Perspectives on Power Quality in a Smart Metering World

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Power quality has been one of the less tangible benefits associated with the mass deployment of smart metering.

However with the increasing levels of complexity within the distribution network, the emergence of distributed power generation and the necessity to ensure network stability under all conditions, access to localised points of quality measurement becomes more important.

In considering power quality in a smart world, it is however important to divide the technical and process requirements and capabilities.

Ideally, smart meters will have in built data quality measures. By utilising the same communications infrastructure as that used to support the "meter to cash" and "device control" processes, this data can be uploaded and fed into the control processes for the distribution network.

If all meters were to include for instance, frequency measurement and voltage stability then it would be possible to assess the quality of power at each point of supply.

However stepping back, the question to be asked is why this would be useful to the operation of a distribution network.

There are three answers to this question –

The data could be used

1. as an input to the real time network control process
2. for restoration purposes
3. for analysis to improve the network

Whilst point 1. has potentially the highest value from the perspective of the data provider, the different demands of smart grid and smart metering makes this complex to deliver and the value to the primary user of the data is questionable.

The underlying issues around using smart metering data for network control purposes are associated with the time base for data collection and the on costs of the functionality within the meter point.

For smart metering, the primary purpose is improved billing and customer service. This is a relatively slow process requiring possibly 4 reads per month and on demand services for change of tenancy and billing queries. The business case for "public network" smart metering solutions (such as those using GPRS), rely on low transactional volumes (although the case can improve with PLC and private/wireless communications).

The second issue is around the meter price point and meter ownership. If the meter is owned by the retailer, remote data collection and control (including disconnection) are the priorities. These requirements drive increased meter costs through the addition of communications and power breakers. As the meter owners look to drive down and minimise the cost of the meter the inclusion of complex power quality measurement is low on the priority list.

Whilst there is the potential for standardisation that includes power quality within the meter, the allocation of the cost and value within a fragmented, deregulated market is complex and this still fails to overcome the underlying issue associated with data collection frequency.

A more prudent approach is to use the data for specific network events for which access to localised data has high but short term value – this is option 2. The most obvious example is the black out. In this case, the value of the data is not in the detection of the outage but more importantly in the management of energy restoration.

Once power is being restored the ability to confirm whether the supply has been reconnected to individual households improves customer service and provides detailed information to resolve the large number of small issues that remain following a major power restoration.

In this case the value of this data is high and as such moving from a slow time base model to a "near time" or "on demand" data model will provide significant benefits. The data is then used and paid for only when required although the price point will reflect the increased cost of the service and the inherent value.

This however assumes that the frequency of data collected and delivered can be increased at the request of the distributor.

It must also be noted that whilst private networks will provide this “on demand” data for a lower incremental cost over public networks (GPRS), PLC is unlikely to be an option for many of these situations.

It should also be noted that restoration management does not rely on advanced power quality capabilities within the meter. The ability to simply detect current flow and voltage will be sufficient to determine the status of each connection point.

The final option 3, has the lowest impact and potentially the highest long term value. By taking an extract of data collected on a slow time base, the information can be analysed to indentify weaknesses within the network. Whilst the cost of data will be low, this method will require more advanced measurement capability which will increase the cost of the meter.

The question here is whether having the information about each metering point actually aids the decision making process.

Siemens have through their activities in smart metering explored many of these issues in real life environments. Most recently, a major deployment of smart meters has identified faulty low voltage distribution cables where the break could be pin pointed between two individual properties in a suburban street.

Similarly using the data collected to identify polarity and tamper issues as well as historical asset assignment errors has helped to cleanup the asset register and improve the accuracy of the customer services database.

Having this increased granularity of data at key points in the network can also be extended to deal with private networks especially for large industrial users or estates. This allows equipment which has a detrimental effect on power quality to be identified and replaced. By covering the entire process from network analysis, smart metering/grid through to the provision of specialist power equipment including low noise drives and controllers, Siemens is able to deliver comprehensive solutions in this field.

This data and its ability to improve the accuracy and timeliness of the field and front office response and the performance of the installed equipment, is highly valuable and demonstrates the true “value added” services that comes with a smart deployment.

So how can power quality become part of a smart metering world?

The answer is relatively simple. Smart metering for the first time provides the opportunity to segment and monitor the installed base. Whilst the majority of the customer base will be similar, the introduction of more distributed sources of energy and load create customer groups that will require enhanced measurement and reporting.

Deploying complex power quality functionality at each supply point is highly questionable and is unlikely to deliver any major benefits above the complexity that this approach will bring.

For the majority of consumers a low cost smart meter is the most suitable solution which delivers the key revenue and customer service benefits as well as being able to contribute to major network events such as restoration.

For more complex segments, a power quality enabled meter will be required. This will have higher costs to operate which can be offset against the increased value captured by this customer group.

Finally, the use of power quality enabled meters to sample network quality at key points will provide improved visibility and prediction capability. Whether these devices use the smart metering communication infrastructure or a faster smart grid network is a matter of choice depending upon the location and technology choices.

So in conclusion,
Power quality has an important role to play within the smart metering world. By taking a segmented approach, the cost of inclusion can be minimised whilst the commercial benefits are maximised.

Sharing infrastructure between smart grid and smart metering can generate major synergy savings so long as the frequency of data delivery can be varied and priced on a transactional basis.

Finally, that power quality is part of a larger smart metering portfolio that can be optimised to suit the needs of the distributor and retailer.