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Communication systems for meters — Wireless mesh networking for meter data exchange

Part 1: Introduction and standardization framework

National foreword

This British Standard is the UK implementation of EN 16836-1:2016.

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Kommunikationssysteme für Zähler - Drahtloses Mesh-Netzwerk für den Zählerdatenaustausch - Teil 1: Einführung und Standardisierungs-Rahmen

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 16836-1:2016) has been prepared by Technical Committee CEN/TC 294 "Communication systems for meters and remote reading of meters", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

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Introduction

The EN 16836 series of standards details requirements for gas meters, water meters and heat meters that can interoperate with products in a mesh network that conform to this standard through a smart energy profile application layer. This standard refers to documents made freely available by the ZigBee Alliance, an organization that manages a mesh network specification (see www.zigbee.org/about/centc294).

This series of standards specifies how a mesh networking radio specification applies within the scope of European standards at the application layer, networking layer and also medium access control/physical layer (MAC/PHY). All parts are intended to be used in conjunction.

The scope of this series is in line with the scope of CEN/TC 294, “Communication systems for meters and remote reading of meters”, and allows data produced by utility meters to be read by a WAN communications hub, another meter, a separate meter display unit or any other device implementing this smart energy profile standard. Within the wider smart energy profile and referenced documents, there are also clusters and data objects that relate to other devices, such as programmable thermostats, but these clusters are outside the scope of CEN/TC 294 and as such are omitted from this standard. However, details of these data items can be found in the same documents that are referenced in this standard.

EN 16836 consists of the following parts:

— EN 16836-1, *Communication systems for meters — Wireless mesh networking for meter data exchange — Part 1: Introduction and standardization framework*

— EN 16836-2, *Communication systems for meters — Wireless mesh networking for meter data exchange — Part 2: Networking layer and stack specification*

— EN 16836-3, *Communication systems for meters—- Wireless mesh networking for meter data exchange — Part 3: Energy profile specification dedicated application layer*

This standard series is created in compliance with the terms of a memorandum of understanding (MOU) between CEN/CELELEC and the ZigBee Alliance. The principles underpinning the relationship between CEN/CENELEC and the ZigBee Alliance are described in the Consortium Bridge procedure. A copy of the MOU and the Consortium Bridge can be obtained from CEN/CENELEC.

In a similar way to the FLAG Association providing registration services for manufacturer codes used in DLMS/COSEM and MBus for meter reading, the ZigBee Alliance acts as a Registration Authority for manufacturer identifiers so that there is a guarantee of no clash between manufacturers.

NOTE The term 'ZigBee' and the ZigBee Logo are registered trademarks of the ZigBee Alliance and their use is subject to the conditions of membership.

1 Scope

This European Standard gives provisions on the standardization framework of communication systems applicable to the exchange of data from metering devices to other devices within a mesh network. It includes information on the application process functions, layered protocols and metering architecture.

This European Standard also specifies how to interpret Parts 2 and 3 of EN 16836 which give a list of references to the ZigBee documents. This standard is applicable to communications systems that involve messages and networking between a meter or multiple meters and other devices in a mesh network, such as in home displays (IHDs) and communications hubs. This standard allows routing between devices and also allows channel agility to avoid contention with other networks of the same type, or networks of other types operating in the same frequency bands.

This standard is designed to support low power communications for devices such as gas and water meters which can make data from such devices available on the mesh network at any time through a proxy capability within a permanently powered device

NOTE 1 This standard specifies a communication protocol that can embrace a multitude of smart metering architectures from a variety of countries. This standard is not designed to limit, or indeed imply a choice or preference to any one of the many possible architectures, but more over provide information on how devices can use this communications standard to publish and receive information from meters over a network.

NOTE 2 This standard defines a protocol that can be used for either a type M interface, or a type H1 interface, however H1 interfaces are not within the scope of CEN/TC 294.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CEN/CLC/ETSI/TR 50572:2011, *Functional Reference Architecture for Communications in Smart Metering Systems*

IEEE 802.15.4, *IEEE Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (LR-WPANs)*

ZigBee Specification – 05-3474 Rev 20, September 7, 2012

ZigBee Pro Stack Profile – 07-4855 Rev 05, January 2008

ZigBee Cluster Library – 07-5123 Rev 04, April 26, 2010

ZigBee Smart Energy Standard 07-5356 Rev 19, December 3, 2014

OTA Cluster Specification 09-5264 Rev 23, March 12, 2014

NOTE The above ZigBee documents and OTA Cluster Specification can be obtained from www.zigbee.org/about/centc294.

3 Terms, definitions, acronyms and abbreviations

For the purposes of this document, the terms, definitions, acronyms and abbreviations given in the following apply.

- ZigBee Specification – 05-3474 Rev 20,
- ZigBee Pro Stack Profile – 07-4855 Rev 05,
- ZigBee Cluster Library – 07-5123 Rev 04,
- ZigBee Smart Energy Profile Specification 07-5356 Rev 19, and
- OTA Cluster Specification 09-5264 Rev 19

4 Application process functions

4.1 Architecture

The ZigBee Protocol operates using a concept of a client server relationship between logical devices in a network and uses a concept of clusters to exchange information. A cluster is a related collection of commands and attributes, which together define an interface to specific functionality. Typically, the entity that stores the attributes of a cluster is referred to as the server of that cluster, and an entity that affects or manipulates those attributes is referred to as the client of that cluster.

In general terms all clusters have a server and a client side, meaning that all information either published or requested on the network is owned by the device attached to the server side of a cluster and received or requested by the device attached to the client side of that particular cluster.

4.2 Basic principles

4.2.1 Mirroring

Mirroring is described in detail in Annex D of the ZigBee Smart Energy Profile Specification 07-5356 Rev 19. The concept of this functionality is to allow data from a battery operated, sleepy device to be available all of the time to other devices on the network by allowing another 'always on' device to hold a copy of the device's data in a proxy or mirror. This proxy or mirror can also be used to allow commands or instructions from an AMI Head End System to be issued to a sleepy device without necessitating the sleepy device to be awake at the time of transmitting the command.

This functionality is commonly used in the case of a gas meter that wakes up every so often to check for commands awaiting it, and to publish its own meter readings, status, alarms etc. The principle is that the gas meter will awaken and query the mirror that is supported in the 'always on' device to determine what commands are awaiting it. The 'always on' device will inform the sleepy device that there are instructions or commands awaiting it and tell the gas meter to stay awake to receive them. The gas meter will then have the chance to write its own cluster data to the mirror ready for other devices on the network to read this data or be sent it (depending on the device and data item).

4.2.2 Tunnelling

This functionality is discussed in detail in ZigBee Smart Energy Profile Specification, D.6, and allows the transport of another protocol over a ZigBee smart energy network without the need for any other device on the network having to understand or interpret the payload of the other protocols packets. Fragmentation functionality within the ZigBee Protocol allows the packets of the tunnelled protocol to be broken down and transported across the smart energy (SE) network in packets that are of appropriate size to be managed by the SE Network. Once packets have been transported from one device to the other over the tunnel, these native format packets are reassembled and presented to the application that understands them.

EXAMPLE A ZigBee smart energy network containing a communications hub, an electricity meter and an IHD, in which the IHD and communications hub only understand ZigBee Smart Energy Profile whereas the electricity meter understands ZigBee Smart Energy Profile and DLMS/COSEM.

Use of this tunnelling function within a ZigBee smart energy network enables the user to route a DLMS/COSEM message to the electricity meter from the head end system through the hub, without the hub having to understand the COSEM message. This equally applies to any other protocol that has the possibility to be transported over a wireless connection, and can be used in many applications including for the transport of manufacturers' own proprietary protocols.

4.2.3 Commissioning

This functionality within the ZigBee Smart Energy Profile is discussed in detail within ZigBee Smart Energy Profile Specification 07-5356 Rev 19, 5.5. However, first every device on the ZigBee smart energy network shall be authorized to join that network and as such has to undergo some form of commissioning process. Within the specification this has been left deliberately flexible in terms of approach to ensure that innovation is not stifled within different implementations. For security purposes it is necessary for certain information relevant to a prospective joining device to be passed to the device on the network containing the trust centre and coordinator. This passing of information happens in an out of band communication which is not in the scope of this European Standard. Normally this passing of information happens through a message from an upstream system connected via the back haul network. Once this joining information is within the coordinator of the network it is possible for joining to be turned on and allow the joining of devices to the network.

4.2.4 Joining and binding

Joining and binding is described in detail in ZigBee Smart Energy Profile Specification 07-5356 Rev 19, 5.5.5. In simple terms it can be described as the process that a device goes through in order to join the network and access services at the application layer of the network. There are a number of security procedures that a device shall complete to establish a secure authenticated connection to the network, as described within ZigBee Smart Energy Profile Specification 07-5356 Rev 19, Annex C and also within ZigBee Specification – 05-3474 Rev 20, Section 4. After a device has joined the network it reviews the services or clusters of other devices on that network and matches with services and clusters that it supports so that it can obtain data concerning those services.

EXAMPLE Binding to price cluster server

If a device connects to a ZigBee smart energy network supporting the price cluster client, it needs to find another device on the network that supports the price cluster server in order to receive pricing messages. The process of joining the network and service discovery allows the IHD to identify all clusters that are of interest to it and 'bind' to those clusters so that it can receive updates as and when the information on the server of that particular cluster is updated. Devices can bind to as many clusters as they like depending on the features that they support. It is also possible for information to be obtained from a device on the network without binding to a cluster by asking for that information after service discovery and also after joining at the application layer.

4.2.5 Discovery

Discovery is described in detail within ZigBee Smart Energy Profile Specification 07-5356 Rev 19, 5.5.5. As discussed in 4.2.4, it relates to the process that a joining device undergoes when binding to clusters on a ZigBee smart energy network. When joining any cluster it is also necessary to see which attributes that cluster supports to be sure to not try and bind to elements that are not present at either the client or server end of the binding relationship.

For every cluster there are required attributes and optional attributes, and it is entirely at the will of the implementer which if any of the optional attributes are supported. During the discovery process when binding it is possible for both client and server devices of a given cluster to find out which common attributes are supported by both parties. Once this has been established both devices will know what can be published by the server and requested by the client.

4.2.6 Security

Zigbee smart energy utilizes a high level of security designed to protect utility network data and maintain the privacy of the users interacting with devices on the network. There are two security levels within ZigBee: network security and application security. Application security uses a hybrid system of symmetric and asymmetric keys, whereby a certificate based key establishment mechanism is utilized in order to establish a symmetric key for communications between two devices on the network. There is a trust centre function within the network that is responsible for managing keys and network access.

As well as establishing secure communications on the network there are also mechanisms within this series of standards for the prevention of replay attacks and also non-repudiation via means of digital signatures.

4.3 Robust messaging

This series describes a number of mechanisms in place for acknowledgements and retries both at the data link layer and also the application layer. There are also message integrity checks at the data link layer.

4.4 Mesh routing

This series includes support for multiple repeaters within a network to assist with message delivery and supports self-healing, scalable mesh networking.

4.5 Interoperability

The ZigBee Smart Energy Profile (as referred to in EN 16836-3:2016) accommodates the interoperable interaction of devices from multiple manufacturers attached to the same network. This goes as far as a mechanism for managing unsupported device features without causing either device or network failure.

4.6 Battery powered device management

This series allows the management of sleeping devices (devices with constrained power sources such as battery operated devices). Sleeping devices behave in a manner such that they are not always connected to the network in a send/receive capacity, and only wake up and connect periodically. This series has provision for supporting these sleeping client devices, and specifies the necessary behaviour on both the client and server side of the protocol.

One of the key functionalities provided for sleeping devices is the ability for a permanently powered device to provide a proxy service for the sleeping device; this behaviour is known as mirroring; please refer to 4.2.1

5 Layered protocols

5.1 General

To facilitate the functionality described in Part 3 of this series, it is assumed a protocol stack divided into layers is used, in order to reduce the complexity of the communicating system. Each layer provides services to the layer above on the basis of the layer below.

The layered model chosen maps to the OSI Seven layer reference model as shown in Table 1:

Table 1 — Mapping of OSI Seven layer reference model to EN 16836–2:2016 and EN 16836–3:2016

OSI Layer	ZigBee layer	Standard Reference
6 + 7	ZigBee Smart Energy Profile	EN 16836–3:2016
3 + 4 + 5	ZigBee Pro Networking	EN 16836–2:2016
1 + 2	IEEE 802.15.4	IEEE 802.15.4

NOTE The OSI 7 layer model is described in ISO/IEC 7498-1 [1].

5.2 Application layer

5.2.1 General

The application layer references of this standard are in three parts:

— ZigBee Smart Energy Profile Specification 07-5356 Rev 19, December 3, 2014

— ZigBee Cluster Library – 07-5123 Rev 04, April 26, 2010

— OTA Cluster Specification 09-5264 Rev 23, March12, 2014

NOTE 1 Tunnelling of other protocols such as EN 13757–3 [2], EN 62056–5–3 [3], EN 62056–6–1 [4] and EN 62056–6–2 [5], is also permitted within this series using the tunnelling cluster specified in EN 16836–3.

NOTE 2 Tunnelling of protocols and alternative object models is possible within other standards from CEN/TC 294.

5.2.2 Companion specification

A companion specification (CS) is a supplementary text relating to the implementation of a standard, usually drafted and published by a market authority such as a consortium, government or customer. It may contain permitted extensions to the existing standard, as well as operating rules within the scope of the existing standard. If a number of options are available within a standard then the companion specification can enumerate which options are required for a particular implementation.

ZigBee Smart Energy Profile is a very diverse and technically capable application profile that specifies a large amount of functionality, as well as the behaviour of devices and how they interface with each other within a network. Many of the clusters and commands are not required for implementation and as such companion specifications are generally used to enumerate which optional features are required for a particular project.

Each implementer shall make a choice about which optional clusters and attributes they wish to code into their particular product. CSs make clear the description of which attributes and clusters are to be implemented as well as describe what extra manufacturer specific profile (MSP) objects they may add to their given product. In a similar way to the existence of CSs within DLMS/COSEM and also Mbus, this concept exists with ZigBee Smart Energy Profile.

The protocol implementation conformance statement (PICS) forms an important part of any CS and effectively lists the clusters, attributes, and commands that the device supports.

5.2.3 Manufacturer specific codes

In general all standard clusters and attributes described within the ZigBee Smart Energy Profile are useable and identifiable by any device on the network. Additionally manufacturers can extend the protocol to facilitate private messages by identifying messages with their own unique manufacturer code, allowing other manufacturers to ignore and not misinterpret messages. These manufacturer codes are managed by the ZigBee Alliance to ensure uniqueness.

5.2.4 Network management

ZigBee is a meshing network protocol that allows devices on a given network to communicate with each other, either directly or through other devices on that network. All relationships on that network are brokered through the network coordinator and authorized by the trust centre of that network. Usually the trust centre of the network is also the coordinator, but this is not required within the specifications. The only requirement is that the device on the network that has the responsibility for being the trust centre shall have some form of alternative communications mechanism within its own application to allow an out of band exchange of information authorizing the joining of new devices to the networks. In smart metering architecture this functionality would normally be performed by the AMI network back haul. The relationship between devices and their respective functionality is outlined in the ZigBee specification document.

This architecture should permit the quick introduction and installation of communicating meters, as well as the ability to extend the system afterwards. Therefore, some rules are given.

The main rules are:

— to have a secure system that is user friendly and easy to install, without the need for specialized tools or equipment;

— to have at least one defined Energy Services Interface (ESI) in the network;

— to allow secure, authorized parties and devices to access the network;

— to provide a trust centre within the network to manage security keys;

— to allow the availability of data from battery powered devices on the network at any time without compromising battery life;

— to have a metering network with a mesh structure;

— to have a system that has a network layer to provide robust networking;

— to utilize the existing IEEE 802.15.4 MAC and physical specifications for low rate wireless personal areas networks;

— to support two way communications to meters and other devices in the network.

5.2.5 Routing

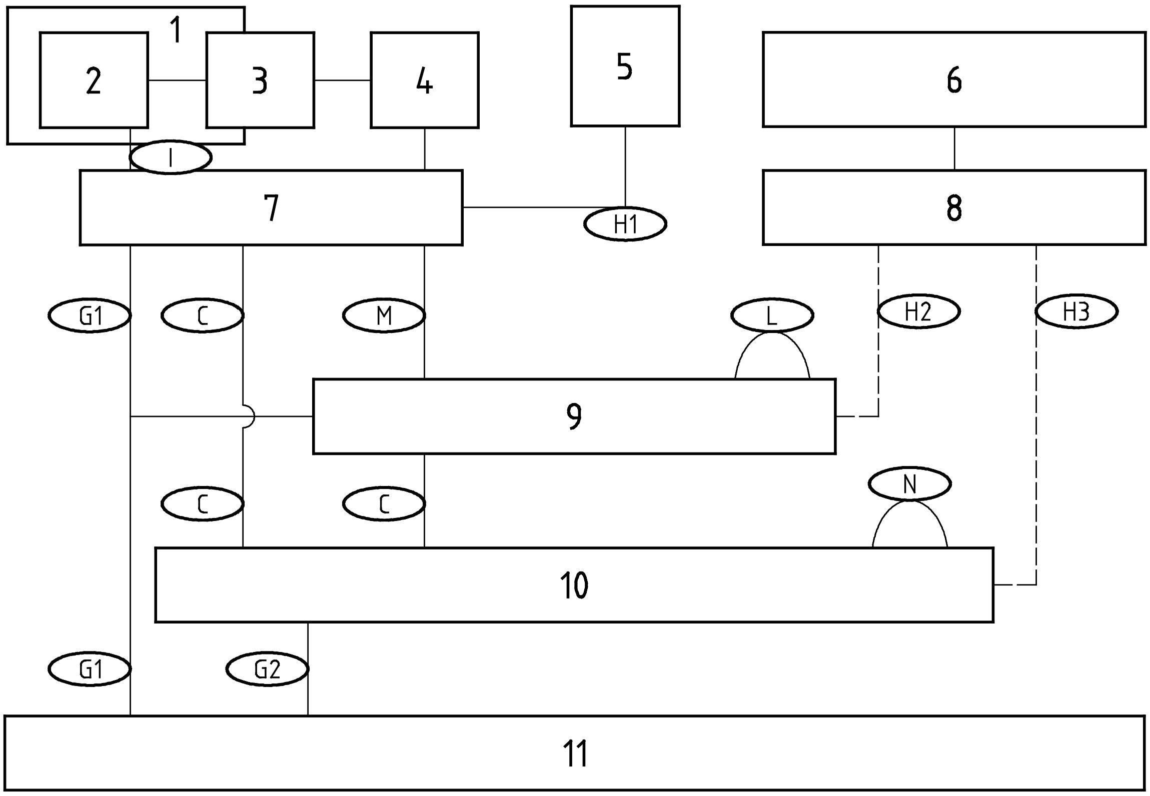
Most ZigBee smart energy devices that are always on have the ability to route messages and application layer packets to and from other devices on the network at the network layer for the purposes of range extension and to allow for self-healing capability within the network. This functionality is described in more detail within ZigBee Specification – 05-3474 Rev 20, 3.6.

5.2.6 System architecture

Figure 1 shows a smart metering functional reference architecture as described in CEN/CLC/ETSI/TR 50572:2011. This communications standard specifies an 'M' interface for the purpose of providing data from energy meters to other devices on the network.

There are many other details to consider when deciding upon architecture for a smart metering roll out, and member states across Europe have come to different conclusions on how this should be done.

NOTE Attention is drawn to national legislation and guidance in this regard.



Key

1 Items required by MID
2 metrology
3 display
4 additional functions
5 simple external consumer display
6 home automation functions
7 meter communication functions
8 HA communication functions
9 Local Network Access Point (LNAP)
10 Neighbourhood Network Access Point (NNAP)
11 AMI Head End System

I is the Internal interface between metering functions communications functions

C is the Interface between NNAP and LNAP or Metering communications functions

M is the Interface between LNAP and Metering communications functions

G1 is the Interface between AMI Head End Systems and LNAP or Metering end devices

G2 is the Interface between AMI Head End Systems and NNAPH1 is the Local interface between from a meter to a simple consumer display

H2 is the Interface from Local Network Access Point to Home Automation End Devices

H3 is the Interface from Neighbourhood Network Access Point to Home Automation End Devices

L is the Interface for devices communicating at the LNAP level to communicate with each other

N is the Interface for devices communicating at the NNAP level to communicate with each other

Figure 1 — Functional reference architecture for communications within smart metering systems[1)]

1) Source: CEN/CLC/ETSI/TR 50572:2011, Figure 2, and EN 13757-1:2014

5.3 Lower layers

The lower layers cover the MAC and PHY as defined by IEEE 802.15.4. In order to define full protocol stacks that are needed for meter interchangeability, all layers shall be consistently defined including MAC/PHY, networking and application layers. Some lower layers have been selected/adopted, and new lower layers can be added as amendments in the future when new technologies mature.

An overall diagram with all the elements needed and their relationships is shown in Figure 2.

Application layer	EN 16836–3:2016
Networking layer	EN 16836–2:2016
MAC/PHY layer	IEEE 802.15.4

Figure 2 — Full protocol stack

6 Metering architecture

This series is compliant with the smart metering architecture described in CEN/CLC/ETSI/TR 50572, and also the use cases it specifies. CEN/CLC/ETSI/TR 50572:2011, A.3 refers to a number of high level use cases that are possible within a smart metering system and Table A.1 specifies how these use cases are met within the scope of this series.

NOTE This standard series describes a mesh networking interface that could be used as a type M, or H1 (see Figure 1 and CEN/CLC/ETSI/TR 50572), however H1 interfaces are not within the scope of CEN/TC 294.

7 Coexistence of ZigBee and other protocols

ZigBee is a self-healing meshing network that is designed to work over low power and lossy networks which have restricted power capabilities but high data rate requirements.

ZigBee is designed to operate in frequency bands that are already in use from other applications and as such has features that allow it to be reliable in unlicensed radio bands that are used by other devices. IEEE 802.11 networks, such as WiFi, do not overly contend the channel mask of a ZigBee network operating in the 2,4 GHz frequency range. Further information is available on the frequency agility capability of ZigBee networks within the ZigBee Specification – 05-3474 Rev 20.

NOTE ZigBee Smart Energy operates within the requirements of EN 300328 [6].

Annex A
(informative)

Use cases

This annex provides a reference to the Smart Metering Coordination Group use cases from CEN/CLC/ETSI/TR 50572, and how they could be fulfilled in the context of this series of standards.

Table A.1 — Mapping of CEN/CLC/ETSI/TR 50572 use cases to EN 16836 (series)

High level functionality	SMCG use case	Standard reference
1 Remote reading of metrological registers and provision of these values to designated market organization(s)	Customer moves In/Out Customer changes supplier Customer has a bill query	Collection of many types of data from a metering device is possible using EN 16836–3:2016, however as this standard is a type of M (orH1) interface then another mechanism would be needed to transport the information over a backhaul network to the relevant market organization via a G1 or G2 interface.
	MDO collects periodic meter reads	Metering Cluster (EN 16836–3:2016, Table 2)
	MDO collects interval data/profiles	Metering Cluster (EN 16836–3:2016, Table 2)
	Concentrator establishes energy balance for substation and meters supplied by that substation and makes this available to NO	N/A
	Collect multiple meter registers at pre-defined date/time to evaluate network or sub-network efficiency or to allocate cost in a building	N/A
	Walk-by meter read	Inter-PAN using an HHT EN 16836–3:2016, Table 2)
	Communication of import and export data are included in above Use-Cases. Management of local generation is supported by Functionality 2	Metering Cluster (EN 16836–3:2016, Table 2)

High level functionality	SMCG use case	Standard reference
2 Two-way communication between the metering system and designated market organization(s)	MO/HES identifies newly installed meter Meter and system set up communication	Collection of many types of data from a metering device is possible using EN 16836–3:2016, however as this standard is a type of M or H1 interface then another mechanism would be needed to transport the information over a backhaul network to the relevant market organization via a G1 or G2 interface. N/A
	MO/HES configures/parameterizes/ adjusts meter	Tunnelling Cluster EN 16836–3:2016, Table 2
	HES (and DC) re-identifies meter after communication network reconfiguration	Rejoining a secured network EN 16836–3:2016, Table 2
	HES (and DC) re-identifies meter after planned or unplanned maintenance of metering system (e.g. Comm. Module, DC, Gateway, Meter, etc.)	Rejoining a secured network EN 16836–3:2016, Table 2
	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)	N/A
	Detect tampering of the metering system (physical integrity, electromagnetic field, communication, security, fraudulent use of the meter by customer, etc.)	Alarms Cluster EN 16836–3:2016, Table 1 Metering Cluster EN 16836–3:2016, Table 2
	Detect tamper of connection to network	Alarms Cluster EN 16836–3:2016, Table 1

High level functionality	SMCG use case	Standard reference
	Provide information on short supply interruptions: number of occurrences For example: Detection of air (no water) in the network Provide information on long supply interruptions: number of occurrences, duration, length For example, no supply/no flow detection (generates immediate alarm) Accidental large network leak (water pipe bursting): 'real' time alarm sent to designated market organization	Metering Cluster EN 16836–3:2016, Table 2
	Permanent low level network leak at consumer premises (e.g. toilet leak): information sent to consumer	Metering Cluster EN 16836–3:2016, Table 2
	Meter stopped or measurement deterioration alarm: information sent to designated market organization	Alarms Cluster EN 16836–3:2016, Table 1 Metering Cluster EN 16836–3:2016, Table 2
	Meter oversized leading to waste of water	Metering Cluster EN 16836–3:2016, Table 2
	Meter undersized leading to premature wear and waste of water	Metering Cluster EN 16836–3:2016, Table 2
	Reversed water flow detection/ Backflow measurement (error of installation, network incident, network pollution prevention, Fraudulent use, etc.)	Alarms Cluster EN 16836–3:2016, Table 1 Metering Cluster EN 16836–3:2016, Table 2 Flow measurement Cluster EN 16836–3:2016, Table 1
	Detect temporary over-voltage/broken neutral	Metering Cluster EN 16836–3:2016, Table 2 Alarms Cluster EN 16836–3:2016, Table 1
	Provide information on sags and swells (supply voltage variations)	Metering Cluster EN 16836–3:2016, Table 2 Alarms Cluster EN 16836–3:2016, Table 1
	Monitoring supply pressure/ temperature	Metering Cluster EN 16836–3:2016, Table 2 Pressure Measurement Cluster EN 16836–3:2016, Table 1

High level functionality	SMCG use case	Standard reference
	Provide information on harmonics	Power Configuration Cluster EN 16836–3:2016, Table 1
	Retrieve diagnostic information upon detection of inconsistent metering results, before planned maintenance, before unplanned maintenance, before uninstallation	Tunnelling Cluster EN 16836–3:2016, Table 2
	The MO retrieves battery status from system components	Metering Cluster EN 16836–3:2016, Table 2 Alarms Cluster EN 16836–3:2016, Table 1
	The MO checks the version and the integrity of the software/firmware deployed	Basic Cluster EN 16836–3:2016, Table 1
	The MO checks, collects the result of memory checks of system components	N/A
	Monitor temperature of meter	N/A
	The MO manages alarms generated by the system and informs other stakeholders. Refers also to checking facilities (EN 14154 [8])	Metering Cluster EN 16836–3:2016, Table 2 Alarms Cluster EN 16836–3:2016, Table 1
	The MO performs routine communication check with concentrators	N/A
	The MO performs routine communication check with gateway/meter	N/A
	The MO retrieves communication statistics	Metering Cluster EN 16836–3:2016, Table 2 LQI and RSSI from EN 16836–2:2016
	Synchronize clock as part of scheduled reading	Time Cluster EN 16836–3:2016, Table 1
	Meter operator sets parameters in meters/concentrators (e.g. location information, thresholds for monitoring, etc.)	Tunnelling Cluster EN 16836–3:2016, Table 2
	MO/Supplier sets security policy	Key Establishment Cluster EN 16836–3:2016, Table 2
	MO/Supplier transfer keys for security algorithms	Key Establishment Cluster EN 16836–3:2016, Table 2

High level functionality	SMCG use case	Standard reference
	NO sets control parameters for local Generation	N/A – Outside scope of TC 294
	Meter operator loads new software/firmware in Meter/Data Concentrator (correct bug, amend functionality)	OTA Establishment Cluster EN 16836–3:2016, 4.3
	Meter operator reloads previous software/firmware (roll back). Supplier sets/modifies contracted power/flow	OTA Establishment Cluster EN 16836–3:2016, 4.4
	Supplier sets operating mode for disconnect switch/valve	Prepayment Cluster EN 16836–3:2016, Table 2 ON/OFF Cluster EN 16836–3:2016, Table 1
	Supplier/NO/MO sends standard messages to the display of the meter	Messaging Cluster EN 16836–3:2016, Table 2
	Supplier/NO/MO sends standard messages to the customer display unit	N/A out of scope for TC 294
	Supplier/NO/MO sends standard messages to home automation interface	N/A out of scope for TC 294
	Supplier provides tariff/price change Information	Price Cluster EN 16836–3:2016, Table 2
	NO provides planned outage information	Demand Response and Load Control Cluster EN 16836–3:2016, Table 2
	Supplier sends current/historic account Information	Metering Cluster EN 16836–3:2016, Table 2 Prepayment Cluster EN 16836–3:2016, Table 2
3 To support advanced tariffing and payment systems	Supplier sets debit/credit mode and parameters (like standing charges, debt recovery, lifeline credit) of the meter, as agreed with the customer	Prepayment Cluster EN 16836–3:2016, Table 2
	Supplier loads purchased credit to the electricity/multi-utility meter	Prepayment Cluster EN 16836–3:2016, Table 2
	Customer loads purchased credit via the electricity/multi-utility meter	Prepayment Cluster EN 16836–3:2016, Table 2
	Customer loads credit via customer display	Prepayment Cluster EN 16836–3:2016, Table 2 N/A out of scope for TC 294
	Supplier/MO sets active tariff schedule as agreed by the customer	Price Cluster EN 16836–3:2016, Table 2

High level functionality	SMCG use case	Standard reference
	Supplier/MO sets passive tariff schedule as agreed by the customer for future activation	Price Cluster EN 16836–3:2016, Table 2
4 To allow remote disablement and enablement of supply, and flow/power limitation	Connect when customer moves in	Prepayment Cluster EN 16836–3:2016, Table 2
	Disconnect when customer moves out. See also on demand reading	N/A
	Disconnect (locally or remotely) when credit exhausted or payment default.	Prepayment Cluster EN 16836–3:2016, Table 2
	Reconnect (locally or remotely) when customer and supplier agree on bill payment arrangements or credit replenished	Prepayment Cluster EN 16836–3:2016, Table 2
	Disconnect (locally) when set normal/ emergency load limit is exceeded or pipe burst. Reconnect manually after loads are removed or pipes repaired	Metering Cluster EN 16836–3:2016, Table 2 ON/OFF Cluster EN 16836–3:2016, Table 1
	Enable/disable disconnection (e.g. Disable disconnection for protected customers)	Prepayment Cluster EN 16836–3:2016, Table 2
	Check supply status (connected /disconnected)	Prepayment Cluster EN 16836–3:2016, Table 2
	Apply normal/emergency threshold for load limitation per customer group. Minimum amount of water flow or volume out of sanitation reasons	Demand Response and Load Control Cluster EN 16836–3:2016, Table 2
	Enable/disable flow or power limitation	Demand Response and Load Control Cluster EN 16836–3:2016, Table 2
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	Supplier/NO provides consumption information	Metering Cluster EN 16836–3:2016, Table 2
	Supplier/NO provides local generation information	Metering Cluster EN 16836–3:2016, Table 2

High level functionality	SMCG use case	Standard reference
6 To provide information via web portal/gateway to an in-home/building display or auxiliary equipment	Supplier/NO provides summary information such as: - total consumption, - tariff (actual, to come), - timely consumption (day, month) Supplier/NO provides summary information such as: - advanced information, - statistics over periods, - scenarios on tariff usage	N/A this is outside the scope of TC 294.

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[6] EN 300328 V1.9.1 (2015-02), *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 - Harmonized EN covering the essential requirements under article 3.2 of the R&TTE Directive*

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