CEN reference: BT N 8590
CENELEC reference: BT138/DG8362/INF

CEN/CENELEC/ETSI SMCG

Date: 2011-02

TC WI

CEN/CENELEC/ETSI SMCG

Secretariat:CCMC

Functional reference architecture for smart metering systems (V0.4.3)

ICS:

Descriptors:

Document type: Technical Report
Document subtype:
Document stage: Working Document
Document language: E

H:\138 BT\March 2011\SMCG\N_8590_CV_Annex1.doc STD Version 2.4a

Foreword

This document (prTR 50XXX) has been prepared by the CEN/CENELEC/ETSI "Smart Meters Coordination Group", the secretariat of which is held by the CEN-CENELEC Management Centre (CCMC).

This document is a working document and is currently sent to BT for comments.

Contents

Page

Introduction

This Technical Report was prepared by the Smart Metering Co-ordination Group (SM-CG). The text of the draft was submitted for approval by correspondence in accordance with the CEN/CENELEC Internal Regulations Part 2 Sub-clause 11.4.3.3 (simple majority) and was approved by CEN and CENELEC as CLC/TR 50XXX on [date] and endorsed by ETSI on [date] during its Board Meeting #xx on [date] with document Bxx(11)xx].

The Technical Report identifies the main possible functional communications implementations relevant for smart metering systems and the standards relevant to meeting the requirements of mandate M/441, in particular to assist the active participation of consumers in the energy markets.

Section 1 sets out the scope of this Technical Report.

Section 2 gives the legislative framework and lists the references underpinning the smart metering work more generally. Section 3 provides relevant extracts from the glossary of commonly used terms developed to support the M/441 mandate work.

For the benefit of stakeholders including the European Commission, Section 4 then sets the standardization work on communications in the context of the overall approach to the M/441 mandate, with particular reference to the link between smart metering and smart grids.

Section 5 considers data privacy / data security

Section 6 ('Architecture') presents a functional reference architecture for smart metering systems, identifying the functional entities and interfaces that the communications standards should address. Section 7 gives a general overview of the co-ordination between the ESOs for each of the specified interfaces.

Section 8 ('Currently available communications standards and further standardization') provides a table setting out current and future communications standards which are considered to be relevant for smart metering in Europe.

The table shows the most relevant current standards together with the communications standards to be developed in the course of the mandate and the ESO technical committee responsible for co-ordinating the standardization work. It also identifies the smart metering interfaces addressed by the standards noted. The table is not meant to be an exhaustive list of standards; other alternative standards will be considered in the future and could be determined to be acceptable standards as well.

Section 9 ('Interoperability & conformance') considers the nature of interoperability required under M/441 and responsibilities for conformance testing.

Annexes are included, to assist understanding of the use cases envisaged and terms used, give examples of practical implementations of the architecture described and to identify relevant product standards.

1 Scope

This [draft] Technical Report is focused on the following communications deliverable within M/441:

> *A European standard comprising a software and hardware open architecture for utility meters that supports secure bidirectional communication upstream and downstream through standardized interfaces and data exchange formats and allows advanced information and management and control systems for consumers and service suppliers.*
>
> *The architecture must be scalable to support from the simplest to the most complex applications.*

Furthermore, the architecture must consider current relevant communications media and be adaptable for future communication media.

The communication standard of the open architecture must allow the secure interfacing for data exchanges with the protected metrological block.

Since no single standard can cover all aspects for the full application range of smart metering systems, the deliverable takes the form of this Technical Report.

The Technical Report is the second document produced by the Smart Metering Co-ordination Group following acceptance of the Mandate 441 (M/441). The first - a response to the mandate - was issued in December 2009 and provided an overview of the current and future standardization activities, considering both the communications and the additional functionalities of smart meters.

Once the standardization activity undertaken in response to Mandate M/441 is complete for both the communications and additional functionality aspects, a final report will be produced providing a list of the finalised standards in both these areas

2 Legislative framework

2.1 Directives

The Energy Services Directive (2006/32/EC) and the recently adopted electricity and gas directives (2009/72/EC and 2009/73/EC) are important elements in the background to the M/441 mandate.

For electricity, the directive requires the implementation of *'intelligent metering systems that shall assist the active participation of consumers in the … market'.* Such systems must be in place for 80% of electricity consumers by the end of 2020 (unless an economic assessment shows that a lower figure is appropriate).

For gas, there may be an economic assessment of such metering systems (by September 2012) but there is no specific target date by which they have to be installed, although as subsequently indicated, this should be achieved within a reasonable period of time.

The number of electricity and gas meters potentially required to be replaced over the coming decade makes this standardization work urgent.

In the water sector, smart metering may contribute to meeting the goals of the Water Framework Directive (2000/60/EC), by allowing better control of water uses by consumers. It may also help implementation of the action plan being currently finalized against water scarcity and the impact of droughts, notably regarding "water performances of buildings".

2.2 Metrological considerations

The Measuring Instruments Directive 2004/22/EC (MID) covers the essential (metrological) requirements of meters and is currently being reviewed in the context of the adoption of the New Legislative Framework 765/2008/EC. The European Commission is now in the process of preparing a report on the implementation of the MID, which has to be with the European Parliament and Council before 30th April 2011. See: http://ec.europa.eu/enterprise/sectors/legal-metrology-and-prepack/public-consultation/index_en.htm

Smart meter standardization undertaken in response to Mandate 441 (M/441) deals with additional functionalities not of a metrological nature which are not prohibited by the MID provided they do not affect the metrology required by the MID[1] . The resulting smart meter standards will thus complement the standards harmonized under the MID.

Consideration should be given at the design stage of any smart metering system to such functions as real-time clocks or tariff schedule registers which may need to be synchronized through external communication. This is to ensure that the metrological characteristics of the meter are not influenced in any inadmissible way by the connection to it of another device, by any feature of the connected device itself or by any remote device that communicates with the meter.

WELMEC has produced Guidelines which set out recommendations for the software used in or connected to the metrologically protected part of measuring instruments and its communications interface(s). The standards to be developed under M/441 should consider these recommendations, in particular concerning the functional requirement of upgrading software / firmware and specific provisions regarding the downloading of legally relevant and non-legally relevant software. Care should be taken at the design stage to ensure that any software / firmware upgrade process does not influence those parts of the meter that are under the control of the MID.

2.3 References

- Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC
- Directive 2009/72/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity
- Directive 2009/73/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy
- Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on Measuring Instruments
- Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data
- Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector
- Directive 2006/24/EC of the European Parliament and of the Council of 15 March 2006 on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks and amending Directive 2002/58/EC

3 Commonly used terms

Many terms used in this document are explained in the standalone glossary of terms commonly used in smart metering, appended to this report. Relevant extracts are given below. In this document, these are marked in *cursive* letters when they first appear.

[1] Member States must allow all instruments that conform with the directive to be placed on the market and put into use on their territory (Art. 8 MID).

Note: The glossary does not supersede more detailed definitions used or to be developed by ESOs.

3.1
Additional functionality
Function that a smart metering system provides over and above the metrological functions covered by the Measuring Instruments Directive.

3.2
Architecture
Structure and behaviour of the technology infrastructure of an enterprise, solution or system.
Note 1: functional architecture can be viewed as the set of basic information processing capabilities available to an information processing system.
Note 2: software architecture of a program or computing system is the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships between them.
Note 3: hardware architecture refers to the identification of a system's physical components and their interrelationships.

3.3
Advanced Metering Infrastructure (AMI)
Infrastructure which allows two way communications between the Head-End System and the meter(s) and may be linked to other in-house devices.

3.4
Automated Meter Management (AMM)
Also called Advanced Metering Management. Refers to smart metering actions requiring communication, for example, remote actions. AMM directly incorporates additional functionalities beyond AMR

3.5
Automatic Meter Reading (AMR)
Technology for remotely obtaining metering data from an on-site meter by communication from an access point outside the premises.
AMR technologies include handheld, mobile or fixed network technologies based on telephony platforms (wired and wireless), radio frequency (RF), or Power Line Carrier (PLC)

3.6
(Data) Concentrator
Intelligent station in a hierarchical communications network where incoming data (generated by multiple meters) is processed as appropriate and then repackaged, relayed, retransmitted, discarded, responded to, consolidated, prioritized and / or increased to multiple messages.

3.7
Conformance
Fulfilment of a product, process or service of specified requirements

3.8
Consumer
End user of electricity, gas, water or heat.
Note 1: The Meter Data Collector (and when applicable also his supplier) may communicate with the consumer through the *AMI*.
Note 2: As the consumer can also generate energy using a Distributed Energy Resource, he is sometimes called the "Prosumer".

3.9
Companion Specification for Energy Metering (COSEM)
Interface model for communicating with energy metering equipment, providing a view of the functionality available through the communication interfaces.
Note: The modelling uses an object oriented approach.

3.10
Customer
Purchaser and/or user of a product or service supplied by an organization. The "Customer" may be the ultimate consumer, user, beneficiary or purchaser.
Note: In the context of Smart Metering the Customer is the same person as the Consumer.

3.11
Customer communications gateway (CCG)
Protocol converter between the internal message standard and the communications channel message standard.
Note: Not necessarily a separate device, it may be an integrated function

3.12
Data security
Prevention of one or more of the following:
a) unauthorized access to information within a data stream;
b) unauthorized alteration of information within a data stream;
c) unauthorized generation of messages which could be taken as valid by the receiving equipment
d) denial of service
See also 'Security'.

3.13
Disconnection
Removal of supply from a consumer premises by physical disconnection of the supply.

3.14
Distributed Generation
Electricity generation from multiple small energy sources thus allowing more efficient energy distribution.
Note: Energy is generated closer to the point of consumption, thus reducing network losses.

3.15
Device Language Message Specification (DLMS)
ISO-OSI Application Layer specification, independent of the lower layers and thus of the communication channel, designed to support messaging to and from (energy) distribution devices in a computer-integrated environment.
Note: DLMS is specified in IEC 62056-53 and is an evolution of the Distribution Line Message Specification specified in IEC 61334-4-41.

3.16
Gateway
Device that fully implements the ISO-OSI model for all layers and is used to convert data protocols between different communication systems and standards.
Note: Gateways work on all seven layers of ISO-OSI architecture. The main job of a gateway is to convert protocols between communications networks.

3.17
Hand-held unit (HHU)
Portable device for reading and programming equipment or meters at the consumer's premises or at the access point.
Note: Also known as Hand-held Terminal Unit

3.18
Home and Building Electronic System (HBES)
System for the integration of control applications and the control and management aspects of other applications within a domestic or building environment, including gateways to different transmission media and public networks.

3.19
Head End System (HES)
Central Data System collecting data via the AMI of various meters in its service area. It communicates via a WAN directly to the meters and/or to Data Concentrators or Gateways.

3.20
Home Area Network (HAN)
In-house LAN which interconnects domestic equipment and can be used for energy management purposes.
Note: There can be multiple HANs inside a customer's premises.

3.21
Index
For gas and water the current reading of the total volume (mass) passed through the meter.
Note: for Electricity/Heat Meters referred to as Register

3.22
Interface
Point or means of interaction between two systems.

3.23
Interoperability
Ability of a system to exchange data with other systems of different types and/or from different manufacturers.

3.24
Load Balancing
Ability to use network information and/or on-site intelligence to reconfigure distribution networks or to limit customer loads to maintain desired levels of service and improve the utilization of assets

3.25
Load Limitation
Restricted capacity / energy flow resulting in self-disconnection of supply by the meter if the defined threshold was exceeded.

3.26
Meter
Instrument for measuring, memorizing and displaying the consumption of a commodity.

3.27
M-bus (Meter Bus)
A communication standard (wired or wireless) for data exchange with end devices, including, but not limited to utility meters

3.28
Meter Data
Meter readings that allow calculation of the quantity of electricity, gas, water or heat consumed over a period. Meter data thus includes daily and monthly meter readings, interval readings and actual meter register values. Other readings and data may also be included (such as quality data, events and alarms)

3.29
Meter Operator (MO)
Entity which offers services on a contractual basis to provide, install and maintain metering equipment related to a supply.
Note: The contract may be with the customer, the supplier or the DNO. The meter may be rented to, or owned by, the customer

3.30
M2M Gateway
Entity associated with a Meter, Data Concentrator and/or Central System providing M2M Service Capabilities and a data path to these entities.

3.31
OBject Identification System (OBIS)
System defining identification codes for commonly used data items in metering and other equipment.
Note: specified in IEC/EN 62056-61

3.32
Open Systems Interconnection (OSI)
Framework for communications processes, defined by ISO, in which the process is divided into seven functional layers, arranged vertically with each having separate and defined responsibility.
Each layer communicates only with the layer immediately above and below.

3.33
Power Line Carrier (PLC)
Communications technique using high frequency signals to transmit data over (high voltage) transmission lines transporting electrical power.
Note: In practice the term PLC is also used for communication over distribution lines (low-voltage PLC).

3.34
Protocol
Rules for communication system operation that must be followed if communication is to be effected.
Protocols cover one or more layers of the OSI model.

3.35
Register
Specific section in the memory of the control and metering unit that records data as determined by the programme in the unit.
Note 1: For gas and water referred to as index.
Note 2: The meter can have more than one register

3.36
Security
Measures that protect and defend information and information systems by assuring their confidentiality, integrity, access controls, availability and accuracy. See also 'Data Security'.

3.37
Smart Grid
Electricity network that intelligently integrates the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to efficiently ensure a more sustainable, economic and secure electricity supply

3.38
Smart Meter
Meter with additional functionalities one of which is data communication

3.39
Supplier
Entity that offers contracts for supply to a consumer (the supply contract) and bills the consumers for consumption
Note: In some countries referred to as Retailer

3.40
Tariff
Price structure (normally comprising a set of one or more rates of charge) applied to the consumption of a product or service provided to a consumer.

3.41
Use Case
Description of the interaction between one or more actors, represented as a sequence of simple steps.
Note 1: Actors are entities that exists outside the system ('black box') under study, and which take part in a sequence of activities in a dialogue with the system to achieve a specific goal. Actors may be end users, other systems, or hardware devices.
Note 2: Each Use Case is a complete series of events, described from the point of view of the actor.

3.42
Wide Area Network (WAN)
Extended data communication network connecting a large number of communication devices over a large geographical area.

4 Approach to standardization

4.1 Principles

As noted in section 5 of the SM-CG report in December 2009, the goal is to facilitate harmonized solutions through appropriate voluntary standards. Member States will then be able to specify their own requirements within such a harmonized framework, taking account of national legislation and specific local considerations.

The European Standards Organizations will first assess the suitability of international, European and national standards and will give preference to (draft) European and international standards. If no suitable standard is available for any specific part of the smart metering system, the ESO shall identify the gap between the existing standard(s) and the required standard(s), considering national proposals where useful, and then work to improve these standard(s) and/or develop new ones where needed. Technical committees will seek co-operation with other relevant fora and consortia.

The ESOs will take care to accept new work items at any time when required (subject to ESO rules), in order to ensure that new technologies can be adopted from the market and incorporated into the standardization process.

4.2 Scope of standardization work

The future standardization work focuses on meeting the needs of the residential (household) and small and medium enterprise (SME) sectors. This corresponds to the focus of M/441 and the need to improve consumers' awareness of their energy and water usage (hereinafter 'consumption').

As required by M/441, standards should permit a range of approaches – from fully integrated instruments to modular and multi-part solutions. Modular and multi-part installations may require additional interfaces between the constituent parts - these interfaces are considered to be outside the scope of M/441.

In order to ensure suitable communications standards to support the development of smart metering systems, the standardization described in this report will take account of the following six broad areas of *additional functionality*, closely based on those identified in the SM-CG report of December 2009:

— Functionality 1: Remote reading of metrological register(s) and provision to designated market organizations

— Functionality 2: Two-way communication between the metering system and designated market organization(s)[2]

[2] This supports additional functions aside from remote reading of metrological registers. Examples are system configuration, collecting supply quality data, managing local generation, detecting tampering, firmware upgrades etc. See also Annex A – Use cases.

— Functionality 3: To support advanced tariffing and payment systems

— Functionality 4: To allow remote disablement and enablement of supply and flow / power limitation

— Functionality 5: To provide secure communication enabling the smart meter to export metrological data for display and potential analysis to the end consumer or a third party designated by the end consumer

— Functionality 6: To provide information via web portal/*gateway* to an in-home/building display or auxiliary equipment

Note that these functionalities are services which can be provided via a smart metering system, without excluding the possibility of certain services being provided by means other than via this system.

This Technical Report on communications considers these additional functionalities only to the extent they are necessary to ensure that there are smart metering communications standards to support the functionalities envisaged.

This list of functionalities should not be seen as a minimum list of smart metering functionalities to be implemented in Europe, since not all functionalities will necessarily feature in all applications or in all Member States and functions outside this list may also be defined.

As the relevant directives in section 2 do not specify essential requirements, the standards identified and/or developed under the M/441 mandate will not be harmonized under those directives. However this does not preclude the possibility of broad regulatory guidelines in the area of electricity and gas smart metering.

The standards are intended to support services which are generally covered by a wider regulatory or legislative framework, including, for example, data protection and data security requirements – see section 5.

To clarify standardization requirements and to ensure consistency in the smart meter dataflows anticipated, it is helpful to consider these functionalities in greater detail, through use cases. This Technical Report describes in greater detail a variety of use cases related to these broad functionalities. It has to be stressed that it is outside the scope of M/441 to decide on the need for smart metering systems to fulfill any particular use case described.

Use cases can be defined at differing levels, depending on their purpose. Annex A shows the use cases adopted by SM-CG relate to each of the above functionalities in order to describe how different actors interact with a smart metering system. However this is illustrative and Technical Committees should take care not to restrict the way in which services can be provided. The use cases are intended to be used to help define functional requirements, which then help determine the nature of the bidirectional (where necessary) upstream and downstream communications required. These thus facilitate the work of technical committees.

In addition to the extract of commonly used terms in section 3, a full glossary has been prepared, which is included as Annex B.3.

4.3 Smart metering in the context of smart grids

The work undertaken in response to M/441 considers the high-level smart metering functionalities which are additional to the traditional metrological requirements applying to electricity and other meters. The major focus of the mandated work under M/441 is the provision of improved information and services to consumers and enabling consumers to better manage their consumption.

Particularly in relation to electricity metering, there is the important additional objective of facilitating *smart grid* applications, notably through the incorporation of distributed generation. Smart grids are outside the immediate scope of this report. However the M/441 mandate envisages smart metering as a key enabler for smart grids, providing for two-way information flows between the meter and the designated market organization(s).

Smart metering systems may exist in the context of larger smart grid infrastructures and may co-exist with home automation systems. This is illustrated in Figure 1.

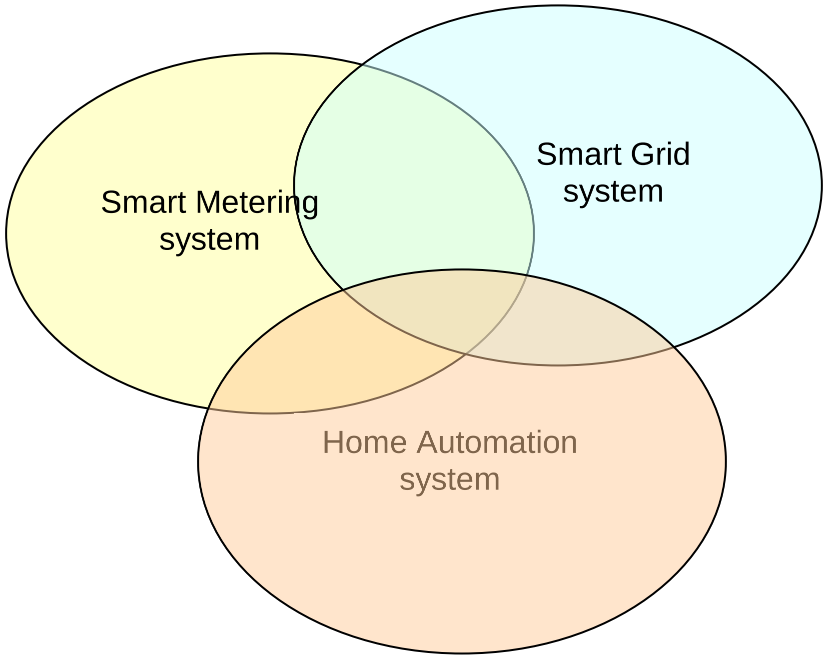


Figure 1 — Smart metering in the context of smart grid and home automation

Applications of smart grid systems and home automation systems may overlap with smart metering applications. The communications infrastructures supporting these applications may be separate or may be usefully shared.

5 Data privacy/Data security

5.1 Introduction

For public acceptance of smart metering, suitable data privacy and protection safeguards need to be in place so that consumers can be confident that their data is treated securely and their privacy is not infringed. In addition, while traditional metering and control systems in premises may be comparatively less susceptible to security attacks, attention should be given to address the vulnerability of smart metering / smart grid systems. Smart metering products and solutions should therefore be designed from the start with appropriate levels of both data privacy and security at their core, and appropriate and scalable solutions found.

As with other aspects of the M/441 standardization work, ESOs are responsible for updating, extending or developing new standards covering the security and data protection aspects of smart metering / smart grid interfaces. Comparing the risks addressed through standards, guidelines and codes of practice in other industries e.g. banking and telecoms already provides a useful basis for what could be appropriate levels of safeguard in highly sensitive areas such as payment data, consumption levels/profiles and connection & disconnection of supply.

The present European legal framework regarding privacy and data protection derives from the EU privacy and data protection directives and treaties. The present data protection directive is due to be reviewed and a separate mandate covering both *data security* and data protection is under consideration.

The purpose, design, functionalities and implementation of any particular smart metering system will to a large extent determine whether or not it will comply with current or future EU privacy and data protection legislation. The review of the data protection directive could therefore make provision for guidelines or codes of practice to be developed in relation to smart metering, complementing EU directives and standards and reflecting the governance and compliance arrangements appropriate for each national and industry situation.

5.2 General security policy and concepts

5.2.1 Principles

The following principles derived from different areas applicable to data security and data privacy issues are of importance in considering smart metering configurations:

— security needs to be seen as an end-to-end characteristic encompassing systems, processes and people, and not in terms of individual components

— security should be designed in at the architectural level, not added later

— from a systems viewpoint, security of the smart metering infrastructure is linked to security of smart grid and home automation networks

— security implementation should be scalable in terms of applications and the capability of devices

— for systems with a long lifetime expectancy such as smart meters, security measures will need to evolve over time as more sophisticated attacks will become available

— cryptographic algorithms provide a wide range of scalable security for systems, sub-systems and components

— security and privacy are permanent tasks to be maintained as an ongoing process by the operating organization

— security in smart metering could be seen as ‘cyber security’ in IT systems due to its high affinity in structure, elements and applications

— smart meters, communication networks and data collector systems must regularly tested for security vulnerabilities by an independent third party.

Therefore in considering standardization, data security and privacy are used more in the sense of ‘cyber security’ and are concerned mainly with securing components (like meters, network access points, etc.) in the overall network with respect to proper system behavior.

Many security considerations are already covered in existing standards and will be taken into account in the development of standards resulting from the M/441 mandate. The ESOs will also need to consider the outcome of any future mandate developed in the context of smart grid standardization.

In general security and privacy are not purely technical issues - the foundation for a successful technological solution is an appropriate security policy – see section 5.2.4 below.

It is worth mentioning that companies have to balance their efforts in security measures. That will result in scenarios where lesser risks could be accepted as residual risks, and more dangerous scenarios, which should result in measures to recognize, to avoid or to mitigate those risks.

Organizational measures will also apply to the involved parties installing and operating the system, but can only be taken into consideration in this document to a limited extent. This however may play an important role in building the consumer trust required to develop the acceptance of smart meters in the public.

5.2.2 Security concept

A security concept refers mainly to an *architecture* model, which represents data flows between role-based data processing functions.

Requirements for the security concept result from the overall security objectives in combination with the derived security services and best practice.

As additional constraints, legal requirements (e.g. metrology & data privacy) will influence the application of security services to dedicated system elements and their interfaces.

From an overall system view, the top-down process has to map the services to the system components and operational process, not forgetting the supporting management systems for initialization, installation, key management etc.

In detail, there are four major security services to support security objectives. They are all relevant for securing sensitive data such as those related to transactions with customers and billing information. They need to be integrated in the perspective of end-to-end communications within the smart metering system, throughout the Local and Neighborhood Network(s), Local / Neighborhood Access Points and *Wide Area Network*:

Security Service	Security objective
— Integrity	- prevent modification of information by unauthorized parties
— Authentication	- determine the true identity of a communication party
— Confidentiality	- prevent disclosure of information to unauthorized parties
— Non-repudiation	- ensure that a party cannot repudiate/refute the validity of data

Some further security services may be requested (list not exhaustive):

— Availability	e.g. protection against Denial of Service attacks This is particularly critical in the case of smart metering, as availability of the smart metering services themselves and availability of supply to the end consumer should be ensured
— Authorization	
— Access control	
— Auditability	
— Protection of third-parties from unauthorized intervention	

In addition, as mentioned above, scalability by security classification will help to select the tailored approach for the target system.
These security services can be realized with different methods and/or techniques with scalability in their characteristics.

Implications for a system, a sub-system or a device may result from the selection of e.g. using symmetric or asymmetric cryptographic methods. In any case the system security will rely on secret security credentials that need to be preserved throughout the whole chain. The implications of the choice of a cryptographic method on the security management process will require careful evaluation.

5.2.3 Tamper resistance

The security concept presented above addresses functional security, which can be standardized and tested. This approach does not however warranty that sensitive devices or processes will be implemented with sufficient skills to resist attacks using sophisticated means such as simple or differential power analysis to discover secret keys used within cryptographic computations.

This is the scope of tamper resistance, which can be ensured e.g. by means of dedicated protection profiles according to ISO / IEC 15408.

5.2.4 Security policy

Standardization in response to M/441 will address the above aspects in the context of an overall smart grid system.

However security policy in general should addresses from an organizational viewpoint all constraints on functions, information flow between functions, access by external systems and threats, including software and access to data by third persons. Maintaining proper security policy is essential for organizations manipulating the secret security credentials used to protect a system, including manufacturing plants incorporating the credentials in the devices. Established information management security standards such as the EN 27000 series are relevant in this respect.

Security policy is under the responsibility of organizations according to their business processes. The major elements of a security policy, in combination with rules, will determine the overall security that is achieved.

Security policy defines goals and elements of the system, to be supported by organizational policy and technical implementations of security mechanisms. From the viewpoint of manufacturer and system solution provider, these are not addressed here - the link takes place via guidelines and rules to initiate, implement, operate and maintain the system by the responsible organization(s), including periodic checking, control and adjustment.

6 Architecture and configuration

6.1 Introduction

The main objective of this section is to present a functional reference architecture for smart metering systems so as to provide a consistent baseline for standardization by CEN, CENELEC & ETSI and thus to support the M/441 mandated work.

There are numerous ways in which this functional architecture can be translated into a physical implementation. Devices and communications interfaces can be configured in differing combinations depending on the solution and application required. While some specific examples of such physical configurations are referred to in the text, this is by way of illustration and is not exhaustive of all the possibilities.

6.2 Scope of architecture

The reference architecture defines the functional entities and communications interfaces in a smart metering system. It is intended to support the development of software and hardware architecture and related standards.

To facilitate *interoperability*, standards should be based on European or international standards and follow the Open System Interconnection (OSI) / IP models as appropriate - see section 10 below.

6.3 Functional reference architecture

Smart metering systems comprise all functions, entities and interfaces from the utility smart metering applications to smart metering end devices and / or home automation devices used in a smart metering context.

The scope of the M/441 mandate with respect to communications is limited to the communication infrastructure between the smart metering *Head End System* and the metering end devices, including all functional entities in between.

Figure 2 below gives a simplified overview of functional entities and interfaces in a smart metering communications network; the boxes correspond to functions that in physical terms can be implemented in a number of different ways. This Technical Report is concerned solely with the communications interfaces depicted in blue in Figure 2.

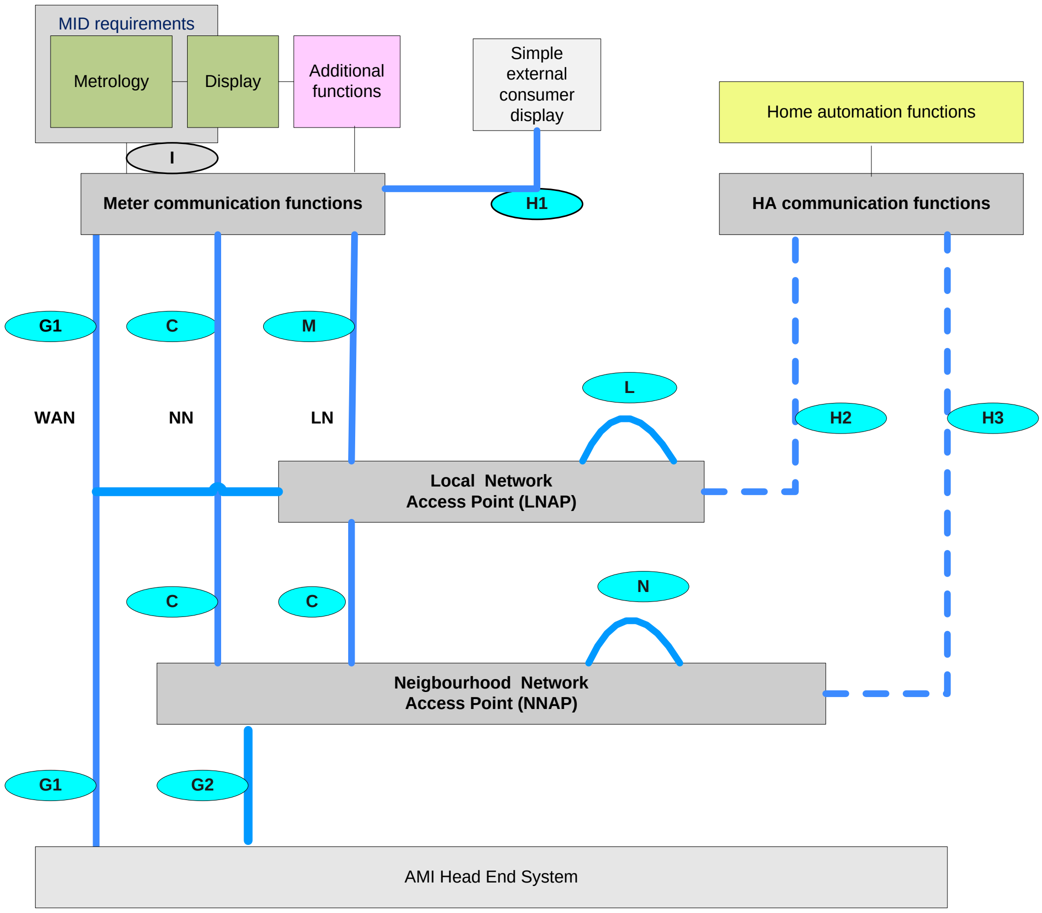


Figure 2 — Reference architecture diagram for smart metering communications

A smart metering system always comprises (a) head end system(s) and metering end devices. The communication network between them may include:

- Wide Area Network (WAN) connecting the head end systems to the local systems or networks
- Neighborhood Network (NN) covering a number of premises (optional);
- Local Network (LN) within the same premises (optional)

A Neighborhood Network, when present, is accessible through a Neighborhood Network Access Point. Similarly, a Local Network, when present, is accessible through a Local Network Access Point.

Metering end devices may have interfaces to communicate on the LN, the NN or the WAN. These are the M, C and G interfaces respectively and at least one of these should be present. Note: the I interface describes the internal link between the metering functions and the communication functions within the metering end device and are outside the scope of the mandate.

A metering end device may have an interface (H1) for a local connection to a simple external consumer display. Home automation end devices (including more advanced displays) may have connections to one or more Network Access Points (H2 & H3).

Access to end devices on the LN is provided by the Local Network Access Point (LNAP). A LNAP has one or more M and H2 interfaces to communicate with the end devices on the LN and one or more C or G interfaces to communicate on the NN and the WAN.

Similarly, access to end devices and to LNAPs on the NN is provided by the Neighborhood Network Access Point (NNAP). A NNAP has a C interface to communicate with entities on the NN and a G interface to communicate through the WAN with the metering head end system(s). It may also have an H3 interface to home automation systems.

Because the Network Access Points (LNAP, NNAP) have to interconnect different networks and may need to translate *protocols*, they contain a gateway function.

The different kinds of metering end devices and display and home automation devices may share a LN or they may have their own LN.

Entities on a given hierarchical level may communicate with each other via an entity at the next higher level. Note: an entity at a higher level is generally closer to the head end system.

Additionally, entities at the same level may communicate with other entities at the same hierarchical level. Note: this permits network configurations with branched, chained or meshed interconnection, by means of the L and N interfaces (see also 6.6.6 below).

In a practical smart metering system, the reference architecture permits a mix of scenarios to be present. For example:

— some metering end devices may be accessible through the WAN using the G interface;

— some metering end devices may be accessible through the WAN + NN via the C interface; and

— some metering end devices may be accessible through the WAN + NN + LN via the M interface

— displays and home automation devices may be accessible through the WAN + NN + LN via the H2 or H3 interface.

Also, while the C interface is used to connect the NNAP and the metering end device, in practice standards envisaged for the M interface may be used.

Regardless of the network paths of the specific implementation, special care about security is necessary to prevent unauthorized monitoring or intervention (see also Section 5: Data privacy / data security).

The functional entities and their interfaces are described in more detail in sections 6.5 and 6.6 below.

6.4 Physical configurations

Not all functions will necessarily be present in any physical infrastructure or specific smart metering implementation. Thus, the model in practice does not require there to be devices for each of the above items in a smart metering implementation.

A major physical precondition that the smart metering configuration has to take into account is the impact of the meter's power supply on communication capabilities. As most gas and water meters and related network components are operated on a battery supply basis, where long battery life is generally a key factor, data communication for these components may not be identical to that for mains-powered devices.

The smart metering configuration should accommodate standardization and technological progress.

Note 1: Smart metering systems may also employ *Hand Held Units (HHUs)* and Point Of Sale Terminals (POSTs). The interfaces between these and the smart metering system entities are out of the scope of this Technical Report. Human interfaces are similarly out of scope.

6.5 Description of functional entities

6.5.1 Introduction

A functional entity may be implemented in different physical devices depending on the configuration needs.

Each functional entity may have application functions and in order to be able to participate in the system it should have communication functions. The communication functions include the interface handler to manage one or more interfaces.

6.5.2 Central communication system / AMI Head End System (HES)

Central communication systems (AMI Head End Systems) communicate with meters (metering end devices) either directly through the WAN, or using additional Neighborhood Networks via NNAPs and / or Local Networks via LNAPs (collectively NAPs).

HESs are typically part of an *AMR* or *AMM* solution. In terms of the M/441 mandate, the focus for standardization is limited to the WAN communication part of an *AMR/AMM* system only. Additional functionalities such as meter management, installation and roll-out services or maintenance operation are beyond the scope of this mandate.

HESs typically manage NAP addresses, *data security* and meter reading pre-processing. In electricity, they provide the top end interface to smart grid functions / applications (the lower-end interface being the NAP function). The interface towards the NAPs is standardized within the M/441 mandate; the interface from HESs towards central energy and meter data management systems is covered by IEC TC 57 and is considered to be out of the scope of this mandate.

6.5.3 Local Network Access Point (LNAP)

The LNAP is a functional entity that allows access to one or more metering end devices and, when equipped with an H2 interface (interfaces), to display / home automation end devices connected to the LN. A LNAP also may allow data exchange between different functional entities connected to the same LN.

The LNAP may act simply as a router transferring messages between the metering end device and the NN and/or the WAN. Alternatively it may provide a range of services including protocol conversion, device management, security and service capabilities as defined and developed by ETSI M2M Working Group. Services may be provided as functions of the LNAP itself or provide proxy services on behalf of limited capability devices connected to the LN.

The LNAP may also comprise metering application functions. In this case, NNAPs / HES application functions exchange data with the metering application functions implemented in the LNAP and the LNAP application functions exchange data with the functions implemented in the end devices.

LNAP metering application functions may include collecting and retaining data from one or several end devices on a scheduled or on-demand basis, forwarding these data, sending commands etc.

In physical terms, the functional entity LNAP can be realized either as

- an explicit device with physical connections to the meter and / or the LN and the WAN and / or NN
- an attachment device in the meter (plug-in module), or
- a simple function block inside an integrated meter construction or
- a mobile device (e.g. hand-held terminal, drive-by).

The LNAP may be used to ensure the local communication of display data and the support of local additional services.

6.5.4 Neighborhood Network Access Point (NNAP)

A NNAP is a functional entity that, when equipped with C interface, allows access to one or more LNAPs or metering end devices and, when equipped with an H3 interface (interfaces), to display / home automation end devices connected to the NN.

An NNAP may also allow data exchange between different functional entities connected to the same NN.

The NNAP communication functions may include NN and end device management, protocol conversion (gateway functionality), security management etc.

The gateway functionality of the NNAP provides the connectivity infrastructure between meters and the central system. It utilizes two separate communication networks. It communicates with the central system via a WAN, and via a NN with the meters and / or LNAPs which it manages, The NNAP is typically used for meter connection via wired (e.g. PLC) or wireless communication in configurations, where a dedicated WAN connection for a single meter / LNAP is not desired.

In addition, the NNAP may also comprise application functions. In this case, HES application functions exchange data with the application functions implemented in the NNAP and the NNAP application functions exchange data with the functions implemented in the LNAPs / end devices. NNAP application functions include collecting and retaining data from one or several end devices and/or LNAPs on a scheduled or on-demand basis, forwarding this data, compressing data, sending commands etc. NNAPs with such application functions are also known as *Data Concentrator*s.

NNAPs may support different communication interfaces with different profiles (PLC, wired, wireless).

6.5.5 Metering End Devices

An electricity meter measures electricity consumption / generation and related data. Such meters are mains-powered and the limitations on communications frequency or volumes applicable to battery-powered meters may not apply. However energy usage should not be excessive.

Non-electricity meters, which measure gas, water or heat, are typically battery-powered and this has important implications for the frequency and duration of data communication possible. The location and installation of meters may also be constraining factors. Battery life, which may be subject to national regulation and/or utility purchasing requirements, has to be taken into account in standardization and metering system design, and in the interests of efficiency, provision may need to be made for short messaging.

Electricity and non-electricity meters conforming to the Measuring Instruments Directive (MID) will meet the essential requirements of the MID and are under metrological control. This includes the conventional meter display.

6.5.6 Displays and Home Automation

Display and home automation end devices are outside the scope of this mandate. However they may be used to provide the following functionalities identified in the M/441 mandate:

— provide accurate information on consumption in order to increase consumer awareness

— provide additional functionalities enabling consumers to interact with their own environment

Display devices fall into two categories – simple consumer external displays & advanced consumer displays. A simple consumer display can be connected directly to the metering end device through interface H1, which may be one-way. Home automation end devices, which include advanced consumer displays, utilize the interface H2 to connect to the LNAP and/or the H3 interface to connect to the NNAP.

6.6 Interfaces

6.6.1 Introduction

This section describes the interfaces referenced in the generic functional architecture shown in Figure 2. For these interfaces, an EN standard in compliance with the CEN, CENELEC and ETSI standardization rules shall be allocated or, if not available, created through the M/441 standardization process. The specification of the protocol stack and the protocol layers should follow the OSI / IP model as appropriate.

The interfaces described in this section do not directly refer to communications standards. Standards can be used for more than one interface (see section 8.2 table). For example communication standards primarily intended for an M interface can also be used for the C interface.

6.6.2 AMI Head End System interface (G interface)

The G interface can be defined with several profiles (shown as G1 and G2 in Figures 3 - 6), depending on the physical network architecture being used. The G1 / G2 interfaces are used to connect the meters / LNAPs / NNAPs directly with an AMI HES.

Typical interface platforms for the G1 and G2 interfaces are PSTN networks, public GPRS and UMTS networks or DSL or broadband TV communication lines. Alternatively, there could be a direct physical PC link or optical cables.

6.6.3 NNAP interface (C interface)

The C interface is used to connect LNAPs and / or metering end devices to an NNAP.

Typical interface technologies are e.g. (not limited to) narrowband PLC communication networks, local wired or wireless networks. Regardless of the network paths of the specific implementation, special care on the security of the C interface is necessary to prevent unauthorized monitoring or intervention (see also section 5 Data Privacy / Data security).

6.6.4 Metering end device interface (M interface)

The M interface can be defined with different profiles depending on the type of metering end device being used (electricity / non-electricity meter).

External communication of electricity meters is represented in Figures 3 – 6 by the "Electricity-meter comms" function, involving meter data exchange by means of an automatic meter reading from local reading devices or remote reading devices. Similarly, external communication of non-electricity meters is represented in Figures 3 - 6 by the "G/W/H meter comms" function.

The M interface is between this communications function of the meter and the LNAP or between metering end devices. The interface defines the access of external devices to internal data on the meter. The interface profile has to offer services that enable the meter to provide access via the LNAP to the functions implemented in the MID part of the meter or outside it.

As noted previously, standards envisaged for the M interface may be used in communications between the metering end device and the NNAP.

6.6.5 Display & Home automation end device interfaces (H1, H2 and H3 interfaces)

The H1 interface connects a metering end device to a simple external consumer display.

The H2 interface connects a LNAP and the H3 interface connects an NNAP with auxiliary devices e.g. a home automation or advanced display functionality.

6.6.6 LNAP/NNAP Peer Interfaces (L and N interfaces)

L is an optional interface which allows an LNAP to be connected to zero or more peer LNAPs. Similarly, N is an optional interface which allows an NNAP to be connected to zero or more NNAPs.

Since the access points (LNAP and NNAP) serve as intermediate communications points within the Reference Architecture supporting one or more subordinate devices, the L and N interfaces allow multiple access points to serve a collection of subordinate devices and allow provisioning of shared or duplicated paths to the head end system.

7 Standardization overview and coordination between the ESOs

Responsibilities for co-ordinating standardization for each of the communication interfaces mentioned are summarized in Figure 3 below.

		Metrology impact	Technology types	Lower layer protocol responsibility	Upper layer protocol responsibility	Data model responsibility
I	*Link between MID meter part and meter comms functions*	*Yes*	*integrated, wired, optical*	*Used by mandate but defined outside*		
M	**Link from Meter comms functions to Local Network Access Point (LNAP)**	No	integrated, wired bus, wireless, PLC, optical	TC 13 / TC 294 /	TC 13 / TC 294	TC 13 / TC 294 /
C	**Link from Meter comms functions / LNAP to Neighbourhood Network Access Point (NNAP)**	No	integrated, wired bus, wireless, PLC	TC 13 / TC 294	TC 13 / TC294	TC 13 / TC294 / TC 57
G1	**Link from Meter comms functions to LNAP / AMI head end system**	No	IP based	ETSI	TC 13 / TC294	TC 13 / TC294
G2	**Link from NNAP to AMI head end system**	No	IP based	ETSI	TC13 / TC294 / ETSI M2M	TC 13 / TC294 / TC57
H1	**Link from Meter comms to support simple external display**	No	wired bus, wireless, PLC, optical	TC 205	TC 205	TC 205
H2 / H3	**Link from LNAP / NNAP to support home automation end device(s)**	No	wireless, PLC, wired bus	TC 205	TC 205	TC 205

Figure 3 — Responsibilities for interface standardization co-ordination, in co-operation with other TCs

8 Currently available communications standards and further standardization

8.1 Introduction

This section identifies the communications standards which are currently the most relevant for smart metering. Section 8.2 below lists in a table both existing communications standards and the standards to be developed in the course of the mandate.

Standards are considered in relation to each of the communications interfaces. They are grouped as follows:

— General standards: these include the specification of the standardization framework, the architectures and use cases, as well as mapping use cases to elements of the data models and protocols

— Lower layer standards: these include lower layer standards according to the OSI / internet model i.e. Phy & MAC layers

— Higher layer standards: these include Network, Transport and Application layer standards

— Data model standards; these include data model and data identification standards

— Communications profile standards: these include the communication profiles / protocol stacks relevant for the various interfaces. A communications profile standard specifies the set of layer standards making up the given profile.

The first column in the table shows the most relevant current standards. However this is not meant to be an exhaustive list of standards; other alternative standards will be considered in the future and could be determined to be acceptable standards as well.

The second column indicates the ESO technical committee responsible for these standards.

The third column lists the communications standards to be developed in the course of the mandate, and the fourth column shows the ESO technical committee responsible for co-ordinating this work.

The remaining columns show the smart metering interfaces addressed by the standards listed.

8.2 Table of existing communications standards & standards to be developed under the mandate

Existing standards	**TC**	**Standards to be developed**	**TC**	**M/441 Interface relevance**							
				M	**H1**	**H2 /H3**	**C**	**G1**	**G2**	**L**	**N**
General standards											
		EN/TR 5XXXX :201X Ed.1.0, *Electricity metering data exchange – Smart metering standardization framework*	CLC TC 13	x	x	x	x	x	x		
		EN/TR 5YYYY: 201X Ed.1.0, *Smart metering use cases and functions* To be developed jointly by CEN TC 294, CENELEC TC13 and ETSI M2M	TBD	x	x	x	x	x	x		
		EN 62056-1-0: 201X Ed. 1.0: *Electricity metering data exchange – The DLMS/COSEM suite – Part 1-0: Framework* (To be extracted from IEC 62056-53 Ed. 2.0:1996 and augmented)	IEC TC 13	x	x	x	x	x	x		
		EN/TR 52056-1-1: 201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 1-1: Mapping the use cases and functions to the COSEM data model*	CLC TC 13	x			x	x	x		
		EN/TR 5ZZZZ-1: 201X Ed.1.0, *Electricity metering data exchange – The METERS and MORE suite – Part 1: Mapping the use cases and functions to the METERS and MORE data model*	CLC TC 13		x	x	x		x		
EN 13757-1:2002 Ed. 1.0, Communication systems for meters and remote reading of meters – *Part 1: Data exchange*[3]	TC 294	EN 13757-1:2002 in revision	TC 294	x	x	x	x				

[3] EN 13757-1 is a frame standard established by CEN/TC 294 for *Communication system for meters and remote reading of meters* (non-electricity). This standard is referencing other parts of EN 13757 series and standards from IEC/EN 62056 series (DLMS/COSEM), including local interfaces, lower and upper layers, data modelling.

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
EN 50090-3-1 Home and Building Electronic Systems – *Part 3-1: Aspects of Application – Introduction to the application structure*	CLC TC 205				x	x					
EN 50090-3-2 Home and Building Electronic Systems – *Part 3-2: Aspects of application – User process for HBES Class 1*	CLC TC 205				x	x					
EN 50090-3-3 Home and Building Electronic Systems (HBES) – *Part 3-3: Aspects of application – HBES Interworking model and common HBES data types*	CLC TC 205				x	x					
		TR 50xxx: Smart metering – HBES architecture and use of standardized communication	CLC TC 205								
ETSI TR 187 002 V2.1.1 *TISPAN NGN Security (NGN_SEC);Threat, Vulnerability and Risk Analysis* ETSI TS 187 001 V2.1.1 *TISPAN NGN Security (NGN Sec): Security Requirements* ETSI TS 187 003 V2.1.1 *TISPAN NGN Security (NGN Sec): Security Architecture*[4]	ETSI							x	x		
EN 14908: *Open Data Communication in Building Automation, Controls and Building Management – Control Network Protocol*	CEN TC 247			x	x	x	x			x	x
Public Cellular Mobile Network								x	x		x

[4] Note: ETSI TC TISPAN has developed the TVRA (Threat, Vulnerability, Risk Analysis) methodology and a set of guidance documents. The TVRA is currently used in ETSI TC TISPAN to derive security requirements and detailed security requirements. In TISPAN, the TVRA has been used to identify security requirements and countermeasure frameworks for IPTV, RACS, NAT, media security, and CPN. For more information on the TVRA, please see http://portal.etsi.org/mbs/Security/writing/TVRA.htm

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
(GSM/GPRS/EDGE/UMTS) Smart Card Platform for mobile communication systems of 2G, 3G and beyond: - ETSI TS 102 221: *Smart Cards; UICC-Terminal interface; Physical and logical characteristics* - ETSI TS 102 223: *Smart Cards; Card Application Toolkit (CAT)* - ETSI TS 102 671 : *Smartcards; Machine to Machine UICC; Physical and logical characteristics* - ETSI TS 102 225: *Smart Cards; Secured packet structure for UICC based applications* - ETSI TS 102 484:*Smart Cards; Secure channel between a UICC and an end-point terminal*											
3GPP All the technologies currently specified by 3GPPP (GERAN, UTRAN, LTE, LTE Advanced Access Networks, CS, GPRS and EPC Core Networks, IMS Subsystem) are relevant in the context of the M2M services, including specifically the SM services. These technologies can be referenced by means of the following "umbrella" specifications: - TS 41.101 - TS 21.101	ETSI							x	x	x	

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
- TS 21.201 - TS 21.202											
<u>ETSI TISPAN</u> <u>Identifiers and Personalization</u> - ETSI TS 184 002 V1.1.1 *Identifiers (IDs) for NGN* <u>Identity Management and Privacy</u> - ETSI TR 187 010 V2.1.1 Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN);*NGN Security; Report on issues related to security in identity management and their resolution in the NGN* <u>Customer Networks Architecture and connection to the NGN</u> Customer IMS endpoints are connected to the NGN according to ETSI TS 122 228 (see below) or customer networks can be connected as in the following references: - ETSI TS 185 005 V2.0.0 *Services requirements and capabilities for customer networks connected to TISPAN NGN* - Draft ETSI TS 185 003 V2.2.4 *TISPAN Customer Network Gateway (CNG) Architecture and Reference Points* - ETSI TS 185 006 V2.1.2 *Customer Devices architecture and Reference Points*	ETSI							x	x	x	x

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
<u>NGN Communication Link and Service requirements</u> - ETSI TS 181 005 v3 *Service and Capability Requirements* - ETSI TS 122 228 v.8.6.0 *IMS Service requirements for the Internet Protocol (IP) multimedia core network subsystem (IMS);Stage 1* - ETSI TS 122 173 V8.7.0 *IMS Multimedia Telephony Service and supplementary services; Stage 1* - ETSI TS 123 228 V8.12.0 *IP Multimedia Subsystem (IMS); Stage 2* - ETSI TS 124 229 V8,12.0 *IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3*											
<u>Public Switched Telephone Network (PSTN)</u> Note: *It is hard to provide any list of Specifications on PSTN as they differ in each national implementation. We may say that all European PSTNs support G.711 (PCM of voice frequencies as a common denominator. G.711 should be able to fulfill the requirements of all data modem connections of the V-series. It should also be considered that multiplexing is not part of the usual capability.*								x	x		

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
<u>Integrated Service Digital Network (ISDN)</u> Note: *Most European networks conform to the ISDN NNI Standard EN 300 356 (European ISUP version 4) which however requires an external IP-interface/gateway, so TISPAN does not intend to consider ISDN communication links within this document. There is a defined standard for ISDN Services at the User Interface (DSS1) EN 300 665. Whilst ubiquitously deployed in some Member States; these services are not available at the majority Accesses in all EU Member States.* However, for completeness please note: - EN 300 356-1 Version 4.2.1 *Integrated Services Digital Network (ISDN);* - Signalling System No.7 (SS7); *ISDN User Part (ISUP) version 4 for the international interface; Part 1: Basic services [ITU-T Recommendations Q.761 to Q.764 (1999) modified]* - EN 300 403-1 Version 1.3.2 *Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Signalling network layer for circuit-mode basic call control; Part 1: Protocol specification [ITU-T Recommendation Q.931 (1993), modified]*								x	x		
<u>Conformance with EMC and radio</u>				x	x	x	x	x	x	x	x

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
standards There is a series of general EMC and radio standards to demonstrate conformity with the R&TTE Directive (1999/5/EC) articles 3.1b and 3.2 respectively, which are relevant to situations where wireless communication is used; these are listed below. Harmonized standards to demonstrat conformity with the R&TTE Directiv (1999/5/EC) article 3.1b: - ETSI EN 310 489-1: *Electromagnetic compatibility and radio spectrum matters (ERM); Electromagnetic Compatibility (EMC) standards for radio equipment and services Part 1 Common technical requirements* - ETSI EN 301 489-7: *Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)* - ETSI EN 301 489-8: *Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 8: Specific conditions for GSM base stations* - ETSI EN 301 489-23: *Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic*											

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
Compatibility (EMC) standard for radio equipment and services; Part 23: Specific conditions for IMT-2000 CDMA, Direct Spread (UTRA and E-UTRA) Base Station (BS) radio, repeater and ancillary equipment - ETSI EN 301 489-24: *Electromagnetic compatibility and Radio spectrum Matters (ERM);Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24:Specific conditions for IMT-2000 CDMA Direct Spread (UTRA and E-UTRA) for Mobile and portable (UE) radio and ancillary equipment* - ETSI EN 301 489-43: *Electromagnetic compatibility and radio spectrum matters (ERM); Electromagnetic Compatibility (EMC) standards for radio equipment and services Part 3 Specific conditions for Short Range devices (SRD) operating on frequencies between 9MHz and 40GHz* Harmonized standards to demonstrat conformity with the R&TTE Directiv (1999/5/EC) article 3.2: - ETSI EN 300220-2 (v2.3.1): *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000MHz frequency range with power levels ranging up to 500 mW* - ETSI EN 300440-2 (v1.4.1): *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be*											

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
used in the 1 GHz to 40 GHz frequency range - ETSI EN 301 511 V9.0.2 (2003-03): *Global System for Mobile communications (GSM);Harmonized EN for mobile stations in the GSM 900 and GSM 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC)* - ETSI EN 301 502 V8.1.2 (2001-07): *Harmonized EN for Global System for Mobile communications (GSM);Base Station and Repeater equipment covering essential requirements under article 3.2 of the R&TTE directive (GSM 13.21 version 8.1.2 Release 1999)* - ETSI EN 301 908-1 V4.2.1 (2010-03): *Electromagnetic compatibility and Radio spectrum Matters (ERM);Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 1: Harmonized EN for IMT-2000, introduction and common requirements, covering the essential requirements of article 3.2 of the R&TTE Directive* - ETSI EN 301 908-2 V4.2.1 (2010-03): *Electromagnetic compatibility and Radio spectrum Matters (ERM);Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD and E-*											

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
UTRA FDD) (UE) covering the essential requirements of article 3.2 of the R&TTE Directive - ETSI EN 301 908-3 V4.2.1 (2010-03) : *Electromagnetic compatibility and Radio spectrum Matters (ERM);Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 3: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD and E-UTRA FDD) (BS) covering the essential requirements of article 3.2 of the R&TTE Directive* - ETSI EN 301 908-13 V4.2.1 (2010-03) : *Electromagnetic compatibility and Radio spectrum Matters (ERM);Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 13: Harmonized EN for IMT-2000, Evolved Universal Terrestrial Radio Access (E-UTRA) (UE) covering the essential requirements of article 3.2 of the R&TTE Directive* - ETSI EN 301 908-14 V4.2.1 (2010-03): *Electromagnetic compatibility and Radio spectrum Matters (ERM);Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 14: Harmonized EN for IMT-2000, Evolved Universal Terrestrial Radio Access (E-UTRA) (BS) covering the essential requirements of article 3.2 of the R&TTE Directive*											

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
- ETSI EN 300328 (v1.7.1): *Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques* - ETSI EN 302 065 (V1.2.1) (all parts): *Electromagnetic compatibility and Radio spectrum Matters (ERM); Ultra WideBand (UWB) technologies for communication purposes; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive* - ETSI EN 302 500 (V1.2.1) (all parts): *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra WideBand (UWB) technology; Location tracking equipment in the frequency range from 6 GHz to 8,5GHz; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive*											
- EN 50065-1:2001– *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148 kHz:*	CLC TC 205A			x	x	x	x	x			
Lower layer standards											
EN 62056-31:1999 Ed. 1.0, *Electricity metering – Data exchange for meter reading,*	IEC TC 13	EN 62056-3-1:201X Ed.2.0 13/1461/CDV, *Electricity metering data exchange – The*	IEC TC 13	x			x				

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
tariff and load control – Part 31: Use of local area networks on twisted pair with carrier signalling		*DLMS/COSEM suite –Part 3-1: Use of local area networks on twisted pair with carrier signalling*									
EN 62056-42:2002 Ed. 1.0, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 42: Physical layer services and procedures for connection-oriented asynchronous data exchange*	IEC TC 13			x	x						
EN 61334-5-1:2001 Ed. 2.0, *Distribution automation using distribution line carrier systems – Part 5-1: Lower layer profiles – The spread frequency shift keying (S-FSK) profile*	IEC TC 57						x				
EN 61334-4-32:1996 Ed. 1.0, *Distribution automation using distribution line carrier systems – Part 4: Data communication protocols – Section 32: Data link layer – Logical link control (LLC)*	IEC TC 57						x				
EN 61334-4-511:2000 Ed. 1.0: *Distribution automation using distribution line carrier systems – Part 4-511: Data communication protocols – Systems management – CIASE protocol*	IEC TC 57						x				
EN 61334-4-512:2002 Ed. 1.0: *Distribution automation using distribution line carrier systems – Part 4-512: Data communication protocols – System management using profile 61334-5-1 – Management Information Base (MIB)*	IEC TC 57						x				
		EN/TS 5VVVV-1:201X Ed.1.0, *Data exchange over power lines – Part 1: Lower layer profile using OFDM modulation Type 1* (Note: this is the PRIME specification)	CLC TC 13				x				
		EN/TS 5VVVV-2:201X Ed.1.0, *Data exchange over power lines – Part 2: Lower layer profile using OFDM modulation Type 2* (Note: this is the G3 specification)	CLC TC 13				x				

Existing standards	**TC**	**Standards to be developed**	**TC**	**M/441 Interface relevance**							
				M	**H1**	**H2 /H3**	**C**	**G1**	**G2**	**L**	**N**
EN 62056-46:2007 Ed.1.1, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 46: Data link layer using HDLC protocol*	IEC TC 13			x	x		x				
EN 62056-47:2007 Ed. 1.0, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 47: COSEM transport layers for IPv4 networks*	IEC TC 13	EN 62056-4-7:2007 Ed. 1.0, Amd. 1: *Electricity metering data exchange – The DLMS/COSEM suite – Part 4-7: COSEM transport layers for IPv4 and IPv6 networks*	IEC TC 13				x	x	x		
		EN/TS 5ZZZZ-4: 201X Ed.1.0, *Electricity metering data exchange –The METERS and MORE suite – Part 4: Lower layer profile using B-PSK modulation*	CLC TC 13		x	x	x				
EN 50090-5-1 Home and Building Electronic Systems – *Part 5-1: Media and media dependent layers – Powerline for HBES Class 1*	CLC TC 205				x	x					
EN 50090-5-2 Home and Building Electronic Systems – *Part 5-2: Media and media dependent layers – Network based on HBES Class 1, Twisted Pair*	CLC TC 205				x	x					
EN 50090-5-3 Home and Building Electronic Systems (HBES) – *Part 5-3: Media and media dependent layers – Radio frequency*	CLC TC 205				x	x					
EN 13321 series : *Open data Communication in Building Automation, controls and building management - Home and building electronic system*	CEN TC 247				x	x					
EN 14908 series: *Open Data Communication in Building Automation, Controls and Building Management – Control Network Protocol*	CEN TC 247				x	x				x	x
EN 13757-2:2004 *Communication systems for and remote reading of meters Part 2: Physical and Link Layer* *Note: twisted pair, base band signalling (M-Bus)*	294			x	x	x	x				

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
EN 13757-4:2004, *Communication systems for and remote reading of meters Part 4: Wireless meter readout*	294	EN 13757-4:2004 potential revision after feasibility study for new modes A necessary revision of EN 13757-4 has started in TC294WG5, noting EEC decision 2005-928-CE relative to "ERMES" frequency band and its reallocation to metering, among other applications.	294	x	x	x	x				
EN 13757-5:2008, *Communication systems for and remote reading of meters Part 5: Wireless relaying*	294			x		x	x				
	ETSI ERM	ETSI TS102887-1 *Smart Metering wireless access protocol: part 1: Physical layer*	ETSI ERM					x	x	x	x
		ETSI TS102887-2 *Smart Metering wireless access protocol: part 2: Data Link Layer (MAC)*						x	x	x	x
Upper layer standards											
EN 62056-53:2007 Ed.2.0, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: COSEM Application layer*		EN 62056-5-3:2007 Ed.2.0, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 5-3: COSEM Application layer*	IEC TC 13	x	x			x	x		
EN 50090-4-1 Home and Building Electronic Systems – *Part 4-1: Media independent layers – Application layer for HBES Class 1*	CLC TC 205				x	x					
EN 50090-4-2 Home and Building Electronic Systems – *Part 4-2: Media independent layers – Transport layer, network layer and general parts of data link layer for HBES Class 1l*	CLC TC 205				x	x					
EN 50090-4-3 Home and Building Electronic Systems (HBES) – *Part 4-3: Media independent layers – Communication over*	CLC TC 205				x	x					

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
IP (EN 13321-2:2006)											
EN 50090-7-1 Home and Building Electronic Systems – *Part 7-1: System management – Management procedures*	CLC TC 205				x	x					
EN 13321 series : *Open data Communication in Building Automation, controls and building management - Home and building electronic system*	CEN TC 247				x	x					
EN 14908 series: *Open Data Communication in Building Automation, Controls and Building Management*	CEN TC 247			x	x	x	x			x	x
EN 13757-3:2004 , *Communication systems for and remote reading of meters Part 3: Dedicated application layer* *Note: (M-Bus)*	CEN TC 294	EN 13757-3: 2004 in revision	CEN TC 294	x	x	x	x				
		EN 62056-5-8:201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 5-8: SML container services*	IEC TC 13					x	x		
		EN/TS 5ZZZZ-5: 201X Ed.1.0, *Electricity metering data exchange – The METERS and MORE suite – Part 5: Application layer*	CLC TC 13		x	x	x		x		
Data model standards											
EN 62056-61: 2006 Ed. 2.0, *Electricity metering - Data exchange for meter reading, tariff and load control - Part 61: Object identification system (OBIS)*	IEC TC 13	EN 62056-6-1: 201X Ed. 3.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-1: Object identification system (OBIS)*	IEC TC 13	**x**			**x**	**x**	**x**		
EN 62056-62:2006 Ed. 2.0, *Electricity metering - Data exchange for meter reading, tariff and load control - Part 62: Interface classes*	IEC TC 13	EN 62056-6-2:201X Ed. 3.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-2: COSEM interface classes*	IEC TC 13	x			x	x	x		
		EN/TS 5ZZZZ-6: 201X Ed.1.0, *Electricity metering data exchange – The METERS and MORE suite –Part 6: Data model*	CLC TC 13		x	x	x		x		

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
EN 50090-3-3 Home and Building Electronic Systems (HBES) – *Part 3-3: Aspects of application – HBES Interworking model and common HBES data types*	CLC TC 205				x	x					
		TR50xxx: Smart metering – Application specification – Display	CLC TC 205		x	x					
		TR50xxx: Smart metering – Application specification – Additional Services	CLC TC 205		x	x					
EN 13321 series : *Open data Communication in Building Automation, controls and building management - Home and building electronic system*	CEN TC 247				x	x					
EN 14908 series: *Open Data Communication in Building Automation, Controls and Building Management*	CEN TC 247			x	x	x	x			x	x
EN 13757-3:2004, *Communication systems for and remote reading of meters Part 3: Dedicated application layer* *Note: (M-Bus)*	CEN TC 294	EN 13757-3: 2004 in revision	CEN TC 294	x	x	x	x				
IEEE-1377 (1997): *Utility Industry Metering Communication Protocol Application Layer (End Device Data Tables)*	-		-	x			x	x	x	x	x
Communication profile standards											
		EN 62056-7-1:201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 7-1: Communication profile for twisted pair local networks using carrier signalling*	IEC TC 13	x			x				
		EN/TS 52056-7-2: 201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 7-2: Communication profile for twisted pair local*	CLC TC 13	x							

Existing standards	TC	Standards to be developed	TC	M/441 Interface relevance							
				M	H1	H2 /H3	C	G1	G2	L	N
		networks using baseband signalling (M-Bus)									
		EN/TS 52056-7-3: 201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 7-3: Communication profile for wireless local networks (wireless M-Bus)*	CLC TC 13	x							
		EN 62056-7-6: 201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 7-6: The 3-layer, connection oriented, HDLC based communication profile* (To be extracted from EN 62056-53 Ed. 2.0)	IEC TC 13	x	x						
		EN/TS 5ZZZZ-7: 201X Ed.1.0, *Data exchange for electricity metering – The METERS and MORE suite – Part 7: Communication profile for power line carrier local networks*	CLC TC 13		x						
		EN 62056-8-3:201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 8-3: Communication profile for power line carrier neighborhood networks using S–FSK modulation*	IEC TC 13				x				
		EN/TS 52056-8-4: 201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 8-4: Communication profile for power line carrier neighborhood networks using OFDM modulation Type 1* *(Note: This is the PLC PRIME communication profile)*	CLC TC 13				x				
		EN/TS 52056-8-5: 201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 8-5: Communication profile for power line carrier neighborhood networks using OFDM modulation Type 2*	CLC TC 13				x				

Existing standards	**TC**	**Standards to be developed**	**TC**	**M/441 Interface relevance**							
				M	**H1**	**H2 /H3**	**C**	**G1**	**G2**	**L**	**N**
		(Note This is the PLC G3 communication profile)									
		EN/TS 5ZZZZ-8: 201X Ed.1.0, *Electricity metering data exchange for – The METERS and MORE suite – Part 8: Communication profile for power line carrier neighborhood networks using B-PSK modulation*	CLC TC 13		x	x	x				
		EN 62056-9-7:201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 9-7: Communication profile for TCP-UDP/IP networks*	IEC TC 13					x			
		EN 62056-9-8:201X Ed.1.0, *Electricity metering data exchange – The DLMS/COSEM suite Part 9-8: Communication profile using SML services*	IEC TC 13					x			
		EN/TS 5ZZZZ-9: 201X Ed.1.0, *Electricity metering data – The METERS and MORE suite – Part 9: Communication profile for TCP/IPv4 networks*	CLC TC 13						x		

8.3 Product standards related to Additional Functionalities

In addition to the above work on communications, the ESO work programme includes standards for additional functionalities - see Annex D.

9 Interoperability and conformance

9.1 Interoperability

9.1.1 Principles

M/441, among others, requests CEN, CENELEC and ETSI to develop European standards in an interoperable framework.

The Glossary defines *interoperability* as the ‘ability of a system to exchange data with other systems of different types and/or from different manufacturers’.

It also defines *interchangeability* as the ‘ability to exchange one device by another without reducing the original functionality and without dysfunction or loss of efficiency for the whole system. Not to be confused with interoperability’.

To achieve interoperability, interfaces between communication hubs shall be based on open standards selected / established by the Technical Committees participating in the execution of M/441. However using internationally agreed standards is not enough to ensure product level interoperability. To ensure interoperability – and, within a given physical medium, interchangeability – project specific companion specifications will be required, that specify what standards are used, what alternatives have to be taken and which options need to be supported by communication entities used in the given system.

Whereas interoperability is a general and achievable objective, the scope of interchangeability is limited due to the fact that in a smart metering system a number of different communication media will be used to adapt to differing economical and technical environments. Whereas communicating entities using the same media are likely to be interchangeable, entities using different communication media (e.g. power line carrier and wireless) may not be interchangeable. In the case of using different standards (e.g. modulation schemes) on the same media, the realistic goal is co-existence, i.e. a system using a certain standard should be able to co-exist with a system using another standard.

9.1.2 Interface standards

Interface standards comprise three main elements:

— lower protocol layer standards, generally comprising the physical and data link layers standards

— higher layer standards, generally comprising the network, transport and applications layer standards as required; and

— data model standards.

The selection of upper layer protocol standards and data model is of key importance in achieving interoperability.

The standards established should clearly and unambiguously specify the requirements, i.e. what elements are mandatory, what elements are optional, what behavior is expected, what is allowed and what is not allowed both in normal conditions and under error conditions. In error conditions, clear error messages and diagnostic information should be provided.

As the requirements for smart metering systems may vary from country to country, their functions will also be different. To allow for such differences, alternatives and optional elements in the interface standards and in particular in the data model standards may be provided.

9.2 Conformance & Interoperability testing

9.2.1 Conformance testing

An important condition in achieving interoperability is the correct implementation of the standards. This can be verified by *conformance testing*. Conformance testing is the act of determining to what extent a single implementation conforms to the individual requirements of its base standard.

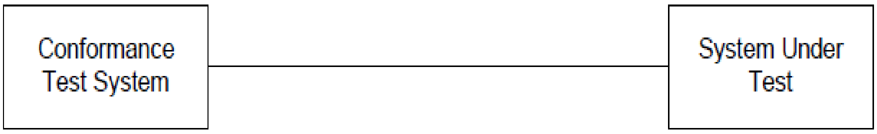


Figure 4 – The principle of conformance testing

During conformance testing, an implementation is tested against a conformance test system as shown in Figure 4 above. Often the scope of conformance testing is limited to end devices. As conformance testing does not belong to the scope of standardization Technical Committees, conformance test systems and a certification scheme shall be made available by a supporting organization of the standard or by third parties. The conformance test plans may be specified either by the Technical Committee developing the base standard or by an organization supporting the standard.

For example: The DLMS user association, which is an open association and driven by the vendors of DLMS components, is involved in certification and testing to ensure that the communication standards using DLMS/COSEM are correctly understood by all market partners.

The DLMS UA Yellow Book specifies a conformance test process and test plans, which can be turned to EN standards if needed.

9.2.2 Interoperability testing

Interoperability testing should be performed to verify that communicating entities within a system are interoperable, i.e. they are able to exchange information in a semantically correct way.

During interoperability testing, entities are tested against peer entities known to be correct. This is shown in Figure 5.

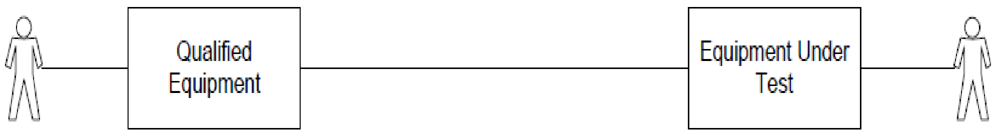


Figure 5 — The principle of interoperability testing

Annex A
(informative)

SM-CG use cases

A.1 Introduction

This annex provides a repository of use cases of potentially wide interest. This repository by nature cannot be complete, because of the differences in the market environment and because of the architectures and technologies.

The use cases describe functionalities which can be envisaged for smart metering systems. They are not prescriptive but are intended to assist ESO Technical Committees in their standardization work and to help the understanding of National Committees and market participants as to the nature of the functionalities rather than defining any particular market model.

— The TCs should use the use cases to specify functional requirements, data models and protocols.

— The NCs and market participants can use the use case repository to pick whatever is useful for their projects. In addition, when they do not find the necessary use cases to cover their needs, they can use the methodology provided to develop their own. Those use cases may be also added to the repository, so it will be a living document.

A.2 Methodology

The methodology to specify the use cases is very important, as it will determine how use cases can be maintained, and how the use cases can be use for product development. A useful (but not easy) tool to use is UML

When developing future use cases, the following structure could be adopted:

— General context, impact and examples

— Characterization/definition of the use case

— Definition of input and/or output parameters for communications

— Timing of information and reactions (alarms, periodicity etc.)

— Test and acceptance criteria

A.3 Table of Use cases

High level functionalities	**Low level functionalities**	**Lowest level functionalities**	**SM-CG Use Cases**
1 **Remote reading of metrological**	1.a Meter readings and other metrological data	1.a.1 On Demand Read	Customer Move In/Out Customer changes supplier Customer has a bill query

High level functionalities	**Low level functionalities**	**Lowest level functionalities**	**SM-CG Use Cases**
registers and provision of these values to designated market organization(s)	recorded at the customer's premises, which are made available to designated market organization(s) at a pre-defined time schedule and on request.	1.a.2 Scheduled Read	MDO collects Daily/Monthly/Quarterly Meter reads MDO collects interval data / profiles Concentrator establishes energy balance for substation and meters supplied by that substation and makes this available to NO Collect multiple meter registers at pre-defined date / time to evaluate network or sub-network efficiency or to allocate cost in a building. Walk-by meter read
	1.b Export metering (i.e. provision of consumption and injection data and on net flows exported)	1.b.1 Export Read	No specific Use Case attached: reading of import and export from/to the supply network is included in above Use-Cases
2 **Two-way communication between the metering system and designated market organization(s)**	2.a Metering system to designated market organization(s). Uploading of data and information to permit e.g. monitoring of supply quality, outages (electricity), network leakage detection (water) and identification of possible meter malfunction - tamper and fraud detection - diagnostics (mainly for electronic components) - meter / metering system status (e.g. battery condition credit/prepayment mode) Also identification of incorrectly sized or blocked meters (water)	2.a.1 New meter Identification	MO / HES identifies newly installed meter Meter and system set up communication MO / HES configures / parameterizes / adjusts meter HES (and DC) re-identifies meter after communication network re-configuration HES (and DC) re-identifies meter after planned or unplanned maintenance of metering system (e.g. Comm. Module, DC, Gateway, Meter, etc.) The HES (and DC) reconfigures itself to adapt to changes on the grid (for example, meters supplied by another substation, thus controlled by another concentrator
		2.a.2 Tamper & Fraud detection	Detect Tampering of the metering system (physical integrity, electromagnetic field, communication, security, fraudulent use of the meter by customer, etc.) Detect tamper of connection to network
		2.a.3 Monitor supply disruption	Provide information on short supply interruptions: number of occurrences. Detection of air (no water) in the network

High level functionalities	**Low level functionalities**	**Lowest level functionalities**	**SM-CG Use Cases**
			Provide information on long supply interruptions: number of occurrences, duration, length No supply/ No flow detection (generates immediate alarm) Accidental large network leak (Water pipe bursting,..): "real" time alarm sent to designated market organization Permanent low level network leak at consumer premises (e.g.: toilet leak): information sent to consumer
		2.a.4 Identify / manage meter and supply network malfunctions	Meter stopped or measurement deterioration alarm: information sent to designated market organization Meter oversized leading to waste of water Meter undersized leading to premature wear and waste of water Reversed water flow detection / Backflow measurement (Error of installation, Network incident, Network pollution prevention, Fraudulent use, etc.) Detect temporary over-voltage / broken neutral
		2.a.5 Monitor supply quality	Provide information on sags and swells (supply voltage variations) Monitoring supply pressure / temperature Provide information on harmonics
		2.a.6 Monitor Diagnostics - electronic components	Retrieve diagnostic information upon detection of inconsistent metering results, before planned maintenance, before unplanned maintenance, before un-installation The MO retrieves battery status from system components The MO checks the version and the integrity of the software / firmware deployed The MO checks collects the result of memory checks of system components Monitor temperature of meter The MO manages alarms generated by the system and informs other

High level functionalities	**Low level functionalities**	**Lowest level functionalities**	**SM-CG Use Cases**
			stakeholders. Refers also to checking facilities (EN14154)
		2.a.7 Monitor meter system status	The MO performs routine communication check with concentrators The MO performs routine communication check with gateway / meter The MO retrieves communication statistics
	2.b Designated market organization(s) to metering system. Downloading data to metering system to enable e.g. - remote configuration of the meter or parameters used by the meter/metering system - clock synchronization - software and firmware updates	2.b.1 Clock synchronization	Synchronize clock as part of scheduled reading
		2.b.2 Remote configuration	Meter operator sets parameters in meters / concentrators (e.g. location information, thresholds for monitoring, etc.) MO / Supplier sets security policy MO / Supplier transfer keys for security algorithms NO sets control parameters for local generation
		2.b.3 Upgrade software & firmware	Meter operator loads new software / firmware in Meter / Data Concentrator (Correct bug, Amend functionality) Meter operator reloads previous software / firmware (roll back)
		2.b.4 Manage contractual parameters - load limits - maximum installed capacity.	Supplier sets / modifies contracted power / flow Supplier sets operating mode for disconnect switch / valve
	2.c Designated market organization(s) to customer i.e. where messages/information shown on metering system. Ability of the metering system to receive messages from	2.c.1 Receive standard message from market organization	Supplier / NO / MO sends standard messages to the display of the meter Supplier / NO / MO sends standard messages to the customer display unit Supplier / NO / MO sends standard messages to Home Automation interface Supplier provides tariff / price

High level functionalities	**Low level functionalities**	**Lowest level functionalities**	**SM-CG Use Cases**
	designated market organization(s), both standard and ad hoc, e.g. on planned interruptions, messages on price changes) and to receive information (incl. account information)		change information
		2.c.2 Receive ad-hoc message from market organization	NO provides planned outage information
		2.c.3 Receive general / account information from market organization	Supplier sends current / historic account information
3. **To support advanced tariffing and payment systems**	3.a Prepayment Metering system to support prepayment (and other payment) options. May also permit credit/prepayment switching.	3.a.1 Prepayment (incl. switching credit << >> prepayment)	Supplier sets debit / credit mode and parameters (like standing charges, debt recovery, lifeline credit) of the meter, as agreed with the customer Supplier loads purchased credit to the electricity / multi-utility meter Customer loads purchased credit via the electricity / multi-utility meter Customer loads credit via customer display
	3.b Multiple rate tariffs Use of multiple registers within meter or recording of interval reads	3.b.1 Communication associated with multiple rate tariffs within Meter	Supplier / MO sets active tariff schedule as agreed by the customer Supplier / MO sets passive tariff schedule as agreed by the customer for future activation
4. **To allow remote disablement & enablement of supply, and flow / power limitation**	4.a Remote connection /disconnection	4.a.1 Remote connection / disconnection	Connect when customer moves in. Disconnect when customer moves out. See also on demand reading Disconnect (locally or remotely) when credit exhausted or payment default. Reconnect (locally or remotely) when customer and supplier agree on bill payment arrangements or credit replenished Disconnect (locally) when set normal / emergency load limit is exceeded or pipe burst. Reconnect manually after loads are removed or pipes repaired. Enable / disable disconnection (e.g. Disable disconnection for protected customers) Check supply status (connected / disconnected)

High level functionalities	**Low level functionalities**	**Lowest level functionalities**	**SM-CG Use Cases**
	4.b Remote flow / power limitation	4.b.1 Remote flow/power limitation	Apply normal / emergency threshold for load limitation per customer group. Minimum amount of water flow or volume out of sanitation reasons Enable / disable flow or power limitation
5. **To provide secure communication enabling the smart meter to export metrological data for display and potential analysis to the end consumer or a third party designated by the end consumer**	5.a Used by customer or other party for load management applications - by means of a local energy management system or home/building control system - where appropriate by direct control of individual devices within the home/building	5.a.1 Load management by Customer or other party on customer's behalf via suitable interface Management of the load on the network (ripple control function)	Customer makes available certain loads for remote load management. Customer reacts to price signals sent and disconnects / reconnects load. Supplier sets daily / monthly consumption limits as agreed by the customer. The customer accepts / rejects it Supplier connect / disconnects certain loads as agreed by the customer for managing the bill (avoid high price periods). The customer accepts / rejects it. Activation of a sprinkler network and diversion of main supply
	5.b Used by customer for information on individual appliance consumption information from micro-generation device(s) on gross electricity generated	5.b.1 Monitoring consumption by Customer	Supplier provides consumption information regarding individual appliances to customer
		5.b.2 Monitoring generation by Customer	Supplier / NO provides local generation information
6. To provide information via web portal/gateway to an in-home/building display or auxiliary equipment	6.a Interfacing with home communications systems / home area network. Enables meter to export metrological and other information for display and potential analysis. Potential for home and building control applications and sophisticated energy management systems	6.a.1 Meter interface to HBES ... info for display / analysis	Supplier/NO provides overall information such as: -Total consumption - Tariff (actual, to come) - Timely consumption (day, month...)
		6.a.2 Meter interface to sophisticated Energy Management System	Supplier/NO provides overall information such as: - Advanced information - Statistics over periods - Scenarios on tariff usage - ….

961

Annex B
(informative)

Abbreviations and glossary of commonly used terms in smart metering

B.1 List of abbreviations

Abbreviation	Description
AMI	Advanced Metering Infrastructure
AMM	Automated Meter Management
AMR	Automatic Meter Reading
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CIS	Customer Information System
COSEM	Companion Specification for Energy Metering
CCG	Customer Communications Gateway
CPE	Customer Premises Equipment
DC	Data Concentrator
DR	Demand Response
DSM	Demand Side Management
DER	Distributed Energy Resource
DLC	Distribution Line Carrier
DLMS	Distribution Language Message Specification
DNO	Distribution Network Operator
ETSI	European Telecommunications Standards Institute
HAN	Home Area Network
HHU	Hand-held unit
HBES	Home and Building Electronic Systems
HBES/BACS	Home and Building Automation and Control products
HES	Head End System
IEC	International Electrotechnical Commission
ISO	International Standards Organization
ISP	Independent Service Provider
LAN	Local Area Network
LN	Local Network
LNAP	Local Network Access Point
MDA	Meter Data Aggregator
MDC	Meter Data Collector

MDMS	Meter Data Management System
MDO	Meter Data Operator
MID	Measuring Instruments Directive
MO	Meter Operator
MDUS	Meter Data Unification and Synchronization System
M2M	Machine to Machine
NN	Neighborhood Network
NNAP	Neighborhood Network Access Point
OBIS	OBject Identification System
OSI	Open Systems Interconnection
PLC	Power Line Carrier
TCO	Total Cost of Ownership
TOU	Time-of-use
VAS	Value Added Services
WAN	Wide Area Network
WS	Web Service
WSDL	Web Services Description Language

B.2 Glossary of commonly used terms - sources

1) Electricity metering - Glossary of terms, IEC 62051, 1st edition 1999-3(2)
2) Electricity metering - Glossary of terms , part 1 - Terms related to data exchange with metering equipment using DLMS/COSEM, IEC 62051-1, 1st edition 2004-1
3) System Requirements Specification - version 1 – October 2009 – UCA Iug - OpenSG – AMI-ENT TF
4) Utility AMI 2008 Home Area Network System Requirements Specification V1.04, August 19, 2008
5) Machine-to-Machine Communications (M2M): Definitions - ETSI draft TR 102 725 V0.3.0
6) ETSI Draft TR 102 691 V0.4.1
7) Wikipedia
8) Dutch Smart Meter Requirements (DSMR) V3.0, March 2010, Netbeheer Nederland
9) EN14154 - Water meters – Part 1 – general requirements and OIML R49-1: 2000
10) EN 50470-1 - Electricity metering equipment (a.c.). General requirements, tests and test conditions, edition 2006
11) International Electrotechnical Vocabulary (IEV) Part 691 – Tariffs for electricity
12) IEC 62055 - Electricity metering – Payment systems - Parts 21 and 31

B.3 Glossary of commonly used terms

Term	Explanation	Source
Actuator	Device which performs some physical action. Note: An actuator might act on the flow of a gas or liquid or on the electricity distribution through a mechanical operation. Dimmers and relays are examples of actuators. The decision to activate the actuator may come from any Object or M2M device (including the M2M gateway)	(5) / (6) - modified
Additional Functionality	Function that a smart metering system provides over and above the metrological functions covered by the Measuring Instruments Directive.	(5) / (6) – modified
Advanced Metering Infrastructure (AMI)	Infrastructure which allows two way communications between the Head-End System and the meter(s) and may be linked to other in-house devices.	(3) - modified
Ancillary Device	Device intended to perform a particular function directly involved in elaborating, transmitting or displaying measurement results.	(9) - modified
Architecture	Structure and behavior of the technology infrastructure of an enterprise, solution or system. Note 1: functional architecture can be viewed as the set of basic information processing capabilities available to an information processing system. Note 2: software architecture of a program or computing system is the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships between them. Note 3: hardware architecture refers to the identification of a system's physical components and their interrelationships.	(7) – modified
Asset Responsible Entity	Organization responsible for installing, configuring and maintaining one or more elements related to Advanced Metering Infrastructure (AMI) assets (e.g. meters, data concentrators, communication devices, gateways).	(5) / (6)
Automated Meter Management (AMM)	Also called Advanced Metering Management. Refers to smart metering actions requiring communication, for example, remote actions. AMM directly incorporates additional functionalities beyond AMR	SMCG

Automatic Meter Reading (AMR)	Technology for remotely obtaining metering data from an on-site meter by communication from an access point outside the premises. AMR technologies include handheld, mobile or fixed network technologies based on telephony platforms (wired and wireless), radio frequency (RF), or Power Line Carrier (PLC)	SMCG
Authentication	Monitoring and verifying of the identity of each party at the beginning of and during a communication.	(1)
Block Tariff	Tariff in which the charge is based on a series of different energy/volume rates applied to successive usage blocks of given size and supplied during a specified period	(11)
Calculator	Part of a meter which receives as input signals from transducer(s) and possibly from associated measuring instruments, performs a calculation and, if appropriate, stores the result(s) in memory until they are required. Note: A calculator may also be capable of bi-directional communication with ancillary devices	(9)
Checking facility	1. Facility incorporated into electronic water meters which enables significant faults to be detected and acted upon. 2. Facility incorporated into a transmission device to verify that all the information which is transmitted (and only that information) is correctly received by the receiving equipment	(9)
(Data) Concentrator	Intelligent station in a hierarchical communications network where incoming data (generated by multiple meters) is processed as appropriate and then repackaged, relayed, retransmitted, discarded, responded to, consolidated, prioritized and / or increased to multiple messages.	(1) - modified
Conformance **Consumer**	Fulfillment of a product, process or service of specified requirements. End user of electricity, gas, water or heat. Note 1: The Meter Data Collector (and when applicable also his supplier) may communicate with the consumer through the AMI. Note 2: As the consumer can also generate energy using a Distributed Energy Resource, he is sometimes called the "Prosumer".	ISO/IEC Guide 2 (1996) (6) - modified
Companion Specification for Energy Metering (COSEM)	Interface model for communicating with energy metering equipment, providing a view of the functionality available through the communication interfaces. Note: The modelling uses an object oriented approach.	(2) – modified

Customer	Purchaser and/or user of a product or service supplied by an organization. The Customer may be the ultimate consumer, user, beneficiary or purchaser. Note: In the context of Smart Metering the Customer is the same person as the Consumer.	(1) - modified
Customer communications gateway (CCG)	Protocol converter between the internal message standard and the communications channel message standard. Note: Not necessarily a separate device, it may be an integrated function.	(1)
Customer premises equipment (CPE)	Equipment installed at the customer's premises.	(1) – modified
Data encryption	Method to ensure data confidentiality. Encryption transforms intelligible data, called plaintext, into an unintelligible form, called ciphertext. This process is reversed through the process of decryption. Once data is encrypted, the ciphertext does not have to be protected against disclosure	SMCG
Data integrity	Ability of a communications system to deliver data from its source to its destination with an acceptable and measurable residual error rate.	(1)
Data security	Prevention of one or more of the following: a) unauthorized access to information within a data stream; b) unauthorized alteration of information within a data stream; c) unauthorized generation of messages which could be taken as valid by the receiving equipment d) denial of service Also see '**Security**'.	(1)
Demand Response (DR)	See '**Demand Side Management**'	(3)
Demand Side Management (DSM)	Implementation of programmes designed to influence product or service demands. Note: Such programmes allow the network to benefit from changes in the timing and magnitude of demand so as to maximize the cost effective use of network resources and enable the customer to benefit by being better able to control total consumption and cost.	(1) – modified
Disconnection	Removal of supply from a consumer premises by physical disconnection of the supply.	(1) - modified

Distributed Generation	Electricity generation from multiple small energy sources thus allowing more efficient energy distribution. Note: Energy is generated closer to the point of consumption, thus reducing network losses.	(3) – modified
Distributed Energy Resource (DER)	Small energy source generating energy locally. Note: Examples of a DER are windmills and solar panels installed at consumers premises.	ESMIG
Distribution Line Carrier (DLC)	Communications technology that enables the transmission and reception of digital information over low-voltage and medium-voltage power distribution networks. Note: DLC is often referred to as "low voltage PLC" and therefore in practice PLC is also used as synonym for DLC.	(1)
Device Language Message Specification (DLMS)	ISO-OSI Application Layer specification, independent of the lower layers and thus of the communication channel, designed to support messaging to and from (energy) distribution devices in a computer-integrated environment. Note: DLMS is specified in IEC 62056-53 and is an evolution of the Distribution Line Message Specification specified in IEC 61334-4-41.	(2)
Distribution Network Operator (DNO)	Organization responsible for managing the electricity, gas, heat and/or water network supplying consumer premises. Note: Also known as Distribution System Operator (DSO)	(5) / (6)
Electronic device	Device employing electronic sub-assemblies to perform some special function. Electronic devices are usually manufactured as separate units and are capable of being tested independently. Note: Electronic devices as defined above may be complete meters or parts of meters/metering systems	(9)
Energy Services Provider	Organization offering energy services to the consumer.	(5) / (6) – modified
Extensible Markup Language (XML)	Set of rules for encoding documents electronically capable of describing many different kinds of data. Its primary purpose is to facilitate the sharing of data across different systems. Note 1: XML is defined by the W3C in the XML 1.0 Specification and several other related specifications. Note 2: XML's design goals emphasize simplicity, generality, and usability over the Internet. It is a textual data format, with strong support via Unicode for the languages of the world	(7) - modified

Function	Process which constantly or at defined intervals, automatically or on demand, performs specific activities such as sampling data, reading a data set, verifying or changing a status, or activating a switch. An application is composed of one or more functions. A function can be basic or optional.	(1)
Gateway	Device that fully implements the ISO-OSI model for all layers and is used to convert data protocols between different communication systems and standards. Note: Gateways work on all seven layers of ISO-OSI architecture. The main job of a gateway is to convert protocols between communications networks	(1) / (7)
Hand-held unit (HHU)	Portable device for reading and programming equipment or meters at the consumer's premises or at the access point. Note: Also known as Hand-held Terminal Unit	(1)
Home and Building Electronic System (HBES)	System for the integration of control applications and the control and management aspects of other applications within a domestic or building environment, including gateways to different transmission media and public networks.	Scope definition of TC205
Home and Building Automation and Control (HBES/BACS) products	Devices intended to be used for the control, monitoring, operation or management of building services and/or home electronic systems that can interact via a communication network.	EN 50491-1
HBES/BACS system	Any combination of HBES/BACS products (including their separate connected/detachable devices) linked together via one or more HBES/BACS networks. Note: Other names used to describe types of HBES/BACS systems include "Home Control Network", "Home Control System", "Home and Building Electronic System", "Building System", "Building Automation System", "Home Automation System", etc.	
HBES Open Communication System	Specialized form of automated, decentralized and distributed process control dedicated to the needs of home and building applications. Note: The HBES open Communication System is defined in EN 50090-1	prEN 50090-1
Head End System (HES)	Central Data System collecting data via the AMI of various meters in its service area. It communicates via a WAN directly to the meters and/or to Data Concentrators or Gateways.	ESMIG
Home Area Network (HAN)	In-house LAN which interconnects domestic equipment and can be used for energy management purposes. Note: There can be multiple HANs inside a customer's premises.	ESMIG

Index	For gas and water the current reading of the total volume (mass) passed through the meter. Note: for Electricity/Heat Meters referred to as Register	TC 294
Interface	Point or means of interaction between two systems.	(1)
Interchangeability	Ability to exchange one device by another without reducing the original functionality and without dysfunction or loss of efficiency for the whole system. Not to be confused with interoperability	SMCG
Interoperability	Ability of a system to exchange data with other systems of different types and/or from different manufacturers.	(2) – modified
Interval Data	Information on energy consumed or demand during a pre-defined interval, typically 15, 30 or 60 minutes. Each value is completed with a time stamp and status. Note: Interval data can be recorded in two ways: • Index/register values logged at pre-set time intervals • Consumption within a defined interval (incremental value of index/register	SMCG
Load Balancing	Ability to use network information and/or on-site intelligence to reconfigure distribution networks or to limit customer loads to maintain desired levels of service and improve the utilization of assets	(1) - modified
Load Limitation	Restricted capacity / energy flow resulting in self-disconnection of supply by the meter if the defined threshold was exceeded	SMCG
Load Profile	Recording and storage of consumption data over a period of time for a specific installation. Note: The data would typically be recorded at appropriate intervals, typically hourly or half-hourly, to allow consumption to be profiled on a daily or weekly basis and to permit Time of Use billing data to be extracted.	(1) – modified
Load Shedding	Process of deliberately disconnecting selected loads from the utility supply system in response to excess demand in order to maintain the stability of the system, to provide supply to as large a number of consumers as possible, or to avoid excessive supply costs. Note: Specific function for electrical power systems	(1) – modified
Load Switch	Device allowing connecting or disconnecting loads on various conditions. The load switch may be integrated with the meter. For gas and water referred to as Valve.	SMCG

Local Area Network (LAN)	Data communication network, connecting a limited number of communication devices (meters and other items) and covering a moderately sized geographical area. Note 1: may be referred to as Meter Network when dedicated to metering. Note 2: may be referred to as Neighborhood Area Network as a network between the Data Concentrator and the Meter or Gateway.	(1) – modified
Logical Data Model	Representation of an organization's data based upon entities and attributes of those entities. Note: A logical data model is often a logical representation of a business' integration or business requirements.	(3)
Meter	Instrument for measuring, memorizing and displaying the consumption of a commodity.	(1) – modified
M-bus (Meter Bus)	A communication standard (wired or wireless) for data exchange with end devices, including, but not limited to utility meters	TC294
Meter Data	Meter readings that allow calculation of the quantity of electricity, gas, water or heat consumed over a period. Meter data thus includes daily and monthly meter readings, interval readings and actual meter register values. Other readings and data may also be included (such as quality data, events and alarms)	(8)
Meter Data Aggregator (MDA)	Entity which offers services to aggregate metering data by grid supply point on a contractual basis. Note: The contract is with a supplier. The aggregate is of all that supplier's customers connected to that particular grid supply point. The aggregate may include both metered data and data estimated by reference to standard load profiles	(1) – modified
Meter Data Collector (MDC)	Entity which offers services on a contractual basis to collect metering data related to a supply and provides it in an agreed format to a data aggregator (that can also be the DNO). Note: The contract is with a supplier or a pool. The collection may be carried out by manual or automatic means.	(1) – modified
Meter Data Management System (MDMS)	System for validating, storing, processing and analyzing large quantities of meter data.	(3) – modified
Meter Operator (MO)	Entity which offers services on a contractual basis to provide, install and maintain metering equipment related to a supply. Note: The contract may be with the customer, the supplier or the DNO. The meter may be rented to, or owned by, the customer	(1)

Micro Generator	Source of electrical energy and all associated equipment designed to operate in parallel with the low voltage system, rated up to specified current / power levels. These levels can vary between Member States.	SMCG
Micro Generation	Local supply of electrical energy to the low-voltage network. Maximum power or current levels are individually set by Member States. As compared to DER a micro generator produces limited power primarily for own use and may involve export to the low-voltage network.	SMCG
M2M Gateway	May be a part of a physical realization of the LNAP and/or NNAP connecting to a Head End System. In addition to the gateway functionality, it provides Service Capabilities and a data path to these entities.	(5) - modified
OBject Identification System (OBIS)	System defining identification codes for commonly used data items in metering and other equipment. Note: Specified in IEC/EN 62056-61	(2) - modified
Open Systems Interconnection (OSI)	Framework for communications processes, defined by ISO, in which the process is divided into seven functional layers, arranged vertically with each having separate and defined responsibility. Each layer communicates only with the layer immediately above and below.	(1) - modified
Payment Meter	Meter with additional functionality that can be operated and controlled to allow the flow of energy according to agreed payment modes	(12) - modified
Prepayment Mode	Payment mode in which disconnection occurs when available credit is exhausted	(12) - modified
Power Line Carrier (PLC)	Communications technique using high frequency signals to transmit data over (high voltage) transmission lines transporting electrical power. NOTE: In practice the term PLC is also used for communication over distribution lines (low-voltage PLC).	(1) - modified
Process	Logically linked sequence of tasks that enables a system to achieve particular objectives. NOTE: A process may interact with other processes. Processes may be business processes or support processes	(12) - modified
Protocol	Rules for communication system operation that must be followed if communication is to be effected. Protocols cover one or more layers of the OSI model.	(1)

Read Data Recipient	Organization or person authorized to receive meter reading data from the smart metering system. NOTE: This actor can be any of the other actors defined in the scope that is authorized to receive read data.	(5) / (6)
Register	Specific section in the memory of the control and metering unit that records data as determined by the programme in the unit. NOTE 1: For gas and water referred to as index. NOTE 3: The meter can have more than one register	(1) / (2)
Requirement	Statement that identifies a necessary attribute, capability, characteristic or quality of a system in order for it to have value and utility to a user. Note 1: In systems engineering, a requirement can be a description of what a system must do, referred to as a Functional Requirement. A requirement may alternatively specify something about the system itself, and how well it should perform its functions. Such requirements are often called Non-Functional Requirements, or 'Performance Requirements' or 'Quality Of Service Requirements'. Note 2: One common way to document a requirement is stating what the system shall do by, for example, generating a Use Case.	(7)
Security	Measures that protect and defend information and information systems by assuring their confidentiality, integrity, access controls, availability and accuracy. See also "**Data Security**".	(4)
Sensor	Device that measures a physical quantity and converts it to an analogue or digital signal that can be read by a programme or a user. Note: Sensed data can be of many types: electromagnetic (e.g. current, voltage, power), mechanical (e.g. pressure, flow, liquid density, humidity), chemical (e.g. oxygen, carbon monoxide, ...), acoustic (e.g. noise, ultrasound), ...	(5)/(6) – modified
Service capabilities	Functions that are to be shared by different applications. Service capabilities make functionalities available through a set of open interfaces using core network functionalities. Service capabilities also allow to simplify and optimize applications development and deployment and to hide network specificities to applications. Service Capabilities may be M2M specific or generic, i.e. providing support to other than M2M applications. Examples include: Data Storage and Aggregation, Unicast and Multicast message delivery, etc.	(5)/(6)– modified

Service provider	Organization providing a product or service. Such service could be the reading of the data and/or status information of metering devices	(1)
Service oriented architecture (SOA)	Concept of grouping business functionality around business processes. These services are then packaged as interoperable services. Note: An SOA architecture allows for the transmission of data between multiple systems as they participate in multiple business processes.	(3)
Simple Object Access Protocol (SOAP)	Protocol for exchanging XML messages for web services in a service oriented architecture implementation.	(3)
Service Level Agreement (SLA)	That part of a service contract where the levels of the services are agreed upon between two systems.	(3)
Smart Grid	Electricity network that intelligently integrates the behavior and actions of all users connected to it – generators, consumers and those that do both – in order to efficiently ensure a more sustainable, economic and secure electricity supply	Eurelectric - Modified
Smart Meter	Meter with additional functionalities one of which is data communication.	SMCG
Supervisory Control and Data Acquisition (SCADA)	System that monitors and controls technical processes such as transmission and distribution of commodities. SCADA-EMS and SCADA-DMS are examples used for control of electric power transmission and distribution networks.	SMCG
Supplier	Entity that offers contracts for supply to a consumer (the supply contract) and bills the consumers for consumption based on meter data received from the Meter Data Operator or Collector. The bill may also include grid-related costs charged by the network to the supplier, in which case the consumer gets only one bill. Note: In some countries referred to as Retailer	(1) – modified
Tariff	Price structure (normally comprising a set of one or more rates of charge) applied to the consumption of a product or service provided to a consumer.	SMCG
Tamper monitoring	Function to detect attempts to corrupt the metering equipment or the data stored within it. It may automatically raise an alarm.	(1) – modified
Theft detection	Facility to identify attempts to circumvent the metering system. It may automatically raise an alarm.	(1) – modified

Time-of-Use (ToU) metering	Meter that records metered or measured quantities according to the periods of the day (e.g. consumption for peak load hours, consumption for day hours, consumption for low load hours) and/or different days of the week, month or year.	(1)
Time-of-Use (ToU) tariff	Price structure with rates that can vary according to the time of use based on time and/or the day (weekday, weekend, holiday, etc). Rates may also vary according to the time of the year.	(1)
Unified Modeling Language (UML)	General purpose modelling language used for object/data modelling. UML is also used to model the interaction between one or more actors in a Use Case.	(3) – modified
Use Case	Description of the interaction between one or more actors, represented as a sequence of simple steps. Note 1: Actors are entities that exists outside the system ('black box') under study, and which take part in a sequence of activities in a dialogue with the system to achieve a specific goal. Actors may be end users, other systems, or hardware devices. Note 2: Each Use Case is a complete series of events, described from the point of view of the actor.	(7) - modified
Use Case actor	Entity involved in a Use Case, e.g. organizations (Consumer, Distribution Network Operator, Read Data Recipient, etc.) and/or systems (HES, CIS, DC, Meter, Gateway, etc)	(5)/(6) – modified
Use Case diagram	Type of behavioral diagram generated using the Unified Modelling Language (UML) and defined by and created from a Use-case analysis. Note 1: The purpose of a Use Case Diagram is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. Note 2: The main function of a use case diagram is to demonstrate what system functions are performed for which actor. Roles of the actors in the system can be thus depicted	(7) – modified
Value Added Service (VAS)	Additional Service that can be provided at the consumer premises, e.g. energy management, security and medical alarms, etc.	(1)
Valve	Device for connecting and interrupting the supply of a non-electric commodity	SMCG
Wide Area Network (WAN)	Extended data communication network connecting a large number of communication devices over a large geographical area.	(1) - modified

Web Service (WS)	Typically application programming interfaces (API) or web APIs that can be accessed over a network, such as the Internet, and executed on a remote system hosting the requested services. Note: In common usage, the term refers to clients and servers that communicate over the Hypertext Transfer Protocol (HTTP) protocol used on the web	(7) – modified
Web Services Description Language (WSDL)	Use of XML format to describe web services and the messages that interface with the web services.	(3)

Annex C
(informative)

Functional reference architecture for smart metering communications and configuration examples

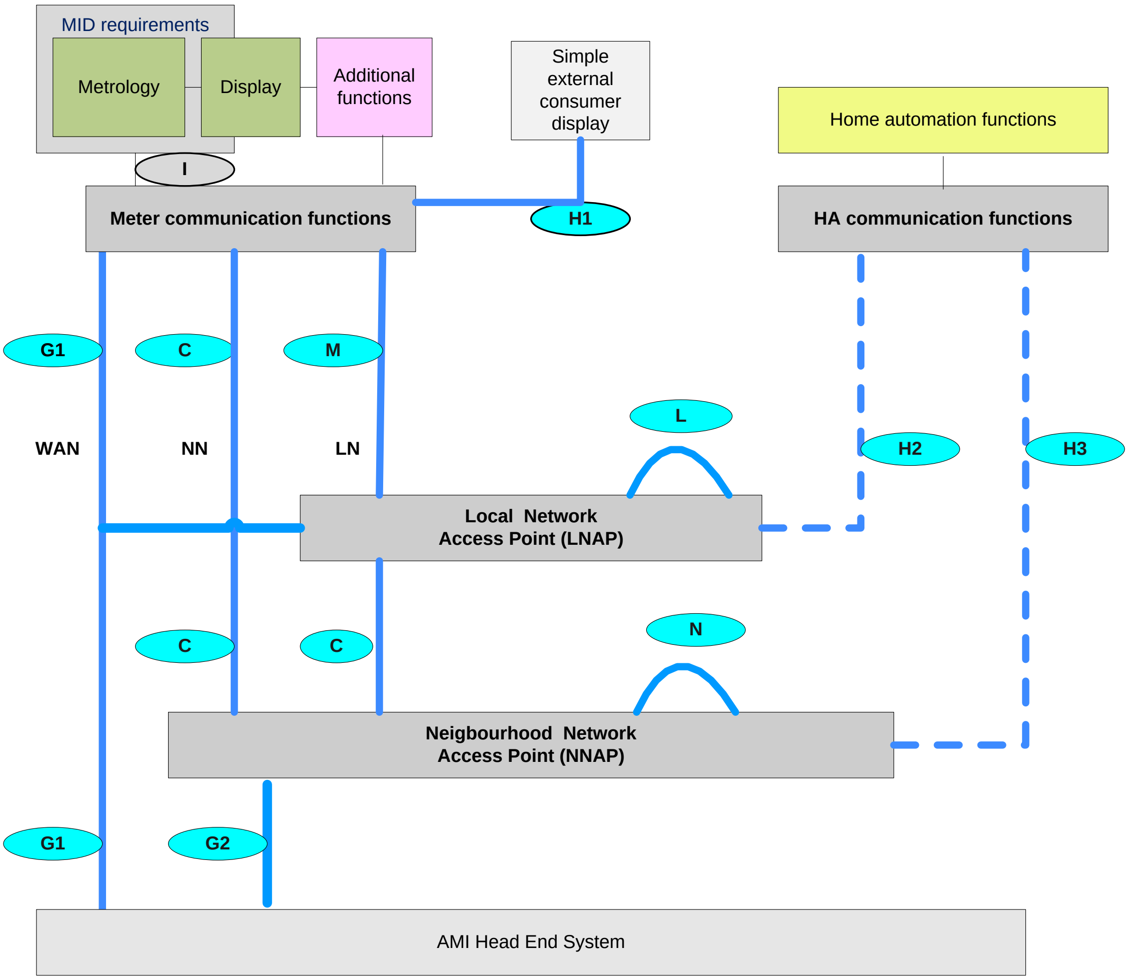
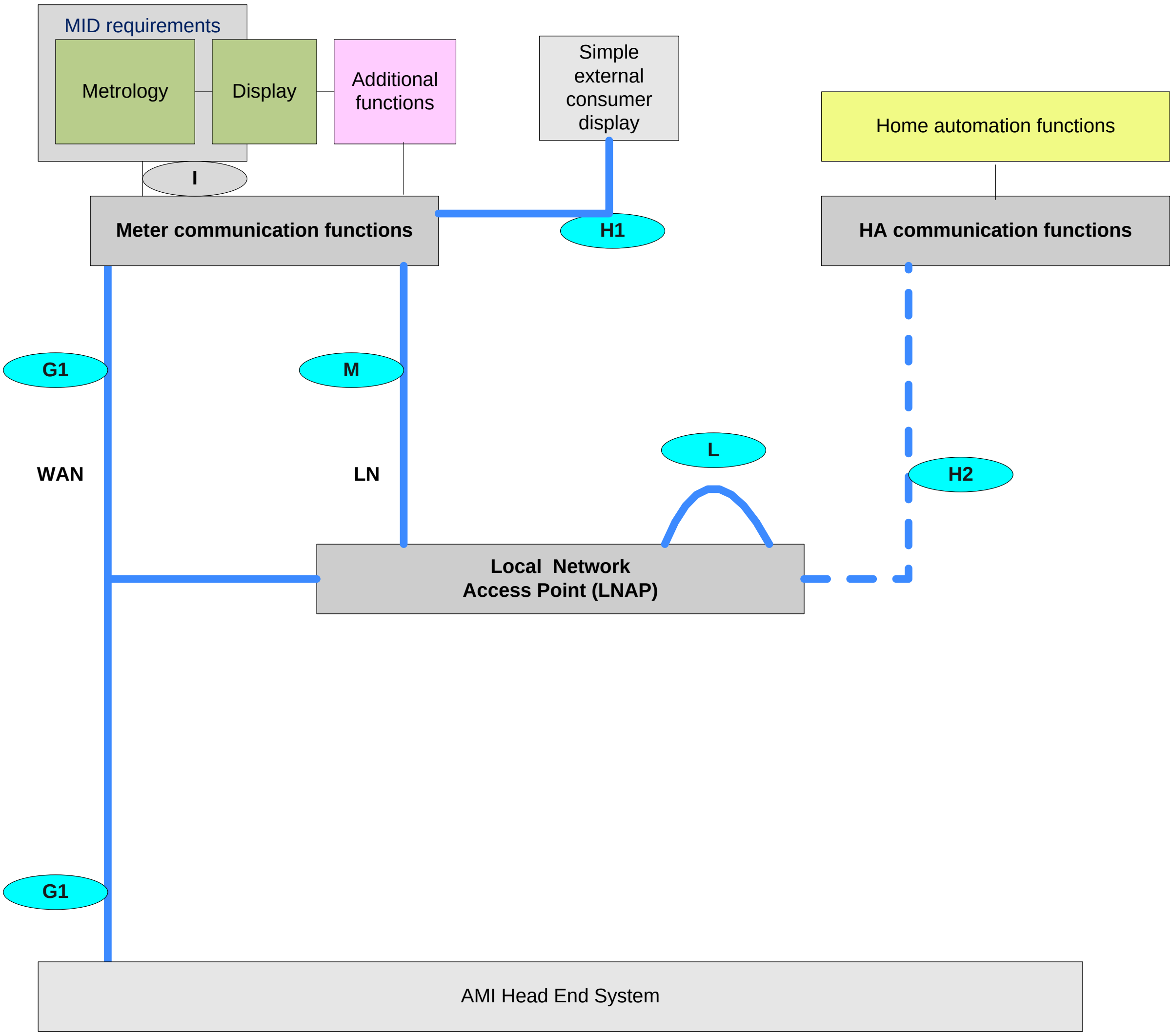
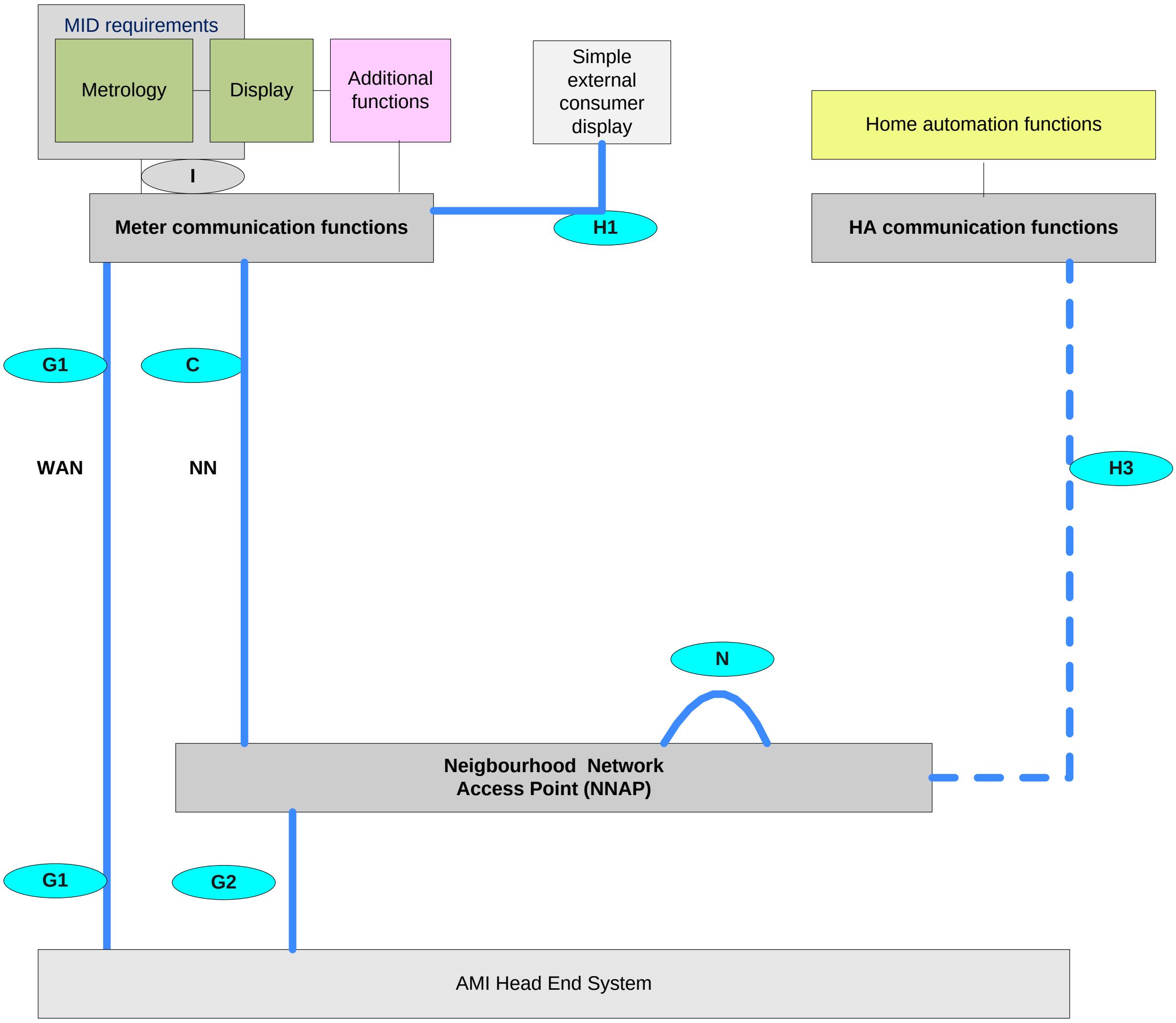


Figure C.1 — Functional reference Architecture for smart metering communications - as shown in section 6.3; Figure 2



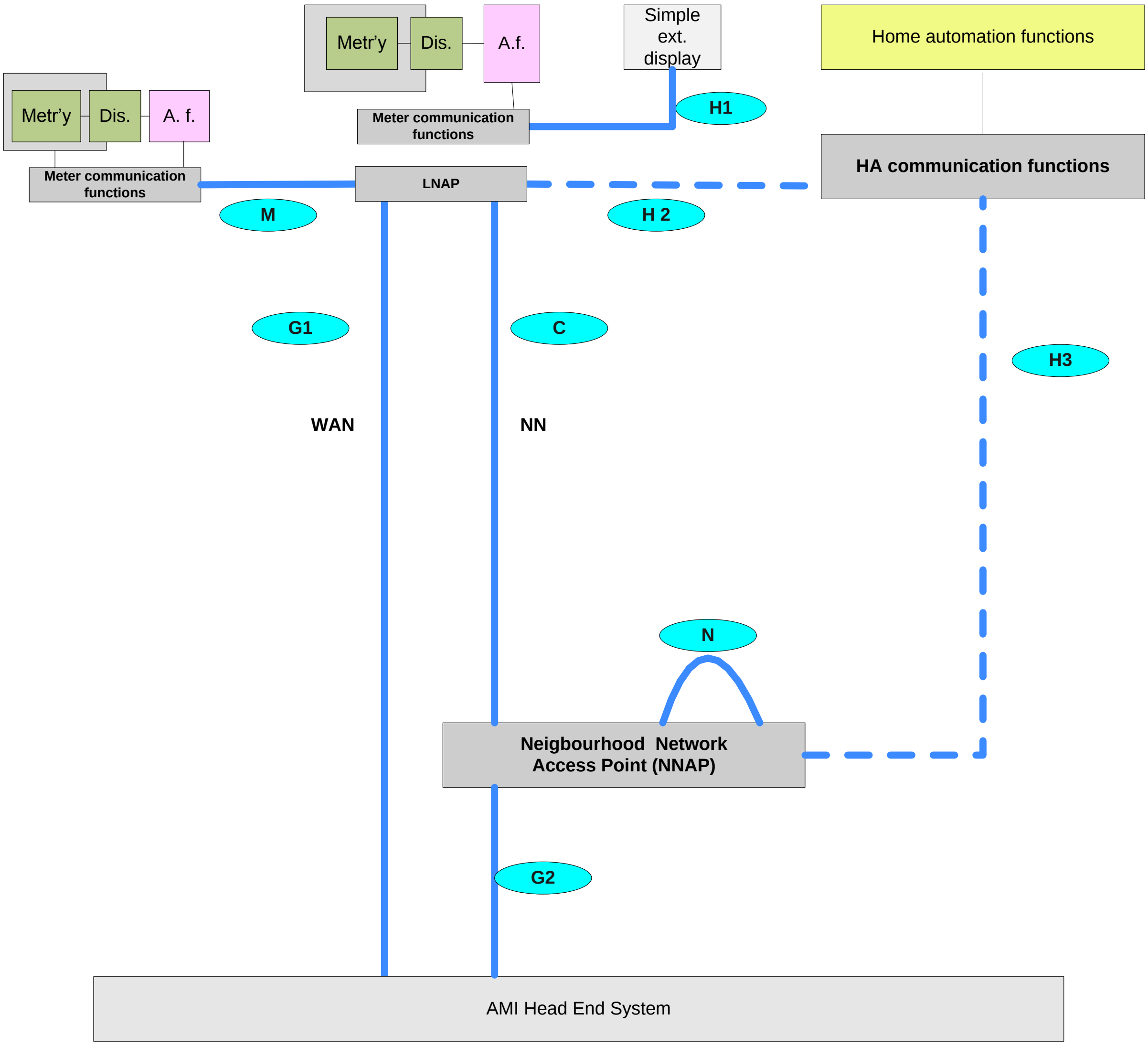
1043

1044 **Figure C.2 — Configuration example (i) – no neighbourhood network**



1045

1046 **Figure C.3 — Configuration example (ii) – no local network**



1047

1048 **Figure C.4 — Configuration example (iii) – G/W/H communications via electricity LNAP**

Annex D
(informative)

Product standards related to additional functionalities

In addition to the above work on communications, the ESO work programme includes standards for additional functionalities, as follows:

<u>Standards for Electricity meters</u> (under the responsibility of CLC TC 13)

— EN 50470-1: Electricity metering equipment (a.c.) Part 1: General requirements, tests and test conditions - Metering equipment (class indexes A, B and C)

— *EN 50470-3: Electricity metering equipment (a.c.) Part 3: Particular requirements - Static meters for active energy (class indexes A, B and C)*

The above two standards are harmonized under the MID.

— EN 62052-11: 2003: Electricity metering equipment (a.c.) - General requirements, tests and test conditions - Part 11: Metering equipment

— EN 62053-21 2003 Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)

— EN 62053-23: 2003: Electricity metering equipment (a.c.) - Particular requirements - Part 23: Static meters for reactive energy (classes 2 and 3)

— EN 62056-24 (draft) Electricity metering equipment (a.c.) – Particular requirements – Part 24: Static meters for reactive energy (classes 0,5 S, 1 S and 1)

Standards for tariff and load control

— EN 62052-11 2003: Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 21: Tariff and load control equipment

— EN 62054-21: 2004: Electricity metering (a.c.) – Tariff and load control – Part 21: Particular requirements for time switches

Standards for payment metering:

— EN 62055-21: 2005: Electricity metering – Payment systems – Part 21: Framework for standardization

— EN 62055-31:2005, Electricity metering – Payment systems Part 31: Particular requirements – Static payment meters for active energy (classes 1 and 2)

<u>Standards for Gas meters</u> (under the responsibility of CEN TC 237)

— EN 1359: Gas Meters – diaphragm gas meters

— EN 12480: Gas Meters – rotary displacement meters

— EN 12261: Gas Meters – turbine gas meters

- EN 12405-1: Gas meters – conversion devices – Part 1 Volume conversion
- EN 14236: Ultrasonic domestic gas meters
- TR 16061: Gas meters – Smart gas meters

Standards for Water meters (under the responsibility of CEN TC 92)

- EN 14154: Water meters

Standards for Heat meters (under the responsibility of CEN TC 176)

- EN 1434: Heat meters

Annex E
(informative)

History

Document history		
V0.1	28th April 2010	D. Johnson: First Draft for discussion on SMCG WGR meeting
V0.1.1	25th May 2010	J. Koss: Modifications based on review during SMCG WGR meeting on 6th May - implementation of clause 11 History - implementation of document header showing document title and revision on each page - incorporation of document SMCG_WGR_0007 section “Architecture” (draft of 21.05.10) including additional editorial modifications - introduction of formal editor’s notes - updates of ETSI standards in sections 6.1, 6.2, 6.3, 6.4 and 7.4
V0.1.2	25th May 2010	D. Johnson: Modifications already advised by TC 237 (J. Sibley), D. Doucet and C. Vigneron, plus minor editorial suggestions
V0.1.3	27th May 2010	J. Koss: - Editorial changes in the headlines of sections 6 and 7 to adapt them to the interfaces listed in section 5. - Deleted interfaces, which are no more listed in the figure 5.1, e.g. C1, C2 is now C
V0.1.4	28th May 2010	D. Johnson: Inclusion of comments from TC13 by B. Schulz plus further editorial changes / questions
V0.1.5	2nd June 2010	D Johnson: redrafted / rearranged sections to reflect written comments on v0.1.4 and teleconference on 1st June 2010
V 0.2	7th June 2010	D. Johnson accepted redrafted sections for version to be circulated for SM-CG meeting on 14th June 2010
V0.2.1	1st July 2010	D. Johnson/Ralf Hoffmann: includes limited changes following SM-CG comments after meeting of 14th June 2010
V0.2.2	2nd July 2010	D.. Johnson: structural & other changes following GDF/Marcogaz comments
V0.3	6h July 2010	D Johnson: Version for consideration at WGR on 9th July Comments/queries from TC 205,TC 237, Eurelectric, GDF-Suez, T&D Europe Eureau & ETSI included
V0.3.1	20th July 2010	D Johnson: V0.3 revised to reflect comments subsequently received from AQUA and TC13 and advice at WGR meeting on 9th July.
V0.3.2	10th Sept 2010	D Johnson: V0.3.1 revised to include comments received at/since WGR meeting on 17th August - section 5 subject to further review

V0.3.3	3rd Oct 2010	D Johnson: V0.3.2 revised to reflect decisions at WGR meeting on 17th September and outcome of subgroup work on section 5 & architectures –for CAG 4th October
V0.3.3rev	4th October 2010	D Johnson: As above but including further Editor's notes indicating work agreed at CAG
V0.3.4	18th October 2010	D Johnson: Includes changes agreed at CAG and WGR on 11th October
V0.3.5	4th November 2010	D Johnson: includes consolidated comments resulting from expert group meeting on 26th/27th October & other amendments to 0.3.4
V0.4.0	9th November 2010	D Johnson: minor corrections to v0.3.5
V0.4.1	21st January 2011	D Johnson: changes resulting from discussion with Commission at SMCG meeting on 18th November and subsequently – interim version to CAG.
V0.4.2	2nd February 2011	D Johnson: updated following advice from CAG, not generally circulated
V0.4.3	4th February 2011	D Johnson: final editorial points