albentia Systems

ALB-W012-000en

WHITE PAPER

White Paper

A proposal for Smart Metering Networking Solution

May-2012
Rev. A1

Introduction

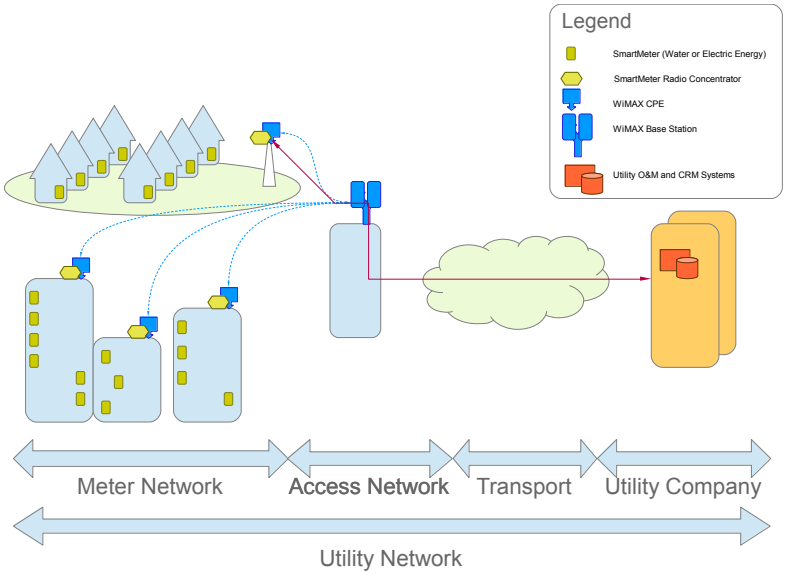
A smart meter is usually an electrical meter that records consumption of electric energy and water in time intervals and communicates that information back to the utility for monitoring and billing purposes. Smart meters enable a two-way communication between the meter and the utility.

Of all technologies involved in smart metering the most critical technological problem is communication. Each meter must be able to reliably and securely communicate the information collected to some central location. Considering the varying environments and locations where meters are found, that problem can be daunting. Among the solutions proposed in the market are: cell phone network usage, ADSL or other residential access, radio (licensed and unlicensed), satellite, PLC(Power Line Communication).

In this white paper we will consider diferent scenarios where meters are found(from urban to rural) and we will offer the reader a complete solution to the communication problem in smart metering.

Solution overview

The following figure summarizes the proposed architecture:



The solution has been divided in 4 different zones of interest:

Meter Network:
This is the metering zone itself. Composed of the smart-meters (water an electric energy) and the local network to connect them to the utility network. In this case wireless radio communication is the proposed solution as it provides a unified solution for both water and electricity scenarios and is generally better suited for a broader range of building topologies.

Access Network:
In charge of connecting the Meter Network to the Transport Network, gives the complete solution the capillarity and presence that it needs. This technical proposal uses WiMAX (802.16-2009) inter-operable wireless network as the preferred solution for the access network.

Transport Network:
The preferred solution in this case is totally dependent on the WAN infrastructure available on the different PoPs (Points of Presence, Base Stations) of the Access Network. In some cases this could be a dedicated land line, optical fiber link or enterprise grade DSL access. The specific solution is to be determined during the site survey phase of the smart-metering implementation project.

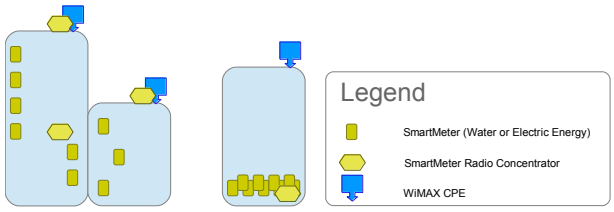
Utility Company Offices:
The final goal of any smart-metering solution is to deliver information about the usage of the network to the utility operation & maintenance and CRM systems and to convey back to the meters and network the adjustments and configuration as needed

Meter network

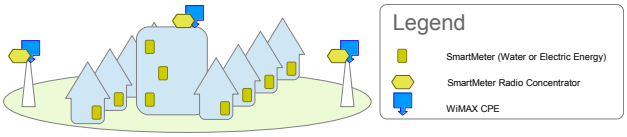
Description
The Meter Network is the zone of interest in the Utility Network where the smart-meters and the data-gathering equipment is located. The main tasks of this area are to:

- Meter the energy (active, reactive...) or water consumption in the home, industry or commercial installation.
- Gather all the data from the meters to a set of concentrator devices in a quick (as needed) and reliable way.
- Implement the utility usual needs: timed tariffs, power consumption curves...
- Provide access to the meters for network operation and maintenance: disconnection of users from the network, device firmware updates, battery life checks, fraud or tamper checks…

Foreseeable scenarios
Depending on the country, area, city or even the specific neighborhood, the meter network topology can be totally different. In order to provide with the best solutions, these scenarios have been simplified to the following ones.
A.Dense urban

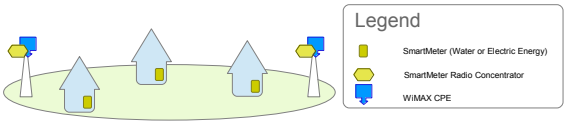


This scenario is dominated by household users, with a high density of meters. The meters can be all concentrated in cabinets in the basement or at street level; alternatively, each apartment can have its own.
This case covers most of the commercial scenarios in which the offices, shops or other venues are found in urban areas.
B.Sparse urban / Dense rural

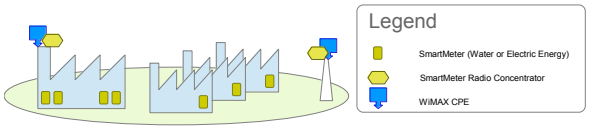


This case is to be found on small towns/villages or in the outskirts of bigger towns. This is a mix of some medium buildings and houses. The meters in this case are more separated from each other, as each house usually has its own meters.

C.Rural



This scenario is composed of detached houses with medium to big distances separating them. Usually each of these houses has its own meters.
D.Industrial



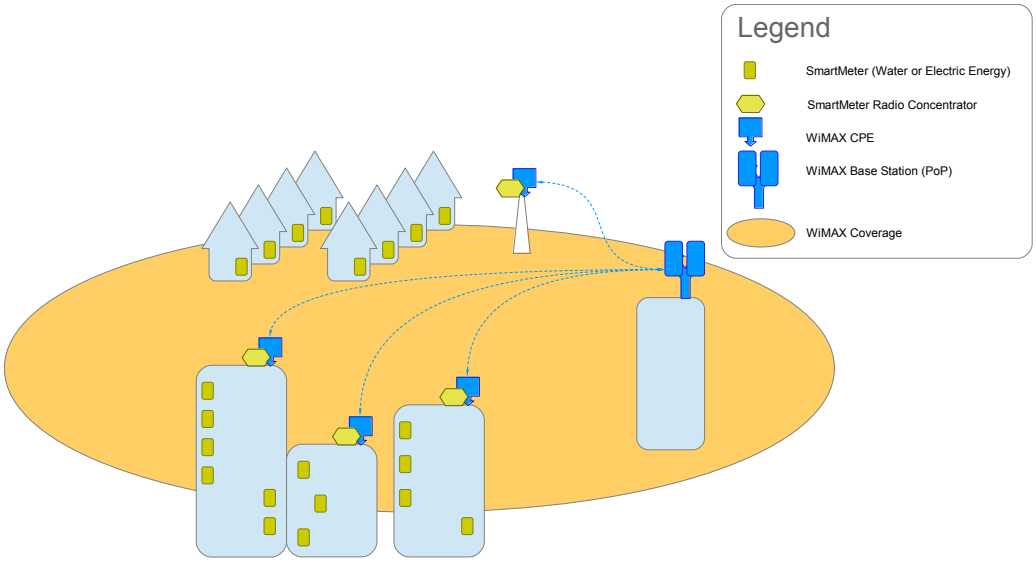
The industrial scenario is characterized by the presence of big buildings, with very specific metering needs in terms of power and type of measures and in some cases with many metering points.
Depending on the size of the industrial premises or its location, as shown in the diagram, different sub-scenarios can be depicted:

- One with very big industries covering large areas and with many metering points (this case would also cover big shopping malls).
- In the case of small or medium industries, such as those found in industrial parks, the approach is very similar to that proposed for the sparse urban areas.

Proposed general solution
The proposed solution is a RF (wireless) metering solution. This solution is based on a set of radio concentrators that connect the meters to the Access Network and is composed of:
Smart water and electric energy meters with support for a RF network which comply with the required technical specifications for the project: number of phases, metering precision, compliance with international standards, support for remote disconnection, required water flows...
Radio concentrators that gather information from the smart-meters and provide a gateway for the Access Network. These concentrators create a mesh-like network in which each meter is part of it. It can be extended with repeaters and some of the smart-meters can also behave as repeaters to extend the coverage in difficult areas. This radio network has the capability to be redundant if more than one concentrator is serving the same smart-meters.

Access network

The following figure summarizes the proposed architecture for the access network showing all the elements involved:



Description
The Access Network is the zone of interest in the Utility Network that connects the Meter Network to the transport network, providing the capillarity, bandwidth and availability needed. The main tasks of this area are to:

- Interconnect the Access Network to the Transport Network.
- Provide general coverage to a broad range of areas and scenarios.
- Provide cost-effective data transport capabilities.
- Provide QoS to be able to separate mission -critical data from secondary traffic.
- Be able to provide bandwidth to scale the network.
- Generate a dense broadband network capable of supporting new services for specific points such as VoIP or Video surveillance.

Taking into account the Meter Network scenarios shown in the previous point of this document, the general considerations for this Access Network are:

A)The number and location of concentrators is very variable: in some cases there will be a concentrator per building and in other cases the same concentrator could be serving a wider area of individual houses.
B)The concentrators are going to be distributed over quite wide areas like small towns or neighborhoods.
C)The ratio number of meters per concentrator is generally high; when it is low, the installation usually has industrial-grade requirements.
D)The concentrators are often located at strategic points of interest.

Proposed solution
Albentia Systems proposes a solution for the Access Network based on a standard MAN wireless network: 802.16-2009 (Fixed WiMAX).
The solution consists of:

- WiMAX Advanced 802.16-2009 Base Stations: these base stations (also called Points of Presence) create a zone of coverage in which the slave devices (WiMAX CPEs) connect to the Access Network. The network topology is Point to Multipoint (PtMP).
- WiMAX CPEs: these are the slave devices of the PtMP network and provide broadband access to any device connected to them. In the proposed architecture these devices are the concentrators or any other which may be useful for the Utility operator, such as video surveillance cameras.

The main characteristics of this network are:

- Each WiMAX Advanced 802.16-2009 Base station can serve up to 1024 CPEs per 4 channel BS (256 CPEs/Channel).
- The total delivered net throughput is up to 140Mbps with 40MHz (4x10MHz channels).
- The system allows for the creation of cells covering more than 1000 sq km when LOS (Line of sight) scenarios are used and more than 785000 sqm in Near LOS scenarios.
- The solution works in the 5.6GHz or 5.8GHz license-exempt bands with transmission power of up to 24dBm.

This solution provides many advantages for the network, some of them being:

- Very good capillarity and big coverage zones.
- Zero cost of spectrum usage.
- Broadband and QoS availability that allows the utility to implement other smart-grid valued-added services (such as video surveillance of critical locations), and separate the mission-critical traffic from the secondary one.
- Standard, well-proven, cost-effective solution that is state of the art technology, and that protects the investment thanks to its evolutionary nature: **Albentia Systems WiMAX Advanced devices are LTE Ready**.

Summary

In this paper a solution for smart metering network communications has been introduced. The proposed solution has been based in wireless communication.

We have divided the network in four sub-networks:
- Meter network
- Access network
- Transport network
- Utility company network

The meter network is the area where the smart-meters and data gathering are located. There are several scenarios of meter networks depending on the topology of the country, we choose these possible scenarios: Dense urban, sparse urban/dense rural, rural and industrial. Each scenario was properly described.
The proposed solution for this part of the network is a RF metering solution, where the smart water and electricity meters communicates in a wireless way with the concentrators which provides gateway for the access network.

The access network is in charge of connecting the meter network to the transport network, providing general coverage to different scenarios, QoS for critical traffic and being able to provide bandwidth to scale the network. Taking in account these specs we propose a solution for the access network based on fixed Wimax 802.16-2009, consisting in:
- Wimax Advanced base stations (BS), creating a zone of coverage of up to 1000 Km^2 in LOS condition and 785000 m^2 in NLOS condition. These stations are able to manage up to 140Mbps of throughput with 24dBm of output power working in 5.xGHz license-exempt band.
- Wimax CPE, which are the slave devices of the network providing broadband access to the BS to any device connected to them.

This solution provides several advantages, among others:
- Capillarity and big coverage areas
- No cost for spectrum usage
- Broadband and QoS that allows the implementation of other value-added services (VoIP, video surveillance…)