METERING INTER-OPERABILITY: A CASE STUDY FROM IRAN

In the first part of a three-part series, we examine the Iranian smart metering programme and the challenges of ensuring interoperability across a variety of legacy systems. Based on the importance of interoperability in the implementation of AMI, it is essential to introduce a detailed solution, protocols, and international standards, in both meter and control centre levels, in order to consider different implementation challenges.

This report is intended to introduce different efforts during implementation of the Iran Smart Metering Project, in terms of interoperability considerations and presentation of technical specifications.

The national smart metering programme in Iran is one of the Ministry of Energy's biggest infrastructure projects. Of particular importance is the challenge of managing interoperability among the different legacy systems, due to the number of different systems from a variety of venders.

Deploying interoperable infrastructure provides for effective and efficient data exchange as well as stable and standard data portability among the variety of systems in the national smart metering programme. The major reference in the Iranian case, considered as the basis of interoperability management among different systems, at a control centre level is IEC 61968-9; and at the meter level, IEC 62056 (DLMS/COSEM protocol).

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The interoperability concept

It is a given and common practice that all data collected from smart meters must be transferred to the control centre in order to be properly used. Furthermore, the control centre must be able to send commands to the meters in order to perform changes in meter parameters, clock alignment and enable remote disconnections. Thus, the meter must provide both local and remote communication functions.

A very important related topic is the choice of the proper suite of protocols. The choice of a specific suite of protocols greatly influences the way the data is represented, the associated payload and the physical medium used for the exchange of data. The choice of frequency range and bandwidth depends on many factors, related to normative aspects (EMC compatibility in the chosen band), performance on network, requirements for transmission rate and costs. Furthermore, the issue of interoperability must be considered.

Interoperability standardisation

There are two main classes of protocols, namely proprietary and standardised. Some protocols, especially the proprietary ones, can be more oriented to reduce payload (data traffic, efficiency and speed) thus increasing the efficiency of data transmission but, because they are not completely standardised, can obstruct adoption by different manufacturers.

In recent years there has been a push by regulatory agencies and international mandates to grow the standardisation of protocols. It may be that an initial proprietary protocol is 'opened' to the market by the developer, creating associations and consortiums, trying to increase the number of manufacturers that will adopt it instead of developing a new protocol.

This can be a good starting point for the development of a field-proof technology, which can then be proposed to the standardisation bodies. The standardisation process is quite long because it has to generalise and include multiple different technologies and principles. Furthermore, different standardisation bodies are oriented to different protocols.

The adoption of an open standard and of a standardised suite of protocols paves the way to interoperability and even *interchangeability* of meters coming from different manufacturers. In order to have future-proof functional requirements for meters, the proposed architecture for communication must be open, especially for the integration of new communication devices.

Given the wide acceptance on the meter market of the IEC 62056 and IEC 61968 standards and previous experience of pilot projects around the world, they are considered as the reference guide for this strategy and plan. IEC 62056 and IEC 61968 also offer comprehensive security structures, for access, authentication and encryption.

Interoperability and interchangeability

The wider definition of interoperability considers the possibility of substitution (removal and replacement) of meters in whatever site of installation – with the guarantee of the previous performance of the system. This definition is also referred to as 'interchangeability'.

Hence, the term interoperability would apply to the middle layer (e.g. different meters can talk to the same DCU and AHE), whilst interchangeability applies at the physical layer (e.g. exchange of one manufacturer's meter for another at a customer's site). The perfect interchangeability of meters from different manufacturers requires a fully defined and agreed set of functionalities and specifications – from the higher levels of the stack defined in the suite of protocols, to the lower levels of communication (and implemented data model).

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An example of a consortium of meter manufacturers acting in this direction is represented by the IDIS 2 association, which is also based upon IEC 62056 (smart meter level). The adoption of an open standard (including the suite of protocols and the data modelling) can greatly help interoperability and even interchangeability of meters coming from different manufacturers.

It is, however, of vital consideration that even by adopting the same suite of protocols, interoperability can't be assured. Problems of interoperability can arise even on the same physical medium or even the same type of modulation. Many different types of PLC are using different frequencies and modulation and they are not compatible and hence not interoperable. The interoperability can be achieved at different levels of the AMI architecture.

interoperability should be provided by manufacturers and be tested during the tendering phase. It's very important to perform a general test before a massive rollout, otherwise the risk is to deploy meters that are not able to communicate with the data concentrator, resulting in additional costs for integration and modification of the devices and firmware. To mitigate the risks, the tender documentation should consider a test in the field before the approval of a final contract and, of course, before a massive rollout.

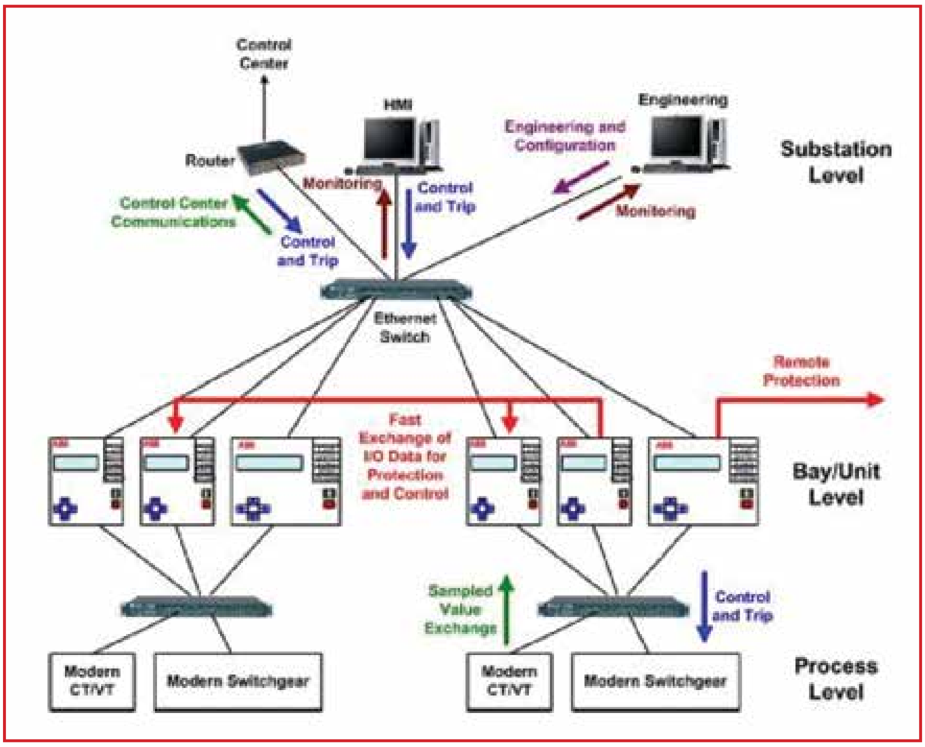

Figure 1: Multi-vendor devices and systems in a typical substation scheme.

Layers of interoperability

Interoperability at 'meter level'
Complete interoperability can be achieved at meter level. This means that meters of different manufacturers, even operating under the same concentrator, if used, can work without reciprocally affecting the functionalities, including communication.

An even stronger constraint defines interoperability as interchangeability, thus requiring that the replacement of a meter from one manufacturer with another of a second manufacturer will allow the complete interactions among the new meters, thus including the services at lower levels, such as the repeater mechanism. This is particularly hard to obtain in residential meters with concentrators.

Interoperability at 'concentrator level'
Defining interoperability at the concentrator level (middle layer) releases some of the constraints at meter level, since the communication between meters and concentrator can be freely defined and adopted, while the concentrators of different manufacturers must adopt a common way of communication with the control centre. Interoperability at DCU level is recommended at the first stages of implementation, thus avoiding the coexistence of PLC smart meters produced by different manufacturers on the LV network under the same substation.

Interoperability at 'MDM level'
This level is the one with the least constraints, since the MDM software will be in charge of requesting information and sending commands according to different standards, thus practically integrating systems which otherwise are completely incompatible.

Interoperability among products from different manufacturers
Interoperability must be performed at least at the 'concentrator level'. This means that, waiting for full standardisation, the meters under the same concentrator will be from the same manufacturer. From the concentrator, the communication medium is IP based (GPRS, Wi-Fi or fibre optic, when available).

The data concentrator will use the same data model thus being accessed in the same way from the AHE. Meters directly connected to the AHE, via GPRS or LAN, adopting the same data model, objects and OBIS codes, will be interoperable. Interoperability issues will be solved at the 'front end' of the AHE software, which can talk with different types of meters and concentrators using different objects and methods according to COSEM OBIS.

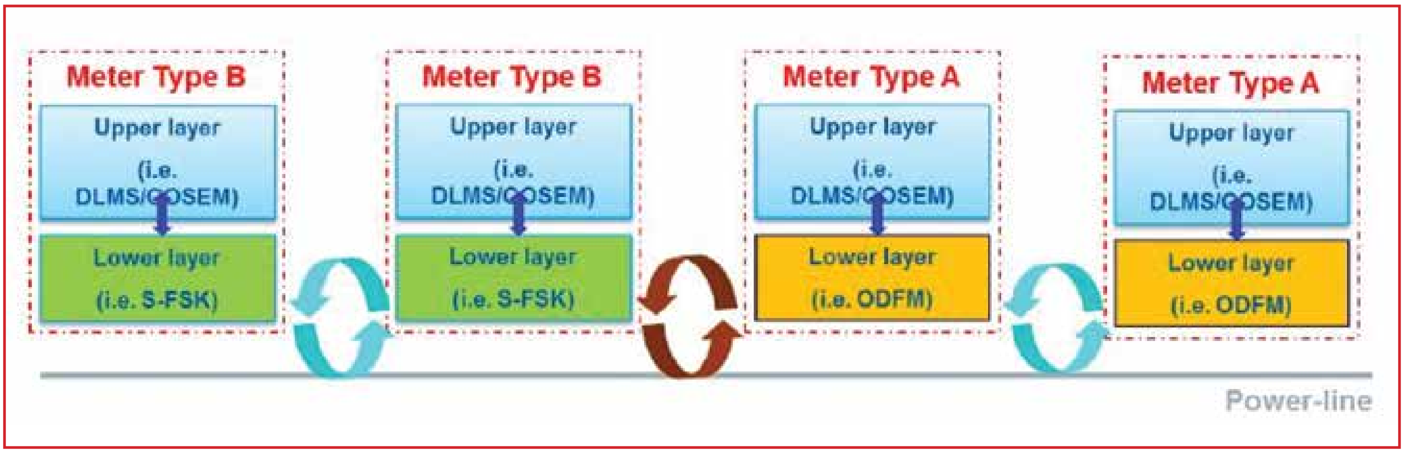

Figure 2: An example of communication among meters (An example: type B can talk only with type B, type A can talk only with type A, type A could potentially prevent proper communication for Type B and vice-versa).

Open standards and associations

To achieve interoperability, the most important instrument is the introduction of open standards at the system level (MDM and AHE) which will ensure that the utility can procure meters from different manufacturers. This can be achieved down to the DCU level where communication will be with all meter types.

The following section describes some example of communication technologies used in open standards:

OPENmeter (European Project): 'The result of the project will be a set of draft standards, based on already existing and accepted standards wherever possible. These standards include the IEC 61334 series PLC standards, the IEC 62056 standards for electricity metering, the EN 13757 series of standards for utility metering other than electricity using M-Bus and other media.'

Prime Alliance (Powerline Related Intelligent Metering Evolution): 'The end objective of PRIME is to establish a complete set of standards on an international level that will permit interoperability among equipment and systems from different manufacturers.'

IDIS: 'The IDIS association develops, maintains and promotes publicly available technical interoperability specifications, known as 'IDIS specifications', based on open standards and supports their implementation in interoperable products.'

G3: 'G3-PLC enables high-speed, highly reliable communications on existing power lines needed to make the 'energy Internet' a reality.'

Meters and More: 'The main goal of the Association is to provide the industry with a proven open protocol for smart metering, thus being a tangible answer to the European Commission's Mandate 441 to achieve standard solutions across the continent.'

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In our next edition, we examine interoperability from the specific perspective of the Iranian environment.

This report was written by MONENCO IRAN, under the auspices of the office of the consulting engineers dispatching, information and telecommunication deputy, smart grid department.