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White Paper

IDIS interoperability – securing long-term investments with interoperable solutions

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Executive summary

In accordance with EU directives, energy utilities have to ensure that 80% of consumers are equipped with intelligent metering systems by 2020. To support this transformation, the European Commission issued two mandates – M441 and M490 – authorizing the three officially recognized European Standardization Organizations (ESO) CEN, CENELEC and ETSI to develop open standards that would form the basis for the interoperable smart metering solutions. Interoperability, however, requires the development of companion specifications and conformance testing.

Organizations such as the IDIS (Interoperable Device Interface Specification) Association provide detailed companion specifications and the corresponding conformance testing environment. They enable the manufacturers to develop interoperable smart metering and smart grid equipment in compliance with the international open standards. The IDIS approach to interoperability involves a strict separation between the use case-driven application models and the technology-driven communication protocols, which ensures the quick integration of new developments into communication technology without changing the functional model of the devices. Through initiatives like IDIS, utilities can profit from interoperable products and thus rest assured that their investment in smart metering technology is future-proof and open for inevitable technological progress.

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Introduction

The drivers

The 3rd Energy Package provides a good basis for the European Union policy framework on smart metering. It foresees a large-scale deployment of interoperable smart metering systems in the EU member states with 80% of households being equipped with smart meters by 2020. The majority of member states have already transposed the corresponding directives[1] into national law based on the positive cost-benefit analyses of smart metering and are currently in the process of full-scale national rollouts.

The technology

Availability of smart metering functionality at each end point on the electricity distribution network provides the technical means to collect a comprehensive set of data on the power consumption patterns in the medium- and low-voltage distribution grid. Local smart meter interfaces to the customer offer the possibility to control local consumption and production of energy. In addition to the communication networks that connect metering points to utilities' IT infrastructure, the foundations are now set for total automation of the electricity distribution network, including local production and consumption. This transition to a smart grid environment requires investments that far exceed mere investment in smart metering. The financial justification for additional investment in smart grids largely depends on the status of the grid infrastructure and on local boundary conditions. Nevertheless, it is crucial that the smart metering infrastructure supports the smooth upgrade to smart grids, both today and in the future. This goal can only be achieved by providing interoperable interfaces based on open international standards between the crucial components of the smart metering chain.

The European Commission has recognized the importance of interoperability based on open international standards by issuing two mandates – M441 and M490 – and authorizing the three officially recognized European Standardization Organizations (ESO) CEN, CENELEC and ETSI to develop open standards that would form the basis for the interoperable smart metering solutions.

EU mandates

Mandates M441 and M490 include both the existing standards and the "standards under development." The list of standards in M490, sect. 10 alone consists of 97 existing and 59 EN/IEC "standards under development" that support smart grid applications. Besides the general standards, which cover topics such as security, safety, etc., the IEC/EN standards can be divided into three categories according to their application area:

- Smart metering standards (e.g. EN/IEC 62056 series) supporting commercial business processes, i.e. billing.
- Standards covering data exchange on the system level (e.g. EN/IEC 61968 series), which support operational business processes on the system level.
- Standards covering network automation in the field (e.g. EN/IEC 61850 series), which support operational processes in the field (e.g. substation automation).

All these standards are made available and are consistently maintained and expanded by the official standardization bodies.

What is an open standard?

An open standard is the result of a consensus process among the key industry players, e.g. manufacturers and users. Participation in this process is open to all stakeholders. The role of the standardization organization is to supervise the standardization process and to ensure that the final documentation is available throughout the industry.

Due to the process described above, a standard always considers a wide range of market demands and regulatory requirements. The regulatory aspect becomes particularly important for products – such as smart meters – used in highly regulated markets. The resulting standard has to be universal and must allow for a certain level of customization to account for the different requirements.

Furthermore, the standards document is expected to provide a sufficiently detailed description to enable the development of interoperable products.

[1] DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of July 13, 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

The manufacturer investing in the implementation of a standard expects that the standard will not be covered by patents and license fees.

Documents that do not fulfill the restrictive requirements of an open standard are published by the standardization organizations as technical specifications or technical reports. However, technical specifications reports never achieve the same level of quality as the proper standards.

At the European level, standards may be harmonized under a specific European directive. Equipment that fulfills these harmonized standards is “assumed” to fulfill the corresponding directive as well. The lists of harmonized standards are regularly published and updated by the European Commission.

Elaboration of a standard does not entail the actual development or the use of the compliant equipment either by vendors or utilities. The development and the use of compliant equipment can only be mandated by the market or by the regulator.

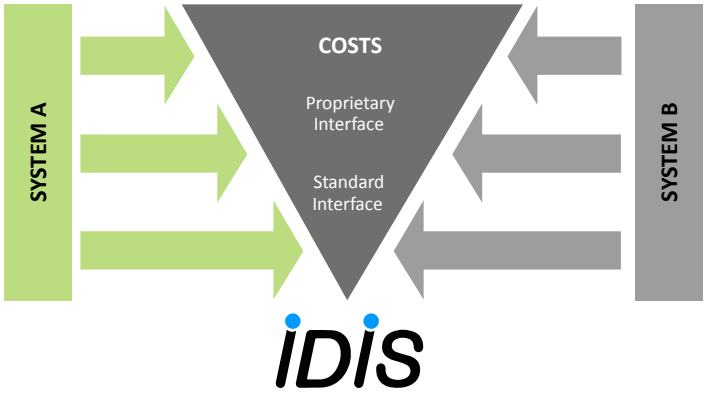
Open standards do not describe solutions customized to the specific needs of a specific user. Standards describe universal solutions that can be customized to the specific needs of a user. Customization is achieved by configuring various options endorsed by the standard. This configuration is described in what is known as a companion specification document that is neither developed, nor published by the standardization organizations.

Utility challenges

With the mass deployment of smart metering technology, utilities are forced to replace their entire meter parks within a relatively short period of time. Besides the substantial investment for the renewal of the entire meter park, well-functioning meters and systems form the indispensable basis of the utility’s business. It is therefore self-evident that the utility – in order to lower the investment risk and the operational risk – prefers systems that can integrate meters of different manufacturers. The meters of different manufacturers must be exchangeable and interoperable.

As shown in Figure 1, integration costs strongly depend on the characteristics of the interfaces between the system components. The highest costs can be expected for proprietary interfaces, and lower costs for interfaces based on an open standard.

Figure 1: Integration costs for a smart metering solution



Another important aspect is the availability of system components. When the wave of smart metering rollouts across the globe subsides, a number of vendors will eventually disappear from the market. With a proprietary solution, the utility risks getting stuck with meters and systems that are no longer supported. With an interoperable solution, however, the utility has a fair chance of finding replacement components even after the market adjustment.

While open standards enable manufacturers to invest in interoperable products without the risk of patent infringements, they do not ensure interoperability per se. Interoperability can only be achieved with a commitment to a specific standard and with a dedicated configuration of the options offered by that standard. Companion specifications and conformance tests are needed to ensure interoperability.

While standards are the responsibility of the respective standardization organizations, companion specifications have been traditionally developed only by the very largest utilities or utility associations. As this procedure is expensive for the utility as well as the smart meter

manufacturer, it is only feasible in large-scale rollouts. For smaller utilities, a contradiction exists between interoperability and customization because the investment required for a multi-manufacturer customized solution is not feasible for the utilities, nor is it feasible for the manufacturers given the small total number of devices. Manufacturers will invest in utility-specific interoperable devices only if the potential market offers a significant financial gain to several vendors.

Solution details

IDIS Association

The IDIS (Interoperable Device Interface Specification) Association was founded to ensure validated interoperability through certification while maintaining the companion specifications in the long term – thus providing investment protection to its members and utilities. Co-founded by Landis+Gyr in 2010, IDIS is now supported by manufacturers across Europe. The association provides companion specifications and a test environment, making interoperable smart metering devices available for all utilities. The IDIS specifications are fully based on the open standards of the EN/IEC 62056 series.

IDIS Association membership is open to any smart meter manufacturer providing conformance-tested IDIS equipment. Members are committed to specifying how the existing and evolving standards are used in products and to providing the necessary test environment required to achieve truly interoperable smart meter equipment.

The specifications are publicly available for any company. Thanks to the rigorous testing procedures and the transparent certification process for IDIS meters carried out by DNV KEMA, end-to-end solution providers can offer systems supporting IDIS meters from different manufacturers.

Interoperability on all levels

Interoperability means the ability of system components to exchange information and to make use of the information exchanged. This goal can only be achieved if the companion specifications account for all levels of the data exchange between the system components.

Figure 2 shows how interoperability is achieved in IDIS. The IDIS architecture distinguishes between the specifications of the meter functionality and the specifications of the communication protocols.

On the functional level, the semantic aspects define the meaning of the data structures exchanged. This part of the IDIS specification is based on the COSEM data models as defined in the IEC 62056-6-1/2 standards. The syntactic part, which defines the data structures and the messages, is based on the DLMS/COSEM application layer standard according to IEC 62056-5-3. This part also contains the definitions of the security protocols to ensure privacy, authenticity and the integrity of the data, and to protect access to the crucial smart metering and smart grid applications.

Figure 2: IDIS interoperability at all levels of the data exchange

IDIS	Level of interoperability	Contents	Standards supported
Functionality + Security	Semantic	application conecpts contained in the data structures	- COSEM: IEC 62056-6-2
PLC S-FSK IEC 61334-5-1 / IP v4/v6 / GPRS / Ethernet / PLC OFDM G3	Syntactic	data structures in the messages (including security)	- DLMS: IEC 62056-5-3
	Network	exchange of messages via different networks	- TCP - UDP - IPv4 - IPv6 - S-FSK PLC network: IEC 62056-8-3
	Connectivity	physical and logical connection for the data exchange	- S-FSK PLC: IEC 61334-5-1 - OFDM G3 PLC: ITU-T G.9903 - Ethernet - GPRS, 3G, ...

At the communication level, the network aspects define the data exchange via different communication networks. In addition to the network protocols optimized for Power Line Communication (PLC) and based on the S-FSK standards, the major internet protocols are supported. Finally, the connectivity aspects account for the physical and logical connection between different devices. Besides wire- and radio-based internet access technologies (Ethernet, GPRS, 3G, etc.), the focus is put on PLC technologies. With S-FSK, a field-proven PLC technology with millions of installations is considered, whereas the G3 specification offers access to the latest Orthogonal Frequency-Division Multiplexing (OFDM) PLC technology.

Consistency built on flexibility

The specification of the device functionality is entirely driven by the smart metering and smart grid use cases, whereas the communication part depends heavily on the existing communication technology. IDIS functionality is therefore based on a single pair of standards (DLMS/COSEM) that are scalable and expandable for existing and future use cases. On the other hand, the IDIS communication part includes a variety of different communication standards covering PLC communication, different internet access technologies and internet protocols. The set of communication protocols can easily be expanded, assuming the availability of new communication technologies.

Strict separation of the meter functionality from the communication protocols ensures the necessary consistency in the functional part but still offers enough flexibility in the communication part. Considering the fact that the semantics and the syntax of the data structures exchanged with the meters also influence business processes beyond the head-end system, consistency at the functional level helps to substantially reduce the system maintenance costs. The influence of the communication protocols is typically limited to the system architecture below the head-end system, which means that any upgrade in communication technology generates only limited adaptation costs.

Consistency of use cases

Table 1 contains the list of use cases supported by the IDIS-certified meter. Interoperability between IDIS meters of different manufacturers is achieved with the IDIS companion specification, which defines more than 300 instances of standardized (IEC 62056-6-2) COSEM interface classes. Should the market require more use cases, the IDIS functionality can be expanded by adding new instances of COSEM interface classes.

Table 1: Smart metering and smart grid use cases covered by the IDIS functionality

Use Case	Description
Meter registration	Process of incorporating devices (E-meters, sub-meters, etc.) into the system.
Remote Tariff Programming	Process of remotely programming the parameters necessary to support time-of-use (TOU)-based tariff contracts.
Meter reading (on demand) for multi-utility meters	Process of spontaneously collecting meter readings upon specific request.
Meter reading (for billing) for multi-utility meters	Process of periodically collecting meter readings for regular billing purposes (periodic readings).
Disconnection and reconnection (E, G)	Process of disconnecting or reconnecting the electricity (E) or gas (G) supply of a consumer.
Clock synchronization	Process of adjusting the internal clock of the metering equipment.
Quality of supply reporting	Process of supervising power outages, sags and swells.
Load management by relay	Process of controlling specific local loads by means of relays.
Firmware update	Process of downloading new firmware to a device.
Meter supervision	Process of supervising events that could compromise the meter and the system.
Consumer information	Process of periodically transmitting consumer information via a local interface
Communication supervision	Process of supervising events affecting the meter to HES communication.

Following the rules defined by the IEC 62056-6-2 standard, these additions can be done consistently, thus avoiding backwards compatibility issues.

IDIS is not limited to electricity meters. There are IDIS specifications for collecting data and interacting with other energy meters, such as those for gas, water and heat.

Consistency between proven and cutting-edge communication technologies

IDIS package 1, released in 2011, includes a detailed specification on the configuration of the S-FSK PLC communication protocols according to IEC 61334-5-1. The S-FSK protocol has been deployed in several million meters by several independent manufacturers. Today, the user may choose between 17 different interoperable IDIS meters produced by five different manufacturers.

IDIS package 2, released in 2013, defines how the IDIS functionality is accessed via IP-based networks using the "traditional" access media such as Ethernet, GPRS and other technologies offered by the telecom providers (left column in Figure 2). With the combination of IDIS PLC meters and IDIS IP meters, the end-to-end solution providers can now offer a reliable and cost-efficient solution based on interoperable meters from independent manufacturers.

With the introduction of the interface to IPv6, the IDIS specification integrates new communication technologies while maintaining consistency, coexistence and backwards compatibility with the existing technologies. Integration of the OFDM PLC technology according to the G3 standard (ITU-T G.9033) in the IDIS specification is underway.

Security by design

IDIS meter use cases require protection of the system components, the interfaces and the information exchanged. In order to maintain system integrity and to protect end-user privacy, IDIS implements security measures endorsed by the IEC 62056 standards.

Access security

Data exchange with the IDIS meter is only possible if the appropriate identification and the authentication of the communicating partners are secured. Appropriate access rights (read, write, execute), including cryptographic protection, are defined for each data element and for each meter function for different users.

Application layer security

To ensure the privacy and the authenticity of the information exchanged, cryptographic protection is provided on the application layer according to IEC 62056-5-3. The requested protection level depends on the data classification. Specifically, the application layer data can be transmitted openly; the data can also be protected through DLMS encryption and authentication by means of cryptographic algorithms of proven security. The application layer security used in IDIS protects data and services between the IDIS client and the IDIS server irrespective of the communication media and networks used in between.

The goal of the IDIS Association is to make interoperable smart metering technology available on the European market.

Commitment to openness

The goal of the IDIS Association is to make interoperable smart metering technology available on the European market. In order to achieve this goal, the IDIS Association supports the entire process from the specification development to the certification of interoperable equipment.

As shown in Figure 3, this process starts with the standards. IDIS considers only proper standards published by official international standardization organizations (IEC, ITU, ISO, etc.). Technical reports and specifications that do not qualify as standards are not considered. The IDIS Association does not specify the standards, nor does it modify them. The strict adherence to official standards is the best insurance against hidden patent claims for the investor in IDIS equipment.

Based on the chosen standards, the IDIS companion specifications are developed to define all the parameters, options and gaps that exist in open standards and allow for a certain level of customization. The specification

of the functional part is entirely based on the IEC 62056 standards, whereas the communication part of the IDIS specifications can be covered by any standard-defining communication protocols suitable for smart metering and smart grid applications. The IDIS companion specifications are publicly available for use by manufacturers and end users without any membership obligation towards the IDIS Association.

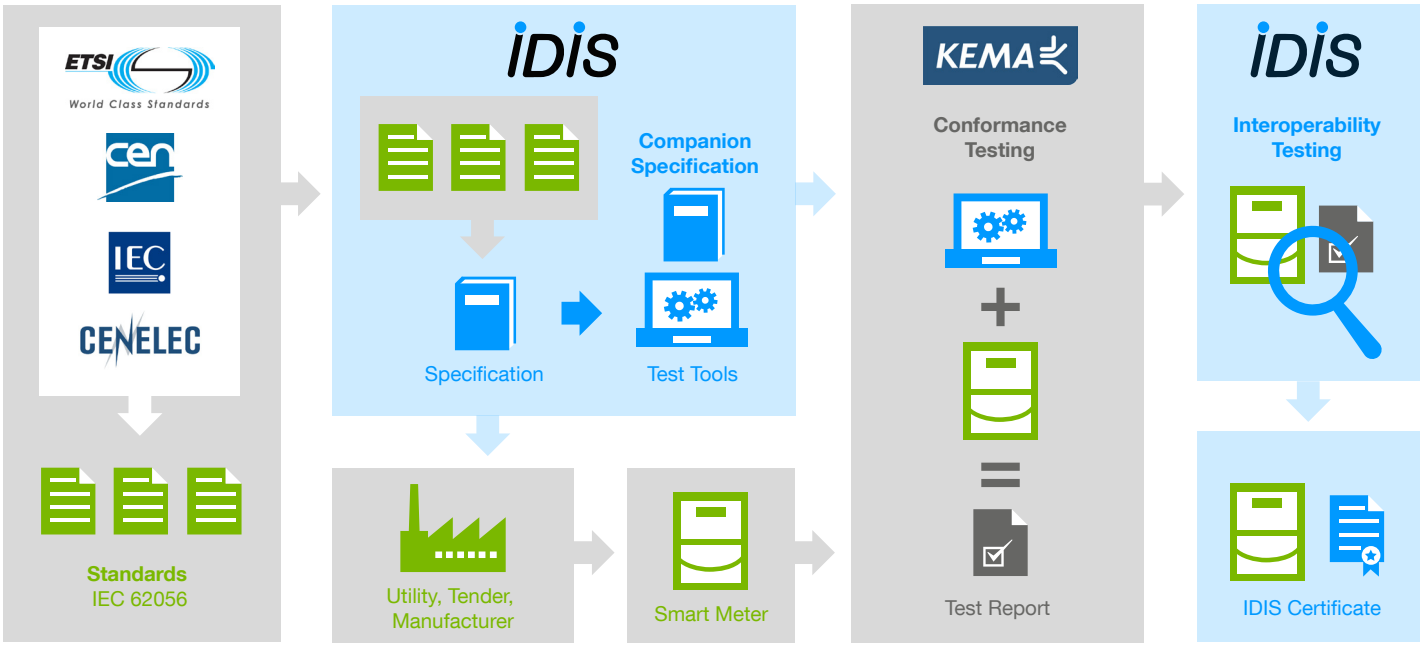
In addition to the IDIS companion specifications, the IDIS Association develops a set of tools for conformance testing according to the IDIS specifications. The test tools are licensed to independent test institutes (e.g. KEMA), which perform conformance testing. The tests are fully automated to ensure reproducible results that cannot be influenced by human interaction. The test institute issues the official test report only after a meter has passed more than a thousand test cases. Meters with a valid test report are accepted for a final interoperability test (FIT) performed by the IDIS Association during which the meter is plugged into a system consisting of a variety of certified IDIS equipment. The IDIS association will grant it the IDIS test label only after the meter has fulfilled all the test requirements. The test label contains a unique identification number and all the test reports are available for download on the IDIS website (http://www.idis-association.com/equipments.html). The IDIS Association provides complete process transparency for the users and the end-to-end solution providers of IDIS meters. Availability of the detailed conformance test reports and the possibility to request reproducible re-testing of the meters significantly simplifies the process of finding the root cause in case of incompatibility.

The entire process shown in Figure 3 is accessible for any party interested in interoperable smart metering equipment without any membership obligation towards the IDIS Association. IDIS members are only responsible for the maintenance of the companion specifications and the test tools. The consistency and market orientation of the specifications is ensured by restricting the IDIS membership to manufacturers who have proven their commitment to IDIS interoperability by producing a certified IDIS meter.

Interoperability in action

In Europe, besides the IDIS Association, there are two examples of very large utilities that have made a commitment to open standards and undertaken the investment in developing the companion specification as well as the testing environment for interoperable devices: Iberdrola in Spain and ERDF in France. In both projects, smart meters from several sources have been customized and tested according to the utility's own requirements.

Figure 3: IDIS process transparency from specification to certification

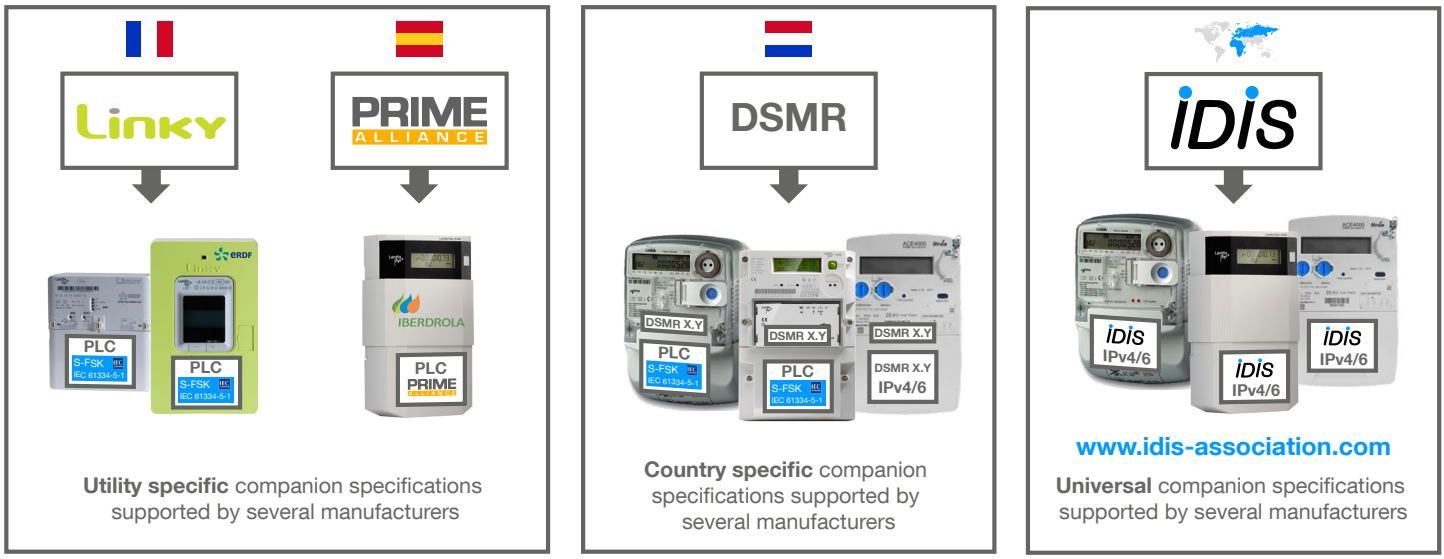


- ERDF launched the LINKY project in France and committed to the deployment of smart meters according to the existing IEC standards (i.e. IEC 62056 for the smart metering applications and the application layer and IEC 61334 for PLC). For this purpose, ERDF has issued the LINKY companion specifications describing how these standards are used and which options are chosen. In addition, ERDF has issued a specification for next-generation G3 PLC technology, which fits into the existing standardization framework and which may be considered for future upgrades, thereby ensuring backwards compatibility to the existing standards.
- The PRIME project launched by Iberdrola in Spain is based on the same upper- and medium-layer standards (IEC 62056), though it uses the PRIME OFDM PLC technology on the physical layer. PRIME technology is designed to fit into the existing standardization framework.

Both utilities are currently in the active phase of large-scale rollouts.

Another initiative to address the issue of interoperability of smart meters includes the utility association Netbeheer in the Netherlands with a companion specification DSMR customized to the needs of the Dutch market.
Figure 4 illustrates three alternative approaches to interoperability in Europe. All of these approaches are based on the DLMS/COSEM standards as the basis for their companion specifications. The IDIS approach is completely driven by manufacturers providing smart metering and smart grid equipment. The goal of the members of the IDIS Association is to increase the smart metering market by reducing the investment risks though interoperability. The functional level of the IDIS specification is designed to cover the use cases and regulatory requirements of the EMEA markets. At the communication level, media with the proven reliability record are supported, allowing the end-to-end solution providers to commit to a minimal performance level, which in turn serves the risk-avert utilities. At the same time, emerging new technologies are also included in the IDIS specification targeting utilities that are willing to invest into the latest technological developments.

Figure 4: Different approaches to interoperability



Summary

When embarking on a smart metering project, utilities can minimize technology investment risk by sourcing from a range of manufacturers offering independently tested, certified interoperable devices. Complying with open standards is a basic condition for the success of the project, but this compliance is not sufficient to achieve the desired interoperability. International standards leave room for further configuration to function within various architectures of EU member states. It is through initiatives such as IDIS that utilities which are not ready to make a substantial upfront investment in interoperability can still profit from interoperable products and thereby ensure that their investment in smart metering technology is future-proof and open for inevitable technological progress.

IDIS is the only open standards-based interoperability specification that is not customized for a specific market and that supports a variety of communication media. With the strict separation between the functional level and the communication level by an IP-based interface, the IDIS specification integrates the latest communication technologies. In order to provide tested interoperability at all levels, the IDIS Association is pursuing a close cooperation with the technology alliances that support the new communication media.

Today, 19 meters from five independent manufacturers have passed the IDIS certification process. A growing number of utilities base their tenders on IDIS, which allows them to avoid the time-consuming development of their own specifications and test environment that would come at great effort and expense to them. The IDIS specifications offer end-to-end solution providers an attractive, cost-efficient way to support meters from several manufacturers with minimal integration effort.

Figure 5: Comparison of different European companion specifications

Interoperability Level			IDIS Meter Specification	DSMR Meter Specification	PRIME Meter Specification	OMS Meter Specification
FUNCTIONALITY	Semantic	target-market utilities	EMEA E, G, H, W[1]	Netherlands E, G, H, W	Iberia E	Germany G, H, W, (E[2])
		standard	COSEM IEC 62056-6-2	COSEM IEC 62056-6-2	COSEM IEC 62056-6-2	M-Bus EN 13757 (IEC 62056-6-2)
	Syntactic		DLMS + security IEC 62056-5-3	DLMS + security IEC 62056-5-3	DLMS IEC 62056-5-3	M-Bus EN 13757
COMMUNICATIONS	Network		S-FSK profile IEC 62056-8-3 TCP, UDP IPv4, IPv6	S-FSK profile IEC 62056-8-3 TCP, UDP IPv4, IPv6	PRIME OFDM PLC ITU-T G.9904	M-Bus EN 13757
	Connectivity		S-FSK PLC IEC 61334-5-1 G3 OFDM PLC ITU-T G.9903 Ethernet, GPRS, UMTS, …	S-FSK PLC IEC 61334-5-1 G3 OFDM PLC ITU-T G.9903 Ethernet, GPRS, UMTS, …	PRIME OFDM PLC ITU-T G.9904	Wireless M-Bus EN 13757 Wired M-Bus EN 13757

[1] E: electricity; G: gas; W: water

[2] Theoretically, OMS can also support E-meters via DLMS/COSEM – however, this feature is rarely used in practice.

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About Landis+Gyr

A trusted name in energy management solutions, Landis+Gyr operates in 30 countries across five continents. Landis+Gyr ranks as the worldwide leader in electricity metering with a preeminent position in Advanced Metering Management. Its meters and solutions empower utilities and end-customers to improve their energy efficiency, reduce their energy costs and contribute to a sustainable use of resources. With a proven track record for more than a century, it's Landis+Gyr's primary goal to help utilities manage energy better.

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