THE NEW EDGE FOR THE ENEL TELEGESTORE: AN INTEGRATED SOLUTION FOR THE REMOTE MANAGEMENT OF ELECTRICITY AND GAS DISTRIBUTION ALLOWING A TOTAL MANAGEMENT OF THE ENERGY CONSUMPTIONS

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ABSTRACT

This paper describes the opportunity for Enel to realize an integrated system for energy management. This will be possible thanks to the existing AMM infrastructure for the remote management of electricity meters and following the regulatory request for a smart gas meter solution. The challenge for Enel is to deploy an innovative solution for the remote management of gas meters enabling both integrated Energy management and possible future innovations.

The Italian Authority (AEEG) has published a decree obliging all the gas distributors to adopt and deploy a remote management system for gas meters.

First the well know and consolidated Telegestore solution will be described, to underline the key factors for the future design and development for the gas solution. Then the current gas market situation, the regulatory issues, requirement and deadline set up by the Authority will be described.

Finally the innovative approach Enel has adapted to address the development of the remote smart gas meter management solution will be described. This includes the activities already performed and defines any possible scenarios for the integration of the new infrastructure with the existing electricity infrastructure, with the aim to enable an integrated, innovative and smart Energy management solution.

INTRODUCTION

Enel is considered the first player in the world that has developed, installed and mass deployed an automatic remote management system for the electric meters.

Thanks to all the tangible benefits following the introduction of the Telegestore solution, the Italian Authority in 2006 decided to extend the remote management to all DSOs (about 100) in order to maximize the benefits for the whole Italian energy system.

The AEEG in 2008 has issued a decree (155/08) focused on the gas market with the aim to achieve the same results and benefits already consolidated in the electricity field, through the installation of new smart gas meters. This decree impose to all gas DSOs to replace all the meters in the time frame 2009-2016, defining the minimum functional and technical requirements.

ENEL, as the second most important player in the Italian gas market, is approaching this project to be compliant with the law pursuing an innovative solution leveraging on its unique experience and proven know how built on the Telegestore project experience.

THE TELEGESTORE SOLUTION

Enel system for Automatic Electricity Meter Management means:
- Remote management of the Entire Energy Distribution Process
- Innovation for Customers’ Relationships
- The engine to re-engineer the distribution processes.

Some of the benefit are:
- Energy efficiency
- Quality of services
- Lower cash cost per customer

An overview of the Telegestore System architecture:
THE ITALIAN GAS DISTRIBUTION MARKET

The Italian gas market is characterized by many small companies that operate in small environments and few big and mid size DSOs. The DSOs sometime owns the network, but in most cases they manage for a defined period public concession released by each Municipality. With the new regulated market, in any case, the duration of these public concessions is limited to 12 years.

The gas distribution starts from primary substations from the national pipeline through the medium pressure network into secondary substations and a low pressure network that supply most of the Customers through the gas meters.

The gas meters are classified according to their max flow rate and use different measurement technology.

In Italy the domestic Customer (up to G6) represent 95% of the entire market, and the metering technology adopted is the traditional diaphragm meter.

It is important to underline that the domestic installation do not have any kind of power supply close to the meter today, for safety reason any single installation is typically far from the electricity source to avoid risk of explosion.

REGULATORY STEPS

The Italian Authority has pointed out, on July 2007, the objectives achievable with the diffusion of remote management of gas meters:
- the timely definition of reliable daily commercial budgets for each consumer;
- the development of the market of the gas;
- the promotion of competition, to advantage the most efficient operators;
- the issue of invoices based on real consumption;
- the reduction of operational costs;
- the promotion of services or initiatives for the improvement of safety and the quality of service;

On 22 October 2008, after collecting opinions from GAS stakeholders, the Italian Authority of Electric Energy Gas (AEEG) ratified the fundamental act nr.155/08. In this act AEEG, has defined functional requirements for the meters and the time schedule for installation. AEEG has involved Italian Gas Committee (CIG) in the development of new standards for smart GAS metering,
first of all the communication protocol standards, but also new metering and operational functions of the meter.

**GAS METER FUNCTIONAL REQUIREMENTS**

**meters up to G6 class**

- Temperature correction: The meter has to implement the temperature correction in order to provide the measurement data at standard conditions (15°C)
- Multi-tariff system and registers: 3 different tariffs and up to 5 time periods within a day;
- Calendar: management of workdays, Saturday, Sunday and holidays; if the meter has lost the time reference indication of which totalizer is increasing;
- Maximum Real Time Clock drift: less than ± 5 minutes in a month;
- Load Profile: it has to be configurable with a minimum granularity of 1 day, it has to store at least 70 days in a circular buffer;
- Shut-off valve: the shut-off valve can be closed remotely and enabled for opening by the customer himself;

**meters > to G6 class**

- Billing periods: storage of measurement data related to the current and previous billing periods;
- Integrity of measurement data: the integrity of measurement and billing data has to be guaranteed;
- Diagnostics: the meter has to implement a diagnostic system in order to monitor components and functionalities;
- Display: the meter has to integrate a LCD display in order to show all data related to contract, billing, diagnostics, etc;
- Software upgrade: the meter has to implement a software download functionality
- Additional interface to a remote display: the meter has to integrate an additional communication port to be able to transfer measurement and billing data to a remote display;
- Remote Transactions:
  a) remote closing of shut-off valve;
  b) enabling shut-off valve to be opened by the customer himself;
  c) RTC remote synchronization;
  d) all other transactions necessary to manage the customer’s contract;

**Additional Functional requirements for meters equal or above to G10**

- Pressure correction: The meter has to implement pressure correction in order to provide the measurement data at standard conditions (1013.25 mbar)
- Maximum Real Time Clock drift: less than ± 3 minutes in a month;
- Load Profile: it has to be configurable with a minimum interval of 1 hour, it has to store at least 70 days in a circular buffer;
- Shut-off valve: not present;
- Pulse emitter: the meter has to integrate a pulse emitter;

**Time Schedules proposed by AEEG**

- Meters of class up to G6: start installation in 2012 to be completed (80% of total) within 2016
- Meters of class equal to G10: start installation in 2011 to be completed (100% of total) within 2012
- Meters of class from G16 to G40: start installation in 2011 to be completed (100% of total) within 2011
- Meters of class from G65 to G650: start installation in 2010 to be completed (100% of total) within 2010

**GAS METERS NEW INFRASTRUCTURE**

The new gas meter infrastructure could potentially achieve the same benefits gained in the electricity sector with the Teligastore deployment but the design has to face many additional key challenges.

**Summary of main constrains and key objectives**

1) in the gas distribution the installation site of the gas meter in the mass market has not the same level of standardization as in the electricity sectors and presents a wider range of on site situations. This has two main implications: a) the choice of the communication media of the infrastructure and its performances should be compliant with this variable environment b) a concentration level must be planned and the positioning of the concentrator, its installation and supply should be compatible with this wide range of field situations.

2) Installation without electric supply: it is necessary to define a solution able to guarantee the meter functionality without direct connection with the electric grid supporting the communication features. A power supply source with a lifetime at least equal or longer than the meter approval validity expiry date is a target to achieve. The meter approval validity expiry date reference (ie 15 years) is very difficult to be achieve for a battery powered product. A deep analysis of how to optimize the communication should be performed.

3) The automatic cut off valve integrated and controlled in the meter is a new concept for the Italian market. In some Countries (ie Japan) has been introduced since 20 years to
enhance the safety performances of the gas distribution. Processes and procedures to manage the Customers must be adapted in order to comply with this new tool. From a product and architecture standpoint a careful analysis of the impact the battery consumption must be performed and implemented according to the results and evidences of point 2).

4) Grid concessions with limited duration in Italy (ie 12 years): it will be necessary to achieve a standardization in order to enable an easy switch between distribution companies without creating barrier.

5) The new gas meter, considering the effort to replace the whole installed base, should be easy to install, not requiring complex additional competences by the gas technicians and potentially reducing the product range to cover all the gas grid needs.

6) The overall regulatory scenario and the innovation that is required in the gas market pushed by the Authority is a great opportunity to be exploited to introduce a new gas meter technology with a measurement core at the edge of the innovation. This new gas meter will enable evolution for both technology and services for the lifetime cycle and give the opportunity to innovate the gas market also in the next generation.

Technology, New infrastructure description and key features

The choice of the communication media and the level of concentration represent the key aspect of the new infrastructure.

Enel is designing a infrastructure for gas starting from the experience and the deployment done with the electricity AMM infrastructure. In particular we consider an opportunity to leverage on the existing equipments in order to optimize the concentrator device. We are designing for the mass market a multi level architecture based on different concentration ratio that is suitable for urban areas as well as rural ones. For the industrial market a different point to point architecture, more suitable to the features of this segment, will be implemented.

The following schema describes the high level architecture for the mass market.

The solution is based on RF protocol to support the communication between gas meter and concentrators. This concentrators will be linked with PLC concentrator where available or with Tlc standard modem. Both devices enable the communication with a sole Central system fully integrated with Gas legacies. ZigBee physical layer is a possible solution that we are evaluating for the RF layer considering the different installation scenarios and the potential optimization that has to be performed on the application layer.

This infrastructure is compatible with the needs of standardization required in the sector as it is open to include and implement all the regulatory requirements at application level that will be issued during 2009 to standardize the gas meter market.

Despite the alternatives available on the market are limited Enel is engaged to identify an innovative gas metering technology: even if the requirements of AEEG can be met independently of the metering technology, adopting a new technology is considered an opportunity in order to provide additional features for the meter that would represent a benefit for the entire system nowadays and for the future.

A POTENTIAL INTEGRATED ENERGY MANAGEMENT

Beyond regulatory acts, there are also strategic reasons why a multi-energy distributor such as ENEL should be investing in an integrated AMM solution:

- possibility to converge data coming from different types of users (gas, electricity, and other kinds of energy) on a common communication infrastructure
- innovative marketing strategies on energy price plans in case of dual fuel offers
- value added budget services to customers, in particular there is the opportunity to collect in
one indoor device the data related to the “energy” family expenses
- possibility to gather a wide range of data and statistical analysis on the most recent data in the most cost effective way
- synergies in installation, configuration and maintenance of the new devices with the devices and IT system of the electricity AMM infrastructure already in operation

One of the most important advantages of an integrated system is the possibility to monitor, control and forecast the electricity and gas consumption enabling smart processes for the optimization of the overall energy system.

In our vision the integration between gas and electricity AMM infrastructure, the consequent shortening time to market, cost effectiveness and additional synergies for all the potential services, will assure significant benefits not only to the energy distribution Companies but to all the market players.