is currently in the installed state.
	electricMeter/removedDate	Date that the meter was removed. This will only be updated in the RNI if the meter is currently in the inventory state.
	electricMeter/AMRDeviceType	AMR-specific device type e.g., 23 for iConA.
	electricMeter/electricNameplate/dials	The dials for the meter.
	electricMeter/electricNameplate/form	The form factor for the meter.
	electricMeter/meterStatusList	List of statuses.

	Attribute/Element	Usage
	electricMeter/meterStatusList/meterStatus	Only one meterStatus is currently supported. This is expected to be the logical state of the meter when it is updated into the RNI. One of {Active, Maintenance, Test}. An unrecognized status will be ignored. If not specified then the current value in RNI is retained.
	electricMeter/moduleList	List of modules.
	electricMeter/moduleList/module@objectID *if the moduleType of the module is FlexNetRadio*	This is the FlexNet ID corresponding to the meter.
	electricMeter/moduleList/module/moduleType	Value is FlexNetRadio for a FlexNet transceiver. Any other moduleType is ignored.
	electricMeter/moduleList/module/firmwareVersion	Firmware version for the radio.
	electricMeter/utilityInfo	
	electricMeter/utilityInfo/serviceLocationID	Service location where the meter was installed.
	electricMeter/utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located. This will be used for routing decisions and hence must be accurate.
	electricMeter/utilityInfo/gpsPoint/latitude	Latitude where the meter is physically located. This will be used for routing decisions and hence must be accurate.
	changedMeters/gasMeters	
	Properties are same as electricMeter except omit the electricNameplate element	
	changedMeters/waterMeters	
	Properties are same as electricMeter except omit the electricNameplate element	

2.1.12.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute an add operation.
	errorObject.objectID*	The MeterID for the meter for which the add notification failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID e.g., `Meter`.

2.1.12.5 Error messages

There could be one or more of these errors in the response.

	Error	Reasons
BUSINESS ERRORS	Invalid data for meter	One or more of the provided meter properties are not valid according to the validation rules in the RNI. Error text may contain additional details.
	Missing meterNo attribute	The `meterNo` is needed to identify the meter being installed.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	Update operation allowed only on Inventory or Installed meter	Meter is known to RNI but the meter is not in Inventory or Installed state.
	Problem accessing database	General database error.
	Service location [] exceeds maximum length of 25	Provided service location is too long.
SYSTEM ERRORS	*Common security errors*	

2.1.12.6 Configuration properties

	Property name	Usage
DATABASE	Gateway.MaxDials	The maximum value acceptable for the dials property of a meter.

2.1.13 MeterRemoveNotification

This method notifies the RNI of a meter that has been uninstalled. The lifecycle state of the meter in the RNI will be changed from *Install* to *Inventory* to indicate that the meter is no longer installed.

The MultiSpeak standard allows meter properties to be specified in this request and the RNI gateway will update supported meter properties along with the lifecycle state change. However, it is unusual for properties to be updated during an uninstall operation. When the meter is removed, the service location ID is reset to null so that old service locations are not retained when added back into service.

2.1.13.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release" xmlns:cpsm="cpsm" xmlns:gml="gml">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:MeterRemoveNotification>
      <ver:removedMeters>
        <ver:electricMeters>
          <ver:electricMeter objectID="3001E" verb="Change" utility="ACME">
            <ver:comments>Uninstall meter</ver:comments>
            <ver:meterNo>3001E</ver:meterNo>
          </ver:electricMeter>
        </ver:electricMeters>
        <ver:waterMeters>
          <ver:waterMeter objectID="BadMeterID" verb="Change" utility="ACME">
            <ver:comments>Send in bad data</ver:comments>
            <ver:meterNo>BadMeterID</ver:meterNo>
          </ver:waterMeter>
        </ver:waterMeters>
        <ver:gasMeters>
          <ver:gasMeter objectID="3001G" verb="Change" utility="ACME">
            <ver:comments>Uninstall and move meter to a test line</ver:comments>
            <ver:meterNo>3001G</ver:meterNo>
            <ver:utilityInfo>
              <ver:gpsPoint>
                <ver:latitude>45.45</ver:latitude>
                <ver:longitude>-100.90</ver:longitude>
              </ver:gpsPoint>
            </ver:utilityInfo>
          </ver:gasMeter>
        </ver:gasMeters>
      </ver:removedMeters>
    </ver:MeterRemoveNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.13.2 Sample response

This sample response shows that of the three meters in the preceding request, two succeeded and one resulted in an error because the meterID was not correct.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="Release"
        SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:MeterRemoveNotificationResponse>
      <ver:MeterRemoveNotificationResult>
        <ver:errorObject objectID="BadMeterID"
            errorString="Device not found"
            nounType="Meter"
            eventTime="2011-11-15T22:20:30.404-05:00"></ver:errorObject>
      </ver:MeterRemoveNotificationResult>
    </ver:MeterRemoveNotificationResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.13.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	removedMeters	List of uninstalled meters.
	removedMeters/electricMeters	List of uninstalled electric meters.
	electricMeter/meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeter@objectID	Same as the meterNo.
	electricMeter@utility	The owner for this meter (the CustomerID).
	electricMeter/removedDate	Date that the meter was uninstalled. If not specified then it is assumed to be now.
	electricMeter/electricNameplate/dials	The dials for the meter.
	electricMeter/electricNameplate/form	The form factor for the meter.
	electricMeter/utilityInfo/serviceLocationID	Service location where the meter was installed. *If not provided, the existing value recorded for this meter in the RNI database is cleared.*
	electricMeter/utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located. This will be used for routing decisions and hence must be accurate. *If not provided, the existing value recorded for this meter in the RNI database is cleared.*
	electricMeter/utilityInfo/gpsPoint/latitude	Latitude where the meter is physically located. This will be used for routing decisions and must be accurate. *If not provided, the existing value recorded for this meter in the RNI database is cleared.*
	removedMeters/gasMeters	List of uninstalled gas meters.
	Properties are same as electricMeter except omit the electricNameplate element.	
	removedMeters/waterMeters	List of uninstalled water meters.
	Properties are same as electricMeter except omit the electricNameplate element.	

2.1.13.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute an add operation.
	errorObject.objectID*	The MeterID for the meter for which the add notification failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID e.g., `Meter`.

2.1.13.5 Error messages

There could be one or more of these errors in the response.

	Error	Reasons
BUSINESS ERRORS	Invalid data for meter	One or more of the provided meter properties are not valid according to the validation rules in the RNI. This is also used to report an attempt to set a data value that overflows the field length constraints in the database. **This may result in a partial update of the meter data in the database**.
	Missing meterNo attribute	The `meterNo` is needed to identify the meter being installed.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	Problem accessing database	General database error.
	Service location [] exceeds maximum length of 25	Provided service location is too long.
SYSTEM ERRORS	*Common security errors*	

2.1.13.6 Configuration properties

	Property name	Usage
DATABASE	Gateway.MaxDials	The maximum acceptable value for the dials property for a meter.

2.1.14 MeterRetireNotification

This method notifies the RNI of a meter that has been retired permanently, or has been sent over to the manufacturer for any possible repair (RMA).

The value of *Retire* or *RMA* in the XML element *meterStatus* in the request is used indicate whether to permanently remove or RMA the meter.

When this operation is used with RMA, in the RNI, the meter lifecycle is switched to the state of *RMA*. After a period of time, if and when the meter is repaired, it can be reinstalled in the same or different customer site using the `MeterAddNotification` operation. If the meter cannot be repaired, it can be retired permanently, by using the *Retire* state in this operation.

When the operation is used for retiring permanently, the meter(s) will be administratively removed from the RNI database.

The *meterStatus* is an optional element, and the absence of this element defaults to the status of *Retire*. The lifecycle status of *RMA* was added in RNI version 4.0, and not having the element *meterStatus* in the request defaults to the earlier behavior (i.e., Retire), thus providing backward compatibility.

2.1.14.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
    xmlns:cpsm="cpsm" xmlns:gml="gml">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:MeterRetireNotification>
      <ver:retiredMeters>
        <ver:electricMeters>
          <ver:electricMeter objectID="3001E" verb="Change" utility="ACME">
            <ver:meterNo>3001E</ver:meterNo>
          </ver:electricMeter>
          <ver:electricMeter objectID="3002E" verb="Change" utility="ACME">
            <ver:meterNo>3002E</ver:meterNo>
            <ver:meterStatusList>
               <ver:meterStatus>RMA</ver:meterStatus>
            </ver:meterStatusList>
          </ver:electricMeter>
        </ver:electricMeters>
      </ver:retiredMeters>
    </ver:MeterRetireNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.14.2 Sample response

This shows a response where of the two meters in the preceding sample request, one meter was retired and the other failed because of a typo in the meterNo.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Branch="0"
    Build="6" BuildString="RELEASE" Company="Sensus" MajorVersion="4"
    MinorVersion="1" SessionID="779"
```

```
    xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:MeterRetireNotificationResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:MeterRetireNotificationResult>
        <ns2:errorObject errorString="Meter not found."
        eventTime="2014-12-19T22:10:12.468-05:00" nounType="Meter" objectID="3002E"/>
      </ns2:MeterRetireNotificationResult>
    </ns2:MeterRetireNotificationResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.14.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	retiredMeters/	List of retired meters.
	retiredMeters/electricMeters	List of retired electric meters.
	electricMeter/meterNo*	The identifier for the retired meter assigned by the utility (the MeterID).
	electricMeter@objectID	Same as the meterNo.
	electricMeter@utility	The utility owner for this meter (the CustomerID).
	electricMeter/meterStatusList/meterStatus	This is an optional element. Valid values are *RMA* and *Retire*. The absence of the element defaults the status to *Retire*. The meterStatus indicates whether to permanently retire the meter or send it to the manufacturer for possible repair.
	retiredMeters/waterMeters	List of retired water meters.
	Properties are same as electricMeter	
	retiredMeters/gasMeters	List of retired gas meters.
	Properties are same as electricMeter	

2.1.14.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the retire notification.
	errorObject.objectID*	The MeterID for the meter which failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID e.g., `Meter`.

2.1.14.5 Error messages

The response may contain one or more of these errors.

	Error	Reasons
BUSINESS ERRORS	Missing meterNo attribute	The `meterNo` is needed to identify the meter being retired.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	Incorrect meter lifecycle state	The specified meter is not in an Inventory state.
	Removing Meter in Installed state not enabled	Meter in Installed state cannot be deleted. It needs to be in Inventory state, or the RNI needs to be configured to allow this operation.
	Invalid lifecycle state in operation	Invalid lifecycle state provided for the request.
	Problem accessing database	General database error.
SYSTEM ERRORS	*Common security errors*	

2.1.14.6 Configuration properties

	Property name	Usage
DATABASE	RemoveSetupBindDataOnMeterDelete (Customer configuration)	Boolean property to determine if the discovered data for a meter should also be removed. This must be kept as True for the meter lifecycle management methods to work consistently. Default is True.

2.1.15 InitiateMeterInstallation

This method notifies the RNI of meters that have been installed in the field and added into the utility back office systems. The resulting action is that an inventoried meter is marked as Installed and the given attributes are updated.

If the meter does not exist in the RNI the meter will be added. If the meter already exists in the RNI in the *Inventory* or *Installed* state, the information in the request will be updated to the RNI. The state will be updated to *Installed* if it is currently *Inventory*.

This request does not use the configuration property *LifeCycle.AllowBypassInventoryState,* which means that a meter that does not exist in the RNI can be added directly to the *Installed* state.

In addition to updating the meters to RNI database, communication with the meter to verify status of physical installation in the field may occur. For this reason asynchronous notifications are used to deliver the outcome of `InitiateMeterInstallation` requests. Meters in the request that failed due to pre

checks are returned with immediate errors (synchronous response), and will not generate asynchronous notifications.

2.1.15.1 Sample request

This request shows a request with one *serviceLocation* and one meter in it. Note the use of the `dataOnly` profile in the `MultiSpeakMsgHeader`. There can be multiple service locations, each containing multiple meters, in one request.

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ver="http://www.multispeak.org/Version_4.1_Release" xmlns:cpsm="cpsm_V4.1_Release"
xmlns:gml="gml_V4.1_Release"
xmlns:sensus="http://www.sensus.com/multispeak4">
   <soapenv:Header>
       <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" sensus:Profile="dataOnly"/>
  </soapenv:Header>
   <soapenv:Body>
      <ver:InitiateMeterInstallation>
         <ver:installLocations>
            <ver:serviceLocation objectID="SL01" utility="ACME">
               <ver:timeZone DSTEnabled="true" UTCOffset="0">ET</ver:timeZone>
               <ver:facilityName>FacilityA</ver:facilityName>
               <ver:serviceAddress>
                  <ver:address1>123 any street</ver:address1>
                  <ver:address2/>
                  <ver:city>Phoenix</ver:city>
                  <ver:state>AZ</ver:state>
                  <ver:postalCode>90210</ver:postalCode>
                  <ver:country>USA</ver:country>
               </ver:serviceAddress>
               <ver:siteID>SiteA</ver:siteID>
               <ver:electricServiceList>
                  <ver:electricService>
                     <ver:billingCycle>15</ver:billingCycle>
                     <ver:meterBase>
                        <ver:electricMeter objectID="3000M" utility="ACME">
                           <ver:meterNo>3000M</ver:meterNo>
                           <ver:installedDate>2006-02-16T15:50:00.000-05:00</ver:installedDate>
                           <ver:AMRDeviceType>23</ver:AMRDeviceType>
                           <ver:meterStatusList>
                              <ver:meterStatus>Installed</ver:meterStatus>
                           </ver:meterStatusList>
                           <ver:moduleList>
                              <ver:module objectID="3000">
                                 <ver:moduleType>FlexNetRadio</ver:moduleType>
                                 <ver:firmwareVersion>1</ver:firmwareVersion>
                              </ver:module>
                           </ver:moduleList>
                           <ver:utilityInfo>
                              <ver:serviceLocationID/>
                              <ver:gpsPoint>
                                 <ver:latitude>1.1</ver:latitude>
                                 <ver:longitude>2.2</ver:longitude>
                              </ver:gpsPoint>
                           </ver:utilityInfo>
                           <ver:electricNameplate>
                              <ver:dials>5</ver:dials>
                              <ver:form>2S</ver:form>
                           </ver:electricNameplate>
                        </ver:electricMeter>
                     </ver:meterBase>
                     <ver:rateCode>RateA</ver:rateCode>
                  </ver:electricService>
               </ver:electricServiceList>
            </ver:serviceLocation>
```

```
        </ver:installLocations>
        <ver:responseURL>http://host/uri2</ver:responseURL>
        <ver:transactionID>555666</ver:transactionID>
      </ver:InitiateMeterInstallation>
   </soapenv:Body>
</soapenv:Envelope>
```

2.1.15.2 Sample response

The following sample response shows that the sample request resulted in an error because of a validation error. There is an error object for every service location and every meter that failed in the request.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version 4.1 Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="Release"
        SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:InitiateMeterInstallationResponse>
      <ns2:InitiateMeterInstallationResult>
        <ns2:errorObject objectID="3000M"
            errorString="Invalid data for meter"
            eventTime="2006-02-16T15:55:00.000-05:00"
            nounType="Meter"/>
      </ns2:InitiateMeterInstallationResult>
    </ns2:InitiateMeterInstallationResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.15.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attribute*	
	Profile	The installation profile. This should be a user defined profile. Valid profile values: *dataOnly or pingMeter*. *dataOnly:* If no profile is specified in the request, the configuration parameter ms4.mr.initiateMeterInstallation.defaultProfile is used to determine a profile, which is specified as *dataOnly* by default. When used, this attribute must be specified in the Sensus namespace. *pingMeter:* Indicates that the method should communicate with the meter to verify the physical existence in the RNI. The outcome of the physical verification is only sent as an asynchronous notification.
BODY	installLocations	List of changed service locations.
	serviceLocation@objectID*	The service location ID associated with a meter. This is used as the identifier for the service location in the RNI. (max length 25)

	Attribute/Element	Usage
	serviceLocation@utility*	The utility (CustomerID) associated with this service location. It is required if the RNI does not have a default CustomerID. See overview section of integration guide for further detail regarding multi-tenant.
	serviceLocation/timeZone	Civilian and/or military time zone standard – AT,ET,CT,MT,PT,AKT,A,B,C if in compliant mode. Non-compliant mode can use the values as defined by the public domain **zoneinfo** (**tz**) database. See http://en.wikipedia.org/wiki/Zoneinfo. The time zones supported by a particular deployment of an RNI may be a limited set. For example, an RNI deployed in a US east coast city may only support the `America/New_York` time zone.
	serviceLocation/timeZone@DSTEnabled	Should be true if location uses DST (only in compliant mode).
	serviceLocation/timeZone@UTCOffset	Not used because the timeZone value implicitly includes this information.
	serviceLocation/facilityName	Facility Name (max length 200).
	serviceLocation/serviceAddress	Street address of this service location, not the billing address for the customer.
	serviceLocation/serviceAddress/address1	Address line 1 (max length 60).
	serviceLocation/serviceAddress/address2	Address line 2 (max length 60).
	serviceLocation/serviceAddress/city	City (max length 60).
	serviceLocation/serviceAddress/state	State (max length 2).
	serviceLocation/serviceAddress/postalCode	Zip (max length 10).
	serviceLocation/serviceAddress/country	Country (max length 25).
	serviceLocation/siteID	Region / project area (max length 25).
	serviceLocation/electricServiceList	Characteristics of the electric services available at this service location.
	electricService	Element that contains the electric meters.
	electricService/billingCycle	The billing cycle of electric meters.
	electricService/meterBase/meterID	Uses these attributes if not specified under electricMeter.
	meterID@meterNo	Uses as meterNo if electricMeter/meterNo is not specified.
	meterID@utility	Uses as the CustomerID if electricMeter@utility is not specified.
	electricService/meterBase/electricMeter	
	electricMeter/meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeter@objectID	Same as the meterNo.
	electricMeter@utility	The owner for this meter (the CustomerID).
	electricMeter/installedDate	Date that the meter was installed. If not specified then it is assumed to be now.

Attribute/Element	Usage
electricMeter/AMRDeviceType	RNI-specific device type e.g., 23 for iConA. **Note***:* The AMRDeviceType of the meter is essential for the communication and hence it has to be available in the RNI by some other means if not being provided in this request.
electricMeter/meterStatusList	List of meterStatus.
electricMeter/meterStatusList/meterStatus	The list supports multiple statuses. It can have a lifecycle status and a logical status. The lifecycle meterStatus is expected to be `Installed` if specified. If not specified it defaults to `Installed`. The logical meterStatus, if specified, can be `Active`, `Maintenance`, or `Test`. If not specified, it defaults to `Active`. Any invalid status is ignored with a warning in the gateway log file.
electricMeter/moduleList	List of modules.
electricMeter/moduleList/module@objectID* (only processed if the moduleType of the module is FlexNetRadio)	This is the FlexnetID for that meter. This is required **only if** the meter does not already exist in the RNI.
electricMeter/moduleList/module/module Type* (only processed if the moduleType of the module is *FlexNetRadio*)	Value is FlexNetRadio for a FlexNet transceiver. This is required **only if** the meter does not already exist in the RNI. Any other moduleType is ignored.
electricMeter/moduleList/module/firmware Version (only processed if the moduleType of the module is *FlexNetRadio*)	Firmware version for the FlexNet radio module.
electricMeter/utilityInfo	Additional utility information related to this meter.
electricMeter/utilityInfo/gpsPoint/longitude	Longitude where the meter is physically located. This will be used for routing decisions and hence must be accurate.
electricMeter/utilityInfo/ gpsPoint/latitude	Latitude where the meter is physically located. This will be used for routing decisions and hence must be accurate.
electricMeter/electricNameplate/dials	The dials for the meter.
electricMeter/electricNameplate/form	The form factor for the meter.
electricService/rateCode	The Rate code for electric meters in this location. For RNI version 4.6.0 and later, if specified, the rate code is validated against the list of rate codes defined for the customer in the RNI. The validation fails if the specified value is not in the list, or the request specifies a value for the rate code but no rate codes are defined for the customer in the RNI.

	Attribute/Element	Usage
	serviceLocation/waterServiceList/	Characteristics of the gas services available at this service location. **Note**: No meterBase element under waterService.
	waterService/waterMeter	Element that contains the water meters. The structure is same as electric service.
	serviceLocation/gasServiceList/	Characteristics of the gas services available at this service location. **Note**: No meterBase element under gasService.
	gasService/gasMeter	Element that contains the gas meters. The structure is same as electric service.

2.1.15.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the retire notification.
	errorObject.objectID*	The MeterID for the meter which failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID (e.g., `Meter`).

2.1.15.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing objectID attribute	The `objectID` is needed to identify the service location being installed.
	Missing utility attribute	Indicates that a customer ID was not provided in the request via the `utility` attribute.
	DeviceType is missing in the request	The AMRDeviceType is needed in the request if it is not already in the RNI database for the meter.
	Must specify valid request	One or more of the provided data in the request are not valid according to the validation rules.
	Non Compliant TimeZone	MultiSpeak standard compliant mode is on (see `Multispeak.MR.TimezoneCompliant`) but value in request is not a MultiSpeak standard compliant time.
	Value provided in header named profile is invalid.	Invalid value provided for the *MultiSpeakMsgHeader* named *Profile*.
	Missing/Invalid FlexNetRadioID.	If the meter does not exist in the RNI the FlexNetRadio is required.
	No locations in the request	The request has no service locations.

	Error	Reasons
	FlexNetRadio ID is already assigned to a different meter	The FlexNet radio ID in the request is already associated with a different meter.
	No meters in serviceLocation	The request in the specified service location. This location will not be processed.
	Meter status [specified status] is not supported for operation InitiateMeterInstallation.	The only lifecycle state supported in this request is *Installed*. All other statues cause this error.
	Missing meterNo attribute	Attribute meterNo is required.
	Invalid data in request	Data validation failure for a value that does not have a specific error message, such as rate code. This applies to RNI version 4.6.0 and later.
	Rate code [X] is invalid for [customerId]. Valid rates codes are [X1, X2].	If a rate code X is given in request, it is validated against the list of rate codes for the customer.
	Problem accessing database	General database error.
SYSTEM ERRORS	*Common security errors*	

2.1.15.6 Configuration properties

	Property name	Usage
DATABASE	Gateway.MaxDials	The maximum value for the dials property for a meter.
	Gateway.MaxRepId	The maximum possible value for the FlexNetRadioID of a meter.

2.1.16 InitiateMeterExchange

This method notifies the RNI of a meter exchange (swap) that has occurred or will occur in the field. This notification typically comes from the CB server (Client Billing server).

The In and Out meters in the exchange are expected to already exist in the RNI database. Ideally, the In-Meter and the Out-Meter are expected to be in the states of *InInventory* and *Installed* respectively, in the RNI. In this case the *serviceLocationID* is optional in the request. The In-Meter or the Out-Meter may be already in the target states of *Installed* and *InInventory* respectively, in the RNI. In this case, a valid *serviceLocationID* is expected in the request. Essentially, a specific meter swap can be reported multiple times without causing any side effect or error.

Upon completion of the request, the In-Meter is changed to the *Installed* lifecycle state, and the Out-Meter is changed to the *InInventory* lifecycle state in the RNI. This request does not change any state on the physical devices; only values in the RNI database are updated.

2.1.16.1 Sample request

```
<soapenv:Envelope
                  xmlns:soapenv=http://schemas.xmlsoap.org/soap/envelope/
                  xmlns:ver=http://www.multispeak.org/Version_4.1_Release
                  xmlns:xsd=http://www.w3.org/2001/XMLSchema
                  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                  xmlns:sensus= "http://www.sensus.com/multispeak4">
 <soapenv:Header>
  <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6"
                           Branch="0"  BuildString="RELEASE" UserID="testUser"
                           Pwd="testPass" SessionID="779" AppName="myApp"
                           AppVersion="1.0"/>
 </soapenv:Header>
 <soapenv:Body>
  <ver:InitiateMeterExchange>
   <ver:exchanges>
    <ver:electricMeterExchanges>
     <ver:electricMeterExchange objectID="GE1237-GE5555">
        <ver:serviceLocationID>ACMEPOD</ver:serviceLocationID>
      <ver:outMeterReading>
       <ver:meterID meterNo="GE5555" objectID="GE5555" utility="ACME">ACME.GE5555</ver:meterID>
      </ver:outMeterReading>
      <ver:inMeterReading>
       <ver:meterID meterNo="GE1237" objectID="GE12345" tility="ACME">ACME.GE1237</ver:meterID>
      </ver:inMeterReading>
     </ver:electricMeterExchange>
    </ver:electricMeterExchanges>
   </ver:exchanges>
   <ver:responseURL>http://myserver/notifications</ver:responseURL>
   <ver:transactionID>Request1234</ver:transactionID>
  </ver:InitiateMeterExchange>
 </soapenv:Body>
</soapenv:Envelope>
```

2.1.16.2 Sample response

Following is the response corresponding to the preceding sample request. This shows the request resulted in an error because of a validation failure. There is an error object for every meter that failed in the request. Absence of error object(s) for a meter indicates that the request was successful.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
                           Company="Sensus"
                           xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:InitiateMeterExchangeResponse
            xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
            xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
            xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:InitiateMeterExchangeResult>
            <ns2:errorObject
                        errorString="Device not found"
                        eventTime="2016-12-12T15:29:38.011-05:00"
                        nounType="Meter" objectID="GE1237"/>
         </ns2:InitiateMeterExchangeResult>
      </ns2:InitiateMeterExchangeResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.16.3 Asynchronous response (notification)

This request results in a *MeterExchangeNotification* to be sent back to the client upon the completion of processing of the request. The notification contains all exchanges that were successfully processed.

2.1.16.4 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	Exchanges	List of exchange data.
	exchanges/electricMeterExchanges	List of electric meter exchange.
	electricMeterExchange@objectID	Unique Identifier for the exchange in the request. For example, a string containing the *MeterNo* of both In and Out meters.
	electricMeterExchange/serviceLocationID	The location ID where meter is exchanged. If In-Meter and the Out-Meter are already in the target states of *Installed* and *InInventory* respectively, a serviceLocationID is expected in the request. Otherwise, the serviceLocationID is optional.
	electricMeterExchange/outMeterReading/meterID	The meter being swapped out.
	electricMeterExchange/outMeterReading/meterID @meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeterExchange/outMeterReading/meterID @objectID*	Same as the meterNo.
	electricMeterExchange/outMeterReading/meterID @utility	The owner for this meter (the CustomerID).
	electricMeterExchange/inMeterReading/meterID	The new meter being used for the exchange.
	electricMeterExchange/inMeterReading/meterID@ meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeterExchange/inMeterReading/meterID@ objectID*	Same as the meterNo.
	exchanges/gasMeterExchanges (Properties are same as electricMeterExchange)	List of gas meter exchanges.
	exchanges/waterMeterExchanges (Properties are same as electricMeterExchange)	List of water meter exchanges.
	transactionID	Transaction ID for this request. This is returned in the `MeterExchangeNotification` triggered by this request.
	responseURL	The URL that the resulting `MeterExchangeNotification` message should be sent to. If not specified then the notification is sent to the URL specified in the `Multispeak.MR.DestinationURL`.

2.1.16.5 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the retire notification.
	errorObject.objectID*	The MeterID for the meter which failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID e.g., `Meter`.

2.1.16.6 Error messages

	Error	Reasons
BUSINESS ERRORS	Device not found	The RNI does not contain the specified meter ID. Both the In and Out meters are expected to exist in the RNI.
	Missing objectID attribute	The `objectID` is not specified.
	Missing utility attribute	Indicates that a customer ID was not provided in the request via the `utility` attribute.
	Missing meterNo attribute	Attribute meterNo is not specified.
	No meterReading in the exchange	An exchange is missing the *meterReading* element.
	No meterID in the exchange	An exchange is missing the *meterID* element.
	Invalid or missing service location	An exchange is invalid or missing the *serviceLocationID* element, which is expected in some scenarios.
	No exchanges in the request	The request does not contain any valid *exchanges* elements.
	Problem accessing database	General database error.
SYSTEM ERRORS	Common security errors	

2.1.17 ServiceLocationChangedNotification

This method notifies the RNI of a change in a service location or associated properties (e.g., address, billing code etc.).

> Multiple meter records may be associated with the same service location. In this case a change to the properties of service location would affect multiple meters.

A new service location is created in the RNI database with the specified *objectID* as the identifier (if the service location in the request does not already exist in the RNI).

The service location may already have been created by an earlier *MeterAddNotification* or *MeterChangeNotification* using the *serviceLocationID* as the identifier. In that case, the ***ServiceLocationChangedNotification*** retrieves the location in the RNI using the specified *objectID* (for *serviceLocationID*) and updates the address associated with the *serviceLocationID*.

2.1.17.1 Sample request

The following request shows an update to one service location.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
    xmlns:cpsm="cpsm_V4.1_Release" xmlns:gml="gml_V4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:ServiceLocationChangedNotification>
      <ver:changedServiceLocations>
        <ver:serviceLocation objectID="123M" utility="ACME">
          <ver:siteID>PHX</ver:siteID>
          <ver:timeZone DSTEnabled="true">ET</ver:timeZone>
          <ver:facilityName>Area51</ver:facilityName>
          <ver:serviceAddress>
            <ver:address1>123 any street</ver:address1>
            <ver:city>Phoenix</ver:city>
            <ver:state>AZ</ver:state>
            <ver:postalCode>90210</ver:postalCode>
            <ver:country>USA</ver:country>
          </ver:serviceAddress>
          <ver:electricServiceList>
            <ver:electricService>
              <ver:electricMeterID>111222E</ver:electricMeterID>
              <ver:revenueClass>TOU</ver:revenueClass>
              <ver:billingCycle>21</ver:billingCycle>
            </ver:electricService>
          </ver:electricServiceList>
        </ver:serviceLocation>
      </ver:changedServiceLocations>
    </ver:ServiceLocationChangedNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.17.2 Sample response

The following sample response shows the acknowledgement of an update that succeeded.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader
        SessionID="779"
        AppName="RNI Gateway (MR)"
        AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:ServiceLocationChangedNotificationResponse>
      <ver:ServiceLocationChangedNotificationResult/>
    </ver:ServiceLocationChangedNotificationResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.17.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attribute*	
BODY	changedServiceLocations/	List of changed service locations.
	serviceLocation@objectID*	The service location ID associated with a meter. This is used as the identifier for the service location in the RNI (max length 25).
	serviceLocation@utility	The utility (CustomerID) associated with this service location.
	serviceLocation/siteID	Region / project area (max length 25).
	serviceLocation/facilityName	Facility name (max length 200).
	serviceLocation/serviceAddress	Street address of this service location, not the billing address for the customer.
	serviceLocation/serviceAddress/address1	Address line 1 (max length 50) .
	serviceLocation/serviceAddress/address2	Address line 2 (max length 50) .
	serviceLocation/serviceAddress/city	City (max length 25)
	serviceLocation/serviceAddress/state	State (max length 2).
	serviceLocation/serviceAddress/postal Code	Zip (max length 10).
	serviceLocation/serviceAddress/country	Country (max length 25).
	serviceLocation/electricServiceList/	Characteristics of the electric services available at this service location.
	serviceLocation/electricServiceList/ electricService/electricMeterID	This should be the meterNo of the meter associated with this service location.
	serviceLocation/electricServiceList/ electricService/billingCycle	The billing cycle for the meter.
	serviceLocation/electricServiceList/ electricService/revenueClass	The rateCode for the meter. For RNI version 4.6.0 and later, if specified, the rate code is validated against the list of rate codes defined for the customer in the RNI. The validation fails if the specified value is not in the list, or the request specifies a value for the rate code but no rate codes are defined for the customer in the RNI.
	serviceLocation/gasServiceList/	Characteristics of the gas services available at this service location.
	serviceLocation/gasServiceList/ gasService/gasMeterID	This should be the meterNo of the meter associated with this service location.
	serviceLocation/gasServiceList/ gasService/billingCycle	The billing cycle for the meter.
	serviceLocation/gasServiceList/ gasService/revenueClass	The rateCode for the meter. For RNI version 4.6.0 and later, if specified, the rate code is validated against the list of rate codes defined for the customer in the RNI. The validation fails if the specified value is not in the list, or the request specifies a value for the rate code but no rate codes are defined for the customer in the RNI.

	Attribute/Element	Usage
	serviceLocation/waterServiceList/	Characteristics of the water services available at this service location.
	serviceLocation/waterServiceList/ waterService/waterMeterID	This should be the meterNo of the meter associated with this service location.
	serviceLocation/waterServiceList/ waterService/billingCycle	The billing cycle for the meter.
	serviceLocation/waterServiceList/ waterService/revenueClass	The rateCode for the meter. For RNI version 4.6.0 and later, if specified, the rate code is validated against the list of rate codes defined for the customer in the RNI. The validation fails if the specified value is not in the list, or the request specifies a value for the rate code but no rate codes are defined for the customer in the RNI.
	serviceLocation/timeZone	Civilian and/or military time zone standard – AT,ET,CT,MT,PT,AKT,A,B,C if in compliant mode. Non-compliant mode can use the values as defined by the public domain **zoneinfo** (**tz**) database. See http://en.wikipedia.org/wiki/Zoneinfo. In either case, the time zones supported by a particular deployment of an RNI may be a limited set. For example, an RNI deployed in a US east coast city may only support `ET` (in compliant mode) or `America/New_York` (in non-compliant mode) time zone.
	serviceLocation/timeZone@DSTEnabled	Should be true if location uses DST (only in compliant mode).
	serviceLocation/timeZone@UTCOffset	Not used because the timeZone value implicitly includes this information.

2.1.17.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the change notification.
	errorObject.objectID*	The service location ID for which the update failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of the object indicated by objectID (e.g., `ServiceLocation`).

2.1.17.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing objectID attribute	The `objectID` is needed to identify the service location being installed.
	Missing utility attribute	Indicates that a customer ID was not provided in the request via the `utility` attribute.
	Invalid data	One or more of the provided service location properties are not valid according to the validation rules in the RNI.
	Non Compliant TimeZone	MultiSpeak standard compliant mode is on (see `Multispeak.MR.TimezoneCompliant`) but the value in the request is not a MultiSpeak standard compliant time.
	Must specify Meter ID for meters when specifying billingCycle or revenueClass	The meter ID should be specified when specifying the billing cycle or revenue class.
	Meter does not exist	The meter ID provided does not exist in the RNI.
	Invalid lifecycle state in operation	Invalid lifecycle state provided for the request.
	Problem accessing database	General database error.
	Service location [] exceeds maximum length of 25	Provided service location is too long.
	Rate code [X] is invalid for [CustomerID]. Valid rates codes are [X1, X2].	If a rate code X is given in the request, it is validated against the list of rate codes for the customer. (This applies to RNI version 4.6.0 and later.)
SYSTEM ERRORS	*Common security errors*	

2.1.17.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.TimezoneCompliant (Customer configuration)	True for MultiSpeak standard compliant mode. False to accept zoneinfo. Default is `True`.
	Gateway.MaxCycle (System configuration)	The maximum value for the billing cycle.

2.1.18 InitiateMeterReadingsByMeterID

This method instructs the RNI to get updated meter readings for a meter. When the meter responds to the RNI with a meter reading, a `ReadingChangedNotification` is published.

The RNI supports the following modes for this operation:

(a) In **on-the-glass mode**, the meter is pinged for its instantaneous reading. This is the preferred mode and also the default out-of-the-box setting. The behavior is consistent across different meter types and configurations. Gas and water devices are supported only when using on-the-glass reading mode. The instantaneous readings are not time-aligned and are not written to the database. Therefore, they cannot be retrieved by any of the GetXXX methods for meter reads.

(b) In **supervisory reading mode**, the RNI pings the meter for its time-aligned billing read. This behavior varies across meter types and configurations. Therefore, it is not recommended for use as the default behavior. These reads are stored in the database and can be retrieved through any of the GetXXX methods for meter reads.

(c) In **serviceQuality mode,** the RNI pings the meter for its service quality data.

The mode for this operation can be specified per-request by using the `Profile` attribute.

Note the following additional differences between the modes:

- Gas and water devices are supported **only** in on-the-glass reading mode.
- TOU reads are retrieved only in supervisory reading mode. This feature may be added to on-the-glass mode in a future release.

2.1.18.1 Sample request

Following is a sample request to initiate a meter read for two meters.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
    xmlns:sensus="http://www.sensus.com/multispeak4">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" sensus:Profile="onTheGlass"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateMeterReadingsByMeterID>
      <ver:meterIDs>
        <ver:meterID meterNo="1001M" serviceType="Electric"
            objectID="1001M"
            utility="ACME">ACME.E.1001M</ver:meterID>
        <ver:meterID meterNo="1002M"
            objectID="1002M"
            utility="ACME">ACME.E.1002M</ver:meterID>
      </ver:meterIDs>
      <ver:transactionID>T2-RNI-12345</ver:transactionID>
    </ver:InitiateMeterReadingsByMeterID>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.18.2 Sample response

Following is the response for the preceding sample request. It shows that the request was accepted for one meter and failed for the other.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)"
        AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateMeterReadingsByMeterIDResponse>
      <ver:InitiateMeterReadingsByMeterIDResult>
        <ver:errorObject errorString="Missing serviceType attribute"
            eventTime="2011-11-24T22:24:08.129-05:00"
            nounType="Meter" objectID="1002M"/>
      </ver:InitiateMeterReadingsByMeterIDResult>
    </ver:InitiateMeterReadingsByMeterIDResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.18.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
	Profile	The meter reading profile. This should be a user defined profile. Ping priority, reading mode, and transmit timeout value are specified in user defined profiles. If no profile is specified in the request, the configuration parameters *ms4.mr.initiateReading.electric.defaultProfile* and *ms4.mr.initiateReading.nonElectric.defaultProfile* are used to determine a profile. The value of the former parameter is used for electric meters and the later for non-electric meters. If a request contains both electric and non-electric meters, and a profile is not specified in the request, all electric meters will use default *electric* profile and all non-electric meters will use default *non-electric* profile in the above mentioned configuration. If a request contains both electric and non-electric meters, and a profile is specified in the request all meters in request will use the specified profile in the request, thus ignoring the default configuration values. This attribute must be specified in the Sensus namespace. Refer to Tech Note – Meter Reading Profiles.
BODY	transactionID	Transaction ID for this request. This is returned in the `ReadingChangedNotification` triggered by this request.
	responseURL	The URL to which the resulting `ReadingChangedNotification` message should be sent. If not specified, the notification is sent to the URL specified in the `Multispeak.MR.DestinationURL`.

	Attribute/Element	Usage
	meterIDs	List of `meterID` elements corresponding to meters to be pinged for up-to-date readings.
	meterID@serviceType*	The service type for the meter, one of {Electric, Water, Gas}.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.1.18.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the add notification.
	errorObject.objectID*	The objectID for the meter with the error.
	errorObject.eventTime*	Timestamp indicating when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	Meter.

2.1.18.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing utility attribute	The `utility` is not provided for the `meterID` in the request. This is required to uniquely identify the meter.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Missing meterIDs	The meterIDs element is not provided in the request, or it does not contains any meterID elements. At least one meterID element must be provided.
	Unsupported serviceType	The `serviceType` value is not supported by the RNI. The currently supported service types are `Electric`, `Gas` and `Water`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	Unsupported device type	A message could not be sent to the meter because its device type is not known. One possible cause is that the meter was added to the RNI without a device type, and the meter has not yet communicated with the RNI.

	Error	Reasons
	Feature is not supported for Water/Gas meters	The initiate meter reading operation is currently not supported for water and gas meters.
	Feature is not supported for this device type	The initiate meter reading is not supported for the meter's device type. One possible cause is missing feature(s) in the RNI for the given device type, which are required to ping the meter.
	No routes to endpoint	The on-air message could not be sent to the meter because the RNI does not have any routes to it.
	Message throttled by communication module	The RNI's traffic management policy has *temporarily* blocked transmissions to the meter. The most common reason is the RNI already has a message queued or in transit for the meter. This is a transient condition, so the client should wait and retry.
	Duplicate entries found in database with same meter identity but different FlexNet radio IDs	The RNI has two meters discovered with the same meter identity, but different FlexNet IDs. This makes any request based on the meter identity ambiguous. Correct this problem by removing the duplicate entry.
	Unable to find specified profile: (<*profilename*>) in profileMap	The meter reading profile specified in the request is not valid. This is most likely seen when there is a typo in the profile name, either in the request or in the RNI profile configuration.
	Could not retrieve meter read information from the meter response. The meter may be experiencing a power fail.	An on-the-glass mode request was sent while the meter was powering down, which interrupts the retrieval of meter readings.
	No billing data found [Billing Cycle or Rate Code]	No billing cycle or rate code was found for the meter. Correct the problem by using **ServiceLocationChangedNotification** to add a service location designating a rate code or billing cycle for the meter. Alternatively, verify setting of configuration property Multispeak.MR ForceTOU is True if rate Codes are not in use.
SYSTEM ERRORS	*Common security errors*	

2.1.18.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.ForceTOU (Customer configuration)	Boolean property to determine whether to force including the tier reads for a meter or let the rate code determine if they are returned. If `True` then tier reads are included regardless of the rate code (assuming the meter is reporting tier reads). If `False` then tier reads are only included if an appropriate TOU rate code has been assigned in the RNI for this meter. Default is `True.`
FILE	toudata.includeTouData (System configuration)	System-wide switch for TOU data reporting through the MultiSpeak gateway. It is unlikely that this will ever be false in a production setting. Default is `True`.
	ms4.mr.initiateReading.electric.defaultProfile	Profile name to use for electric meters in InitiateMeterReadingsByMeterID request if no profile is specified in the request. Default is `onTheGlass`. **Note**: For RNI version 4.0 and later, changes to this property must be made in /opt/flexnet/conf/flexnet.local.properties.
	ms4.mr.initiateReading.nonElectric.defaultProfile	Profile name to use for non-electric meters in InitiateMeterReadingsByMeterID request if no profile is specified in the request. Default is `onTheGlass`. **Note**: For RNI version 4.0 and later, changes to this property must be made in /opt/flexnet/conf/flexnet.local.properties.

2.1.19 GetLatestReadingByMeterID

This method gets the **most recent** register readings (end readings) that are available for a meter. The RNI returns the most recent readings from its database.

This method also obtains TOU readings if the meter is set up to report TOU read data to the RNI.

> The most recent reads for TOU may be a partial set depending on the time of the day. For example, a meter is configured with TOU switch points at 6 am, 2 pm, and 8 pm. Then at 4 pm, the first two tiers (A and B) *may* have already been collected, so a request to get the latest reads would return just the two tiers.

2.1.19.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
```

```
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetLatestReadingByMeterID>
      <ver:meterID meterNo="1001M" serviceType="Electric"
          objectID="1001M" utility="ACME">acme.electric.1001M</ver:meterID>
    </ver:GetLatestReadingByMeterID>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.19.2 Sample response

2.1.19.2.1 Sample response for non-TOU reading

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ns2:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetLatestReadingByMeterIDResponse>
      <ver:GetLatestReadingByMeterIDResult>
        <ver:meterID meterNo="1001M" serviceType="Electric"
            objectID="1001M"
            utility="ACME">acme.electric.1001M</ver:meterID>
        <ver:deviceID>1001</ver:deviceID>
        <ver:readingValues>
          <ver:readingValue>
            <ver:units>kWh</ver:units>
            <ver:value>5555.0</ver:value>
            <ver:readingType>Billing</ver:readingType>
            <ver:fieldName>posKWh</ver:fieldName>
            <ver:measurementPeriod>Current</ver:measurementPeriod>
            <ver:timeStamp>2010-12-30T10:30:00.000-05:00 </ver:timeStamp>
            <ver:readingStatusCode originatingSystemID="2"
                codeCategory="0" codeIndex="0"/>
            <ns2:readingTypeCode UOMCategory="0.12"
                accumulationBehavior="9" dataQualifier="0"
                displayableUOM="72" flowDirection="1"
                measurementCategory="0.0"
                name="Summation Forward Energy (Wh)"
                phaseIndex="0" timeAttribute="0"
                unitsMultiplier="0">0.0.9.1.0.12.0.0.0.0.72</ns2:readingTypeCode>
          </ver:readingValue>
          <ver:readingValue>
            <ver:units>kW</ver:units>
            <ver:value>234.0</ver:value>
            <ver:readingType>Billing</ver:readingType>
            <ver:fieldName>maxDemand</ver:fieldName>
            <ver:measurementPeriod>Current</ver:measurementPeriod>
            <ver:timeStamp>2010-12-30T10:30:00.000-05:00</ver:timeStamp>
            <ver:readingStatusCode originatingSystemID="2"
                codeCategory="0" codeIndex="0"/>
          </ver:readingValue>
          <ver:readingValue>
            <ver:units>Nbr of demand resets</ver:units>
            <ver:value>151</ver:value>
            <ver:readingType>Billing</ver:readingType>
            <ver:fieldName>demandResetCounter</ver:fieldName>
            <ver:measurementPeriod>Current</ver:measurementPeriod>
            <ver:timeStamp>2010-12-30T10:30:00.000-05:00</ver:timeStamp>
            <ver:readingStatusCode originatingSystemID="2"
                codeCategory="0" codeIndex="0"/>
            <ns2:readingTypeCode UOMCategory="2.4" accumulationBehavior="1"
                dataQualifier="0" displayableUOM="111" flowDirection="0"
                measurementCategory="0.0"
                name=" BulkQuantity DemandReset (Count)"
```

```
                phaseIndex="0" timeAttribute="0"
                unitsMultiplier="3">0.0.1.0.2.4.0.0.0.0.111</ns2:readingTypeCode>
          </ver:readingValue>
        </ver:readingValues>
      </ver:GetLatestReadingByMeterIDResult>
    </ver:GetLatestReadingByMeterIDResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.19.2.2 Sample response that also includes TOU (tier) readings

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader
       AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"
       SessionID="?" xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:GetLatestReadingByMeterIDResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:GetLatestReadingByMeterIDResult>
        <ns2:meterID meterNo="15027M" objectID="15027M" serviceType="Electric" utility="ACME"/>
        <ns2:deviceID>15027</ns2:deviceID>
        <ns2:readingValues>
          <ns2:readingValue>
            <ns2:units>Wh</ns2:units>
            <ns2:value>36429853</ns2:value>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>netKWh</ns2:fieldName>
            <ns2:timeStamp>2011-11-01T19:00:00.000Z</ns2:timeStamp>
            <ns2:readingStatusCode codeCategory="0"
                codeIndex="0" originatingSystemID="2"/>
            <ns2:readingTypeCode UOMCategory="0.12"
                accumulationBehavior="1" dataQualifier="0"
                displayableUOM="72" flowDirection="4"
                measurementCategory="0.0"
                name="BulkQuantity Net Energy (Wh)"
                phaseIndex="0" timeAttribute="0"
                unitsMultiplier="0">0.0.1.4.0.12.0.0.0.0.72</ns2:readingTypeCode>
          </ns2:readingValue>
          <ns2:readingValue>
            <ns2:units>kWh</ns2:units>
            <ns2:value>442.274</ns2:value>
            <ns2:ratePeriod>0</ns2:ratePeriod>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>posKWh</ns2:fieldName>
            <ns2:timeStamp>2010-11-08T02:23:20.000-05:00</ns2:timeStamp>
            <ns2:readingTypeCode UOMCategory="0.12"
                accumulationBehavior="9" dataQualifier="0"
                displayableUOM="72" flowDirection="1"
                measurementCategory="0.0"
                name="Summation Forward Energy (KWh)"
                phaseIndex="0" timeAttribute="0"
                unitsMultiplier="3">0.0.9.1.0.12.0.0.0.3.72</ns2:readingTypeCode>
          </ns2:readingValue>
          <ns2:readingValue>
            <ns2:units>kW</ns2:units>
            <ns2:value>0.176</ns2:value>
            <ns2:ratePeriod>0</ns2:ratePeriod>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>maxDemand</ns2:fieldName>
            <ns2:timeStamp>2010-11-08T02:23:20.000-05:00</ns2:timeStamp>
            <ns2:readingTypeCode UOMCategory="0.8"
                accumulationBehavior="6" dataQualifier="8"
                displayableUOM="38" flowDirection="1"
                measurementCategory="0.0"
                name="Billing Maximum Indicating Forward Demand (KW)"
                phaseIndex="0" timeAttribute="8"
                unitsMultiplier="3">8.8.6.1.0.8.0.0.0.3.38</ns2:readingTypeCode>
```

```
            </ns2:readingValue>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>12.026</ns2:value>
              <ns2:ratePeriod>0</ns2:ratePeriod>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>negKWh</ns2:fieldName>
              <ns2:timeStamp>2010-11-08T02:23:20.000-05:00</ns2:timeStamp>
              <ns2:readingTypeCode UOMCategory="0.12"
                  accumulationBehavior="9" dataQualifier="0"
                  displayableUOM="72" flowDirection="19"
                  measurementCategory="0.0"
                  name="Summation Reverse Energy (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.9.19.0.12.0.0.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>228.0</ns2:value>
              <ns2:ratePeriod>1</ns2:ratePeriod>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>tou1PosKWh</ns2:fieldName>
              <ns2:timeStamp>2010-11-08T02:23:20.000-05:00</ns2:timeStamp>
              <ns2:readingTypeCode UOMCategory="0.12"
                  accumulationBehavior="9" dataQualifier="0"
                  displayableUOM="72" flowDirection="1"
                  measurementCategory="3.1"
                  name="Summation Forward Energy TouRateA (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.9.1.0.12.3.1.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
            <ns2:readingValue>
              <ns2:units>kW</ns2:units>
              <ns2:value>0.176</ns2:value>
              <ns2:ratePeriod>1</ns2:ratePeriod>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>tou1MaxDemand</ns2:fieldName>
              <ns2:timeStamp>2010-11-08T02:23:20.000-05:00</ns2:timeStamp>
              <ns2:readingTypeCode UOMCategory="0.8"
                  accumulationBehavior="6" dataQualifier="8"
                  displayableUOM="38" flowDirection="1"
                  measurementCategory="3.1"
                  name="Billing Maximum Indicating Forward Demand TouRateA (KW)"
                  phaseIndex="0" timeAttribute="8"
                  unitsMultiplier="3">8.8.6.1.0.8.3.1.0.3.38</ns2:readingTypeCode>
            </ns2:readingValue>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>148.294</ns2:value>
              <ns2:ratePeriod>2</ns2:ratePeriod>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>tou2PosKWh</ns2:fieldName>
              <ns2:timeStamp>2010-11-08T02:23:20.000-05:00</ns2:timeStamp>
              <ns2:readingTypeCode UOMCategory="0.12"
                  accumulationBehavior="9" dataQualifier="0"
                  displayableUOM="72" flowDirection="1"
                  measurementCategory="3.2"
                  name="Summation Forward Energy TouRateB (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.9.1.0.12.3.2.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
          </ns2:readingValues>
        </ns2:GetLatestReadingByMeterIDResult>
      </ns2:GetLatestReadingByMeterIDResponse>
    </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.19.2.3 Sample response with error message

```
<SOAP-ENV:Envelope
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
        AppVersion="4.3.0-SNAPSHOT" Branch="0" Build="1" BuildString="Release"
        Company="Sensus" MajorVersion="4" MinorVersion="1" SessionID=""
        xmlns="http://www.multispeak.org/Version_4.1_Release" />
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:GetLatestReadingByMeterIDResponse>
      <ns2:GetLatestReadingByMeterIDResult errorString="Device not found">
        <ns2:meterID meterNo="99999" objectID="99999"
            serviceType="Electric" utility="ACME" />
      </ns2:GetLatestReadingByMeterIDResult>
    </ns2:GetLatestReadingByMeterIDResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.19.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterID	The meter of interest.
	meterID@serviceType*	The service type for the meter.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.1.19.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	**meterID@meterNo***	Meter number of the meter whose reading is being returned.
	meterID@serviceType*	The service type for the meter.
	meterID@utility*	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	errorString	This is set if the requested meter reading could not be retrieved.
	deviceId	The FlexNet ID (Radio endpoint ID).
	readingValues	Series of meter readings.
	readingValue/fieldName*	Name for the quantity from the MultiSpeak Formatted Block implementation guidelines e.g., maxDemand.

	Attribute/Element	Usage
	readingValue/units*	Units of measure (e.g., kW).
	readingValue/value*	Numeric value of the measured quantity.
	readingValue/timestamp*	Time of measurement. This may be normalized to a time boundary.
	readingValue/measurementPeriod	Fixed value of Current since this is the latest read.
	readingValue/readingType	This is one of Billing for electric meters, Gas Usage for gas meters and Water usage for water meters.
	readingValue/ratePeriod	Only used for and always present for TOU readings. This corresponds to the tier number whose quantities are being reported (e.g., 0, 1, 2, 3, 4). Tier 0 is a special value that indicates the sum of all the other tiers.
	readingValue/readingStatusCode	Describes the quality of the meter reading using IEC 61968-9 Annex D (Quality code enumerations).
	readingStatusCode@originatingSystemID	The value will always be 2 (metering system network) to indicate that this data is from the RNI store.
	readingStatusCode@codeCategory	Subset of values from IEC 61968-9 Annex D.
	readingStatusCode@codeIndex	Subset of values from IEC 61968-9 Annex D.
	readingValue/readingTypeCode	Describes the quality of the meter reading using IEC 61968-9 Annex C (Reading code enumerations).
	readingTypeCode@UOMCategory	Subset of values from IEC 61968-9 Table C.5.
	readingTypeCode@accumulationBehavior	Subset of values from IEC 61968-9 Table C.3.
	readingTypeCode@dataQualifier	Subset of values from IEC 61968-9 Table C.2.
	readingTypeCode@displayableUOM	Subset of values from IEC 61968-9 Table C.10.
	readingTypeCode@flowDirection	Subset of values from IEC 61968-9 Table C.4.
	readingTypeCode@measurementCategory	Subset of values from IEC 61968-9 Table C.7.
	readingTypeCode@name	Displayable name of the reading type code derived from its constituent parts.
	readingTypeCode@phaseIndex	Subset of values from IEC 61968-9 Table C.8.
	readingTypeCode@timeAttribute	Subset of values from IEC 61968-9 Table C.1.
	readingTypeCode@unitsMultiplier	Subset of values from IEC 61968-9 Table C.9.

2.1.19.4.1 Reading type codes

The following table contains the currently supported reading types. The readingTypeCode in this table is only a representative value because it is a multi-part value and some of its constituent parts can have multiple possible values for the same reading type (e.g., energy consumption can be in Wh, KWh etc.).

Description	fieldName	Units	Representative readingTypeCode
Forward energy register reading	posKWh	Wh	0.0.1.1.0.12.0.0.0.0.72 BulkQuantity Forward Energy (Wh)
Reverse energy register reading	negKWh	Wh	0.0.1.19.0.12.0.0.0.0.72 BulkQuantity Reverse Energy (Wh)
Peak demand over a demand window	maxDemand	kW	8.8.6.1.0.8.0.0.0.3.38 Billing Maximum Indicating Forward Demand (kW)
Peak demand over a demand window for apparent power	maxDemand	kVA	8.8.6.1.0.8.0.0.0.3.61 Billing Maximum Indicating Forward Demand (kVA)

Description	fieldName	Units	Representative readingTypeCode
Reverse peak demand over a demand window	negMaxDemand	kW	8.8.6.19.0.8.0.0.0.3.38 Billing Maximum Indicating Reverse Demand (kW)
Reverse peak demand over a demand window for apparent power	negMaxDemand	kVA	8.8.6.19.0.8.0.0.0.3.61 Billing Maximum Indicating Reverse Demand (kVA)
Simple NET (F-R) register reading	netKWh	kWh	0.0.1.4.0.12.0.0.0.3.72 BulkQuantity Net Energy(KWh)
Reverse energy detection (F+R) register reading	totalKWh	kWh	0.0.1.20.0.12.0.0.0.3.72 BulkQuantity Total Energy(KWh) -
Forward energy register reading for apparent power	posKVAh	VAh	0.0.1.1.0.12.0.0.0.0.71 BulkQuantity Forward Energy (VAh)
Reverse energy register reading for apparent power	negKVAh	VAh	0.0.1.19.0.12.0.0.0.0.71 BulkQuantity Reverse Energy (VAh)
Simple NET (F-R) register reading for apparent power	netKVAh	kVAh	0.0.1.4.0.12.0.0.0.3.71 BulkQuantity Net Energy(KVAh)
Reverse energy detection (F+R) register reading for apparent power	totalKVAh	kVAh	0.0.1.20.0.12.0.0.0.3.71 BulkQuantity Total Energy(KVAh)
Reactive energy register reading	posKVARh	VARh	0.0.1.1.0.12.0.0.0.0.73 BulkQuantity Forward Energy (VARh)
Reverse reactive energy register reading	negKVARh	VARh	0.0.1.19.0.12.0.0.0.0.73 BulkQuantity Reverse Energy (VARh)
Simple NET (F-R) register reading for reactive power	netKVARh	kVARh	0.0.1.4.0.12.0.0.0.3.73 BulkQuantity Net Energy(KVARh)
Reverse energy detection (F+R) register reading for reactive power	totalKVARh	kVARh	0.0.1.20.0.12.0.0.0.3.73 BulkQuantity Total Energy(KVARh)
Corrected gas consumption	corrGasVol	cubic feet	0.3.1.1.0.61.0.0.0.0.119 Compensated BulkQuantity Forward NaturalGas (Ft3)
Uncorrected gas consumption	uncorrGasVol	cubic feet	0.20.1.1.0.61.0.0.0.0.119 Uncompensated BulkQuantity Forward NaturalGas (Ft3)
Water consumption	waterVol	US gl	0.0.1.1.0.63.0.0.0.0.122 BulkQuantity Forward Water (US gallons)
Gas consumption	gasVol	US gl	0.0.1.1.0.61.0.0.0.0.122 BulkQuantity Forward NaturalGas (US gallons)
Gas consumption	gasVol	liters	0.0.1.1.0.61.0.0.0.0.X5 BulkQuantity Forward NaturalGas (liters) X5 is a placeholder as IEC 61968-9 does not define liters
Forward energy for Tier 2	tou2PosKWh	kWh	0.0.9.1.0.12.3.2.0.3.72 Summation Forward Energy TouRateB (KWh)
Reverse energy for Tier 2	tou2NegKWh	kWh	0.0.9.19.0.12.3.2.0.3.72 Summation Reverse Energy TouRateB (KWh)
Peak demand for Tier 2	tou2MaxDemand	kW	0.8.6.0.0.8.3.2.0.3.38 Maximum Indicating Demand TouRateB (KW)
Simple NET for Tier 2	tou2netKWh	kWh	0.0.9.4.0.12.3.2.0.3.72 Summation Net Energy TouRateB (KWh)

Description	fieldName	Units	Representative readingTypeCode
Reverse energy detection for Tier 2	tou2totalKWh	kWh	0.0.9.20.0.12.3.2.0.3.72 Summation Net Energy TouRateB (KWh)
Max demand timestamp for Tier 1	tou1MaxDemandDateTime		8.8.6.1.0.8.3.1.0.0.108 Billing Maximum Indicating Forward Demand TouRateA (timeStamp)
Demand reset counter	demandReset Counter	Nbr of demand resets	0.0.1.0.2.4.0.0.0.0.111 BulkQuantity DemandReset (Count)
Battery consumption	batteryConsumption	mAh	0.0.1.0.0.0.0.0.0.253.106 BulkQuantity (mAh)
Temperature	temperature	F	0.0.6.0.0.46.0.0.0.0.X2 Indicating Temperature (degree F)
Temperature	temperature	C	0.0.6.0.0.46.0.0.0.0.23 Indicating Temperature (degree C)
Pressure	pressure	Static pound per square inch	0.0.6.0.0.0.0.0.0.0.X9 Indicating (psi)
Pressure	pressure	Bar	0.0.6.0.0.0.0.0.0.0.X8 Indicating (Bar)
Absolute pressure	pressure	BarA	0.0.6.0.0.0.0.0.0.0.X12 Indicating (bara)
Chlorophyll	chlorophyll	microgram per liter	0.0.6.0.0.0.0.0.0.0.X23 Indicating (ug/L)
Chlorophyll	chlorophyll	Relative Fluorescence Unit	0.0.6.0.0.0.0.0.0.0.X21 Indicating (RFU)
Dissolved oxygen	dissolvedOxygen	milligram per liter	0.0.6.0.0.0.0.0.0.0.X24 Indicating (mg/L)
Hydrogen sulfide	hydrogenSulphide	PPM	0.0.6.0.0.0.0.0.0.0.52 Indicating (PPM)
Weight	weight	kg	0.0.6.0.0.0.0.0.0.0.X19 Indicating (kg)
Weight	weight	lb	0.0.6.0.0.0.0.0.0.0.X18 Indicating (lb)
Other instrumentation	other	not applicable	0.0.6.0.0.0.0.0.0.0.0 Indicating ()
Turbidity	tubidity	NTU	0.0.6.0.0.0.0.0.0.0.X25 Indicating (NTU)
Level	level	ft	0.0.6.0.0.0.0.0.0.0.X28 Indicating (ft)
Level	level	inches	0.0.6.0.0.0.0.0.0.0.X14 Indicating (inches)
Level	level	cm	0.0.6.0.0.0.0.0.0.0.X17 Indicating (cm)
Level	level	yd	0.0.6.0.0.0.0.0.0.0.X26 Indicating (yd)
Free chlorine	freeChlorine	milligram per liter	0.0.6.0.0.0.0.0.0.0.X24 Indicating (mg/L)
Total chlorine	totalChlorine	milligram per liter	0.0.6.0.0.0.0.0.0.0.X24 Indicating (mg/L)
pH factor	pHFactor	SU	0.0.6.0.0.0.0.0.0.0.X15 Indicating (SU)
Conductivity	conductivity	millisiemens per centimeter	0.0.6.0.0.0.0.0.0.0.X20 Indicating (mS/L)
Blue green algae	blueGreenAlgae	cells per milliliter	0.0.6.0.0.0.0.0.0.0.X22 Indicating (cells/mL)

Description	fieldName	Units	Representative readingTypeCode
Blue green algae	blueGreenAlgae	Relative Fluorescence Unit	0.0.6.0.0.0.0.0.0.X21 Indicating (RFU)
Total harmonic distortion-voltage	totalHarmonicDistortionVoltage	T.H.D. Voltage	0.0.6.0.0.47.0.0.0.0.X29 Indicating TotalHarmonicDistortion (VTHD)
Total harmonic distortion-current	totalHarmonicDistortionCurrent	T.H.D. Current	0.0.6.0.0.47.0.0.0.0.X30 Indicating TotalHarmonicDistortion (ITHD)
Total demand distortion	totalDemandDistortion	T.D.D	0.0.6.0.0.0.0.0.0.0.X31 Indicating (TDD)

Notes:

- For TOU readings, the `fieldName` and `readingTypeCode` depends on the tier being reported.
- The values in blue are used because the source documents did not have appropriate constants.

2.1.19.4.2 Reading status codes

The following table contains the currently supported readingStatusCode values.

Description	Quality Code	
No errors	2.0.0	
Data outside expected range	2.5.256	Quarantined read flagged by the RNI.
Known missing read	2.5.259	
Numeric overflow	1.4.1	
Partial interval	1.4.2	
Long interval	1.4.3	
Skipped interval	1.4.4	
Test mode data	1.4.5	
Configuration changed	1.4.6	
Recording stopped	1.4.7	
Invalid interval	1.5.257	
Power fail (common status)	1.2.32	
Time adjusted (common status)	1.4.64	We have used the enumeration for ClockSetForward even though the RNI does not know the direction of time adjustment (lead v/s lag).
Clock set forward (common status)	1.4.64	See notes for time-adjusted status.
Clock set backward (common status)	1.4.128	ESM capability.

2.1.19.5 Error messages

This response message definition does not contain error objects. Therefore, business errors are reported through the `errorString` attribute on `GetLatestReadingByMeterIDResult`.

	Error	Reasons
BUSINESS ERRORS	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Unsupported serviceType	The `serviceType` value is not supported by the RNI. The currently supported service types are `Electric`, `Gas`, and `Water`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
SYSTEM ERRORS	*Common security errors*	

2.1.19.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.ForceTOU (Customer configuration)	Boolean property to determine whether to force including the tier reads for a meter or let the rate code determine if they are returned. If `True`, then tier reads are included regardless of the rate code (assuming the meter is reporting tier reads). If `False`, then tier reads are only included if an appropriate TOU rate code has been assigned in the RNI for this meter. Default is `True`.
	MeterReading.IncludeDemandReset (Customer configuration)	Boolean property to determine whether to include the demand reset count readings in the result. Default is `False`.
FILE	toudata.includeTouData (System configuration)	System-wide switch for TOU data reporting through the MultiSpeak gateway. It is unlikely that this will ever be false in a production setting. Default is `True`.

2.1.20 GetReadingsByMeterID

This method gets meter readings from the RNI for a specified meter and date range.

This method obtains the register end readings, as well as TOU readings, if the meter is set up to report TOU read data to the RNI. For each day in the requested range, only the end-of-day complete set of tier readings is returned.

2.1.20.1 Sample request

Following is a sample request to get readings for the two hours between 4 pm and 6 pm on 4/5/2012.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetReadingsByMeterID>
      <ver:meterID meterNo="1001M" serviceType="Electric"
                   utility="ACME">ACME.Electric.1001M</ver:meterID>
      <ver:startDate>2012-04-05T16:00:00.000-04:00</ver:startDate>
      <ver:endDate>2012-04-05T18:00:00.000-04:00</ver:endDate>
    </ver:GetReadingsByMeterID>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.20.2 Sample response

Following is a sample response for the sample request.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ns2:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:GetReadingsByMeterIDResponse>
      <ns2:GetReadingsByMeterIDResult>
        <!-- The set of meterReading elements, usually one per meter but there
             could be more than one per meter -->
        <ns2:meterReading>
          <ns2:meterID meterNo="1001M" serviceType="Electric" utility="ACME"/>
          <ns2:deviceID>1001</ns2:deviceID>
          <!-- A set of reading values -->
          <ns2:readingValues>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>3057</ns2:value>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>posKWh</ns2:fieldName>
              <ns2:timeStamp>2012-04-05T20:30:00.000Z</ns2:timeStamp>
              <ns2:readingStatusCode
                  codeCategory="0" codeIndex="0" originatingSystemID="2"/>
              <ns2:readingTypeCode UOMCategory="0.12" accumulationBehavior="1"
                  dataQualifier="0" displayableUOM="72" flowDirection="1"
                  measurementCategory="0.0"
                  name="BulkQuantity Forward Energy (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.1.1.0.12.0.0.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
```

```
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>3225</ns2:value>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>posKWh</ns2:fieldName>
              <ns2:timeStamp>2012-04-05T21:30:00.000Z</ns2:timeStamp>
              <ns2:readingStatusCode
                  codeCategory="0" codeIndex="0" originatingSystemID="2"/>
              <ns2:readingTypeCode UOMCategory="0.12" accumulationBehavior="1"
                  dataQualifier="0" displayableUOM="72" flowDirection="1"
                  measurementCategory="0.0"
                  name="BulkQuantity Forward Energy (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.1.1.0.12.0.0.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
          </ns2:readingValues>
        </ns2:meterReading>
      </ns2:GetReadingsByMeterIDResult>
    </ns2:GetReadingsByMeterIDResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.20.3 Sample response showing demand reset counter

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ns2:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:GetReadingsByMeterIDResponse>
      <ns2:GetReadingsByMeterIDResult>
        <!-- The set of meterReading elements, usually one per meter but there
             could be more than one per meter -->
        <ns2:meterReading>
          <ns2:meterID meterNo="1001M" serviceType="Electric" utility="ACME"/>
          <ns2:deviceID>1001</ns2:deviceID>
          <!-- A set of reading values -->
          <ns2:readingValues>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>3057</ns2:value>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>posKWh</ns2:fieldName>
              <ns2:timeStamp>2012-04-05T20:30:00.000Z</ns2:timeStamp>
              <ns2:readingStatusCode
                  codeCategory="0" codeIndex="0" originatingSystemID="2"/>
              <ns2:readingTypeCode UOMCategory="0.12" accumulationBehavior="1"
                  dataQualifier="0" displayableUOM="72" flowDirection="1"
                  measurementCategory="0.0"
                  name="BulkQuantity Forward Energy (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.1.1.0.12.0.0.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>3225</ns2:value>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>posKWh</ns2:fieldName>
              <ns2:timeStamp>2012-04-05T21:30:00.000Z</ns2:timeStamp>
              <ns2:readingStatusCode
                  codeCategory="0" codeIndex="0" originatingSystemID="2"/>
              <ns2:readingTypeCode UOMCategory="0.12" accumulationBehavior="1"
                  dataQualifier="0" displayableUOM="72" flowDirection="1"
                  measurementCategory="0.0"
                  name="BulkQuantity Forward Energy (KWh)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.1.1.0.12.0.0.0.3.72</ns2:readingTypeCode>
            </ns2:readingValue>
```

```
            <ns2:readingValue>
              <ns2:units>Nbr of demand resets</ns2:units>
              <ns2:value>151</ns2:value>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>demandResetCounter</ns2:fieldName>
              <ns2:timeStamp>2012-04-05T21:30:00.000Z</ns2:timeStamp>
              <ns2:readingStatusCode
                  codeCategory="0" codeIndex="0" originatingSystemID="2"/>
              <ns2:readingTypeCode UOMCategory="2.4" accumulationBehavior="1"
                  dataQualifier="0" displayableUOM="111" flowDirection="0"
                  measurementCategory="0.0"
                  name=" BulkQuantity DemandReset (Count)"
                  phaseIndex="0" timeAttribute="0"
                  unitsMultiplier="3">0.0.1.0.2.4.0.0.0.0.111</ns2:readingTypeCode>
            </ns2:readingValue>
          </ns2:readingValues>
        </ns2:meterReading>
      </ns2:GetReadingsByMeterIDResult>
    </ns2:GetReadingsByMeterIDResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.20.4 Sample response showing TOU reads

Following is a sample response showing a meter configured with TOU tiers. This sample only shows the total (cumulative) readings and one tier, for brevity. An actual response may also include an additional *meterReading* element with the cumulative readings and additional measured quantities.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
    Branch="0" Build="6"
    BuildString="Release" Company="Sensus" MajorVersion="4" MinorVersion="1"
    SessionID="12345678" xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:GetReadingsByMeterIDResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:GetReadingsByMeterIDResult>
        <ns2:meterReading>
          <ns2:meterID meterNo="1N6028953748" objectID="1N6028953748" serviceType="Electric"
utility="ACME"/>
          <ns2:deviceID>46803574</ns2:deviceID>
          <ns2:readingValues>
            <ns2:readingValue>
              <ns2:units>kW</ns2:units>
              <ns2:value>0.828</ns2:value>
              <ns2:ratePeriod>0</ns2:ratePeriod>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>maxDemand</ns2:fieldName>
              <ns2:timeStamp>2013-07-29T08:42:25.000Z</ns2:timeStamp>
              <ns2:readingTypeCode UOMCategory="0.8"
              accumulationBehavior="6" dataQualifier="8"
              displayableUOM="38" flowDirection="1" measurementCategory="3.0"
              name="Billing Maximum Indicating Forward Demand TouTotal(KW)"
              phaseIndex="0" timeAttribute="8"
              unitsMultiplier="3">8.8.6.1.0.8.3.0.0.3.38</ns2:readingTypeCode>
            </ns2:readingValue>
            <ns2:readingValue>
              <ns2:units>kWh</ns2:units>
              <ns2:value>12.201</ns2:value>
              <ns2:ratePeriod>0</ns2:ratePeriod>
              <ns2:readingType>Billing</ns2:readingType>
              <ns2:fieldName>negKWh</ns2:fieldName>
              <ns2:timeStamp>2013-07-29T08:42:25.000Z</ns2:timeStamp>
              <ns2:readingTypeCode UOMCategory="0.12"
```

```
            accumulationBehavior="9" dataQualifier="0"
            displayableUOM="72" flowDirection="19" measurementCategory="3.0"
            name="Summation Reverse Energy TouTotal(KWh)"
            phaseIndex="0" timeAttribute="0"
            unitsMultiplier="3">0.0.9.19.0.12.3.0.0.3.72</ns2:readingTypeCode>
          </ns2:readingValue>
          <ns2:readingValue>
            <ns2:units>kWh</ns2:units>
            <ns2:value>1807.798</ns2:value>
            <ns2:ratePeriod>0</ns2:ratePeriod>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>posKWh</ns2:fieldName>
            <ns2:timeStamp>2013-07-29T08:42:25.000Z</ns2:timeStamp>
            <ns2:readingTypeCode UOMCategory="0.12"
            accumulationBehavior="9" dataQualifier="0"
            displayableUOM="72" flowDirection="1" measurementCategory="3.0"
            name="Summation Forward Energy TouTotal(KWh)"
            phaseIndex="0" timeAttribute="0"
            unitsMultiplier="3">0.0.9.1.0.12.3.0.0.3.72</ns2:readingTypeCode>
          </ns2:readingValue>
          <ns2:readingValue>
            <ns2:units>kW</ns2:units>
            <ns2:value>0.000</ns2:value>
            <ns2:ratePeriod>1</ns2:ratePeriod>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>tou1MaxDemand</ns2:fieldName>
            <ns2:timeStamp>2013-07-29T08:42:25.000Z</ns2:timeStamp>
            <ns2:readingTypeCode UOMCategory="0.8"
            accumulationBehavior="6" dataQualifier="8"
            displayableUOM="38" flowDirection="1" measurementCategory="3.1"
            name="Billing Maximum Indicating Forward Demand TouRateA (KW)"
            phaseIndex="0" timeAttribute="8"
            unitsMultiplier="3">8.8.6.1.0.8.3.1.0.3.38</ns2:readingTypeCode>
          </ns2:readingValue>
          <ns2:readingValue>
            <ns2:units>kWh</ns2:units>
            <ns2:value>12.201</ns2:value>
            <ns2:ratePeriod>1</ns2:ratePeriod>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>tou1NegKWh</ns2:fieldName>
            <ns2:timeStamp>2013-07-29T08:42:25.000Z</ns2:timeStamp>
            <ns2:readingTypeCode UOMCategory="0.12"
            accumulationBehavior="9" dataQualifier="0"
            displayableUOM="72" flowDirection="19" measurementCategory="3.1"
            name="Summation Reverse Energy TouRateA (KWh)"
            phaseIndex="0" timeAttribute="0"
            unitsMultiplier="3">0.0.9.19.0.12.3.1.0.3.72</ns2:readingTypeCode>
          </ns2:readingValue>
          <ns2:readingValue>
            <ns2:units>kWh</ns2:units>
            <ns2:value>898.012</ns2:value>
            <ns2:ratePeriod>1</ns2:ratePeriod>
            <ns2:readingType>Billing</ns2:readingType>
            <ns2:fieldName>tou1PosKWh</ns2:fieldName>
            <ns2:timeStamp>2013-07-29T08:42:25.000Z</ns2:timeStamp>
            <ns2:readingTypeCode UOMCategory="0.12"
            accumulationBehavior="9" dataQualifier="0"
            displayableUOM="72" flowDirection="1" measurementCategory="3.1"
            name="Summation Forward Energy TouRateA (KWh)"
            phaseIndex="0" timeAttribute="0"
            unitsMultiplier="3">0.0.9.1.0.12.3.1.0.3.72</ns2:readingTypeCode>
          </ns2:readingValue>
          …… [Additional readingValue elements for other rate tiers]
        </ns2:readingValues>
      </ns2:meterReading>
    </ns2:GetReadingsByMeterIDResult>
  </ns2:GetReadingsByMeterIDResponse>
 </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.20.5 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterID	The meter whose readings are being requested.
	meterID@serviceType*	The service type for the meter.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	startDate*	The starting timestamp for the range of readings.
	endDate*	The ending timestamp for the range of readings. If the endDate is in the future then it returns reads until the present time.

2.1.20.6 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	**meterID@meterNo***	Meter number of the meter whose reading is being returned.
	meterID@serviceType*	The service type for the meter.
	meterID@utility*	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	errorString	This is set if the requested meter reading could not be retrieved.
	deviceId	The FlexNet ID (Radio endpoint ID).
	readingValues	Series of meter readings.
	readingValue/fieldName*	Name for the quantity from the MultiSpeak Formatted Block implementation guidelines (e.g., maxDemand).
	readingValue/units*	Units of measure (e.g., kW).
	readingValue/value*	Numeric value of the measured quantity.
	readingValue/timestamp*	Time of measurement. This may be normalized to a time boundary.
	readingValue/readingType	This is one of Billing for electric meters, Gas Usage for gas meters, and Water usage for water meters.
	readingValue/ratePeriod	Only used for and always present for TOU readings. This corresponds to the tier number whose quantities are being reported (e.g., 0, 1, 2, 3, 4). Tier 0 is a special value that indicates the sum of all the other tiers.

	Attribute/Element	Usage
	readingValue/readingStatusCode	Describes the quality of the meter reading using IEC 61968-9 Annex D (quality code enumerations).
	readingStatusCode@originatingSystemID	The value will always be 2 (metering system network) to indicate that this data is from the RNI store.
	readingStatusCode@codeCategory	Subset of values from IEC 61968-9 Annex D.
	readingStatusCode@codeIndex	Subset of values from IEC 61968-9 Annex D.
	readingValue/readingTypeCode	Describes the quality of the meter reading using IEC 61968-9 Annex C (reading code enumerations).
	readingTypeCode@UOMCategory	Subset of values from IEC 61968-9 Table C.5.
	readingTypeCode@accumulationBehavior	Subset of values from IEC 61968-9 Table C.3.
	readingTypeCode@dataQualifier	Subset of values from IEC 61968-9 Table C.2.
	readingTypeCode@displayableUOM	Subset of values from IEC 61968-9 Table C.10.
	readingTypeCode@flowDirection	Subset of values from IEC 61968-9 Table C.4.
	readingTypeCode@measurementCategory	Subset of values from IEC 61968-9 Table C.7.
	readingTypeCode@name	Displayable name of the reading type code derived from its constituent parts.
	readingTypeCode@phaseIndex	Subset of values from IEC 61968-9 Table C.8.
	readingTypeCode@timeAttribute	Subset of values from IEC 61968-9 Table C.1.
	readingTypeCode@unitsMultiplier	Subset of values from IEC 61968-9 Table C.9.

2.1.20.6.1 Reading type codes

The supported `readingTypeCode` values are further described in section 2.1.19.4.1.

2.1.20.6.2 Reading status codes

The supported `readingStatusCode` values are defined in section 2.1.19.4.2

2.1.20.7 Error messages

This response message definition does not contain `errorObject` or `errorString` elements. Therefore, business errors are reported through a SOAP Fault. The error text shown in the following table will be in the `faultString`.

	Error	Reasons
BUSINESS ERRORS	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request or a value that is not one of the MultiSpeak defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Unsupported serviceType	The `serviceType` value is not supported by the RNI. The currently supported service types are `Electric`, `Gas`, and `Water`.
	A valid startDate needs to be provided	The startDate element is not specified or the value provided is not an XML dateTime compliant format.
	A valid endDate needs to be provided	The endDate element is not specified or the value provided is not an XML dateTime compliant format.

	Error	Reasons
	The supplied endDate needs to be later than the startDate	The endDate value is before the startDate value.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
SYSTEM ERRORS	*Common security errors*	

2.1.20.8 Configuration properties

	Property name	Usage
DATA BASE	MeterReading.IncludeDemandReset	Boolean property to determine whether to include the demand reset count readings in the result. Default is False.

2.1.21 GetReadingsByMeterIDAndFieldNameIntervalData

This method gets interval readings, including derived interval data, from the RNI for a specified meter and date range. Specific *channels* can also be optionally requested by setting the `fieldName` in the request.

2.1.21.1 Sample request

Following is a request to get all the forward kWh interval readings from 4:00 to 5:00 am. Note that the `posKWh` field name does *not* imply a multiplier, so the returned readings may be in Wh.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetReadingsByMeterIDAndFieldNameIntervalData>
      <ver:meterID meterNo="1001M" serviceType="Electric"
         objectID="1001M" utility="ACME">ACME.Electric.1001M</ver:meterID>
      <ver:endDate>2011-07-07T05:00:00.000-04:00</ver:endDate>
      <ver:startDate>2011-07-07T04:00:00.000-04:00</ver:startDate>
      <ver:fieldName>
        <ver:string>posKWh</ver:string>
      </ver:fieldName>
    </ver:GetReadingsByMeterIDAndFieldNameIntervalData>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.21.2 Sample response

Following is the response to the sample request. It contains the four 15-minute intervals going back from 5:00 am.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version 4.1 Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"
        LastSent="1366906501000"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetReadingsByMeterIDAndFieldNameIntervalDataResponse>
      <ver:GetReadingsByMeterIDAndFieldNameIntervalDataResult>
        <ver:intervalData>
          <ver:profiles>
            <!-- Profiles of data contained in the blocks below -->
            <ver:profile profileID="ELECTRIC_15MIN_CONSUMPTION">
              <ver:name>15 minute consumption for electric</ver:name>
              <ver:intervalLength units="Minutes">15</ver:intervalLength>
              <ver:channels>
                <ver:channel>
                  <ver:index>0</ver:index>
                  <ver:fieldName>posKWh</ver:fieldName>
                  <ver:units>Wh</ver:units>
                </ver:channel>
              </ver:channels>
            </ver:profile>
          </ver:profiles>
          <!-- The reading data blocks, usually one per meter but there
               could be more than one block per meter -->
          <ver:blocks>
            <ver:block>
              <ver:profileID>ELECTRIC_15MIN_CONSUMPTION</ver:profileID>
              <ver:meterID meterNo="1001M" serviceType="Electric"
                   objectID="1001M" utility="ACME" />
              <ver:endReadingList>
                <ver:endReading>
                  <ver:channelIndex>0</ver:channelIndex>
                  <ver:reading>1050</ver:reading>
                  <ver:readingDate>2011-07-07T05:00:00.000-04:00</ver:readingDate>
                </ver:endReading>
              </ver:endReadingList>
              <ver:logTime>2011-07-07T05:02:00.000-04:00</ver:logTime>
              <ver:intervalStart>2011-07-07T05:00:00.000-04:00</ver:intervalStart>
              <!-- Four intervals of data, each w/ status and delta -->
              <ver:dB>
                <ver:chs>
                  <ver:ch>
                    <ver:idx>0</ver:idx>
                    <!-- 1st interval has a status
                         2nd interval has 2 statuses and
                         3rd and 4th intervals have no status
                                                  -->
                    <ver:d>50,1;23,1,2;15;40</ver:d>
                  </ver:ch>
                </ver:chs>
                <!-- One common status per interval. -->
                <ver:cS>0,0,,3</ver:cS>
              </ver:dB>
            </ver:block>
          </ver:blocks>
        </ver:intervalData>
      </ver:GetReadingsByMeterIDAndFieldNameIntervalDataResult>
    </ver:GetReadingsByMeterIDAndFieldNameIntervalDataResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.21.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterID	The meter whose readings are being requested.
	meterID@serviceType*	The service type for the meter.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	startDate*	The starting timestamp for the range of readings.
	endDate*	The ending timestamp for the range of readings. If the endDate is in the future then it returns reads until the present time.
	lastReceived	A marker indicating which page to retrieve. This is the value from the `LastSent` attribute from the previous response. Omit this element for the initial request.
	fieldName	Identifies the channels of data being requested. This may contain one or more of the supported MultiSpeak field names. If absent then all the channels that the RNI has interval data for will be returned.
	fieldName/string	One of the supported fieldName values from section 2.1.21.3.1.

2.1.21.3.1 Supported field names

The purpose of `GetReadingsByMeterIDAndFieldNameIntervalData` is to get interval readings. The list of supported fieldNames for this method is limited to *those for which interval deltas are supported* in the FlexNet system.

fieldName	Description
avgVoltage	Average Voltage
maxVoltage	Maximum Voltage
minVoltage	Minimum Voltage
posKWh	Forward energy register reading
negKWh	Reverse energy register reading
netKWh	Simple NET (F-R) register reading
totalKWh	Reverse Energy Detection (F+R) register reading
posKVAh	Forward energy register reading for apparent power
negKVAh	Reverse energy register reading for apparent power
netKVAh	Simple NET (F-R) register reading for apparent power
totalKVAh	Reverse Energy Detection (F+R) register reading for apparent power
posKVARh	Reactive energy register reading
negKVARh	Reverse Reactive energy register reading
netKVARh	Simple NET (F-R) register reading for reactive power
totalKVARh	Reverse Energy Detection (F+R) register reading for reactive power

fieldName	Description
corrGasVol	Corrected Gas consumption
uncorrGasVol	Uncorrected Gas consumption
waterVol	Water consumption
batteryConsumption	Battery charge consumption

Notes:

- The values in blue are used because the source document, *MultiSpeak Formatted Block Implementation guidelines*, did not have appropriate constants.

2.1.21.4 Response parameters

	Attribute/Element	Usage
HEADER	AppName	Web service client application name. This is only used for logging.
	AppVersion	Web service client application version. This is only used for logging.
	Company	Web service client application vendor. This is only used for logging.
	ObjectsRemaining	The remaining number of readings to fulfill this request. A value of zero indicates that there are no more readings remaining. A negative value indicates an unknown number of readings remaining.
	LastSent	A marker identifying the last element in this response. This should be used as the `lastReceived` value in the subsequent request to get the next page of data.
BODY	Same as `IntervalDataNotification` with the exception that `block/logTime` is not provided.	

2.1.21.4.1 Reading status codes

The supported `readingStatusCode` values are defined in section 2.1.19.4.2.

2.1.21.5 Error messages

This response message definition does not have `ErrorObjects`. Therefore, all errors are returned as SOAP Faults. The messages in the following table are in the `faultString` of the SOAP fault.

The absence of the conventional `ErrorObject` structure from this response also imposes some additional constraints on how errors are reported.

- Partial success cannot be reported. If there are any errors in the request then the result is a SOAP fault.
- Multiple error messages cannot be reported. If there are multiple errors in the request then the resulting SOAP fault will have the error message for the first error seen.

	Error	Reasons
BUSINESS ERRORS	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request or a value that is not one of the MultiSpeak defined serviceType(s) has been provided. This is required to uniquely identify the meter.

	Error	Reasons
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Unsupported serviceType	The `serviceType` value is not supported by the RNI. The currently supported service types are electric, gas, and water.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	A valid startDate needs to be provided	The startDate element is not specified or the value provided is not an XML dateTime compliant format.
	A valid endDate needs to be provided	The endDate element is not specified or the value provided is not an XML dateTime compliant format.
	The supplied endDate needs to be later than the startDate	The endDate value is before the startDate value.
	Unsupported fieldName	The value of the `fieldName` in the request is not supported for this method.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store or a meter in the request belongs to a customer ID that the user does not permissions to access.

2.1.21.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.GetIntervalData.Max ReadingsCount (Customer configuration)	Maximum of interval blocks returned for one request to get interval reads. A block is demarcated by a register reading from the meter hence the granularity of a block depends on the transmissions received from the meter. In general one block will contain multiple actual readings. Default is `2000`. **Note**: This count is prior to merging the blocks, if enabled (see `intervalData.mergeBlocks`).
FILE	intervalData.mergeBlocks (Customer configuration)	Boolean flag to toggle the merging of adjacent blocks in the response. Default is `False`.

2.1.22 GetReadingsByMeterIDListAndFieldNameIntervalDataExt

A variant of `GetReadingsByMeterIDAndFieldNameIntervalData` (see 2.1.20.2). The input may have a list of meters instead of just one.

*This is a **preview** implementation for a custom integration. This method should **not** be used for any other integrations.*

2.1.23 InitiateUsageMonitoring

This method notifies the RNI of meters where **zero usage** is expected (i.e., **move out**). The RNI will set the *logical* state for the meter record from Active to Inactive. This does not disable meter read collection or outage detection for this meter in the RNI.

2.1.23.1 Sample request

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateUsageMonitoring>
      <ver:meterIDs>
        <ver:meterID meterNo="15761M" serviceType="Electric"
        objectID="15761" utility="ACME"/>
        <ver:meterID meterNo="1002M" serviceType="Electric"
        objectID="1002" utility="ACME"/>
      </ver:meterIDs>
    </ver:InitiateUsageMonitoring>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.23.2 Sample response

Following is the response corresponding to the previous sample request. This shows that of the two meters in the request, the operation succeeded for one and failed for one. The failure was caused because the meter was not in the Active logical state.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
      Company="Sensus" SessionID="77"
      xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:InitiateUsageMonitoringResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:InitiateUsageMonitoringResult>
        <ns2:errorObject errorString="Invalid logical state"
        eventTime="2012-07-26T10:03:17.140-04:00" nounType="Meter" objectID="15761M"/>
      </ns2:InitiateUsageMonitoringResult>
    </ns2:InitiateUsageMonitoringResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.23.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request headers*	
BODY	meterIDs/	List of `meterID` elements corresponding to meters to be put in zero-usage monitoring.
	meterID@serviceType*	The service type for the meter.
	meterID@utility	Utility code for the meter (customerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.1.23.4 Response parameters

	Attribute or Element name	Usage
HEADER	*Common response headers*	
BODY	errorObject	Multiple elements, one per failed meter.
	errorObject.objectID*	The MeterID for the meter for which the operation failed.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	Meter.

2.1.23.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Invalid lifecycle state	The meter is not yet in the Install state. The `MeterAddNotification` can be used to notify the gateway that the meter has been installed.
	Invalid logical state	The meter has a logical state for which this operation is not supported. The most common reasons for this are the following: a) InitiateUsageMonitoring was previously invoked for this meter, but was never cancelled so the meter is already in the Inactive logical state. b) InitiateDisconnectedStatus was previously invoked for this meter, but was never cancelled so the meter is in the Disconnected logical state.
	Device not found	The specified meterID was not found in the RNI.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.

	Error	Reasons
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Duplicate entries found in database with same meter identity but different FlexNet Radio IDs.	The RNI has two meters discovered with the same meter identity, but different FlexNet ids. This makes any request based on the meter identity ambiguous. Correct this problem by removing the duplicate entry.
	Unsupported serviceType	The `serviceType` value is not supported by the RNI. The currently supported service types are electric, gas, and water.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store or a meter in the request belongs to a customer ID that the user does not permissions to access.

2.1.23.6 Configuration properties

	Property name	Usage
DATA BASE	DefaultCustomerID	The CustomerID for the utility that owns the meters in the RNI.
FILE	usagemonitoring.statechange.enforce	A flag to enforce the logical state transitions as described in 2.1.1.3 Meter Logical States. Default is `True`.

2.1.24 CancelUsageMonitoring

This method notifies the RNI of cancellation of zero usage monitoring (i.e., **move in**). It is the complement of `InitiateUsageMonitoring` and causes the logical state for the meter to be changed from Inactive to Active.

2.1.24.1 Sample request

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:CancelUsageMonitoring>
      <ver:meterIDs>
        <ver:meterID meterNo="15761M" serviceType="Electric"
          objectID="15761" utility="ACME"/>
        <ver:meterID meterNo="1002M" serviceType="Electric"
          objectID="1002" utility="ACME"/>
      </ver:meterIDs>
    </ver:CancelUsageMonitoring>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.24.2 Sample response

Following is the response corresponding to the preceding request. This shows that of the two meters in the request, the operation succeeded for one and failed for the other, because it was not in the Inactive logical state.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
      Company="Sensus" SessionID="779"
      xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:CancelUsageMonitoringResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:CancelUsageMonitoringResult>
        <ns2:errorObject errorString="Invalid logical state"
        eventTime="2012-07-26T10:03:17.140-04:00" nounType="Meter" objectID="15761M"/>
      </ns2:CancelUsageMonitoringResult>
    </ns2:CancelUsageMonitoringResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.24.3 Request parameters

Same as `InitiateUsageMonitoring`.

2.1.24.4 Response parameters

Same as `InitiateUsageMonitoring`.

2.1.24.5 Error messages

Same error conditions as for `InitiateUsageMonitoring`, with the following difference.

The most common reason for the Invalid logical state is that `InitiateUsageMonitoring` was not previously invoked for this meter to put it in an Inactive logical state.

2.1.24.6 Configuration properties

Same as `InitiateUsageMonitoring`.

2.1.25 InitiateDisconnectedStatus

This method *notifies* the RNI of meters that have been disconnected and no AMR reading is expected. The RNI changes the connection state of the meter to Disconnected in its data store. This method does not trigger a remote disconnect nor disable meter read collection or outage detection.

2.1.25.1 Sample request

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateDisconnectedStatus>
      <ver:meterIDs>
        <ver:meterID meterNo="15761M" serviceType="Electric"
          objectID="15761" utility="ACME"/>
        <ver:meterID meterNo="1002M" serviceType="Electric"
          objectID="1002" utility="ACME"/>
      </ver:meterIDs>
    </ver:InitiateDisconnectedStatus>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.25.2 Sample response

Following is the response corresponding to the previous sample request. This shows that of the two meters in the request, the operation succeeded for one and failed for one. The failure occurred because the meter was not in the Inactive logical state.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
      AppVersion="4.3.0-SNAPSHOT" Company="Sensus" SessionID="77"
      xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:InitiateDisconnectedStatusResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:InitiateDisconnectedStatusResult>
        <ns2:errorObject errorString="Invalid logical state"
          eventTime="2012-07-26T10:03:17.140-04:00"
          nounType="Meter" objectID="15761M"/>
      </ns2:InitiateDisconnectedStatusResult>
    </ns2:InitiateDisconnectedStatusResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.25.3 Request parameters

Same as `InitiateUsageMonitoring`.

2.1.25.4 Response parameters

Same as `InitiateUsageMonitoring`.

2.1.25.5 Error messages

Same error conditions as for `InitiateUsageMonitoring`, with the following difference.

The most common reason for the Invalid logical state error are as follows:

a) `InitiateDisconnectedstatus` was previously invoked for this meter, but was never cancelled so the meter is already in the Disconnected logical state.

b) `InitiateUsageMonitoring` was previously invoked for this meter, but was never cancelled so the meter is in the Inactive logical state.

2.1.25.6 Configuration properties

Same as `InitiateUsageMonitoring`.

2.1.26 CancelDisconnectedStatus

This method notifies the RNI of meters that should be removed from disconnected status. This is the complement of InitiateDisconnectedStatus and causes the logical state of the meter to be changed from Disconnected to Active.

2.1.26.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:CancelDisconnectedStatus>
      <ver:meterIDs>
        <ver:meterID meterNo="15761M" serviceType="Electric"
            objectID="15761" utility="ACME"/>
        <ver:meterID meterNo="1002M" serviceType="Electric"
            objectID="1002" utility="ACME"/>
      </ver:meterIDs>
    </ver:CancelDisconnectedStatus>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.26.2 Sample response

Following is the response corresponding to the previous sample request. This shows that of the two meters in the request, the operation succeeded for one and failed for one. The failure occurred because the meter was not in the Disconnected logical state.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
    AppVersion="4.3.0-SNAPSHOT" Company="Sensus" SessionID="77"
    xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:CancelDisconnectedStatusResponse
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:CancelDisconnectedStatusResult>
        <ns2:errorObject errorString="Invalid logical state"
          eventTime="2012-07-26T10:03:17.140-04:00" nounType="Meter" objectID="15761M"/>
      </ns2:CancelDisconnectedStatusResult>
    </ns2:CancelDisconnectedStatusResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.26.3 Request parameters

Same as `InitiateUsageMonitoring`.

2.1.26.4 Response parameters

Same as `InitiateUsageMonitoring`.

2.1.26.5 Error messages

Same error conditions as for `InitiateUsageMonitoring`, with the following difference.

The most common reason for the Invalid logical state error is that `InitiateDisconnectedStatus` was not previously invoked for this meter, so this meter is not in a Disconnected logical state.

2.1.26.6 Configuration properties

Same as `InitiateUsageMonitoring`.

2.1.27 EstablishMeterGroup

A **meter group** is used to send messages to multiple meters efficiently. Meters must be enrolled in a group before they can receive group addressed messages. Meter groups are created using this method. A group is associated with a customer and only meters associated with that customer can be added to the group. A meter can belong to multiple groups at the same time.

2.1.27.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:EstablishMeterGroup>
      <ver:meterGroup objectID="zipcode27560" verb="New" utility="ACME">
        <ver:groupName>zipcode27560</ver:groupName>
        <ver:comments>All meters in zip 27560</ver:comments>
      </ver:meterGroup>
      <ver:serviceType>Electric</ver:serviceType>
    </ver:EstablishMeterGroup>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.27.2 Sample response

```
<soapenv:Envelope      xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
       xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
   <soapenv:Header>
      <ns2:MultiSpeakMsgHeader SessionID="779"
              AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:EstablishMeterGroupResponse/>
</soapenv:Body>
</soapenv:Envelope>
```

2.1.27.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterGroup	The meter of interest.
	meterGroup@utility	Utility code for the meter group (CustomerID).
	meterGroup@objectID	The unique identifier for the meter group. This must be globally unique across all meter groups in the RNI.
	meterGroup/groupName*	The unique identifier for the meter group. This must be globally unique across all meter groups in the RNI.
	meterGroup/comments	A human friendly description of the group.
	serviceType	The service type for the meter group. At present the only supported type is Electric.

2.1.27.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the add notification.
	errorObject.objectID*	The objectID for the meter group with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of entity identified by the objectID (e.g., Meter Group).

2.1.27.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing groupName for Meter Group	The groupName element is missing.
	Empty groupName for Meter Group	The groupName value is empty.
	Meter group already exists	The specified meter group already exists.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store or a meter in the request belongs to a customer ID that the user does not permissions to access.

2.1.27.6 Configuration properties

None.

2.1.28 DeleteMeterGroup

This method deletes a meter group from the RNI. The meter group must be empty.

2.1.28.1 Sample request

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:DeleteMeterGroup>
      <ver:meterGroup objectID="zipcode27560" utility="ACME">
        <ver:groupName>zipcode27560</ver:groupName>
      </ver:meterGroup>
    </ver:DeleteMeterGroup>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.28.2 Sample response

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ns2:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
        Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:DeleteMeterGroupResponse/>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.28.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterGroup	The meter group to be deleted.
	meterGroup@utility	Utility code for the meter group (CustomerID).
	meterGroup@objectID	The unique identifier for the meter group. This must be globally unique across all meter groups in the RNI.
	meterGroup/groupName*	The unique identifier for the meter group. This must be globally unique across all meter groups in the RNI.

2.1.28.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the operation.
	errorObject.objectID*	The objectID for the meter group with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of entity identified by the objectID (e.g., Meter Group).

2.1.28.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing groupName for Meter Group	The groupName element is missing.
	Empty groupName for Meter Group	The groupName value is empty.
	Meter Group does not exist	The specified group name does not exist.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store or a meter in the request belongs to a customer ID that the user does not permissions to access.

2.1.28.6 Configuration properties

None.

2.1.29 InsertMeterInMeterGroup

This method adds meters to a meter group. Meters must be enrolled in a meter group before they can receive group addressed messages. A meter can belong to multiple groups at the same time.

2.1.29.1 Sample request

The following shows a sample request to add two meters to a meter group.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:InsertMeterInMeterGroup>
      <ver:meterGroupID>zipcode27560</ver:meterGroupID>
      <ver:meterIDs>
        <ver:meterID meterNo="1001M" serviceType="Electric"
            objectID="1001M" utility="ACME">ACME.E.1001M</ver:meterID>
        <ver:meterID meterNo="1002M" serviceType="Electric"
            objectID="1002M" utility="ACME">ACME.E.1002M</ver:meterID>
      </ver:meterIDs>
    </ver:InsertMeterInMeterGroup>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.29.2 Sample response

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ns2:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
        Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:InsertMeterInMeterGroupResponse/>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.29.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**meterGroupID***	The unique identifier for the meter group. This must be globally unique across all meter groups in the RNI.
	meterIDs	A list of meters to be added to the group.
	meterID@serviceType	The service type for the meter. At present, the only supported service type is Electric.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.1.29.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the operation.
	errorObject.objectID*	The objectID for the Meter or MeterGroup with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType	The type of entity identified by the objectID (e.g., Meter or MeterGroup).

2.1.29.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing meterGroupID	The meterGroupID element is missing from the request.
	Empty meterGroupID	The meterGroupID value is empty in the request.
	Missing meterNo	The meterNo attribute is missing.
	Empty meterNo	The meterNo attribute value is empty.
	Device not found	The specified meter is not known to the RNI.
	Meter already in group	Tried to add a meter that is already present in the meter group.
	Failed to insert meter into group	The attempt to add the meter to the meter group failed on the server.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store, or a meter in the request belongs to a customer ID that the user does not have permission to access.

2.1.29.6 Configuration properties

None.

2.1.30 RemoveMetersFromMeterGroup

This method removes one or more meters from a meter group.

2.1.30.1 Sample request

The following shows a sample request to remove one meter from a meter group.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:RemoveMetersFromMeterGroup>
      <ver:meterGroupID>zipcode27560</ver:meterGroupID>
      <ver:meterIDs>
        <ver:meterID meterNo="1001M" serviceType="Electric"
        objectID="1001M" utility="ACME">ACME.E.1001M</ver:meterID>
      </ver:meterIDs>
    </ver:RemoveMetersFromMeterGroup>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.30.2 Sample response

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ns2:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ns2:RemoveMetersFromMeterGroupResponse/>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.30.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**meterGroupID***	The unique identifier for the meter group. This must be globally unique across all meter groups in the RNI.
	meterIDs	A list of meters to be removed from the group.
	meterID@serviceType	The service type for the meter. Currently the only supported service type is Electric.
	meterID@utility	The utility code for the meter (CustomerID).
	meterID@objectID	A locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.1.30.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to execute the operation.
	errorObject.objectID*	The objectID for the meter or meter group with the error.
	errorObject.eventTime*	Timestamp for when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType	The type of entity identified by the objectID (e.g., MeterGroup).

2.1.30.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing meterGroupID	The meterGroupID element is missing from the request.
	Empty meterGroupID	The meterGroupID value is empty in the request.
	Missing meterNo	The meterNo attribute is missing.
	Empty meterNo	The meterNo attribute value is empty.
	Device not found	The specified meter is not known to the RNI.
	Meter does not exist in group	An attempt was made to remove a meter not in the specified meter group.
	Failed to remove meter from group	The attempt to remove the meter from the meter group failed on the server.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store, or a meter in the request belongs to a customer ID that the user does not permission to access.

2.1.30.6 Configuration properties

None.

2.1.31 EstablishReadingSchedules

This method establishes a meter reading schedule for billing group, where the billing group is defined by the billing cycle associated with meters in the RNI. This method can also be used to establish a one-time reading schedule for a set of meters (ad hoc group). This provides the flexibility to read meters that may have missed their regular billing cycle.

*This is a **preview** implementation for a custom integration. This method should **not** be used for any other integrations.*

2.1.32 InitiateMeterEventsResetExt

This method provides the ability to clear alarm conditions on an end device.

*This is a **preview** implementation for a custom integration. This method should **not** be used for any other integrations.*

2.1.33 InitiateEndpointConfigurationChangeExt

*This is a **preview** implementation for a custom integration. This method should **not** be used for any other integrations.*

2.1.34 InitiateDemandReset

This method resets demand registers on meters. The RNI validates the request and queues up the demand reset transactions. Failed on-air attempts are retried for the specified expiration duration. When the demand reset for a meter completes (or expires), a `MeterEventNotification` is published.

2.1.34.1 Sample request

The following shows a request to perform an on-air demand reset on three meters with a 24-hour retry period.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateDemandReset>
      <ver:meterIDs>
        <ver:meterID meterNo="1001M" serviceType="Electric" utility="ACME"/>
        <ver:meterID meterNo="1002M" serviceType="Electric" utility="ACME"/>
        <ver:meterID meterNo="1003M" serviceType="Electric" utility="ACME"/>
      </ver:meterIDs>
      <ver:responseURL>http://myserver/notifications</ver:responseURL>
      <ver:transactionID>my_txId_001</ver:transactionID>
      <ver:expTime units="Hours">24</ver:expTime>
    </ver:InitiateDemandReset>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.34.2 Sample response

The following response shows an error for meter 1100M because it does not support on-air demand reset. The absence of errors for meters 1000M and 1200M implies that they were accepted by the RNI and are being processed.

```
<SOAP-ENV:Envelope
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version_4.1_Release" >
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
        Company="Sensus" MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"/>
  </SOAP-ENV:Header>
```

```
  <SOAP-ENV:Body>
    <ns2:InitiateDemandResetResponse>
      <ns2:InitiateDemandResetResult>
        <ns2:errorObject objectID="1002M" errorString="Feature not supported"
            eventTime="2013-07-16T19:53:36.913Z" nounType="Meter"/>
      </ns2:InitiateDemandResetResult>
    </ns2:InitiateDemandResetResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.34.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterIDs	A list of meters to be demand reset.
	meterID@serviceType*	The service type for the meter.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	A locally unique identifier for the meterID element. Recommend that this have the same value as the `meterNo` attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	transactionID	Transaction ID for this request. This is returned in the `MeterEventNotification` triggered by this request.
	responseURL	The URL to which the resulting `MeterEventNotification` message should be sent.
	expTime@units*	The time unit for the expTime value. One of {Milliseconds, Seconds, Minutes, Hours, Days}. This attribute is required when expTime element is present.
	expTime	The time allowed for the demand reset to take place. This must be a positive integer, if specified. Default is 24 hours.

2.1.34.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	InitiateMeterEventsResetResult	Container for result. Can contain one or more ErrorObjects.
	errorObject	Multiple elements, one per failure.
	errorObject.objectID*	The objectID for the meter with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of entity identified by the objectID (e.g., Meter).

2.1.34.5 Error messages

The response may contain one or more of the errors in the following table.

	Error	Reasons
BUSINESS ERRORS	Feature not supported	The meter does not support on-air demand reset.
	Device not found	The specified `meterID` is not in the RNI.
	Duplicate entries found in database with same meter identity but different FlexNet Radio IDs.	Lookup of meter was ambiguous due to multiple instances of the same meter identity existing which map to different FlexNet Radio IDs.
	Invalid lifecycle state	Meter is not in Installed state.
	Unsupported expTime	The `expTime` value is not in the supported range.
	Unsupported expTime@units	The `expTime@units` value is not in the supported set.
	Unable to submit meter	Meter could not be submitted for further demand reset processing.
	Request is already present in database for this meter identity.	Meter could not be submitted for further demand reset processing, because a request already exists.
SYSTEM ERRORS	*Common security errors*	

2.1.34.6 Configuration properties

The configurations related to publishing the MeterEventNotification for a demand reset action should be set before using this method (see section 2.2.4.4).

2.1.35 InitiateDemandResetSchedulingExt

This method can be used to schedule one-time future demand reset on endpoints that support the one-time scheduling capability. This method communicates with the meter to set the time at which the meter will perform a demand reset. MeterEventNotification(s) associated with this request are to update the requestor as to the success or failure of the scheduling operation. When the demand reset actually occurs in the meter at the scheduled time, no notifications are sent. GetLatestReadingByMeterID should be used following the scheduled time to obtain the demand value.

2.1.35.1 Sample request

The following shows a request to schedule a demand reset on three meters to occur on July 7, 2018 @ 8 PM GMT.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
```

```
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateDemandResetSchedulingExt>
      <ver:meterIDs>
        <ver:meterID meterNo="1001M" serviceType="Electric" utility="ACME"/>
        <ver:meterID meterNo="1002M" serviceType="Electric" utility="ACME"/>
        <ver:meterID meterNo="1003M" serviceType="Electric" utility="ACME"/>
      </ver:meterIDs>
      <ver:scheduledTime>2018-07-07T20:00:00.000Z</ver:scheduledTime>
      <ver:responseURL>http://myserver/notifications</ver:responseURL>
      <ver:transactionID>my_request_id</ver:transactionID>
    </ver:InitiateDemandResetSchedulingExt>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.35.2 Sample response

The following response shows an error for meter 1002M because it does not support the on-air demand reset one-time scheduling feature. The absence of errors for meters 1001M and 1003M implies that they were accepted by the RNI and are being processed.

```
<SOAP-ENV:Envelope
    xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ns2="http://www.multispeak.org/Version 4.1 Release" >
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
        Company="Sensus" MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:InitiateDemandResetSchedulingResponse>
      <ns2:InitiateDemandResetSchedulingResult>
        <ns2:errorObject objectID="1002M" errorString="Feature not supported"
            eventTime="2018-06-16T19:53:36.913Z" nounType="Meter"/>
      </ns2:InitiateDemandResetSchedulingResult>
    </ns2:InitiateDemandResetSchedulingResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.35.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterIDs	A list of meters to be one-time scheduled for demand reset.
	meterID@serviceType*	The service type for the meter.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	A locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.

	Attribute/Element	Usage
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	transactionID	Transaction ID for this request. This is returned in the MeterEventNotification triggered by this request.
	responseURL	The URL to which the resulting MeterEventNotification message should be sent.
	scheduledTime	The time at which the demand reset should occur. Refer to overview section of the integration guide for supported time formats.

2.1.35.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	InitiateMeterEventsResetResult	Container for result. Can contain one or more ErrorObjects.
	errorObject	Multiple elements, one per failure.
	errorObject.objectID*	The objectID for the meter with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	The type of entity identified by the objectID (e.g., Meter).

2.1.35.5 Error messages

The response may contain one or more of the errors in the following table.

	Error	Reasons
BUSINESS ERRORS	Feature not supported	The meter does not support on-air demand reset scheduling.
	Device not found	The specified `meterID` is not in the RNI.
	Duplicate entries found in database with same meter identity but different FlexNet Radio IDs.	Lookup of meter was ambiguous due to multiple instances of the same meter identity existing which map to different FlexNet Radio IDs.
SYSTEM ERRORS	*Common security errors*	

2.1.36 GetHistoryLogByMeterID

This method returns the history log data stored in the RNI database for a given installed meterID.

2.1.36.1 Sample request

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
<soapenv:Header>
<ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
 Build="6" Branch="0" BuildString="RELEASE" UserID="testUser" Pwd="testPswd"
 SessionID="779" AppName="myApp" AppVersion="1.0" Company="myCo"/>
</soapenv:Header>
   <soapenv:Body>
      <ver:GetHistoryLogByMeterID>
             <ver:meterID meterNo="1001M" serviceType="Electric"
                  objectID="1001M" utility="ACME"></ver:meterID>
         <ver:startDate>2016-05-24T22:24:08.129-05:00</ver:startDate>
         <ver:endDate>2016-06-28T22:24:08.129-05:00</ver:endDate>
      </ver:GetHistoryLogByMeterID>
   </soapenv:Body>
</soapenv:Envelope>
```

2.1.36.2 Sample response

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Branch="0"
Build="6" BuildString="RELEASE" Company="Sensus" MajorVersion="4" MinorVersion="1"
SessionID="779" xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
        <ns2:GetHistoryLogByMeterIDResponse
             xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
             xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
             xmlns:ns5="http://www.w3.org/1999/xlink">
          <ns2:GetHistoryLogByMeterIDResult>
             <ns2:historyLog>
                <ns2:meterID meterNo="1001M" objectID="1001M" serviceType="Electric"
```

```
                    utility="ACME"/>
               <ns2:eventList>
                  <ns2:event>
                     <ns2:dateTime>2016-06-07T00:45:26.000Z</ns2:dateTime>
                     <ns2:meterEvent codeString="Reverse Energy" domain="3"
                              domainPart="33" index="219" type="1">
                              3.33.1.219.</ns2:meterEvent>
                  </ns2:event>
               </ns2:eventList>
            </ns2:historyLog>
         </ns2:GetHistoryLogByMeterIDResult>
      </ns2:GetHistoryLogByMeterIDResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.36.3 Sample response with error message

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
                           Company="Sensus" SessionID="?"
                           xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogByMeterIDResponse
                     xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
                     xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
                     xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogByMeterIDResult>
            <ns2:historyLog errorString="Unsupported serviceType: Electric, Gas and Water are the
only supported Service Types.">
               <ns2:meterID/>
            </ns2:historyLog>
         </ns2:GetHistoryLogByMeterIDResult>
      </ns2:GetHistoryLogByMeterIDResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.36.4 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**meterID***	The meter whose history logs are being requested.
	meterID@serviceType*	The service type for the meter.
	meterID@utility*	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the `meterID` element. Recommend that this have the same value as the `meterNo` attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	startDate	The starting timestamp for the range of logs.
	endDate	The ending timestamp for the range of logs.

2.1.36.5 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	**GetHistoryLogByMeterIDResult***	
	historyLog	History log element.
	historyLog@errorString	This is set if the requested meter log could not be retrieved.
	historyLog/meterID*	Meter ID of the meter whose event history is returned.
	historyLog/meterID@meterNo*	Meter number of the meter whose event history is being returned.
	historyLog/meterID@serviceType*	Service type for the meter.
	historyLog/meterID@objectID	Locally unique identifier for the `meterID` element.
	historyLog/meterID@utility*	Utility code for the meter (CustomerID).
	historyLog/eventList	Array of event history elements.
	historyLog/eventList/event/dateTime*	Date time of the history event.
	historyLog/eventList/event/meterEvent*	Array of meter events.
	historyLog/eventList/event/meterEvent/domain*	Value based on IEC 61968-9 Table E.1.
	historyLog/eventList/event/meterEvent/domainPart*	Value based on IEC 61968-9 Table E.2.
	historyLog/eventList/event/meterEvent/type*	Value based on IEC 61968-9 Table E.3.
	historyLog/eventList/event/meterEvent/index*	Value based on IEC 61968-9 Table E.4.
	historyLog/eventList/event/meterEvent/value	Refer to Meter Event Codes section of this document for details.
	historyLog/eventList/event/meterEvent/codeString*	Refer to Meter Event Codes section of this document for details.

2.1.36.6 Error messages

The errorString of the response may contain one or more of the errors in the following table.

	Error	Reasons
BUSINESS ERRORS	Missing `meterNo` attribute	The `meterNo` in the request has not been provided. This is required to uniquely identify the meter.
	Missing `serviceType` Attribute	The `serviceType` is not provided for the `meterID` in the request or a value that is not one of the MultiSpeak defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Unsupported `serviceType: Electric, Gas and Water are the only supported Service Types`	The `serviceType` value is not supported by the RNI. The currently supported service types are `Electric`, `Gas` and `Water`.

	Error	Reasons
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	A valid `startDate` needs to be provided	The `startDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where an `endDate` is provided, `startDate` must be provided as well.
	A valid `endDate` needs to be provided	The `endDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where a `startDate` is provided, `endDate` must be provided as well.
	`startDate` cannot be later than `endDate`.	The `endDate` value is before the startDate value.
	Max events count exceeded.	The results found have exceeded the maximum number of records allowed as configured in the Multispeak.MR.GetEventHistory.MaxEventsCount.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store or a meter in the request belongs to a customer ID that the user does not permissions to access.

2.1.36.7 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.GetEventHistory.MaxEventsCount	This property configured at the RNI level determines the maximum number of results to be returned in a GetHistoryLogs<> response. It can be overridden for each customer. The default value is 1000.

2.1.37 GetHistoryLogsByDate

This method returns the history log data from the RNI database for all installed meters given a date range. The calling parameter `lastReceived` is included so that large sets of data can be returned in manageable blocks.

This is a paged interface and uses the `LastSent` and `lastReceived` properties for paging.

2.1.37.1 Sample request

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ver="http://www.multispeak.org/Version 4.1 Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6" Branch="0"
BuildString="RELEASE" UserID="gatewayUser" Pwd="gateway123" SessionID="779" AppName="myApp"
AppVersion="1.0" Company="myCo"/>
   </soapenv:Header>
   <soapenv:Body>
      <ver:GetHistoryLogsByDate>
           <ver:startDate>2016-06-06T22:24:08.129-05:00</ver:startDate>
         <ver:endDate>2016-06-12T22:24:08.129-05:00</ver:endDate>
         <ver:lastReceived>100</ver:lastReceived>
      </ver:GetHistoryLogsByDate>
   </soapenv:Body>
</soapenv:Envelope>
```

2.1.37.2 Sample response

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Branch="0"
Build="6" BuildString="RELEASE" Company="Sensus" LastSent="1100" MajorVersion="4"
MinorVersion="1" ObjectsRemaining="464" SessionID="779"
xmlns="http://www.multispeak.org/Version 4.1 Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogsByDateResponse xmlns:ns2="http://www.multispeak.org/Version 4.1 Release"
xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogsByDateResult>
            <ns2:historyLog>
               <ns2:meterID meterNo="234561100M" objectID="234561100M" serviceType="Electric"
utility="ACME"/>
               <ns2:eventList>
                  <ns2:event>
                     <ns2:dateTime>2016-06-08T03:00:26.000Z</ns2:dateTime>
                     <ns2:meterEvent codeString="Reverse Energy" domain="3" domainPart="33"
index="219" type="1">3.33.1.219.</ns2:meterEvent>
                  </ns2:event>
               </ns2:eventList>
            </ns2:historyLog>
         </ns2:GetHistoryLogsByDateResult>
      </ns2:GetHistoryLogsByDateResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.37.3 Sample response with error message

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader
                  AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
                  Company="Sensus" SessionID="?"
                  xmlns="http://www.multispeak.org/Version 4.1 Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogsByDateResponse
              xmlns:ns2=http://www.multispeak.org/Version 4.1 Release
              xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
              xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogsByDateResult>
            <ns2:historyLog errorString="A valid endDate needs to be provided"/>
         </ns2:GetHistoryLogsByDateResult>
      </ns2:GetHistoryLogsByDateResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.37.4 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**startDate***	The starting timestamp for the range of logs.
	endDate*	The ending timestamp for the range of logs.
	lastReceived	The `LastSent` value from the previous response. The returned records will commence with the first record after the `lastReceived` record.

2.1.37.5 Response parameters

	Attribute/Element	*Usage*
HEADER	*Common response header attributes*	
BODY	**GetHistoryLogsByDateResult/***	
	historyLog/	History log element.
	historyLog/meterID*	Meter ID of the meter whose event history is returned.
	historyLog/meterID@meterNo*	Meter number of the meter whose event history is being returned.
	historyLog/meterID@serviceType*	The service type for the meter.
	historyLog/meterID@objectID	Locally unique identifier for the meterID element.
	historyLog/meterID@utility*	Utility code for the meter (CustomerID).
	historyLog/eventList/	Array of Event history elements.
	historyLog/eventList/event/dateTime*	Date time of the history event.
	historyLog/eventList/event/meterEvent/*	Array Of Meter Events.
	historyLog/eventList/event/meterEvent/domain*	Value based on IEC 61968-9 Table E.1.
	historyLog/eventList/event/meterEvent/domainPart*	Value based on IEC 61968-9 Table E.2.
	historyLog/eventList/event/meterEvent/type*	Value based on IEC 61968-9 Table E.3.
	historyLog/eventList/event/meterEvent/index*	Value based on IEC 61968-9 Table E.4.
	historyLog/eventList/event/meterEvent/value	Refer to Meter Event Codes section of this document for details.
	historyLog/eventList/event/meterEvent/codeString*	Refer to Meter Event Codes section of this document for details.

2.1.37.6 Error messages

The errorString of the response may contain one or more of the errors in the following table.

	Error	Reasons
BUSINESS ERRORS	A valid `startDate` needs to be provided	The `startDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where an `endDate` is provided, `startDate` must be provided as well.
	A valid `endDate` needs to be provided	The `endDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where a `startDate` is provided, `endDate` must be provided as well.
	`startDate` cannot be later than `endDate`.	The `endDate` value is before the `startDate` value.
SYSTEM ERRORS	Userid and password are incorrect	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.
	User is not allowed to perform the action on the specified resource	The user does not have the required permission(s) in the user store or a meter in the request belongs to a customer ID that the user does not permissions to access.

2.1.37.7 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.GetEventHistory.MaxEventsCount	This property configured at RNI level determines the maximum number of results to be returned in a GetHistoryLogs<> response. It can be overridden for each customer. The default value is 1000.

2.1.38 GetHistoryLogsByDateAndEventCode

This method returns the history log data from the RNI database for all installed meters given the eventCode and a date range. The calling parameter lastReceived is included so that large sets of data can be returned in manageable blocks. This is a paged interface and uses the LastSent and lastReceived properties for paging.

2.1.38.1 Sample request

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader UserID="testUser" Pwd="test123" />
   </soapenv:Header>
   <soapenv:Body>
      <ver:GetHistoryLogsByDateAndEventCode>
         <ver:eventCode domain="3" domainPart="26" type="1"
               index="185"></ver:eventCode>
        <ver:startDate>2016-05-24T04:00:00.000-04:00</ver:startDate>
         <ver:endDate>2016-05-28T04:00:00.000-04:00</ver:endDate>
         <ver:lastReceived>100</ver:lastReceived>
      </ver:GetHistoryLogsByDateAndEventCode>
   </soapenv:Body>
</soapenv:Envelope>
```

2.1.38.2 Sample response

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader
                AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
                Company="Sensus" LastSent="1000" ObjectsRemaining="1775"
                xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogsByDateAndEventCodeResponse
           xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
           xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
           xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogsByDateAndEventCodeResult>
            <ns2:historyLog>
               <ns2:meterID
                  meterNo="234561015M"
                objectID="234561015M"
                serviceType="Electric"
                utility="ACME"/>
               <ns2:eventList>
                  <ns2:event>
                     <ns2:dateTime>2016-06-07T01:02:41.000Z</ns2:dateTime>
                     <ns2:meterEvent codeString="Power Failed"
                                     domain="3"
                                     domainPart="26"
                                     index="185"
                                     type="1">3.26.1.185.</ns2:meterEvent>
                  </ns2:event>
                  <ns2:event>
                     <ns2:dateTime>2016-06-07T12:02:41.000Z</ns2:dateTime>
                     <ns2:meterEvent codeString="Power Failed"
                                     domain="3"
                                     domainPart="26"
                                     index="185"
                                     type="1">3.26.1.185.</ns2:meterEvent>
                  </ns2:event>
               </ns2:eventList>
            </ns2:historyLog>
          </ns2:eventList>
          </ns2:historyLog>
         </ns2:GetHistoryLogsByDateAndEventCodeResult>
      </ns2:GetHistoryLogsByDateAndEventCodeResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Sample response with error message:

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
                           Company="Sensus"
                           xmlns="http://www.multispeak.org/Version_4.1_Release"/>
```

```
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogsByDateAndEventCodeResponse
                        xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
                        xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
                        xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogsByDateAndEventCodeResult>
            <ns2:historyLog errorString="Event Code cannot be null."/>
         </ns2:GetHistoryLogsByDateAndEventCodeResult>
      </ns2:GetHistoryLogsByDateAndEventCodeResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.38.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**startDate***	The starting timestamp for the range of logs.
	endDate*	The ending timestamp for the range of logs.
	lastReceived	The `LastSent` value from the previous response. The returned records will commence with the first records after the `lastReceived` record.
	eventCode*	
	eventCode@domain*	Value based on IEC 61968-9 Table E.1.
	eventCode@domainPart*	Value based on IEC 61968-9 Table E.2.
	eventCode@type*	Value based on IEC 61968-9 Table E.3.
	eventCode@index*	Value based on IEC 61968-9 Table E.4.
	eventCode@codeString*	Refer to the *Meter event codes* section of this document for details.
	eventCode@value	Refer to the *Meter event codes* section of this document for details.

2.1.38.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	**GetHistoryLogsByMeterIDAndEventCodeResult/***	
	historyLog/	History Log Element.
	historyLog@errorString	This is set if the requested meter log could not be retrieved.
	historyLog/meterID*	Meter ID of the meter whose event history is returned.
	historyLog/meterID@meterNo*	Meter number of the meter whose event history is being returned.
	historyLog/meterID@serviceType*	The service type for the meter.
	meterID@objectID	Locally unique identifier for the meterID element.

	Attribute/Element	Usage
	historyLog/meterID@utility*	Utility code for the meter (CustomerID).
	historyLog/eventList/	Array of Event History Elements.
	historyLog/eventList/event/dateTime*	Date time of the history event.
	historyLog/eventList/event/meterEvent/*	Array Of Meter Events.
	historyLog/eventList/event/meterEvent/domain*	Value based on IEC 61968-9 Table E.1.
	historyLog/eventList/event/meterEvent/domain Part*	Value based on IEC 61968-9 Table E.2.
	historyLog/eventList/event/meterEvent/type*	Value based on IEC 61968-9 Table E.3.
	historyLog/eventList/event/meterEvent/index*	Value based on IEC 61968-9 Table E.4.
	historyLog/eventList/event/meterEvent/value	Refer to the *Meter event codes* section of this document for details.

2.1.38.5 Error messages

The errorString of the response may contain one or more of the errors in the following table.

	Error	Reasons
BUSINESS ERRORS	Meter Event Code cannot be null.	The `eventCode` is not provided in the request. This is a required parameter.
	Meter Event Code not Supported.	`eventCode` provided is not supported by RNI.
	Unsupported serviceType: Electric, Gas and Water are the only supported Service Types.	The `serviceType` value is not supported by the RNI. The currently supported service types are `Electric`, `Gas`, and `Water`.
	A valid `startDate` needs to be provided	The `startDate` property is not specified or the value provided is not an XML dateTime compliant format. In cases where an `endDate` is provided, `startDate` must be provided as well.
	A valid `endDate` needs to be provided	The `endDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where a `startDate` is provided, `endDate` must be provided as well.
	`startDate` cannot be later than `endDate`	The `endDate` value is before the startDate value.
	Missing domain attribute	The domain attribute cannot be empty.
	Missing domainPart attribute	The domainPart attribute cannot be empty.
	Missing index attribute	The index attribute cannot be empty.
	Missing type attribute	The type attribute cannot be empty.

	Error	Reasons
SYSTEM ERRORS	Common security errors	

2.1.38.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.GetEventHistory.MaxEventsCount	This property configured at RNI level determines the maximum number of results to be returned in a GetHistoryLogs<> response. It can be overridden for each customer. The default value is 1000.

2.1.39 GetHistoryLogsByMeterIDAndEventCode

This method returns the history log data from the RNI database for a given installed `meterID` and `eventCode`.

2.1.39.1 Sample request

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader UserID="testUser" Pwd="test123" />
   </soapenv:Header>
   <soapenv:Body>
      <ver:GetHistoryLogsByMeterIDAndEventCode>
         <ver:meterID meterNo="1001M" serviceType="Electric" objectID=""
utility="ACME"></ver:meterID>
         <ver:eventCode codeString="Reverse Energy" domain="3" domainPart="33" index="219"
type="1">?</ver:eventCode>
         <ver:startDate>?</ver:startDate>
         <ver:endDate>?</ver:endDate>
      </ver:GetHistoryLogsByMeterIDAndEventCode>
   </soapenv:Body>
</soapenv:Envelope>
```

2.1.39.2 Sample response

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
                           Company="Sensus"
                           xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogsByMeterIDAndEventCodeResponse
                  xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
                  xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
                  xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogsByMeterIDAndEventCodeResult>
            <ns2:historyLog>
               <ns2:meterID meterNo="1001M"
                            objectID="1001M"
                            serviceType="Electric"
                            utility="ACME"/>
               <ns2:eventList>
                  <ns2:event>
                     <ns2:dateTime>2016-06-09T04:00:26.000Z</ns2:dateTime>
                     <ns2:meterEvent codeString="Reverse Energy"
                                     domain="3"
```

```
                                    domainPart="33"
                                    index="219"
                                    type="1">3.33.1.219.</ns2:meterEvent>
                  </ns2:event>
               </ns2:eventList>
            </ns2:historyLog>
         </ns2:GetHistoryLogsByMeterIDAndEventCodeResult>
      </ns2:GetHistoryLogsByMeterIDAndEventCodeResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.39.3 Sample response with error message

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
Company="Sensus" SessionID="?" xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
      <ns2:GetHistoryLogsByMeterIDAndEventCodeResponse
xmlns:ns2="http://www.multispeak.org/Version_4.1_Release" xmlns:ns3="cpsm_V4.1_Release"
xmlns:ns4="gml_V4.1_Release" xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:GetHistoryLogsByMeterIDAndEventCodeResult>
            <ns2:historyLog errorString="Unsupported serviceType: Electric, Gas and Water are the
only supported Service Types.">
               <ns2:meterID/>
            </ns2:historyLog>
         </ns2:GetHistoryLogsByMeterIDAndEventCodeResult>
      </ns2:GetHistoryLogsByMeterIDAndEventCodeResponse>
   </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.1.39.4 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	**meterID***	The meter whose history logs are being requested.
	meterID@serviceType*	The service type for the meter.
	meterID@utility*	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the `meterID` element. Recommend that this have the same value as the `meterNo` attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	startDate	The starting timestamp for the range of logs.
	endDate	The ending timestamp for the range of logs.
	eventCode*	
	eventCode@domain*	Value based on IEC 61968-9 Table E.1.
	eventCode@domainPart*	Value based on IEC 61968-9 Table E.2.
	eventCode@type*	Value based on IEC 61968-9 Table E.3.
	eventCode@index*	Value based on IEC 61968-9 Table E.4.
	eventCode@codeString*	Refer to Meter Event Codes section of this document for details.
	eventCode@value	Refer to Meter Event Codes section of this document for details.

2.1.39.5 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	**GetHistoryLogByMeterIDResult/***	Array of meter history log elements.
	historyLog/*	History log element.
	historyLog@errorString	This is set if the requested meter log could not be retrieved.
	historyLog/meterID*	Meter ID of the meter whose event history is returned.
	historyLog/meterID@meterNo*	Meter number of the meter whose event history is being returned.
	historyLog/meterID@serviceType*	The service type for the meter.
	meterID@objectID	Locally unique identifier for the `meterID` element.
	historyLog/meterID@utility*	Utility code for the meter (CustomerID).
	historyLog/eventList/	Array of event history elements.
	historyLog/eventList/event/dateTime*	Date time of the history event.
	historyLog/eventList/event/meterEvent/*	Array of meter events.
	historyLog/eventList/event/meterEvent/domain*	Value based on IEC 61968-9 Table E.1.
	historyLog/eventList/event/meterEvent/domainPart*	Value based on IEC 61968-9 Table E.2.
	historyLog/eventList/event/meterEvent/type*	Value based on IEC 61968-9 Table E.3.
	historyLog/*	History log element.
	historyLog@errorString	This is set if the requested meter log could not be retrieved.
	historyLog/meterID*	Meter ID of the meter whose event history is returned.

2.1.39.6 Error messages

The errorString of the response may contain one or more of the errors in the following table.

	Error	Reasons
BUSINESS ERRORS	Meter Event Code cannot be null.	The `eventCode` is not provided in request. This is required parameter.
	Meter Event Code not Supported.	`eventCode` provided is not supported by RNI.
	Unsupported serviceType: Electric, Gas and Water are the only supported Service Types.	The `serviceType` value is not supported by the RNI. The currently supported service types are `Electric`, `Gas` and `Water`.

	Error	Reasons
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	A valid startDate needs to be provided	The `startDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where an `endDate` is provided, `startDate` must be provided as well.
	A valid endDate needs to be provided	The `endDate` element is not specified or the value provided is not an XML dateTime compliant format. In cases where a `startDate` is provided, `endDate` must be provided as well.
	startDate cannot be later than endDate.	The `endDate` value is before the startDate value.
	Missing domain attribute	The domain attribute cannot be empty.
	Missing domainPart attribute	The domainPart attribute cannot be empty.
	Missing index attribute	The index attribute cannot be empty.
	Missing type attribute	The type attribute cannot be empty.
SYSTEM ERRORS	Common security errors	Credentials provided in the request header are not valid. Usually indicates a mismatch between the user store and the customer billing system.

2.1.39.7 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.GetEventHistory.MaxEventsCount	This property configured at RNI level determines the maximum number of results to be returned in a GetHistoryLogs<> response. It can be overridden for each customer. The default value is 1000.

2.1.40 InitiateHistoryLogRequestByMeterIDExt

This method may be used to initiate a request to obtain records stored in ANSI C12.19 log tables from the meter (limited to electric meters only). When the meter responds to the RNI with the requested logs, a `HistoryLogChangedNotification` is published. Note, this information is retrieved from the meter metrology and not stored in the RNI database. As such, GetHistoryLog* methods will not return the same information.

The tables that may be retrieved by this request vary based on the device type.

2.1.40.1 Supported history log tables per device type

AMR Device Type	C1219 Table		Table Name
	Type	Number	
105 – Aclara I210+c 109 – Aclara kV2c	Std	76	MetroEventLog
	Mfg	112	MetroSagSwell
96 – StratusIQ	Std	74	MetroEventLog
109 – Aclara kV2c (endpoint must be FlexNet V2)	Mfg	42	MetroFwdlLog

2.1.40.2 Sample request

Following is a sample request to retrieve five records from C12.19 standard table 76 (Event Log table).

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                  xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
                              xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
      </soapenv:Header>
   <soapenv:Body>
      <ver:InitiateHistoryLogRequestByMeterIDExt>
            <ver:extensionsList>
                <ver:extensionsItem>
                      <ver:extName>C1219TableType</ver:extName>
                      <ver:extValue>Std</ver:extValue>
                      <ver:extType>string</ver:extType>
                </ver:extensionsItem>
                <ver:extensionsItem>
                      <ver:extName>C1219TableNumber</ver:extName>
                      <ver:extValue>76</ver:extValue>
                      <ver:extType>integer</ver:extType>
                </ver:extensionsItem>
            </ver:extensionsList>
              <ver:meterID meterNo="1001M" serviceType="Electric"
                           objectID="1001"
                             utility="ACME">ACME.Electric.1001M
              </ver:meterID>
              <ver:maxRecordsToRetrieve>5</ver:maxRecordsToRetrieve>
              <ver:responseURL>http://mycompany.com/logAnalysis</ver:responseURL>
              <ver:transactionID>1-23x</ver:transactionID>
      </ver:InitiateHistoryLogRequestByMeterIDExt>
   </soapenv:Body>
</soapenv:Envelope>
```

Following is a sample request to retrieve 200 (*maxRecordsToRetrieve not provided*) records from C12.19 standard table 76 using the table name extension (MetroEventLog).

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                  xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
                              xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
      </soapenv:Header>
   <soapenv:Body>
      <ver:InitiateHistoryLogRequestByMeterIDExt>
              <ver:extensionsList>
                <ver:extensionsItem>
                      <ver:extName>TableName</ver:extName>
                      <ver:extValue>MetroEventLog</ver:extValue>
                      <ver:extType>string</ver:extType>
                </ver:extensionsItem>
              </ver:extensionsList>
              <ver:meterID meterNo="1001M" serviceType="Electric"
                           objectID="1001"
                             utility="ACME">ACME.Electric.1001M
              </ver:meterID>
              <ver:responseURL>http://mycompany.com/logAnalysis</ver:responseURL>
              <ver:transactionID>1-23x</ver:transactionID>
      </ver:InitiateHistoryLogRequestByMeterIDExt>
   </soapenv:Body>
</soapenv:Envelope>
```

2.1.40.3 Sample response

Following is the response showing that the request was accepted.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)"
        AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:InitiateHistoryLogRequestByMeterIDExtResponse>
      <ver:InitiateMeterLogRequestByMeterIDExtResult/>
    </ver:InitiateHistoryLogRequestByMeterIDExtResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.40.4 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	transactionID	Transaction ID for this request. This is returned in the `HistoryLogChangedNotification` triggered by this request.
	responseURL	The URL that the resulting `HistoryLogChangedNotification` message should be sent to. If not specified then the notification is sent to the URL specified in the `Multispeak.MR.DestinationURL`.
	meterID@serviceType*	The service type for the meter: {Electric}.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.
	maxRecordsToRetrieve	Unsigned integer. Maximum number of records to retrieve from the target table. When not provided, 200 records will be retrieved. When provided, must be greater than 0.

	Attribute/Element	Usage
	extensionsList*	

Name	Type	Value
C1219TableIType[1]	string	Mfg-manufacturer or Std -standard
C1219TableNumber[1]	integer	Numeric table number such as 76.

Alternatively, theTableName extension may be used instead of the above extensions to identify the target table.

Name	Type	Value
TableName[1]	string	Use value from Table Name column in 2.1.40.1 Example: MetroEventLog

[1] *see 2.1.40.1 for a list of supported tables per device type.*

2.1.40.5 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to accept the request.
	errorObject.objectID*	The objectID for the meter with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	Meter.

2.1.40.6 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Unsupported serviceType	The specified `serviceType` is not supported by the RNI. The currently supported service types are `Electric`, `Gas` and `Water`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.

	Error	Reasons
	Unsupported device type	The device type is not known for the meter. This could be because the meter was added to the RNI without a device type and the meter has not reported in yet. Or the operation is not supported by the target device.
	Duplicate entries found in database with same meter identity but different FlexNet Radio IDs.	The RNI has two meters discovered with the same meter identity, but different FlexNet ids. This makes any request based on the meter identity ambiguous. Correct this problem by removing the stale entry.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Unsupported serviceType	The specified `serviceType` is not supported by the RNI. The currently supported service types are `Electric`, `Gas`, and `Water`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** there is a typo in the meterID.
	Unsupported C1219TableIdentifier	The operation is not supported for the specified table and target device.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Max records to retrieve must be greater than zero.	The maxRecordsToRetrieve when provided must be greater than zero.
	A Valid Meter ID tag must be provided	The meterID element is required.
SYSTEM ERRORS	*Common security errors*	

2.1.41 InitiateDiagnosticReportByMeterIDExt

This method may be used to initiate a request to obtain a diagnostic report from the meter. The content of the diagnostic report varies based on the meter firmware and manufacturer. Refer to the meter specifications for further details.

2.1.41.1 Sample request

Following is a sample request to retrieve a diagnostic report.

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                  xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
                              xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="RELEASE"
        UserID="testUser" Pwd="testPass" SessionID="779"
        AppName="myApp" AppVersion="1.0" Company="myCo" />
      </soapenv:Header>
   <soapenv:Body>
      <ver:InitiateDiagnosticReportByMeterIDExt>
         <ver:meterID meterNo="1001M" serviceType="Electric"
                      objectID="1001" utility="ACME"> ACME.Electric.1001M</ver:meterID>
         <ver:responseURL>http://mycompany.com/diagnosticNotification</ver:responseURL>
         <ver:transactionID>1-7x2</ver:transactionID>
      </ver:InitiateDiagnosticReportByMeterIDExt>   </soapenv:Body>
</soapenv:Envelope>
```

2.1.41.2 Sample response

Following is the response showing that the request was accepted.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader SessionID="779"
        AppName="RNI Gateway (MR)"
        AppVersion="4.5.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
      <ns2:InitiateDiagnosticReportByMeterIDResponseExt
          xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
          xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
          xmlns:ns5="http://www.w3.org/1999/xlink">
        <ns2:InitiateDiagnosticReportResult/>
      </ns2:InitiateDiagnosticReportByMeterIDResponseExt>
  </soapenv:Body>
</soapenv:Envelope>
```

2.1.41.3 Request parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	transactionID	Transaction ID for this request. This is returned in the `HistoryLogChangedNotification` triggered by this request.
	responseURL	The URL that the resulting `HistoryLogChangedNotification` message should be sent to. If not specified then the notification is sent to the URL specified in the `Multispeak.MR.DestinationURL`.
	meterID@serviceType*	The service type for the meter: {Electric}.
	meterID@utility	Utility code for the meter (CustomerID).

	Attribute/Element	Usage
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.1.41.4 Response parameters

	Attribute/Element	Usage
HEADER	*Common response header attributes*	
BODY	errorObject	Multiple elements, one per failure to accept the request.
	errorObject.objectID*	The objectID for the meter with the error.
	errorObject.eventTime*	Timestamp of when the failure occurred on the server.
	errorObject.errorString*	Detailed (user friendly) error message.
	errorObject.nounType*	Meter.

2.1.41.5 Error messages

	Error	Reasons
BUSINESS ERRORS	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.
	Unsupported serviceType	The specified `serviceType` is not supported by the RNI. The currently supported service types are `Electric`, `Gas`, and `Water`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** a typo in the meterID.
	Unsupported device type	The device type is not known for the meter. This could be because the meter was added to the RNI without a device type and the meter has not reported in yet. Or the operation is not supported by the target device.
	Duplicate entries found in database with same meter identity but different FlexNet Radio IDs.	The RNI has two meters discovered with the same meter identity, but different FlexNet ids. This makes any request based on the meter identity ambiguous. Correct this problem by removing the stale entry.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	Missing meterNo attribute	The `meterNo` is not provided for the `meterID`.

	Error	Reasons
	Unsupported serviceType	The specified `serviceType` is not supported by the RNI. The currently supported service types are `Electric`, `Gas`, and `Water`.
	Device not found	The `meterID` is not known to the RNI. This usually indicates that the communicating applications are out-of-sync **or** there is a typo in the meterID.
	Missing serviceType attribute	The serviceType is not provided for the `meterID` in the request, or a value that is not one of the MultiSpeak-defined serviceType(s) has been provided. This is required to uniquely identify the meter.
	A Valid Meter ID tag must be provided	The meterID element is required.
SYSTEM ERRORS	*Common security errors*	

2.2 MR Notification client

2.2.1 Overview

The RNI includes a web service client that publishes meter readings as notifications to the integrating system. These are typically consumed by the MDM or CB systems.

This notification client uses the generic NOT_Server WSDL and therefore, is agnostic of the application that consumes these notifications.

2.2.1.1 References

MultiSpeak v4.1.6 reference for the NOT Server abstract function (member access only): https://apps.cooperative.com/content/multispeak/specifications/416/NOT_Server.asmx.

2.2.1.2 Batching (flow control)

In order to manage the flow of notifications emitted, a batching mechanism is implemented by the MR notification client. Batching behavior may be controlled by batch size and batch time. The batch size determines how many events must be pending for a particular destination before they are published in one SOAP payload. The batch time determines the maximum time that the client buffers an event before publishing it.

A batch (containing events) that reaches either limit triggers transmission of that batch of events in a SOAP notification.

Refer to section 2.2.2.4 or 2.2.3.4 for details regarding configuration for the specific notification (`IntervalDataNotification` or `ReadingChangedNotification`).

2.2.1.3 Reliable delivery

If the remote system is not available to receive notification messages, then the messages are saved in a disk-persistent cache for later delivery. The number of retries is configurable. This provides resilience to short network outages, maintenance events, etc. Refer to section 2.2.2.4 or 2.2.3.4 for details regarding configuration for the specific notification (IntervalDataNotification or ReadingChangedNotification). Delivery is **not** guaranteed and resource limitations (disk space/memory) may force notifications to be discarded.

For RNI version 4.1 and later, interval data notifications use store and forward. Refer to the Sensus tech note titled *Store and Forward for MultiSpeak Notifications* for detailed information about this capability.

2.2.2 IntervalDataNotification

The `IntervalDataNotification` is used to report interval reads from the RNI. An `intervalReads` element contains sets of *contiguous* readings from *multiple* meters. Each contiguous set of reading data (and associated status indicators) is provided in a compact form in the `intervalBlock/data` element. The values in the data element should be interpreted using the metadata (`intervalProfile` and `statusMetadata`) in the `intervalReads` element.

The RNI may also receive some ancillary data with each read transmission from the meter (e.g., the peak demand). This ancillary data is *optionally* provided as additional channels which have an `endReading` but no interval values (see section 2.2.2.1.2).

2.2.2.1 Sample notification

2.2.2.1.1 Electric 15-minute consumption intervals

The following shows four intervals from a meter configured for full NET metering (separate forward and reverse kWh channels).

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6" Branch="0"
    BuildString="Release" UserID="test" Pwd="test" AppName="RNI Gateway (MR)"
    AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:IntervalDataNotification>
      <ver:intervalReads>
        <!--The statusSeparator and intervalSeparator MUST NOT
            be the same. If they both have the same value then its
            an ERROR-->
        <ver:statusDelimiter>,</ver:statusDelimiter>
        <ver:intervalDelimiter>;</ver:intervalDelimiter>
        <ver:profiles>
          <!-- Profiles of data contained in the blocks below -->
          <ver:profile profileID="ELECTRIC_15MIN_FULLNET_C">
            <ver:name>15 minute NET metering for electric</ver:name>
            <ver:intervalLength units="Minutes">15</ver:intervalLength>
            <ver:channels>
              <ver:channel>
                <ver:index>0</ver:index>
                <ver:fieldName>posKWh</ver:fieldName>
                <ver:units>kWh</ver:units>
              </ver:channel>
```

```
            <ver:channel>
              <ver:index>1</ver:index>
              <ver:fieldName>negKWh</ver:fieldName>
              <ver:units>kWh</ver:units>
            </ver:channel>
          </ver:channels>
        </ver:profile>
      </ver:profiles>
      <!-- The reading data blocks, usually one per meter but there
           could be more than one block per meter -->
      <ver:blocks>
        <ver:block>
          <ver:profileID>ELECTRIC_15MIN_FULLNET_C</ver:profileID>
          <ver:meterID meterNo="ABC000002" serviceType="Electric"
              objectID="ABC000002" utility="acme"/>
          <ver:endReadingList>
            <ver:endReading>
              <!-- The end reading for the forward kWh channel -->
              <ver:channelIndex>0</ver:channelIndex>
              <ver:reading>1050</ver:reading>
              <ver:readingDate>2010-05-22T15:00:00.000-05:00</ver:readingDate>
            </ver:endReading>
            <ver:endReading>
              <!-- The end reading for the reverse kWh channel -->
              <ver:channelIndex>1</ver:channelIndex>
              <ver:reading>50</ver:reading>
              <ver:readingDate>2010-05-22T15:00:00.000-05:00</ver:readingDate>
            </ver:endReading>
          </ver:endReadingList>
          <ver:logTime>2010-05-22T15:07:00.000-05:00</ver:logTime>
          <ver:intervalStart>2010-05-22T14:00:00.000-05:00</ver:intervalStart>
          <!-- Four intervals of data -->
          <ver:dB>
            <ver:chs>
              <ver:ch>
                <!-- Intervals for the forward kWh channel -->
                <ver:idx>0</ver:idx>
                <ver:d>50,2.0.0;23,2.0.0;15;40,2.0.0</ver:d>
              </ver:ch>
              <ver:ch>
                <!-- Intervals for the reverse kWh channel -->
                <ver:idx>1</ver:idx>
                <ver:d>0;0;50;25</ver:d>
              </ver:ch>
            </ver:chs>
            <!-- One common status per interval -->
            <ver:cS>2.0.0,2.0.0,1.4.2,2.0.0</ver:cS>
          </ver:dB>
        </ver:block>
      </ver:blocks>
    </ver:intervalReads>
  </ver:IntervalDataNotification>
 </soapenv:Body>
</soapenv:Envelope>
```

2.2.2.1.2 Electric 1-hour consumption intervals with peak demand

The following shows four intervals of consumption (kWh) with a single peak demand value corresponding to the end reading. The peak demand is the maximum recorded since the last demand reset and may have occurred prior to the reporting period covered by this data block.

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version 4.1 Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6"
    Branch="0" BuildString="Release" UserID="test" Pwd="test"
    AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:IntervalDataNotification>
      <ver:intervalReads>
        <ver:statusDelimiter>,</ver:statusDelimiter>
        <ver:intervalDelimiter>;</ver:intervalDelimiter>
        <ver:profiles>
          <!-- Profiles of data contained in the blocks below -->
          <ver:profile profileID="ELECTRIC_1HOUR_C_D">
            <ver:name>1 hour consumption with demand</ver:name>
            <ver:intervalLength units="Hours">15</ver:intervalLength>
            <ver:channels>
              <ver:channel>
                <ver:index>0</ver:index>
                <ver:fieldName>posKWh</ver:fieldName>
                <ver:units>kWh</ver:units>
              </ver:channel>
              <ver:channel>
                <ver:index>1</ver:index>
                <ver:fieldName>maxDemand</ver:fieldName>
                <ver:units>kW</ver:units>
              </ver:channel>
            </ver:channels>
          </ver:profile>
        </ver:profiles>
        <!-- The reading data blocks, usually one per meter but there
             could be more than one block per meter -->
        <ver:blocks>
          <ver:block>
            <ver:profileID>ELECTRIC_1HOUR_C_D</ver:profileID>
            <ver:meterID meterNo="ABC000002" serviceType="Electric"
              objectID="ABC000002" utility="acme"/>
            <ver:endReadingList>
              <ver:endReading>
                <!-- The end reading for the forward kWh channel -->
                <ver:channelIndex>0</ver:channelIndex>
                <ver:reading>1050</ver:reading>
                <ver:readingDate>2010-05-22T15:00:00.000-05:00</ver:readingDate>
              </ver:endReading>
              <ver:endReading>
                <!-- The peak demand value -->
                <ver:channelIndex>1</ver:channelIndex>
                <ver:reading>50</ver:reading>
                <ver:readingDate>2010-05-22T15:00:00.000-05:00</ver:readingDate>
              </ver:endReading>
            </ver:endReadingList>
            <ver:logTime>2010-05-22T15:07:00.000-05:00</ver:logTime>
            <ver:intervalStart>2010-05-22T14:00:00.000-05:00</ver:intervalStart>
            <ver:dB>
              <ver:chs>
                <ver:ch>
                  <ver:idx>0</ver:idx>
                  <ver:d>50,2.0.0;23,2.0.0;15,2.0.0;40</ver:d>
                </ver:ch>
              </ver:chs>
              <ver:cS>2.0.0,2.0.0,2.0.0,1.4.2</ver:cS>
            </ver:dB>
          </ver:block>
        </ver:blocks>
      </ver:intervalReads>
    </ver:IntervalDataNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.2.2.2 Notification parameters

	Attribute/Element	Usage
HEADER	*Common notification header attributes*	
BODY	**statusDelimiter***	Separator between the readings and status values. Default is a comma.
	intervalDelimiter*	Seperator between consecutive intervals. Default is semi-colon.
	Profiles	A set of reading profiles to interpret the data blocks in this message.
	profile/profileID*	The identifier for a profile. This is used to reference the profile from one or more blocks. For example, ELECTRIC_15_MINUTE_SINGLE_CHANNEL. *Note: The profile ID is local in scope to one message. It should **not** be assumed to have the same meaning across messages.*
	profile/intervalLength*	Duration of the intervals in the data blocks that use this profile (e.g., 15 mins, 30 mins, 1 hour etc.).
	profile/channels*	The list of channels (energy parameters for electric meters) in profile.
	profile/channels/channel/index*	Arbitrary channel index with local scope. A numeric sequence starting at 0 is used for the channel indices.
	profile/channels/channel/ fieldName*	The specific type of parameter being measured in this channel. The set of values supported by the RNI is listed in section 2.2.2.2.1.
	profile/channels/channel/ units*	Unit of measure (e.g., kWh).
	Blocks	A set of reading data blocks, usually one per meter.
	block/profileID*	The ID for the profile that this block adheres to.
	block/meterID/@meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	block/meterID/@objectID*	Same value as the meterNo attribute.
	block/meterID/@service Type*	The service type of the meter. One of `Electric`, `Gas`, `Water`, `Unknown`.
	block/meterID/@utility*	Utility code for the meter (CustomerID).
	block/logTime*	Time when the read transmission was received at the RNI.
	block/intervalStart*	The start time for the **first** interval.
	block/endReadingList	List of end reads, one per channel in this data block. This is the known good register read corresponding to the last read interval. This is optional because it is possible to receive interval reads in a notification without an end reading.

	block/../endReading/ channelIndex*	The index of the channel from this profile to which this end reading applies. The units of measure for the reading property are determined by the channel.
	block/../endReading/ reading*	The end reading value for this channel (e.g., the consumption in kWh).
	block/../endReading/readingDate	The top of the most recent interval is the end reading date.
	block/dB*	This structure carries a series of records (values), each matching the syntax described.
	dB/chs	Channel of interval data and status codes for use in an IntervalData object.
	dB/cS	Common status string. This status field is for status information for each interval that is common to all channels.
	dB/chs/ch	Channel of interval data and status codes for use in an IntervalData object.
	dB/chs/ch/idx*	Channel index from the profile.
	dB/chs/ch/d*	Interval data separated by the Interval delimiter and status delimiter (e.g., 10,2.0.0;50;40,3.1.2).

2.2.2.2.1 Channels

A channel of interval data is identified by a MultiSpeak `fieldName`. A list of supported fieldNames can be found in section 2.1.21.3.1.

The `IntervalDataNotification` may also include the `maxDemand` even though it is a non-interval quantity. This is an *interim* Sensus specific optimization to piggyback additional readings data on the interval read reporting stream.

The maxDemand is the *peak demand over a demand reset window that is **not** time synched to the interval boundary*. Thus, multiple intervals may be reported with the same value for peak demand and it *does **not** mean that the peak was reached for **every** interval*.

2.2.2.2.2 Profile codes

The following table lists the profiles currently supported by the RNI. This is a *representative* list and should not be considered exhaustive because the profile is constructed dynamically based on the number and type of channels reported by a meter.

For example meters can sample at different intervals, but the following list only shows the 15-minute interval profiles.

The general format for a profile ID is [service type]_[sample rate]_[channel indicators]. In order to keep the profile ID short, the channel indicators use abbreviations for **C**onsumption, **A**pparent power, **R**eactive power, and **D**emand.

	Profile (profile/profileID)	Channels (profile/../channel/fieldName)
SINGLE CHANNEL PROFILES	ELECTRIC_15MIN_CONSUMPTION	posKWh
	ELECTRIC_15MIN_NET_C	netKWh
	ELECTRIC_15MIN_TOTAL_C	totalKWh
	ELECTRIC_15MIN_APPARENT	posKVAh
	ELECTRIC_15MIN_NET_A	netKVAh
	ELECTRIC_15MIN_TOTAL_A	totalKVAh
	GAS_1HR_CORRECTED_CONSUMPTION	corrGasVolume
	GAS_1HR_UNCORRECTED_CONSUMPTION	uncorrGasVolume
	WATER_4HOUR_CONSUMPTION	waterVol
	BATTERY_CONSUMPTION	batteryConsumption
TWO CHANNEL PROFILES	ELECTRIC_15MIN_FULLNET_C	posKWh, negKWh
	ELECTRIC_15MIN_FULLNET_A	posKVAh, negKVAh
	ELECTRIC_15MIN_C_R	posKWh, posKVARh
	ELECTRIC_15MIN_TOTAL_C_R	totalKWh, totalKVARh
	ELECTRIC_15MIN_NET_C_R	netKWh, netKVARh
	WATER_4HR_CC_UC	CorrGasVol,UncorrGasVol
SINGLE CHANNEL (plus peak demand)	ELECTRIC_15MIN_C_D	posKWh, maxDemand
	ELECTRIC_15MIN_NET_C_D	netKWh, maxDemand
	ELECTRIC_15MIN_TOTAL_C_D	totalKWh, maxDemand
	ELECTRIC_15MIN_A_D	posKVAh, maxDemand
	ELECTRIC_15MIN_NET_A_D	netKVAh, maxDemand
	ELECTRIC_15MIN_TOTAL_A_D	totalKVAh, maxDemand
TWO CHANNEL (plus peak demand)	ELECTRIC_15MIN_FULLNET_C_D	poskWh, negkWh, maxDemand
	ELECTRIC_15MIN_FULLNET_A_D	posKVAh, negKVAh, maxDemand
	ELECTRIC_15MIN_C_R_D	posKWh, posKVARh, maxDemand
	ELECTRIC_15MIN_TOTAL_C_R_D	totalKWh, totalKVARh, maxDemand
	ELECTRIC_15MIN_NET_C_R_D	netKWh, netKVARh, maxDemand

2.2.2.2.3 Status codes

The *status codes* are the values for specific status events. The following table provides the key to interpret the status indicators in the interval data blocks.

These are provided on a best effort basis. The absence of a status code for an interval does not guarantee a good read, it just means that there are no problems with the read that are known to the RNI at the time of sending.

The supported status codes are defined in section 2.1.19.4.2.

2.2.2.3 Expected response

Responses are *mandatory* when an `IntervalDataNotificaton` request is published. The expected response is the `IntervalDataNotificationResponse` or a SOAP Fault. Either of these responses will be interpreted as successful delivery (regardless of errors returned in the response). If no response is provided, redelivery may be attempted depending on reliable delivery configuration. In large deployments the volume of notifications will be high. While the delivery mechanism has built-in flow control and retries, it is essential that the server receiving an `IntervalDataNotification` sends back the response very quickly to avoid backups and possible lost messages.

2.2.2.4 Configuration properties

	Property name	Usage
DATABASE	Gateway.Publish.MeterRead (System configuration)	A **system level** on/off switch for the meter reading events published by the RNI core. This is technically not a MultiSpeak configuration but must be set to `True` in order for the MultiSpeak gateway to receive **meter reads** and subsequently publish `IntervalDataNotification`.
	Multispeak.MR.DestinationEnabled (Customer configuration)	An on/off switch for the MR notification client in the RNI. This should be set to `True` when the remote service is ready to receive notifications. Default is `False`.
	Multispeak.MR.DestinationURL (Customer configuration)	The URL of the remote web service (e.g., https://www.myhost.com/multispeak/cb).
	Multispeak.MR.DestinationUserId (Customer configuration)	The user ID on the remote system to be used by the RNI gateway. This is the value used for the `UserID` header attribute of the request.
	Multispeak.MR.DestinationPassword (Customer configuration)	The password corresponding to the user account on the remote system (see the previous property). This is the value used for the Pwd header attribute of the request.

	Property name	Usage
	Multispeak.MR.IntervalDataNotification .BatchSize (Customer configuration)	The number of reading blocks that the MR system will batch per SOAP message (e.g., a value of 100 means that MR waits until it receives 100 blocks for that destination and then forwards them in one `IntervalDataNotification` message). If both batch size and batch times are specified, then either condition may trigger the SOAP message to be sent. Default is 1000.
	Multispeak.MR.IntervalDataNotification .BatchTime (Customer configuration)	The time in **milliseconds** that the MR system holds readings to batch into a SOAP message. For example, a value of 5000 means that MR buffers events for 5 seconds before sending them in one IntervalDataNotification message. **Note**: Even if the batching is primarily being controlled with the batchSize property, a non-zero value should **always** be specified for the batch time property so that readings do not get buffered in the MR system indefinitely. Default is 120000 (2 minutes).
	Multispeak.MR.IntervalDataNotification .MaxAttempts[1] (Customer configuration)	Number of retry attempts to send a SOAP message to the subscriber. After the attempt limit is reached, the notification is discarded. Null value indicates no limit. Default is null. Prior to RNI 4.1, this value was called **RetryCount**. It is renamed on upgrade from RetryCount as semantics were not clear. On upgrade/migration if RetryCount>0 then MaxAttempts becomes null[indicates retry forever], RetryCount<=0 MaxAttempts becomes 1 [indicates try once].
	Multispeak.MR.IntervalDataNotification .MaxAge[1] (Customer configuration)	Age in milliseconds beyond which notifications with a creation time older than MaxAge are discarded. Null indicates no age limit. Default is null.
	Multispeak.MR.IntervalDataNotification .AttemptInterval (Customer configuration)	Time in milliseconds between delivery attempts. Default is 30000 (i.e., 30 seconds).
	Multispeak.MR.PublishDerived Summation.WATER	For water meters, publish derived summations as EndReadings in IntervalDataNortification.

[1]MaxAge NULL combined with MaxAttempts NULL creates a system of record configuration. (Notifications are retried until the store and forward notification cache file is rotated out.)

2.2.3 ReadingChangedNotification

This notification can be both solicited and unsolicited.

A solicited `ReadingChangedNotification` is published by the RNI in response to a prior `InitiateMeterReadingsByMeterID` request and reports cumulative register reads and tier/TOU reads.

An unsolicited `ReadingChangedNotification` is used to report snapshot read data from the RNI.

2.2.3.1 Sample notification

The following is the result of pinging a meter that is configured for simple NET (F-R) with peak demand.

```
<soapenv:Envelope
    xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
    xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
        Company="Sensus" MajorVersion="4" MinorVersion="1" Build="6"
        Branch="0" BuildString="Release" Pwd="testpass"
        UserID="testuser" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:ReadingChangedNotification>
      <ver:changedMeterReads>
        <ver:meterReading utility="ACME">
          <ver:meterID meterNo="15001M" objectID="15001M"
              serviceType="Electric" utility="ACME" />
          <ver:readingValues>
            <ver:readingValue>
              <ver:units>Wh</ver:units>
              <ver:value>23718729</ver:value>
              <ver:readingType>Billing</ver:readingType>
              <ver:fieldName>netKWh</ver:fieldName>
              <ver:timeStamp>2011-07-26T09:00:00.000-04:00</ver:timeStamp>
              <ver:readingStatusCode codeCategory="0" codeIndex="0"
                  originatingSystemID="2" />
              <ver:readingTypeCode UOMCategory="0.12"
                  accumulationBehavior="9" dataQualifier="0"
                  displayableUOM="72" flowDirection="4"
                  measurementCategory="0.0"
                  name="Present BulkQuantity Net Energy (Wh)" phaseIndex="0"
                  timeAttribute="0" unitsMultiplier="0">
                15.0.1.4.0.12.0.0.0.0.72</ver:readingTypeCode>
            </ver:readingValue>
          </ver:readingValues>
        </ver:meterReading>
      </ver:changedMeterReads>
    </ver:ReadingChangedNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

2.2.3.2 Notification parameters

	Attribute/Element	Usage
HEADER	*Common notification header attributes*	
BODY	transactionID	The `transactionID` from the RNI-initiated request (if applicable), or empty otherwise. Subscribing applications can use this to correlate an `InitiateMeterReadingByMeterID` with this notification. The correlation on the subscriber should handle unknown or empty values.
	meterID@meterNo*	Meter number of the meter associated with the returned reading.
	meterID@serviceType*	The service type for the meter.
	meterID@utility*	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	errorString	This is set if the requested meter reading could not be retreived.
	deviceId	The FlexNet ID (Radio endpoint ID).
	readingValues	Series of meter readings.
	readingValue/fieldName*	Name for the quantity from the MultiSpeak Formatted Block implementation guidelines (e.g., maxDemand).
	readingValue/units*	Units of measure (e.g., kW).
	readingValue/value*	Numeric value of the measured quantity.
	readingValue/timestamp*	Time of measurement. This may be normalized to a time boundary.
	readingValue/measurementPeriod	Fixed value of Current as this is the latest read.
	readingValue/readingType	This is one of Billing for electric meters, Gas Usage for gas meters, and Water usage for water meters. **Present** indicates a current or instantaneous reading.
	readingValue/ratePeriod	Only used for and always present for TOU readings. This corresponds to the tier number whose quantities are being reported (e.g., 0, 1, 2, 3, 4). Tier 0 is a special value that indicates the sum of all the other tiers. Can only be present as a result of InitiateMeterReadingsByMeterID when onTheGlassMode mode is turned off (if configured with TOU rate code or forceTOU).
	readingValue/readingStatusCode	Describes the quality of the meter reading using IEC 61968-9 Annex D (Quality code enumerations).
	readingStatusCode@originatingSystemID	The value is always 2 (metering system network) to indicate that this data is from the RNI store.
	readingStatusCode@codeCategory	Subset of values from IEC 61968-9 Annex D.
	readingStatusCode@codeIndex	Subset of values from IEC 61968-9 Annex D.

	Attribute/Element	Usage
	readingValue/readingTypeCode	Describes the quality of the meter reading using IEC 61968-9 Annex C (Reading code enumerations).
	readingTypeCode@UOMCategory	Subset of values from IEC 61968-9 Table C.5.
	readingTypeCode@accumulation Behavior	Subset of values from IEC 61968-9 Table C.3.
	readingTypeCode@dataQualifier	Subset of values from IEC 61968-9 Table C.2.
	readingTypeCode@displayableUOM	Subset of values from IEC 61968-9 Table C.10.
	readingTypeCode@flowDirection	Subset of values from IEC 61968-9 Table C.4.
	readingTypeCode@measurement Category	Subset of values from IEC 61968-9 Table C.7.
	readingTypeCode@name	Displayable name of the reading type code derived from its constituent parts.
	readingTypeCode@phaseIndex	Subset of values from IEC 61968-9 Table C.8.
	readingTypeCode@timeAttribute	Subset of values from IEC 61968-9 Table C.1.
	readingTypeCode@unitsMultiplier	Subset of values from IEC 61968-9 Table C.9.

These are the same parameters as the `GetLatestReadingByMeterID` response (see section 2.1.19.4).

2.2.3.2.1 Reading type codes

Description	fieldName	Units	Representative readingTypeCode
Forward energy register reading - Instantaneous	posKWh	Wh	15.0.1.1.0.12.0.0.0.0.72 Present BulkQuantity Forward Energy (Wh)
Reverse energy register reading - Instantaneous	negKWh	Wh	15.0.1.19.0.12.0.0.0.0.72 Present BulkQuantity Reverse Energy (Wh)
Simple NET (F-R) register reading - Instantaneous	netKWh	kWh	15.0.1.4.0.12.0.0.0.3.72 Present BulkQuantity Net Energy (KWh)
Reverse energy detection (F+R) register reading - Instantaneous	totalKWh	kWh	15.0.1.20.0.12.0.0.0.3.72 Present BulkQuantity Total Energy (KWh)
Forward energy register reading for apparent power - Instantaneous	posKVAh	Vah	15.0.1.1.0.12.0.0.0.0.71 Present BulkQuantity Forward Energy (VAh)
Reverse energy register reading for apparent power - Instantaneous	negKVAh	Vah	15.0.1.19.0.12.0.0.0.0.71 Present BulkQuantity Reverse Energy (VAh)
Simple NET (F-R) register reading for apparent power - Instantaneous	netKVAh	kVAh	15.0.1.4.0.12.0.0.0.3.71 Present BulkQuantity Net Energy (KVAh)
Reverse energy eetection (F+R) register reading for apparent power - Instantaneous	totalKVAh	kVAh	15.0.1.20.0.12.0.0.0.3.71 Present BulkQuantity Total Energy (KVAh)
Reactive energy register reading - Instantaneous	posKVARh	VARh	15.0.1.1.0.12.0.0.0.0.73 Present BulkQuantity Forward Energy (VARh)
Reverse reactive energy register reading – Instantaneous	negKVARh	VARh	15.0.1.19.0.12.0.0.0.0.73 Present BulkQuantity Reverse Energy (VARh)

Description	fieldName	Units	Representative readingTypeCode
Corrected gas consumption - Instantaneous	corrGasVol	cubic feet	15.3.1.1.0.61.0.0.0.0.119 Present Compensated BulkQuantity Forward NaturalGas (Ft3)
Uncorrected gas consumption - Instantaneous	uncorrGasVol	cubic feet	15.20.1.1.0.61.0.0.0.0.119 Present Uncompensated BulkQuantity Forward NaturalGas (Ft3)
Water consumption - Instantaneous	waterVol	US gl	15.0.1.1.0.63.0.0.0.0.122 Present BulkQuantity Forward Water (US gallons)
Battery consumption	Battery Consumption	mAh	0.0.1.0.0.0.0.0.0.253.106 BulkQuantity (mAh)
Temperature	temperature	F	0.0.6.0.0.46.0.0.0.0.X2 Indicating Temperature (degree F)
Temperature	temperature	C	0.0.6.0.0.46.0.0.0.0.23 Indicating Temperature (de
Pressure	pressure	Static pound per square inch	0.0.6.0.0.0.0.0.0.0.X9 Indicating (psi)
Pressure	pressure	Bar	0.0.6.0.0.0.0.0.0.0.X8 Indicating (Bar)
Absolute pressure	pressure	BarA	0.0.6.0.0.0.0.0.0.0.X12 Indicating (bara)
Chlorophyll	chlorophyll	microgram per liter	0.0.6.0.0.0.0.0.0.0.X23 Indicating (ug/L)
Chlorophyll	chlorophyll	Relative Fluorescence Unit	0.0.6.0.0.0.0.0.0.0.X21 Indicating (RFU)
Dissolved oxygen	dissolvedOxygen	milligram per liter	0.0.6.0.0.0.0.0.0.0.X24 Indicating (mg/L)
Hydrogen sulfide	Hydrogen Sulphide	PPM	0.0.6.0.0.0.0.0.0.0.52 Indicating (PPM)
Weight	weight	kg	0.0.6.0.0.0.0.0.0.0.X19 Indicating (kg)
Weight	weight	lb	0.0.6.0.0.0.0.0.0.0.X18 Indicating (lb)
Other instrumentation	other	not applicable	0.0.6.0.0.0.0.0.0.0.0 Indicating ()
Turbidity	tubidity	NTU	0.0.6.0.0.0.0.0.0.0.X25 Indicating (NTU)
Level	level	ft	0.0.6.0.0.0.0.0.0.0.X28 Indicating (ft)
Level	level	inches	0.0.6.0.0.0.0.0.0.0.X14 Indicating (inches)
Level	level	cm	0.0.6.0.0.0.0.0.0.0.X17 Indicating (cm)
Level	level	yd	0.0.6.0.0.0.0.0.0.0.X26 Indicating (yd)
Free chlorine	freeChlorine	milligram per liter	0.0.6.0.0.0.0.0.0.0.X24 Indicating (mg/L)
Total chlorine	totalChlorine	milligram per liter	0.0.6.0.0.0.0.0.0.0.X24 Indicating (mg/L)
pH factor	pHFactor	SU	0.0.6.0.0.0.0.0.0.0.X15 Indicating (SU)
Conductivity	conductivity	millisiemens per centimeter	0.0.6.0.0.0.0.0.0.0.X20 Indicating (mS/L)
Blue green algae	blueGreenAlgae	cells per milliliter	0.0.6.0.0.0.0.0.0.0.X22 Indicating (cells/mL)
Blue green algae	blueGreenAlgae	Relative Fluorescence Unit	0.0.6.0.0.0.0.0.0.0.X21 Indicating (RFU)

2.2.3.3 Expected response

Responses are *mandatory* when a `ReadingChangedNotification` request is published. The expected response is a `ReadingChangedNotificationResponse` or a SOAP Fault. Either of these responses will be interpreted as a successful delivery (regardless of errors returned in the response). If no response is provided, redelivery may be attempted depending on reliable delivery configuration.

2.2.3.4 Configuration properties

	Property name	Usage
DATABASE	Multispeak.MR.DestinationEnabled (Customer configuration)	An on/off switch for the MR notification client in the RNI. This should be set to `True` when the remote service is ready to receive notifications. Default is `False`.
	Multispeak.MR.DestinationURL (Customer configuration)	The URL of the remote web service (e.g., https://www.myhost.com/multispeak/mdm).
	Multispeak.MR.DestinationUserId (Customer configuration)	The user ID on the remote system to be used by the RNI gateway. This is the value used for the `UserID` header attribute of the request.
	Multispeak.MR.DestinationPassword (Customer configuration)	The password corresponding to the user account on the remote system (see the previous property). This is the value used for the `Pwd` header attribute of the request.
	Multispeak.MR.ReadingChangedNotification .BatchSize (Customer configuration)	The number of readings the MR system will batch per SOAP message. For example, a value of 100 indicates that MR waits until it receives 100 readings for that destination and then forwards them in one IntervalDataNotification message. If both batch size and batch times are specified, then either condition may trigger the SOAP message to be sent. Default is 5.
	Multispeak.MR. ReadingChangedNotification.BatchTime (Customer configuration)	The time in milliseconds that the MR system holds readings to batch into a SOAP message. For example, a value of 5000 means that MR buffers events for 5 seconds before sending them in one IntervalDataNotification message. ***NOTE:*** *Even if the batching is primarily being controlled with the* ***batchSize*** *property, a non-zero value should always be specified for the batch time property so that readings do not get buffered in the MR system indefinitely.* Default is `100`.

	Property name	Usage
	Multispeak.MR. ReadingChangedNotification.MaxCache Count (Customer configuration)	Maximum number of caches that the notification client should keep in play. A higher number of caches provides a better tolerance to slow consumer and event floods. This is due to the notification client having a bigger sandbox for processing events. This value should be bounded depending on the available memory on the server. Recommend that the value in a production system is **2 or higher**. Default is `100`.
	Multispeak.MR. ReadingChangedNotification.RetryCount (Customer configuration)	Number of retry attempts to send a SOAP message to the subscriber. Default is 5.
	Multispeak.MR. ReadingChangedNotification.MaxAuto Recoveries	If all configured retry attempts complete without success, the gateway enters an auto recovery state in which additional rounds of retries are scheduled. This value controls the maximum number of auto recovery cycles before undeliverable data is purged. A value of -1 indicates unlimited (i.e., data is never purged). Default is 32.
	Multispeak.MR. ReadingChangedNotification.AutoRecovery Interval	Time in **milliseconds** between auto recovery attempts. Default is `900000` (i.e., 15 minutes).
	Gateway.Publish.ReadingChanged (System configuration)	A **system level** on/off switch for the reading changed meter reading events published by the RNI core for register and snapshot reads. This is technically not a MultiSpeak configuration, but must be set to `True` in order for the MultiSpeak gateway to receive unsolicited read notifications changed and subsequently publish `ReadingChangedNotification`.

2.2.3.5 Error messages

	Error	Reasons
BUSINESS ERRORS	No response from meter	The device did not respond to the reading request. One possible reason may be that the device is not powered on. This may be a transient condition so the client should wait and retry.
	No routes to endpoint	The on-air message could not be sent to the meter because the RNI does not have any routes to it.
	Message throttled by communication module	The RNI's traffic management policy has **temporarily** blocked transmissions to the meter. The most common reason is the RNI already has a message queued or in transit for the meter. This is a transient condition so the client should wait and retry.
	Request was preempted	The request was aborted because a higher priority request preempted it.
	Could not retrieve meter read information from the meter response. The meter may be experiencing a power fail.	When the `InitiateMeterReadingsByMeterID` is sent in on-the-glass mode, a meter experiencing a power fail may result in this message being produced.

2.2.4 MeterEventNotification

This is a flexible multi-purpose notification for reporting many types of meter events.

2.2.4.1 *Sample notification*

The following is a meter event notification reporting **tamper** for meter 1001M.

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
  xmlns:cpsm="cpsm_V4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6"
        Branch="0" BuildString="Release" UserID="testuser" Pwd="testpass"
        AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:MeterEventNotification>
      <ver:events verb="Change" utility="ACME">
        <ver:eventInstances>
          <ver:eventInstance>
            <ver:meterID meterNo="1001M" serviceType="Electric"
                objectID="1001M" utility="ACME"/>
            <ver:meterEvent domain="3" domainPart="33"
                type="1" index="257" codeString="Tamper">
              3.33.1.257.</ver:meterEvent>
            <ver:timeStamp>2011-07-26T09:00:02.000-04:00</ver:timeStamp>
          </ver:eventInstance>
        </ver:eventInstances>
      </ver:events>
    </ver:MeterEventNotification>
  </soapenv:Body>
</soapenv:Envelope>
```

The following is a meter event notification reporting a **demand reset** for 1001M.

```
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Branch="0"
    Build="6" BuildString="Release" Company="Sensus" MajorVersion="4"
    MinorVersion="1" Pwd="mockpasswd" UserID="mockuser"
    xmlns="http://www.multispeak.org/Version_4.1_Release"/>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body>
    <ns2:MeterEventNotification
      xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
      xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
      xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:events verb="Change">
        <ns2:eventInstances>
          <ns2:eventInstance>
            <ns2:meterID meterNo="1001M" objectID="1001M"
              serviceType="Electric" utility="ACME"/>
            <ns2:meterEvent codeString="DemandReset" domain="3"
              domainPart="8" index="61" ns6:OutOfSequence="true"
              ns6:ResetCounter="123" type="1"
              xmlns:ns6="http://www.sensus.com/multispeak4">3.8.1.61.</ns2:meterEvent>
            <ver:timeStamp>2011-07-26T09:00:02.000-04:00</ver:timeStamp>
          </ns2:eventInstance>
        </ns2:eventInstances>
      </ns2:events>
      <ns2:transactionID>txId_001</ns2:transactionID>
    </ns2:MeterEventNotification>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.2.4.2 Notification parameters

	Attribute/Element	Usage
HEADER	*Common notification header attributes*	
BODY	transactionID	The `transactionID` from the RNI initiated request (if applicable) or empty otherwise. The correlation on the subscriber should handle unknown or empty values.
	events@verb*	Fixed value: Change.
	events@utility*	Utility code for the meters reporting events (CustomerID).
	eventInstances	Series of `eventInstance`. Event instances are optional. However, when an `eventInstance` is included, the values highlighted in **bold*** within the `eventInstance` are required.
	eventInstance/meterID@meterNo*	Meter number of the meter whose event is being reported.
	eventInstance/meterID@serviceType*	The service type for the meter.
	eventInstance/meterID@utility*	Utility code for the meter (CustomerID).
	eventInstance/meterID@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	eventInstance/meterEvent@codeString*	Refer to the following Meter Event Codes section of this document for details.
	eventInstance/meterEvent@domain*	Value based on IEC 61968-9 Table E.1.
	eventInstance/meterEvent@domainPart*	Value based on IEC 61968-9 Table E.2.
	eventInstance/meterEvent@type*	Value based on IEC 61968-9 Table E.3.
	eventInstance/meterEvent@index*	Value based on IEC 61968-9 Table E.4.
	eventInstance/meterEvent@value	Refer to the following Meter Event Codes section of this document for details.
	eventInstance/meterEvent@codeString	Optional textual description of the `meterEvent`. Refer to the following Meter Event Codes section of this document for details.
	eventInstance/meterEvent@ResetCounter (proprietary extension)	The value of the demand reset counter corresponding to this reset event.
	eventInstance/meterEvent@OutOfSequence (proprietary extension)	An indicator of whether the demand reset counter was out of sequence. This helps identify if a demand reset was performed on the meter using field tools (i.e., **not** using the RNI).
	eventInstance/timestamp	Time of event as known to the RNI.

2.2.4.2.1 Meter event codes

These values are derived from IEC 61968-9 Annex E EndDeviceEvent Category Enumerations. Meter event codes in these tables are represented using the following format:

<domain>.<domainpart>.<type>.<index>.<value>

The <value> portion is optional and is only provided if applicable to the particular event.

Caution: *The IEC 61968-9 document does not clearly delineate the* ***code string*** *values. For this reason,* ***integrators should develop to the meter event code rather than the code string.***

2.2.4.2.1.1 Electric meter events

Code String	Meter Event Code
Brown Out	3.38.1.150.
Clock Error	3.36.1.29.
Communications Warning	3.21.1.32.1
Corrupt Block	3.18.1.79.531
Customer Request	3.31.1.68.7
Dc Detected in circuit	3.21.1.538.
Demand Limiting Period	3.31.1.68.13
Device System Error	3.21.1.279.
Disconnect Load Side Voltage Sense	3.38.1.68.
EEPROM Failure -No Readable Blocks	3.18.1.79.526
EEPROM Read Error	3.18.1.78.
EEPROM Read Retry	3.18.1.79.535
EEPROM/HAN Write Timeout	3.18.1.79.536
Emergency Conservation Period	3.31.1.68.12
HARD EEPROM Fail	3.18.1.79.544
Hard Kwh Error	3.21.1.523.
High Temperature Detected	3.35.1.93.
Implied Power Fail	3.26.1.185.1
Implied Power Restore	3.26.1.216.1
Internal Firmware Error -200	3.18.1.79.527
Internal Firmware Error -400	3.18.1.79.528
Local Request	3.31.1.68.6
Locked Closed	3.31.1.68.10
Locked Open	3.31.1.68.9
Low Battery Voltage Electric	3.2.1.150.
Low Loss Potential	3.21.1.522.
Memory Block CRC Retry	3.18.1.79.532
Memory Block Write Error	3.18.1.79.533
Memory Full	3.18.1.200.

Code String	Meter Event Code
Memory Write Error	3.18.1.79.534
Memory Write Error	3.18.1.79.546
Memory Write Failure - No Free Blocks	3.18.1.79.529
Meter Read Failure	3.20.1.203.
Meter Unprogrammed	3.11.1.155.
Meter comms interface errors	3.23.1.157.
Meter register error	3.20.1.209.
Metrology A Ph distortion	3.25.1.600.1
Metrology B ph distortion	3.25.1.600.2
Metrology Bad Password	3.24.1.88.
Metrology Battery and Potential Failure	3.21.1.69.1
Metrology C ph distortion	3.25.1.600.3
Metrology Calibration Error	3.21.1.203.
Metrology Checksum Error	3.18.1.79.547
Metrology Code Error	3.21.1.127.
Metrology Configuration Error	3.21.1.40.
Metrology Cover Detect	3.10.1.257.
Metrology Cross Phase Received KWH	3.21.1.219.1
Metrology DC Detect	3.21.1.79.1
Metrology DSP Error	3.21.1.73.
Metrology Data Error	3.21.1.52.1
Metrology Demand Overload	3.8.1.178.
Metrology EEPROM Error	3.18.1.78.1
Metrology High Distortion	3.25.1.600.
Metrology High Line Current	3.6.1.94.1
Metrology High Temp	3.35.1.93.1
Metrology Inactive phase current	3.25.1.100.
Metrology Integrity Check	3.21.1.32.
Metrology Inversion Tamper	3.33.1.219.1
Metrology Leading KVARH	3.6.1.137.
Metrology Loss of Program	3.11.1.268.
Metrology Measurement Error	3.21.1.52.
Metrology Meter Chip Error	3.21.1.79.
Metrology Metering Error	3.21.1.209.
Metrology Non Volatile Memory Error	3.18.1.79.541
Metrology Over Voltage	3.21.1.93.
Metrology Over Voltage Phase A	3.21.1.93.1
Metrology Over Voltage Phase B	3.21.1.93.2
Metrology Over Voltage Phase C	3.21.1.93.3
Metrology Phase difference	3.25.1.159.

Code String	Meter Event Code
Metrology Processor Failed	3.21.1.193.
Metrology RAM Error	3.18.1.79.539
Metrology RAM TEST Fail	3.18.1.79.542
Metrology ROM Error	3.18.1.79.540
Metrology ROM TEST Fail	3.18.1.79.543
Metrology Received KWH	3.21.1.219.
Metrology Register Check Error	3.21.1.232.
Metrology SOFT EEPROM Fail	3.18.1.79.545
Metrology Sample Missing	3.21.1.203.1
Metrology System Error	3.21.1.79.2
Metrology Time Adjusted	3.21.1.264.
Metrology Under Voltage	3.21.1.150.
Metrology Under Voltage Phase A	3.21.1.150.1
Metrology Under Voltage Phase B	3.21.1.150.2
Metrology Under Voltage Phase C	3.21.1.150.3
Metrology Voltage Reference Error	3.38.1.79.
Metrology Voltage unbalance	3.38.1.98.
Metrology Watchdog Timeout	3.21.1.280.
Metrology Write Failed	3.18.1.79.529.1
Optical Port lockout	3.1.1.2.
Over Current	3.6.1.94.
Over Voltage	3.38.1.93.
Partial Data Mismatch	3.18.1.79.537
Power Fail	3.26.1.185.
Power Restore	3.26.1.216.
Processor Low Voltage	3.38.1.149.
RD Auto Correct	3.31.1.68.11
Read Data Quarantine	3.5.1.110.
Reverse Energy	3.33.1.219.
Service Limiting Close	3.31.1.68.1
Service Limiting Open Due To High Current	3.31.1.68.2
Service Limiting Open Due To High Demand	3.31.1.68.3
Single Phase B Fail	3.25.1.85.1
Single Phase C Fail	3.25.1.85.2
Single Phase Fail	3.25.1.85.
Soft Kwh Error	3.21.1.524.
Startup Load Limit	3.31.1.68.5
Startup Restore	3.31.1.68.4
Switch Auto-correction Initiated	3.31.1.525.2
Switch Auto-correction Initiated	3.31.1.525.1

Code String	Meter Event Code
Switch chatter detected	3.31.1.526.1
Switch in wrong state	3.31.1.159.1
Switch in wrong state	3.31.1.159.2
Tamper	3.33.1.257.
Time Adjusted	3.36.16.264.
Tou Schedule	3.31.1.68.8
Unstable Power	3.26.1.270.
DemandReset failed	3.8.1.62.x Specific failure indicated via the optional value of x as follows: x=0 (General error) x=5 (Transacton failure) x=6 (Too many attempts) x=7 (Process timeout) x=8 (Scheduling Failed)

2.2.4.2.1.2 Water meter events

The events in the following table are reported by NA2W water meters. This is the complete set of events supported by the MultiSpeak gateway. Actual events reported vary based on the specific SmartPoint/SmartMeter model or manufacturer, as well as installation configuration (not all devices support all events). Please consult the meter firmware specifications to identify events supported by the specific manufacturer/device.

Code String	Meter Event Code
Beyond End Of Life	503.21.1.521.
Bidirectional Communication Failed	503.19.1.32.1
Configuration Error	503.18.1.173.
Configuration Error	503.21.1.40.
Critical Hardware Warning	503.21.17.79.
Customer Leak	503.21.1.79.1
Customer Leak	503.21.1.79.
Cut Wire	503.33.1.184.
Dead Battery	503.2.1.17.
EMF Range	503.21.1.506.
Empty Pipe	503.21.1.503.
Encryption Failed	503.19.1.43.1
Failed To Complete Meter Firmware Upgrade	503.21.1.272.2
Failed To Start Meter Firmware Upgrade	503.21.1.272.1
Glide Slope	503.21.1.509.
Hardware Alerts Paused	503.2.2.139.1
Hardware Failure	503.21.17.79.3
Hardware Fault	503.21.17.79.2

Code String	Meter Event Code
High Current	503.6.1.93.
High Flow	503.21.1.507.1
High Flow	503.21.1.507.
Internal Communication Error	503.21.1.32.
Low Field	503.21.1.505.
Low Metrology Battery Volts	503.21.1.276.
Low SmartPoint Battery Volts	503.23.1.149.
Low Valve Battery Volts	503.510.1.149.
Magnetic Tamper	503.33.1.152.
Meter Communication Failed	503.23.1.32.1
Meter Disconnect Tamper	503.33.1.68.
Meter Read Failure	503.20.1.203.
Meter Reboot	503.21.1.31.
Near End Of Life	503.21.1.520.
Near End of Life	503.21.1.149.
Operational Alerts Paused	503.2.2.139.2
Pressure Alerts Paused	503.2.2.139.3
Read Data Quarantine	503.5.1.110.1
Register Error	503.21.1.203.5
Register Over Temperature	503.35.1.93.
Reverse Flow	503.33.1.219.
Reverse Flow	503.33.1.219.1
Swapped Meter	503.20.7.27.1
Temperature Alerts Paused	503.2.2.139.4
Tilt Tamper	503.33.1.257.1
Touch Read Failure	503.21.1.157.
Upgrade Mode	503.21.1.272.
Valve State Changed	503.641.1.530.
Valve Transition Failure	503.511.1.85.
Very Low Battery Start	503.21.1.525.
Beyond End Of Life	503.21.1.521.
Bidirectional Communication Failed	503.19.1.32.1
Configuration Error	503.18.1.173.
Configuration Error	503.21.1.40.
Critical Hardware Warning	503.21.17.79.
Customer Leak	503.21.1.79.1
Customer Leak	503.21.1.79.
Cut Wire	503.33.1.184.
Dead Battery	503.2.1.17.
EMF Range	503.21.1.506.

Code String	Meter Event Code
Empty Pipe	503.21.1.503.
Encryption Failed	503.19.1.43.1
Failed To Complete Meter Firmware Upgrade	503.21.1.272.2
Failed To Start Meter Firmware Upgrade	503.21.1.272.1
Glide Slope	503.21.1.509.
Hardware Alerts Paused	503.2.2.139.1
Hardware Failure	503.21.17.79.3
Hardware Fault	503.21.17.79.2
High Current	503.6.1.93.
High Flow	503.21.1.507.1

*Sent by the SmartMeter when SmartPoint and meter communicate in SmartMeter mode.

2.2.4.2.1.3 Gas device events

The events are reported by the gas meters or gas correctors.

Code String	Meter Event Code
Air In Meter	4.21.1.539.
Battery Door Tamper	4.10.1.257.1
Beyond End Of Life	4.21.1.521.
Bidirectional Communication Failed	4.19.1.32.
Broken Pipe 35 Day Gas	4.0.1.139.1
Calibration Lost	4.21.1.541.
Compensation Failure	4.13.1.543.
Configuration Lost	4.21.1.40.
Corrector Alarm	4.13.1.277.
Cut Wire 35 Day	4.33.1.184.
Cut Wire 35 Day	4.33.1.184.1
Excess Flow	4.0.1.139.
Hardware Alerts Paused	4.2.2.139.1
High Flow	4.29.1.515.
High Pressure	4.29.1.93.1
High Pressure Warning	4.29.1.93.2
Index Lost	4.21.1.540.
Low Battery	4.2.1.150.
Low Battery Voltage Gas Latched	4.21.1.149.1
Low Pressure	4.29.1.150.1
Low Pressure Warning	4.29.1.150.2
Low Voltage Alarm Gas	4.21.1.149.
Magnetic Tamper 35 Day	4.33.1.152.1
Memory Error	4.18.1.79.

Code String	Meter Event Code
Meter Communication Fail	4.21.1.32.1
Meter HW Failure	4.20.1.84.
Meter Power Reset	4.21.1.214.
Meter Reboot	4.21.1.31.
Metrology HW Failure	4.21.1.84.
Metrology Tamper	4.21.1.257.
Near End Of Life	4.21.1.520.
Non-standard operation	4.21.1.542.
Operational Alerts Paused	4.2.2.139.2
Optical Port Communication Failure	4.642.1.32.
Over Temperature	4.35.1.93.
Physical Tamper	4.33.1.263.
Pressure Alerts Paused	4.2.2.139.3
Pressure Compensation Failure	4.29.1.543.
Radio Communication Error	4.21.1.32.
Read Data Quarantine	4.5.1.110.2
Reverse Flow Gas SmartPoint Latched	4.33.1.219.1
Seismic Event	4.21.1.512.
Temperature Alerts Paused	4.2.2.139.4
Temperature Compensation Failure	4.35.1.543.
Tilt Tamper	4.33.1.263.1
Unknown Gas	4.21.1.543
Valve Malfunction	4.13.1.79.
Air In Meter	4.21.1.539.
Battery Door Tamper	4.10.1.257.1
Beyond End Of Life	4.21.1.521.
Broken Pipe 35 Day Gas	4.0.1.139.1
Calibration Lost	4.21.1.541.
Configuration Lost	4.21.1.40.
Cut Wire	4.33.1.184.
Cut Wire 35 Day	4.33.1.184.1
Excess Flow	4.0.1.139.
Corrector Alarm	4.13.1.277.
Hardware Alerts Paused	4.2.2.139.1
Hardware Alerts Resumed	4.2.2.139.0
High Flow	4.29.1.515.
High Pressure Alarm	4.29.1.93.1
High Pressure Warning	4.29.1.93.2
Index Lost	4.21.1.540.

Code String	Meter Event Code
Low Battery	4.2.1.150.
Low Battery Voltage Gas Latched	4.21.1.149.1
Low Pressure Alarm	4.29.1.150.1
Low Pressure Warning	4.29.1.150.2
Low Voltage Alarm Gas	4.21.1.149.
Magnetic Tamper 35 Day	4.33.1.152.1
Meter Comm Fail 35 Day Gas	4.21.1.32.1
Meter HW Failure	4.20.1.84.
Meter Power Reset	4.21.1.214.
Meter Reboot	4.21.1.31.
Metrology HW Failure	4.21.1.84.
Metrology Tamper	4.21.1.257.
Near End Of Life	4.21.1.520.
Non-standard operation	4.21.1.542.
Optical Port Communication Failure	4.642.1.32.
Over Temperature Alarm	4.35.1.93.
Physical Tamper	4.33.1.263.
Pressure Compensation Failure	4.29.1.543.
Radio Communication Error	4.21.1.32.
Reverse Flow Gas SmartPoint Latched	4.33.1.219.1
Seismic Event Alarm	4.21.1.512.
Temperature Compensation Failure	4.35.1.543.
Tilt Tamper 35 Day	4.33.1.263.1
Unsatisfactory Reading	4.620.1.515.3
Valve Malfunction	4.13.1.79.

2.2.4.2.1.4 Smart Gateway meter events

These events are supported by a Smart Gateway device.

Code String	Meter Event Code
15% of battery remaining	520.2.17.80.15
25% of battery remaining	520.2.17.80.25
5% of battery remaining	520.2.17.80.5
Battery Consumption Inside Range.	520.2.1.516.
Battery Consumption Outside Range.	520.2.1.515.
Digital Input A Alarm Gas	520.11.2.4.1
Digital Input A Alarm Gas Latched	520.11.2.4.3
Digital Input B Alarm Gas	520.11.2.4.2
Digital Input B Alarm Gas Latched	520.11.2.4.4
Digital Input A Alarm Water	520.11.2.4.1

Code String	Meter Event Code
Digital Input A Alarm Water Latched	520.11.2.4.3
Digital Input B Alarm Water	520.11.2.4.2
Digital Input B Alarm Water Latched	520.11.2.4.4

The following events may be reported by sensors attached to the NA2W meters or Smart Gateway devices. Not all events are supported by the sensors in every product. Consult product specific sensor information to determine which events are supported. The first part of the event code varies with the service type of the Smart Gateway to which the sensor is attached. It is **4** for gas and **503** for water.

Code String	Meter Event Code
Algae Change Rate Over Limit	503.627.1.517.
Algae Change Rate Under Limit	503.627.1.518.
Algae Inside Range	503.627.1.156.
Algae Outside Range	503.627.1.515.
Algae Over Limit	503.627.1.93.
Algae Under Limit	503.627.1.150.
Chlorophyll Change Rate Over Limit	503.628.1.517.
Chlorophyll Change Rate Under Limit	503.628.1.518.
Chlorophyll Inside Range	503.628.1.156.
Chlorophyll Outside Range	503.628.1.515.
Chlorophyll Over Limit	503.628.1.93.
Chlorophyll Under Limit	503.628.1.150.
Communications Failure Sensor	503.600.1.32.
Communications Failure Sensor	4.600.1.32.
Conductivity Change Rate Over Limit	503.623.1.517.
Conductivity Change Rate Under Limit	503.623.1.518.
Conductivity Inside Range	503.623.1.516.
Conductivity Outside Range	503.623.1.515.
Conductivity Over Limit	503.623.1.93.
Conductivity Under Limit	503.623.1.150.
Dissolved Oxygen Change Rate Over Limit	503.629.1.517.
Dissolved Oxygen Change Rate Under Limit	503.629.1.518.
Dissolved Oxygen Inside Range	503.629.1.156.
Dissolved Oxygen Outside Range	503.629.1.515.
Dissolved Oxygen Over Limit	503.629.1.93.
Dissolved Oxygen Under Limit	503.629.1.150.
Free Chlorine Change Rate Over Limit	503.633.1.517.
Free Chlorine Change Rate Under Limit	503.633.1.518.
Free Chlorine Inside Range	503.633.1.156.
Free Chlorine Outside Range	503.633.1.515.

Code String	Meter Event Code
Free Chlorine Over Limit	503.633.1.93.
Free Chlorine Under Limit	503.633.1.150.
High Level	503.622.1.93.
High Level	4.622.1.93.
High Pressure	503.620.1.93.
High Pressure	4.620.1.93.
High Temperature	4.621.1.93.
High Temperature	503.621.1.93.
Hydrogen Sulfide Change Rate Over Limit	503.630.1.517.
Hydrogen Sulfide Change Rate Under Limit	503.630.1.518.
Hydrogen Sulfide Inside Range	503.630.1.156.
Hydrogen Sulfide Outside Range	503.630.1.515.
Hydrogen Sulfide Over Limit	503.630.1.93.
Hydrogen Sulfide Under Limit	503.630.1.150.
Level Inside Range	4.622.1.516.
Level Inside Range	503.622.1.516.
Level Outside Range	503.622.1.515.
Level Outside Range	4.622.1.515.
Low Level	503.622.1.150.
Low Level	4.622.1.150.
Low Pressure	503.620.1.150.
Low Pressure	4.620.1.150.
Low Temperature	503.621.1.150.
Low Temperature	4.621.1.150.
Other Change Rate Over Limit	503.631.1.517.
Other Change Rate Under Limit	503.631.1.518.
Other Inside Range	503.631.1.156.
Other Outside Range	503.631.1.515.
Other Over Limit	503.631.1.93.
Other Under Limit	503.631.1.150.
PH Change Rate Over Limit	503.624.1.517.
PH Change Rate Under Limit	503.624.1.518.
PH Inside Range	503.624.1.516.
PH Outside Range	503.624.1.515.
PH Over Limit	503.624.1.93.
PH Under Limit	503.624.1.150.
Pressure Inside Range	4.620.1.516.
Pressure Inside Range	503.620.1.516.
Pressure Outside Range	503.620.1.515.

Code String	Meter Event Code
Pressure Outside Range	4.620.1.515.
Sensor Read Failure	4.600.1.157.
Sensor Read Failure	503.600.1.157.
Temperature Inside Range	503.621.1.516.
Temperature Inside Range	4.621.1.516.
Temperature Outside Range	503.621.1.515.
Temperature Outside Range	4.621.1.515.
Total Chlorine Change Rate Over Limit	503.632.1.517.
Total Chlorine Change Rate Under Limit	503.632.1.518.
Total Chlorine Inside Range	503.632.1.156.
Total Chlorine Outside Range	503.632.1.515.
Total Chlorine Over Limit	503.632.1.93.
Total Chlorine Under Limit	503.632.1.150.
Turbidity Change Rate Over Limit	503.626.1.517.
Turbidity Change Rate Under Limit	503.626.1.518.
Turbidity Inside Range	503.626.1.516.
Turbidity Outside Range	503.626.1.515.
Turbidity Over Limit	503.626.1.93.
Turbidity Under Limit	503.626.1.150.
Unsatisfactory Reading	4.620.1.515.3
Weight Change Rate Over Limit	503.625.1.157.
Weight Change Rate Under Limit	503.625.1.158.
Weight Inside Range	503.625.1.156.
Weight Outside Range	503.625.1.155.
Weight Over Limit	503.625.1.93.
Weight Under Limit	503.625.1.150.
Alga Inside Range	503.627.1.156.
Alga Outside Range	503.627.1.515.
Alga Over Limit	503.627.1.93.
Alga Under Limit	503.627.1.150.
Chlorophyll Inside Range	503.628.1.156.
Chlorophyll Outside Range	503.628.1.515.
Chlorophyll Over Limit	503.628.1.93.
Chlorophyll Under Limit	503.628.1.150.
Communications Failure Sensor	4.600.1.32.
Communications Failure Sensor	503.600.1.32.
Conductivity Inside Range	503.623.1.516.
Conductivity Outside Range	503.623.1.515.
Conductivity Over Limit	503.623.1.93.

Code String	Meter Event Code
Conductivity Under Limit	503.623.1.150.
Dissolved Oxygen Inside Range	503.629.1.156.
Dissolved Oxygen Outside Range	503.629.1.515.
Dissolved Oxygen Over Limit	503.629.1.93.
Dissolved Oxygen Under Limit	503.629.1.150.
Free Chlorine Inside Range	503.633.1.156.
Free Chlorine Outside Range	503.633.1.515.
Free Chlorine Over Limit	503.633.1.93.
Free Chlorine Under Limit	503.633.1.150.
High Pressure	503.620.1.93.
High Pressure	4.620.1.93.
High Temperature	4.621.1.93.
High Temperature	503.621.1.93.
Hydrogen Sulfide Inside Range	503.630.1.156.
Hydrogen Sulfide Outside Range	503.630.1.515.
Hydrogen Sulfide Over Limit	503.630.1.93.
Hydrogen Sulfide Under Limit	503.630.1.150.
Level/Distance Inside Range	503.622.1.516.
Level/Distance Inside Range	4.622.1.516.
Level/Distance Outside Range	4.622.1.515.
Level/Distance Outside Range	503.622.1.515.
Level/Distance Over Limit	503.622.1.93.
Level/Distance Over Limit	4.622.1.93.
Level/Distance Under Limit	4.622.1.150.
Level/Distance Under Limit	503.622.1.150.
Low Pressure	503.620.1.150.
Low Pressure	4.620.1.150.
Low Temperature	4.621.1.150.
Low Temperature	503.621.1.150.
Other Inside Range	503.631.1.156.
Other Outside Range	503.631.1.515.
Other Over Limit	503.631.1.93.
Other Under Limit	503.631.1.150.
PH Inside Range	503.624.1.516.
PH Outside Range	503.624.1.515.
PH Over Limit	503.624.1.93.
PH Under Limit	503.624.1.150.
Pressure Inside Range	503.620.1.516.
Pressure Inside Range	4.620.1.516.

Code String	Meter Event Code
Pressure Outside Range	4.620.1.515.
Pressure Outside Range	503.620.1.515.
Sensor Read Failure	503.600.1.157.
Sensor Read Failure	4.600.1.157.
Temperature Inside Range	4.621.1.516.
Temperature Inside Range	503.621.1.516.
Temperature Outside Range	503.621.1.515.
Temperature Outside Range	4.621.1.515.
Total Chlorine Inside Range	503.632.1.156.
Total Chlorine Outside Range	503.632.1.515.
Total Chlorine Over Limit	503.632.1.93.
Total Chlorine Under Limit	503.632.1.150.
Turbidity Inside Range	503.626.1.516.
Turbidity Outside Range	503.626.1.515.
Turbidity Over Limit	503.626.1.93.
Turbidity Under Limit	503.626.1.150.
Unsatisfactory Reading	4.620.1.515.3
Weight Inside Range	503.625.1.156.
Weight Outside Range	503.625.1.155.
Weight Over Limit	503.625.1.93.
Weight Under Limit	503.625.1.150.

2.2.4.2.2 Additional attributes

If additional information needs to be carried in an event, attributes may be added to the `meterEvent` element in the `MeterEventNotification`. For example for a demand reset event, the following additional attributes within the http://www.sensus.com/multispeak4 namespace may be present:

- ResetCounter – the current value of the DemandReset Counter returned from the meter.
- OutOfSequence – a Boolean indicating whether the RNI has detected a gap in the DemandReset Counters it has received from the meter. If true, it indicates that a DemandReset has taken place outside the visibility of the RNI, perhaps through a hand held device. Note: this attribute is not displayed when the value is false.
- StatusMessage – If present this String provides additional human readable information regarding the meterEvent.

2.2.4.3 Expected response

Responses are *mandatory* when a `MeterEventNotification` request is published. The expected response is a `MeterEventNotificationResponse` or a SOAP Fault. Either of these responses will be interpreted as a successful delivery (regardless of errors returned in the response). If no response is provided, redelivery may be attempted depending on reliable delivery configuration.

2.2.4.4 Configuration properties

	Property name	Usage
DATABASE	Gateway.Publish.MeterEvent (System configuration)	A **system level** on/off switch for the meter events published by the RNI core. This is technically not a MultiSpeak configuration but must be set to `True` in order for the MultiSpeak gateway to receive **meter events** and subsequently publish them.
	Multispeak.MR.MeterEvent.Destination Enabled (Customer configuration)	An on/off switch for the meter event notification client in the RNI. This should be set to True when the remote service is ready to accept these notifications. Default is `False`.
	Multispeak.MR.MeterEvent.DestinationURL (Customer configuration)	The URL of the destination web service (e.g., https://www.myhost.com/multispeak/mdm).
	Multispeak.MR.MeterEvent.DestinationUserId (Customer configuration)	The user ID on the remote system to be used by the RNI gateway. This is the value used for the `UserID` header attribute of the request.
	Multispeak.MR.MeterEvent.Destination Password (Customer configuration)	The password corresponding to the user account on the remote system (see above). This is the value used for the Pwd header attribute of the request.
	Multispeak.MR.MeterEvent.BatchSize (Customer configuration)	The number of events the MR system will batch per SOAP message e.g., a value of 100 means that MR will wait until it receives 100 events for that destination and then forward them on in one MeterEventNotification message. If both batch size and batch times are specified, then either condition may trigger the SOAP message to be sent. Default is 5.
	Multispeak.MR.MeterEvent.BatchTime (Customer configuration)	The time in milliseconds that the MR system will hold events to batch into a SOAP message. For example, a value of 5000 means that MR will buffer events for 5 seconds before sending them in **one** MeterEventNotification message. **Note**: Even if the batching is primarily being controlled with the batchSize property, a non-zero value should always be specified for the batch time property so that readings do not get buffered in the MR system indefinitely. Default is `100`.

	Property name	Usage
	Multispeak.MR.MeterEvent.MaxCache Count (Customer configuration)	Maximum number of caches that the notification client should keep in play. A higher number of caches provides a better tolerance to slow consumers and event floods because the notification client has a bigger sandbox for processing events. This value should be bounded depending on the available memory on the server. Recommend that the value in a production system be 2 or higher. Default is `100`.
	Multispeak.MR.MeterEvent.RetryCount (Customer configuration)	Number of retry attempts to send a SOAP message to the subscriber. Default is `5`.
	Multispeak.MR.MeterEvent.RetryInterval (Customer configuration)	Time in **milliseconds** between retry attempts. Default is `150000` (i.e., 2 ½ minutes).
	Multispeak.MR.MeterEvent.MaxAuto Recoveries	If all configured retry attempts have completed without success, the gateway will enter an auto recovery state in which additional rounds of retries will be scheduled. This value controls the maximum number of auto recovery cycles before undeliverable data is purged. (-1 is unlimited i.e., data is never purged). Default is `32`.
	Multispeak.MR.MeterEvent.AutoRecovery Interval	Time in **milliseconds** between auto recovery attempts. Default is `900000` (i.e., 15 minutes).
	Multispeak.MR.MeterEventNotification.DR. DestinationEnabled (Customer configuration)	Enables or disables the sending of MultiSpeak MeterEventNotifications related to Demand Reset.
	Multispeak.MR.MeterEventNotification.DR. DestinationURL (Customer configuration)	The URL of the destination web service where the Demand Reset events should be sent, (e.g., https://www.myhost.com/multispeak/mdm).
	Multispeak.MR.MeterEventNotification.DR. DestinationUserId (Customer configuration)	The userid to be included in the MultiSpeakMsgHeader of MeterEventNotifications related to DemandReset.
	Multispeak.MR.MeterEventNotification.DR. DestinationPassword (Customer configuration)	The password to be included in the MultiSpeakMsgHeader of MeterEventNotifications related to DemandReset.

2.2.4.4.1 Configuration properties for Demand Reset events

The MeterEventNotification is used to convey the result of an InitiateDemandReset request. These will most likely go to a different destination than all the other meter events, hence the gateway has separate configurations for the demand reset events. At present the demand reset events are only *solicited* notifications.

	Property name	Usage
DATABASE	Multispeak.MR.MeterEventNotification.DR.DestinationEnabled (Customer configuration)	Enables or disables the sending of MultiSpeak MeterEventNotifications related to Demand Reset.
	Multispeak.MR.MeterEventNotification.DR.DestinationURL (Customer configuration)	The URL of the destination web service where the Demand Reset events should be sent, e.g., https://www.myhost.com/multispeak/mdm
	Multispeak.MR.MeterEventNotification.DR.DestinationUserId (Customer configuration)	The userid to be included in the MultiSpeakMsgHeader of MeterEventNotifications related to DemandReset.
	Multispeak.MR.MeterEventNotification.DR.DestinationPassword (Customer configuration)	The password to be included in the MultiSpeakMsgHeader of MeterEventNotifications related to DemandReset.

2.2.5 MeterInstalledNotification

This notification is sent out in response to InitiateMeterInstallation SOAP request. The resulting error, if any, will be reported in the *errorString* attribute of the meter. If the operation is successful the *errorString* attribute will be absent or empty in the corresponding meter element.

The *InitiateMeterInstallation* request can contain multiple service locations and meters. But a notification will always have **only one** meter, which means the client will receive one separate notification for every meter in the request.

Note that the RNI database will be updated with the information that was provided in the *InitiateMeterInstallation* request regardless of any success or failure that may occur attempting to verify communications with the meter.

2.2.5.1 Sample notification

The following shows a sample notification with one electric meter.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
       AppVersion="4.3.0-SNAPSHOT"
       Branch="0" Build="6" BuildString="Release"
       Company="Sensus" MajorVersion="4" MinorVersion="1" Pwd="testpass" UserID="testuser"
       xmlns="http://www.multispeak.org/Version_4.1_Release"/>
   </SOAP-ENV:Header>
   <SOAP-ENV:Body>
       <ns2:MeterInstalledNotification xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
       xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
       xmlns:ns5="http://www.w3.org/1999/xlink">
         <ns2:addedMeters>
            <ns2:electricMeters>
               <ns2:electricMeter objectID="1N6032288359" utility="ACME">
```

```
                <ns2:meterNo>1N6032288359</ns2:meterNo>
                <ns2:meterStatusList>
                    <ns2:meterStatus>MeterDataUpdated</ns2:meterStatus>
                </ns2:meterStatusList>
                <ns2:utilityInfo>
                   <ns2:serviceLocationID>Service001</ns2:serviceLocationID>
                </ns2:utilityInfo>
             </ns2:electricMeter>
          </ns2:electricMeters>
       </ns2:addedMeters>
       <ns2:transactionID>123456</ns2:transactionID>
    </ns2:MeterInstalledNotification>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

The following shows a sample notification with one electric meter where communication with the meter was verified.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
       <SOAP-ENV:Header>
              <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
               AppVersion="4.3.0-SNAPSHOT"
               Branch="0" Build="6" BuildString="Release"
               Company="Sensus" MajorVersion="4" MinorVersion="1"
               Pwd="testpass" UserID="testuser"
               xmlns="http://www.multispeak.org/Version 4.1 Release"/>
       </SOAP-ENV:Header>
       <SOAP-ENV:Body>
              <ns2:MeterInstalledNotificatio>
               xmlns:ns2=http://www.multispeak.org/Version 4.1 Release
               xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
               xmlns:ns5="http://www.w3.org/1999/xlink">
              <ns2:addedMeters>
                     <ns2:electricMeters>
                            <ns2:electricMeter objectID="1N6032288359" utility="ACME">
                                   <ns2:meterNo>1N6032288359</ns2:meterNo>
                                   <ns2:meterStatusList>
                                   <ns2:meterStatus>CommunicationEstablished</ns2:meterStatus>
                                   </ns2:meterStatusList>
                                   <ns2:utilityInfo>
                                   <ns2:serviceLocationID>Service001</ns2:serviceLocationID>
                                   </ns2:utilityInfo>
                                   </ns2:electricMeter>
                            </ns2:electricMeters>
              </ns2:addedMeters>
              <ns2:transactionID>123456</ns2:transactionID>
              </ns2:MeterInstalledNotification>
       </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

The following shows a sample notification with one electric meter where communication with the meter failed due to a lack of a route to the meter.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
       <SOAP-ENV:Header>
              <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
                                   AppVersion="4.3.0-SNAPSHOT"
                                   Branch="0" Build="6" BuildString="Release"
                                   Company="Sensus" MajorVersion="4" MinorVersion="1"
                                   Pwd="testpass" UserID="testuser"
                                   xmlns="http://www.multispeak.org/Version 4.1 Release"/>
       </SOAP-ENV:Header>
       <SOAP-ENV:Body>
              <ns2:MeterInstalledNotification
                   xmlns:ns2=http://www.multispeak.org/Version 4.1 Release
                   xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
                   xmlns:ns5="http://www.w3.org/1999/xlink">
              <ns2:addedMeters>
```

```
                        <ns2:electricMeters>
                                <ns2:electricMeter errorString="NO_ROUTE_TO_DEVICE">
                                        <ns2:comments>MeterSampleRate | NO_ROUTES_TO_DEVICE
executing GET (CMD: 8|P015SetupPing)</ns2:comments>
                                        <ns2:meterNo>1N6024013213</ns2:meterNo>
                                </ns2:electricMeter>
                        </ns2:electricMeters>
                </ns2:addedMeters>
                <ns2:transactionID>123456</ns2:transactionID>
                </ns2:MeterInstalledNotification>
        </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

The following shows a sample notification with one electric meter where communication with the meter failed due to a lack of a response from the meter.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
        <SOAP-ENV:Header>
                <MultiSpeakMsgHeader AppName="RNI Gateway (MR)"
                                     AppVersion="4.3.0-SNAPSHOT"
                                     Branch="0" Build="6" BuildString="Release"
                                     Company="Sensus" MajorVersion="4" MinorVersion="1"
                                     Pwd="testpass" UserID="testuser"
                                     xmlns="http://www.multispeak.org/Version_4.1_Release"/>
        </SOAP-ENV:Header>
        <SOAP-ENV:Body>
                <ns2:MeterInstalledNotification
                    xmlns:ns2=http://www.multispeak.org/Version_4.1_Release
                    xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
                    xmlns:ns5="http://www.w3.org/1999/xlink">
                        <ns2:addedMeters>
                        <ns2:electricMeters>
                                <ns2:electricMeter errorString="DEVICE_RESPONSE_TIMEOUT">
                                        <ns2:comments>MeterSampleRate | ALL_ROUTES_ATTEMPTED
executing GET (CMD: 8|P015SetupPing)</ns2:comments>
                                        <ns2:meterNo>1N6024013213</ns2:meterNo>
                                </ns2:electricMeter>
                        </ns2:electricMeters>
                        </ns2:addedMeters>
                        <ns2:transactionID>123456</ns2:transactionID>
                </ns2:MeterInstalledNotification>
        </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.2.5.2 *Notification parameters*

	Attribute/Element	Usage
HEADER	*Common notification header attributes*	
BODY	transactionID	The `transactionID` from the initiated request. Subscribing applications can use this to correlate an `InitiateMeterInstallation` with this notification.
	addedMeters/electricMeters/	Series of electric meters
	electricMeter@utility	Utility code for the meter (CustomerID).
	electricMeter@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.

	Attribute/Element	Usage
	electricMeter@errorString	This will have the error, if any, for the meter during the processing of the `InitiateMeterInstallation` request. If the processing is successful the attribute may be absent or empty.
	electricMeter/meterNo	The identifier for the meter assigned by the utility (the MeterID).
	electricMeter/comments	Comments containing additional details of any errors. If the processing is successful the element may be absent or empty.
	electricMeter/meterStatusList	Series of status strings.
	meterStatusList/meterStatus	This will have the value *MeterDataUpdated* if the operation completed successfully, but no attempt was made to verify communication with the meter. If there was an attempt to verify meter communication and it was successful, it will have the value *CommunicationEstablished*.
	electricMeter/utilityInfo	Utility Info for a meter.
	utilityInfo/serviceLocationID	Location ID.
	addedMeters/waterMeters/	Series of water meters.
	(same structure as electric meter)	
	addedMeters/gasMeters/	Series of gas meters (same structure as electric meter).
	(same structure as electric meter)	

2.2.5.3 Expected response

Responses are *mandatory* when an asynchronous `MeterInstalledNotification` is published. The expected response is a `MeterInstalledNotificationResponse` or a SOAP Fault. Either of these responses will be interpreted as a successful delivery (regardless of errors returned in the response.

2.2.6 Meter exchange notification

This notification is sent out in response to InitiateMeterExchange SOAP request. The notification will contain all exchanges that were successfully processed. The exchanges in the request that have failed and reported in the immediate/synchronous response is not included in the notification.

2.2.6.1 Sample notification

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ver="http://www.multispeak.org/Version_4.1_Release" xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6" Branch="0"
BuildString="RELEASE" UserID="testUser" Pwd="testPass" SessionID="779" AppName="RNI Gateway (MR)"
AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
   </soapenv:Header>
   <soapenv:Body>
      <ver:MeterExchangeNotification>
         <ver:meterChangeout objectID="Request1234">
            <ver:electricMeterExchanges>
               <ver:electricMeterExchange>
                  <ver:serviceLocationID>SL01</ver:serviceLocationID>
                  <ver:outMeterReading>
                     <ver:meterID meterNo="GE5555" objectID="GE5555" serviceType="Electric"
utility="ACME">ACME.GE5555</ver:meterID>
```

```
                    </ver:outMeterReading>
                    <ver:inMeterReading>
                       <ver:meterID meterNo="GE12345" objectID="GE12345" serviceType="Electric"
utility="ACME">ACME.GE12345</ver:meterID>
                    </ver:inMeterReading>
                    <ver:timeStamp>2016-08-20T15:07:00.000-05:00</ver:timeStamp>
                 </ver:electricMeterExchange>
              </ver:electricMeterExchanges>
              <ver:waterMeterExchanges/>
              <ver:gasMeterExchanges/>
              <ver:propaneMeterExchanges/>
           </ver:meterChangeout>
        </ver:MeterExchangeNotification>
     </soapenv:Body>
</soapenv:Envelope>
```

2.2.6.2 Notification parameters

	Attribute/Element	Usage
HEADER	*Common request header attributes*	
BODY	meterChangeout	List of exchange data.
	meterChangeout@objectID	`TransactionID` of the `InitiateMeterExchage` request that resulted in this notification. **Note**: The MultiSpeak standard does not provide a `transactionID` element in the notification, and hence, the objectID is being used.
	meterChangeout/electricMeterExchanges	List of electric meter exchange.
	electricMeterExchange@errorString	The error message while processing the meter, if any. If the operation was successful the attribute will be absent or the value will be empty.
	electricMeterExchange/serviceLocationID	Service location where the meter was installed.
	electricMeterExchange/outMeterReading/meterID	The meter being swapped out.
	electricMeterExchange/outMeterReading/meterID@meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeterExchange/outMeterReading/meterID@objectID*	Same as the meterNo.
	electricMeterExchange/outMeterReading/meterID@utility	The owner for this meter (the CustomerID).
	electricMeterExchange/inMeterReading/meterID	The meter being swapped in.

	Attribute/Element	Usage
	electricMeterExchange/inMeterReading/meterID@meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeterExchange/inMeterReading/meterID@objectID*	Same as the meterNo.
	exchanges/waterMeterExchanges (Properties are same as electricMeterExchange)	List of water meter exchanges.
	exchanges/gasMeterExchanges (Properties are same as electricMeterExchange)	List of gas meter exchanges.

2.2.6.3 *Error messages*

	Error	Reasons
BUSINESS ERRORS	Device not found	The RNI does not contain the specified meter ID.
	Device in unexpected lifecycle state	The meter is not in the expected lifecycle state in the RNI. The In meter is expected to be in the *Installed* lifecycle state and the Out meter is expected to be in the *InInventory* lifcycle state.

2.2.7 HistoryLogChangedNotification

This is a solicited notification sent in response to an InitiateHistoryLogRequestByMeterID. This notification contains C12.19 log table data.

2.2.7.1 *Sample notification*

This is a history log changed notification reporting one standard and one manufacturer event for meter 1001M from C12.19 standard table 76.

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                                xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
                                xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader
            xmlns="http://www.multispeak.org/Version_4.1_Release"
            AppName="RNI Gateway (MR)"
            AppVersion="4.3.0-SNAPSHOT" Branch="0" Build="6"
            BuildString="Release" Company="Sensus" MajorVersion="4"
            MinorVersion="1" Pwd="testpass" UserID="testuser"/>
         </soapenv:Header>
   <soapenv:Body>
     <ver:HistoryLogChangedNotification>
        <ver:changedHistoryLogs>
         <ver:historyLog verb="Change">
          <ver:extensionsList>
                <ver:extensionsItem>
                      <ver:extName>transactionID</ver:extName>
                      <ver:extValue>1-23x</ver:extValue>
                      <ver:extType>String</ver:extType>
                </ver:extensionsItem>
                <ver:extensionsItem>
                      <ver:extName>C1219TableType</ver:extName>
                      <ver:extValue>Std</ver:extValue>
                      <ver:extType>String</ver:extType>
                </ver:extensionsItem>
                <ver:extensionsItem>
                      <ver:extName>C1219TableNumber</ver:extName>
                      <ver:extValue>76</ver:extValue>
```

```
                    <ver:extType>Integer</ver:extType>
                </ver:extensionsItem>
                    <ver:extName>C1219TableDescription</ver:extName>
                    <ver:extValue>Event Log Table</ver:extValue>
                    <ver:extType>String</ver:extType>
                </ver:extensionsItem>
                <ver:extensionsItem>
                    <ver:extName>AMRDeviceType</ver:extName>
                    <ver:extValue>105</ver:extValue>
                    <ver:extType>String</ver:extType>
                </ver:extensionsItem>
                <ver:extensionsItem>
                    <ver:extName>AMRVendor</ver:extName>
                    <ver:extValue>Sensus</ver:extValue>
                    <ver:extType>String</ver:extType>
                </ver:extensionsItem>
                <ver:extensionsItem>
                    <ver:extName>AMRDeviceDescription</ver:extName>
                    <ver:extValue>Aclara I210+c SmartMeter</ver:extValue>
                    <ver:extType>String</ver:extType>
                </ver:extensionsItem>
            </ver:extensionsList>
            <ver:meterID
                        meterNo="1001M" serviceType="Electric"
                        objectID="1001"
                        utility="ACME">ACME.Electric.1001M</ver:meterID>
            <ver:eventList>
                <ver:event sequenceNumber="1">
                 <ver:dateTime>2011-11-15T22:20:30.404</ver:dateTime>
                      <ver:meterEvent
                       domain="3" domainPart="21" type="600" index="0" value="11"
                       codeString="Electric Meter Metrology Manufacturer Event 11"
                       ns6:descDisplay="Diagnostic 6-Under Voltage"
                      xmlns:ns6="http://www.sensus.com/multispeak4">
                          3.21.600.0.11
                      </ver:meterEvent>
                      <ver:userID>002</ver:userID>
                      <ver:argument>0x05</ver:argument>
                </ver:event>
                <ver:event sequenceNumber="2">
                      <ver:dateTime>2011-11-15T22:21:18.297</ver:dateTime>
                      <ver:meterEvent
                       domain="3" domainPart="26" type="1" index="216"
                       codeString="Power Restored"
                       ns6:descDisplay="Primary Power Up"
                      xmlns:ns6="http://www.sensus.com/multispeak4">
                          3.26.1.216.
                      </ver:meterEvent>
                      <ver:userID>002</ver:userID>
                </ver:event>
            </ver:eventList>
          </ver:historyLog>
     </ver:changedHistoryLogs>
     </ver:HistoryLogChangedNotification>
   </soapenv:Body>
</soapenv:Envelope>
```

This is a history log changed notification reporting one sag and one swell from C12.19 manufacturer table 112 (Voltage Event Monitor Log Table) for meter 1001M (an Aclara i210+c meter).

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                                xmlns:ver="http://www.multispeak.org/Version 4.1 Release"
                                xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader
            xmlns="http://www.multispeak.org/Version 4.1 Release"
            AppName="RNI Gateway (MR)"
            AppVersion="4.3.0-SNAPSHOT" Branch="0" Build="6"
            BuildString="Release" Company="Sensus" MajorVersion="4"
```

```
        MinorVersion="1" Pwd="testpass" UserID="testuser"/>
      </soapenv:Header>
<soapenv:Body>
  <ver:HistoryLogChangedNotification>
     <ver:changedHistoryLogs>
      <ver:historyLog verb="Change">
       <ver:extensionsList>
             <ver:extensionsItem>
                   <ver:extName>transactionID</ver:extName>
                   <ver:extValue>2-18b</ver:extValue>
                   <ver:extType>String</ver:extType>
             </ver:extensionsItem>
             <ver:extensionsItem>
                   <ver:extName>C1219TableType</ver:extName>
                   <ver:extValue>Mfg</ver:extValue>
                   <ver:extType>String</ver:extType>
             </ver:extensionsItem>
             <ver:extensionsItem>
                   <ver:extName>C1219TableNumber</ver:extName>
                   <ver:extValue>112</ver:extValue>
                   <ver:extType>Integer</ver:extType>
             </ver:extensionsItem>
             <ver:extensionsItem>
                   <ver:extName>C1219TableDescription</ver:extName>
                   <ver:extValue>Voltage Event Monitor Log Table</ver:extValue>
                   <ver:extType>String</ver:extType>
             </ver:extensionsItem>
             <ver:extensionsItem>
                   <ver:extName>AMRDeviceType</ver:extName>
                   <ver:extValue>105</ver:extValue>
                   <ver:extType>String</ver:extType>
             </ver:extensionsItem>
             <ver:extensionsItem>
                   <ver:extName>AMRVendor</ver:extName>
                   <ver:extValue>Sensus</ver:extValue>
                   <ver:extType>String</ver:extType>
             </ver:extensionsItem>
             <ver:extensionsItem>
                   <ver:extName>AMRDeviceDescription</ver:extName>
                   <ver:extValue>Aclara I210+c SmartMeter</ver:extValue>
                   <ver:extType>String</ver:extType>
             </ver:extensionsItem>
       </ver:extensionsList>
       <ver:meterID
                    meterNo="1001M" serviceType="Electric"
                    objectID="1001"
                    utility="ACME">ACME.Electric.1001M</ver:meterID>
       <ver:eventList>
            <ver:event sequenceNumber="1">
             <ver:dateTime>2016-08-21T22:20:30.404</ver:dateTime>
                  <ver:meterEvent
                   domain="3" domainPart="38" type="17" index="223"
                   codeString="Voltage sag"
                   ns6:descDisplay="Sag"
                   ns6:voltagePhaseA="213.1"
                   ns6:duration="5"
                   xmlns:ns6="http://www.sensus.com/multispeak4">
                     3.38.17.223.
                  </ver:meterEvent>
             </ver:event>
             <ver:event sequenceNumber="2">
             <ver:dateTime>2016-08-23T22:28:30.173</ver:dateTime>
                  <ver:meterEvent
                   domain="3" domainPart="38" type="17" index="248"
                   codeString="Voltage swell condition"
                   ns6:descDisplay="Swell"
                   ns6:voltagePhaseA="230.8"
                   ns6:duration="2"
                   xmlns:ns6="http://www.sensus.com/multispeak4">
                     3.38.17.248.
                  </ver:meterEvent>
```

```
                </ver:event>
            </ver:eventList>
        </ver:historyLog>
    </ver:changedHistoryLogs>
    </ver:HistoryLogChangedNotification>
   </soapenv:Body>
</soapenv:Envelope>
```

This is a history log changed notification reporting firmware download logs C12.19 manufacturer table 42 for meter 1001M (an Aclara kV2c meter).

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                                xmlns:ver="http://www.multispeak.org/Version 4.1 Release"
                                xmlns:cpsm="cpsm_V4.1_Release">
   <soapenv:Header>
      <ver:MultiSpeakMsgHeader
            xmlns="http://www.multispeak.org/Version 4.1 Release"
            AppName="RNI Gateway (MR)"
            AppVersion="4.3.0-SNAPSHOT" Branch="0" Build="6"
            BuildString="Release" Company="Sensus" MajorVersion="4"
            MinorVersion="1" Pwd="testpass" UserID="testuser"/>
         </soapenv:Header>
   <soapenv:Body>
     <ver:HistoryLogChangedNotification>
        <ver:changedHistoryLogs>
              <ns2:extensionsList>
                 <ns2:extensionsItem>
                    <ns2:extName>transactionID</ns2:extName>
                    <ns2:extValue>1-25x-fwdlLogs</ns2:extValue>
                    <ns2:extType>string</ns2:extType>
                 </ns2:extensionsItem>
                 <ns2:extensionsItem>
                    <ns2:extName>C1219TableNumber</ns2:extName>
                    <ns2:extValue>42</ns2:extValue>
                    <ns2:extType>integer</ns2:extType>
                 </ns2:extensionsItem>
                 <ns2:extensionsItem>
                    <ns2:extName>C1219TableType</ns2:extName>
                    <ns2:extValue>Mfg</ns2:extValue>
                    <ns2:extType>string</ns2:extType>
                 </ns2:extensionsItem>
                 <ns2:extensionsItem>
                    <ns2:extName>C1219TableDescription</ns2:extName>
                    <ns2:extValue>Firmware Download Log Events</ns2:extValue>
                    <ns2:extType>string</ns2:extType>
                 </ns2:extensionsItem>
                 <ns2:extensionsItem>
                    <ns2:extName>AMRDeviceDescription</ns2:extName>
                    <ns2:extValue>Aclara kV2c</ns2:extValue>
                    <ns2:extType>string</ns2:extType>
                 </ns2:extensionsItem>
                 <ns2:extensionsItem>
                    <ns2:extName>AMRDeviceType</ns2:extName>
                    <ns2:extValue>109</ns2:extValue>
                    <ns2:extType>string</ns2:extType>
                 </ns2:extensionsItem>
                 <ns2:extensionsItem>
                    <ns2:extName>AMRVendor</ns2:extName>
                    <ns2:extValue>SENS</ns2:extValue>
                    <ns2:extType>string</ns2:extType>
                 </ns2:extensionsItem>
              </ns2:extensionsList>
              <ns2:meterID meterNo="82175813" objectID="82175813" serviceType="Electric"
utility="ACME"/>
              <ns2:eventList>
                 <ns2:event sequenceNumber="26">
                    <ns2:dateTime>2019-03-25T19:07:11.000</ns2:dateTime>
```

```
                    <ns2:meterEvent codeString="Download Started" domain="3" domainPart="11"
index="72" ns6:descDisplay="Download Started" type="0" value="1"
xmlns:ns6="http://www.sensus.com/multispeak4">3.11.0.72.1</ns2:meterEvent>

<ns2:argument>{"RawHexadecimalEventInfo":"000000000000000000000000","imageVersion":4,"imageRevisi
on":14,"imageBuild":7,"imageSignature":"7901780405e9e001"}</ns2:argument>
                 </ns2:event>
                 <ns2:event sequenceNumber="27">
                    <ns2:dateTime>2019-03-25T19:13:19.000</ns2:dateTime>
                    <ns2:meterEvent codeString="Download Completed" domain="3" domainPart="11"
index="72" ns6:descDisplay="Download Completed" type="0" value="2"
xmlns:ns6="http://www.sensus.com/multispeak4">3.11.0.72.2</ns2:meterEvent>

<ns2:argument>{"RawHexadecimalEventInfo":"080e0427a6dfce26b1966700","imageVersion":4,"imageRevisi
on":14,"imageBuild":7,"imageSignature":"7901780405e9e001"}</ns2:argument>
                 </ns2:event>
                 <ns2:event sequenceNumber="28">
                    <ns2:dateTime>2019-03-25T19:13:38.000</ns2:dateTime>
                    <ns2:meterEvent codeString="Image Ready" domain="3" domainPart="11"
index="72" ns6:descDisplay="Image Ready" type="0" value="3"
xmlns:ns6="http://www.sensus.com/multispeak4">3.11.0.72.3</ns2:meterEvent>

<ns2:argument>{"RawHexadecimalEventInfo":"080e0427a6dfce26b1966700","imageVersion":4,"imageRevisi
on":14,"imageBuild":7,"imageSignature":"7901780405e9e001"}</ns2:argument>
                 </ns2:event>
                 <ns2:event sequenceNumber="29">
                    <ns2:dateTime>2019-03-25T19:13:38.000</ns2:dateTime>
                    <ns2:meterEvent codeString="Activate Request" domain="3" domainPart="11"
index="72" ns6:descDisplay="Activate Request" type="0" value="5"
xmlns:ns6="http://www.sensus.com/multispeak4">3.11.0.72.5</ns2:meterEvent>

<ns2:argument>{"RawHexadecimalEventInfo":"000000000000000000000000","imageVersion":4,"imageRevisi
on":14,"imageBuild":7,"imageSignature":"7901780405e9e001"}</ns2:argument>
                 </ns2:event>
                 <ns2:event sequenceNumber="30">
                    <ns2:dateTime>2019-03-25T19:13:49.000</ns2:dateTime>
                    <ns2:meterEvent codeString="Activate Successful" domain="3" domainPart="11"
index="72" ns6:descDisplay="Activate Successful" type="0" value="6"
xmlns:ns6="http://www.sensus.com/multispeak4">3.11.0.72.6</ns2:meterEvent>

<ns2:argument>{"RawHexadecimalEventInfo":"7901780405e9e00100000000","imageVersion":4,"imageRevisi
on":14,"imageBuild":8,"imageSignature":"27a6dfce26b19667"}</ns2:argument>
                 </ns2:event>
                  </ns2:eventList>
    </ver:changedHistoryLogs>
    </ver:HistoryLogChangedNotification>
   </soapenv:Body>
</soapenv:Envelope>
```


2.2.7.2 Notification parameters

	Attribute/Element	Usage
HEADER	*Common notification header attributes*	
BODY	transactionID	The `transactionID` from the RNI initiated request (if applicable) or empty otherwise. The correlation on the subscriber should handle unknown or empty values.
	historyLog@verb*	Fixed value “Change.”

<table>
<tr><th></th><th>Attribute/Element</th><th>Usage</th></tr>
<tr><td></td><td>extensionsList*</td><td>Required extensions:
<table>
<tr><th>Name</th><th>Type</th><th>Value</th></tr>
<tr><td>C1219TableIType[1]</td><td>String</td><td>“Mfg”-manufacturer or “Std” -standard</td></tr>
<tr><td>C1219TableNumber[1]</td><td>Integer</td><td>Numeric table number e.g., “76.”</td></tr>
<tr><td>C1219TableDescription</td><td>String</td><td>“Event Log Table” or “Voltage Event Monitor Table”</td></tr>
<tr><td>AMRDeviceType</td><td>String</td><td>Sensus defined device identifier e.g., “105.”</td></tr>
<tr><td>AMRVendor</td><td>String</td><td>“Sensus”</td></tr>
<tr><td>AMRDeviceDescription</td><td>String</td><td>Sensus defined textual device description.</td></tr>
</table>
Optional Extensions:
<table>
<tr><th>Name</th><th>Type</th><th>Value</th></tr>
<tr><td>transactionID</td><td>String</td><td>The <code>transactionID</code> from the initiate request (if applicable).</td></tr>
</table>
Note 1: Currently supported C12.19 tables are ‘Std’ ‘76’ and ‘Mfg’ ‘112’.</td></tr>
<tr><td></td><td>eventList</td><td>Series of event elements. Events are optional. However, when an event is included, the values highlighted in bold* within the event are required.</td></tr>
<tr><td></td><td>event@sequenceNumber</td><td>Sequence corresponding to the C12.19 log table entry.</td></tr>
<tr><td></td><td>event/meterEvent@codeString*</td><td>Refer to the Meter event codes section of this document for details.</td></tr>
<tr><td></td><td>event/meterEvent@domain*</td><td>Value based on IEC 61968-9 Table E.1.</td></tr>
<tr><td></td><td>event/meterEvent@domainPart*</td><td>Value based on IEC 61968-9 Table E.2.</td></tr>
<tr><td></td><td>event/meterEvent@type*</td><td>Value based on IEC 61968-9 Table E.3.</td></tr>
<tr><td></td><td>event/meterEvent@index*</td><td>Value based on IEC 61968-9 Table E.4</td></tr>
<tr><td></td><td>event/meterEvent@duration</td><td>Optional duration (proprietary extension). If used this will be an integer in seconds.</td></tr>
<tr><td></td><td>event/meterEvent@voltagePhaseA</td><td>Optional voltage information (proprietary extension).</td></tr>
<tr><td></td><td>event/meterEvent@value</td><td>Refer to History Log Event Codes section of this document for details.</td></tr>
<tr><td></td><td>event/meterEvent@codeString*</td><td>Textual name of the CIM event. Refer to History Log Event Codes section of this document for details.</td></tr>
<tr><td></td><td>event/meterEvent@descDisplay*</td><td>Textual description of the event. May be manufacturer specific.</td></tr>
<tr><td></td><td>event/dateTime*</td><td>Time of event as recorded in the C12.19 log table entry. Absence of time zone information indicates value is in meter local time.</td></tr>
<tr><td></td><td>event/userID</td><td>The User ID corresponding to the C12.19 log table entry.</td></tr>
<tr><td></td><td>event/argument</td><td>Event-specific data (varies per manufacturer).</td></tr>
</table>

2.2.7.2.1 History log event codes

These values are derived from CIM IEC 61968-9 Annex E EndDeviceEvent Category Enumerations. Meter event codes in these tables are represented with the following format:

<domain>.<domainpart>.<type>.<index>.<value>

The <value> portion is optional and will only be provided if applicable to the particular event.

Caution: The IEC 61968-9 document does not clearly delineate the code string values. For this reason, integrators should develop to the meter event code rather than the code string.

2.2.7.2.1.1 History log event codes

Code String	Meter Event Code
Power Failed	3.26.1.185.
Power Restored	3.26.1.216.
Time Changed	3.36.16.264.
Unit accessed by reader	7.1.17.202.
End device accessed for write	7.1.17.282.
Configuration Changed	3.11.7.213.
Demand Reset	3.8.1.61.
Self meter read	3.21.15.231.
Test mode started	3.22.19.242.
Test mode ended	3.22.19.243.
Electric Meter Metrology Manufacturer Event 'x'	3.21.600.0.x This is a variable identifier used to convey manufacturer specific events. The value 'x' will be replaced with the manufacturer provided ID number.
Voltage sag	3.38.17.223.
Voltage swell condition	3.38.17.248.

2.2.8 DiagnosticReportNotificationExt

This is a solicited notification sent in response to an InitiateDiagnosticReportByMeterIDExt. This notification contains diagnostic information. The information included varies based on the firmware and meter manufacturer. Consult the firmware/meter specifications for further details regarding support for the diagnostic report capability, as well as information available in the report.

2.2.8.1 Sample notification

This is a diagnostic report notification reporting various diagnostic values from the meter.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <MultiSpeakMsgHeader AppName="RNI Gateway (MR)" AppVersion="0.0.0-SNAPSHOT"
              Branch="0" Build="6" BuildString="Release" Company="Sensus"
              MajorVersion="4" MinorVersion="1" Pwd="testPass" UserID="testUser"
              xmlns="http://www.multispeak.org/Version 4.1 Release"/>
   </SOAP-ENV:Header>
```

```
<SOAP-ENV:Body>
   <ns2:DiagnosticReportNotificationExt
           xmlns:ns2="http://www.multispeak.org/Version_4.1_Release"
           xmlns:ns3="cpsm_V4.1_Release" xmlns:ns4="gml_V4.1_Release"
           xmlns:ns5="http://www.w3.org/1999/xlink">
      <ns2:diagnosticReport>
         <ns2:extensionsList>
            <ns2:extensionsItem>
               <ns2:extName>dspDataSwitch</ns2:extName>
               <ns2:extValue>false</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>phaseASecondarySusceptance</ns2:extName>
               <ns2:extValue>65535</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>phaseAVoltageAngle</ns2:extName>
               <ns2:extValue>0</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>phaseBVoltageAngle</ns2:extName>
               <ns2:extValue>3599</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>Reactive Demand Received (index: 3)</ns2:extName>
               <ns2:extValue>183</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>romError</ns2:extName>
               <ns2:extValue>false</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>phaseBCurrentAngle</ns2:extName>
               <ns2:extValue>0</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>expandedRecordingSwitch</ns2:extName>
               <ns2:extValue>false</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>Q-hour Energy (index: 15)</ns2:extName>
               <ns2:extValue>597</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>phaseCCurrentAngle</ns2:extName>
               <ns2:extValue>0</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>transformerLossComponesenation</ns2:extName>
               <ns2:extValue>0</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>phaseASecondaryReactance</ns2:extName>
               <ns2:extValue>65535</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>currentMonth</ns2:extName>
               <ns2:extValue>11</ns2:extValue>
               <ns2:extType>string</ns2:extType>
```

```
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Reactive Demand Delivered (index: 2)</ns2:extName>
   <ns2:extValue>48</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>ramError</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>touSwitch</ns2:extName>
   <ns2:extValue>true</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>registerFunction</ns2:extName>
   <ns2:extValue>6</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>instXfmrCorrectionSwitch</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>totalizationSwitch</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Reactive Energy Delivered (index: 5)</ns2:extName>
   <ns2:extValue>674</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>lowPotential</ns2:extName>
   <ns2:extValue>true</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>deviceType</ns2:extName>
   <ns2:extValue>109</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Real Energy Received (index: 1)</ns2:extName>
   <ns2:extValue>730</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Real Demand Delivered (index: 0)</ns2:extName>
   <ns2:extValue>343</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseAVoltagePhase</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseBVoltagePhase</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>instTransformerCorrection</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
```

```
<ns2:extensionsItem>
   <ns2:extName>hardwareVersionNumber</ns2:extName>
   <ns2:extValue>52</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseCCurrentMagnitude</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Real Energy Uni (index: 2)</ns2:extName>
   <ns2:extValue>3281</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>currentHour</ns2:extName>
   <ns2:extValue>9</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>currentMinute</ns2:extName>
   <ns2:extValue>26</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseCVoltagePhase</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>batteryAndPotentialFail</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseACurrentPhase</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseBCurrentPhase</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseBSecondaryResistance</ns2:extName>
   <ns2:extValue>65535</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseCSecondaryResistance</ns2:extName>
   <ns2:extValue>65535</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseCCurrentPhase</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseCVoltageAngle</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseACurrentAngle</ns2:extName>
   <ns2:extValue>32767</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
```

```
      <ns2:extName>unprogrammed</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>Reactive Energy Uni (index: 8)</ns2:extName>
      <ns2:extValue>1751</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCaution8</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>firmwareVersionNumber</ns2:extName>
      <ns2:extValue>4</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseBSecondaryConductance</ns2:extName>
      <ns2:extValue>65535</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCaution4</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseBVoltageGain</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCaution5</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>demandResetEnable</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>watchdogTimeoutError</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>maxClassAmps</ns2:extName>
      <ns2:extValue>200</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>instXfmrLossCompSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseCSecondarySusceptance</ns2:extName>
      <ns2:extValue>65535</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCaution1</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
```

```
                  <ns2:extName>Apparent/Arithmetic Apparent/Distortion VAh (index:
12)</ns2:extName>
                  <ns2:extValue>4477</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>diagnosticCaution2</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>diagnosticCaution3</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>phaseAVoltageMagnitude</ns2:extName>
                  <ns2:extValue>2420</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>diagnosticCaution6A</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>revenueGuardPlusSwitch</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Real Energy Delivered (index: 0)</ns2:extName>
                  <ns2:extValue>2550</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>numberOfDemandValues</ns2:extName>
                  <ns2:extValue>5</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>phaseCSecondaryConductance</ns2:extName>
                  <ns2:extValue>65535</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>baseFirmwareVersion</ns2:extName>
                  <ns2:extValue>262145</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>eventLogSwitch</ns2:extName>
                  <ns2:extValue>true</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Reactive Energy Uni (index: 9)</ns2:extName>
                  <ns2:extValue>1733</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>currentGMTSettingState</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>firmwareBuildVersion</ns2:extName>
                  <ns2:extValue>4</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
```

```
                  <ns2:extName>currentSeason</ns2:extName>
                  <ns2:extValue>0</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>hardwareRevisionNumber</ns2:extName>
                  <ns2:extValue>49</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>phaseBSecondarySusceptance</ns2:extName>
                  <ns2:extValue>65535</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>meterSerialNumber</ns2:extName>
                  <ns2:extValue>78096631</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>lossOfProgram</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>loadControlState</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Reactive Energy Net (index: 11)</ns2:extName>
                  <ns2:extValue>999999680</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>phaseBSecondaryReactance</ns2:extName>
                  <ns2:extValue>65535</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>currentDay</ns2:extName>
                  <ns2:extValue>2</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Reactive Energy Received (index: 6)</ns2:extName>
                  <ns2:extValue>1058</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>meterId</ns2:extName>
                  <ns2:extValue>0000000000000000</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Apparent/Arithmetic Apparent/Distortion VA (index:
4)</ns2:extName>
                  <ns2:extValue>395</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>meterType</ns2:extName>
                  <ns2:extValue>ACLR</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>fitzallForm</ns2:extName>
                  <ns2:extValue>12576</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
```

```
      <ns2:extName>diagnosticCounter1</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter2</ns2:extName>
      <ns2:extValue>1</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCaution7A</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter3</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter4</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseACurrentMagnitude</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>expandedMeasurementsSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseCVoltageGain</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>firmwareRevisionNumber</ns2:extName>
      <ns2:extValue>13</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter6</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter7</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter8</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>timeRemainingInSubinterval</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>distortionPowerFactor</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>Real Energy Net (index: 3)</ns2:extName>
```

```
                  <ns2:extValue>1819</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>currentDayOfTheWeek</ns2:extName>
                  <ns2:extValue>FRIDAY</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>altCommSwitch</ns2:extName>
                  <ns2:extValue>true</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>currentYear</ns2:extName>
                  <ns2:extValue>18</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Reactive Energy Net (index: 10)</ns2:extName>
                  <ns2:extValue>999999680</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>currentSecond</ns2:extName>
                  <ns2:extValue>21</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>phaseCCurrentGain</ns2:extName>
                  <ns2:extValue>0</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Reactive Energy Received (index: 7)</ns2:extName>
                  <ns2:extValue>1058</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>phaseBCurrentMagnitude</ns2:extName>
                  <ns2:extValue>0</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>reserved3</ns2:extName>
                  <ns2:extValue>false</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>reserved2</ns2:extName>
                  <ns2:extValue>0</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>reserved1</ns2:extName>
                  <ns2:extValue>0</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>waveformCaptureSwitch</ns2:extName>
                  <ns2:extValue>true</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>configurationId</ns2:extName>
                  <ns2:extValue>10</ns2:extValue>
                  <ns2:extType>string</ns2:extType>
               </ns2:extensionsItem>
               <ns2:extensionsItem>
                  <ns2:extName>Apparent/Arithmetic Apparent/Distortion VAh (index:
14)</ns2:extName>
```

```
      <ns2:extValue>6014</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>reserved6</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>reserved5</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>demandThreshOverload</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>reserved4</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseAVoltageGain</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>elementVolts</ns2:extName>
      <ns2:extValue>9</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>voltageEventMonitorSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>powerQualityMeasureSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>meterErrors</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>eepromError</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>byQaudrantMeasurementsSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseASecondaryConductance</ns2:extName>
      <ns2:extValue>65535</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>processControlCode2</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>processControlCode1</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
```

```
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseCVoltageMagnitude</ns2:extName>
      <ns2:extValue>2420</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter5B</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>rtpState</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>demandSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseASecondaryResistance</ns2:extName>
      <ns2:extValue>65535</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter5C</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>badPassword</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>diagnosticCounter5A</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>recordingSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>measurementError</ns2:extName>
      <ns2:extValue>false</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>ansiForm</ns2:extName>
      <ns2:extValue>8224</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>pulseOutputSwitch</ns2:extName>
      <ns2:extValue>true</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>timeZoneOffset</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
   </ns2:extensionsItem>
   <ns2:extensionsItem>
      <ns2:extName>phaseACurrentGain</ns2:extName>
      <ns2:extValue>0</ns2:extValue>
      <ns2:extType>string</ns2:extType>
```

```
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>baseType</ns2:extName>
   <ns2:extValue>1</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Real Demand Received (index: 1)</ns2:extName>
   <ns2:extValue>94</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>lowBattery</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>leadingKVarh</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>timeChanged</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>messageVersion</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>Apparent Energy (index: 13)</ns2:extName>
   <ns2:extValue>3811</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>meterMode</ns2:extName>
   <ns2:extValue>2</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseCSecondaryReactance</ns2:extName>
   <ns2:extValue>65535</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>recievedKWh</ns2:extName>
   <ns2:extValue>true</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseBVoltageMagnitude</ns2:extName>
   <ns2:extValue>2420</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>phaseBCurrentGain</ns2:extName>
   <ns2:extValue>0</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>highTemperature</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
<ns2:extensionsItem>
   <ns2:extName>hugeLPSwitch</ns2:extName>
   <ns2:extValue>false</ns2:extValue>
   <ns2:extType>string</ns2:extType>
</ns2:extensionsItem>
```

```
            <ns2:extensionsItem>
               <ns2:extName>meterSealState</ns2:extName>
               <ns2:extValue>false</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>optionBoardError</ns2:extName>
               <ns2:extValue>false</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>opticalPortEnable</ns2:extName>
               <ns2:extValue>true</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>Reactive Energy Delivered (index: 4)</ns2:extName>
               <ns2:extValue>693</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>kvaKvarKqSwitch</ns2:extName>
               <ns2:extValue>true</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>firmwareUpdateVersion</ns2:extName>
               <ns2:extValue>0</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
            <ns2:extensionsItem>
               <ns2:extName>numberOfMeasurements</ns2:extName>
               <ns2:extValue>16</ns2:extValue>
               <ns2:extType>string</ns2:extType>
            </ns2:extensionsItem>
         </ns2:extensionsList>
         <ns2:meterID meterNo="1001M" objectID="1001" serviceType="Electric" utility="ACME"/>
      </ns2:diagnosticReport>
      <ns2:transactionID>1-7x2</ns2:transactionID>
   </ns2:DiagnosticReportNotificationExt>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

2.2.8.2 *Notification parameters*

	Attribute/Element	Usage
HEADER	*Common notification header attributes*	
	transactionID	The `transactionID` from the RNI initiated request (if applicable) or empty otherwise. The correlation on the subscriber should handle unknown or empty values.
	extensionsList	If present, contains a repeating list of extensionsItem elements. Each extensionsItem coveys specific diagnostic values.
	extensionsList/extensionsItem	
	extensionsList/extensionsItem/extName	Textual name of the diagnostic item.
	extensionsList/extensionsItem/extValue	String value containing the value of the diagnostic item.

	Attribute/Element	Usage
	extensionsList/extensionsItem/extType	One of {String}.
	meterID@serviceType	The service type for the meter: {Electric}.
	meterID@utility	Utility code for the meter (CustomerID).
	meterID@objectID	Locally unique identifier for the meterID element.
	meterID@meterNo*	The identifier for the meter assigned by the utility.

2.3 CB client

2.3.1 Overview

This is a web service client on the AMI head end system to get meter information from the Customer Billing (CB) service on a remote application. The methods in this client provide a way for the AMI head end to sync up with the system-of-record for meters. These complement the MeterAdd/Change/RemoveNotification methods implemented by the MR server in the RNI.

The MultiSpeak gateway deployment includes both a command line script (see section 2.3.4) and a web interface to run each of the methods in this section.

The web interface URL is [protocol]://[rni_web_server]/multispeakv4-cb-client.

2.3.1.1 References

These methods are described at (member access only):
https://apps.cooperative.com/content/multispeak/specifications/416/CB_Server.asmx.

2.3.2 GetAllMeters

This operation gets meter data for all meters from the CB and *adds* meters in the RNI or *updates* them if already present. This is used to synchronize the relevant meter data in the RNI with the CB (system of record).

2.3.2.1 Sample request

Following is a sample *initial* request for meters from the CB. Subsequent requests will include the `lastReceived` property.

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
      Build="6" Branch="0" BuildString="Release" UserID="test"
      Pwd="test" AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT"
      Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetAllMeters/>
  </soapenv:Body>
</soapenv:Envelope>
```

2.3.2.2 Sample response

Following is a sample *final* response with one meter record. The zero value `ObjectsRemaining` indicates that there are no other meters in the CB.

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version_4.1_Release"
  xmlns:cpsm="cpsm_V4.1_Release" xmlns:gml="gml_V4.1_Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader
        MajorVersion="4" MinorVersion="1" Branch="6" Build="0" BuildString="RELEASE"
        ObjectsRemaining="0" LastSent="22M" />
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetAllMetersResponse>
      <ver:GetAllMetersResult verb="Change">
        <ver:electricMeters>
          <ver:electricMeter utility="ACME" objectID="22M">
            <ver:meterNo>22M</ver:meterNo>
            <ver:manufacturer>SI</ver:manufacturer>
            <ver:catalogNumber>3242-3001</ver:catalogNumber>
            <ver:AMRDeviceType>23</ver:AMRDeviceType>
            <ver:AMRVendor>SENS</ver:AMRVendor>
            <ver:meterStatusList>
              <ver:meterStatus>Installed</ver:meterStatus>
            </ver:meterStatusList>
            <ver:moduleList>
              <ver:module objectID="22" utility="ACME">
                <ver:moduleType>FlexNetRadio</ver:moduleType>
                <ver:firmwareVersion>1</ver:firmwareVersion>
              </ver:module>
            </ver:moduleList>
            <ver:utilityInfo>
              <ver:serviceLocationID>22S</ver:serviceLocationID>
              <ver:customerID>ACME</ver:customerID>
              <ver:gpsPoint>
                <ver:latitude>88.7</ver:latitude>
                <ver:longitude>120.6</ver:longitude>
              </ver:gpsPoint>
            </ver:utilityInfo>
            <ver:electricNameplate>
              <ver:numberOfElements>2</ver:numberOfElements>
              <ver:baseType>A-Base</ver:baseType>
              <ver:dials>5</ver:dials>
              <ver:form>2S</ver:form>
              <ver:multiplier>1.0</ver:multiplier>
              <ver:demandMult>2.0</ver:demandMult>
            </ver:electricNameplate>
          </ver:electricMeter>
        </ver:electricMeters>
      </ver:GetAllMetersResult>
    </ver:GetAllMetersResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.3.2.3 Request parameters

	Attribute/Element	Usage
HEADER	**UserID***	User ID on the remote application (CB).
	Pwd*	Clear text password corresponding to the *UserID*.
	AppName*	MultiSpeak gateway client name (e.g., RNIGateway).
	AppVersion*	MultiSpeak gateway client version (e.g., 1.0).
	Company*	MultiSpeak gateway client provider (e.g., Sensus).
BODY	lastReceived	The lastSent value from the previous response. The returned meters will commence with the first ID after the lastReceived ID.

2.3.2.4 Response parameters

	Attribute/Element	Usage
HEADER	AppName	Web service client application name. This is only used for logging.
	AppVersion	Web service client application version. This is only used for logging.
	Company	Web service client application vendor. This is only used for logging.
	ObjectsRemaining	The number of meters remaining in the CB *at that point in time*. A value of zero indicates that there are no more meters remaining. A negative value is interpreted as an unknown number of meters remaining. **Note:** If the `ObjectsRemaining` attribute is not provided then it is assumed to be zero.
	LastSent	A marker identifying the last element in this response. This is passed back to the server as the value of lastReceived in the subsequent request.
BODY	electricMeters	
	electricMeter@objectID	Locally unique identifier for the meterID element. Recommend that this have the same value as the meterNo attribute.
	meterID@utility	Utility code for the meter (the CustomerID).
	electricMeter/meterNo*	The identifier for the meter assigned by the utility (the MeterID).
	electricMeter/AMRVendor*	The Vendor ID for the AMR system that supports this meter (e.g., SENS). Meters that do not belong to the Sensus system will be ignored.
	electricMeter /utilityInfo/serviceLocationID	Service location identifier associated with the meter.
	electricMeter /utilityInfo/gpsPoint/latitude	The latitude where the meter is installed.
	electricMeter /utilityInfo/gpsPoint/longitude	The longitude where the meter is installed.

	Attribute/Element	Usage
	electricMeter/installedDate	Date that the meter was installed. If not specified and the meter is not already installed, then this is assumed to be now.
	electricMeter/AMRDeviceType	AMR specific device type (e.g., 23 for iConA).
	electricMeter/meterStatusList/meterStatus	Target state of the meter when it is added into the RNI. This may be one of `InInventory` or `Installed`. If no `meterStatus` is specified then it is assumed to be `Installed`. Only one `meterStatus` is expected in the `meterStatusList`.
	electricMeter/electricNameplate/dials	The dials for the meter.
	electricMeter/electricNameplate/form	The form factor for the meter.
	electricMeter/moduleList/module@objectID*	This is the FlexnetID for that meter, if the moduleType is FlexNetRadio. This is required **only if** the meter does not already exist in the RNI.
	electricMeter/moduleList/module/moduleType*	Value is FlexNetRadio for a FlexNet transceiver. This is required **only if** the meter does not already exist in the RNI. This is the only module type currently supported.
	electricMeter/moduleList/module/firmwareVersion	Firmware version for the FlexNet transceiver, if the moduleType is FlexNetRadio.
	gasMeters	
	Similar to electricMeter	
	waterMeters	
	Similar to electricMeter	

2.3.2.5 Error messages

	Error	Reasons
SYSTEM ERRORS	WebServiceIOException MalformedURLException	The value of `Multispeak.CB.DestinationURL` is not a valid URL.
	WebServiceIOException Connection Refused	The destination web service is not accepting connections. Ensure that the `Multispeak.CB.DestinationURL` in the database is correct and that the remote service is running.
	WebServiceTransportException Internal Server Error [500]	The remote CB service has responded with message that is not understood by the web services infrastructure. Some common causes are: • A SOAP version mismatch between the integrating applications. • The service responded with a non-SOAP message like an HTTP error code.

2.3.2.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.CB.DestinationEnabled (Customer configuration)	An on/off switch for the CB client in the RNI. This should be set to True.
	Multispeak.CB.DestinationURL (Customer configuration)	The URL of the CB web service (e.g., https://www.myhost.com/multispeak/cb).
	Multispeak.CB.DestinationUserId (Customer configuration)	The user ID on the CB system used by the MultiSpeak gateway. This is the value used for the `UserID` header attribute of the request.
	Multispeak.CB.DestinationPassword (Customer configuration)	The password corresponding to the user account on the CB system (see above). This is the value used for the Pwd header attribute of the request.
FILE	ws.filter.amrVendorId (System configuration)	Expected value of the `AMRVendorID` for all meters managed by this system.
	rniMeterBatchSize (application.properties)	Large `GetAllMetersResponse` will be sub-divided into smaller batches during update into the RNI based on this value. Default=100 (modification NOT recommended).

2.3.3 GetAllServiceLocations

The method gets the service location data for all meters in the CB and updates the corresponding entries in the RNI, if present. This synchronizes the relevant service location data in the RNI with the CB (system of record).

2.3.3.1 Sample request

This is a request to get the batch of service locations after Loc-Area51. The `lastReceived` value is the `LastSent` from the previous response.

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version 4.1 Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1" Build="6"
      Branch="0" BuildString="Release" UserID="test" Pwd="test"
      AppName="RNI Gateway (MR)" AppVersion="4.3.0-SNAPSHOT" Company="Sensus"/>
  </soapenv:Header>
  <soapenv:Body>
    <ver:GetAllServiceLocations>
      <ver:lastReceived>Loc-Area51</ver:lastReceived>
    </ver:GetAllServiceLocations>
  </soapenv:Body>
</soapenv:Envelope>
```

2.3.3.2 Sample response

```
<soapenv:Envelope
  xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
  xmlns:ver="http://www.multispeak.org/Version 4.1 Release">
  <soapenv:Header>
    <ver:MultiSpeakMsgHeader MajorVersion="4" MinorVersion="1"
        Build="6" Branch="0" BuildString="Release"
        ObjectsRemaining="0" LastSent="3000S" />
  </soapenv:Header>
  <soapenv:Body>
    <GetAllServiceLocationsResponse
```

```
      xmlns="http://www.multispeak.org/Version_4.1_Release">
      <GetAllServiceLocationsResult>
        <serviceLocation utility="ACME" objectID="3000S">
          <comments>SWEngg Facility</comments>
          <serviceAddress>
            <address1>500 Perimeter Park</address1>
            <city>Morrisville</city>
            <state>NC</state>
            <postalCode>27609</postalCode>
          </serviceAddress>
          <electricServiceList>
            <electricService objectID="111222E">
              <revenueClass>TOU</revenueClass>
              <billingCycle>21</billingCycle>
            </electricService>
          </electricServiceList>
        </serviceLocation>
      </GetAllServiceLocationsResult>
    </GetAllServiceLocationsResponse>
  </soapenv:Body>
</soapenv:Envelope>
```

2.3.3.3 Request parameters

	Attribute/Element	Usage
HEADER	**UserID***	User ID on the CB assigned to the MultiSpeak gateway.
	Pwd*	Clear text password corresponding to the *UserID*.
	AppName*	MultiSpeak gateway client name e.g., RNI Gateway.
	AppVersion*	MultiSpeak gateway client version e.g., 1.0.
	Company*	MultiSpeak gateway client provider e.g., Sensus.
BODY	lastReceived	The `lastSent` value from the previous response. The returned meters will commence with the first ID after the `lastReceived` ID.

2.3.3.4 Response parameters

	Attribute/Element	Usage
HEADER	AppName	Web service client application name. This is only used for logging.
	AppVersion	Web service client application version. This is only used for logging.
	Company	Web service client application vendor. This is only used for logging.
	ObjectsRemaining	The number of meters remaining in the CB *at that point in time*. A value of zero indicates that there are no more meters remaining. A negative value is interpreted as an unknown number of meters remaining. *Note- if the attribute is not provided it is assumed to be zero.*
	LastSent	A marker identifying the last element in this response. This is passed back to the server as the value of `lastReceived` in the subsequent request.
BODY	**serviceLocation/objectID***	The service location ID associated with a meter.
	serviceLocation/siteID	Region / project area.
	serviceLocation/serviceAddress	Street address of this service location, not the billing address for the customer.

	Attribute/Element	Usage
	serviceAddress/address1	Address line 1.
	serviceAddress/address2	Address line 2.
	serviceAddress/city	City.
	serviceAddress/state	State.
	serviceAddress/postalCode	Zip.
	serviceAddress/country	Country.
	serviceLocation/electricService List/	Characteristics of the electric services available at this service location. Only one `electricService` expected in this list.
	electricServiceList/ electricService/billingCycle	The billing cycle for meter(s) at this service location.
	electricServiceList/ electricService/revenueClass	The `rateCode` for meter(s) at service location.

2.3.3.5 Error messages

	Error	Reasons
SYSTEM ERRORS	WebServiceIOException MalformedURLException	The value of `Multispeak.CB.DestinationURL` is not a valid URL.
	WebServiceIOException Connection Refused	The destination web service is not accepting connections. Ensure that the `Multispeak.CB.DestinationURL` in the database is correct and that the remote service is running.
	WebServiceTransportException Internal Server Error [500]	The remote CB service has responded with message that is not understood by the web services infrastructure. Some common causes are: • A SOAP version mismatch between the integrating applications. • The service responded with a non-SOAP message like an HTTP error code.
BUSINESS ERRORS	Service Location does not exist	The CB returned a service location ID that does not belong to any meter in the RNI. This is an **expected** occurance if the CB contains more meters than the RNI.

2.3.3.6 Configuration properties

	Property name	Usage
DATABASE	Multispeak.CB.DestinationEnabled (Customer configuration)	An on/off switch for the CB client in the RNI. This should be set to True.
	Multispeak.CB.DestinationURL (Customer configuration)	The URL of the CB web service e.g., https://www.myhost.com/multispeak/cb.
	Multispeak.CB.DestinationUserId (Customer configuration)	The user ID on the CB system used by the MultiSpeak gateway. This is the value used for the `UserID` header attribute of the request.

	Property name	Usage
	Multispeak.CB.DestinationPassword (Customer configuration)	The password corresponding to the user account on the CB system (see above). This is the value used for the Pwd header attribute of the request.
FILE	rniServiceLocationBatchSize (Application configuration)	Large GetAllServiceLocationsResponse will be sub-divided into smaller batches during update into the RNI based on this value. Default is 50. (Modification NOT recommended.)
	meterlifecycle.serviceLocation.strictUpdate Disable (Application configuration)	This configuration controls whether missing service locations will be added to the RNI. If this value is true, then missing service locations will be added to the RNI. If this value is false, missing service locations will not be added. Default is `False`.
	meterlifecycle.ignoreMissingServiceLocation (Application configuration)	The GetAllServiceLocationsResponse for some customers contains service locations that are not intended to be added to the RNI. If the meterlifecycle.serviceLocation.strictUpdateDisable configuration setting is `False`, then any new service locations will not be added and an error will be returned. This property allows this condition to be treated as a no-op instead of an error, so that overall process can succeed. Default is `True`.

2.3.4 CB script

The MultiSpeak installation includes a command line utility to trigger data synchronization using the `GetAllMeters` and `GetAllServiceLocations` CB_Server web methods.

This uses the `Multispeak.CB.DestinationURL` configuration values in the RNI to identify the remote CB web service endpoint.

The script is `/opt/flexnet-gateway/webapps/multispeakv4-cb-client/WEB-INF/bin/cb.sh`.

Log messages are written out to `cb.log`.

2.3.4.1 Usage

Change directory to `/opt/flexnet-gateway/webapps/multispeakv4-cb-client/WEB-INF/bin/` prior to running the script.

The usage is as follows. All flags are optional because the script will prompt for missing information as needed.

```
cb.sh [-q|-v]
            [-c <Customer ID>]
            [-lm <last received meter object ID or ALL>]
            [-ls <last received service location object ID or ALL>]
            [<operation>]
```

Options that are not provided as arguments to the script will be prompted as user input. Hence when the script is to be run from schedulers and CRON jobs it is desirable to provide all the required options as script arguments.

2.3.4.2 Options

Option		Description
-h		Displays the help message.
-q|-v		Supported verbosity level options for the script output are quiet and verbose. If none are specified then defaults to normal verbosity.
-c <Customer ID>		The CustomerID identifies the company whose CB service should be invoked. This must be provided for all operations.
-lm <Last received meter object ID or ALL>		Object ID that will be used as the lastReceived element in CB requests. Use **ALL** for all meters from the beginning.
-ls <Last received service location object ID or ALL>		Service location object ID that will be used as the lastReceived element in CB requests. Use **ALL** for all locations from the beginning.
Operations (required)	**PingURL**	Pings the the remote CB server.
	GetMethods	Retrieves the supported methods from the remote CB service. Use this to verify that the remote service supports the GetAllMeters and GetAllServiceLocations methods.
	StartSyncAll	Starts the data synchronization. This includes meter and location synchronization.
	StartSyncMeters	Starts meter synchronization. This option is provided in case the `GetAllMeters` needs to be run separately. If both meter and location data needs to be synchronized then use StartSyncAll.
	StartSyncServiceLocations	Starts service location synchronization. This option is provided in case the `GetAllServiceLocations` needs to be run separately. Service locations can only be updated with this operation, i.e., no new service locations will be created. If both meter and location data needs to be synchronized then use StartSyncAll.
	StopSyncAll	Stops the data synchronization. This is the complement of StartSyncAll.
	StopSyncMeters	Stop the meter synchronization. This is the complement of StartSyncMeters.
	StopSyncServiceLocations	Stop the service location synchronization. This is the complement of StartSyncServiceLocations.
	GetSyncMeterStatus	Display the status of the meter synchronization.
	GetSyncServiceLocation Status	Display the status of the service location synchronization.

2.3.4.3 Examples

To verify connectivity with the remote CB service

```
cb.sh –v –c ACME PingURL
```

To start a data synchronization

```
cb.sh –v –c ACME StartSyncAll
```

To start a data synchronization

```
cb.sh –v –c ACME –lm ALL StartSyncMeters
cb.sh –v –c ACME StartSyncMeters
cb.sh –v –c ACME StartSyncAll
```

***Note**: The first command above will not display the menu or prompt for inputs, as all possible input values are already provided in the command. The other two commands also will not display menu option but prompt for the starting location ID for synchronization.*

To view the status of a data synchronization:

```
cb.sh –v –c ACME GetSyncMeterStatus
cb.sh –v –c ACME GetSyncServiceLocationStatus
```

To stop a data synchronization:

```
cb.sh –v –c ACME StopSyncAll
```

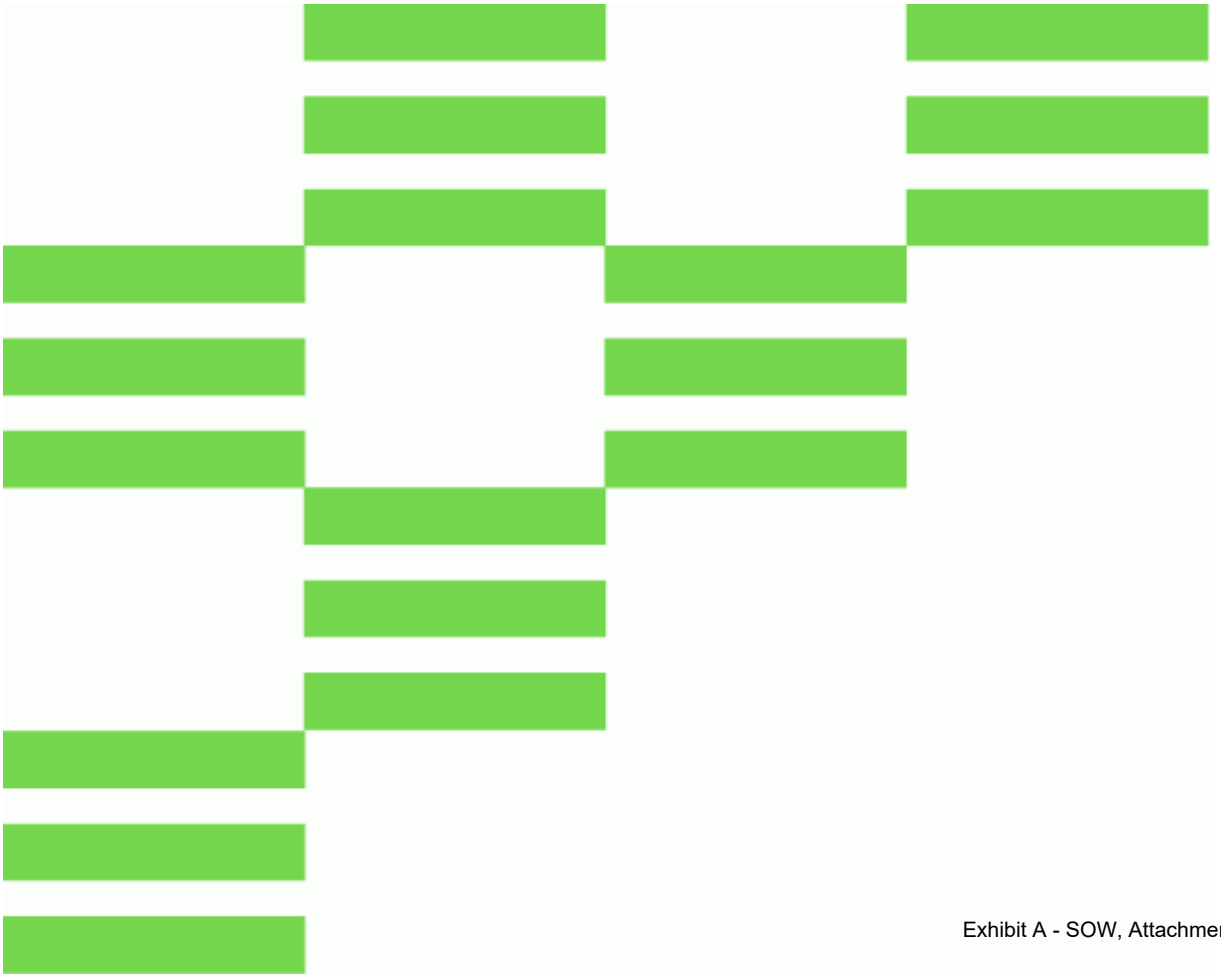
To continue a data synchronization from `serviceLocationID`:

```
cb.sh –v –c ACME –lm <meterID> –ls <serviceLocationID> StartSyncAll
```

RNI Extended CMEP Specifications

Reference Manual

ARM-10006-19



Revision history

Rev. No.	Date	Description
01	02-JAN-08	Initial Release
02	05-JUL-12	Updated for RNI 3.1.0
03	01-JAN-15	Updated for RNI 3.2.0
04	26-MAY-15	Updated for RNI 3.3.0
05	10-AUG-15	Updated for RNI 3.3.1
06	28-SEP-15	Updated for RNI 3.3.2
07	10-FEB-16	Updated for RNI 4.0
08	05-MAY-16	Updated for RNI 4.1.0
09	10-OCT-16	Updated for RNI 4.2.0
10	01-AUG-17	Updated for RNI 4.2.1
11	10-OCT-17	Updated for RNI 4.3.0
12	08-JUN-18	Updated for RNI 4.3.1: • Modified description of alarm mapped to R0 bit 49, and changed alarm record version to 20180101 for 4.3.1 • Modified description of alarm mapped to R0 bit 47 • Added new alarm R2 bit 54 • Switched descriptions for alarm mapped to R1 bit 60 and R1 bit 61
13	28-AUG-18	Updated for RNI 4.4.0: • Added MeterBodyId flexible field • Added new alarms CMEP BIT R2-55 to R3-2 • Modified alarm record version from 20180101 to 20180201 • Added 'A' as a commodity type • Moved MEPEC01 serial number to meter ID
14	05-SEP-18	Additional updates for RNI 4.4.0: • Minor updates to the following tables: Digit positions and field names, MLA01 Extended record format, MEPEC01 Extended record format, and Commodity • More significant updates to the Meter-level alarms – set 2 table • Added the Meter-level alarms – set 3 table
15	26-OCT-18	Updates for RNI 4.4.1: • Modified Alarm record version from 20180201 to 20180801 • Added alarms from R3-3 till R4-5 • Reformatted and explained the units for electric, gas, water in more detail
16	25-FEB-19	Updates for 4.5.0: • Updated the descriptions of alarms that are no longer generated in the RNI, or are not displayed in CMEP
17	29-APR-19	Updates for 4.5.1: • Modified Alarm record version from 20180801 to 20190301 • Added alarms from R4-6 to R4-13
18	27-AUG-19	Updates for 4.6.0: • Modified Alarm record version from 20190301 to 20190501 • Added alarms from R4-14 to R4-30 • Modified description of CMEP alarm bit R0-57 • Modified description of flexible field 4 Physical Channel Identifier in Table 2
19	29-OCT-19	Updates for 4.6.1: • Modified Alarm record version from 20190501 to 20190901 • Changed description of R0-57 from Valve Malfunction to Valve Transition Failure • Changed description of R2-12 from High Flow Gas Alarm to High Flow • Changed description of R2-35 from Low Battery with no transmission to Low Battery Voltage • Changed description of R4-30 from Air Detection Shutoff to Air in Meter Shutoff • added new bit R4-31 for Radio Communication Failed

Copyright

Sensus
637 Davis Drive
Morrisville, NC 27560
1-800-638-3748
www.sensus.com

Document: RNI Extended CMEP Specifications
Document Number: ARM-10006-19

Contents

Overview 1

Device type and reports 1

Data types and flexible field values 2

Representation of channel identifier in MEPMD01 3

Extended record formats 3

MEPMD01 3

MEPMD02 4

MLA01 5

MEPEC01 6

Protocol text defined values 8

Record type 8

Purpose 8

Commodity 8

Units 9

TOU label 12

Data quality flags 12

Meter-level alarms 13

Meter lifecycle state code 23

Parameter values for MEPEC01 23

Additional parameter values for MEPEC01 (extended) 24

TOU data type 25

Appendix A: Original CMEP specification (partial) 25

California Metering Exchange Protocol 25

Purpose 25

Specific business objectives 25

Implementation overview 26

Specific protocol features 26

Record types 27

Header fields 27
Time values 28
Protocol text 28
Metering service data records 30
Metering values vs. date/time intervals 30
Time-of-use metering 30
Beginning and end of month meter reads 31
MEPMD01 – Metering Data Type 1 – interval data 31
MEPMD02 – Metering data type 2 – TOU data 32
Equipment configuration records 34
MEPEC01 – Equipment configuration data type 1 34

Overview

The California Metering Exchange Protocol (CMEP) is a delivery format available from the FlexNet™ Regional Network Interface (RNI). The protocol defines a comma-separated-value (CSV) ASCII file format with a small number of record (row) types each having a fixed sequence of fields. Although the original protocol defines record types for exchange of metering and non-metering data (for example, administrative, billing, distribution loss), the FlexNet RNI only utilizes three of the original ten record types, and those only in one direction to the customer.

This document defines an extended form of the CMEP protocol. It is extended from the original in the following ways:

1. MEPMD01, MEPMD02, and MEPEC01 record types are each given specific mappings to quantities as gathered by the FlexNet™ RNI.
2. A new record type, MLA01, based on the MEPMD01 type, is defined for delivery of meter-level alarms. Meter-level alarms are distinct from data quality flags in that they are not associated with a particular interval or register read.
3. Options to receive attributes in a specific order have been added.
4. Additional Protocol Text values have been defined, some of which are longer than the original specification limitation of 12 characters.
5. Data quality flags have been mapped to an extended form of the data quality member of the value triples for inclusion in MEPMD01 and MEPMD02.

The general mapping of record types to data types is as follows:

- MEPMD01: Metering Data Type 1 – interval data, pulse data, reference register reads
- MEPMD02: Metering Data Type 2 – TOU data, net metering
- MLA01: Meter Level Alarms
- MEPEC01: Equipment Configuration Type 1 – Meter configuration information

Device type and reports

CMEP requires a commodity value in every record for each of the Sensus supported formats. The commodity value (e.g., electric, gas, or water) can be interpreted from a meter's device type, which can be provided using MDMIF or received through on-air messages from the meter. A meter whose device type cannot be determined or is unknown will NOT be included in subsequent reports.

For example, if an electric meter is installed using MDMIF but the transaction does not include the device type, the meter is not included in a report using the MEPMD01 record until the device type is received from the meter.

Data types and flexible field values

The original protocol specifies that all values may contain one of the following data types: numeric integer, numeric floating-point, calendar date, time, date/time, time interval, arbitrary text, or a predefined protocol text entry. The format and use of each of these types is specified in the partial copy of the original CMEP protocol attached in Appendix A: Original CMEP specification (partial).

The following common field values apply to all record types:

- SenderID = SENSUS
- Sender Customer Id = <CustomerId>:<Key for flexible fields>

Sender Customer Id is a combined value field composed of <CustomerId>:<Key for flexible fields>. The CustomerId identifies the intended recipient of the file. The key for the flexible fields is a six-digit value specifying the record source for up to six field values which support multiple uses.

The six-digit positions are identified by zero-based numbering, e.g., 012345. The following table indicates each of the flexible fields.

Table 1: Digit positions and field names

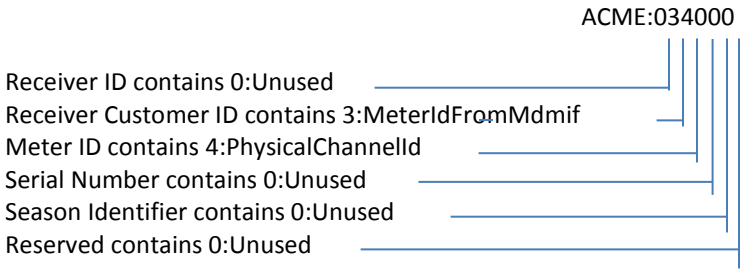
Digit Position	Field Name
0	Receiver Id (MEPMD01, MEPMD02, MLA01, MEPEC01)
1	Receiver Customer Id (MEPMD01, MEPMD02, MLA01, MEPEC01)
2	Meter Id (MEPMD01, MEPMD02, MLA01, MEPEC01)
3	Serial Number (reserved)
4	Season Identifier (MEPMD02)
5	Reserved

The numeric values to use in each digit position are enumerated as shown in the following table.

Table 2: Flexible field data sources

Value	Description	Configuration Name
0	Field is unused (available)	Unused
1	Sensus FlexNet Id for the meter	FlexNetIdForMeter
2	Customer Meter Id as reported by the meter	MeterIdAsReportedByMeter
3	Customer Meter Identifier as submitted via MDMIF	MeterIdFromMdmif
4	Physical Channel Identifier (For MEPMD02 it represents channel * 100 + Quantity type)	PhysicalChannelId
5	POD (Point of Delivery)	POD
6	TOU data types, see Table 31	TOUDataType
7	Meter Body Id	MeterBodyId
8-9	Reserved	

For example, if the record format is MEPMD01 and this field value is ACME:034000, then the intended recipient is ACME, the Receiver Customer Id field is set to the customer meter identifier as submitted via MDMIF (3 in Table 2), and the Meter Id field is used to report the physical channel identifier (4 in Table 2).



For another example, a field value of ACME:000100 is only supported for MEPEC01. This indicates that the **Serial Number** field is used as a flexible field to convey the FlexNet Id for the meter (1 in Table 2).

The following general properties apply to all record types:

- All timestamps are UTC unless otherwise configured in the **tblConfigValues** RNI database table, using the **Cmep.LocalizeTimestamps** configuration key.
- CMEP protocol features remain the same, unless specifically noted otherwise.

Representation of channel identifier in MEPMD01

Interval data can be collected for multiple physical channels per meter, some or all of which may have the same unit of measure. Therefore, Sensus has developed a way to identify the physical channel when reporting interval data. The MEPMD01 record type supports two different ways of specifying the physical channel.

Method 1 uses a combined text representation in field units. This method requires the **Units** field to specify the unit of measure and a channel identifier. This is shown in examples in the original CMEP specification in Appendix A: Original CMEP specification (partial).

Method 2 uses the **Meter ID** field as a numeric channel identifier and the **Units** field for the unit of measure. Method 2 supports an arbitrary number of physical channels, but requires the client to map the physical channel numbers to the correct logical channels within their MDM system. If method 2 is used, the **Units** values are limited to the subset of protocol text values that do not include the channel type modifiers.

Extended record formats

MEPMD01

Table 3: MEPMD01 Extended record format

Field Name	CMEP Data Type	Example Value	Notes
Record Type	Protocol Text	MEPMD01	See Table 7 for details.
Record Version	Date	20080501	Fixed value – release date of this protocol to production.
Sender ID	Arbitrary Text	SENSUS	Fixed value.

Field Name	CMEP Data Type	Example Value	Notes
Sender Customer ID	Arbitrary Text	ACME:034000	Sensus code for the customer:Key for flexible fields.
Receiver ID	Arbitrary Text	<empty>	Flexible field – see Table 2 for options.
Receiver Customer ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Time stamp	Date/Time	200801310855	Date and time this record was created.
Meter ID	Arbitrary Text	1	Flexible field – see Table 2 for options.
Purpose	Protocol Text	OK	See Table 8 for details.
Commodity	Protocol Text	E	See Table 9 for details.
Units	Protocol Text	KWH	See Table 12 for details.
Calculation Constant	Numeric-Float	1.0	Multiplier to convert data values to engineering units.
Interval	Time-Interval	00000015	Time interval between readings.
Count	Numeric-Integer	48	Number of triples to follow. Maximum of 48 allowed per record.
Data (triples)	Date/Time, Protocol Text, Numeric-Float	200801300030, R0, 3.2505	End time of the interval (may be left empty after the first triple if Interval field is provided). Data quality flag: see Table 22.

MEPMD02

Table 4: MEPMD02 Extended record format

Field Name	CMEP Data Type	Example Value	Notes
Record Type	ProtocolText	MEPMD02	See Table 7 for details.
Record Version	Date	20080501	Fixed value – Release date of this protocol to production.
Sender ID	ArbitraryText	SENSUS	Fixed value.
Sender Customer ID	ArbitraryText	ACME:012300	Sensus code for the customer:Key for flexible fields.
Receiver ID	ArbitraryText	ABC1234	Flexible field – see Table 2 for options.
Receiver Customer ID	ArbitraryText	ABC1234	Flexible field – see Table 2 for options.
Time Stamp	Date/Time	200801310855	Date and time this record was created.
Meter ID	ArbitraryText	ABC1234	Flexible field – see Table 2 for options.
Purpose	ProtocolText	OK	See Table 8 for details.

Field Name	CMEP Data Type	Example Value	Notes
Commodity	ProtocolText	E	See Table 9 for details.
Units	ProtocolText	KWHREG	See Table 12 for details.
Season Identifier	ProtocolText	<empty>	Flexible field – see Table 2 for options.
Calculation Constant	Numeric-Float	1.0	Multiplier to convert data values to engineering units.
Data Start Time	Date/Time	200801310000	Date and time that the data interval reported in this record began.
Data Timestamp	Date/Time	200802010000	Date and time that ends the interval reported in this record.
Count	Numeric-Integer	1	Number of triples to follow. Maximum of 48 allowed per record.
Data (triples)	ProtocolText, ProtocolText, Numeric-Float	ON-PEAK, R0, 345.6789	Time-of-use label: see Table 21, Data quality flag: see Table 22, Measured Value.

MLA01

Table 5: MLA01 Extended record format

Field Name	CMEP Data Type	Example Value	Notes
Record Type	Protocol Text	MLA01	See Table 7 for details.
Record Version	Date	20190901	Fixed value – release date of this protocol to production.
Sender ID	Arbitrary Text	SENSUS	Fixed.
Sender Customer ID	Arbitrary Text	ACME:012000	Sensus code for the customer Key for flexible fields.
Receiver ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Receiver Customer ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Time Stamp	Date/Time	200801310855	Date and time this record was created.
Meter ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Purpose	Protocol Text	OK	See Table 8 for details.
Commodity	Protocol Text	E	See Table 9 for details.
Units	Protocol Text	METERDQ	Fixed for this record type.
Calculation Constant		<Blank>	Always blank. Does not apply. FOR THIS customer RECORD TYPE ONLY.

Field Name	CMEP Data Type	Example Value	Notes
Interval		<Blank>	Usually the width of time intervals used when all values are not time stamped. Does not apply for this customer record type because every triple contains a timestamp indicating the time of event.
Count	Numeric-Integer	4	Number of alarms (triples) reported in the row.
Data (triples)	Date/Time, Protocol Text, Numeric-Integer	200801301128, R0, 2	Time of event, Data quality flag: fixed as R0 or R1 or R2, Meter Alarms: see Table 23 and Table 24.

MEPEC01

Table 6: MEPEC01 Extended record format

Field Name	CMEP Data Type	Example Value	Description
Record Type	Protocol Text	MEPEC01	See Table 7 for details.
Record Version	Date	20080501	Fixed value – release date of this protocol to production.
Sender ID	Arbitrary Text	SENSUS	Fixed.
Sender Customer ID	Arbitrary Text	ACME:150300	Sensus code for the customer:Key for flexible fields.
Receiver ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Receiver Customer ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Time Stamp	Date/Time	<Date/Time>	Date and time this record was created.
Record ID	Arbitrary Text	<Blank>	Optional field in MEPEC01.
Operation Type	Protocol Text	CFG	CFG used for current configuration, no change has occurred.
Purpose	Protocol Text	OK	OK for normal transmission.
Comment	Arbitrary Text	<Blank>	Optional field in MEPEC01.
Commodity	Protocol Text	E	See Table 9 for details.
Activity	Protocol Text	<Blank>	<Blank> used to indicate an automatic transmission caused this record to be sent.
Equipment Type	Protocol Text	METER	The kind of equipment in the record.
Manufacturer	Arbitrary Text	<Blank>	Name of manufacturer, not needed for this extract.
Model		<Blank>	Model name of device, not needed for this extract.

Field Name	CMEP Data Type	Example Value	Description
Meter ID	Arbitrary Text	ABC1234	Flexible field – see Table 2 for options.
Identifier	Protocol Text	<Blank>	Optional field in MEPEC01. Not needed for this extract.
Date of Purchase	Date	<CCYYMMDD>	The meter inventory date.
Date of Installation	Date	<CCYYMMDD>	The meter installation date. Blank installation date indicates a meter that is not installed.
Owner	Numeric-Float	<Blank>	Owner of the device. Not needed in this extract.
Count	Numeric-Integer	<Integer value>	Number of parameters (pairs) to follow. Maximum of 48 allowed per record.
Data (pairs)	Parameter, Value	POD, 5	Parameter name, Parameter value. See Table 29 for parameter names/values. See Table 30 for extended mode parameter names/values.

Protocol text defined values

This section includes tables of defined values. These are the lists of fixed value fields, like units or time of use labels. Any field defined by CMEP as type *Protocol Text* is defined here with a list of permissible values. The original spec limits the *Protocol Text* value to 12 characters, but some values have been increased beyond that limit.

Record type

Table 7: Record type

Protocol Text	Description
MEPMD01	Interval data
MEPMD02	TOU data
MLA01	Meter-level alarms
MEPEC01	Meter sync

Purpose

Table 8: Purpose

Protocol Text	Description
OK	Normal transmission

Commodity

Table 9: Commodity

Protocol Text	Description
A	C&I Electric
E	Electric
G	Gas
W	Water
S	Steam
L	Lighting

Units

All units ending with REG indicate a register reading (cumulative). Related units not ending with REG indicate an interval reading (a delta).

If a measured quantity is qualified by net flow properties, then these properties are indicated as part of the Unit string using a prefix, e.g., GKWHREG indicates a cumulative register read of KWH *received*. There are four prefix classes.

Table 12 represents labels describing legacy meters only. Meters which support the Enhanced Supervisory Message (ESM) protocol can be configured for many unique and uncommon quantities, e.g., ITHD Element A, or Phasor Apparent VA Q4 fund + harmonics; the derivation of these labels is described in “Appendix D: Database and Reporting Support of C12.19 Sources” in the *RNI Reports Operation Reference Manual*.

Table 10: Fixed units for legacy electric meters

Protocol Text	Description
DateTime	Date time in form YYYYMMDDHHmm (same format as used for the CMEP Date type when specified to the minute)
Vrms	Voltage Root Mean Square
Vavg	Average Voltage
V	Voltage
Arms	Average Root Mean Square
C	Celsius
F	Fahrenheit
K	Kelvin
Voltage Phase Angle	Voltage Phase Angle
Current Phase Angle	Current Phase Angle
Hz	Hertz
Count	Numeric Quantity
Sense Input	Sense Input for Electric devices
PF	Power Factor
Pulse	Direct meter pulse reading
VOLTCAVG	Voltage (residential meters): average
VOLTCMAX	Voltage (residential meters): maximum
VOLTCMIN	Voltage (residential meters): minimum

Table 11: Dynamic unit prefixes for legacy electric readings

Prefix	Net Flow Property
<None>	F (delivered)
G	R (received by utility, i.e., generated by endpoint)
N	F-R (simple net)
S	F+R (sum)

Table 12: Dynamic unit prefix scales for legacy electric readings

Prefix	Scale - Description
<None>	10^1
H	hecto – 10^2
K	kilo – 10^3
G	Giga – 10^9
T	Tera – 10^12
C	Centi – 10^-2
M	Milli – 10^-3
U	Micro – 10^-6

Table 13: Dynamic units for legacy electric readings

Protocol Text	Unit - Description
<None>	unknown
W	Watt
VAR	Volt-ampere reactive
VA	Volt-ampere
Q	Electric Charge

Table 14: Dynamic unit timebase for legacy electric readings

Protocol Text	Description
<None>	none
H	hour

Table 15: Examples (Not an exhaustive list)

<NetFlow><Scale><Unit><Timebase>

Example	Description
KWH, KVAH, KVARH	Electric energy
KW, KVA, KVAR	Electric demand or load
GKWHREG	Received kilowatt hour summation read
NHW	Net hectowatt read

Table 16: Units for gas and water meters

Protocol Text	Unit - Description
ACFT	Acre Feet Delivered
CF	Cubic Feet Delivered
CM	Cubic Meter Delivered
GAL	Gallons Delivered
IG	Imperial gallons delivered
L	Liters Delivered

Table 17: Unit prefixes for gas readings

Prefix	Prefix - Description
<None>	None
D	Deci - 10x
C	Centi - 100x
M	Milli – 1000x

Table 18: Unit suffix for gas readings

Suffix	Suffix - Description
<None>	none
x10	Milli * 10 – 10000x

Table 19: Unit compensation suffix for gas readings

Suffix	Description
<None>	Compensation not specified
-C	Compensated : Previously was Corrected
-U	Uncompensated : Previously was Uncorrected

Table 20: Examples (Not an exhaustive list)

<Prefix><Unit><suffix><compensation suffix>

Example	Description
CF, DCF, CCF, MCF	Cubic Feet (correction unspecified), also DCF (CFx10), CCF (CFx100), and MCF (CFx1000)
CF-C, DCF-C, CCF-C, MCF-C	CF corrected, also DCF-C, CCF-C, and MCF-C
CF-U, DCF-U, CCF-U, MCF-U	CF uncorrected, also DCF-U, CCF-U, and MCF-U
CM, DCF, CCM, MCM	Cubic meters (correction unspecified), also DCM, CCM, and MCM
DGAL-U	Deci gallon (Gas meter measuring in gallon) Uncompensated
MCMx10	Milli * 10 cubic meter

TOU label

Any of the RATE_A through RATE_G labels can be customized by modifying **tblConfigValues.Cmep.DefaultRateLabel.Tier0** through **tblConfigValues.Cmep.DefaultRateLabel.Tier6**. For more information, see the *RNI Report Operation Reference Manual*.

Table 21: TOU label

Protocol Text	Description
TOTAL	Always available – the Rate defined as active all the time
RATE_A thru RATE_G	These are default labels used for the non-Total rates when customer specific labels are not available.
TBD	Other TOU labels as required per customer

Data quality flags

Data quality flags include R (Raw), N (Missing or otherwise unusable, see table), E (Estimated), A (Adjusted), D (Derived), or M (Adjusted and Derived), immediately followed by an integer.

A read can be adjusted by applying the meter's PT/CT multiplier. If the **Cmep.ApplyTransformerMultipliers** configuration key in the **tblConfigValues** RNI database table is set to true, then all reads are reported as Adjusted.

All reads are marked D (derived) if the **RNI.MeterRead.Model.Interval** configuration key in the **tblConfigValues** RNI database table is set to Derived.

If the **Cmep.ApplyTransformerMultipliers** configuration key is set to true and the **RNI.MeterRead.Model.Interval** configuration key is set to Derived, the reads are all marked with M (Adjusted and Derived).

The accompanying integer is a value from 0 (zero) to the maximum value for a 32-bit unsigned integer and must be interpreted as a bitmask.

For example, if the Power Restoral flag is set for a raw read, then the Protocol Text value is R4r. If the data is missing for an interval or the read is invalid, the Protocol Text value is N32. If no bits are set for a normal read, then the value is R0, indicating an error-free interval.

Different meter types support different subsets of these flags.

Table 22: Data quality flags

Bit Position	Indicates this if bit is set (equal to 1)	Can apply to Interval Value	Can apply to Register Read
0	Comm failure (meter could not be read)	X	X
1	Power outage	X	X
2	Power restoral	X	X
3	Voltage sag	X	X
4	Voltage swell	X	X
5	Missing, Invalid, Power Outage, Power Restoral, Skipped	X	X
6	Daylight savings in effect		
7	Quarantined data	X	X
8	Time Adjustment (direction unspecified)	X	X
9	Overflow	X	X
10	Long interval	X	X
11	Short interval	X	X
12	Test mode	X	X
13	Register rollover detected	X	X
14	*Register reset detected		
15	Clock out of sync	X	X
16	*Meter install		
17	*Meter uninstall		
18-31	Reserved		

Note: Bit Position with Asterisk (*) is not currently implemented.

Meter-level alarms

An R0 indicates the alarms from Set 0.

An R1 indicates the alarms from Set 1.

An R2 indicates the alarms from Set 2.

An integer between 0 and the max value for a 64 bit unsigned integer – must be interpreted as a bitmask.

Examples: If the first and second bits are set, then the Protocol Text value is 3. If only the tenth bit is set, the Protocol Text value is 512. If no bits are set, the value is 0.

Different meter types support different subsets of these alarms.

Note: Unless indicated otherwise, all meter-level alarms are current.

Record Version in Release 4.6.1 is 20190901. *Record Version* is the second field in the header for each row: MLA01, **20190901**, SENSUS, ACME.

Table 23: Meter-level alarms – Set 0

Bit Position	Indicates this if bit is set (equal to 1)
0	Power Failure
1	Power Restore
2	Tamper
3	Brown Out
4	Meter Read Failure
5	Register Over Temperature
6	RAM Failure
7	ROM Failure
8	7759 Calibration Error
9	7759 Register Checksum Error
10	7759 Reset Error
11	DALI Driver Failure
12	General CRC Error
13	Low Power Factor Warning
14	Watch Dog Restart
15	High Power
16	Soft KWH Error
17	Low Power
18	High Current
19	Cycling Lamp Warning
20	Unchanged Light Level
21	Hard KWH Error
22	<No RNI Alarm mapped to this BIT for display in CMEP>
23	Reverse Power
24	Low Loss Potential
25	Low Battery Error
26	Open Circuit
27	Meter or Metrology Meter Un-programmed

Bit Position	Indicates this if bit is set (equal to 1)
28	Clock Error
29	Over Voltage
30	<No RNI Alarm mapped to this BIT for display in CMEP>
31	<No RNI Alarm mapped to this BIT for display in CMEP>
32	Metro Bad Register Number
33	Memory Block No Good Blocks
34	Memory Block Buffer Size Error
35	Memory Block Bad Index
36	Memory Block Cannot Mark Bad Event
37	<No RNI Alarm mapped to this BIT for display in CMEP>
38	Blocked Relay
39	History OverFlow
40	Cut Wire
41	Customer Leak
42	High flow
43	Reverse Flow
44	Internal Communication Error
45	Register Error
46	Magnetic Tamper
47	Tilt Tamper
48	Time Adjustment (direction unspecified)
49	Corrector Alarm
50	Customer Leak
51	Low Pressure Shutoff
52	High Pressure Shutoff
53	Excess Flow
54	Seismic Event
55	Low Pressure
56	High Pressure Warning
57	Valve Transition Failure (Gas)
58	Swapped Meter
59	Meter Communication Failed

Bit Position	Indicates this if bit is set (equal to 1)
60	<No RNI Alarm mapped to this BIT for display in CMEP>
61	Over Current Alarm
62	Unused
63	Unused

Table 24: Meter-level alarms – set 1

Bit Position	Indicates this if bit is set (equal to 1)
0	Battery Door Tamper
1	Dead Battery
2	Digital Input A
3	Digital Input B
4	Upgrade Mode
5	<No RNI Alarm mapped to this BIT for display in CMEP>
6	Near End of Life
7	Valve State Changed
8	Critical Hardware Warning
9	Fixture Type Change
10	<No RNI Alarm mapped to this BIT for display in CMEP>
11	Single Phase Fail
12	Configuration Error
13	<No RNI Alarm mapped to this BIT for display in CMEP>
14	<No RNI Alarm mapped to this BIT for display in CMEP>
15	Low Metrology Battery Volts
16	<No RNI Alarm mapped to this BIT for display in CMEP>
17	<No RNI Alarm mapped to this BIT for display in CMEP>
18	Empty Pipe
19	Valve Transition Failure
20	Low Temperature
21	High Temperature
22	Low SmartPoint Battery Volts
23	Low Valve Battery Volts
24	<No RNI Alarm mapped to this BIT for display in CMEP>

Bit Position	Indicates this if bit is set (equal to 1)
25	Incorrect Switch State
26	Switch Autonomous Correction
27	Position Sensor Chatter
28	Service Limit Close
29	Service Limit Open High Current
30	Service Limit Open High Demand
31	Very Low Meter Battery
32	Metrology Unavailable
33	Encryption Failed
34	<No RNI Alarm mapped to this BIT for display in CMEP>
35	<No RNI Alarm mapped to this BIT for display in CMEP>
36	High Level
37	Low Level
38	Sensor Low Battery
39	Sensor Communications Failure
40	Sensor Read Failure
41	Hardware Fault
42	Meter Reboot
43	Valve Closed Automatically
44	Twenty Five Percent Of Battery Remaining
45	Fifteen Percent Of Battery Remaining
46	Five Percent Of Battery Remaining
47	Bidirectional Communications Failed
48	Lamp Failure
49	Board Failure
50	Daylight Burner
51	GPS Position
52	Self-Discovery Failure
53	Low Current
54	GPS Location Changed
55	Memory Error Partial Mismatch
56	Memory Error Read Timeout

Bit Position	Indicates this if bit is set (equal to 1)
57	Memory Error Reread Error
58	Memory Error Write Error
59	Memory Warning Block Marked Bad
60	Memory Warning Corrupt Block
61	Memory Warning Block CRC
62-63	Unused

Table 25: Meter-level alarms – set 2

Bit Position	Indicates this if bit is set (equal to 1)
0	Disconnect Open Indicator
1	Metrology Meter Chip Error
2	DC Detected in Circuit
3	Device System Error
4	Metrology Loss Of Program
5	Metrology Leading KVARH
6	Disconnect Load Side Voltage Sense
7	Remote Disconnect Switch State Changed
8	Meter Processor Failed
9	Metrology High Temperature
10	Beyond End of Life
11	Near End Of Life (Gas)
12	High Flow (Gas)
13	Pressure Compensation Failure
14	Temperature Compensation Failure
15	Unsatisfactory Reading
16	Air In meter
17	Metrology Tamper
18	Physical Tamper
19	Non-standard operation
20	Optical Port Communication Failure
21	Meter Power Reset
22	Meter HW Failure

Bit Position	Indicates this if bit is set (equal to 1)
23	Metrology HW Failure
24	Calibration Lost
25	Configuration Lost
26	Index Lost
27	Meter Malfunction 35 Day Gas
28	Metrology Integrity Error
29	Demand Overload
30	Operational Alarm Suppression
31	Hardware Alarm Suppression
32	Pressure Alarm Suppression
33	Temperature Alarm Suppression
34	Metrology EEPROM Error
35	Low Battery Voltage
36	Metrology Battery and Potential Failure
37	Failed To Start Meter Firmware Upgrade
38	Failed To Complete Meter Firmware Upgrade
39	Metrology Reset
40	GPS Hardware Failure
41	Relay Corrected
42	Memory Error
43	Metrology System Error
44	Metrology Received KWH
45	Metrology High Line Current
46	Metrology Measurement Error
47	Metrology Non Volatile Memory Error
48	Metrology Cover Detect
49	Metrology Register Check Error
50	Metrology DC Detect
51	Metrology Metering Error
52	Metrology Inversion Tamper
53	Power Surge
54	Hardware Failure

Bit Position	Indicates this if bit is set (equal to 1)
55	RAM Test Fail
56	ROM Test Fail
57	Hard EEPROM Error
58	Soft EEPROM Error
59	Unstable Power
60	Memory Full
61	Meter comms interface error
62-63	Unused

Table 26: Meter-level alarms – set 3

Bit Position	Indicates this if bit is set (equal to 1)
0	Compensation Failure
1	Optical Port Lockout
2	Unknown Gas
3	High Conductivity
4	Low Conductivity
5	Conductivity Inside Range
6	Conductivity Outside Range
7	High pH
8	Low pH
9	pH Inside Range
10	pH Outside Range
11	High Weight
12	Low Weight
13	Weight Inside Range
14	Weight outside Range
15	High Turbidity
16	Low Turbidity
17	Turbidity Inside Range
18	Turbidity Outside Range
19	High BG Algae
20	Low BG Algae

Bit Position	Indicates this if bit is set (equal to 1)
21	BG Algae Inside Range
22	BG Algae Outside Range
23	High Chlorophyll
24	Low Chlorophyll
25	Chlorophyll Inside Range
26	Chlorophyll Outside Range
27	High Dissolved Oxygen
28	Low Dissolved Oxygen
29	Dissolved Oxygen Inside Range
30	Dissolved Oxygen Outside Range
31	High Hydrogen Sulfide
32	Low Hydrogen Sulfide
33	Hydrogen Sulfide Inside Range
34	Hydrogen Sulfide Outside Range
35	Other Sensor High Measurement
36	Other Sensor Low Measurement
37	Other Sensor Inside Range
38	Other Sensor Outside Range
39	High Free Chlorine
40	Low Free Chlorine
41	Free Chlorine Inside Range
42	Free Chlorine Outside Range
43	High Total Chlorine
44	Low Total Chlorine
45	Total Chlorine Inside Range
46	Total Chlorine Outside Range
47	Metrology Inactive Phase Current
48	Metrology Phase Difference
49	Metrology Total Distortion
50	Metrology Voltage Unbalance
51	Metrology A Phase Distortion
52	Metrology B Phase Distortion

Bit Position	Indicates this if bit is set (equal to 1)
53	Metrology C Phase Distortion
54	Metrology Over Voltage
55	Metrology Under Voltage
56	Metrology Bad Password
57	Metrology DSP Error
58	Metrology Cross Phase Received KWH
59	Metrology Voltage Reference Error
60	Single Phase B Fail
61	Single Phase C Fail
62-63	Unused

Table 27: Meter-level alarms – set 4

Bit Position	Indicates this if bit is set (equal to 1)
0	Pressure Inside Range
1	Pressure Outside Range
2	Level Inside Range
3	Level Outside Range
4	Temperature Inside Range
5	Temperature Outside Range
6	Metrology Under Voltage Phase B
7	Metrology Over Voltage Phase B
8	Metrology Under Voltage Phase C
9	Metrology Over Voltage Phase C
10	Metrology Code Error
11	Metrology Data Error
12	Metrology Under Voltage Phase A
13	Metrology Over Voltage Phase A
14	Factory Error
15	Low Flow
16	Flow Inside Range
17	Flow Outside Range
18	High Odorant Concentration

Bit Position	Indicates this if bit is set (equal to 1)
19	Low Odorant Concentration
20	Odorant Concentration Inside Range
21	Odorant Concentration Outside Range
22	Permanent Error
23	Temporary Error
24	High Pressure Shutoff
25	Low Pressure Shutoff
26	High Temperature Shutoff
27	Rapid Temp Rise Shutoff
28	Excess Flow Shutoff
29	Reverse Flow Shutoff
30	Air in Meter Shutoff
31	Radio Communication Failed

Meter lifecycle state code

Table 28: Meter lifecycle state code

State	Description
Inventory	The meter is in the Inventory state and is not expected to return readings.
Install	The meter is in the Install state and is expected to return readings.

Parameter values for MEPEC01

Table 29: Parameter values MEPEC01

Value	Description
CYCLE,<Arbitrary Text>	Meters current billing cycle.
STATE,<Protocol Text>	Current meter state, either Inventory or Install or null.
SDATE,<Date>	The date at which the meter entered its current life cycle state in the form YYYYMMDDHHmm.
LAT, <floating point number>	Geographical latitude of the meter.
LONG, <floating point number>	Geographical longitude of the meter.
INTREQ,<0 or 1 for true or false>	Indicates whether or not interval data should be returned with read data in reports. The default value is 0.
RESET, <0 or 1 for true or false>	Demand Reset Setting information.

Value	Description
POD, <Arbitrary Text>	Point of Delivery of the meter.
INTLEN, <integer>	Interval length in minutes.

Additional parameter values for MEPEC01 (extended)

Table 30: Extended parameter values MEPEC01

Value	Description
REPID,< integer >	Rep ID
CHAN,< integer >	Channel sensor is on
CUST,<Arbitrary Text>	Customer short name
ENCRY, < Arbitrary Text >	Encryption status
LRECV, < Arbitrary Text >	Last message receive
DEVID,< Arbitrary Text >	Device ID of sensor
STATUS, < Arbitrary Text >	Sensor status
DTYPE, <Arbitrary Text>	Device type/sensor type
PTYPE, < Arbitrary Text >	Product type
MAN, < Arbitrary Text >	Manufacturer
MODEL, < Arbitrary Text >	Model
SER, < Arbitrary Text >	Serial # of sensor
ELEV, < Arbitrary Text >	Elevation
EOFF, < floating point number >	Elevation offset
MSR, < integer >	Meter sample rate
STR, < integer >	Supervisory transmit rate
SPVER, < Arbitrary Text >	Firmware version of SmartPoint module
MVER, < Arbitrary Text >	Firmware version of meter
PVER, < Arbitrary Text >	Product version
UNITS, < Arbitrary Text >	Unit of measure

TOU data type

Table 31: TOU data type

State	Description
0	Current values/snapshot
1	Time at self-read/contract hour
2	Time at last demand reset
3	Time at last season
4	Time when tier changes

Appendix A: Original CMEP specification (partial)

California Metering Exchange Protocol

Version 1.20 - Update for EDI DASR compatibility

Underlined text indicates changes from CMEP Version 1.1

March 7, 2000

Purpose

The California Metering Exchange Protocol is intended for use in transmitting gas and electric utility metering, billing, and administrative information between companies. Communications between customers and Utility Distribution Companies (UDC), Energy Service Providers (ESP), Metering Agents (MA) and Billing Agents (BA) must be supported. This protocol has been developed to support the business activities needed to allow utility customers to choose among multiple Service Providers (SPs), which may be commercially independent from their Utility Distribution Company (UDC). This direct access process was mandated to be in operation on January 1, 1998. No alternative protocol was available for implementation and inter-company testing in 1997.

Specific business objectives

1. Meet the January 1, 1998 implementation deadline. It should be acknowledged that several parallel processes are in place and progressing to meet the same business needs as this protocol. Among them are the utilities industry Utilities Communications Architecture group, the group developing the ANSI standard Document Communications Infrastructure (DCI) document types, and the California utility companies and SP coordination committee. None of these alternatives will be ready in the required time frame.
2. Provide a simple to implement, workable, and reliable protocol to support business communications between metering agencies, SPs, and billing agencies. This protocol must be easy to implement and use. It will be used on multiple machine types and it will be implemented in multiple programming languages. It must solve immediate business needs without adding complexity. It must contain features that provide assurance that communications errors can easily be detected.
3. Provide an inexpensive to implement protocol that may comfortably be abandoned. Utility restructuring is occurring at a pace that is much beyond the capabilities of standards bodies to respond. This protocol is intended for interim use while standards bodies are producing an appropriate replacement.

Implementation overview

This protocol is a compromise between reality and what might be ideal. The set of features that make up a good communications protocol has continuously evolved. Protocols designed today are free flowing, flexible, and extensible. Modern programming tools tend to support this new style of communications protocols. A well-known example of this new style protocol is the Hypertext Transfer Protocol (HTTP) commonly used in Internet communications.

Though the California Metering Exchange Protocol is new, it is constrained by a necessity to be supportable with computer systems and programming languages that are far from modern. However, simply finding a lowest common denominator set of communications features is problematic. Older systems tend to rely on rigidly structured, fixed field length, fixed record length protocols. This rigidity tends to limit the adaptability of a protocol. Fixed length fields and records often embody significant wasted transmission bandwidth since individual fields must be sized to contain the largest possible entry for them.

The compromise chosen for the California Metering Exchange Protocol is to use fixed record formats with variable length fields. This approach provides relative ease in mapping communications data formats to traditional fixed format records while allowing some of the communications bandwidth savings of the modern protocol style. It does not provide all of the flexibility and adaptability inherent in the modern style. The California Metering Exchange Protocol data content consists of multiple lines of ASCII text, each terminated with ASCII Carriage Return and Line Feed characters. Only a very small number of different line types are used. Each line begins with type name and type version fields to allow correct interpretation of its contents. Individual fields on a line are separated with the ASCII Comma character. Fields are packed tightly, with leading and trailing blank space removed. Empty fields are carried as simply a single comma.

The text lines that make up the California Metering Exchange Protocol are designed to support both block mode and continuous stream data transmission methods. Block mode transmission nominally consists of placing multiple text lines in a file or communications buffer and transmitting that file or buffer as a single unit. Continuous stream data transmission simply transmits text lines, one after the other, with no identifiable beginning or end to the sequence. Supporting both modes in the same protocol is only slightly more difficult than providing a robust version of either.

Specific protocol features

There is a simple set of features or rules embodied in the California Metering Exchange Protocol:

- Data content is a sequence of ASCII text lines terminated with ASCII Carriage Return and Line Feed characters.
- Each line is a complete record.
- No line shall exceed a total length of 2048 characters including end of line Carriage Return and Line Feed. This limit is imposed to simplify and clarify implementation issues.
- Each record stands alone as an atomic entity. This is a context free protocol.
- Each record consists of a series of variable length fields; each delimited with the ASCII Comma character.
- Field text that contains the ASCII Comma character is enclosed between ASCII Quotation marks at the field boundaries.
- No single field shall exceed a total length of 256 characters including any delimiting characters. This limit is imposed to simplify and clarify implementation issues.
- Field contents are packed. Leading and trailing white space is removed when records are sent and ignored when received. If leading or trailing white space itself is significant, the field must be enclosed between ASCII Quotation marks at the field boundaries.
- Empty or unused fields are indicated with a single ASCII Comma character.
- Each record begins with a consistent set of fields, called a header, to facilitate identification and interpretation.

- Each record ends with an optional CRC field which lies between the last supplied comma in the record and the terminating Carriage Return and Line Feed characters. The CRC type is CRC-16. When supplied, this field is encoded as a hexadecimal integer totaling 5 characters in length, including the leading ASCII 'H' character. When not supplied, the CRC field is left empty.
- Records may be truncated at any field after the header. Those fields not supplied are assumed to be empty. When records are truncated, the CRC field is still assumed to lie between the last actually supplied comma and the terminating Carriage Return, Line Feed characters.
- Field text may contain one of the following data types: Numeric Integer, Numeric Floating-Point, a calendar Date, Time, a Date/Time, a Time Interval, Arbitrary Text, or a predefined Protocol Text entry.
- Numeric values are encoded as ASCII text. Two kinds of numeric values are provided: Integer and Floating-Point. Integer values are encoded in decimal with optional leading Plus (+) or Minus (-) signs or in hexadecimal. Hexadecimal values are indicated by a leading ASCII character 'H'. Floating Point values may be encoded as simple integers, with trailing decimal point and one or more decimal digits, or scientific notation of the form: [+][-]9.9E[+][-]9 where [+][-] means an optional plus or minus sign, 9 means one or more decimal digits, and E means one of the following characters 'E', 'e', 'D', or 'd'. Floating point values, however, must be limited to a specific range. Though they may be encoded in scientific notation, floating point numbers will be converted to +/- 9999999999.99999 form by PG&E for internal use. Numeric fields may not exceed 16 characters in length. Empty numeric fields are interpreted as the value zero.
- Time and Date values are encoded as ASCII text. Date only fields are encoded as CCYYMMDD. Time fields are encoded as HHMM. Date/Time fields are encoded as CCYYMMDDHHMM. Allowed values CCYYMMDD0000 through CCYYMMDD2359. Empty Date and Date/Time fields are undefined except where explicitly handled.
- Time Interval values are encoded as ASCII text. They are encoded MMDDHHMM. Empty Time Interval fields are interpreted as zero intervals. Interval values of less than an hour must repeat on the hour. Interval values of less than a day must repeat at midnight.
- Arbitrary Text fields contain free- form text such as customer name and address information. Empty text fields are interpreted as blank.
- Protocol Text fields contain values that are predefined and have a limited set of possible values. They are used as data type indicators and as qualifiers or feature flags. Predefined text values are chosen so as to make their meanings easily inferred by someone familiar with the technology they describe. Empty text fields are interpreted as blank. Protocol Text fields may not exceed 12 characters in length, not counting the delimiting comma. This limit is imposed to simplify and clarify implementation issues.

Record types

There are six categories of inter-company transactions that must be supported for direct access:

- End use customer administration
- Metering service
- Billing service
- Distribution loss factors
- Equipment configuration
- Record reject for errors

Separating communications into these categories simplifies the job of identifying communications purpose and content. Record types and their use are discussed in detail in the following sections.

Header fields

All records in the California Metering Exchange Protocol begin with a consistent set of fields. They are the **Record Type** and **Record Version** fields. The supported record types are as follows:

- MEPAD01 – Administrative Data Type 1 – DASR
- MEPAD02 – Administrative Data Type 2 – credit data
- MEPMD01 – Metering Data Type 1 – interval data

- MEPMD02 – Metering Data Type 2 – TOU data
- MEPBD01 – Billing Data Type 1 – billed dollars
- MEPBD02 – Billing Data Type 2 – interval pricing plan
- MEPBD03 – Billing Data Type 3 – TOU pricing plan
- MEPLF01 – Distribution Loss Factors – electric
- MEPEC01 – Equipment Configuration Type 1
- MEPRR01 – Record Reject Type 1

The Record Version field is a **Date** field, as previously described in *Specific Protocol Features*, which contains the date that this specific record format was defined. This version number changes only when interpreting as some other version would produce invalid results.

Time values

Time is not a trivial concern. Many problems occur if time and date are not handled properly. Customers may be billed incorrectly. Usage statistics may be invalidated. The changes to and from daylight savings time confuse billing algorithms. Companies will be dealing with customers in multiple time zones. A single, standard approach to handling time and date is necessary.

The California Metering Exchange Protocol records and transmits all information using the international standard, Universal Coordinated Time (UTC). UTC, for the purposes of this document, is simply Greenwich Mean Time (GMT) without daylight savings time correction. UTC is an internationally recognized time representation and is actually used internally in nearly all of our modern computer systems, including desktop PCs.

Meter readings, administrative operations, and billing transactions are all reported in UTC. Some account billing is based upon time-of-day which is normally defined in terms of local time. For those accounts, conversion from UTC to local time must be performed. Each meter's configuration information includes time zone descriptions for both standard and daylight savings time. Time values must be corrected to local time for billing purposes by adding the appropriate time zone value to the UTC value, taking into account crossing day and month boundaries.

The California Metering Exchange Protocol time calculations may appear complex and obscure to people who are unfamiliar with the internal operation of modern computer systems. The algorithms to perform these operations are both simple and well known. Converting time values from UTC to local time and back is so common that most people take these operations for granted, not realizing that it is even taking place. This protocol simply utilizes UTC for its intended purpose.

Protocol text

Protocol text values are predefined text strings. Their use allows constant and reliable parameter identification. Their use also provides boundaries to the range of values that may be used in fields. Most Protocol text values are defined in the description of the fields to which they apply. One specific type of Protocol text value is common to multiple fields and is listed here for convenience:

UNITS

KWHREG – Meter dial or register readings for printing on monthly bill.

KVAHREG – Meter dial or register readings for printing on monthly bill.

KVARHREG – Meter dial or register readings for printing on monthly bill.

GASREG – Meter dial or register readings for printing on monthly bill.

PULSE – Direct meter pulse readings.

KW – Kilowatt demand, usually expressed as peak value in time interval.

KVA – Kilovolt-ampere demand, usually expressed as peak value in time interval.

KVAR – Kilovolt-Ampere-Reactive demand, usually expressed as peak value in time interval. Values may be positive or negative depending upon power factor. Values are positive for VARs produced by customer or negative for VARs consumed by customer. Induction motors consume watts and VARs. A condenser bank produces VARs. An over-excited generator produces watts and VARs. An under-excited generator produces watts and consumes VARs.

KWH – Kilowatt hours used.

KVAH – Kilovolt-ampere hours.

KVARH – Kilovolt-Ampere-Reactive hours. Values may be positive or negative depending upon power factor. See KVAR above for further notes.

GKW – Kilowatt generation, received from customer, usually expressed as peak value in time interval. Used when customer is generating power.

GKVA – Kilovolt-Ampere generation received from customer, usually expressed as peak value in time interval. Used when customer is generating power.

GKVAR – Kilovolt-Ampere Reactive generation received from customer, usually expressed as peak value in time interval. Used when customer is generating power. Values may be positive or negative depending upon power factor. See KVAR above for further notes.

GKWH – Kilowatt hours received from customer. Used when customer is generating power.

GKVAH – Kilovolt-Ampere hours received from customer. Used when customer is generating power.

GKVARH – Kilovolt-Ampere Reactive hours received from customer. Used when customer is generating power. Values may be positive or negative depending upon power factor. See KVAR above for further notes.

VOLTS – Volts

BTU – British Thermal Units

THERM – Therms

GAL – Gallons

IG – Imperial Gallons

L – Liters

CF – Cubic Feet

CCF – Hundreds of Cubic Feet

MCF – Thousands of Cubic Feet

ACFT – Acre-Feet

LBS – Pounds

$ – US Dollars

Metering service data records

California Metering Exchange Protocol metering communications occur to enable customer energy use and service billing. Most information transmitted in Metering Service Data records consists of meter reading and energy use data about specific customers.

Metering service data records are typically generated by the MA and supplied to the UDC and ESP. In the case of shut-off or turn-on, the UDC may be responsible for generating appropriate MEPMD01 records with final and initial meter readings. In the case of a change out, the party changing out the meter may be responsible for providing the final and initial meter readings to the MA.

Metering service data record transmissions are not acknowledged on a record-by-record basis. Records that contain data that is deemed incorrect by a receiving party may be rejected and returned to the sender.

Metering values vs. date/time intervals

The values transmitted in Metering service data records are typically an accumulation of some quantity, such as kilowatt-hours, over an interval of time. Each value has an associated **Date/Time** field as a timestamp. That timestamp could conceivably identify the beginning or ending time of the interval. Each of these approaches has advantages and disadvantages. **The California Metering Exchange Protocol uses end-of-interval Date/Time timestamps.**

Whether beginning or end of interval timestamps are used, a problem arises that complicates totaling commodity usage on a day by day basis. Either the first or last reading for a day will be listed with the previous or next day's date. The use of end-of-interval timestamps does not complicate this problem. Totaling algorithms must deal with the fact that the timestamp for the last interval of the day will be for the beginning of the first interval of the next day.

One potential solution to the end-of- interval totaling problem is to simply offset the midnight reading to 23:59. This approach is inadequate simply because billing days often do not begin and end at midnight. Some other time of the day, such as 0700 local time is used. Offsetting all timestamps by one minute might minimize this one minor totaling problem but would introduce a systemic error in data representation. If such measures are desirable, they should be applied to the data after it is transmitted via California Metering Exchange Protocol.

Time-of-use metering

There are two broad categories of metering data intervals employed for different accounts. The first is pure interval values, such as those accounts that are billed on total energy use on an hourly or monthly basis. The second is what is traditionally known as time-of-use where energy use is broken into as many as five or more components. These components are normally labeled on-peak, off-peak, and so on. (PG&E typically defines three components: on-peak, part-peak, and off-peak). Time-of-use billing has typically been applied to monthly totals of individual use components but day-by-day billing is possible.

Time-of-use totaling is usually complicated by the treating of weekdays, weekends and holidays differently when assigning usage to on-peak, off-peak, or other categories. Often, all day Sunday is treated as an off-peak period. Time-of-use metering totals must therefore be identified by their component names and the overall time interval for which they are accumulated. Time-of-use and Interval data formats differ sufficiently to justify supporting them with two separate record types. Interval data is supported by MEPMD01 - Metering Data Type 1 records and time-of-use with MEPMD02 -Metering Data Type 2 records.

Beginning and end of month meter reads

Nominally, data transmissions of cumulative meter reads, such as monthly meter reads, should include both beginning of period and end of period date and usage values. This allows receiving entities to verify that no reading overlaps or gaps have occurred.

MEPMD01 – Metering Data Type 1 – interval data

Interval Data is data that represents regular interval accumulation of energy usage information, such as 15-minute, hourly, daily, or monthly accumulation or demand. Most energy metering information may be represented using this record. The exception is traditional time-of-use (TOU) usage accumulation that has complex irregular interval definition. TOU data may be represented using MEPMD02 record type.

MEPMD01 represents a format to facilitate the transfer of metering data. It is not intended to define how a utility customer's energy use is administered or billed. MEPMD01 supports single meter socket values. Utility customers with more than one meter per account must be explicitly handled. Billing for a single utility customer that involves the aggregation of metering values may be done by some negotiated scheme by the UDC acting as a metering agent. It could also be handled by using MEPMD01 records to transfer metering values separately, as separate metering accounts, to be combined later in that customer's billing service. Both methods are supportable by MEPMD01.

The sequence of fields in this record is:

1. **Record Type**: *Protocol Text:* Always MEPMD01
2. **Record Version**: *Date (CCYYMMDD):* Currently 19970819
3. **Sender ID**: *Arbitrary Text:* Identity of the entity sending this record. It will typically be a Dun and Bradstreet number. Currently, only the first 16 characters of this field will be recognized by PG&E.
4. **Sender customer ID**: *Arbitrary Text:* This is the senders identification reference for the account to which this record applies. Currently, only the first 12 characters of this field will be recognized by PG&E.
5. **Receiver ID**: *Arbitrary Text:* Identity of the intended recipient entity of this record. It will typically be a Dun and Bradstreet number. Currently, only the first 16 characters of this field will be recognized by PG&E.
6. **Receiver customer ID**: *Arbitrary Text:* This is the receiving entities identification reference for the account to which this record applies. Currently, only the first 12 characters of this field will be recognized by PG&E.
7. **Time stamp**: *Date/Time (CCYYMMDDHHMM):* Date and Time that this record was created.
8. **Meter ID**: *Arbitrary Text:* This is the placard identifier or faceplate serial number to physically identify a meter. This is usually some arbitrary combination of letters and numbers that make up a meter manufacturer's serial number. It may, however, be some other easily found identifying label on the metering equipment. This field may optionally be used as a channel identifier for situations where that information is useful. Currently, only the first 12 characters of this entry will be recognized by PG&E.
9. **Purpose**: *Protocol Text:* Indicates the reason for this data transmission. Defined values include the following:
    - **OK** – Normal transmission.
    - **RESEND** – Retransmission of previously sent data.
    - **SUMMARY** – Summary of SP totaled data. Summary data usually consists of values calculated from metering data such as monthly totals calculated from 15 minute readings. This data is often supplied on a regular basis (such as for quarterly reports).
    - **HISTORY** – Archival account data. Archival data is retrieved from long term storage and may be of lesser time resolution than its original collection period. This data of generally supplied once per request for analysis purposes.
    - **PROFILE** – Account usage profile data.
    - **TEMPLATE** – Account usage template data.
    - **REJECT** – Data is rejected and is being returned to sender.

10. **Commodity**: *Protocol Text:* Describes what commodity type this account is for. Defined values are:
    - **E** – Electricity
    - **G** – Gas
    - **W** – Water
    - **S** – Steam
11. **Units**: *Protocol Text:* Describes the units of the data values. Examples of values are: KWHREG, KWH, and THERM. A complete list of abbreviations is supplied in the Protocol Text Units listing. Data quality flags are used to indicate the raw, estimated, valid, etc. status of values transmitted.
12. **Calculation Constant**: *Numeric Floating-Point:* Defines an optional value which is used as a multiplier to convert data values to engineering units. Typically this parameter is used with PULSE data to allow calculation of equivalent KWH and THERM values.
13. **Interval**: *Time Interval (MMDDHHMM):* Describes the time interval between readings. Metering data is transmitted as Date/Time and value pairs. In many cases, however, the time intervals for the data values are so regular that Date/Time information past the first reading is essentially redundant. This field may be used to minimize this redundancy problem. If a Date/Time field, after the first reading in a line, is empty, it is calculated by adding this interval to the Date/Time of the previous value. This field is ignored if no empty Date/Time fields are encountered in the record. This field is optional if Date/Time fields are supplied for all values.
14. **Count**: *Numeric Integer:* Indicates the number of Date/Time, flag, and value sets to follow. A maximum of 48 sets is allowed per record.
15. **Data**: *Date/Time (CCYYMMDDHHMM), Protocol Text, and Numeric Floating-Point triplet:* Each data entry is a set of three fields. The number of data entry sets is described in the Count field. When an Interval field is supplied, Date/Time fields after the first may left empty to be calculated when the record is read. An empty Date/Time field is calculated by adding the time interval described in the Interval field to the supplied or calculated Date/Time value of the previous entry pair in this record. The Protocol Text field is an optional field used as a data quality flag. Defined values are:
    - (empty) – An empty flag field indicates that the value is OK and validated.
    - **E** – Value is estimated. Estimation method is described in account's MEPAD01 record.
    - **A** – Value is an adjustment. Adjustments are made to correct metering inconsistencies or errors.
    - **N** – Value is empty. No value is sent for this interval. May be sent as the first entry for a new account.
    - **R** – Value is raw. No validation has been performed on value.

MEPMD02 – Metering data type 2 – TOU data

The sequence of fields in this record is:

1. **Record Type:** *Protocol Text:* Always MEPMD02
2. **Record Version**: *Date (CCYYMMDD):* Currently 19970819
3. **Sender ID**: *Arbitrary Text:* Identity of the entity sending this record. It will typically be a Dun and Bradstreet number. Currently, only the first 16 characters of this field will be recognized by PG&E.
4. **Sender customer ID**: *Arbitrary Text:* This is the senders identification reference for the account to which this record applies. Currently, only the first 12 characters of this field will be recognized by PG&E.
5. **Receiver ID**: *Arbitrary Text:* Identity of the intended recipient entity of this record. It will typically be a Dun and Bradstreet number. Currently, only the first 16 characters of this field will be recognized by PG&E.
6. **Receiver customer ID**: *Arbitrary Text:* This is the receiving entities identification reference for the account to which this record applies. Currently, only the first 12 characters of this field will be recognized by PG&E.
7. **Time stamp**: *Date/Time (CCYYMMDDHHMM):* Date and Time that this record was created.
8. **Meter ID**: *Arbitrary Text:* This is the placard identifier or faceplate serial number to physically identify a meter. This is usually some arbitrary combination of letters and numbers that make up a meter manufacturer's serial number. It may, however, be some other easily found identifying label on the

metering equipment. This field may optionally be used as a channel identifier for situations where that information is useful. Currently, only the first 12 characters of this entry will be recognized by PG&E.

9. **Purpose**: *Protocol Text*: Indicates the reason for this data transmission. Defined values are as follows:
    - **OK** – Normal transmission.
    - **RESEND** – Retransmission of previously sent data.
    - **SUMMARY** – Summary of SP totaled data. Summary data usually consists of values calculated from metering data such as monthly totals calculated from daily readings. This data is often supplied on a regular basis (such as for quarterly reports).
    - **HISTORY** – Archival account data. Archival data is retrieved from long term storage and may be of lesser time resolution than its original collection period. This data of generally supplied once per request for analysis purposes.
    - **PROFILE** – Account usage profile data.
    - **TEMPLATE** – Account usage template data.
    - **REJECT** – Data is rejected and is being returned to sender.
10. **Commodity**: Protocol Text: Describes what commodity type this account is for. Defined values are:
    - **E** – Electricity
    - **G** – Gas
    - **W** – Water
    - **S** – Steam
11. **Units**: *Protocol Text:* Describes the units of the data values. Examples of values are: KWHREG, KWH, and THERM. A complete list of abbreviations is supplied in the Protocol Text Units listing. Where multiple unit types and seasons are transmitted, separate MEPMD02 records are sent for each. Data quality flags are used to indicate the raw, estimated, valid, etc. status of values transmitted.
12. **Season identifier**: *Protocol Text:* This identifies the season for which the values apply. Defined values are: **S** – Summer and **W** – Winter. This field may be left blank for accounts that do not differentiate between seasons. If this field is blank, it is interpreted as indicating winter for those accounts that do. A record may contain data for one season only. Data for different seasons must be sent in separate records.
13. **Calculation Constant**: *Numeric Floating-Point:* Defines an optional value which is used as a multiplier to convert data values to engineering units. Typically this parameter is used with PULSE data to allow calculation of equivalent KWH and THERM values.
14. **Data Start Time**: *Date/Time (CCYYMMDDHHMM):* Describes date and time that the data interval reported in this record began.
15. **Data Timestamp**: *Date/Time (CCYYMMDDHHMM):* Describes date and time that ends the interval reported in this record.
16. **Count**: *Numeric Integer:* Indicates the number of label-flag-value sets to follow. A maximum of 6 sets is allowed per record.
17. **Data**: *Protocol Text, Protocol Text, and Numeric Floating-Point triplet:* Each data entry is a set of three fields. A maximum of 6 sets is allowed per record. Each set consists of a Protocol Text time-of-use component label field, a Protocol Text data quality flag, and a Numeric Floating-Point value. The number of data entry sets is previously described in the Count field. Defined values for the quality flag field are described in the MEPMD01 record. (An empty indicates that the value is OK.) Defined values for the label field are as follows:
    - ON-PEAK
    - OFF-PEAK
    - PART-PEAK
    - PEAK-2
    - PEAK-3
    - PEAK-4
    - TOTAL

Equipment configuration records

California Metering Exchange Protocol equipment configuration communications occur to enable metering equipment descriptions to be transferred between companies. MA (meter owners, installers, and maintainers) supplies this information to UDC for disaster recovery purposes. The UDC is typically the first response agency during major service disruptions. Equipment Configuration data is normally stored by UDC for recall by field repair crews to facilitate restoration service to UDC customers.

MEPEC01 – Equipment configuration data type 1

The sequence of fields in this record is as follows:

1. **Record Type**: *Protocol Text*: Always MEPEC01
2. **Record Version**: *Date (CCYYMMDD)*: Currently 19980618
3. **Sender ID**: *Arbitrary Text*: Identity of the entity sending this record. It will typically be a Dun and Bradstreet number. Currently, only the first 16 characters of this field will be recognized by PG&E.
4. **Sender customer ID**: *Arbitrary Text*: This is the senders identification reference for the account to which this record applies. Currently, only the first 12 characters of this field will be recognized by PG&E.
5. **Receiver ID**: *Arbitrary Text*: Identity of the intended recipient entity of this record. It will typically be a Dun and Bradstreet number. Currently, only the first 16 characters of this field will be recognized by PG&E.
6. **Receiver customer ID**: *Arbitrary Text*: This is the receiving entities identification reference for the account to which this record applies. Currently, only the first 12 characters of this field will be recognized by PG&E.
7. **Time stamp**: *Date/Time (CCYYMMDDHHMM)*: Date and Time that this record was created.
8. **Record ID**: *Arbitrary Text*: This is an optional field that may be supplied in a request record. The contents of this field will be returned unchanged in the corresponding response record. The length of this text shall not exceed 16 characters.
9. **Operation Type**: *Protocol Text*: The kind of operation that triggered the transmission of this record. Defined values are as follows:
    - **UPDATE** – This is notice of a change in configuration.
    - **UPDATE-ACK** – Acknowledge configuration change.
    - **UPDATE-NAK** – Reject configuration change.
    - **REMOVE** – This is notice of deletion of a configuration item.
    - **REMOVE-ACK** – Acknowledge deletion.
    - **REMOVE-NAK** – Reject deletion.
    - **CFG-REQ** – (SP to UDC) Request configuration.
    - **CFG** – This is current configuration, no change has occurred.
    - **CFG-NAK** – Reject a configuration data request.
10. **Purpose**: *Protocol Text:* Indicates the reason for this data transmission. Defined values are:
    - **OK** – Normal transmission.
    - **RESEND** – Retransmission of previously sent data.
    - **CORRECT** – Correction to previously sent data.
11. **Comment**: *Arbitrary Text:* An optional field used to supply additional information about the indicated operation. This field is typically used in NAK transmissions to indicate the reason for rejecting a request. The length of this text shall not exceed 64 characters.
12. **Commodity**: *Protocol Text:* Describes what commodity type this account is for. Defined values are:
    - **E** – Electricity
    - **G** – Gas
    - **W** – Water
    - **S** – Steam

13. **Activity**: *Protocol Text:* Describes what kind of activity caused this record to be sent. Defined values are:
    - **(empty)** – Automatic transmission
    - **CHANGE** – Equipment/Meter Change
    - **SET** – Meter Set
    - **REMOVE** - Equipment/Meter Removed.
    - **MAINT** - Equipment/Meter Maintenance.
14. **Equipment Type**: *Protocol Text:* (Generated by MA) The kind of equipment this record describes. Defined values are:
    - **METER** – A meter. When meter and recorder functions are combined in one unit, both METER and RECORDER equipment type records are supplied for that combined unit.
    - **RECORDER** – Meter data recorder.
    - **PT** – A metering potential transformer.
    - **CT** – A metering current transformer.
15. **Manufacturer**: *Arbitrary Text:* (Generated by MA) Manufacturer's name. Currently, only the first 22 characters of this field will be recognized by PG&E.
16. **Model**: *Arbitrary Text:* (Generated by MA) This device's model name or number. Currently, only the first 22 characters of this field will be recognized by PG&E.
17. **Meter ID**: *Arbitrary Text:* (This is the placard identifier or faceplate serial number to physically identify a meter. This is usually some arbitrary combination of letters and numbers that make up a meter manufacturer's serial number. It may, however, be some other easily found identifying label on the metering equipment. This field may optionally be used as a channel identifier for situations where that information is useful. Currently, only the first 12 characters of this entry will be recognized by PG&E.
18. **Identifier**: *Arbitrary Text:* (Generated by MA) An optional identifier to aid visual identification of this device. Currently, only the first 22 characters of this field will be recognized by PG&E.
19. **Date of purchase**: *Date (CCYYMMDD):* (Generated by MA) The date this device was purchased. Month and day values may be estimated.
20. **Date of installation**: *Date (CCYYMMDD):* (Generated by SP) The date this device was installed.
21. **Owner**: *Arbitrary Text:* (Generated by SP) Name of entity that owns this device. This field may contain the value CUSTOMER to indicate customer ownership else an SP identifier should be used. Currently, only the first 16 characters of this field will be recognized by PG&E.
22. **Parameter count**: *Numeric Integer:* Indicates the number of Parameter pairs to follow. A maximum of 16 sets is allowed per record.
23. **Parameters**: *Protocol Text and Arbitrary Text pair:* Each parameter entry is a set of two fields. The number of parameter sets is described in the Parameter Count field. The Protocol Text field of each pair contains an identifier for the kind of parameter the following Arbitrary Text describes. The Arbitrary Text field of each pair contains descriptive text. The length of this Arbitrary Text field shall not exceed 30 characters. There are four groups of parameters, one for Meters, one for recorders, one for transformers, and one general purpose group.

    1. Defined Protocol Text values for METERs include the following:

        - **DEMAND-TYPE** – What quantity this meter measures (i.e., KWH, KVARH, CF, etc.). When multiple DEMAND-TYPEs are measured on a single meter, the types are all listed with ASCII space characters (20 hexadecimal) as separators.
        - **CLASS-CODE** – Meter Class Code
        - **FORM** – Meter Form type
        - **VOLTS** – Voltage rating
        - **AMPS** – Current rating in AMPS

- **SVC-VOLTS** – Service Voltage
- **PHASE** – Meter Phase
- **WIRES** – The number of wires
- **DELTA-WYE** – Delta/Wye configuration
- **KYZ-OUTPUT** – Pulse R/I
- **KH** – Meter Kh constant
- **KE** – Meter ke constant
- **PPDR** – Pulses per disk revolution
- **DIAL-K** – Dial K (Register) constant
- **BILLING-K** – Billing Constant
- **REG-RATIO** – Register Ratio
- **N-DIALS** – Number of dials
- **INT-ID** – Internal Meter ID
- **P-MULT**– Pulse Multiplier
- **RKVA-ID** – RKVA Meter Identifier
- **REC-ID** – Recorder Identifier

2. Defined Protocol Text values for RECORDERs are:
   - **COMM-TYPE** – The kind of communications path, examples: dialup, Internet, and ATT-PCS
   - **PROTOCOL** – The communications protocol, examples: MFGR (manufacturer's proprietary protocol), TCP/IP, and C12.XX
   - **FORMAT** – Data format if different from or at higher level than communications protocol
   - **ADDRESS** – Communications network address or dialup circuit number
3. Defined Protocol Text values for transformers are:
   - **RATIO** – Transformer ratio, expressed as ratio to one
   - **PRIMARY** – Primary rating in volts or amps
   - **INSULATION** – Insulation voltage class
   - **LOCATION** – Location code for this device, typically INDOORS or OUTDOORS
   - **HI-LO** – High-side/low-side designator, example values: HIGH and LOW
   - **SINGLE-DUAL** – Single or dual configuration designator, example values: SINGLE and DUAL
4. General Use Protocol Text values are:
   - **OTHER** – Other unspecified equipment parameter
   - **NOTE** – General text