SMART GRID AND AUTOMATIC METER MANAGEMENT: DREAM OR REALITY?

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INTRODUCTION

With the start of the electrification, the energy distributors dreamed to have an overall real time picture of their installation. Today this wish is still pious wish. The real time supervision is limited mainly to the high voltage (HV) network and the medium voltage (MV) departures in the majority of the companies of energy distribution.

To have an idea of the state of Mid-voltage networks, the electricians invented several subterfuges, namely a great plan version paper or its static data-processing version. In both cases, the concept of real time acts as science fiction.

Whose fault is it? The real availability of telecommunication infrastructures. Indeed, who says supervision of a network requires a lot of communication. What was set up relatively easily for the high voltage stations by the deployment of the optical fiber networks becomes much more complicated and expensive when it is a matter of connecting several thousands of sub-stations in the distribution networks to a dispatching centre (SCADA-DMS). A modern management of a distribution network requires having at any time a clear vision of the situation. The tendency is resolutely directed towards the automation of the energy distribution networks to make smart grid happens.

WHAT CAN WE DO AGAINST THAT?

One mean to meet this new requirement is to deploy Powerline Communication (PLC) network types in complement to optical fiber networks. The PLC technology makes it possible to use the existing infrastructures (cables) already in place in order to reduce the investments of connections of the various objects to the dispatching centers. The availability of PLC industrialized products and directed towards a common standard opens the door to various synergies between the transmission needs for the energy related applications (remote control, automatic meter reading, measurements of quality, …) like for the applications of pure telecommunications (Internet, telephony). The various types of services can be separate and protected in order to benefit from synergies of investments, operations and maintenance and to thus guarantee the performance of the applications.

WHY SHALL WE DO IT?

Benefits from this full telecommunication infrastructure are multiple and will be required by the regulated energy market (especially energy distribution) in order to improve processes with the clear target to reduce costs. The deregulated market will also have a lot of new communication requirement but in order to generate new revenues streams.

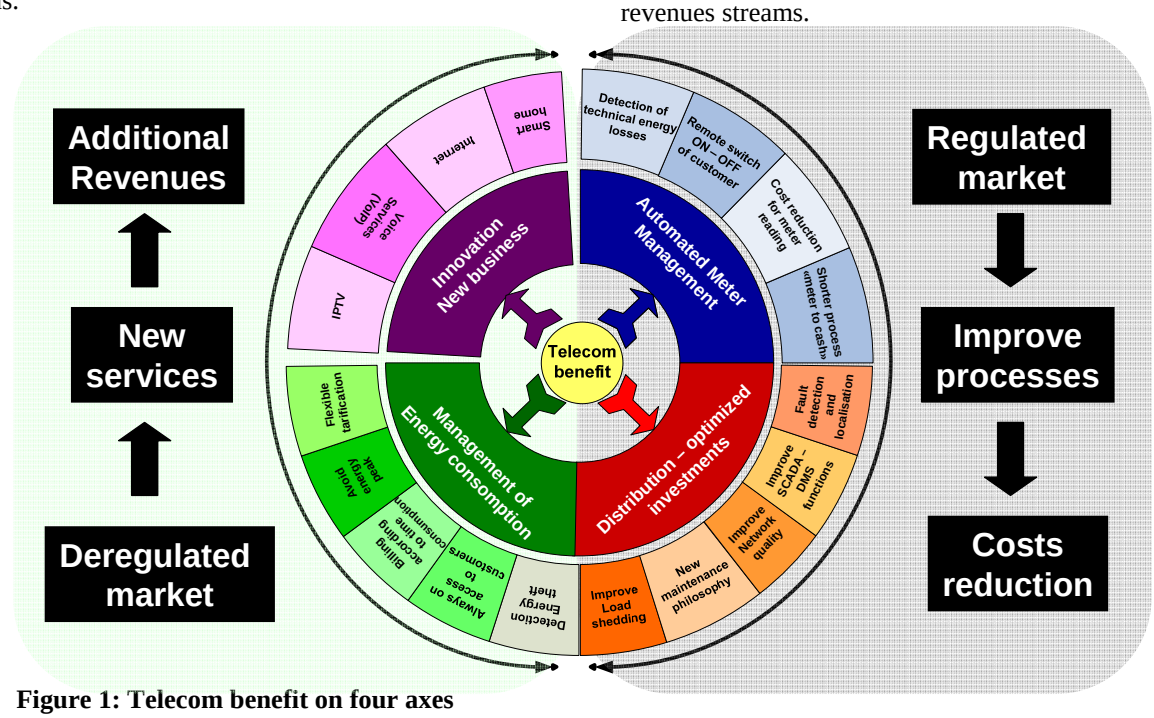

Figure 1: Telecom benefit on four axes

The figure above (Figure 1) presents the possible benefits procured by intensive telecommunication infrastructures usage for:

- Automated Meter Management and Distribution Management for the regulated market (monopoly)
- Management of energy consumption and innovation & new business for the commercial company.

Automated Meter Management

This activity is important for all energy distributors and will still growth and evolve in the next couple of years. The communication mechanism and especially the availability of new technologies will open new perspective in order to modify process (improvement) and reduce costs. The possible benefits are:

- Shorter process "meter to cash"
- Costs reduction for meter reading
- Remote switch ON and OFF of customers
- Detection of technical energy losses

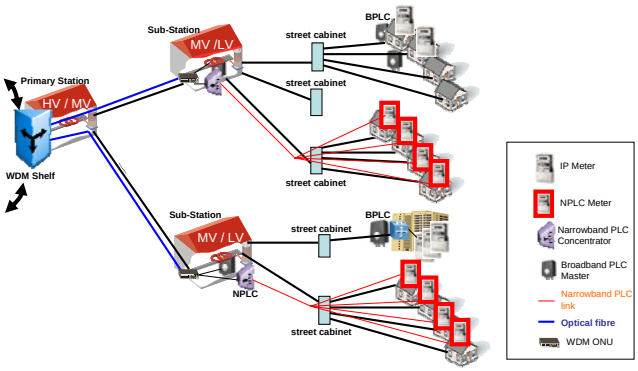

Figure 2: AMR based on fix IP network

Convergence on IP protocol and availability of Broadband PLC (BPLC) and Narrowband PLC (NPLC) types of transmission media opens various architectures and solutions which are scalable (investments level). In any case, optical fibre is required on the backbone side (core network) !

Distribution – optimized investments

The distribution management system (DMS) make only sense if real time communications are available in order detect, localise and control mid-voltage network equipments as switch gear, fault detectors, … The extended amount of real data generated by all of those mid-voltage equipments will open new perspective for the maintenance philosophy. Additional requirement as load shedding also needs more electronic communication. In two words, we can say "smart grid".

The possible benefits are:

- Fault detection and localisation
- Improve SCADA-DMS functions
- Improve Network quality
- New maintenance philosophy
- Improve load shedding

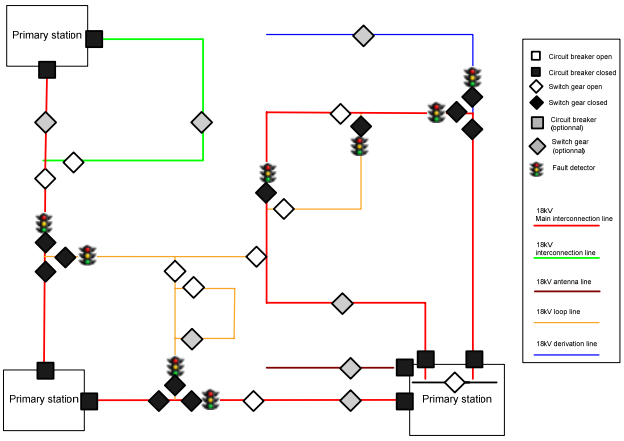

Figure 3: Distribution network breakers and detectors

Circuit breaker and fault detector represented on the figure above requires real time communication with the SCADA-DMS in order to allow the dispatcher to take decision about network isolation and restoration. The availability of those equipments is necessary to reduce the service interruption time and, in deed, generate better quality for the end-customer. The best way to provide the large amount of communication link to all of those elements is to use IP routed networks types and not serial point to point link type (too many lines will be required). The continuous remote control of infrastructure elements of the distribution network is essential to improve the availability and the quality of energy distribution services.

Management of energy consumption

Market deregulation brings more competition and force energy seller to provide different products and services. Availability of more communication opportunities opens very interesting perspective as flexible tariffs, avoidance of energy peak, detection of energy theft, billing according to time consumption, always on communication with customer.

Innovation and new business

When communication infrastructures are available, real innovation like "smart home" and triple play services (Internet, telephony and IPTV) are possible on the same basic network for acceptable costs and interesting revenues streams and investments drivers.

SOLUTION'S PROPOSAL

The convergence of all kind of services towards IP types of protocol drives important change on telecommunication, services and as well utilities activities. Then, the optimal use of the existing resources, empty roll and optical fiber at the high and medium voltage levels as well as cables at the low voltage level with PLC technology are opportunities to deliver telecom services based on a common IP protocol.

Long-term Strategy

"Optical fiber will be ***the*** solution in the local loop": it is just a matter of time. The bandwidth of optical fiber is large enough to cover future needs, to break down the Megabit race and it is a secured investment. Energy distributors are managing very well, since a long time, roll-out and maintenance of larges infrastructures. Then, they are logically able to construct and supervise big deployment of fiber networks with the same kind of processes and organization. Starting this kind of project can only be made with a long term strategy!

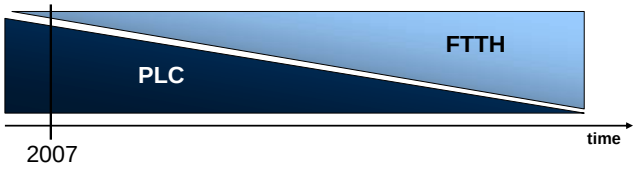

Figure 4: long term infrastructure vision

Combining optical fiber and Powerline (PLC) technologies provide a good way to make real time end-customers connectivity happen. In fact, optical fiber is often already available at the high voltage primary station but normally only a small percentage of mid-voltage stations are connected to this media. Then, the first task is to bridge HV primary stations with LV networks by laying optical fiber together with the MV cables (MV stations interconnection). This first investment provides the basic requirements to start with "smart grid" (SCADA-DMS applications) and "AMM" using optical connectivity and PLC for last mile access on LV network.

With the time, the fiber network will growth towards customer homes and PLC will be used more as indoor solution at reasonable costs and without negotiations with the building owners.

Bandwidth and services limitations are only related to lack of technologies performances. With PLC technology on access side (last mile), it will be difficult rather impossible to deliver IPTV, High definition TV contents and all ultra-broadband services. In the other hand, energy related services (AMM, network control …) can be delivered with combination of existing technologies (Optical networks and/or xDSL and/or PLC and/or wireless technologies). Full optical network (FTTH) will remove bandwidth limitations and technology issues then, the focus will come only on contents! Most of customers are ready to pay for services and contents not for "technologies". Probably, the most important limitation of this strategy will come from utilities them self who do not like to start risky projects. The biggest risk is related to marketing and sales capacities, no sales will directly kill the strategy!

Technologies issues

WDM PON is one on the technologies which combine Passive Optical Network (PON) argument (easy to deploy, less active component, no power consumption, less maintenance on remotes sites,…) but allow extension the very high bandwidth capacities (more than 100Mbit/s per user). In addition, the full combination of FTTC, FTTB, FTTH, VDSL, and Wireless provide the biggest synergies and technologies choice during roll-out of networks. The investment can be calibrated in relation with topology, distance, number of customers, and types of household and optimized as much as possible (costs – service level required - revenues).

To be concrete, energy related needs (SCADA-DMS) and PLC networks can be connected to FTTx (x means C=curb, B=building, H=home) scenarios without any troubles because of common IP protocol. Security issues should be carefully analyzed during the design of core and access networks.

Today, PLC performances are able to provide up to 50 Mbit/s on the access (last mile) and 100Mbit/s on indoor part (last inch).

WDM PON and PLC can be integrated as shown on the next figure from the transformer stations directly with PLC or from the street cabinet. The same IP infrastructure is then able to be used for energy related services and telecommunications needs.

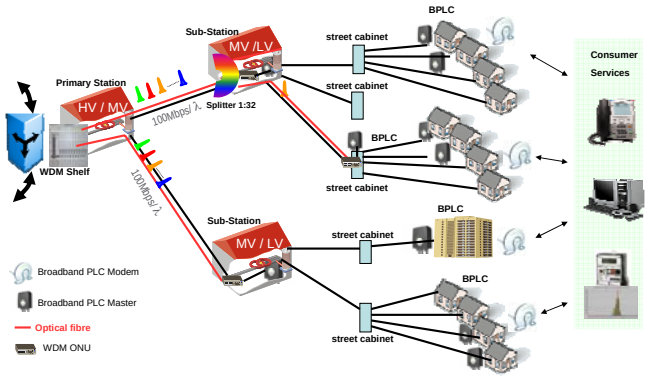

Figure 5: Telecom and Energy application integration

Business model and utility roles

Business model choice is not easy and it is important to evaluate the impact on fixed target (i.e. smart grid or AMM) for the energy distributor.

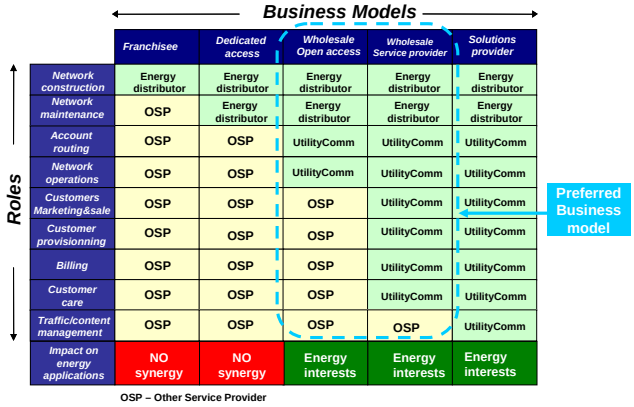

Figure 5: Business models and roles

The figure above presents different business models and possible actor roles. What means all of those models?

- Franchisee: Energy distributor build network but allow third party service provider (OSP) to operate the whole value chain.
- Dedicated Access: Energy distributor build network and awards exclusive rights to access network then make the basic maintenance.
- Wholesale Open Access: Energy distributor build network and awards exclusive rights to access network then make the basic maintenance. Energy distributor creates or is shareholder from "UtilityComm Company" in order to manage the network based service (IP) but in wholesale scenario only.
- Wholesale Service Provider: Energy distributor build network and awards exclusive rights to access network then make the basic maintenance. Energy distributor create or is shareholder from "UtilityComm Company" in order to manage the network based service (IP) but act in both wholesale and direct retails scenarios including customer care.
- Solutions Provider: Energy distributor build network and awards exclusive rights to access network then make the basic maintenance. "UtilityComm" will operate the whole value chain.

Only the three last business models will bring real synergies and help energy distributor for "energy related services" like AMM or SCADA-DMS. In fact, ***wholesale open access*** and ***wholesale service provider*** are the preferred models according to utility interests and best investment scheme. The role of energy distributor is also clear and fit with the potential of its available resources (right competences).

Choices, investment scheme and expected return

Wholesales service provider model is the best scenario for Energy Distributor direct interests and avoidance of weaknesses (sales & marketing forces) using "UtilityComm" type's of company. Investments should be supported through "UtilityComm" by private equity or long term loan (bank).

In this case, energy distributor will be paid for utilisation of existing infrastructures (proportionally by space requirements) and will pay for using "UtilityComm" services (i.e. for AMM) but energy distributor should not make itself a large investment out of its core business. Using acceptable hypothesis, return on investment is possible in less than 10 years (ROI < 10 years) and internal rate of return (with terminal value) will be around 15%.

RISK ANALYSIS

Most of risks are concentrated on two majors points:

- End-customers sales performances and competences of "UtilityComm" in a very aggressive market such as telecommunication, multimedia and entertainment (revenues generation).
- Respect of evaluated investment level per customer (civil works and technology).

CONCLUSION

Full optical fiber, PLC and IP networks roll-out is a huge investment and can be only paid back by creating most possible synergies between different services (Internet, voice, IPTV, AMM, distribution network improvements, shorter energy interruptions …). In addition, it is essential to follow clear strategy (ultimate target is to have FTTx) and to operate adequate business model in order to avoid conflict of interests and internal competition. Availability of IP or NPLC meters, BPLC equipments on MV and LV networks are key elements to make sense for energy distributors.

Making such "UtilityComm" project in real life would be an essential driver to move "smart grid" from dream to reality!

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