

The Implementation of Smart Metering Systems for Electricity Consumption in Croatia

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Abstract- The smart metering system is used for the remote measurement of measurands for a purpose of billing, and to process and transmit measurement results. Generation and transmission of measurement information by electric impulses has already been used at summarizing billing meters where the base meter is equipped with the impulses generator which directly or indirectly emits impulse to a master summarizing meter. The application of more developed remote meter reading systems has intensified in the last decade of previous century. Today, most of distribution companies in Europe use remote meter reading systems to read the electricity consumption of industrial facilities on medium and high voltage level of distribution.

The smart metering system allows continuous reading and recording of many measurands, e.g. power quality and load curve, as well as early-stage failure detection, monitoring of the meter lid opening alarm (detection of unlicensed actions), detection of the opposite energy flow and many other appropriate signals. The advantage of these systems, besides the remote reading, is the possibility to control and set-up the parameters of the system without sending a human to the location. All mentioned induces the long-term reduction in financial expenses for the distribution system operator.

The most common communication systems for information and control signals transmission are GSM (Global System Mobile) and PLC (Power Line Carrier). PLC is prevailing lately due to its smaller cost and independence of the GSM operator. The PLC technology is mostly used to the closest distribution transformer station, from where information is carried to the rest of the system by optic cables.

The primary constraint on application of described systems is cost reduction and reaching reasonable cost effectiveness.

I. Introduction

The liberalization of electricity markets, as well as European Directives regarding energy and ecology issues have set the market and technological limitations, which require continuous real-time monitoring and control of the distribution power system. In addition, it is expected that market participants exchange information on daily basis. The regarded alterations imposed the implementation of electricity metering surveillance, as well as control and electricity consumption reading systems. Although the complete implementation of these systems has not yet finished, determination to fully implement the advanced electricity meter systems is ubiquitous.

Speeding development of information and telecommunication sector provides infrastructure for implementation of different services on top of electricity consumption metering. The range of services is beginning with simpler AMR (Automated Meter Reading), through AMM (Automated Meter Management), AMI (Advanced Meter Infrastructure), Demand-Response Management, Real-time Pricing, to Smart Grid and Smart House. Although the most advanced of mentioned systems are far from practical implementation, with their definitions being still marketing-oriented, it is certain that these systems will be fully implemented in practice in the near future.

Automated meter management system is becoming the vital part of power systems. Regardless on the technology used, it is essential for surveillance and control of the system functions in generation, transmission, distribution, and consumption levels. Therefore, the AMR system needs to be adjusted to the business and operational surroundings with a clear vision to secure optimal business activities, taking into consideration the limitations of external technological environment.

Today in Croatia the contemporary billing data acquisition and processing is being done only with industrial customers with metering points on medium or high voltage levels. The meters reading plan is based on standard accounting terms given in [1].

The electricity entities have growing concerns about metering devices and, respectively, the billing data that they

store. Moreover, the issues of timely, reliable and efficient billing data acquisition, reducing business costs, reducing data processing time and minimizing human error come into focus [2].

Besides the fact that they have shorter reading times, modern data acquisition systems allow equal accounting periods and remote operation (controlling and setting parameters). Therefore, financial savings (depreciation of vehicles, toll charges, etc.) and saving in human resources (i.e. the employees can attend to maintenance instead of metering reading) are made [3]. In addition, these systems provide power quality control, synchronization of metering periods during simultaneous peak load accounting, load curves at all metering points, timely detection of fault or malfunction, alarm for unauthorized operation of the metering units, detection of reverse load flows due to wrong wiring and optimized electricity consumption. Obviously, the remote metering systems are being transformed into metering units control systems which allow a two-way communication with the metering points [4].

The following chapters describe the level of remote metering system implementation in Croatia and provide economic and technological cost effectiveness assessment. Since in Italy, Sweden and Finland smart metering has been or is fully implemented [5], this paper does not present smart metering as a new concept but presents its unique implementation procedure in Croatian power system and analyses costs and benefits of introduction of this system.

II. Remote metering points reading system of Croatian Power Utility

Croatian Power Utility is continually embedding and developing remote metering points reading systems for about a decade. Basic remote metering points reading and controlling services are implemented. Currently there are more than 20 000 metering points which are being read remotely, mainly industrial and entrepreneurship customers with allocated power above 30 kW. All modern remote reading devices are included, as well as the majority of communication channels (GSM, GPRS, PLC, LAN). The entire information system (application and database) were consolidated in 2007.

The remote metering points reading system in Croatian Distribution System Operator contains technology which allows, on demand or by predefined schedule, automatic readings of electricity consumption data, control values, events and alarms. These data are saved in a single data base which is used for billing purposes, as well as detection of failure operation and other analysis.

Figure 1 presents the scheme of the remote reading system which contains servers with SEP2W applications, servers with data bases and protected access via internet and web servers.

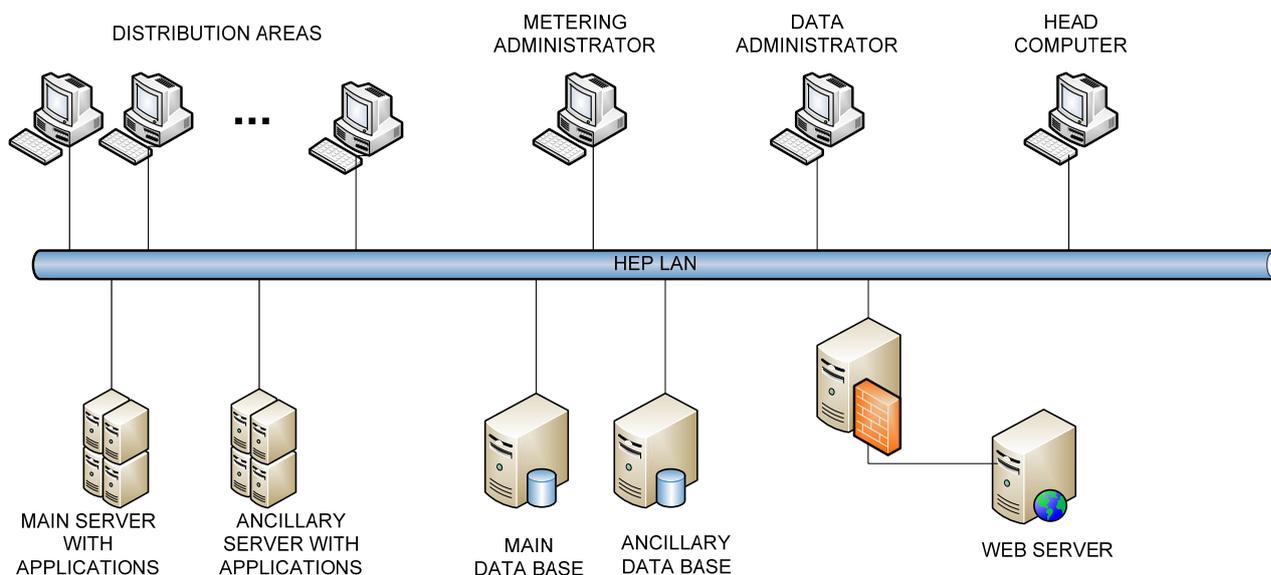


Figure 1. Croatian Distribution System remote reading system scheme

Remote metering points reading system of Croatian Distribution System Operator, besides AMR systems functionalities, seizes some characteristics of AMI systems since it enables two-way communication with meters and communication equipment, remote meter parametering and on/off meter switching.

Remote metering points reading system technology includes application of power devices, measurement and industry electronics, mobile and fixed telecommunications, power lines communication (PLC, DLC), radio communications and computer technology. Available infrastructure capacity in Croatia allows reading of all metering points with peak power above 30 kW in one day. The organization of measurement data gathering, saving and delivering is defined by Regulations on measurement data. Currently, the regarded meters are read on the first day of every month, while load curves are gathered weekly.

In order to avoid communication channels congestion, distribution areas read data according to an agreed schedule. Measurement points are usually being read during the night, between 00 and 07 AM. After coming to work distribution area employees verify the readings and read unread points if any. After identifying the list of measurement points which cannot be read remotely, it is delivered to workers for field reading. After gathering of all metering data, they are being prepared for transfer to the Billing System application, as shown in Figure 2.

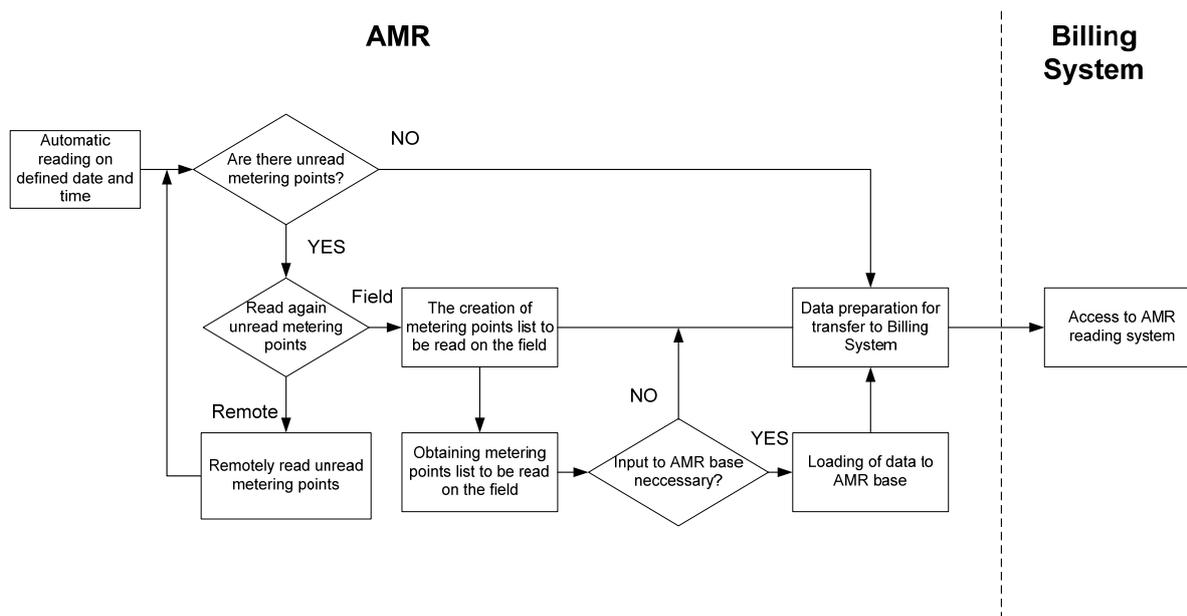


Figure 2. Remote reading procedure of metering points using AMR system in Croatian Distribution System Operator

III. Economic cost effectiveness assessment

A. Classical metering points reading cost

The calculation in Table 1 is based on the area of app. 3 500 km² with 150 high and medium voltage metering points:

- work force cost for reading of the meters: 4 €/hour
- vehicle cost including its amortization: 40 €/day
- fuel cost are based on assumption on fuel consumption of 7 l/100 km
- overall reading cost for one year

Table 1. The classical metering points reading costs for 150 metering points scattered around the area of app. 3500 km²

	a	b	c	d
Sum €/year	4 224	5 350	680	10 254
Sum €/year by metering point	28,2	35,7	4,5	68,4

B. Remote metering points reading cost

The communication media used in this calculations is GSM CSD at 9,6 kbps. The metering devices contain communication module which communicates according to IEC62056-21 [6] protocol and specification is based in compliance with EDIS system of information identification. Data gathering from metering devices is carried out by SEP2W program package which is used for monthly electricity consumption data readings on 150 metering points.

The calculation in Table 2 is based on the area of app. 3 500 km² with 150 high and medium voltage metering points:

- a) monthly register reading cost: 0,14 €/reading
- b) prepaid voucher cost
- c) overall reading cost for one year

Table 2. The remote metering points reading costs for 150 metering points scattered around the area of app. 3500 km²

	a	b	c
Sum €/year	252	1 780	2 032
Sum €/year by metering point	1,7	11,9	13,5

The calculation in Table 3 is based on the area of app. 3 500 km² with 150 high and medium voltage metering points and includes consumption curve reading, which generates much greater data traffic:

- a) monthly register reading cost: 1,22 €/reading
- b) prepaid voucher cost
- c) overall reading cost for one year

The more detailed information on duration and cost of remote readings is given in [7].

Table 3. The remote metering points reading costs, including consumption curve reading, for 150 metering points scattered around the area of app. 3500 km²

	a	b	c
Sum €/year	2 196	1 780	3 976
Sum €/year by metering point	14,6	11,9	26,5

It is evident that overall costs of remote meters reading are fairly reduced in comparison with classical metering point reading costs. Since the costs of remote meters reading system mounting are approximately 600 €, and entrepreneurship consumers' electricity consumption is registered monthly, it is considered their installation will pay out in 11 years.

IV. Conclusions

Remote metering and control systems increase the quality of metering services in electricity distribution business. Since electricity market in Croatia is gradually opening to entrepreneurship consumers it is expected that implementation of remote reading and controlling of electricity meters will also be carried out for entrepreneurs with installed power under 30 kW in the near future.

Beside the economic benefits of remote meters reading system, if one takes into consideration technical benefits of such system, e.g. possibility of mass and individual tariff modification, setting the power supply on and off for each customer, control of power quality parameters, etc., it is evident that remote meters reading systems optimize the cost of operation for distribution operator and impose advanced standards of service.

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