IOT Technologies
Heat Energy (District Heating) Management

Abstract: IOT Technologies along with its local systems integrator Citrus Solutions (a subsidiary of Lattelecom) has recently completed the city-wide rollout of a state-of-the-art wireless smart grid system in Latvia's capital city Riga for Rigas Siltums, the district heating company in Riga. The IOT Technologies Heat Energy Management System provides Rigas Siltums with full-two communications with every smart meter in its heat energy distribution network, supporting a number of customer objectives including demand reads and smart meter updates, system-wide reads of all smart meters, as well as intrusion alerts and leak detection at customer energy control room sites. The entire IOT Technologies system is managed on a fully transparent basis by the Rigas Siltums SAP ERP system.

Rigas Siltums: Rigas Siltums ("RS") is the largest supplier of district heating in Lativa. RS services the majority of all residential building in Riga (almost 8,000 building connections and more than 500,000 residents). In each of the almost 8,000 buildings serviced by Rigas Siltums, the service connection point is monitored by a Kamstrup smart meter, usually located in a basement energy control room. Several years ago RS installed a utility ERP system from SAP with an Oracle data base.

The meter locations, the local weather, the RS utility ERP system, as well as regulatory requirements were precursors to RS' desire to find an automated control system that would meet their needs and those of the regulatory requirements.

Issues Facing Rigas Siltums: There were a number of issues facing Rigas SIltums. These are presented below, and while each issue had its own relative degree of importance, all were issues to be resolved in order to address RS' business requirements and operating objectives, as well as meet the regulatory requirements.

Regulatory Requirements: Regulatory requirements dictated the need to have timely and extensive operational data available. There was a need to apply tariff changes periodically, where such changes were dependent upon having available accurate meter data for all system meters at exactly the same time. There were new requirements for levels of service that could not be met by the current systems and manual meter readings available at that time to RS.

Meter Reading: Prior to system implementation, RS would deploy more than 300 office workers in order to physically collect information from every single meter in the system. This was typically done twice per month, with the time spent reading meters by the utility employees being time unavailable for other important operational activities. The meter reading tasks were not limited to just the consumption information, but also included the collection of a large number of parameters, including temperature, pressure, and any other of the 19 parameters measured and recorded by the Kamstrup smart meters.

Weather: The mean temperature in June is about 17 °C. Winter lasts from the middle of December to the middle of March. The mean January temperature is -2°C with occasional extreme temperature drops down to -40°C. The average length of the heating season is up to 200-210 days in the year. The weather was a significant factor when deploying more than 300 office workers out into the field twice per month for two to three days at a time in weather where temperatures of -30°C were not uncommon.

Availability of Current Information: The issue of having current information available was important to RS, because resolving this issue would enable RS to address:

- Customer complaint responses
- Management of inter-departmental communications
- Identification of issues before they reach a critical stage

System Leakage: Another operational issue facing RS was leakage within the building distribution system. Early identification of such leaks would enable RS to ensure that its customers were properly receiving all of the heat energy for which they were being billed.

Unauthorized Access: The RS energy control rooms are located in the basements of every building. Prior to system implementation, RS had no knowledge of unauthorized access to a control room. In many instances during the off-season, residents would turn off the power to the RS smart meters – creating a situation where there would be no supply of heating once the cold season began until the situation was rectified via a physical RS visit to the energy control room. In other instances, building residents would attempt to adjust the Kamstrup smart meters and other heating system components in an attempt to improve the level of heating in the building – oftentimes creating the need for an RS field technician visit.

Rigas Siltums System Requirements: The system specified by Rigas Siltums was required to incorporate the following capabilities and features:

- Complete system reading: On a fully automated basis, and within three hours of a request for the reading of every single meter in the system, all meter information was to have been retrieved with a level of completeness exceeding 99%.

- Demand reading: Support was required for the demand reading of any or all parameters stored within the Kamstrup smart meters – for one customer account or a group of accounts; a provision was also to be provided that allowed for the specification of a meter reading as of a specific hour (time) and date.
- Synchronized data: The system was to provide the ability to collect smart meter data on a synchronized basis in order to provide a snapshot of the complete system data at a specified point in time.
- Smart meter parameter updates: Support for direct update of parameters in specific meters or a specified group of meter; as will be seen below, the implemented solution also provides for remote ("over the air") firmware updates of all system components such as endpoints and base station transceivers.
- Outage management: Management of power outage alerts where segments of the system might be affected (with loss of supply of heating energy) due to loss of electrical power.
- Leak detection alerts: Provision of alerts for leakage in the building premises – an indicator of an obligatory maintenance visit.
- Intrusion alerts: Immediate notification of entry into any RS customer site control room throughout the coverage area.
- Non-cellular solution: A non-cellular solution was preferred due to the relatively high cost of data transfer via the cellular network. In addition, the cellular network could not guarantee the level of system availability for data collection required by the customer.
- Interface to available public and private backhauls: RS owned fiber-optic nodes in parts of the city and required the use of these network nodes as the data collection backhaul from the system data collection points wherever possible. A hybrid backhaul solution was required utilizing both the fiber optic network nodes as well as ADSL connections.
- Transparent operation: RS had previously implemented a comprehensive SAP ERP system for the management of all operations, including customer relationship management, billing, asset management, system maintenance, etc.; a fully-integrated, completely transparent, and seamless interface was required for the link to the data collection and management system to be implemented in the field; as such, all requests for data, demand reads, etc. were to have been requested via RS personnel using the SAP system, transparent to the fact that all such requests were to be forwarded to the management system for processing and return of data.
- Historical data base: Archival of all collected system data for the purposes of later analysis and reporting.

The Solution: IOT Technologies' full two-way fixed network utilizing IOT Technologies' proprietary wireless technology.

The system incorporates a full two-way communications system supporting all of the customer's data collection requirements as well as a full set of smart grid management tools. The system also supports "over-the-air" updates, whereby IOT Technologies firmware in all of the system components can be modified and upgraded over the network.

System components include:

- Endpoints: The RF transceiver endpoints are connected to Kamstrup smart meters and equipped with additional ports for leak detection devices as well as door intrusion sensors; the endpoints communicate directly or indirectly (via a repeater) with gateway base station transceivers.
- Gateway base station transceivers: Data collection/communication nodes that communicate with endpoints and repeaters, and doing so directly (or indirectly via repeaters) for the purpose of requesting information or updating smart meter parameters; the gateway base station transceivers utilize a hybrid backhaul network consisting of RS fiber optic network nodes and ADSL connections for communications with the system control center software.
- Control center software: IOT Technologies' SQL-based network management system interfaced via API's to RS' SAP ERP system, with full transparency with respect to system operation (i.e. via commands and requests from the SAP system, RS' customer support personnel and technical operators are able to retrieve and update information with the IOT Technologies network management system).

Key features of the system include the following:

- Superior radio/wireless coverage: A minimum amount of system infrastructure was required – in an area of 225 square kilometers all system endpoints (almost all located in basements) were covered by 41 gateway base stations and 45 repeaters; this translates to one gateway base station transceiver and one repeater for every 5.5 square kilometers of coverage area.
- Real-time synchronized reads: Synchronized reads of all system smart meters is completed with a reception rate level exceeding 99% within three hours utilizing a proprietary polling algorithm.

- Demand reads: A demand read of any system smart meter or predefined group of endpoints can be executed at any time from within the RS SAP system with results returned within 30 seconds.
- Outage alert: The IOT Technologies endpoints are equipped with battery backup in order to generate a “last gasp” message for the purpose of issuing a power outage alert message. A message is also generated upon return of power.
- Management reporting: A full range of standardized and customizable management reports based upon current and archived data are available via IOT Technologies' web-based GUI.
- On-line access: Secure on-line access to network and meter data is available (utilized by system installers, maintenance personnel, and management).

Results and Benefits: A large number of benefits have accrued to Rigas Siltums following the complete system rollout of the IOT Technologies Heat Energy Management system. These include:

- The system has demonstrated robust and stable interfaces and appropriate protocols in the Heat Energy Management system inter-connection with other Rigas Siltums systems (e.g. SAP, Oracle, etc.).
- Rigas Siltums now has the ability to create meaningful data tables and, most importantly, with accurate and up-to-date information.
- Rigas Siltums has been able to perform efficient data processing in its legacy systems based upon on-line information received from the Heat Energy Management system.
- Operational benefits that Rigas Siltums has realized:
    - The ease of use of the SAP interface for access to system information has improved the professional level of services Rigas Siltums can provide internally and to its customers.
    - The access to timely and accurate data has benefited not only the commercial aspects of managing the heat energy distribution system, but has provided benefits throughout the Rigas Siltums organization, such as interaction between departments.
    - The on-line access to current system data has facilitated the processing of system data within the commercial department and the forwarding of pertinent data to other departments within Rigas Siltums for use in their respective daily activities.
    - The information collected by the Heat Energy Management system has been utilized by the Rigas Siltums Inspection Department for its daily relations with customers; when contacted by customers reporting problems, Rigas Siltums staff is equipped with accurate data – often precluding the need for on-site visits.

- The comprehensive nature of the Heat Energy Management system software has enabled the Rigas Siltums staff to identify and monitor technical faults in the heat energy distribution system, such as:
    - Reporting of electricity outages at customer sites
    - Alerts and maintenance information leading to reduced damage to heat energy pipes
    - Resulting in:
        - Significant reductions in the time to carry out repair processes
        - Better service to Rigas Siltums customers
        - Minimization of losses in the heat energy pipe network
        - Improvement in the heat energy distribution system efficiency
        - Substantial savings in unnecessary expenses