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BSI Standards Publication

Electricity metering data exchange — The DLMS/COSEM suite

Part 9-7: Communication profile for TCP-UDP/IP networks

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National foreword

This British Standard is the UK implementation of EN 62056-9-7:2013. It is identical to IEC 62056-9-7:2013. It partially supersedes BS EN 62056-53:2007.

The UK participation in its preparation was entrusted to Technical Committee PEL/13, Electricity Meters.

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Electricity metering data exchange - The DLMS/COSEM suite - Part 9-7: Communication profile for TCP-UDP/IP networks

(IEC 62056-9-7:2013)

Échange des données de comptage de l'électricité - La suite DLMS/COSEM - Partie 9-7: Profil de communication pour réseaux TCP-UDP/IP (CEI 62056-9-7:2013)

Datenkommunikation der elektrischen Energiemessung - DLMS/COSEM - Teil 9-7: Festlegungen zur Nutzung von TCP-UDP/IP-Netzen (IEC 62056-9-7:2013)

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Foreword

The text of document 13/1520/FDIS, future edition 1 of IEC 62056-9-7, prepared by IEC/TC 13 "Electrical energy measurement, tariff- and load control" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62056-9-7:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-04-04
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-05-28

This document supersedes EN 62056-53:2007 (PART).

EN 62056-9-7:2013 includes the following significant technical changes with respect to EN 62056-53:2007:

Note: Whereas IEC 62056-53 Ed. 2.0 contains the specification of the DLMS/COSEM communication profiles, IEC 62056-5-3 Ed.1.0 replacing the earlier edition does not.

- The title of the standard has been aligned with the title of other parts of the revised IEC 62056 series;
- Clause 4, Targeted communication environments has been extended, a functional reference architecture figure has been added;
- Clause 5, The structure of the profile(s) has been extended, the Figure has been generalized and simplified;
- In clause 6, Identification and addressing scheme, the port number assigned by the IANA for DLMS/COSEM has been added;
- In subclause 9.1, Two paragraphs specifying how confirmed and unconfirmed COSEM-OPEN and xDLMS service invocations have been added;
- Subclause 9.6, Transporting long messages, has been amended. It specifies now that for transporting long messages, application layer block transfer can be used (also available now with SN referencing);
- The clause on Multi-drop configurations has been removed.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62056-9-7:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 62056-6-1	NOTE	Harmonised as EN 62056-6-1[1)] (not modified).
IEC 62056-6-2	NOTE	Harmonised as EN 62056-6-2[1)] (not modified).

[1)] at draft stage.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 62056-5-3 [2)]	-	Electricity metering data exchange - The DLMS/COSEM suite - Part 5-3: DLMS/COSEM application layer	EN 62056-5-3 [2)]	-
IEC 62056-47	2006	Electricity metering - Data exchange for meter reading, tariff and load control - Part 47: COSEM transport layers for IPv4 networks	EN 62056-47	2007

[2)] At draft stage.

CONTENTS

ELECTRICITY METERING DATA EXCHANGE – THE DLMS/COSEM SUITE –

Part 9-7: Communication profile for TCP-UDP/IP networks

1 Scope

This part of IEC 62056 specifies the DLMS/COSEM communication profile for TCP-UDP/IP networks.

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.

IEC 62056-47:2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 47: COSEM transport layer for IPv4 networks*

IEC 62056-5-3:2013, *Electricity metering data exchange – The DLMS/COSEM suite – Part 5-3: DLMS/COSEM application layer*

NOTE See also the Bibliography.

3 Terms, definitions and abbreviations

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

3.1 Terms and definitions

3.1.1
client
a station, asking for services. Normally the master station

3.1.2
server
a station, delivering services. The tariff device (meter) is normally the server, delivering the requested values or executing the requested tasks

3.2 Abbreviations

AA	Application Association
AARE	A-Associate Response – an APDU of the ACSE
AARQ	A-Associate Request – an APDU of the ACSE
ACSE	Association Control Service Element
AL	Application Layer
AP	Application Process
APDU	Application Layer Protocol Data Unit

ARP	Address Resolution Protocol
ASE	Application Service Element
ATM	Asynchronous Transfer Mode
COSEM	Companion Specification for Energy Metering
DLMS	Device Language Message Specification
FDDI	Fiber Distributed Data Interface
HDLC	High-level Data Link Control
HTTP	Hypertext Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
IP	Internet Protocol
LN	Local Network
NN	Neighbourhood Network
OSI	Open System Interconnection
PDU	Protocol Data Unit
PhL	Physical Layer
PPP	Point-to-Point Protocol
RLRE	A-Release Response – an APDU of the ACSE
RLRQ	A-Release Request – an APDU of the ACSE
SAP	Service Access Point
TCP	Transmission Control Protocol
TL	Transport Layer
UDP	User Datagram Protocol
WAN	Wide Area Network
xDLMS	Extended DLMS

4 Targeted communication environments

The TCP-UDP/IP based communication profiles are suitable for remote data exchange with metering equipment via IP enabled networks such as wide area networks, neighbourhood networks or local networks. This is shown in Figure 1.

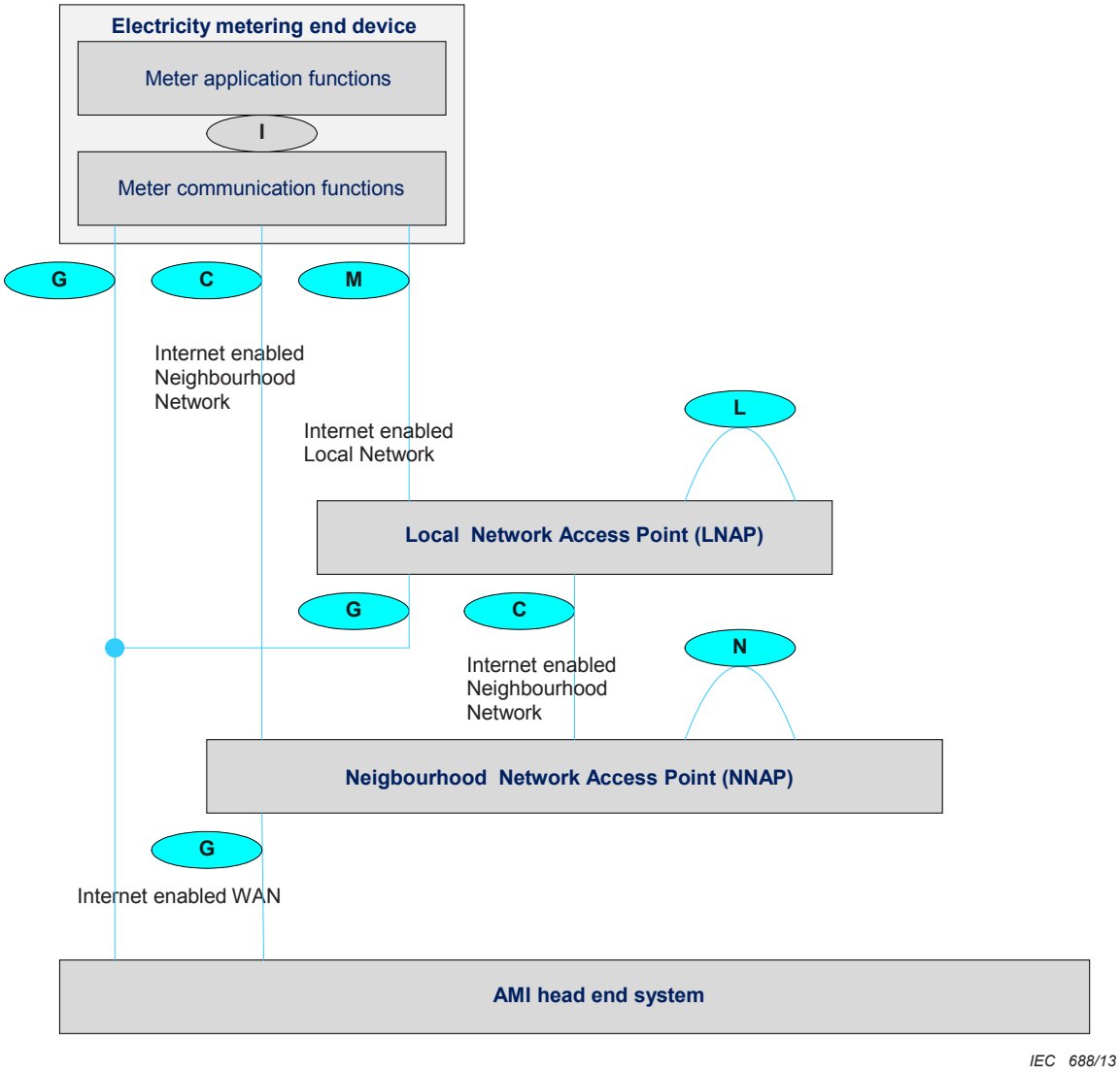

Figure 1 – Communication architecture

5 Structure of the profile(s)

The COSEM TCP-UDP/IP based communication profiles consist of five protocol layers:

- the DLMS/COSEM application layer, specified in IEC 62056-5-3;
- the COSEM transport layer, specified in IEC 62056-47;
- a network layer: the Internet protocol: IPv4, specified in STD 0005 or IPv6 specified in RFC 2460;
- a data link layer: any data link protocol supporting the network layer;
- a physical layer: any PhL supported by the data link layer chosen.

The COSEM AL uses the services of one of the TLs (TCP or UDP) via a wrapper, which, in their turn, use the services of the IP network layer to communicate with other nodes connected to this abstract network. The COSEM AL in this environment can be considered as another Internet standard application protocol, which may co-exist with other Internet application protocols, like FTP, HTTP, etc. See IEC 62056-47:2006, Figure 1.

The TCP-UDP/IP layers are implemented on a wide variety of real networks, which, just with the help of this IP Network abstraction, can be seamlessly interconnected to form Intra- and Internets using any set of lower layers supporting the Internet Protocol.

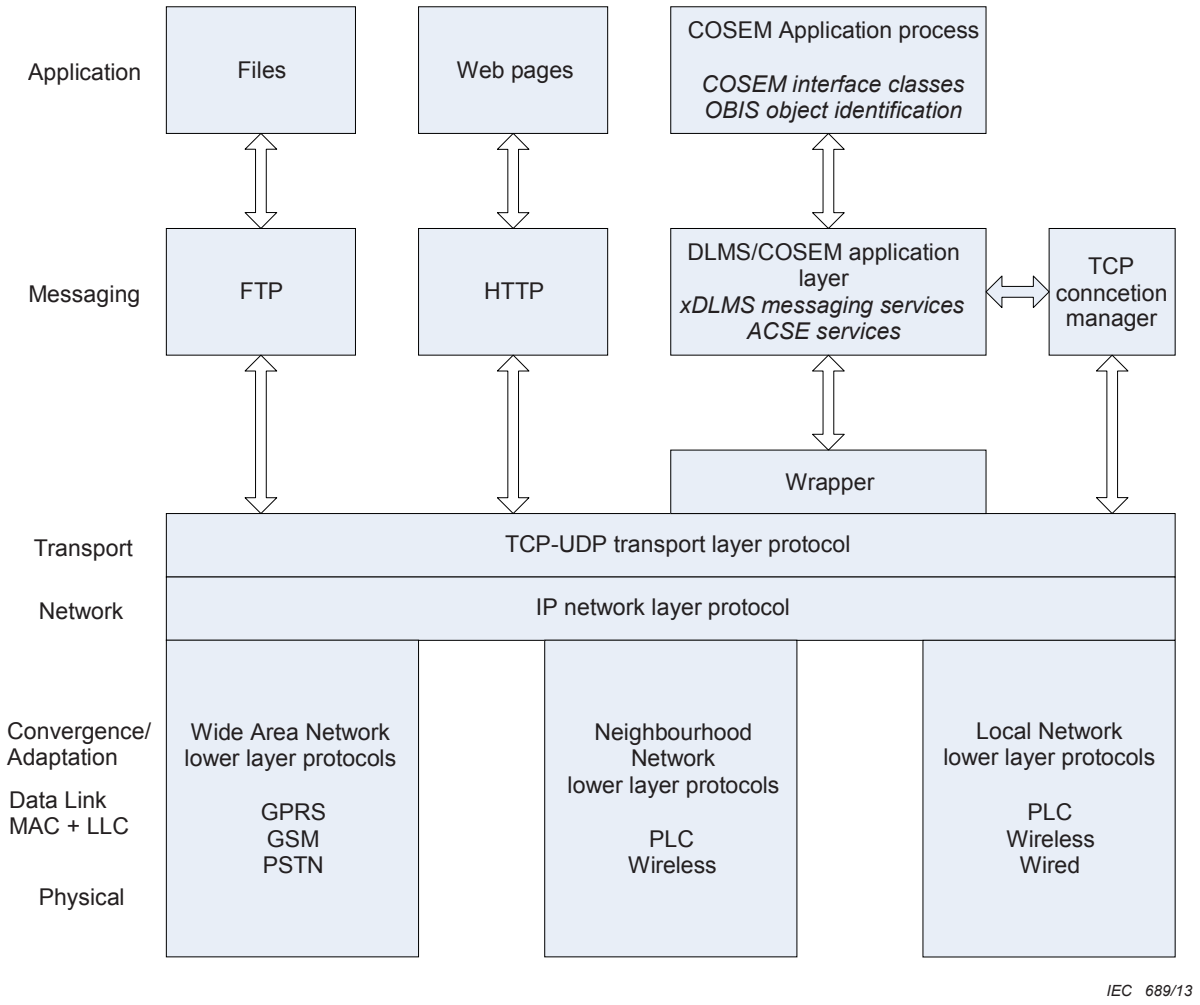

Figure 2 – Examples for lower-layer protocols in the TCP-UDP/IP based profile(s)

Below the IP layer, a range of lower layers can be used. One of the reasons of the success of the Internet protocols is just their federating force. Practically any data networks, including Wide Area Networks such as GPRS, ISDN, ATM and Frame Relay, circuit switched PSTN and GSM networks (dial-up IP), Local Area Networks, such as Ethernet, neighbourhood networks and local networks using power line carrier or wireless protocols, etc., support TCP-UDP/IP networking.

Figure 2 shows a set of examples – far from being complete – for such communication networks and for the lower layer protocols used in these networks. Using the TCP-UDP/IP profile, DLMS/COSEM can be used practically on any existing communication network.

6 Identification and addressing scheme

Although real-world devices even in the Internet environment are connected to real-world physical networks, at a higher abstraction (and protocol) level it can be considered as if these devices would be connected to a virtual – IP – network. On this virtual network, each device has a unique address, called IP address, which non-ambiguously identifies the device on this network.

Any device connected to this virtual IP network can send message(s) to any other connected device(s) using only the IP address to designate the destination device, without being concerned about the complexity of the whole physical network. Specific characteristics – the data transmission medium, the media access strategy, and the specific data-link addressing / identification scheme – of the particular physical network(s) participating in the route between the source and the destination device are hidden for the sender device. These elements are handled by intermediate network devices, called routers.

Therefore, in the TCP-UDP/IP based profiles COSEM physical devices are non-ambiguously identified by their network – IP – address.

The identification of COSEM client AP and server APs requires an additional address.

Both TCP and UDP provide additional addressing capability at the transport level, called *port*, to distinguish between applications. The AL is listening only on one TCP or UDP port for exchanging messages between any client and server APs. As in a single physical device several client or server APs may be present, an additional addressing capability is needed. This is provided by the wrapper sublayer, see IEC 62056-47. The wrapper provides an identifier – wPort – similar to the TCP or UDP port numbers, but on the top of these layers. A particular COSEM client AP and/or a particular COSEM logical device in the same physical device can be thus identified by its wPort number.

In summary, in the TCP-UDP/IP based profiles the following identification rules apply:

- COSEM physical devices are identified by their IP address;
- the COSEM AL is listening only on one UDP or TCP port. See IEC 62056-47:2006, Clause 4;
- COSEM logical devices and client APs within their respective host physical devices are identified by their wPort numbers. Reserved wPort numbers are specified in IEC 62056-47;
- lower layer addresses (SAP-s) are not considered (hidden).

COSEM AAs are identified by the identifiers of the two end-points as described above. Figure 3 shows an example.

AAs established between the client AP_01 and Logical_Device_01 in Host_device_01 (AA 1) and Logical_Device_02 in Host_Device_02 (AA2) respectively are identified by:

AA 1: { (163.187.45.19, T_N, 31) (163.187.45.36, T_M, 527) }

AA 2: { (163.187.45.19, T_N, 31) (163.187.45.78, T_M, 3013) }

NOTE 1 T_N and T_M mean the TCP port used for DLMS/COSEM in the client host device and the server host devices respectively. For DLMS/COSEM, the following port numbers have been registered by the IANA. See http://www.iana.org/assignments/port-numbers.

- dlms/cosem 4059/TCP DLMS/COSEM
- dlms/cosem 4059/UDP DLMS/COSEM

NOTE 2 In these two AAs the client side end-point identifiers are the same. However, the server side end-point identifiers are different, so the two AAs are identified unambiguously and therefore they can be used simultaneously.

NOTE 3 In these examples, IPv4 addresses are used.

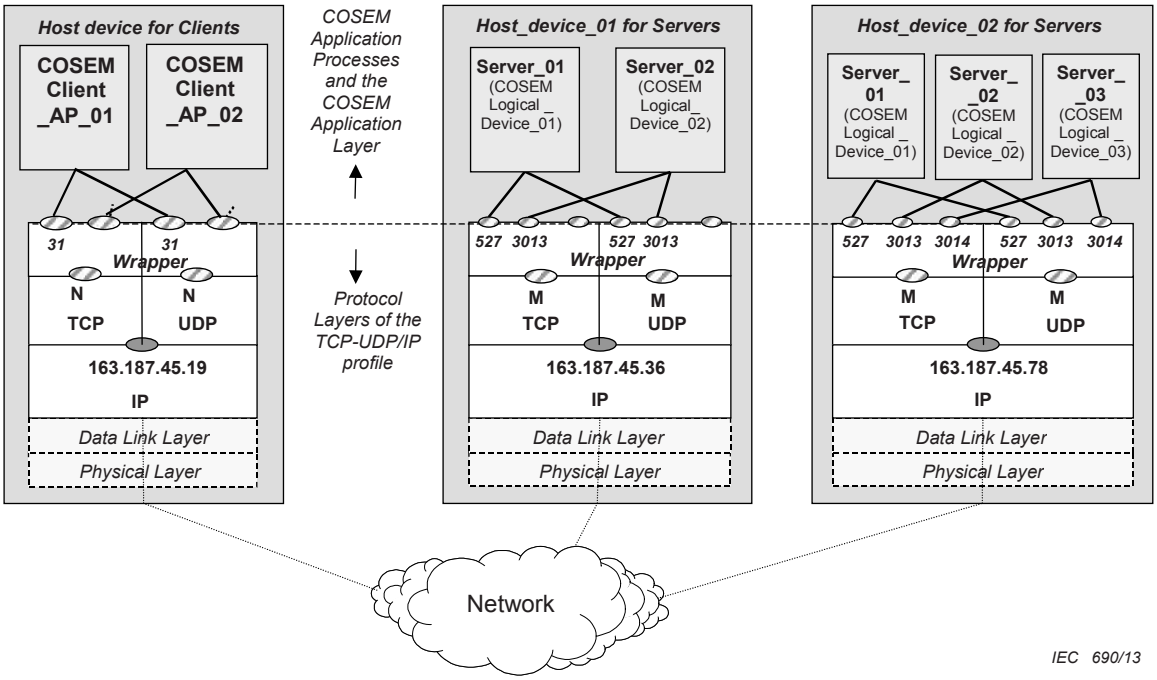

Figure 3 – Identification / addressing scheme in the TCP-UDP/IP based profile(s)

7 Supporting layer services and service mapping

As specified in IEC 62056-47, the COSEM TCP TL provides the following services to its service users:

- Connection management services, provided for the TCP connection manager AP:
  - TCP-CONNECT: .request, .indication, .response, .confirm;
  - TCP-DISCONNECT: .request, .indication, .response, .confirm.
- Data exchange services, provided for the COSEM AL; these services can be used only when the TCP connection is established:
  - TCP-DATA: .request, .indication, (. confirm).

The TCP TL also provides a TCP-ABORT service to the service user COSEM AL to indicate the disconnection/disruption of the TCP layer connection.

The UDP TL provides only one service to the service user COSEM AL: a connection-less, best effort data delivery service.

- UDP-DATA: request, .indication, (.confirm).

NOTE A TCP.confirm / UDP .confirm service primitive is optionally available.

Figure 4 summarizes these services.

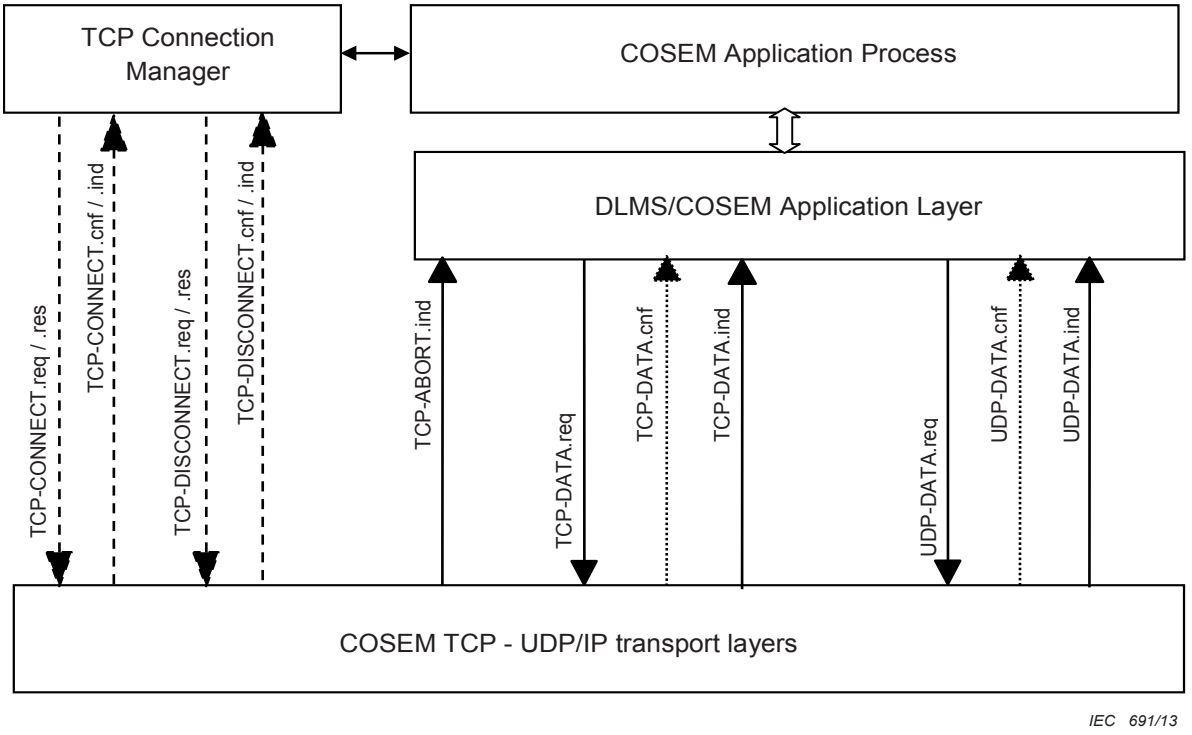

Figure 4 – Summary of TCP / UDP layer services

For connection management, the COSEM TCP TL provides the full set of the TCP-CONNECT and TCP-DISCONNECT services, both at the client and at the server sides. The purpose of this is to allow also the server to establish and release TCP connections. See also 9.7. As in all COSEM profiles, AA establishment and release is initiated by the client AP in these profiles as well.

The user of these services is not the COSEM AL, but the TCP Connection Manager AP. This process is implementation dependent, therefore it is out of the scope of this standard. The only requirements with regard to this process are:

- the TCP connection manager process shall be able to establish the supporting TCP connection without the intervention of the COSEM client- or server AP(s);
- the COSEM client- and server APs shall be able to retrieve the TCP and IP portion of the Protocol_Connection_Parameters parameter from the TCP connection manager before sending / receiving a COSEM-OPEN.request / .indication.

For data exchange, both the client- and the server ALs use the complete set of the service primitives provided by the COSEM TCP-UDP TLs.

The correspondence between an AL (ASO) service invocation and the supporting COSEM TCP-UDP layer service invocation is given in IEC 62056-47.

8 Communication profile specific service parameters of the COSEM AL services

Only the COSEM-OPEN service has communication profile specific parameters, the Protocol_Connection_Parameters parameter. This contains the following data:

- Protocol (Profile) Identifier TCP/IP or UDP/IP;
- Server_IP_Address COSEM Physical Device Address;

- Server_TCP_or_UDP_Port The TCP or UDP port used for DLMS/COSEM;
- Server_wrapper_Port COSEM Logical Device Address;
- Client_IP_Address COSEM Client's Physical Device Address;
- Client_TCP_or_UDP_Port, The TCP or UDP port used for DLMS/COSEM;
- Client_wrapper_Port COSEM application process (type) identifier.

Any server address parameter may contain special addresses (All-station, No-station, etc.). For more information, see IEC 62056-47.

9 Specific considerations / constraints

9.1 Confirmed and unconfirmed AAs and service invocations, packet types used

Table 1 shows the rules for establishing confirmed and unconfirmed AAs, the type of data transfer services available in such AAs and the TL packet types used for carrying APDU-s. In this table, grey areas represent cases, which are out of the normal operating conditions: either not allowed or have no useful purpose.

According to this:

- it is not allowed to establish an unconfirmed AA using the TCP/IP protocol. It is prevented by the Client AL, which locally and negatively confirms COSEM-OPEN.request primitive invocations trying to do that;
- it is not allowed to request an xDLMS service in a confirmed way (Service_Class = Confirmed) within an unconfirmed AA, established on the top of the UDP layer. This is also prevented by the Client AL. Servers, receiving such APDUs shall simply discard them, or, shall send back a ConfirmedServiceError APDU or, if the feature is implemented, send back the optional ExceptionResponse APDU.

Table 1 – Application associations and data exchange in the TCP-UDP/IP based profile

Application association establishment				Data exchange	
Protocol connection parameters	**COSEM-OPEN service class**	**Use**	**Type of established application association**	**Service class**	**Use**
Id: TCP/IP TCP port numbers, IP addresses	Confirmed	1/ Connect TCP layer 2/ Exchange AARQ/AARE APDU-s transported in TCP packets	Confirmed	Confirmed	TCP packet
				Unconfirmed	TCP packet
	Unconfirmed	Local negative confirmation	None	-	-
				-	-
Id: UDP/IP UDP port numbers, IP addresses	Confirmed	Exchange AARQ/AARE APDU-s transported in UDP datagrams	Confirmed	Confirmed	UDP datagram
				Unconfirmed	UDP datagram
	Unconfirmed	Send AARQ in a UDP datagram	Unconfirmed	Confirmed (not allowed)	-
				Unconfirmed	UDP datagram

In the TCP-UDP/IP based profiles, the Service_Class parameter of the COSEM-OPEN service is linked to the response-allowed parameter of the xDLMS InitiateRequest APDU. If the COSEM-OPEN service is invoked with Service_Class == Confirmed, the response-allowed parameter shall be set to TRUE. The server is expected to respond. If it is invoked with Service_Class == Unconfirmed, the response-allowed parameter shall be set to FALSE. The server shall not send back a response.

The Service_Class parameter of the GET, SET and ACTION services is linked to the confirmed/unconfirmed bit of the Invoke-Id-And-Priority byte. If the service is invoked with Service_Class = Confirmed, the confirmed/unconfirmed bit shall be set to 1, otherwise it shall be set to 0.

9.2 Releasing application associations: using RLRQ/RLRE is mandatory

In the TCP-UDP/IP based profile, using the A-RELEASE services of the ACSE – by invoking the COSEM-Release.request primitive with Use_RLRQ_RE == TRUE – is mandatory for the following reasons:

- according to the identification / addressing scheme used in this profile, an AA is identified by two triplets, including the IP Address, the TCP (or UDP) port number and the wPort number. In other words, all AAs within this profile are established using only one TCP (or UDP) port. This means, that disconnecting the TCP connection (this way of releasing AA shall also be supported) would release all AAs established. Using the RLRQ/RLRE APDU-s allows to release confirmed AAs in a selective way;
- it is allowed to establish both confirmed and unconfirmed AAs on the connectionless UDP TL. The only way to release such associations is the use of the RLRQ/RLRE services.

NOTE In fact, using the RLRQ/RLRE APDU-s is specified as optional only to keep backward compatibility with earlier versions of the specification, which did not include this possibility.

9.3 Service parameters of the COSEM-OPEN / -RELEASE / -ABORT services

The optional User_Information parameters of the COSEM-OPEN / -RELEASE services are not supported in this communication profile.

9.4 xDLMS client/server type services

No specific features / constraints apply related to the use of client/server type services.

9.5 EventNotification Service and TriggerEventNotificationSending service

This subclause describes the communication profile specific elements of the protocol of the EventNotification service, see IEC 62056-5-3:2012, 6.9.

As in this profile both the TCP and UDP profile allow sending data in an unsolicited manner, the Trigger_EventNotification_Sending service is not used.

The EventNotificationRequest APDU may be sent either using the connectionless data services of the COSEM UDP-based TL or by the connection-oriented data services of the COSEM TCP-based TL. In this latter case, a TCP connection has to be built first by the TCP Connection Manager process.

The optional Application_Addresses parameter is present only when the EventNotification.request service is invoked outside of an established AA.

9.6 Transporting long messages

The data field of the wrapper layer shall always carry a complete xDLMS APDU. If the message is long, then application layer block transfer can be used.

9.7 Allowing COSEM servers to establish the TCP connection

In DLMS/COSEM, supporting layer connections are generally established during AA establishment following the invocation of the COSEM-OPEN.request primitive by the client AP (the PhL connection shall be already established before invoking the COSEM-OPEN.request primitive). Therefore linking the process of establishing an AA and connecting the supporting layer is just natural.

However, in some cases it would be useful if the server could also initiate the connection of the TCP layer. This is particularly interesting in the TCP-UDP/IP based profile, when the server does not have a public IP address. In this case, as the client does not “see” the physical device hosting the server(s), it is not able to establish the required TCP layer connection.

In order to allow the server to establish the TCP layer connection, the full set of service primitives of the TCP-CONNECT service is available both on the client and the server side.

NOTE These services are used by the TCP connection manager, not by the AL.

9.8 The COSEM TCP-UDP/IP profile and real-world IP networks

IEC 62056-47, IEC 62056-5-3:2013 and this standard specify all DLMS/COSEM-specific elements necessary to use DLMS/COSEM over the Internet, using the TCP-UDP/IP based communication profile.

On real Internet networks, there are other elements, which need to be considered. For example, in this standard it is specified, that physical devices hosting COSEM APs are identified with an IP address, but it is not specified, how to obtain such an IP address. As these elements are not specific to COSEM, they are not in the scope of this international standard.

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Index

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