

# **REACTIVE AND PROACTIVE METERING SOLUTIONS FOR REVENUE PROTECTION**

## **A new way of solving old problems.**

Utilities in South Africa have always faced the problem of collecting the payments from the consumers for the supplied electricity. In 1990' there were several attempts to develop a secure prepayment solution, which would enable consumption of electricity in "pay-as-you-go" mode. In 1993 Eskom consolidated these developments into Standard Transfer Specifications (STS), which today has become an international standard, used in more than 80 countries all over the world.

However, experience proved that through implementation of prepayment metering, Utilities solve the problem of financial losses only partially, as prepayment meters do not address another important component of economic loss – electricity theft. A stand-alone prepayment meter doesn't provide information about pilferage. Thus, buying monthly a minimum credit, just for the reason not to provoke suspicions, the malevolent consumer after tampering with the meter can use electricity limitless, without the threat to be traced by the Utility.

Having analyzed the situation in South Africa and on similar markets we developed a solution which would address both issues simultaneously and would offer an ultimate protection of Utility revenue – ADDAX IMS. This solution was developed in 2007 and it was based on the combination of our existing hi-end metering system and STS prepayment. The meters are equipped with a wide range of anti-tampering means, like: meter cover opening sensor, terminal cover opening sensor, magnetic field sensor, differential current sensor, reverse connection sensor, password protected optical port. Two-way communications over PLC enabled prompt transmission of alarms to Utility's office, allowing it to react immediately to fraud attempts.

However, not always the theft happens through tampering with the meter. Bypassing is a very popular way of stealing electricity and, unfortunately, the sensors integrated into the meter cannot detect it. As a solution to this problem we have implemented the balance metering, which timely informs the Utility about losses on a certain segment, e.g. substation, block of flats etc.

Thus, such a system is much more efficient than a stand-alone prepayment solution, giving the Utility not only the possibility to improve revenue collection, but also providing the information necessary to promptly react to frauds within its network. This system represents a reactive approach to revenue protection, where the Utility detects the fraud attempts and identifies the malevolent consumers, and has to take certain measures to stop the pilferage.

In 2010 we went even farther. Based on the assumption that reactive approach to revenue protection involves additional costs and efforts from the part of the Utility to stop the fraud and punish the thieves, which sometimes is difficult or almost impossible within certain areas with a high level of criminality, we have developed a Proactive Revenue Protection (PRP) solution.

It is obvious, that the main issue, that allows tampering with or bypassing the meter, is the access to it, so we have oriented on creating a solution which, in addition to the existing antifraud means, would remove the meter from consumer's reach.

Meanwhile, the circumstances within the markets we have taken as a base for our research, dictated certain conditions, which would have made such a revenue protection applicable there and the main condition were the cost efficiency. While developing the concept, we have adopted several “cost decreasing” goals, targeting:

- hardware costs;
- maintenance (repair and replacement) costs; and
- data collection costs.

A distinctive feature of this solution is the design of the meter, which is divided into modules based on functionality criterion.

The metering set within the CMS solution has four basic components:

- Base Board,
- Metering Modules (MM),
- Net Node (NN) and
- Customer Interface Units (CIU).

**Fig. 1 CMS metering set**



**Fig. 2 Wired and wireless Customer Interface Units**



We have cleared the meter from everything except its primary features: measurement and load control. The visualization and customer control functions have been switched to an external Customer Interface Unit. The functionality related to communications and Meter Modules' operation management have been grouped into the Net Node. In order to save space and decrease costs, the power supply unit has also been moved into the Net Node, which supplies power to Metering Modules through local bus. Thus, through division and grouping of certain features, we have decreased the size of the metering set and received a product meeting one of the basic conditions: cost efficiency.

Further, the division allows distancing the measurement unit from the customer.

The compactness of the metering set within the CMS solution and the presence of remote CIUs allow mounting the meters in hard-to-access locations – i.e. on the pole or in the basements, thus cutting off the possibility of bypassing or tampering with the meter. The access to the metering modules is secured through other means as well – the metering set has built-in sensors for cabinet cover opening.

To solve the issue of payments collection, we have integrated the prepayment functionality into the metering set that can be used optionally, as a mean of influencing the non-payers. The prepayment solution is based on the STS standard, which proved itself as an efficient and secure mean of payments collection.

The design of the metering set has been conceived to save space and offer feasibility. The Base Board carries the Metering Modules and the Net Node, and it is being produced in three modifications: 6, 9 and 12 single-phase slots.

One important feature of the CMS is the realization of the contact slots in the Base Board – the Metering Modules are easily mountable, with no need to fasten the power cables – the module has just to be inserted in its “nest”. Such wise, the replacement of the modules is simple and takes less than a minute, thus minimizing the replacement costs. The modular design of the CMS offers another, not less important, advantage as well: in the event of a fault, the split design doesn't require the replacement of the whole metering point, but only of the faulty module – NN, MM or CIU, resulting in a decrease of maintenance costs.

The Metering Modules are single-phase meters, and then poly-phase (two- or three-phase) meters can be built by linking together several single-phase modules.

In addition to the measurement functionality, the Metering Module performs Load Management, which is a distinctive feature of our solution, compared to other products on the market. The Load Management functionality has been enabled through the integration of 100A relays into the Metering Modules.

The consumer loads can be managed in two ways: based on a pre-set configuration for thresholds or, manually from the control center.

The relay is used as well to disconnect the consumer for negative cash-balance if the prepayment feature is enabled.

For consumer's safety, the reconnection is split in two stages: first the control center sends a command to the meter that the consumer can be reconnected, followed by a message displayed on the CIU, and then, the consumer presses the safety button on the CIU to switch on the meter.

A challenge we had to meet during the development was the simultaneous disconnection of all three phases in the case of a poly-phase consumer, in order to secure his home appliances from stepped shutdown. To solve that, we have implemented into the Net Node the function of synchronized disconnection/reconnection of coupled meter modules.

The Net Node controls the operation of the Metering Modules, collects the metering data through the local bus and then, resends it to the control center. The NN supports up to 12 Metering Modules and CIUs.

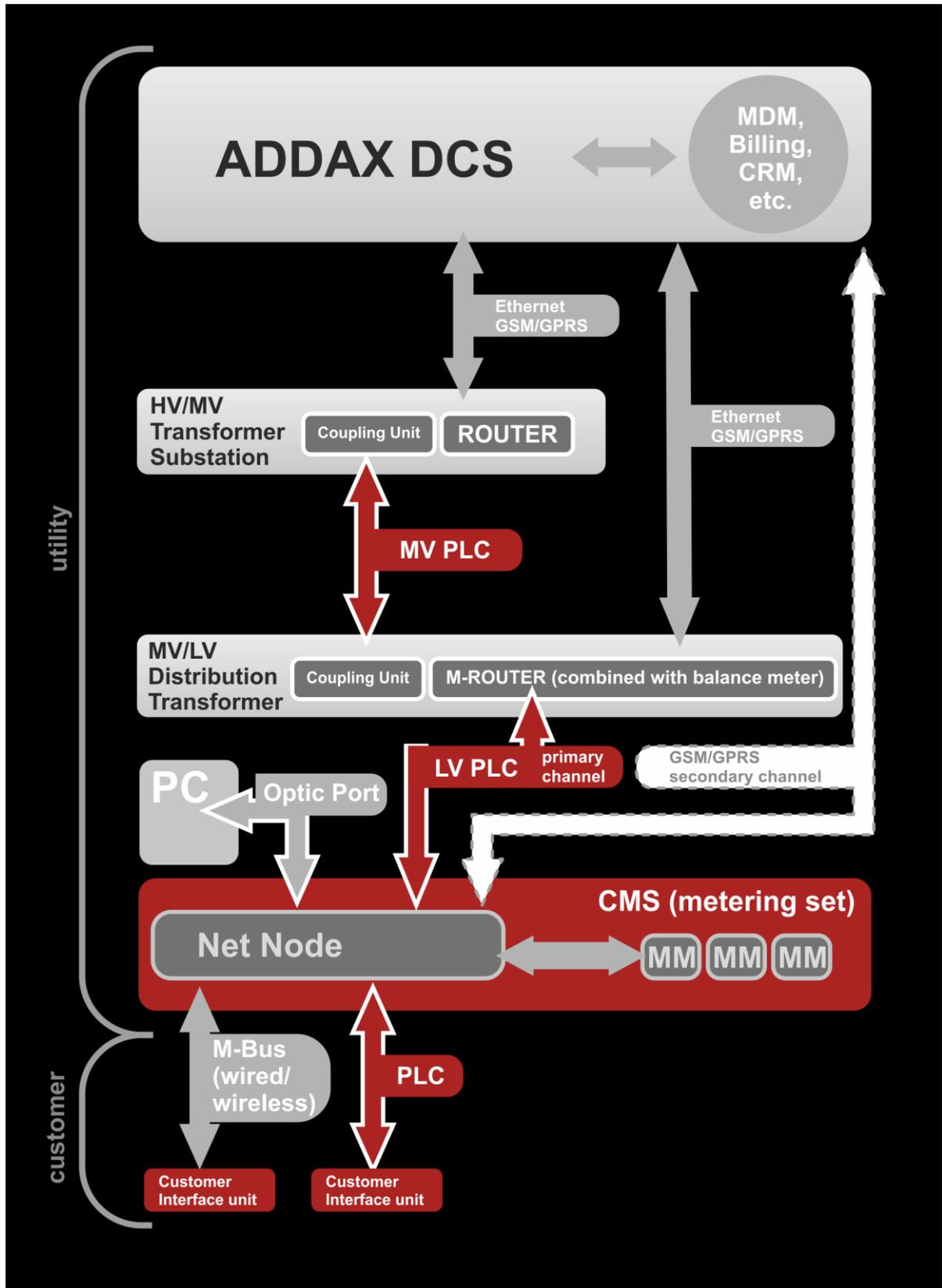
As in all metering solutions developed by ADD GRUP, the CMS uses LV and MV PLC, a technology which demonstrated its feasibility and reliability in about 50 deployments, covering around 1.9 million metering points.

The ADDAX.net communication solution relies on routing data through Routers, installed at transformer substations. Data Concentrators can be used instead of Routers, when there are several operators accessing common metering data.

The distribution substation is equipped with ADDAX communication devices – Router (or Data Concentrator) and a Coupling Unit, designed to inject the signal into the MV power lines. At the upper level transformer substation another communications set is installed, receiving the data packages and forwarding them to the Control Center. Usually the HV/MV substations are interconnected with the control center, i.e. through an Ethernet link – any of the available media can be integrated into ADDAX.net architecture. The CMS solution can be realized on different communication profiles: ADDAX net (employing FSK modulation) and IEC-61334-5-1 (based on S-FSK modulation). The IEC-61334-5-1 (DLMS/COSEM) communication profile enables the interoperability with other smart metering solutions, thus, avoiding vendor lock-in for the Utilities. In the near future we plan to implement the OFDM modulation as well, which would enable compatibility with G3 and PRIME. Another valuable advantage of the CMS is the possibility to switch easily to another communication solution, without touching the meter – only the Net Node needs to be replaced.

Such wise, the employment of LV and MV PLC, in combination with the existing Utility's data exchange network, leads to a considerable decrease of data collection costs.

Fig. 3 Architecture of ADDAX Centralized Metering Solution



Optionally, the metering set can communicate with the control center directly through GSM/GPRS – the Net Node has a built-in modem for this purpose. The slot for the SIM-card is situated on the front cover of the Net Node, thus the insert or replacement of the card is easy – it doesn't require the opening of the case. The basic channel for data exchange between the Net Node and Remote Displays is LV PLC, thus there is no need to install additional communication infrastructure. For the consumers, which are supplied with energy in prepayment mode, we have provided a Customer Interface Unit with keypad, which communicates with the Net Node through M-Bus (wired or wireless).

#### Conclusions:

We have developed an efficient revenue protection solution for our customers where both, reactive and proactive approaches are viable. Now the Utility has the choice to employ one or the other, or their combination, depending on its goals, project environment and consumer behavior.

**About the author:** Andrei Panchuk joined ADD GRUP in 2002 as a marketing specialist. In 2006 he was appointed as the Head of Marketing Section. He possesses a BA degree in marketing from the Academy of Economic Studies of Moldova.

**About the company:** ADD GRUP is a leader in developing smart metering solutions with a focus on flexibility, reliability and cost efficiency. Recently we have launched the 7<sup>th</sup> generation of ADDAX meters, based on open standards and more advanced communication techniques. ADD GRUP have deployed around 1,9 million smart meters with PLC communications in around 20 countries worldwide. Our portfolio includes a full range of solutions for Smart Utilities: electricity, water, heat and gas metering, and street lighting management.