European Smart Grids Task Force
Expert Group 1 – Standards and Interoperability

Interoperability, Standards and Functionalities applied in the large scale roll out of smart metering

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Report on a survey regarding Interoperability, Standards and Functionalities applied in the large scale roll out of smart metering in EU Member States

Smart Grids Task Force

Expert Group 1 – Standards and Interoperability

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Content

1. Scope

The Steering Committee of the Smart Grids Task Force decided in December 2014 to assess the current roll-out of smart metering systems in seventeen Member States with reference to i) their degree of interoperability with other components/operations of the energy system, meaning in practice the implementation of the M/490 standardised local interfaces (H1, H2 and H3); and ii) checking whether these smart metering set-ups are equipped with functionalities for the provision of energy management services, i.e. examine compliance with the EC recommended, and consumer-benefitting, functionalities (a), (b) and (f) (EC Recommendation 2012/148/EU).

To perform this work, an ad-hoc Expert Group (EG1, see Annex E) was set up in January 2015. A tailored questionnaire was sent in February to the seventeen Member States that decided for a national (in most cases only for electricity) roll-out of smart metering by 2020. EG1 embarked on this fact finding mission greatly relying upon expertise from the European Standardisation Organisations, and in particular the CEN-CENELEC-ETSI Smart Meter (M/441) and the Smart Grid (M/490) Coordination Groups.

The work has been focused on monitoring and analysing what functionalities, standards and interfaces are used in smart metering systems being rolled-out in Europe in order to deliver the desired functionality for consumer's benefit, connectivity and interoperability between the metering infrastructure and other network platforms in the energy market for encouraging consumer interest in energy saving and demand flexibility actions. The results of this investigation give a snapshot of current developments and provide useful information to those that are still in planning state.

In practice, the investigation concentrated on the following aspects:

I. **Deployment of specifically three smart metering functionalities – *(a), b), (f)* -** from the set of ten recommended (EC Recommendation 2012/148/EU) to secure benefits and contribute to increases in energy efficiency and demand response. These functionalities were chosen since they relate to the information, and its update frequency, made available to consumers (and any third party they designate) to help them modulate their energy demand in time and volume, access a wider range of tariffs, and be ultimately incentivized to actively participate in the energy market.

II. **Implementation of local interfaces** within the metering infrastructure **to support the delivery of these functionalities.** Such interfaces can be used for the smooth exchange of information and inter-working between the metering infrastructure and devices, components, processes, or other network platforms in the energy market. EG1 efforts focused on the interfaces identified in the smart grid/metering standardisation work, namely the two direct interfaces at home level and one at station level that could be used as communication pathways (see interfaces H1, H2 and H3 in Annex A).

III. **Available communication standards** chosen for the selected local interfaces, and possible **additional companion standards** developed reflecting the level of **interoperability (to be) reached on these interfaces.** In practice, this dictates the level of interoperability to be reached among the operator responsible for metering and the consumer or other participants in the energy market.

2. Introduction

Following the Directives 2009/72/EC and 2009/73/EC, at least 80% of electricity consumers shall be equipped with intelligent metering systems by 2020 where roll-out of smart meters is assessed positively; in the case of gas, no target is set and the roll-out has to be within reasonable time. Currently, a large number of EU Member States are already in the process of mass deployment of smart metering (the scope of the questionnaire – see Annex B - the response to which is herein discussed was large scale roll out).

With regards to smart metering systems, the European Commission promotes the use of appropriate standards and best practice to ensure energy management and information services focused on customers' needs. Furthermore, with the provisions in the above mentioned directives, Member States are required to ensure interoperability among the operators responsible for metering and other participants in the electricity system. (In Ref. 3 below, *interoperability* has been generally defined as *'the ability of two or more networks, systems, devices, applications or components to interwork, to exchange and use information in order to perform required functions.')*

The ten common minimum functionalities for smart metering systems recommended by the EC (Recommendation 2012/148/EU), and defined in principal for electricity metering, are in line with available and coming standards, and target the empowerment of the final customer. Of particular relevance are those functionalities that enable:

1. the provision of data to consumers at frequent enough intervals to support the provision of energy services:

    - *Functionality (a): Provide readings directly to the customer and any third party designated by the consumer.*

      This functionality is essential in a smart metering system, as direct consumer feedback is essential to ensure energy savings on the demand side. There is a significant consensus on provision of standardized interfaces which would enable energy management solutions in 'real time', such as home automation, and different demand response schemes and facilitate secure delivery of data directly to the customer. Accurate, user-friendly and timely readings provided directly from the interface of customer's choice to the customer and any third party designated by the consumer are strongly recommended since they are the key to running demand response services, taking 'online' energy-saving decisions and effective integration of distributed energy resources. In order to stimulate energy saving, Member States are strongly recommended to ensure that final customers using smart metering systems are equipped with a standardized interface which provides visualized individual consumption data to the consumer

    - *Functionality (b): Update the readings referred to in point (a) frequently enough to allow the information to be used to achieve energy savings.*

      This functionality relates purely to the demand side, namely the end customer. If consumers are to rely on the information provided by the system, they need to see the information responding to their action. The rate has to be adapted to the response time of the energy-consuming or energy-producing products. The general consensus is that an update rate of every 15 minutes is needed at least. Further developments and new energy services are likely to lead to faster communications. It is also recommended that the smart metering system should be able to store customer consumption data for a reasonable time in order to allow the customer and any third party designated by the consumer to consult and retrieve data on past consumption. This should make it possible to calculate costs related to consumption.

2. consumer participation particularly when coupled with advanced tariff schemes:

   - *Functionality (f): Support advanced tariff systems. This functionality relates to both the demand side and the supply side.*
     Smart metering systems should include advance tariff structures, time-of-use registers and remote tariff control. This should help consumers and network operators to achieve energy efficiencies and save costs by reducing the peaks in energy demand. This functionality, together with functionalities referred to in points (a) and (b), is a key driving force for empowering the consumer and for improving the energy efficiency of the supply system. It is strongly recommended that the smart metering system allows automatic transfer of information about advanced tariffs options to the final customers, e.g. via standardized interface mentioned under (a).

However, according to the outcome of the benchmarking study performed by the European Commission in 2014 (Ref. 4), only 50% of the Member States that decided for a full roll-out of electricity smart metering (in total 16[1] at that moment), have reported they will completely comply with the 10 recommended functionalities, while several seem to lack especially compliance with the functionalities (a), (b) or (f). If one or more of these functionalities are not present, some of the information which the consumers require to take educated decisions on their consumption may not be available.

Following a request from the Steering Committee of the Smart Grids Task Force to further analyze the situation, its Expert Group on standards and interoperability (EG1) was mobilized and drew on the expertise of the Smart Grid Coordination Group[2], for undertaking this investigation. The ad-hoc working group formed to this respect identified a list of available and coming technical standards for enabling the implementation of energy management services and focusing on consumers' needs. These should allow the development of solutions and systems to comply with the abovementioned functionalities via a local connection of a gateway or system with the smart meter installed at the customer's premises (see the diagram in Annex A where the relevant H interfaces are defined).

In order to analyze the actual use of these or other standards and solutions for that local interface, and the current or future compliance to the functionalities (a), (b) and (f), the EG1 decided to organize a survey among the (now 17[3]) EU Member States that decided positively for a full scale smart metering roll-out in their countries. It is noted that the survey covered the implementation of infrastructure for both gas and electricity metering. Therefore, even though the aforementioned functionalities are defined principally for electricity, the Member States were asked to provide their responses regarding these functionalities as applicable also for gas metering.

[1] Austria, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Poland, Romania, Spain, Sweden and Great Britain.
[2] The Smart Grid Coordination Group (SG-CG) had been jointly set up by the European standardization organizations CEN, CENELEC and ETSI for the mandate M/490; now renamed into Smart Energy Grid Coordination Group – SEG-CG.
[3] Latvia was added to the group of the sixteen Member States identified earlier as proceeding with a large-scale roll-out of electricity smart metering.

3. The process

As stated earlier, the Expert Group 1 (EG1) of the Smart Grid Task Force (see Annex E) was tasked by the Steering Committee of the Smart Grids Task Force to execute the survey mentioned above. An editorial Team was created under EG1 that prepared a Questionnaire (see Annex B) to be sent to the 17 selected Member States: Austria, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Luxembourg, Malta, the Netherlands, Poland, Romania, Spain, Sweden and Great Britain. All of these Member States replied to the questionnaire, but further investigations proved to be necessary to get the final, comprehensive answers on the questions posed.

The questionnaire was sent out in February 2015 and the first reactions were received until mid-May 2015. Additional information and clarifications were received on request by the end of May.

According to the planning, the findings from the survey were presented to the Steering Committee of the Smart Grid Task Force on 12 June 2015 and to a dedicated Workshop on 09 July 2015 addressed to all EU Member States' national smart metering representatives.

Annex C gives an overview of the answers received and annex D incorporates the full set of answered questionnaires.

This report summarises the main findings from the survey carried out in these Member States and presents the conclusions and a set of recommendations to the European Commission and Member States.

4. The results

All 17 Member States that were approached responded to the questionnaire. In most cases the answers were bundled into one set for the Member State. In the case of Spain and Poland individual answers were received from the responsible largest Distribution Network Operators (due to the fact that the DSOs are deploying different systems and thus different ways for implementing the functionalities).

The answers that could not be clarified are colored yellow in the overview (Annex C).

The questions that focus specifically on interoperability (5.1-5.10 in Annex B) were not always completely understood by Member States. Specific standards used are not always mentioned and additional specifications (profiles) are set only in a few cases (GB, NL, FR and IE more recently). Recommendations in section 7 will focus on this issue.

Some facts that can be concluded from the answers received from 17 Member States:

1. **Functionality (a): provide readings directly to the consumer and any third party designated by the consumer.** All 17 Member States indicate to have (or intend to have) functionality (a) implemented from the beginning, whereas Denmark, Italy, and Sweden will do so at a later stage (in the next planned roll-out).

2. **Functionality (b): update the readings referred to in functionality (a) frequently enough to allow the information to be used to achieve energy savings.** By 2020, 14 Member States will have

implemented functionality (b) with a refreshment rate of at least 15 min. 11 of these Member States, (AT, DK, FI, FR, GR, IE, LU, NL, PL, RO, GB) intend to roll-it out from the beginning of the deployment, and 3 Member States (IT, MT, SE) will do so at a later stage; for SE a time plan of 2017-2025 is announced, whereas for MT and IT the time plans are unknown. 3 Member States intend to implement or enable functionality (b) on consumer request (LV, EE, FI) and one Member State only partially and not throughout (ES, see chapter 5 and Annex D). 8 Member States confirmed to be able to provide near real-time information on electricity (GB, NL, FI, FR, PL, SE, LU, IE: every 10 seconds or "near real-time").

3. **Functionality (f): support advanced tariff systems.** Three countries (EE, RO, LV) will implement functionality (f) later. 5 Member States (AT, SE, DK, IE, FI) will not implement this functionality in the metering system; they indicate this can be done through a centralized system. IE allows for the aggregation of 30 minute interval data into consumption per tariff within Supplier systems - only the cumulative register is displayed on the meter. In circumstances where interval data collection is not possible, a standard ToU tariff register will be configured on the meter. The rest (FR, GR, IT, LU, MT, NL, PL, ES, GB) indicate that they have this functionality already, or they intend to roll-out from the beginning.

4. Interfaces H1, H2 and H3.

- Three countries (LV, EE, FI) will implement or enable one of the interfaces H1, H2 or H3 on consumer request. 4 (RO, IT, SE, MT) will implement later (timing not specified, some depending on DSO decision). 1 (DK) implemented an H interface in meters installed after 2011. 1 (ES) will not implement either one of the H interfaces, although 1 Spanish DSO indicates this will be done through a later upgrade of the meter (software), see note above. All others are already implementing at least 1 of the H interfaces.

- 7 (LV, EE, RO, IT, DK, ES, MT) indicate to make information currently available through a website instead of using one of the H interfaces (that might be implemented later or on consumer request).

- There are 10 countries (GB, EE, FR, GR, ES, PL, RO, IT, MT, IE) that indicate facing technical or regulatory barriers or challenges in implementing the functionalities and/or the H interfaces. Several indicate a technical (and maybe regulatory) problem with interferences on the electricity network between PLC signals and disturbances from other equipment[4]. As economic barrier, ES raised the concern that more interfaces might increase the price of the meter and to overcome this promote a more flexible approach.

- One country (PL) indicated that no decision has been taken yet to roll-out smart meters and that there is no common requirement specification agreed and used by the Polish DSOs in their pilot projects.

[4] IEC SC77 AWG8 is currently dealing with this issue. A questionnaire has been circulated among stake holders (utilities, manufacturers...) to assess the situation. As a result of this action, more information has been requested to the organizations that answered to the survey.

- Only 5 Member States (NL, FR, IE, DK and GB) defined additional specifications for interoperability on H1-3 and 6 (GB, NL, FR, GR, ES, LU) have testing procedures in place.
- All countries indicate that software is upgradable.

5. Short overview per country

Austria

In Austria, the regulator E-Control is responsible for 100% of the national smart meter rollout. Resulting from a running national survey on the smart meter implementation, functionalities and standards, updated information is expected by second half of 2015. The response of E-Control is summarized as follows:

- Will implement functionalities (a), (b) initially
- Functionality (f) is implemented but not necessarily on the meter but on website
- Information provisioning is free of charge
- Frequency of information provision: at least 15min.
- Implements interface H1. No information available on H1 standards
- Austrian regulator started a survey on the use of standards for interfaces H1, H2 and H3.
- A website will be available for the customers

Denmark

In Denmark, the Danish Energy Association (a commercial and professional organisation for Danish energy companies) provided feedback on behalf of the Danish DSO members who are responsible for 100% of the national smart meter rollout. The response of the Danish Energy Association is summarized as follows:

- Functionality (a) is partly implemented (only for meters after 2011)
- Information provisioning is free of charge
- Functionality (b) is implemented initially
- Frequency of information provision: 1hr or 15 min. (meters after 2011 15 min.)
- Functionality (f) implemented by using a central data hub
- Interfaces H1 and H2 defined, supporting functionality (a) and (b), for meters installed after 2011
- No specific standard has been chosen for interface H1, but open standards will be required.
- Additional definitions for H1: DLMS/COSEM data model will probably be used
- Standards for interface H2: open standards wired (RS-485) or wireless (wM-Bus), and DLMS.
- Technical issues: for H1 interface on old meters; no requirements for H2 and H3
- A web portal is available in some DSOs. Others have apps for mobile phones.

Estonia – Electricity

In Estonia, the Ministry of Economic Affairs and Communications provided consolidated feedback on information of 8 out of 36 national DSOs and TSO. Based on a 95% national smart meter rollout, the biggest DSO (Elektrilevi) covers 87,5%, the next two cover (VKG Elektrivorgud and Imatra Elekter) 2,8% each, 4th covers 1% and the remaining 32 DSOs cover under 1%. The response of the Ministry of Economic Affairs and Communications is summarized as follows:

- Will implement functionality (a) initially
- Implements interface H1 for information provision to consumers
- Frequency of information provision: 60 minutes (online, via data hub)
- Standard used for H1, H2 and H3: CEN/CENLEC/ETSI Standards and IEC/ISO standards

Finland – Electricity

In Finland, the Ministry of Employment and Economy (MEE), supported by the Finnish Energy Industries who gave technical recommendations for electricity meters already in 2007, is responsible for the national smart meter rollout. The rollout was already performed from 2007 – 2014 with a penetration reached between 97% and 100%. The response of MEE is summarized as follows:

- Implemented functionalities (a), (b) and (f) initially
- Implements interface H1 for information provision to consumers
- Frequency of information provision: fastest every 0.5 seconds
- Standard used for H1: EN 62053-31, EN 13757-2, EN 62056-7-5
- Additional profiles for H1: none

France – Electricity

In France, the General Directorate of Energy and Climate, together with the regulator Commission de régulation de l'énergie (CRE) and ERDF who is in charge of 95% of French electricity distribution networks, is responsible for 95% of the national electricity smart meter rollout. ERDF already worked on a pilot in 2010 for the implementation of new functionalities in 300000 meters, now implementing a plan to modernize its 35 million electricity meters nationwide. The response of the General Directorate of Energy and Climate is summarized as follows:

- Will implement functionalities (a), (b) and (f) initially
- Frequency of information provision: every 2 seconds
- Implements interface H1 for information provision to consumers
- Standard used for H1: IEC 62056-7-2
- Additional profiles for H1: TIC historical mode ERDF-NOI-CPT-02E

France - Gas

In France, the General Directorate of Energy and Climate is responsible for >95% of the national gas smart meter rollout. The response of the General Directorate of Energy and Climate is summarized as follows:

- Functionalities (a), (b) Implemented, initially
- Functionality (f) not implemented, in agreement with regulator
- Information provision is free of charge
- Frequency of information provision: some meters provide 15 min. interval data on website
- Implements interface H1 for information provision to consumers, initially.
- Standard used for H1: IEC/ISO standard
- Additional profiles: Consumption pulses are copied to H1 interface without transformation
- CEN TC294 EN 13757 are used for interoperability, conformance test done in lab. Environment

Greece - Electricity

In Greece, the DSO HEDNO is responsible for 100% of the national smart meter rollout which is performed in different stages:

i. Realised: all MV consumers (approx. 13000)
ii. Ongoing: Big LV consumers >55 kVA (approx. 60000 and 12000 PV producers)
iii. Pilot for residential planned (approx. 200000)
iv. Full roll-out after completion of the pilot project

The response of HEDNO is summarized as follows:

- Will implement functionalities (a), (b) and (f) initially
- Frequency of information provision: less than 30 seconds
- Implements interface H1 for information provision to consumers
- Standard used for H1: CEN/CENELEC/ETSI/IEC/ISO wireless or PLC standards, still to be selected
- Consumption information is also available through a website

Ireland – Electricity and Gas

In Ireland, the Commission for Energy Regulation (CER) is responsible for 100% of the national smart meter rollout. The response of CER is summarized as follows:

- Will implement functionalities (a), (b) and (f) initially
- Frequency of information provision: “near real time” (electricity); 30 minutes refresh for gas
- Implements interface H2 for information provision to consumers
- Standard used for H2: open standard solution, still to be selected
- Additional profiles for H2: “H2 home area network guide” will be published

Italy

In Italy, the DSO ENEL Distribuzione is responsible for approx. 85% of the national smart meter rollout, which is finished since 2006. The response of ENEL, verified by the regulatory authority, is summarized as follows:

- Will implement functionality (b) through an upgrade of the system
- Functionalities (a) and (f) implemented, initially (first generation, currently working)
- Information provisioning is free of charge (at the moment)
- Frequency of information provision: at least 10min. (limit is 3 min.)
- H2 interface will be implemented through an upgrade (already tested in pilot projects with good results in energy savings; Regulatory authority already issued a public consultation paper that envisages the market based approach for deploying the device with bi-directional interface H2 tested in pilot projects)
- Standards for interface H2: will connect to the meter by PLC and will provide a USB port (wired) or dongle (wireless)
- Information is also provided via website
- Second generation: regulator is in charge for defining functional requirements (d.lgs. 102/14, art.9 para.3); a public consultation is expected in the second half of 2015

Latvia- Electricity

In Latvia, the DSO Sadales Tikls AS is responsible for 100% of the national smart meter rollout. Sadales Tikls AS is leading DSO in Latvia and serves 99% of all Latvian electricity customers. The response of Sadales Tikls AS is summarized as follows:

- Will implement functionalities (a) initially and (b) only upon consumer request (the functionality is implemented and tested but only enabled on consumer request)
- Functionality (f) is implemented but limited to 4 tariff zones
- Local interfaces H1, H2 or H3 can be enabled upon consumer request. A third party service can be used by consumer to access local data.
- Implements DSO web portal for information provision to consumers (hourly load profile data, daily and monthly consumption and billing information)
- Frequency of information in the web portal: daily update (hourly load profile data).

Luxemburg

In Luxemburg, the Economic interest group of the 7 gas & electricity DSOs (Luxmetering G.I.E) provided feedback on behalf of the national DSO who are responsible national smart meter rollout. The Luxmetering project started beginning 2015 and is now in the design phase. The electricity and gas rollout is planned for July 2016. The response of the Luxmetering *G.I.E is summarized as follows:*

- Will implement functionalities (a), (b) and (f) initially
- Information provisioning through local port P1 will be free of charge
- Frequency of information provision: 2-10 sec (E); 15 minutes (G).
- Implements interface H1 and H2 in the same port P1
- Standards for interface H1: based on dutch standard DSMR 4.2.1 (based in IEC 62056-212)
- Additional definitions for H1: a companion for P1 will be elaborated.

Malta

In Malta, the DSO Enemalta is responsible for 100% of the national smart meter rollout, which is now at about 95% of the massive deployment. The response of Enemalta is summarized as follows:

- Will implement functionalities (a) through a web page and (b), later, through H2.
- Will implement functionality (f), initially
- Information provisioning is free of charge.
- Frequency of information provision: at least 10min is foreseen.
- H2 interface will be implemented later, after a previous test in a pilot project, now under study.
- Standards for interface H2: will connect to the meter by PLC and will provide a USB port (wired) or a wireless interface through a dongle (Wifi and ZigBee)

The Netherlands – Electricity and Gas

In the Netherlands, the combined Dutch DSO in branch association Netbeheer Nederland is responsible for 100% of the national smart meter rollout. The response of Netbeheer Nederland is summarized as follows:

- Will implement functionalities (a), (b) and (f) initially
- Frequency of information provision: 10 seconds for electricity meters, 60 minutes for gas meters. Next generation meters (deployed as of 2016) will have: every second for electricity meters and every 5 minutes for gas meters.
- Implements interface H1 for information provision to consumers
- Standard used for H1: EN 62056-21
- Additional profiles for H1: DSMR3.0/4.x/5.0 P1 Companion Standards

Poland

In Poland, the national rollout responsibility is mainly spilt across 5 biggest DSOs: TAURON Dystrybucja SA, PGE Dystrybucja SA, ENERGA-OPERATOR SA , ENEA Operator Sp. z o.o. and RWE Stoen Operator Sp z o.o. The response of the Polish DSOs is summarized as follows:

- No provisions have been adopted related to the roll out of smart meters yet
- DSOs are doing pilots for which CAPEX has been granted by the Regulator
- The common requirements for smart meters were published on the website of Polish Regulator but DSOs are not obliged to fulfil it
- No agreement on the requirements for communication standards for the meter has been concluded yet (different implementations in the pilots)
- As a result, there is no guaranteed interoperability within Poland.

Romania

In Romania, the Romanian Energy Regulatory Authority (ANRE) is responsible for 100% of the national smart meter rollout, with pilots of the national DSOs in 2015 which are now under development. The

specific implementation of technical solutions will be decided after testing the results of the pilots. The response of ANRE is summarized as follows:

- Will implement functionalities (a), (b) initially
- Will implement functionality (f) via later upgrades
- Information regarding the consumption is available for the consumer free of charge. The dedicated smart system functionalities are available for consumers. Ensuring the data transfer from the system or from the meter is subject to the services (internet access, phone app) provided by the suppliers.
- Frequency of information provision: 15-60 min.
- Most DSOs will implement functionality (a) through a web portal
- Some DSOs will implement functionality b) through a H2 local interface

Spain – Electricity

In Spain billing will be based in hourly consumption measurement and real market (hourly) price, so consumer will be empowered to manage his demand and pay a real production market price. The response of the Spanish DSOs is summarized as follows:

- Will implement functionalities (a) and (f) initially
- One Spanish DSO claims that has implemented functionality (b) without complying to the update frequency of at least every 15 minutes and another indicates that it is under development (see note in results, chapter 3).
- One DSO will implement interface H2 (through PLC) in a later stage
- Frequency of information provision: daily (*)
- Implements web portal for information provision to consumers 24 hours later.

(*) One Spanish DSO indicates that consumers can request an update of meter data through the web portal with average response time of 20 seconds.

Sweden

In Sweden, the Swedish Energy Markets Inspectorate implemented regulations leading to the smart meter roll-out. The DSOs are 100% responsible for the actual roll-out. Parts of the response are relating to the second generation of smart meters suggested to be rolled out between 2017 and 2025. The response of the Swedish Energy Markets inspectorate is summarized as follows:

- Functionalities (a),(b),(f) not implemented; are recommended for the roll out of the second generation smart meters (2017-2025)
- Functionality (f) should not necessarily be provided through the metering system
- Information provisioning is free of charge
- Frequency of information provision: near real time (seconds)
- H1, H2, H3 in second generation but not defined yet

UK- Great Britain – Electricity and Gas

In the United Kingdom, the governmental Department of Energy and Climate Change (DECC) is responsible for setting the regulatory framework for 100% of the national smart meter rollout in Great Britain (i.e. not including Northern Ireland where responsibility for energy markets lies with the Northern Ireland Executive's Department for Enterprise, Trade and Investment). Energy suppliers are responsible for the installation and on-going maintenance of smart meters in GB. The response of DECC is summarized as follows:

- Will implement functionalities (a), (b) and (f) initially, at the start of the deployment
- Frequency of information provision: 10 seconds for electricity meters and 30 minutes for gas meters
- Implements interface H2 for information provision to consumers
- Standards used for H2 (SMHAN[5]): prEN 16838 (ZigBee),
- Standards used for H2 (WAN[6]): EN 62056 (DLMS/COSEM); ASN1; prEN 16838 (ZigBee)
- Additional implementation details for the standards used for H2 are set out in the GB Companion Specification V0.8.1

6. Conclusions

The conclusions that can be drawn from the answers received are the following:

1. **Functionalities**

- Compared with the Commission's benchmarking study (data collection in 2013[7]) more Member States implement or plan to implement functionalities (a) and (b), therefore progress has been made. All 17 Member States that responded implement functionality (a), with three (DK, IT, SE) of them indicating to do so in the next planned roll-out. 3 (LV, EE, ES) out of 17 Member States (18%) do not implement functionality (b) as it was specified by the Commission in its Recommendation (with at least 15 minute update frequency). 2 of them (LV, EE) will do so on consumer request.

- The 3 Member States currently not implementing functionality (b) represent approximately 30 million[8] (15%) from the approximately 200 million meters to be installed in the EU by the Member States by 2020.

- Five Member States (AT, SE, DK, IE, FI) will not use the smart metering system to implement functionality (f). In these cases it is important to understand if consumers will be able to check their consumption per tariff zone on the meter, if tariff zones are used for billing. IE indicated that

[5] Smart Metering Home Area Network
[6] Wide Area Network
[7] COM(2014) 356 and supporting SWD(2014) 188, SWD(2014) 189
[8] source SWD(2014) 189 and Bergh Insight

this is not possible on the meter in majority of the cases (where central ToU calculation is possible).

2. Interfaces and interoperability

- Only one Member State (ES) will (partly) not use the H interfaces. Others will implement these interfaces initially, later or on consumer request, and the majority intends to roll-out interface H1
- 7 Member States (DK, EE, ES, LV, IT, MT, RO) indicated that they currently use a web-portal as an alternative or complementary to the H1, H2, H3 interfaces although these interfaces might be implemented later or on consumer request. Further work is required to understand any impact of using a web interface instead of the direct interfaces on the provision of information to consumers, especially with regard to the availability of real time consumption information.
- The main barriers identified are:

  i. Interference between PLC signals and disturbances generated by electrical equipment (such as Power Convertors) on the electricity network (see also the footnote 4 on page 7).
  ii. The responsibility for implementation of the H interfaces and related investment not, or not clearly, defined
  iii. Legacy systems: some Member States started their roll-out at a time that solid European standards for the H interfaces were not available. A mandatory implementation of new standards without a sufficiently long transition period would lead to high cost and stranded investments. FI and PL identified this as a challenge.

- A majority of Member States did not make additional definitions for improving interoperability on the H interfaces. That leads to the conclusion that more attention should be drawn to the approach of reaching interoperability on various layers through profiles / companion standards.
- In the references made to standards for the H interfaces, the CENELEC TC205 standards (EN 50491-11 and -12) are never mentioned. Since they deal with data definitions, there is a risk that the data and its format provided by the AMI is not aligned with the data and formats required by in-home energy management systems (the CEM in the architecture diagram in Annex A).

7. Recommendations

Based on the conclusions above, the following recommendations have been developed:

- The results from this survey show another outcome, an evolution, since the Commission's benchmarking study in 2014. Therefore, the progress in roll-out regarding the common minimum recommended functionalities and H interfaces should be measured and reported in a new benchmark in 2017. The Commission services are herein recommended to follow this up.

- For Member States that do not intend to implement functionality (b), an Impact Assessment should be performed for having functionality (b), and even adopting the full set of the recommended common minimum functionalities (2012/148/EU) and putting in place the required interfaces.

- In case the smart metering system is not used to implement functionality (f), it must be clear how consumers can check their consumption per tariff locally.

- A majority of Members States did not produce additional specifications or profiles to improve interoperability. Since various smart meter roll-outs still have to start and, reaching interoperability requires certain measures to be taken (see Annex F), any interoperability issues that arise should be registered. The CEN-CLC-ETSI Smart Meter Coordination Group will investigate whether a procedure for this registration with feedback into European standardization and affected user groups could be envisaged.

- Those Member States that did not define profiles / companion standards yet should be supported with explanation and examples. Annex F of this report contains a short explanation about the way to reach interoperability. Member States are also encouraged to consult accompanying specifications that have already been issued and made publicly available by others.

- Since no references have been made to the CENELEC TC205 standards for the H-interfaces, the alignment between data definitions on the side of the CEM (Customer Energy Manager) and on the side of the AMI (Advanced Metering Infrastructure) should be checked: is the data provided by the AMI in line with the data needed for in-home energy management. This should be done on two levels:

    - At European level, alignment of the data formats by mapping the standards referred to for the H interfaces with e.g. the TC205 standards. This can be an action for the CEN-CENELEC-ETSI Smart Meters Coordination Group where all responsible Technical Committees are represented.

    - Also at European level, it is recommended to analyse the required functionality for the architecture used for management of flexible demand (see Annex A), evaluate current standards and the conditions for testing/certification of the interfaces.

    - At national level, alignment of the data formats provided by the AMI and required for in-home energy management.

  If deficiencies are identified, they need to be rectified. Appropriate measures must be proposed to guarantee interoperability on the information/data layer with the commercial channel in order to enable the development and provision of consumer-benefitting services and products.

- In addition to the recommendations above that are based on the survey results, it is recommended that consumers have: i) easy access to consumption information; ii) solutions "behind the meter" to present or process the "near real time" feedback on current usage; and iii) accurate billing and privacy and security of information. Action is also required to achieve the other desired consumer outcomes from smart metering by:

    - Enabling all consumers to realize benefits from smart meters

    - Ensuring that consumers have a high level of satisfaction with their experience of smart metering deployment

    - Encouraging consumers to be actively engaged with the smart energy market

The key elements for each of these desired outcomes need to be defined in order to ensure that smart metering roll-out is a success for consumers, so that appropriate measures and metrics can be established at European level to gauge progress and identify shortcomings at national level.

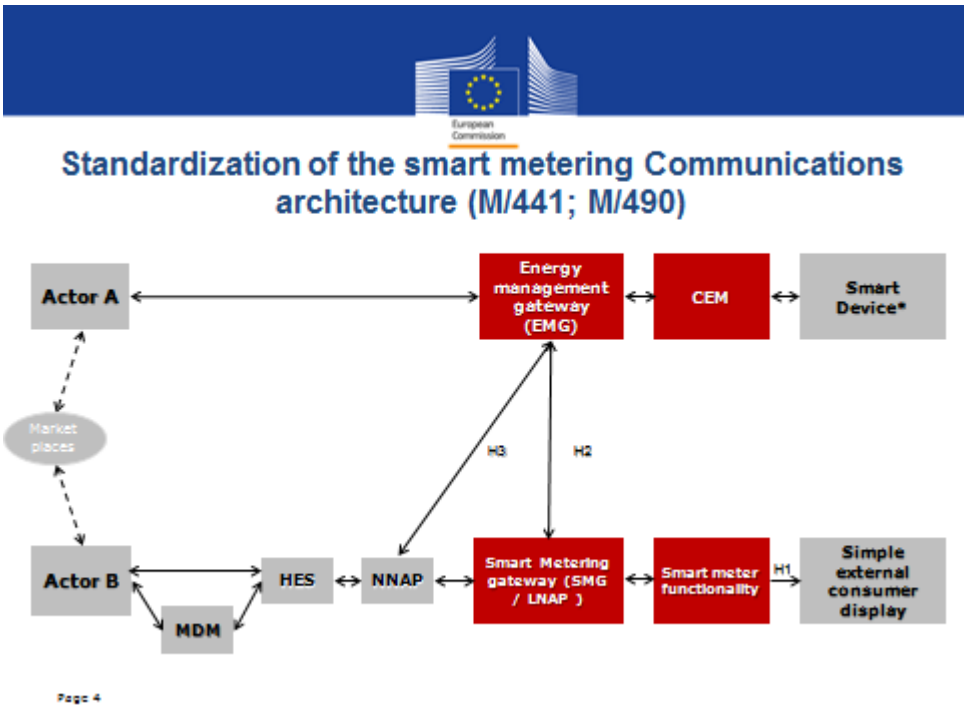
8. References

The following documents help explain the focus and background to this survey and clarify the terminology used in the questionnaire:

1. Smart Meters Coordination Group report CEN-CLC-ETSI TR50572: " Functional reference architecture for communications in smart metering systems" ftp://ftp.cen.eu/cen/Sectors/List/Measurement/Smartmeters/CENCLCETSI_TR50572.pdf
2. 2012/148/EU: Commission Recommendation on preparations for the roll out of smart metering systems *http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=G0D3JTGb413ZDy0Xq3gfj4crJrk8m97yvJGTLSTgvZk3tfZj3ypY!537741541?uri=CELEX:32012H0148*
3. Smart Grid Coordination Group report "Smart Grid Interoperability" *ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Interoperability_Report.pdf*
4. Report from the Commission: Benchmarking Smart Metering Deployment in the EU-27 with a focus on electricity
    - Commission Report (COM(2014) 356) *http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1403084595595&uri=COM:2014:356:FIN*
    - Country fiches (SWD(2014) 188) *http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1403084595595&uri=SWD:2014:188:FIN%20*
    - Cost-benefit data analysis (SWD(2014) 189) *http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1403084595595&uri=SWD:2014:189:FIN%20*

5. Interoperability Tool (IOP-Tool) of CEN-CENELEC-ETSI WG Interoperabilityftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Interoperability_IOPtool.xlsx

Annex A - Communications architecture (M/441; M/490)



- *Actor B is the one responsible for collecting meter data for regulated business processes.*
- *Actor A is a commercial party offering energy services to consumers*
- *The red boxes and grey ones on the right are located inside consumers' premises*
- *H1 is a simple uni-directional interface on the meter at customer premises for interconnection of for example a home display with a high refreshment rate*
- *H2 and H3 are bi-directional, more intelligent interfaces with the meter or NNAP. Might be included as an internal function of the meter or data concentrator, or in a modem, communication hub or gateway separate from the meter.*
- *MDM: Meter Data Management: collection, storage and validation of metering data before it is processed by actor B and sent to a market party (actor A) Where in the answers to the questionnaire is referred to websites, enabling customers to view their metering data and to give their consent on distributing this to a market party, it relates to a portal on this MDM*
- *LNAP = Local Network Access Point, it provides access to devices or information in an in-home/building communication network. Might be included as an internal function of the meter*
- *NNAP = Neighborhood Network Access Point, it provides access to multiple premises connected to a neighborhood network. A Data Concentrator is an example of a NNAP*

Annex B - Questionnaire

Identification

A. Member State: **[Member State]**
B. Organization (who filled in this questionnaire):
- Name: [**…..]**
- Contact person ,who filled in or is related to the answers on this questionnaire, who can be contacted in case of questions: **[Name / email address/ telephone number]**
- Type: **[DSO, branch association, regulator, etc., including name]**

C. If you are only partly responsible for the definition of requirements for the smart metering functionalities, interfaces and standards, please clarify for which parts or geographical area: **[clarification]**
D. If you are (partly) responsible for the roll-out of Smart Meters in your country, please indicate for which part of the national roll-out that will be**: [x%]**

Where appropriate and in case there are differences, please answer the questions below separately for gas and electricity.

Functionalities

Where there are functional differences (related to functionalities (a), (b) or (f)) in a roll-out already (partly) realised, please specify the stages in the roll-out and quantities of meters per stage and answer the questions below per stage.

1. Is functionality (a) (as described in the minimum functionalities in the Commission Recommendation (2012/148/EU)) implemented?
   [Yes/ No, comments and argumentation]

1.1 Is this implemented in the initial implementation, through later upgrades or a next roll-out (please include planning)?
[Initial, later upgrades, next roll out + planning]

1.2 Will the information provided to the consumer be free of charge? **[Yes/No]**

2. Is functionality (b) (as described in the minimum functionalities in the Commission Recommendation (2012/148/EU)) implemented?
   [Yes/ No, comments and argumentation]

2.1 Is this implemented in the initial implementation, through later upgrades or a next roll-out (please include planning)?
[Initial, later upgrades, next roll out + planning]

2.2 What is the frequency of the information provision to consumers? [every x seconds/minutes]. Can this frequency be changed? [Yes/No]. If yes what are the limits? [x-y seconds/minutes].

3. Is functionality (f) (as described in the minimum functionalities in the Commission Recommendation (2012/148/EU)) implemented?
[Yes/ No, comments and argumentation]

3.1 Is this implemented in the initial implementation, through later upgrades or a next roll-out (please include planning)?
[Initial, later upgrades, next roll out + planning]

4. What local interfaces within the metering infrastructure (see diagram: H1, H2, H3) are implemented for functionalities a) and b)?
Please cross the cells in the following table

Interface Functionality	H1	H2	H3	Other
a)				
b)				

4.1 Is H1 implemented in the initial implementation, through later upgrades or a next roll-out (please include planning)?
[Initial], later upgrades, new roll-out + planning]

4.2 Is H2 implemented in the initial implementation, through later upgrades or a next roll-out (please include planning)?
[Initial], later upgrades, new roll-out + planning]

4.3 Is H3 implemented in the initial implementation, through later upgrades or a next roll-out (please include planning)?
[Initial], later upgrades, new roll-out + planning]

4.4 Are other interfaces implemented in relation to the functionalities for consumer information provision a), b) in the initial implementation or through later upgrades? **[Provide descriptions of these interfaces: what information, what channel, what time resolution, what refresh rate, whether planned initially or through later upgrades. Clarify if possible with a diagram related to the one in Annex A]**

4.5 Are there any technical, legal and regulatory challenges or barriers related to the implementation of the local H1, H2 or H3 or alternative interfaces? **[yes/no]**
If yes, how is solving of these challenges or barriers foreseen?
[open answer]

Interoperability H1, H2, H3, and other interfaces

5.1 What physical interface and communication standards are or will be used on the H1 interface? **[CENCENELEC/ETSI standards/ IEC/ISO standards/others (to be clarified)]**[**Also specify specific versions and additions that are implemented].**

5.2 What additional definitions (e.g. profiles / companion standards) are made in order to ensure interoperability on the H1 interface? Please provide a copy of related documents**. [open answer]**

5.3What physical interface and communication standards are or will be used on the H2 interface? **[CENCENELEC/ETSI standards/ IEC/ISO standards/others (to be clarified)]**[**Also specify specific versions and additions that are implemented].**

5.4 What additional definitions (e.g. profiles / companion standards) are made in order to ensure interoperability on the H2 interface? Please provide a copy of related documents**. [open answer]**

5.5 What physical interface and communication standards are or will be used on the H3 interface? **[CENCENELEC/ETSI standards/ IEC/ISO standards/others (to be clarified)]**[**Also specify specific versions and additions that are implemented].**

5.6 What additional definitions (e.g. profiles / companion standards) are made in order to ensure interoperability on the H3 interface? Please provide a copy of related documents**. [open answer]**

5.7 What physical interface and communication standards are or will be used on any alternative interfaces in relation to functionalities a), b) or f) (if applicable)? **[CENCENELEC/ETSI standards/ IEC/ISO standards/others (to be clarified)]**[**Also specify specific versions and additions that are implemented].**

5.8 What additional definitions (e.g. profiles / companion standards) are made in order to ensure interoperability on the alternative interfaces (if applicable). Please provide a copy of related documents**. [open answer]**

5.9 Is the infrastructure upgradable in order to cover new consumer-related functionalities in the future? [yes/no] Please explain what elements of the infrastructure are upgradable (hardware and software)

5.10 What measures are planned to ensure that interoperability is achieved and maintained? (think of interoperability and conformance testing) [open answer].

Annex C – Answers from the Member States (overview)

See separate table (excel)

Annex D – Detailed responses from the Member States (answered questionnaires)

See separate document

Annex E – Expert Group 1 – Interoperability Group

List of participants

Name	Organisation
Manuel Sánchez (EG1 chair)	European Commission- DG ENER
Constantina Filiou (ET)	
Kai Tullius	
Henrik Dam	
Ulrike Nuscheler	
Patricia Arsene (ET)	European Commission – DG CNECT
Daniel Hanekuyk	European Commission DG GROW
Neil Avery	ANEC
John Ketchell (alternate)	
Peter Hermans (ET)	Stedin for CEDEC
Steven Frère	Eandis for EDSO
Manuel Jesus de Tellechea (ET)	ENDESA for Eurelectric
Willem Strabbing (ET)	ESMIG
Enrique García	Iberdrola for EUTC
Jos Dehaeseleer	ORES for MARCOGAZ
Aitor Amezua	Ormazabal for T&D Europe
Antonio Tortolero	Schneider Electric for Orgalime
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Joerg Seiffert (ET)	Eon/CENELEC
David Johnson	CEN
Thomas Willson	ECOS
Peter Claes	VP of IFIEC Europe

(ET): Editorial Team

Annex F - How to reach interoperability

End of 2014, the WG Interoperability (WGI) of CEN-CENELEC-ETSI published their final report on methodologies and definitions to facilitate smart grid interoperability as deliverable of M/490 [Ref. 3]. This Annex summarizes the process of how to reach interoperability that is defined in more detail in the WGI final report.

The selection of official (de-jure) open standards, additional definition of profiles and finally testing of the implementation are key elements in this process.

In general, interoperability can be reached by following the steps below:

a) Functional analysis and use case creation

Interoperability can generally exist on different layers of a smart metering system:

- Physical layer which is the hardware to connect systems or devices such as coax or power cables
- Communication layer which describes the communication technology (e.g. PLC or Ethernet) and the transport (e.g. TCP/IP)
- Information layer detailing the data model to ensure that devices are speaking the "same language"
- Functional layer specifying the functions and related interactions to be implemented

Full interoperability can only exist if all layers are interoperable. The process of reaching interoperability therefore starts with the last bullet: defining the functionality of information exchange. In other words: what data will be exchanged and how. The development of Use Cases is a good practice to define the functionalities. These Use Cases describe the information exchange in steps of transactions between components of the metering system.

To support this part of the process in a standardized way (e.g. by the creation of use cases), the methodology according to IEC 62559-2 can be used. The Smart Meter Coordination Group (SM-CG) has defined example Smart Metering Use Cases using IEC 62559-2 as a part of its work under the M441 mandate.

b) Standards and specification selection

Based on the functional analysis and use case creation, the architecture showing the interfaces between components of the smart metering system is the basis for the selection of the appropriate standard(s) and specification(s). The functional architecture shown in Annex A is an example, and the SM-CG developed a reference architecture specifically for smart metering, see Reference 1.

Standards are available that cover the physical layer, communication layer and information layer mentioned above. Generally these standards are specified in separate documents belonging to a suite of standards.

The selection of appropriate standards for any layers and individual interfaces (also for H1, H2 and H3) can be supported by the SM-CG overview of standards [Ref. 1] and the "IOP Tool" of WGI which can be accessed under:

ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Interoperability_IOPtool.xlsx

c) Profiling based on standards and specifications as identified above

An interoperability profile is a document that describes how standards or specifications are deployed to support the requirements of a particular application or function. This means that on top of the selection of a communication standard such as EN 52056 and EN 62056 (in step b) an additional specification has to be developed. In general, standards cover a broad spectrum of functionalities that not all have to be implemented. Furthermore they contain options that have to be further detailed. This implies that, additional definitions will have to be made that describe the way a standard will be used, and fixes the options. These additional definitions are called "interoperability profiles", namely BAP[1] and BAIOP[2]:

d) Testing

Testing is one of the most important phases to reach interoperability. Although many other types of tests exist, the two main types of testing to demonstrate interoperability are conformance testing and interoperability testing.

An important condition in achieving smart meter interoperability is the correct implementation of the standards and specifications. This can be verified by conformance testing: the concerning system/component is tested against , a test tool or reference implementation of the standard. This is likely to be the most common type of testing program. Conformance testing is also a prerequisite for interoperability testing. This test also verifies what part of the standard is implemented if it is not a full scope implementation.

Interoperability testing should be performed to verify that devices within a system are interoperable, i.e. they are able to exchange information according to the defined functionalities (Use Cases). During interoperability testing, devices are tested together with other components of the total architecture known to be correct (according to BAIOP). It is significantly different from conformance testing because it is possible for two devices that individually comply to a standard (resulting is a positive conformance test) to be still unable to interoperate. This situation can arise for example when devices have implemented different or conflicting options or cover a different part of the standard(s).

Notes:

[1]A Basic Application Profile (BAP) is an interpretation of relevant parts of the applicable standards and specifications and is intended to be used as building blocks for interoperable specifications, e.g. by specifying the requirements the different layers as described under a). BAPs must not have options, all selected criteria are mandatory to achieve interoperability.

[2]To reach interoperability a BAP has to be extended for interoperability testing which is called a Basic Application Interoperability Profile (BAIOP), including the detailed setup to test the individual technical requirements of a BAP.