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How will new technology change the revenue protection processes in the future?

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Introduction

New metering technologies are introduced all over the world to address energy shortages, meter reading problems, revenue protection processes, customer service improvement and a host of other business case related issues. Many governments and energy regulatory bodies have introduced legislation to enforce the deployment of new metering technologies. It is important to realize that the world is faced with two major issues namely the greenhouse effect and a shortage of generation capacity. One of the many ways to improve energy efficiency is the introduction of Advance Metering Infra Structure (AMI) or so-called Smart Metering (SM). It is a complex and technically demanding process involving all the role-players from engineering, finance, legislation, customer care to political intervention.

This paper will however focus on the impact of the deployment of AMI systems on the Revenue Protection (RP) processes and procedures. Traditional methodologies used by RP operators will have to be adapted to take advantage of the new information collection capabilities of AMI systems. It will thus also be necessary to train and re-skill RP teams to do things differently. Data analysis will become the main RP tool available to utilities to prevent fraudulent use of electricity as well as ensuring that revenue due by customers for electricity used can be collected effectively.

What is smart metering?

To understand and appreciate the proposed changes in RP skills it will be necessary to define Smart Metering for the purpose of this paper. There is no universal definition and we will have to decide what is applicable in this case. The European Smart Metering Alliance (ESMA) (Koponen, 2008) defined smart metering as follows:

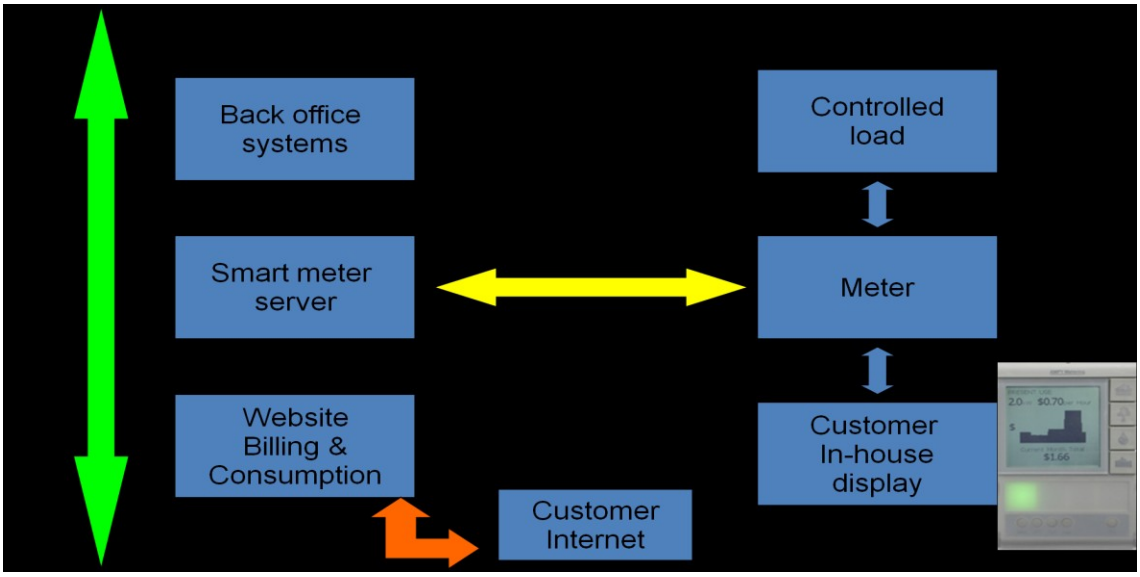
"Smart metering has the following features:

- *Automatic processing, transfer, management and utilisation of metering data*
- *Automatic management of meters*
- *2 way data communication with meters*
- *Provides meaningful and timely consumption information to the relevant actors and their systems, including the energy consumer*
- *Supports services that improve the energy efficiency of the energy consumption and the energy system (generation, transmission, distribution and especially enduse)"*

In the South African context this definition is probably quite close to what is expected apart from the fact that load management is a major additional requirement. The NRS 049 specification goes a long way to define the AMI requirements in South Africa.

In a block diagrammatic format the system will at least include the following functional elements. The system will include a metering element performing the actual electricity metering, control the load via a load switch as well as display vital information on a customer interface located within a customer's house. The metering system will be connected to the main Smart Meter server at the utility's offices via a two way communication system. The actual configuration is not important for the purpose of this paper. All the information like tariffs, meter readings, tampering alarms remote switching and load control will be communicated via the communication channel. The information will be directly available to billing systems, customer care sections, network planning sections, financial section and all engineering operations. The customer will be kept in the loop by the Customer Interface Unit (CIU) in the house as well as access to a website where the data relevant to a particular connection will be published.

Fig 1: SM block diagram:



Conventional Revenue Protection processes

Conventional revenue processes were constructed to address current metering systems (including electro mechanical, electronic and prepayment systems) without any real-time, bi-directional communication systems installed. The only method to access the meter's condition would be a physical visit to the connection site and to record the different parameters relating to the meters and customers. This is obviously an expensive and time consuming operation. It also only ensures that the meter was/ not in a good condition at the moment of the visit. Tampering could take place 5 minutes after the audit visit

The only feedback mechanisms are the actual manual readings and in the case of prepayment systems the sales records. All of these parameters are subject to fraudulent actions and misuse.

The main processes are thus as follows:

- Meter audits (physical visits)
- Billing/ prepayment consumption reports
- Disconnect non-payer/ tamperer by visiting the site.
- Follow up visits to ensure that the customer does not re-connect himself.
- Frequency of visits once every 1 to 5 years
- Meter reader can be used to report tampering

Although these methodologies can be quite effective, it is a tedious task to keep on visiting the installations. It however ensures that the utility maintain a certain level of visibility that may be a deterrent to would be tamperers and electricity thieves. The utility could also, via these processes, keep a watchful eye on the meter installation condition and maintain a good (sometimes not so good) relationship with customers.

Non-Technical losses

Non Technical losses normally include losses in units due to the following reasons

- Incorrect metering
- No Metering
- Incorrect meter readings
- Tampering with meters
- Bypassing of meters

These losses can normally be addressed by human and process intervention i.e. correction error and charging the culprit for the losses or disconnecting the supply. The problem is normally not to intervene but to detect the problem timeously to curb losses and send a clear message to the customers who allow

these fraudulent actions to happen. It could however also result from a technical failure of a meter or an incorrect meter installation. The customer receiving the power, although via an incorrect meter, is still responsible for the loss.

The revenue losses can also be of a commercial nature in the revenue collection process

- Incorrect billing
- Incorrect tariffs
- Ineffective revenue collection

The financial revenue losses are normally not caused by the customer but most due to ineffective quality control mechanisms or mistakes by the utility staff.

To quantify unit losses in South Africa the Eskom 2009 generation and sales figures were used (Van den Berg, 2010). This portion of the losses does not include the commercial losses mentioned above.

- Non-technical losses amounts to 10% in the RSA according to a PB Power report
- Non technical losses Eskom 5927 GWh (50% of Distribution loss)
- Non technical losses of redistributors 4417 GWh (5% of energy purchased)
- Total cost at average Eskom supply price R0.25 = R2,586 bil
- Total cost at average Eskom residential selling price R0.53 = R5,482 bil

These losses are recurrent and it justifies a significant investment in processes and technology to reduce the losses to a more acceptable level.

SM facilities to support RP

Smart metering will not prevent human and system errors. It will however serve as a monitoring and early warning system to trigger the necessary corrective processes. The SM system will provide the following functionality to assist in the revenue protection process.

- Detect tampering by monitoring the meter alarms.
- Improved meter reading and billing accuracy due to the fact that meter readings are recorded every ½ hour and the resultant profile stored.
- Meter readings or the lack of it will be reported at least every 24hours. If any anomaly occurs it will be known.

- If a meter or the communication to the meter fails the SM back office system will detect and report it for attention by a field technician.
- SM will enable automated energy balancing by accumulating meter data from the customers connected to a specific mini-sub where total energy is also recorded.
- Many software packages also include pattern detection functions to identify any major deviation from the normal consumption levels.
- Remote disconnection for non-payment.

According to NIST (Xanthus Consulting International, 2009) the following RP functionality should be provided by the SM system

- *Tamper Detection*
- *Anomalous Readings detection*
- *Periodic Meter Status to Detect Any Tampering*
- *Suspicious Meter*
- *Remote Disconnect for Non-Payment*

New approach to RP processes:

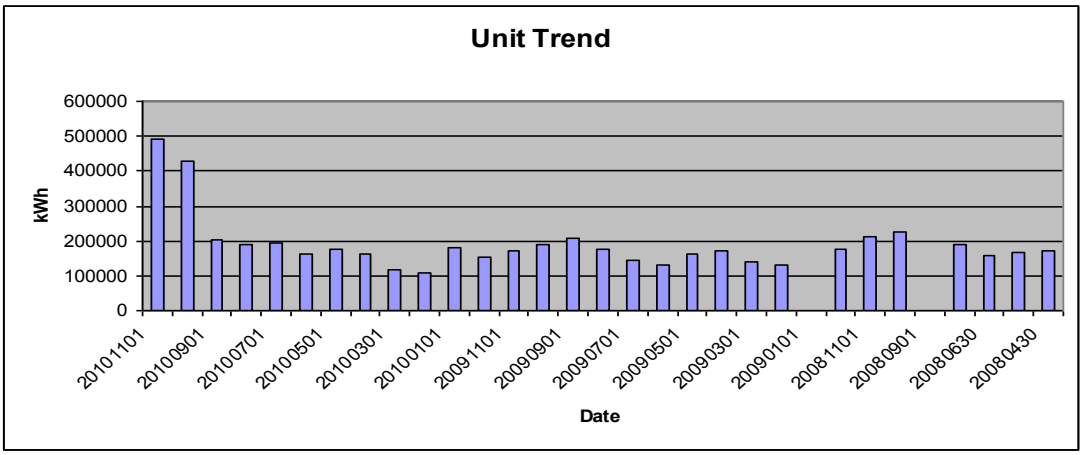
- The RP operators will thus not have to embark on sweep audits due to the fact that the system is self auditing.
- ½ hour consumption data uploaded every day as well as alarms from the meters will enable RP operators to identify tampered or faulty meters on a daily basis.
- Field work will be directed at specific tamper cases resulting in more efficient processes.
- Many RP processes will be meter data related rather than field work driven.
- Automated energy balancing will assist RP operators to identify problem areas effectively.
- Data from billing systems will assist with the identification of tariff problems, billed reading problems, non-payment issues.

Collection and analysis of data from SM systems

SM metering systems will collect ½h profile, alarm as well as consumption data from meters in the field. The shear vastness of the amount of data collected can easily lead to a situation where data is collected but not used effectively. It is thus essential to incorporate a well designed Meter Data Management System(MDMS) into the SM system. The MDMS will enable the utility to store data but more essential analyze and report on specific conditions. In this instance it will be important to extract possible energy loss conditions, meter failures, tampering cases, low consumption and suspect consumption pattern from the data.

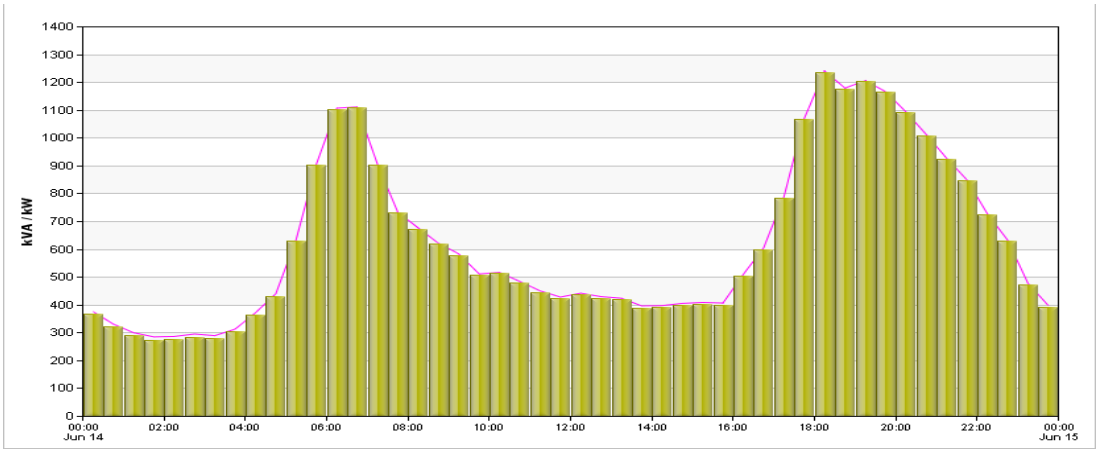
Typical information relating to the monthly consumption trends (fig 2, 3, 4) can be viewed for a group or individual customers to interpret the consumption in a particular area. Any major deviation from the norm can possibly be a sign of metering or tampering problems. In the example cases one can see the gaps in the monthly reading data as well as exceptionally high readings. It is impossible to scan all the meter readings manually and software functionality is required to analyze and report the possible problems.

Fig 2: Monthly Unit Trends



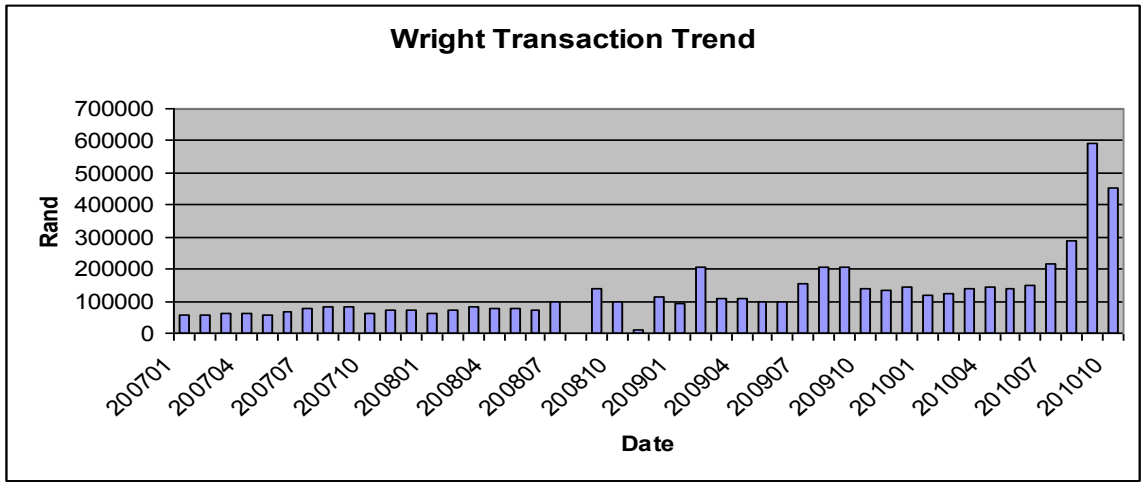
In the same context the daily consumption patterns can be constructed from individual or group data. From a RP point of view this graph can be very helpful to determine potential energy theft. Efficient power usage can also be monitored. Combined with Time of Use (TOU) tariffs this information can be a good indicator of energy theft if for example the customers use energy in peak time slots or a very low energy use. MDMS analysis facilities will enable one to identify unusual energy consumption behaviour and an inspection can be launched in that area.

Fig 3: Daily Residential Unit Trend



The transaction trend of a particular consumer will immediately highlight billing and or reading problems. In the case in Fig 4 one can detect missing bills as well as unusually high consumption patterns indication possible metering problems.

Fig 4: Transaction Trends



New systems approach

According to Synaptitude Consulting (Synaptitude Consulting, 2010) losses due to procedural design can cost utilities a significant amount.

“Utility organizations lose 2 to 5% of their revenue from preventable operational losses, especially in a smart meter/smart grid environment”

“These losses are due to a lack of/poor design of internal controls. Manual inspections to detect and resolve errors and inconsistencies are ineffective and overly burdensome. Utility organizations must face these challenges by implementing a set of controls and processes across multiple internal organizations and systems that are automated, independent, and continuous, to eliminate and mitigate the risk of revenue leakage due to these operational losses.”

It is thus vital to have the supporting processes in place to attend to possible energy losses indicated by the SM data analysis within the MDMS. The processes should include all the role-players in the utility from management, finance technical support, customer care to revenue protection operations.

Meter data analysis can assist to detect fraud and in-house errors (Loeff, 2009).

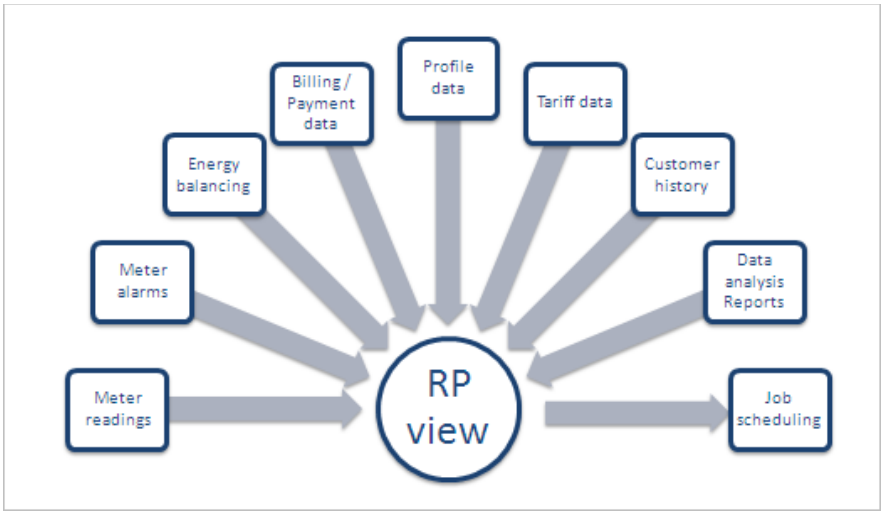
“However, data analysis is another game altogether. Not only does it help utilities catch energy diversion, it helps cut administrative losses, too. "About 80 percent of losses we help utilities find are not related to theft," Willis says.
Rather, losses stem from a variety of slip- ups, including meter malfunction”

The MDM system will provide a single view of the various parameters regarding revenue protection. This data will guide the RP operator to the problem areas as well as manage the actions taken to solve the problem. Information regarding the problem found should also be recorded on the system to store the history of a particular customer and connection.

An effective data analysis facility will enable the operator to view and combine information from various systems and trigger the appropriate action in the form of a job card for a field worker. The field worker will return the results and the system will store this information in a customer history database. The system will provide a seamless view on the following items:

- One view of: (see Fig5)
    - Meter readings
    - Meter alarms
    - Energy balance metering
    - Billing data
    - Tariff data
    - Customer history and type
    - Payment data
    - Various analysis and reporting options
    - Inspection scheduling and feedback
    - Meter failure feedback

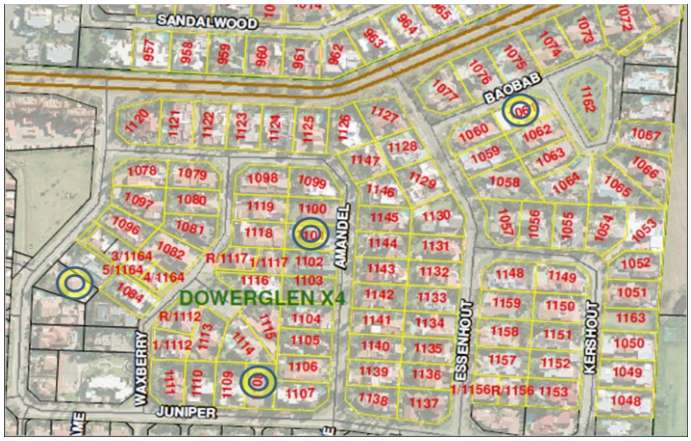
Fig5: One view data



Advantages of using new methodologies

- 24h monitoring of all meters.
- Auto energy balancing.
- Payment and billing monitoring.
- Only audit meters on exception reports/ more efficient operations.
- Early warning of any fraudulent actions at the metering site.
- GPS tagging of meters during the installation phase will allow the RP operators to go to a specific meter directly.
- GIS display of MDMS data will give a quick overview of a particular area and graphically indicate possible problem areas. (see Fig 6)

Fig 6: GIS map of possible problem cases



Skills to drive new processes

The newer technology will require that RP operators be retrained to use the SM systems efficiently. Fewer field personnel and more skilled personnel will be required. It will not be the norm to perform large “blind” audits on the meter installations if the systems function effectively. The time used to audit large installations can be used to zoom in on problem cases and attend to the individual cases before it becomes an area problem. One has to remember that people will rectify the problems reported by the MDMS. These people will have to be skilled to do to perform that function effectively.

Knowledge in the following fields of expertise will be required to ensure effective revenue protection programs:

- Computer systems
- Databases usage
- Reports generation with the MDMS
- Data interpretation
- SM metering systems
- GIS systems
- RP processes

The field workers will have to be trained to do first line maintenance and testing. They should be able to install and commission new meters. The traditional meter inspector will have to be retrained to ensure that the new system can be supported. It will not be cost effective to send an RP worker to identify a problem only to call a technician to replace the meter , record the installation data en activate the new meter.

Conclusion

- New meter technology will require the development of RP operators to acquire new skills to understand and use SM data to manage energy losses.
- SM systems will enable the utility to monitor metering systems 24h/7
- Energy balancing metering will generate and provide automatic loss reduction information
- Non-payment control will be more efficient with remote disconnection facilities
- RP programs will be much more cost efficient and effective with alarm and consumption feedback from the meters in the field.

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