IEC 62056-8-5

Edition 1.0   2017-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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inside

**Electricity metering data exchange –The DLMS/COSEM suite –
Part 8-5: Narrow-band OFDM G3-PLC communication profile for neighbourhood networks**

**Échange des données de comptage de l'électricité – La suite DLMS/COSEM –
Partie 8-5: Profil de communication OFDM G3-CPL à bande étroite pour les réseaux de voisinage**

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International Standard IEC 62056-8-5 has been prepared by IEC technical committee 13: Electrical energy measurement and control.

This bilingual version (2018-01) corresponds to the monolingual English version, published in 2017-08.

The text of this International Standard is based on the following documents:

CDV	Report on voting
13/1708/CDV	13/1740/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

A list of all parts in the IEC 62056 series, published under the general title *Electricity metering data exchange – The DLMS/COSEM suite*, can be found on the IEC website.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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INTRODUCTION

As defined in IEC 62056-1-0, the IEC 62056 DLMS/COSEM suite provides specific communication profile standards for communication media relevant for smart metering.

Such communication profile standards specify how the COSEM data model and the DLMS/COSEM application layer can be used on the lower, communication media-specific protocol layers.

Communication profile standards refer to communication standards that are part of the IEC 62056 DLMS/COSEM suite or to any other open communication standard.

This International Standard specifies the DLMS/COSEM communication profile for ITU-T G.9903:2014 PLC communication based on OFDM technology.

ITU-T G.9903 PLC is designed to meet the following aims:

- Robustness: the communication profile shall be suited to severe powerline environments (see 5.3.2);

- Performance and scalability: it embeds adaptive modulation to use the proper modulation according to the quality of the link (see 5.3.2) within dense environments (up to 2 000 nodes in the same PAN);

- Security: it shall offer a secure environment (see 7.4);

- Openness: it shall be based on open standards in order to support multi-supplier solutions (see Clause 5);

- Flexibility and future proof: it shall be able to support future applications through using IPv6 networking capabilities (see 5.3.4);

This standard follows the rules defined in IEC 62056-5-3:2017, Annex A.

**ELECTRICITY METERING DATA EXCHANGE –
THE DLMS/COSEM SUITE –**

**Part 8-5: Narrow-band OFDM G3-PLC communication profile
for neighbourhood networks**

1 Scope

This part of IEC 62056 specifies the IEC 62056 DLMS/COSEM communication profile for metering purposes based on the Recommendations ITU-T G.9901: *Narrowband orthogonal frequency division multiplexing power line communication transceivers – Power spectral density specification* and ITU-T G.9903:2014*, Narrowband orthogonal frequency division multiplexing power line communication transceivers for G3-PLC networks*, an Orthogonal Frequency Division Multiplexing (OFDM) Power Line Communications (PLC) protocol.

The physical layer provides a modulation technique that efficiently utilizes the allowed bandwidth within the CENELEC A (3 kHz – 95 kHz), CENELEC B (95 kHz – 125 kHz), ARIB (10 kHz – 450 kHz) and FCC (no specific frequency band limitations) bands, thereby allowing the use of advanced channel coding techniques. This enables a robust communication in the presence of narrowband interference, impulsive noise, and frequency selective attenuation.

The medium access control (MAC) layer allows the transmission of MAC frames through the use of the power line physical channel. It provides data services, frame validation control, node association and secure services.

The 6LoWPAN adaptation sublayer enables an efficient interaction between the MAC and the IPv6 network layer. The use of the IPv6 network protocol – the latest generation of IP protocols – opens a wide range of potential applications and services for metering purposes (but the applications are not limited to metering).

The transport layer, the application layer and the data model are as specified in the IEC 62056 DLMS/COSEM suite.

The scope of this communication profile standard is restricted to aspects concerning the use of communication protocols in conjunction with the COSEM data model and the DLMS/COSEM application layer. Data structures specific to a communication protocol are out of the scope of this communication profile standard.

NOTE   They are specified in the specific protocol standards.

Any project specific definitions of data structures and data contents may be provided in project specific companion specifications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-300, *International Electrotechnical Vocabulary – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements – Part 312: General terms relating to electrical measurements – Part 313:*

Types of electrical measuring instruments – Part 314: Specific terms according to the type of instrument

IEC TR 62051, *Electricity metering – Glossary of terms*

IEC TR 62051-1, *Electricity metering – Data exchange for meter reading, tariff and load control – Glossary of terms – Part 1: Terms related to data exchange with metering equipment using DLMS/COSEM*

IEC 62056-1-0, *Electricity metering data exchange – The DLMS/COSEM suite – Part 1-0: Smart metering standardisation framework*

IEC 62056-4-7:2015, *Electricity metering data exchange – The DLMS/COSEM suite – Part 4-7: DLMS/COSEM transport layer for IP networks*

IEC 62056-5-3:2017, *Electricity metering data exchange – The DLMS/COSEM suite – Part 5-3: DLMS/COSEM application layer*

IEC 62056-6-1, *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-1: Object identification system (OBIS)*

IEC 62056-6-2, *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-2: COSEM interface classes*

IEC 62056-9-7:2013, *Electricity metering data exchange – The DLMS/COSEM suite – Part 9-7: Communication profile for TCP-UDP/IP networks*

Recommendation ITU-T G.9903:2014, *Narrowband Orthogonal Frequency Division Multiplexing Power Line Communication Transceivers for G3-PLC Networks* available at http://www.itu.int/rec/T-REC-G.9903/en

IETF RFC 768, *User Datagram Protocol. Edited by J. Postel. August 1980. Available from* http://www.ietf.org/rfc/rfc768.txt

IETF RFC 2460, *Internet Protocol, Version 6 (IPv6) Specification. Edited by S. Deering, R. Hinden. December 1998. Available from* http://www.ietf.org/rfc/rfc2460.txt

IETF RFC 4193, *Unique Local IPv6 Unicast Addresses. Edited by R. Hinden, B. Haberman. October 2005. Available from* http://www.ietf.org/rfc/rfc4193.txt

IETF RFC 4291, *IP Version 6 Addressing Architecture. Edited by R. Hinden, S. Deering. February 2006. Available from* http://www.ietf.org/rfc/rfc4291.txt

IETF RFC 4944, *Transmission of IPv6 Packets over IEEE 802.15.4 Networks. Available from* http://www.ietf.org/rfc/rfc2460.txt

IETF RFC 6282, *Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks. Available from* http://www.ietf.org/rfc/rfc2460.txt

IETF RFC 4861, *Neighbor Discovery for IP version 6 (IPv6). Available from* http://www.ietf.org/rfc/rfc4861.txt

IETF RFC 4862, *IPv6 Stateless Address Autoconfiguration. Available from* http://www.ietf.org/rfc/rfc4862.txt

IEEE 802.15.4:*IEEE Standard for Low-Rate Wireless Networks*

3   Terms, definitions and abbreviated terms

3.1   Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-300, IEC TR 62051, IEC TR 62051-1 and the following apply.

NOTE   Where there is a difference between the definitions in the glossaries and those contained in communication profile standards established by TC 13, then the latter take precedence in applications of the relevant standard.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

• IEC Electropedia: available at http://www.electropedia.org/

• ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
PAN coordinator
entity implementing the G3-PLC protocol capable of controlling the network

3.1.2
PAN device
entity implementing the G3-PLC protocol which does not embed coordinator functionalities

3.2   Abbreviated terms

AA	Application Association
APDU	Application Layer Protocol Data Unit
ARIB	Association of Radio Industries and Businesses (Japan)
6LoWPAN	IPv6 over Low power Wireless Personal Area Networks
CENELEC	European Committee for Electrotechnical Standardization
COSEM	Companion Specification for Energy Metering
DLMS	Device Language Message Specification
FCC	Federal Communications Commission (US)
IEC	International Electrotechnical Commission
IP	Internet Protocol
ITU-T	International Telecommunication Union – Telecommunication
LBA	LoWPAN Bootstrapping Agent
LBP	LoWPAN Bootstrapping Protocol
MAC	Media Access Control
NNAP	Neighbourhood Network Access Point
OFDM	Orthogonal Frequency Division Multiplexing
OSI	Open System Interconnection
PAN	Personal Area Network
PLC	Power Line Communication
PSK	Pre-Shared Key
TCP	Transmission Control Protocol
UDP	User Datagram Protocol

Furthermore, the abbreviations given in ITU-T G.9903:2014, Clause 4 also apply.

4   Targeted communication environments

The DLMS/COSEM narrow-band OFDM G3-PLC communication profile for neighbourhood networks is intended for remote data exchange on Neighbourhood Networks (NN) between Neighbourhood Network Access Points (NNAPs) and Local Network Access Points (LNAPs) or End Devices using OFDM technology over the low voltage electricity distribution network as a communication medium. The functional reference architecture is shown in Figure 1.

End devices – typically electricity meters – comprise application functions and communication functions. They may be connected directly to the NNAP via the C interface, or to an LNAP via an M interface, while the LNAP is connected to the NNAP via the C interface. The LNAP function may be co-located with the metering functions.

A NNAP comprises gateway functions and it may comprise concentrator functions. Upstream, it is connected to the Metering Head End System (HES) using suitable communication media and protocols. The communication channel between the NNAP and HES is out of scope of this document.

End devices and LNAPs may communicate to different NNAPs, but to one NNAP only at a time. From the PLC communication point of view, the NNAP acts as the PAN coordinator while end devices and LNAPs act as PAN devices.

NNAPs and similarly LNAPs may communicate to each other, but this is out of the scope of this document, which covers the C interface only.

When the NNAP has concentrator functions, it acts as a DLMS/COSEM client. When the NNAP has gateway functionality only, then the HES plays the role of a DLMS/COSEM client. The end devices or the LNAPs play the role of DLMS/COSEM servers.

A mixed architecture is also possible, i.e. both the HES and the NNAP can act as a client.
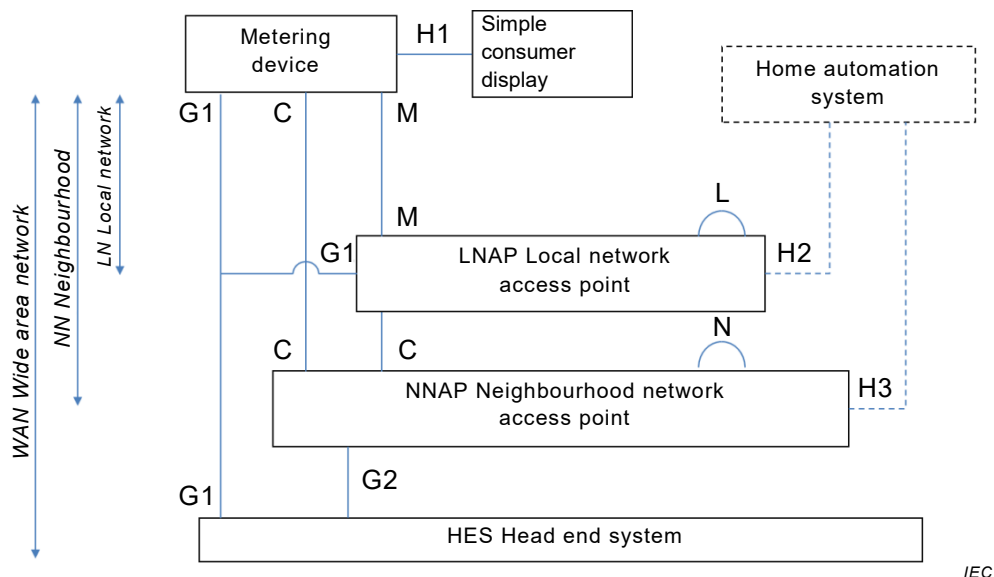

Figure 1 – Entities and interfaces of a smart metering system using the terminology of IEC 62056-1-0

5 Use of the communication layers for this profile

5.1 Information related to the use of the standard specifying the lower layers

The proposed communication model natively integrates a network layer and an IP suite transport layer which opens the way to a vast range of Internet applications and ensures great flexibility in the system architecture. It provides the possibility of having:

- either a decentralized architecture, where the NNAP (also known as data concentrator) acts as an application relay, with more or less autonomy. The exchanges at application level in this case are limited to the dialogue between the meters / LNAPs and the NNAPs;

- or a more centralized architecture in which the NNAP simply acts as a network gateway and the meters (LNAPs dialogue directly with HES from an application layer point of view).

A combination of these architectures is also possible. A centralized architecture can be dedicated for sensitive and/or on-demand requests whereas distributed architecture can be used for recurrent operations.

The network layer chosen is based on the IPv6 protocol (IETF RFC 2460).

The protocol used for the transport layer is UDP (IETF RFC 768), which provides unreliable transport of datagrams in connectionless mode. Reliability of exchanges within the PLC network is brought by the combination of lower layer robustness (such as retries or physical layer forward error correction) and DLMS/COSEM services.

The ITU-T G.9903:2014 specification defines a standardized header compression mechanism based on IETF RFC 6282 enabling IPv6 and UDP header compression.

5.2 Structure of the communication profiles

The protocol stack uses the following protocol layers as shown in Figure 2:

- The DLMS/COSEM Application layer as specified in IEC 62056-5-3 covering the Application, Presentation and Session functionalities;

- The DLMS/COSEM Transport layer as specified in IEC 62056-4-7:2015, used with the DLMS/COSEM UDP/IPv6 profile over the G3-PLC network;

- The ITU-T G.9903:2014 Data link layer, that consists of the IETF 6LoWPAN Adaptation Layer (IETF RFC 4944, IETF RFC 6282) and the MAC sublayer;

- The ITU-T G.9903:2014 Physical layer adapted to the band used (see ITU-T G.9903:2014, Clause 7).

Following this reference model, a profile is fully defined using G3-PLC physical and data link layers, UDP/IPv6, the DLMS/COSEM application layer and the COSEM object model.

NOTE   The COSEM interface classes for setting up and managing data exchange over the narrow-band OFDM G3-PLC networks are specified in IEC 62056-6-2.
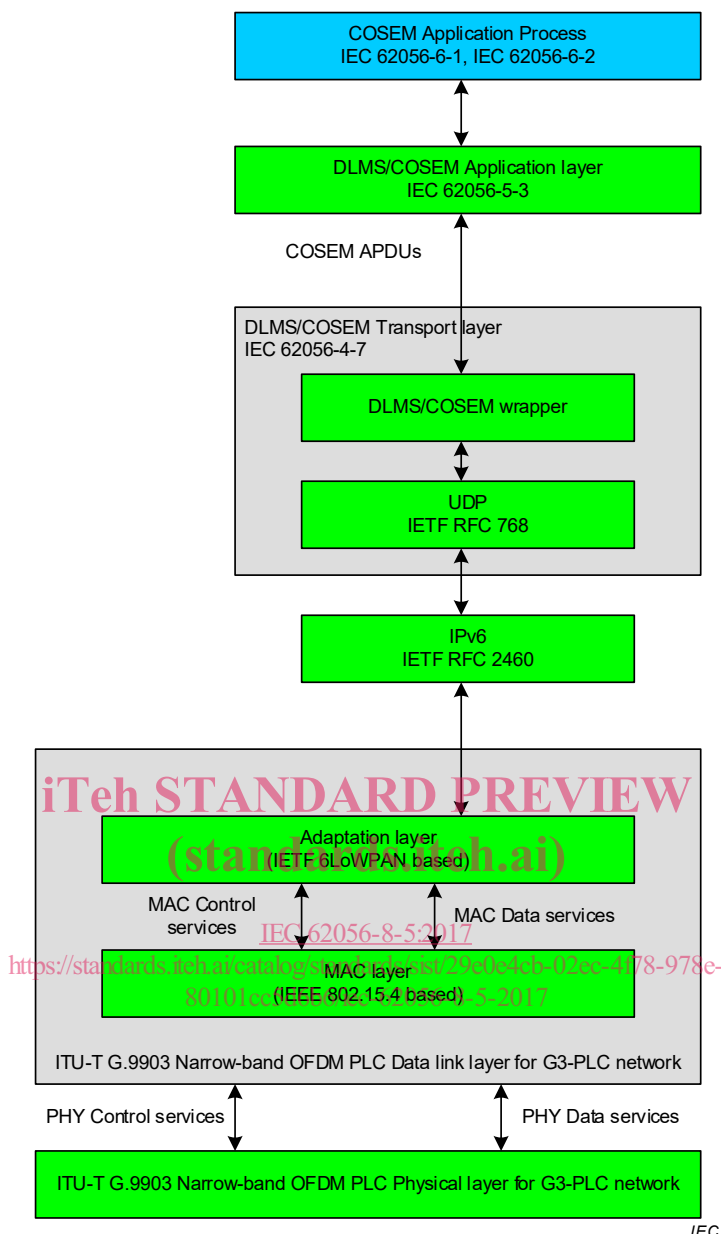
Figure 2 – G3-PLC protocol architecture

5.3 Lower protocol layers and their use

5.3.1 Overview

The UDP/IPv6 based communication profile is fully in line with the DLMS/COSEM communication profile for UDP/IP, as specified in IEC 62056-9-7:2013. Refer to that standard for more information. This subclause provides information related to the binding of UDP/IPv6 layers with the ITU-T G.9903:2014 protocol layers.

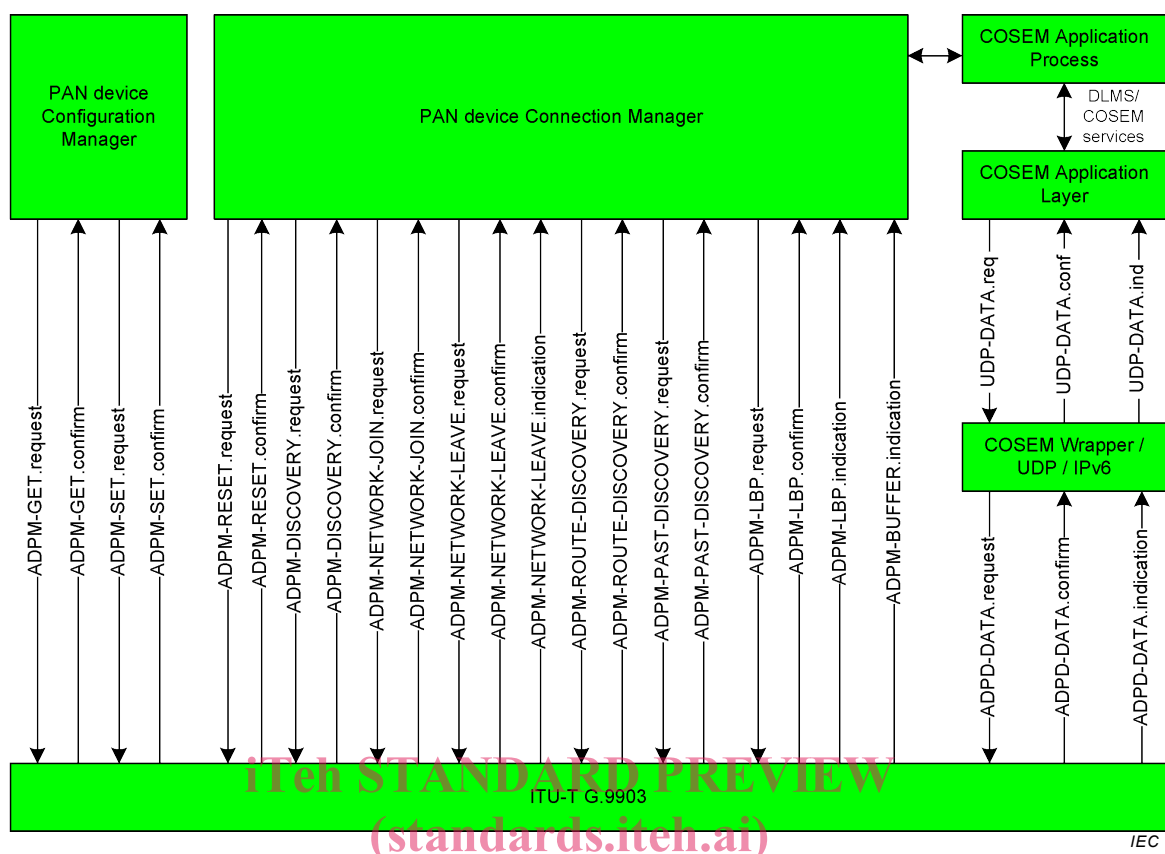The general architecture is the following, see Figures 3 and 4:

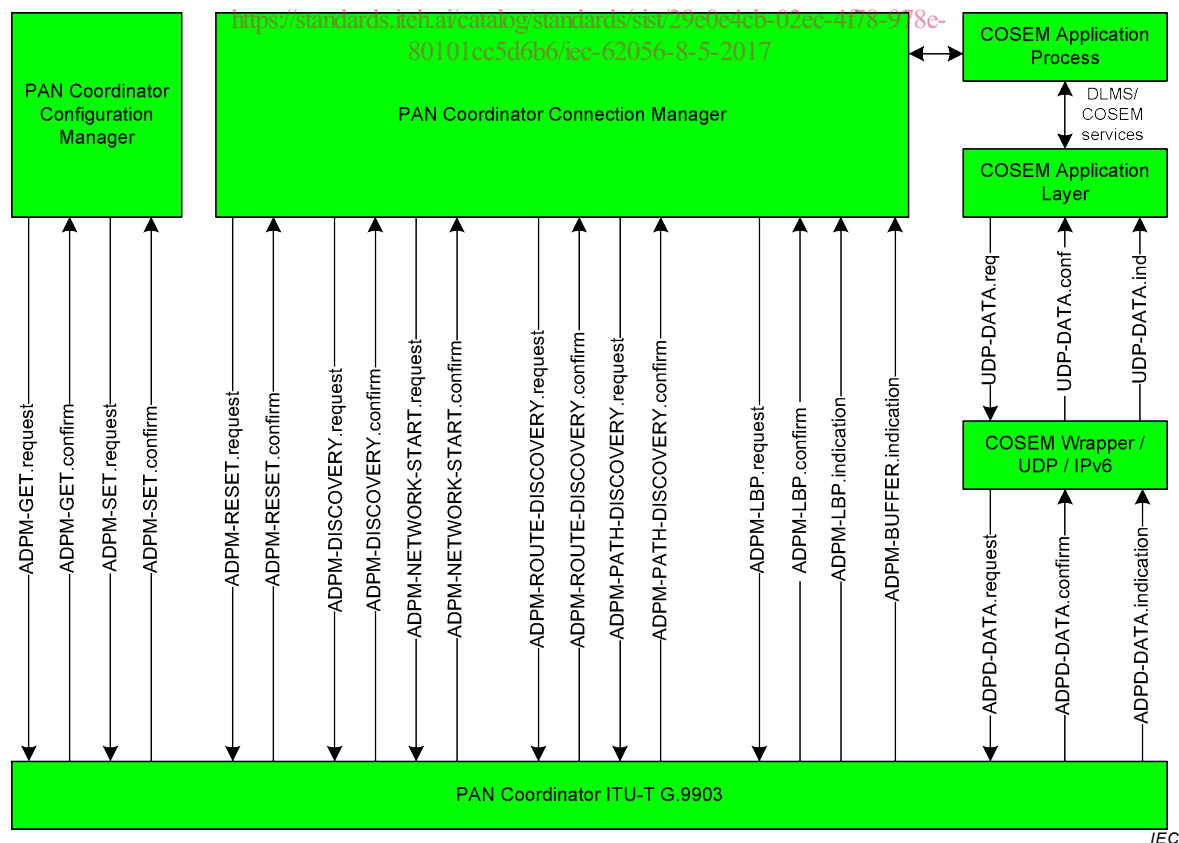**Figure 3 – PAN device communication profile architecture**

Figure 4 – PAN coordinator communication profile architecture