PD CLC/TS 50568-8:2015

BSI Standards Publication

Electricity metering data exchange — The DLMS/COSEM suite

Part 8: SMITP B-PSK PLC communication profile for neighbourhood networks — Including: The Original-SMITP PLC B-PSK communication profile, The Original-SMITP Local data exchange profile and The Original-SMITP IP communication profile

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National foreword

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

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Published by BSI Standards Limited 2015

ISBN 978 0 580 85915 1
ICS 35.240.60; 91.140.50

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 May 2015.

Amendments/corrigenda issued since publication

Date	Text affected

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CLC/TS 50568-8

April 2015

ICS 35.240.60; 91.140.50

English Version

Electricity metering data exchange - The DLMS/COSEM suite - Part 8: SMITP B-PSK PLC communication profile for neighbourhood networks - Including: The Original-SMITP PLC B-PSK communication profile, The Original-SMITP Local data exchange profile and The Original-SMITP IP communication profile

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Foreword

This document (CLC/TS 50568-8:2015) has been prepared by CLC/TC 13, "Electrical energy measurement and control".

The following date is fixed:

- latest date by which the existence of this document has to be announced at national level (doa) 2015-07-24

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Introduction

This Technical Specification is based on the results of the European OPEN Meter project, Topic Energy 2008.7.1.1, Project no.: 226369, www.openmeter.com.

1 Scope

This Technical Specification contains 4 profile specifications

- the DLMS/COSEM SMITP B-PSK PLC Profile (clause 4)
- the Original-SMITP B-PSK PLC Profile (clause 5)
- the Original-SMITP IP Profile (clause 6)
- the Original-SMITP Local data exchange profile (clause 7)

The **DLMS/COSEM SMITP B-PSK profile** (see Clause 4) defines the use of the CLC/TS 50568-4 communication protocol and methods to access and exchange data modelled by the COSEM objects of EN 62056-6-2 via the EN 62056-5-3 application layer. This clause is in line with the DLMS/COSEM suite as described in EN 62056-1-0.

The **Original-SMITP Profiles** (Clauses 5, 6 and 7) define the use of the CLC/TS 50568-4 communication protocol and methods to access and exchange data modelled by the Original-SMITP Data Model (clause 10) via the Original-SMITP Application Layer (Clause 9). These clauses are not part of the DLMS/COSEM suite as described EN 62056-1-0.

NOTE The expression Original-SMITP refers to the open Smart Metering Information and Telecommunication Protocol originally developed and maintained by the Meters and More Association (see Foreword). The Original SMITP specifications were developed prior to the availability of the DLMS/COSEM SMITP B-PSK profile.

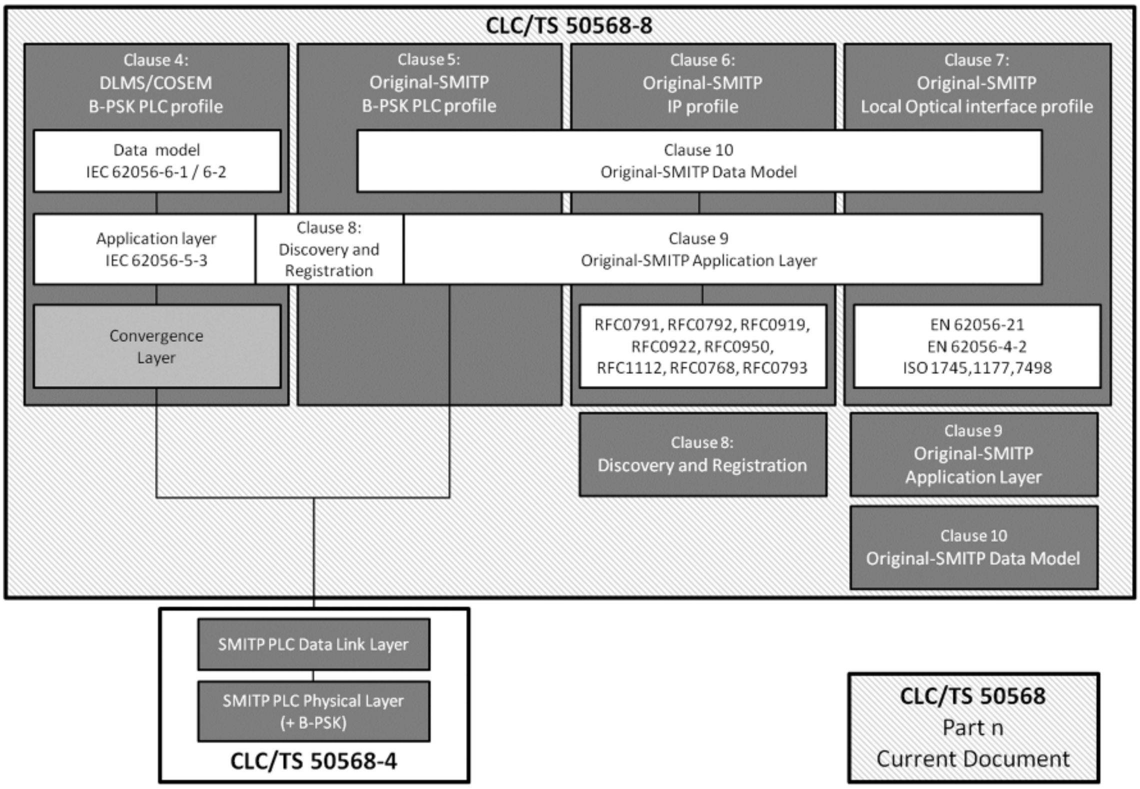


Figure 1 – Document structure of CLC/TS 50568-8

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.

CLC/TS 50568-4:2015, *Electricity metering data exchange — The Smart Metering Information and Telecommunication Protocols (SMITP) suite — Part 4: Physical layer based on B-PSK modulation + Data Link Layer*

EN 62056-21, *Electricity metering — Data exchange for meter reading, tariff and load control — Direct local data exchange (IEC 62056-21)*

EN 62056-42, *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 62056-42)*

EN 62056-5-3, *Electricity metering data exchange – The DLMS/COSEM Suite - Part 5-3*: *DLMS/COSEM application layer (IEC 62056-5-3)*

EN 62056-6-2, *Electricity metering data exchange – The DLMS/COSEM Suite - Part 6-2: COSEM Interface classes (IEC 62056-6-2)*

SP 800-38A, Morris Dworkin*, Recommendation for Block Cipher Modes of Operation - Methods and Techniques, December 2001*

NIST SP 800-38B, Morris Dworkin*, Recommendation for Block Cipher Modes of Operation: The CMAC Mode for Authentication, May 2005*

ISO 1745*, Information processing — Basic mode control procedures for data communication systems*

ISO 1177, *Information processing — Character structure for start/stop and synchronous character oriented transmission*

ISO 7498, *Information processing systems — Open systems interconnection — Basic reference model*

3 Acronyms and abbreviations, terms, definitions and notations

3.1 Acronyms and abbreviations

For the purpose of this document, the following acronyms and abbreviations apply.

AA:	Application Association
ACA:	Absolute Communication Address
ACK:	Acknowledgement
AES:	Advanced Encryption Standard
AES-CMAC:	Advanced Encryption Standard – Cipher-based Message Authentication Code
AES-CTR:	Advanced Encryption Standard – Counter Mode Encryption
AES-ECB:	Advanced Encryption Standard – Electronic Codebook
AL:	Application Layer
AMM:	Automatic Metering Management
AP:	Application Process
APDU:	Application Protocol Data Unit
ATTR:	Attribute of SMITP message
AV:	Any Value
A-XDR:	Adapted eXtended Data Representation
bcd:	Binary Coded Decimal
B-PSK:	Binary Phase Shift Keying
CF:	Control Function
COSEM:	Companion Specification for Energy Metering
CT:	Current Transformer
DCS:	Digital Cross-connect System
DLMS:	Device Language Messaging Specification
DM:	Data Model
DSAP:	Destination Service Access Point
DST:	Daylight Saving Time
GPRS:	General Packet Radio Service
GSM:	Group Special Mobile
HES:	Head End System
HHU:	Hand Held Unit
IC:	Interface Class
IP:	Internet Protocol
Len:	Length (in bytes)
LLC:	Logical Link Control
LMON:	Last Message Order Number
ECTL:	Link Service Access Point
LSb:	Least Significant bit
LSB:	Least Significant Byte

LV:	Low Voltage
MAC:	Media Access Control
MBZ:	Must Be Zero
MDF:	More Data Follow
MU:	Measurement Unit
NA:	Not Applicable
NACK:	Negative Acknowledgement
NNAP:	Neighbourhood Network Access Point
NN:	Neighbourhood Networks
NTW:	Network
OBIS:	Object Identification System
OPA:	Optical Powerline Access
PLC:	Power Line Carrier
PQ:	Power Quality
RES:	Reserved
RTC:	Real Time Clock
SAP:	Service Access Point
SCA:	Section Communication Address
SEQ:	Sequence
SSAP:	Source Service Access Point
STD:	Standard Time
TB:	Tele-management from AMM system
TCP:	Transmission Control Protocol
TCR:	Silencing level threshold
TCT:	Silencing level parameter
TMAC:	Truncated MAC
ULP:	Upper Layer Protocol
UMTS:	Universal Mobile Telecommunications System
WAN:	Wide Area Network

3.2 Terms and definitions

For the purpose of this document the following terms and defintions apply:

3.2.1
concentrator section
identification code of the network managed by the concentrator

3.2.2
node subsection
identification code of the sub network within the network identified by concentrator section

3.2.3
node progressive
unique node ID within the node subsection

3.3 Notations

For the purpose of this document the following notations apply:

- 1 byte = 8 bits;
- fields and bytes naming: capital alphanumeric characters;
- transmission bit order of byte/field relative to the representative mode: first right bit = first transmitted bit;
- transmission bit order of byte/field relative to their weight: least significant bit = first transmitted bit.

4 The DLMS/COSEM SMITP B-PSK PLC profile

4.1 Structure of the profile

The reference model of the DLMS/COSEM SMITP B-PSK PLC communication profile is shown in figure below. It is based on a simplified – or collapsed – three layer OSI architecture. The layers are the physical layer, the data link layer, the convergence layer and the application layer. The data link layer is split into the MAC sub layer and the LLC sub layer.

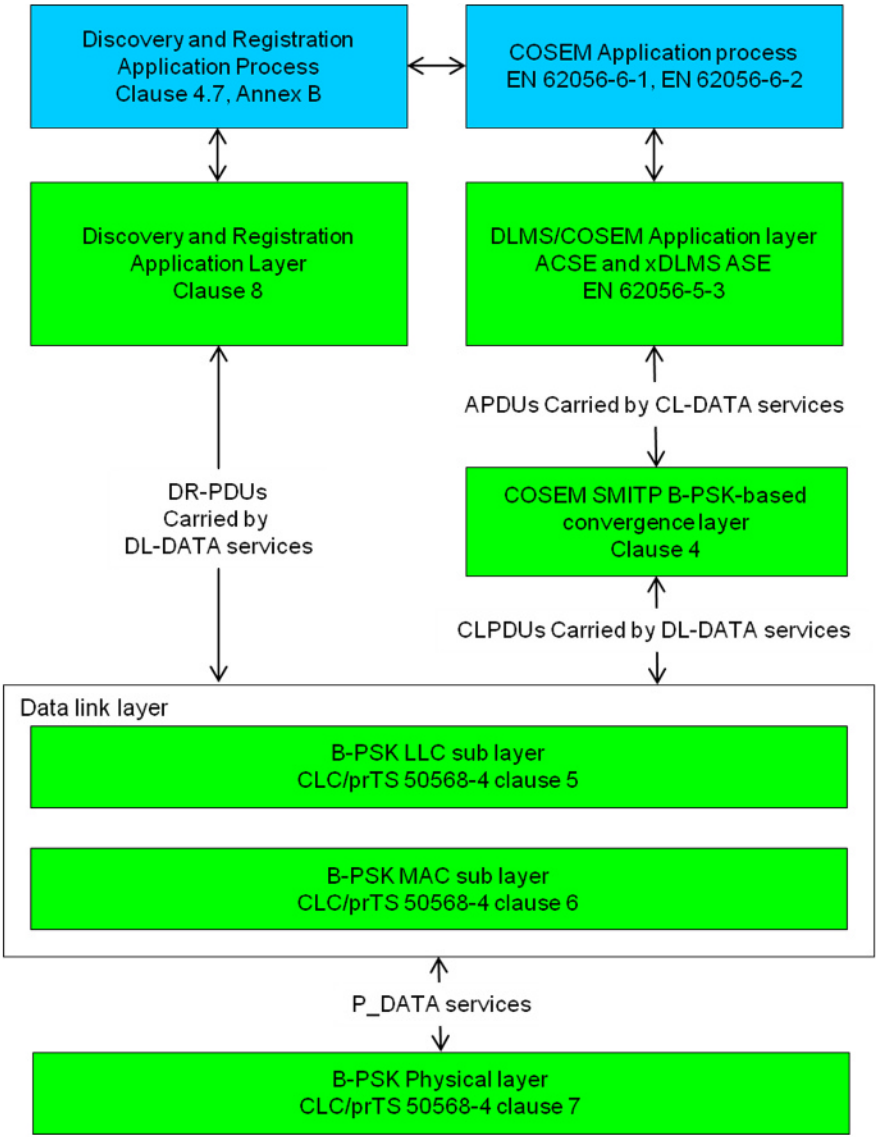


Figure 2 – The DLMS/COSEM SMITP B-PSK PLC communication profile

4.2 Physical layer

The Physical layer provides the interface between the equipment and the physical transmission medium, that is the distribution network. It transports binary information from the source to the destination.

The Physical Layer is specified in CLC/TS 50568-4:2015, Clause 7. It provides to the MAC sub-layer P_DATA services to transfer MPDUs to a peer MAC sub layer entity(ies) using the distribution network as the transport medium.

4.3 Data link layer

4.3.1 General

The data link layer consists of two sub layers: the Medium Access Control (MAC) and the Logical Link Control (LLC) sub layer.

The MAC sub layer handles access to the physical medium and provides physical device addressing. The decision to access the medium is made by the initiator, directly for its own MAC sub layer, or indirectly for other MAC sub layers that are requested to transmit a response to a request sent previously by the initiator.

The LLC sub layer controls the logical links.

4.3.2 The MAC sub layer

The MAC sub layer of the DLMS/COSEM SMITP B-PSK PLC communication profile is specified in CLC/TS 50568-4:2015, Clause 6. It provides the following services to its service user LLC sub layer:

- the MA_DATA services. These services allow the LLC sub layer entity to exchange LLC data units with peer LLC sub layer entities;
- the MA_EVENT.indication service. The usage of this service is specified in CLC/TS 50568-4:2015, Clause 6.

4.3.3 The LLC sub layer

The LLC sub layer is as specified in CLC/TS 50568-4:2015, Clause 5. It provides to the upper layers the DL_DATA services. These services allow the application layer entity to exchange application data with peer application entity(ies), either directly or through the convergence layer.

Management of ECTL field in LPDU is as follows:

- DSAP field shall be fixed to:
    - 0000 if the LPDU is used to transport CLPDUs;
    - 0001 if the LPDU is used to transport DR-PDUs ;
- SSAP field shall be always 0000.

4.4 Application to data link convergence layer

4.4.1 General

The B-PSK-based Data Link provides to the DLMS/COSEM application layer the basic data services required: unicast and multicast data transfer. In order to cover all the COSEM application layer requirements additional features are implemented in this convergence layer, in particular:

- Segmentation and Reassembly;
- SAP management.

4.4.2 Service specification for the DLMS/COSEM SMITP B-PSK-based convergence layer

4.4.2.1 General

The DLMS/COSEM SMITP B-PSK convergence layer providesunbalanced service between Master and Slave, meaning that the slave cannot spontaneously initiate a communication. In fact it is only allowed to transmit data to the Master via a .response service that can be issued after an .indication service only..

The DLMS/COSEM SMITP B-PSK convergence layer provides only data communication services in connection-less mode

Both confirmed and unconfirmed services are supported by this convergence layer, confirmed services shall make use of RA and RB service classes when invoking DL-DATA services, unconfirmed services shall make use of S service class when invoking DL-DATA services.

The .request, .response and .indication service primitives are mandatory; the implementation of .confirm service, which is a local service primitive, is optional.

NOTE DSAP and SSAP referenced in this clause have no relationship with the DSAP sub-field described in 4.3.3 and in CLC/TS 50568-4:2015, Clause 5. DSAP and SSAP referenced in this clause are transparently passed between the communication endpoint systems Application Layers, any description of these fields or this usage is out of the scope of this document.

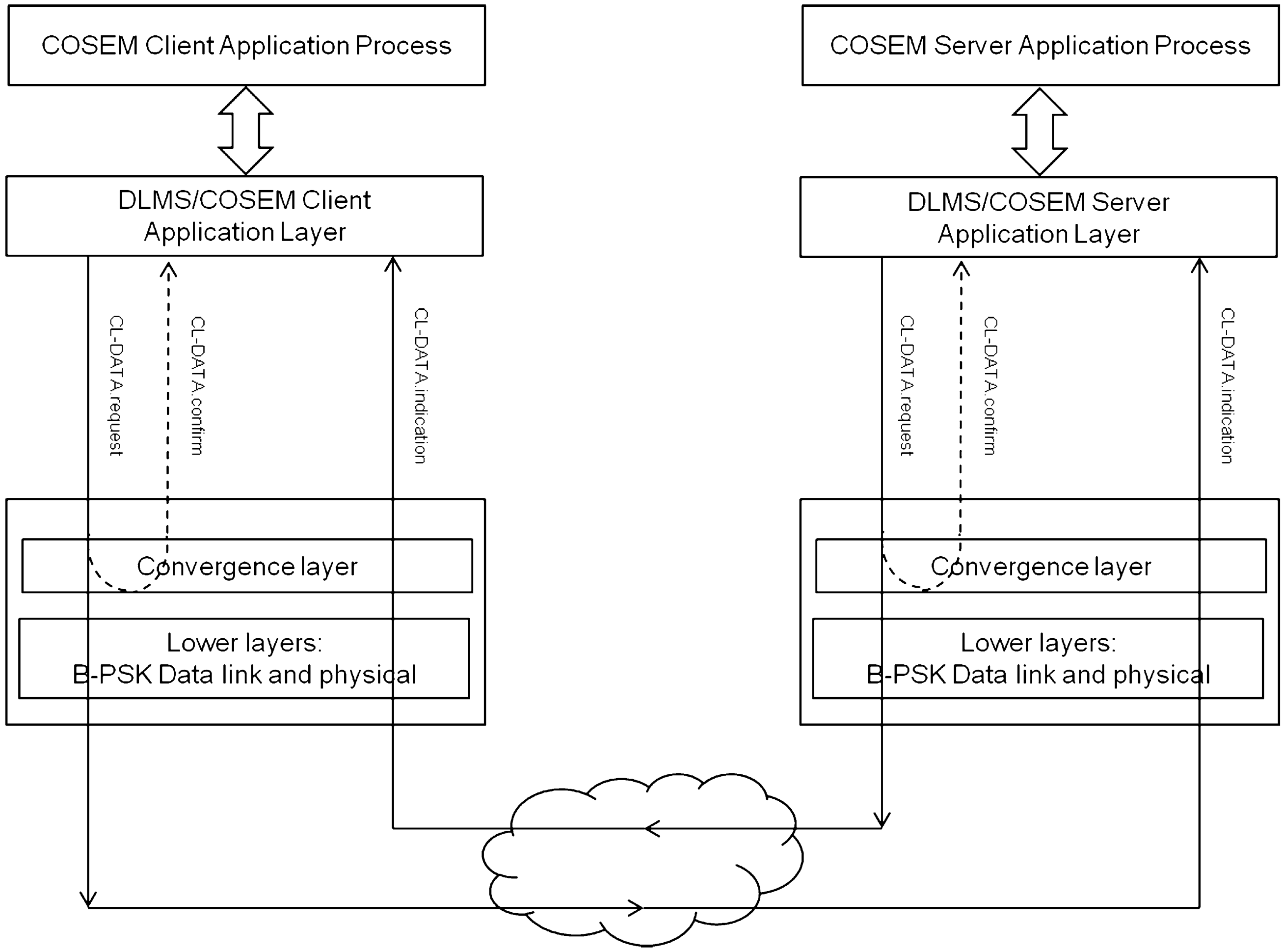


Figure 3 – Services of the DLMS/COSEM to B-PSK convergence layer

4.4.2.2 CL-DATA.request

Function

This service primitive is invoked by the Client service user DLMS/COSEM application layer to request the transmission of an APDU to the Server DLMS/COSEM application layer.

Service parameters

CL-DATA.request {

Data_link_communication_parameters,

SSAP,

DSAP,

Data_length,

Data

}

Data_Link_communication_parameters are transparently passed to the DL-DATA.request; definition of these parameters is given in CLC/TS 50568-4:2015, Clause 5.

SSAP is the Service Access Point of the originating entity; it is used to indicate which application entity generated the APDU.

DSAP is the Service Access Point of the destination entity; it is used to indicate to which application entity the APDU shall be delivered.

Data_Length is the length of the APDU to be transferred to the server application layer entity.

Data is the APDU to be transferred to the server application layer entity.

Use

The CL-DATA.request primitive is invoked by the client DLMS/COSEM application layer to request sending an APDU to a single peer application layer, or, in the case of multi- or broadcasting, to multiple peer application layers. The same primitive is also invoked by the server DLMS/COSEM application layer, as a response to an CL-DATA.indication event in case the application layer requested a confirmed service.

The invocation of this service primitive shall cause the convergence layer to segment the APDU if needed, to assemble the convergence layer PDU (see clause 4.4.3), and then to call the DL_DATA.request with the properly formed CLPDUs.

4.4.2.3 CL-DATA.confirm

Function

This optional service primitive is invoked by the convergence layer to confirm to the service user DLMS/COSEM application layer the result of the previous CL-DATA.request service. The service represents a local confirmation only.

Service parameters

CL-DATA.confirm {

Data_link_communication_parameters,

Transmission_status

}

Data_Link_communication_parameters are transparently passed from the DL-DATA.confirm; definition of these parameters is given in CLC/TS 50568-4:2015, Clause 5.

Transmission_status is local confirmation of transmission status, Transmission_status == OK means that the PDU has been correctly transmitted. No indication on the reception status of the peer entity is given.

Use

If implemented, this service primitive is used to confirm the result of a previous CL-DATA.request. It is locally generated and indicates that the complete Data of the .request primitive could be correctly sent or not. In case of segmentation, the confirm is invoked after sending the last segment.

An CL-DATA.confirm with Result == OK means only that the Data has been sent, and does not mean that the Data has been (or will be) successfully delivered to the destination.

4.4.2.4 CL-DATA.indication

Function

This service primitive is invoked by the DLMS/COSEM application Layer to indicate to the service user DLMS/COSEM application layer that an APDU has been received from a remote application layer.

Service parameters

CL-DATA.indication {

SSAP,

DSAP,

Data_length,

Data

}

SSAP is the Service Access Point of the originating entity, it is transparently passed to the peer application layer entity.

DSAP is the Service Access Point of the destination entity, it is transparently passed to the peer application layer entity.

Data_Length is the length of the APDU to be transferred to the peer application layer entity.

Data is the APDU to be transferred to the peer application layer entity.

Use

The CL-DATA.indication service primitive is used to indicate to the service user DLMS/COSEM application layer that an APDU from the peer layer entity has been received.

The primitive is generated following the reception of all the segments composing an APDU by the B-PSK Data Link layer. If not all the segments have been correctly received the APDU is discarded.

4.4.3 Protocol specification for the DLMS/COSEM SMITP B-PSK-based transport layer

4.4.3.1 The convergence layer protocol data unit (CLPDU)

There are two CLPDU formats, the Type 1, depicted in Figure 4, is used to transfer the first segment of each APDU, the Type 2, depicted in Figure 5, is used for the following segments if any.

↓ First transmitted byte

Control	DSAP	SSAP	DATA

Figure 4 – Type 1 CLPDU format

↓ First transmitted byte

Control	DATA

Figure 5 – Type 2 CLPDU format

DSAP

The DSAP address field identifies the service access point for which the data field is intended.

SSAP

The SSAP address field identifies the specific service access point from which the Data field was initiated.

Control Field

The Control field consists of one byte; it is formatted as indicated in Figure 6

↓ First transmitted bit

0	1	2	3	4	5	6	7
WT	MDF	RES		SEQ			

Figure 6 – Control field format

WT (CLPDU Type) can assume two different values:

- WT=0 in frames using Type 1 format;
- WT=1 in frames using Type 2 format.

MDF (More Data Follow) can assume two different values:

- MDF=0 if the frame is the last one in a sequence in this direction;
- MDF=1 if there are other APDU segments which needs to be sent in the same direction.

RES is a 2 bit field of value 00.

SEQ is the sequence number of the current segment, the numbering always starts from 0. In case the APDU is accommodated in only one frame the SEQ field assumes value 0.

Data

Data is the APDU segment to be transferred to the peer application entity.

4.4.3.2 Maximum transfer unit size and segment size

The theoretical maximum transfer unit (MTU) size is composed of 16 segments of the maximum length, one with Type 1 header and 15 with Type 2 header. It is possible for an implementation to limit the MTU to a lower value, given that the minimum allowed size is 242 bytes.

Given that the complete APDU shall accommodate in no more than 16 segments, the decision about the number of segments and the size of each segment is left to the transmitter side implementation.

Provided the minimum size specified above, the MTU size is implementation dependant, and it is noticed to the AL using the CL_mtu_size variable (see Annex D).

4.4.3.3 Exchange of frames not requiring segmentation (confirmed service)

4.4.3.3.1 General

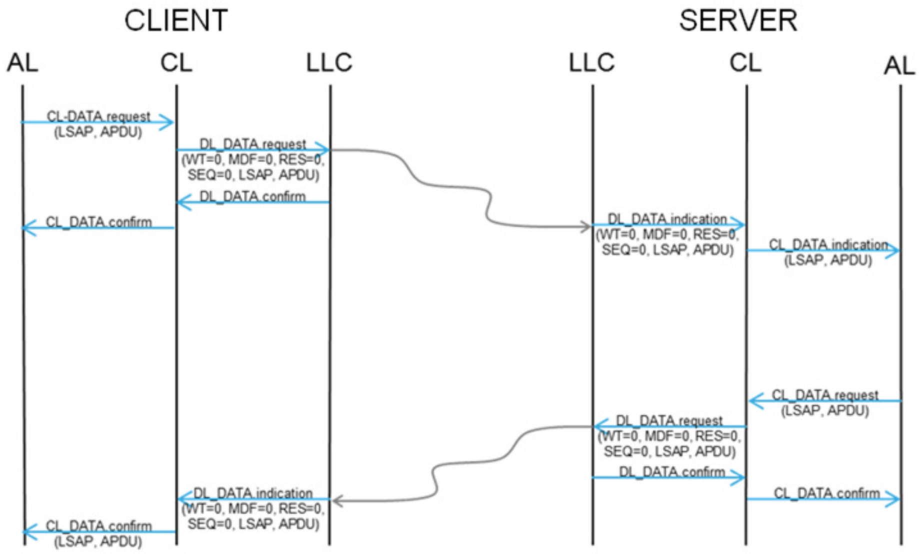


Figure 7 – Sequence chart of a CL transfer not requiring segmentation

4.4.3.3.2 Client transmitting phase

At client side, upon reception of a CL-DATA.request from the application layer entity, a single CLPDU is generated. Type 1 frame is used where control field has the following format:

(WT = 0, MDF = 0, RES = 0 SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters (see CLC/TS 50568-4:2015, Clause 5):

(ECTL = 0x00, Service_class = RA or RB, Max_resp_len = CL_mtu_size)

CL_mtu_size specified in the DLDATA.request invocation is the one of the addressed server, and not the one specified in the client.

At the reception of DL-DATA.confirm an optional CL-DATA.confirm can be generated.

4.4.3.3.3 Server transmitting phase

At Server side the reception of a DL-DATA.indication triggers a CL-DATA.indication, the convergence layer is put in a state on which it waits for a CL-DATA.request issued by the application layer entity.

At the reception of the CL-DATA.request primitive the convergence layer generates a CLPDU. Type 1 frame is used where the control field has the following format:

(WT = 0, MDF = 0, RES = 0 SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x00)

The resulting frame exchange is showed in Figure 7.

4.4.3.4 Exchange of frames requiring segmentation (unconfirmed service)

4.4.3.4.1 General

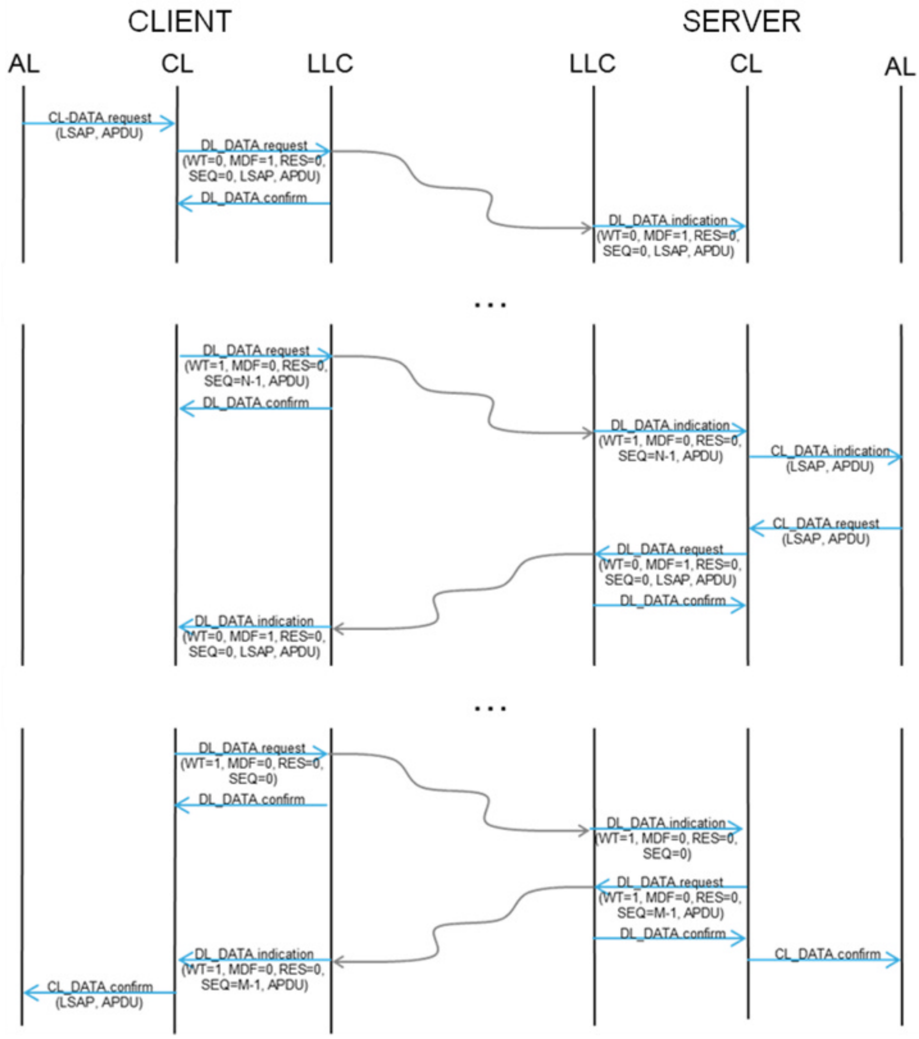


Figure 8 – sequence chart of a CL transfer requiring segmentation at both sides

At client side, upon reception of a CL-DATA.request from the application layer entity, the APDU is segmented in N segments, the resulting data exchange is described below and showed in Figure 8 .

Provided that DL layer already provides a procedure to ensure point to point reliable communication, based on acknowledge and retransmission mechanisms, no lost segment recovery mechanism is provided with this specification.

The behaviour of the Client and Server systems in case of loss of segments is described in 4.4.3.6.

4.4.3.4.2 Client in transmitting phase

At first the client side convergence layer generates a CLPDU with the first segment to be sent, CLPDU shall use frame type 1 where control field has the following format:

(WT = 0, MDF = 1, RES = 0 SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = RA or RB, Max_resp_len = CL_mtu_size)

At the reception of the DL-DATA.indication, the server side convergence layer generates a CLPDU with no data (this is used to acknowledge the reception of a segment to the client), the CLPDU shall use type 2 where control field has the following format:

(WT = 1, MDF = 0, RES = 0 SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000)

At client side, at the reception of the DL-DATA.indication a CLPDU containing the second segment of data is generated. CLPDU shall use frame type 2 is used where the control field has the following format:

(WT = 1, MDF = 1, RES = 0 SEQ = 1)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = RA or RB, Max_resp_len = 1)

The server side generates again a CLPDU with no data and the same format as before.

After the transmission of the N-1th segment, at the reception of the DL-DATA.indication, the client convergence layer generates the last CLPDU of this transaction. The CLPDU shall use frame type 2 where control field has the following format:

(WT = 1, MDF = 0, RES = 0 SEQ = N-1)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = RA or RB, Max_resp_len = CL_mtu_size)

4.4.3.4.3 Server in transmitting phase

At the reception of the last segment, which can be verified by checking the value of MDF field in the control byte, the server side convergence layer issues a CL-DATA.indication to the application layer entity passing the re-assembled ADPU.

Upon reception of a CL-DATA.request the APDU is segmented in M segments.

The convergence layer generates a CLPDU with the first APDU segment. The CLPDU shall use frame type 1, where control field has the following format:

(WT = 0, MDF = 1, RES = 0 SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000)

At the reception of the DL-DATA.indication the client side convergence layer, basing on the MDF bit of control field, generates a CLPDU with no data. The CLPDU shall use frame type 2 where control field has the following format:

(WT = 1, MDF = 1, RES = 0 SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = RA or RB, Max_resp_len = CL_mtu_size)

After the transmission of the M-1th segment, at the reception of a DL-DATA.indication, the server side convergence layer generates the last CLPDU of the transaction and optionally issues a CL-DATA.confirm to the application layer entity. The CLPDU shall use frame format 2 where control field has the following format:

(WT = 1, MDF = 0, RES = 0 SEQ = M-1)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000)

Upon reception of the corresponding DL-DATA.indication the client side convergence layer issues a CL-DATA.indication to the application layer entity passing the re-assembled APDU.

4.4.3.5 Exchange of frames requiring segmentation (unconfirmed service)

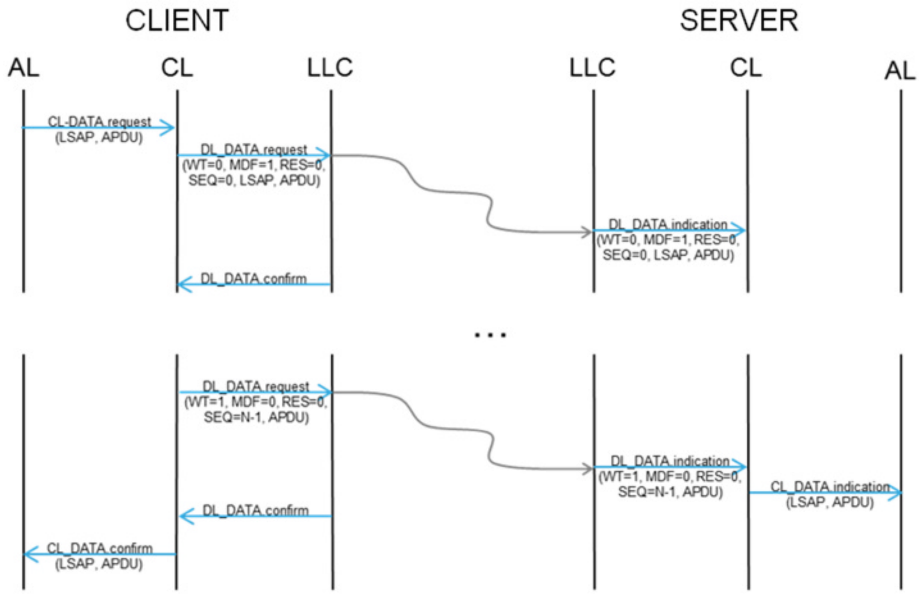


Figure 9 – sequence chart of a CL transfer requiring segmentation using the unconfirmed service

At client side, upon reception of a CL-DATA.request from the application layer entity, the APDU is segmented in N segments, the resulting data exchange is described below and showed in Figure 9.

At first the client side convergence layer generates a CLPDU with the first segment to be sent, CLPDU shall use frame type 1 where control field has the following format:

(WT = 0, MDF = 1, RES = 0, SEQ = 0)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = S)

Since DL is using an unconfirmed service (Service Class S), postponed confirmation is used, so as soon as the client DL issues the corresponding DL-DATA.confirm primitive the CL can transmit the next segment of the APDU, so a CLPDU containing the second segment of data is generated. CLPDU shall use frame type 2 is used where the control field has the following format:

(WT = 1, MDF = 1, RES = 0, SEQ = 1)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = S)

After the transmission of the N-1th segment, at the reception of the DL-DATA.confirm, the client convergence layer generates the last CLPDU of this transaction. The CLPDU shall use frame type 2 where control field has the following format:

(WT = 1, MDF = 0, RES = 0, SEQ = N-1)

CL invokes a DL-DATA.request passing the CLPDU formed as above mentioned, using the following parameters:

(ECTL = 0x0000, Service_class = S)

4.4.3.6 Management of errors in the procedure

In case a malformed CLPDU is received or a DL-DATA.confirm with negative result is issued by the data link, the transaction shall be terminated, whether this event is notified to the application layer entity and how is summarized in the table below.

Table 1 – Convergence layer error management scheme

Side	Status	Event	Actions
Client	Transmitting/receiving	DL-DATA.confirm with negative result	Optionally issues a CL-DATA.confirm with negative result. Abort transaction
Client	Transmitting/receiving	Reception of a malformed CLPDU	Optionally issues a CL-DATA.confirm with negative result. Abort transaction
Server	Transmitting/receiving	DL-DATA.confirm with negative result	Optionally issues a CL-DATA.confirm with negative result. Abort transaction
Server	Transmitting/receiving	Reception of a malformed CLPDU	Optionally issues a CL-DATA.confirm with negative result. Abort transaction.

A CLPDU is considered malformed if:

– The control field is not consistent with what described in 4.4.3.1:

– The SEQ number is different from what was expected.

In case a malformed CLPDU is received at Server side, where the CLPDU can be interpreted as the initial segment of a new transaction (SEQ == 0), the Server system can decide whether to ignore this CLPDU or to consider it as new transaction having aborted the previous one.

4.5 Application layer

The application layer is the DLMS/COSEM application layer as specified in EN 62056-5-3. It provides services to the COSEM application process (AP) and uses the services of the convergence layer.

4.6 Application process

4.6.1 General

On the server side, the COSEM device- and object model – as specified in EN 62056-6-2 applies. Each logical device represents an AP.

The client side APs make use of the resources of the server side AP. A physical device may host one or more client APs.

4.6.2 Establishing application association

The AAs can only be established with server systems properly registered to the NNAP. By a communication point of view a server node is properly registered when it is configured within the client system that is the master node of the sub network, and the MAC layer address is assigned to the server node by the master node itself.

A pre-established AA can also be used once the registration procedure has been successfully completed.

The mechanisms for discovery and registering of server nodes are described in the following 4.7.

4.6.3 Releasing application association

As the LLC sublayer supporting the DLMS/COSEM application layer is connectionless, the COSEM-Release service may be invoked with the Use_RLRQ_RLRE option = TRUE to release an AA.

To secure the RLRQ APDU against denial-of-service attacks – executed by unauthorized releasing of the AA – the user-information field of the RLRQ APDU may contain the xDLMS InitiateRequest APDU, authenticated and encrypted using the AES-GCM-128 algorithm, the global unicast encryption key and the authentication key (the same as in the AARQ APDU).

4.6.4 Service parameters of the COSEM-OPEN, -RELEASE and -ABORT services

No specific features / constraints apply related to the usage of COSEM-OPEN, -ABORT and -RELEASE services.

4.6.5 Transporting messages

Unsollicited services are not supported in this profile,, no other specific features / constraints apply related to the usage of DLMS/COSEM client/server services.

4.6.6 Transporting long messages

In the SMITP B-PSK profile, the LLC sub layer imposes a limitation on the length of the payload that can be transported. To remove this constraint, segmentation can be applied at the convergence layer and application layer block transfer is available.

4.6.7 Broadcasting

Broadcast messages can be sent by the data NNAP (concentrator), acting as a client, to servers using broadcast addresses as specified in in CLC/TS 50568-4:2015, Clause 6.

4.7 PLC network management

4.7.1 Introduction

PLC network management is provided by the Discovery and Registration Services, as described in Clause 8 of this document.

The discovery and registration services are the following:

- The Discover service;
- The Register service;
- The Deregister service
- The DiscoverForward service;
- The DiscoverReport service;
- The DiscoverForwardReport service;

- The RegisterReport service;
- The TCTset service;
- The Status service;
- The Ping service.

4.7.2 The Discover services

The Discover service is used to discover new meters. It is possible to use Discover service to discover meters which are already registered, in case they require an alternative route to improve the communication link, this is done properly managing the TCT value of the meters and the TCR parameter in the primitives.

The Discover services are used only when the active initiator is the concentrator, in those cases where the concentrator delegates a server to act as an active initiator, the DiscoverForward services shall be used.

The Discover service primitive shall provide the parameters as shown in 8.1.1.2. The concentrator shall issue a DL_DATA.request using multicast destination address and RCx Discipline without repeaters.

In order to guarantee the network communication stability the Client is allowed, at any time, to find alternate routes to reach a meter, even if it is already registered; for this reason the meter unit shall be able to answer to a DiscoverPDU even in case it is already registered; the allowance to answer to a DiscoverPDU is based uniquely in the filtering parameters specified for the Discover service. In case the meter is already registered it will accept DiscoverPDUs only if they orginate from the Concentrator that has registered the meter.

4.7.3 The Register service

The Register service is used to perform meter configuration. It assigns a MAC address (the SCA) to an unregistered meter.

The Register service primitive shall provide the parameters as shown in 8.1.1.8. The concentrator shall issue a DL_DATA.request using unicast address and SAx Discipline.

4.7.4 The Deregister service

The deregister service is used to force a registered meter to become unregistered, the previously assigned SCA is no more valid and the concentrator can re-assign it to a newly registered meter other than the deregistered one.

The Deregister service primitive shall provide the parameters as shown in 8.1.1.10. The concentrator shall issue a DL_DATA.request using unicast address and RAx Discipline.

4.7.5 The DiscoverForward service

The DiscoverForward service is used to discover meters which are not reachable by the concentrator, or when the communication link with the concentrator is not reliable. Using this service the concentrator delegates a meter to become an active initiator, providing a remote discover service originating from the selected meter.

The meter which receives a DiscoverForwardService issues a DiscoverPDU equivalent to the one generated by the Concentrator.

The DiscoverForward service primitive shall provide the parameters as shown in 8.1.1.5. The concentrator shall issue a DL_DATA.request using unicast address of the receiver as repeater address, multicast address as destination address, and RCx Discipline with repeaters

4.7.6 The DiscoverReport service

The DiscoverReport service is used as a response to the Discover service at meter side, only meters matching the filtering criteria specified by the Discover service (TCR, AddToAddress and RightShiftAdd) shall use this service.

The DiscoverReport service primitives shall provide the parameters as shown in 8.1.1.3. The meter shall issue a DL_DATA.request using unicast address and SAx Discipline.

4.7.7 The DiscoverForwardReport service

The DiscoverForwardReport service is used as a response to the DiscoverForward service at meter side; only meters matching the filtering criteria specified by the DiscoverForward service (TCR, AddToAddress and RightShiftAdd) shall use this service.

The DiscoverForwardReport service primitive shall provide the parameters as shown in 8.1.1.6. The meter (which is the destination system of a previously issued DiscoverForward service) shall issue a DL_DATA.request using unicast address and SAx Discipline.

4.7.8 The RegisterReport service

The RegisterReport service is used as a response to the Register service at meter side.

The RegisterReport service primitive shall provide the parameters as shown in 8.1.1.9. The meter shall issue a DL_DATA.request using unicast address and SAx Discipline.

4.7.9 The TCTset service

The TCTset service is used by the concentrator to silence a meter which has been already discovered, to prevent that it answers to the following discover requests. Its value has only a relative meaning, since it defines the maximum level of TCR (see 8.1.1.2 and 8.1.1.5) at which a meter is allowed to answer a Discover or a DiscoverForward request.

The TCTset service primitive shall provide the parameters as shown 8.1.1.4. The concentrator shall issue a DL_DATA.request using unicast address and RAx Discipline.

4.7.10 The Status Service

The Status service is used to acknowledge the TCTset, the DiscoverForward, the Deregister and the Ping services.

The Status service primitive shall provide the parameters as shown in 8.1.1.7. The meter shall issue a DL_DATA.request using unicast address and SAx Discipline.

4.7.11 The Ping service

The Ping service is used to check that a meter is already registered and still present on the network. It also allows allows verifying that the right physical device is linked to the right MAC address. It also prevents the time_out_no_activity timer to expire.

The process starts with a Ping.request service primitive issued by the concentrator. The service contains the ACA of the physical device pinged.

The Ping service primitive shall provide the parameters as shown in 8.1.1.11. The originating system shall issue a DL_DATA.request using unicast address and RAx Discipline.

4.7.12 Applying filtering criteria to Discovery procedure

The Discover and the DiscoverForward services allow a pre-selection on the meters which are allowed to answer with the appropriate Report service, this filtering action can be applied to the phase where the PLC modem of the meter is connected to, the ACA address of the meter or to an internal parameter, the so called TCT.

If requested by the initiator only the meters which have the PLC modem connected to the phase used for the transmission of the message containing the Discover, or DiscoverForward, service shall answer to the request and perform the discovery process.

Filtering on ACA address is performed through two parameters (AddToAddress and RightShiftAdd) in this way: the receiver adds to its ACA the AddToAddress parameter, then it divides the result by $2^{RightShiftAdd}$, if the remainder of this division is zero then the meter is allowed to answer to the request and perform the discovery process.

Filtering on TCT is used to prevent already discovered meters from answering to the discovery requests. Every meter has an internal parameter, the so called TCT, which has a default value of 255, a system is allowed to answer to the request only if TCR parameter specified on it is lower than its TCT value. The TCT value of each node can be changed using the TCTset service.

4.7.13 Meter discovery procedure

4.7.13.1 General

Since the B-PSK DL is managed following a strict master-slave policy, the Concentrator (that is the master of the network) keeps the control of the entire procedure.

NOTE The implementation of such a procedure is up to Concentrator manufacturer, so that, using the Discovery and Register services, it can build the procedure with the best performance.

Discovery and Register services are described in Clause 8 of the document.

An example of meter discovery procedure is shown in Annex A.

4.7.13.2 Routing table updating

Preliminary remarks:

– meter discovery procedure can run periodically in background on the Concentrator, in order to monitor any new meter installed on the network or any meter that become “unregistered” (after Activity_timeout seconds without any activity on the PLC);
– when a meter is not polled from the Concentrator for an adequate and configurable amount of time, it sets to zero the value of his SCA address (ad-hoc modelled timeout register). In this way it declares itself unregistered.

Case A: a new meter is discovered.

When a Concentrator, during the discovery procedure, finds a new meter, it communicates to AMM system its ACA address in order to receive the authorization to register it.

Case B: a meter became inaccessible.

When the Concentrator is not able to communicate with a meter, following an adequate algorithm it executes a certain number of retries.

Any Concentrator manufacturer is free to build and optimize such a procedure. A configurable inaccessibility timeout should be implemented within the Concentrator in order to monitor the connection with each PLC node. When such a timeout expires the Concentrator could notify the problem to the AMM system that verifies if a lost meter has been, for example, associated to another Concentrator (in case of high level network reconfiguration due to maintenance works). In this case, the AMM could ask to the first Concentrator to unregister that meter from its database. Otherwise it could require the Concentrator to perform again the discover procedure or set it in local maintenance addressed to field operators.

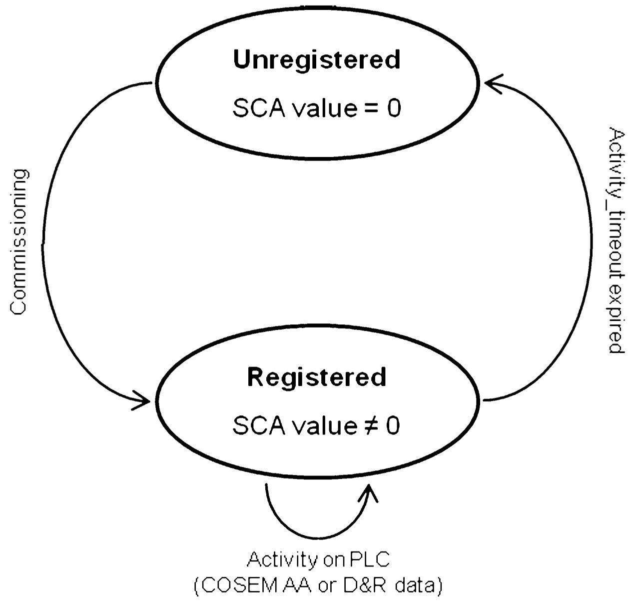


Figure 10 – Meter's state diagram

Changes on the network topology, moving more meters from one Concentrator to another one (e.g. in case of maintenance activities during a long period) is performed automatically when a Concentrator is turned off. In fact, when a concentrator is turned off, it stops polling his meters; in this way the meters turn themselves to unregistered state and they become available to respond to a meter discovery procedure started by another Concentrator.

4.8 Addressing

Each node in the PLC network can be addressed using either an absolute communication address (ACA) or a section communication address (SCA). ACA is fixed and globally unique for each node and, in general, it is used during the network initialization phase. SCA is assigned by the network controller, which guarantees its uniqueness in every PLC network. ACA and SCA addresses are managed at MAC layer level.

ACA is a unicast address.

SCA provides two-level addressing inside the PLC network, which are identified by:

- Node subsection;
- Node progressive.

It is possible to define SCA multicast addresses at node subsection level and SCA broadcast addresses. Details on the addressing scheme are given in CLC/TS 50568-4:2015, Clause 6.

4.9 System variables

CL_MTU_Size is the maximum transfer unit size (in bytes) the system can manage through CL-DATA services.

Timeout_no_activity is the amount of time a system should wait from the last activity on the PLC before re-setting its TCT value to the default value of 255.

TCT is the silencing level of the node, any request of discovery having a TCR level higher than the TCT level of the system shall be ignored.

5 The Original-SMITP B-PSK PLC profile

5.1 Overview

The PLC profile based on B-PSK modulation is used for remote data exchange on Neighbourhood Networks (NN) between Neighbourhood Network Access Points (NNAP) and End Devices using B-PSK power line technology over the low voltage electricity distribution network as a communication medium.

End devices – typically electricity meters – comprise application function and communication functions. They may be connected directly to the NNAP via the C interface.

The NNAP device, also known as Concentrator, is connected upstream to the Metering Head End System (HES) through interface G.

The reference architecture is shown in Figure 11.

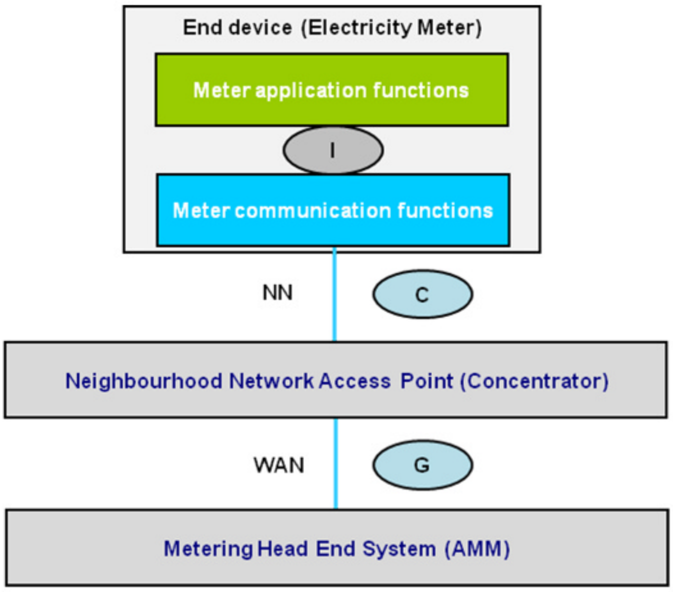


Figure 11 – Reference communication architecture

5.2 Structure of the profile

The protocol stack for PLC profile based on B-PSK modulation is shown in Figure 12.

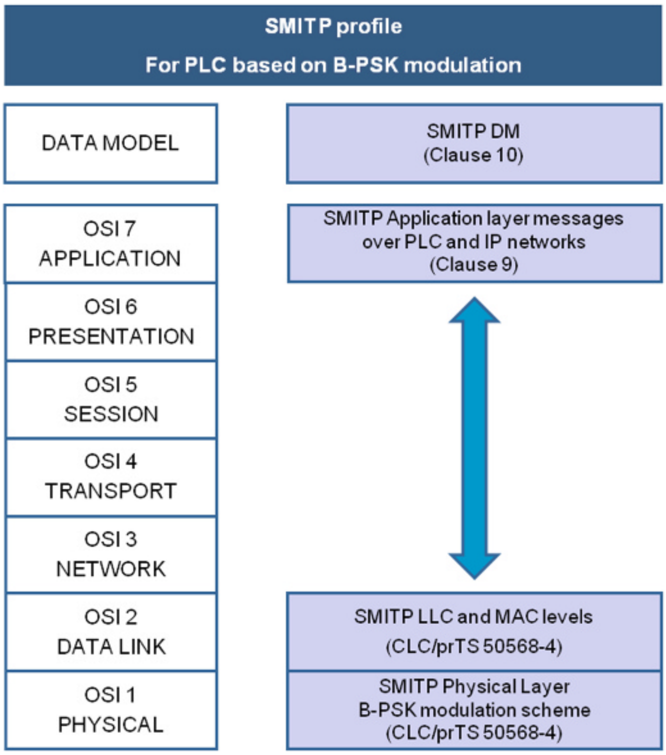


Figure 12 – Protocol stack for SMITP on PLC

5.3 Physical layer

5.3.1 Introduction

The SMITP Physical layer is described in CLC/TS 50568-4:2015.

The physical layer provides the interface between the equipment and the physical transmission medium. It transports binary information from the source to the destination.

In transmission it performs the coding and encapsulation of the payload in a physical frame, the 32 bit CRC calculation and the modulation in Binary Phase Shifting Key (B-PSK) at 4800 bps.

In reception it performs bit, byte and frame synchronization, the demodulation of the frame (B-PSK), the decoding of the payload and CRC checking. It makes a signal to noise ratio (SNR) estimation.

5.3.2 Crosstalk management

In the SMITP system, the Concentrator initiates the communication to the meters, which have been detected by the discovery mechanism (see par.5.7.1). The Concentrator is connected to all three phases, which are managed independently for communications, and since the phase of the meter is known, it establishes communications to each meter over this specific phase. Nevertheless, there are particular cases where a Concentrator cannot reach a meter in a direct way over the correct phase, but only via a crosstalk connection to another phase; in this case, the Concentrator recognizes during the discovery process that the meter is not reachable through its corresponding phase, but via another phase, and then manages the connection via cross talk correctly.

Concerning cross talk with other Concentrators, each Concentrator manages only the meters that are present in its Meter addresses table, established during the discovery procedure, and no others, so it will never try to reach a meter that is out of its domain. In this way the crosstalk (which is always possible in a Power Line Network) does not introduce any interference problem between a Concentrator and a meter bound by another one.

5.3.3 Communication performance assessment and management

Communication performance related to a meter is assessed by a Concentrator, for example counting the percentage of responses of the meter to the Concentrator's requests. If the percentage of responses is under a predefined threshold, it is up of the Concentrator to find a better path to reach it, using the mechanism of the meter discovery procedure (see 5.7.1).

5.4 Data Link layer

The SMITP Data Link layer is described in CLC/TS 50568-4:2015.

It consists of two sublayers: the Medium Access Control (MAC) sublayer and the Logical Link Control (LLC) sublayer.

The MAC sublayer handles the access to the physical medium and provides physical device addressing. It provides repetition and physical interfacing functionalities.

The repetition functions are:

– an end-to-end connectionless service between master node and all the net slave nodes;
– timers management related to net busy condition in master nodes and repeaters.

The physical interfacing functions are:

– frame encapsulation;
– received frames filtering, on the basis of a single or grouped address;
– frame errors detection. Wrong frames are rejected (no error recovery);
– electric phase connectivity detection.

The access mode to the physical medium is half-duplex.

LLC sub-layer interfaces the Application layer on the upper side and the MAC sub-layer on the lower side; it shall perform the following functions:

– it is responsible about the execution of end-to-end exchange procedures to guarantee a correct access procedure that avoids any possible collision on the net (in any moment a single node can ask a transmission request on MAC level); it manages access times to the LV communication on the master node;
– it operates end-to-end between the master node and all the net slave nodes; it offers a connectionless-type service to equipment applications, according to the kind of exchange procedure required;
– in the master node, it indicates net availability to application; user can request transmission of another message, upon reception of this indication;
– in the master nodes it manages re-transmissions (retry) on exchanges with expected answer. The mechanism of retransmission is vendor specific.

LLC sub-layer does not check the correctness of the disciplines used by the application layer; it is applications care to use discipline properly.

5.5 Application layer

The SMITP Application layer is described in Clause 9.

It provides the set of messages exchanged between the nodes present on the low voltage net. Three different types of nodes are foreseen:

– Concentrator: is the master of the net; there is always one and only one Concentrator for each section (identifier of the network managed by Concentrator).
– A-Node: is a peripheral unit which can communicate with the Concentrator (in this case it acts as slave) or with an associated B-Node (in this case it acts as master). The A-nodes are typically the meters.

– B-Node: is a peripheral unit which can communicate with the Concentrator or with an associated A-Node; it always acts as slave. It is typically the end customer device.

The application layer provides the services needed to manage meters and end customer devices:

– parameters programming activity, with access to SMITP data model;
– data exchange activity, with access to SMITP data model;
– software download;
– acknowledgements of requests or actions;
– remote command execution;
– encryption and authentication.

It also provides the services to manage the network.

NOTE For the identification codes of the mentioned messages in the following clauses, please, refer to Clause 9.

5.6 SMITP Data model

The SMITP Data model is described in Clause 10.

By an abstract point of view, the SMITP Data Model consists of data grouped in tables, each table representing an homogeneous set of parameters (registers). Each parameter can be accessed with specific rights (writable/not writable and readable/not readable) depending of the nature of the data.

These data can be retrieved individually, in sets of logically bound data (entire tables) or by user defined sets of data (Custom tables), allowing a fast and flexible scheme of data access.

Data retrieving is possible through Table ID, which is used to identify uniquely a SMITP table, and Register ID, which is used to identify uniquely a register within a SMITP table.

5.7 Application process

5.7.1 Meter discovery procedure

Because the SMITP network is managed following a strict master-slave policy, the Concentrator (that is the master of the network) keeps the control of the entire procedure. The implementation of such a procedure is up to Concentrator manufacturer, so that, using the features and messages available in the protocol (application layer) , he can build the procedure with the best performance.

Discovery services are described in Clause 8 of the document.

An example of meter discovery procedure is showed in Annex B.

5.7.2 Routing table updating

Preliminary remarks:

– meter discovery procedure can run periodically in background on the Concentrator, in order to monitor any new meter installed on the network or any meter that become “orphan” (ad-hoc modelled timeout register).
– when a meter is not polled from the Concentrator for an adequate and configurable amount of time, it sets to zero the value of his SCA address (ad-hoc modelled timeout register). In this way it declares itself orphan.

Case A: a new meter is discovered.

When a Concentrator, during the discovery procedure, finds a new meter, it communicate to AMM system its ACA address in order to receive the authorization to register it.

Case B: a meter became inaccessible.

When the Concentrator is not able to communicate with a meter, following an adequate algorithm (any Concentrator manufacturer is free to build and optimize such a procedure) it executes a certain number of retries.

Only in case of a long time inaccessibility, the Concentrator could notify the problem to the AMM system. When the AMM system receives this kind of alert from a Concentrator, it verifies if the lost meter was, for example, associated to another Concentrator (in case of high level network reconfiguration due to maintenance works). In this case, the AMM could ask to the first Concentrator to delete the meter from its routing table. Otherwise it could translate the Concentrator's message in a local maintenance request addressed to field operators.

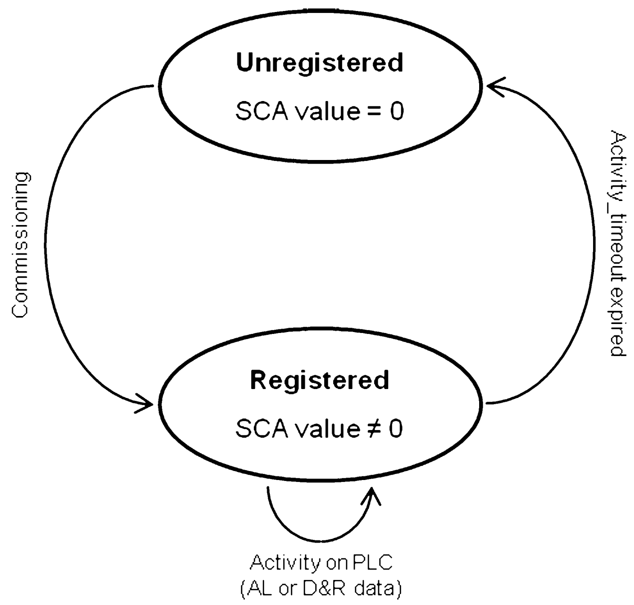


Figure 13 – Meter's state diagram

Changes on the network topology, moving more meters from one Concentrator to another one (e.g. in case of maintenance activities during a long period) is performed automatically turning off a Concentrator. In fact, when a concentrator is turned off, it stops polling his meters; in this way the meters turn themselves to orphan state and they become available to respond to a meter discovery procedure started by another Concentrator.

5.7.3 Meter's clock synchronization

For the correct operation of the system, all registered meters should be synchronized with an external temporal reference that comes from the Central System or AMM system. The Concentrators store this reference for their own synchronization and it should be sent periodically to the meters.

The meters store the current date and time that can be modified through a writing message WRITE.REQ (without/with protection).

The WRITE.REQ message without protection can only be used in the following cases:

- the node clock has never been synchronized;
- node lost every temporal reference (i.e. power fail, HW fail …);
- the deviation between the Concentrator time and the node time is smaller than a predetermined value.

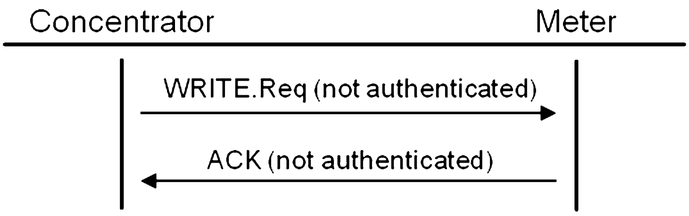


Figure 14 – Synchronization without protection

If any of the described conditions is fulfilled, the writing of the register should be done through a protected message WRITE.REQ.

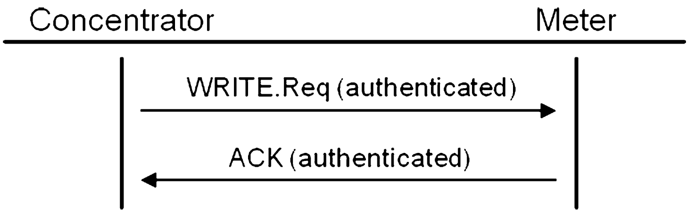


Figure 15 – Synchronization with protection

5.7.4 Reading and writing operations

5.7.4.1 Primitives for SMITP data model

It is possible to execute reading and writing operations on meter registers from the Concentrator via a sequence of application layer messages. Meter registers are organized in tables and to access a register (both for reading and writing) a 2 byte code is needed (1 byte for Table ID and 1 byte for Row ID).

Reading and writing operations can be authenticated, so each primitive has an equivalent version in case the authentication mechanism is active.

5.7.4.2 Reading operations

A reading operation is made through the primitive READ.REQ for individual registers (002 without protection, 102 with protection), READTAB.REQ (006/106) specific for several registers belonging to the same table and READTAB.REQ (008/108) for entire table data.

In case the reading is satisfactory, the Concentrator receives from the meter the response messages READ.RESP (003/103), READTAB.RESP (007/107) and READTAB.RESP (009/109) containing the requested data inside the payload.

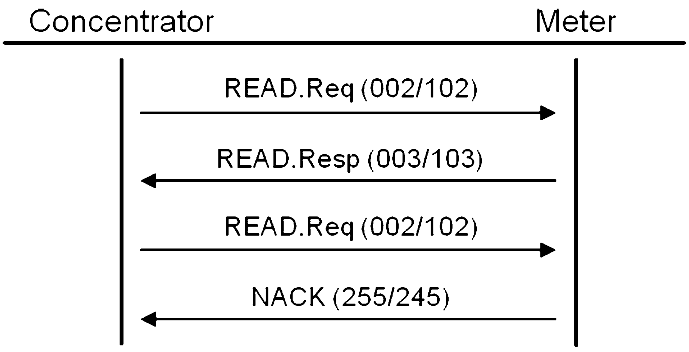


Figure 16 – Individual registers reading

If there is any problem on the reading operation, the meter will respond with a NACK message (255 without authentication, 245 with authentication) indicating the corresponding error code.

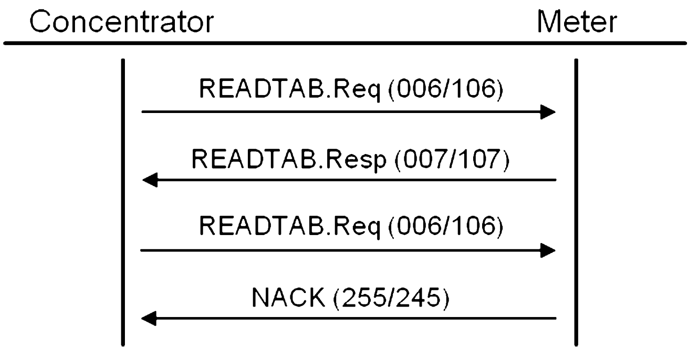


Figure 17 – Table registers reading

5.7.4.3 Writing operations

A writing operation is made through the primitive WRITE.REQ (004/104) for individual registers, WRITETAB.REQ (010/110) for several registers belonging to the same table.

In case the writing operation is satisfactory, the Concentrator receives from the meter an ACK message (253/243). Otherwise, if there is any problem on the writing, it receives a NACK message (255/245) with the corresponding error code.

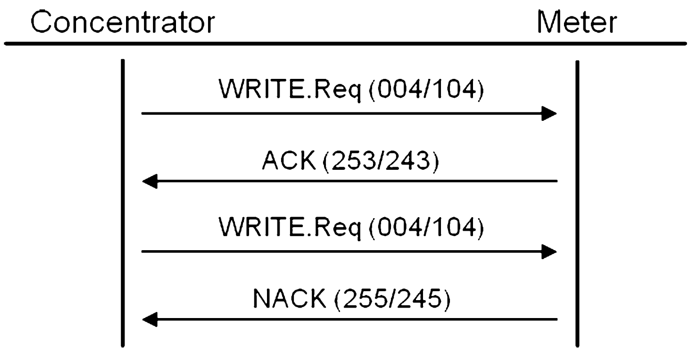


Figure 18 – Individual registers writing

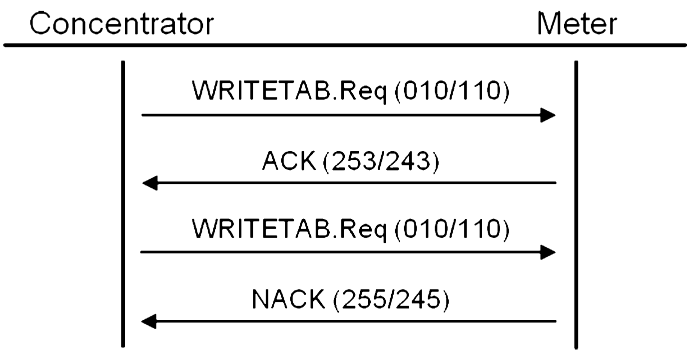


Figure 19 – Table registers writing

5.7.5 Download procedure

The meter software update is possible due to the available messages at the application layer for the control of this task. The stored/handled information is the following (acronyms are for used for concision of description):

– FRFPN: Final packet number. It shows the last packet of firmware that the meter should receive.

– SWOT: Switchover time. It shows the date at which the meter will proceed to activate the firmware loaded through the procedure.

– FRAD: Digest of the entire firmware. It is used by the meter to check the integrity of the received firmware.

– FRCW: to control and monitor the download procedure in case of writing or reading. While for writing it works as a way of sending commands to control the downloading procedure, on reading gives a sequence of status indicators (mask of bits) of the procedure so that the written values cannot be recovered again. The values to be considered on the mentioned information are:

  - WRITE:

    – STARTLOAD: it starts the procedure of charge. Activate the INPROGRESS bit and delete the remaining control bits.

    – ABORTLOAD: it aborts the procedure of charge. It deletes all the control bits.

  - READ:

    – INPROGRESS: it indicates if there is a procedure of load in execution. It is deleted when a STARTLOAD is received or a SWITCHREADY is activated.

    – RECEIVEDALL: it indicates that all the packets have been received and that activation date can be written. It is deleted when the STARTLOAD or ABORTLOAD commands are written.

    – DIGESTERR: it indicates that it has been detected an error in the digest firmware calculation regarding the FRAD value. It is deleted when the STARTLOAD or ABORTLOAD commands are written.

    – SWITCHREADY: ready to launch the switchover. It is activated after RECEIVEDALL activation and digest checking against FRAD value. It is deleted when the STARTLOAD or ABORTLOAD commands are written.

    – SWITCHDONE: it indicates that the switchover was done correctly.

The firmware update procedure consists of the following steps:

1) Update of the FRFPN and FRAD info indicating the final packet number and the complete firmware digest;
2) Update of the FRCW info with the command STARTLOAD corresponding value. If FRCW is read we will receive the INPROGRESS flag;
3) sending firmware packets using application layer REPROG messages to update a node. These messages are sent using SCA addressing, so meters have to be registered in the Concentrator. In case of broadcast programming, when the Concentrator finishes sending all the packets, it checks in each meter if some packets has not been received. Then Concentrator continues sending REPROG messages transporting those firmware packets still not received. In case of local programming, if the packet is received correctly on the meter, it sends the corresponding ACK (not authenticated) message. Otherwise the meter sends no acknowledge message or a NACK (not authenticated) message and the Concentrator will send again the REPROG message with the same firmware packet;
4) once all firmware packets have been received correctly by the meter, the Concentrator updates SWOT with the desired date and time to activate the new firmware.

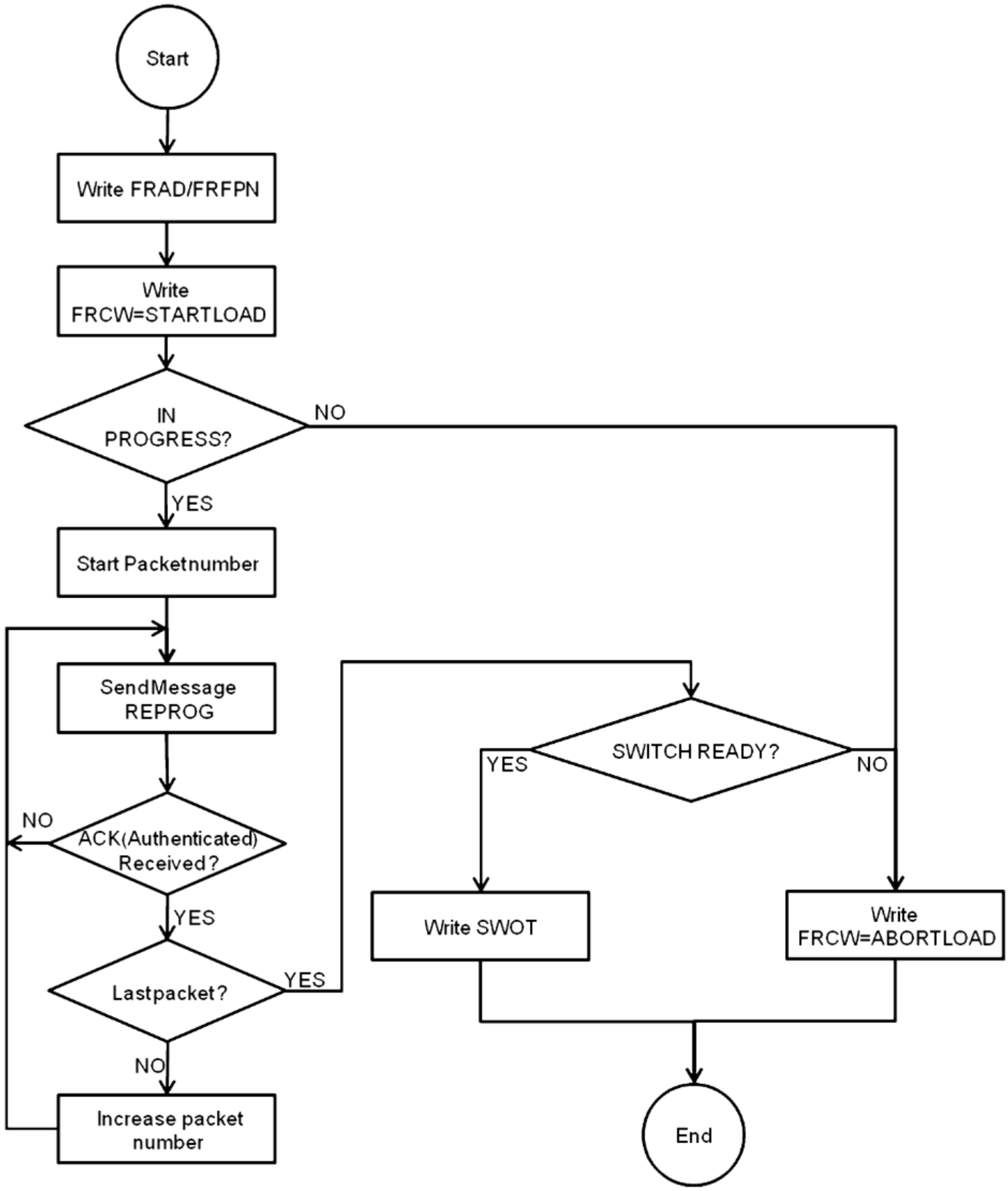


Figure 20 – Download procedure

5.7.6 Display management

5.7.6.1 Introduction

The meter shall display information of interest to the customer on a LCD module composed of 16 alphanumeric characters (5 x 7 dots) x 1 line and icons (special symbols or operating indicators).

The display is divided in two totally independent areas:

– Register Area (RegA): this area is used to show meter data. All the data elements contain:

- register Code Identifier (text label that may be assigned to the data registers to be identified on the display);
- register Data Value;
- register Data Measurement Unit.

– Operating Indicators Area (icons).

The operating indicators may be shown and refreshed in any moment, whatever data is being displayed in Register Area.

The Operating Indicators Area can indicate simultaneously the following information:

– quadrant in use;

– data unit for active and reactive energy/power;

– per phase: voltage and current presence;

– alarm condition indicator;

– PLC communication indicator;

– primary verification led in “reactive” mode;

– cut-off element open (this indication is placed at the most right-bottom position).

The control of the quadrant icons is based on the active (A) and reactive (R) energy measurements; therefore the highlighted icon shall be updated every change of the sign of A or R. At the start up of the meter the highlighted icon is based on the last measurement.

The active tariffs (one for each contract) are identified by means of a specific symbol that is placed close to the right side of the register Code Identifier when the related active energy register is shown in LCD idle mode. In any other LCD mode, this identification solution has not to be performed. This process will be performed only if a multi-tariff structure is active.

5.7.6.2 Display mode management

The meter handles and stores up to 240 messages. Each message is composed by 16 alpha-numeric symbols and by a set of control information used to define the related special characteristics described in the sections below.

The set of handled messages is shown on the LCD module of the meter according to the display configuration set by the operator. The way the messages are displayed is configured and is associated to the following transition events:

– Timeout event. Messages are shown after a programmable timeout. Four different timeouts can be defined (the configured value is readable) and assigned to specific info.

– Short press button event. Messages are shown when the front panel button is pushed for less than a programmable period of time.

– Long press button event. Messages are shown when the front panel button is pushed for more than a programmable period of time.

The meter implements special messages to be used in order to optimize the visualization of data related to measurements of different tariffs.

An example message structure is described below:

Table 2 – Example of message structure to be displayed

DSP						
DSP_SYM	**DSP_CODING**	**MSG_ID**	**DSP_TEXT**	**DSP_SM**	**DSP_DIVIDE**	**DSP_SI**

DSP_SYM: a set of flags corresponding to each special symbol to be displayed. When a flag bit is 1, the associated symbol is displayed.

DSP_CODING: code number of the data to be displayed.

MSG_ID: an unique message identification code assigned by the AMM system to each message structure in the table.

DSP_TEXT: contains the actual text to be displayed and it is comprised of 16 ASCII characters. A special character '}' is used to indicate where in the message the selected register has to be placed.

DSP_SM: if non-zero, it gives the number of one of the 104 special messages. They are pre-defined messages that are used in order to optimize the visualization of data related to measurements of different tariffs. An example would be a message to display the active tariff in conjunction with its associated value of the total consumption.

DSP_DIVIDE: number (power of 10) by which the absolute value held in the register is divided for.

DSP_SI: set of flags indicating special instructions for the message. These may include instructions to display the specified register as text or maybe to display leading zeroes.

6 The Original-SMITP IP profile

6.1 Overview

The PLC profile based on B-PSK modulation is used for remote data exchange on Neighbourhood Networks (NN) between Neighbourhood Network Access Points (NNAP) and End Devices using B-PSK power line technology over the low voltage electricity distribution network as a communication medium.

End devices – typically electricity meters – comprise application function and communication functions. They may be connected directly to the NNAP via the C interface.

The NNAP device, also known as Concentrator, is connected upstream to the Metering Head End System (HES) through interface G, via IP enabled networks.

The reference architecture is shown in Figure 21.

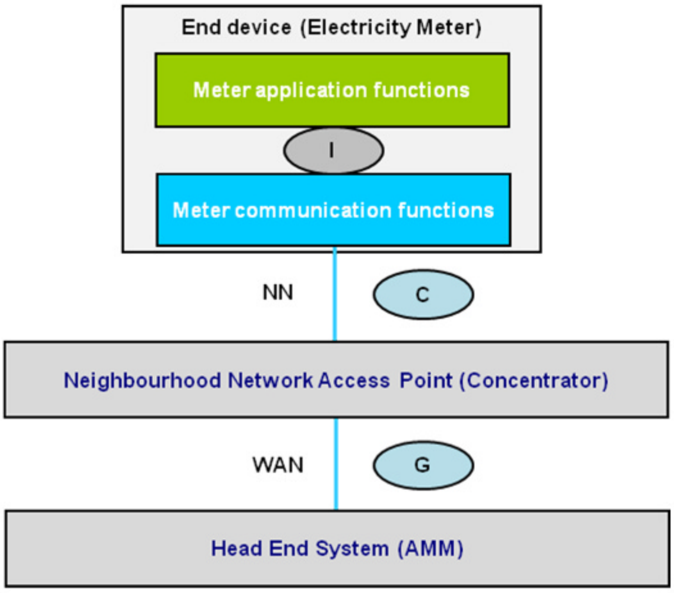


Figure 21 – Reference communication architecture

6.2 Structure of profile

Figure 22 shows the SMITP protocol stack on IP profile for the communication on a public network between the Central System and the Concentrator.

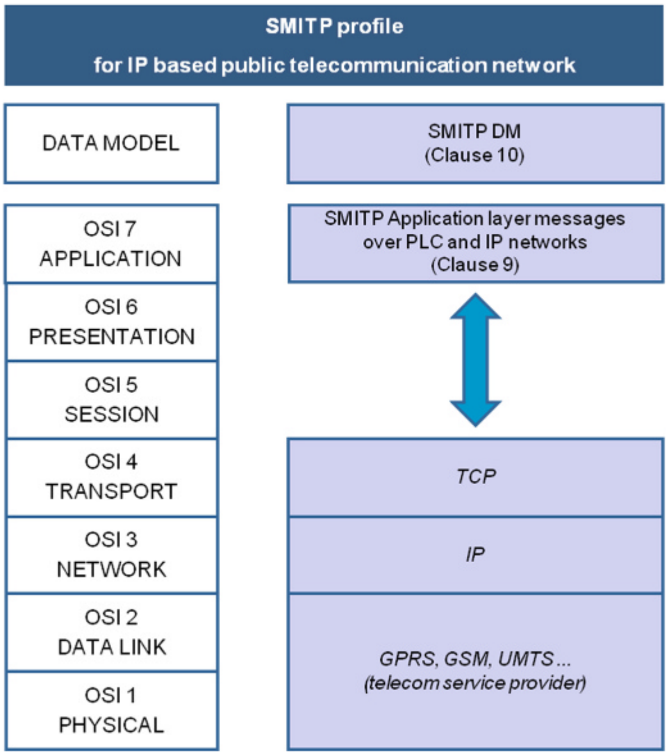


Figure 22 – Protocol stack for SMITP on IP

6.3 Physical and data link layers

The lower layers for this interface provide the physical medium to communicate the central system and the Concentrator, the medium access control and the addressing.

Due to the geographical dispersion of the Concentrators, and the lack of private communications networks among them, public telecommunication networks will be used where available: GPRS, UMTS, GSM, PSTN.

The services provided by these layers will be those supported by the public networks used, mainly error free data transportation.

6.4 Transport and network layers

6.4.1 General

The SMITP Application Layer uses the transport layer always in a connection-oriented mode, based on the connection-oriented Internet transport protocol, called Transmission Control Protocol or TCP STD0005, STD0006 and STD0007.

TCP is an end-to-end reliable protocol. This reliability is ensured by a conceptual “virtual circuit”, using a method called “Positive Acknowledgement with Retransmission” or PAR. It provides acknowledged data delivery, error detection, data re-transmission after an acknowledgement time-out, etc., therefore is dealing with lost, delayed, duplicated or erroneous data packets. In addition, TCP offers an efficient flow control mechanism and full duplex operation, too.

TCP, as a connection-oriented transfer protocol, involves three phases: connection establishment, data exchange and connection release. These phases are performed by a logical TCP management entity that uses standard ULP/TCP services. Any message of the SMITP Application Layer to be encapsulated in TCP packets is managed by this entity. This task could be implemented through the use of any standard TCP management library. 9.5 reports an example explaining the TCP/IP encapsulation of a SMITP TB Application layer message.

In the connection procedure, the client (AMM system) shall to send the requests toward the server (Concentrator) TCP port 50000, and the server (Concentrator) shall send the responses using its TCP port 50001.

6.4.2 TCP Service Request Primitives

6.4.2.1 UNSPECIFIED-PASSIVE-OPEN.request

Parameters: source-port, [timeout], [timeout-action], [precedence], [security-range]

Description: this primitive is used to listen for connection attempt at specified security range and precedence from any remote destination.

6.4.2.2 FULLY-SPECIFIED-PASSIVE-OPEN.request

Parameters: source-port, destination-port, destination-address, [timeout], [timeout-action], [precedence], [security-range]

Description: this primitive is used to listen for connection attempt at specified security range and precedence from specified destination.

6.4.2.3 ACTIVE-OPEN.request

Parameters: source-port, destination-port, destination-address, [timeout], [timeout-action], [precedence], [security]

Description: this primitive is used to request a connection at a particular security and precedence to a specified destination.

6.4.2.4 ACTIVE-OPEN-WITH-DATA.request

Parameters: source-port, destination-port, destination-address, [timeout], [timeout-action], [precedence], [security], data, data-length, PUSH-flag, URGENT-flag

Description: this primitive is used to request a connection at a particular security and precedence to a specified destination and transmit data together.

6.4.2.5 SEND.request

Parameters: local-connection-name, data, data-length, PUSH-flag, URGENT-flag, [timeout], [timeout-action].

Description: this primitive is used to transfer data across named connection.

6.4.2.6 ALLOCATE.request

Parameters: local-connection-name, data-length.

Description: this primitive is used to issue incremental allocation for data to be received.

6.4.2.7 CLOSE.request

Parameters: local-connection-name.

Description: this primitive is used to close connection in regular way.

6.4.2.8 ABORT.request

Parameters: local-connection-name.

Description: this primitive is used to close connection immediately.

6.4.2.9 Status.request

Parameters: local-connection-name.

Description: this primitive is used to query connection status.

6.4.3 TCP Service Response Primitives:

6.4.3.1 OPEN-ID.confirm

Parameters: local-connection-name, source-port, destination-port, destination-address.

Description: this primitive is used to inform TCP user about the connection name assigned to pending connection requests in an Open Primitive.

6.4.3.2 OPEN-FAILURE.confirm

Parameters: local-connection-name.

Description: this primitive is used to report failures of an Active Open request.

6.4.3.3 OPEN-SUCCESS.confirm

Parameters: local-connection-name.

Description: this primitive is used to report completion of a pending Open request.

6.4.3.4 DELIVER.indication

Parameters: local-connection-name, data, data-length, URGENT-flag.

Description: this primitive is used to report arrival of data.

6.4.3.5 CLOSING.indication

Parameters: local-connection-name.

Description: this primitive is used to report that remote TCP user has issued a Close and that all data sent by remote user have been delivered.

6.4.3.6 TERMINATE.confirm

Parameters: local-connection-name, description.

Description: this primitive is used to report that the connection has been terminated; a description of the reason for termination is provided.

6.4.3.7 STATUS-RESPONSE.confirm

Parameters: local-connection-name, source-port, source-address, destination-port, destination-address, connection-state, receive-window, send-window, amount-awaiting-ACK, amount-awaiting-receipt, urgent-state, precedence, security, timeout.

Description: this primitive is used to report current status of connection.

6.4.3.8 ERROR.indication

Parameters: local-connection-name, error description.

Description: this primitive is used to report service-request or internal error.

6.4.4 Example of primitives working

The following figures describe the use of TCP-ULP primitives in case of the ULP of an TCP connection opening request by a client (see Figure 21), a data exchange (see Figure 24) and a TCP connection closing request by a server (see Figure 25). The client is always the AMM system and the server is the Concentrator.

NOTE Primitives between TCP and IP protocols are inserted in order to detail the behaviour within the system but they are out of scope in this document.

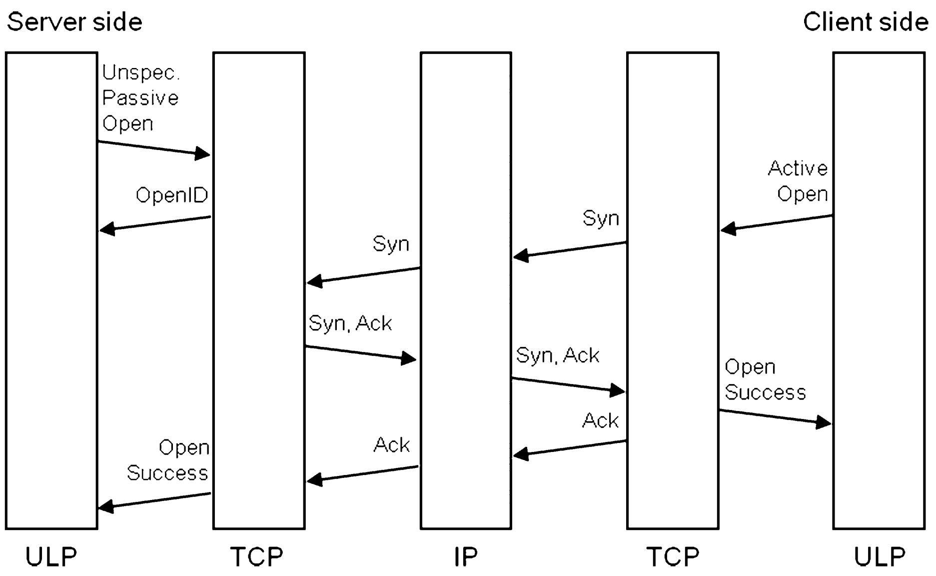


Figure 23 – Connection Opening

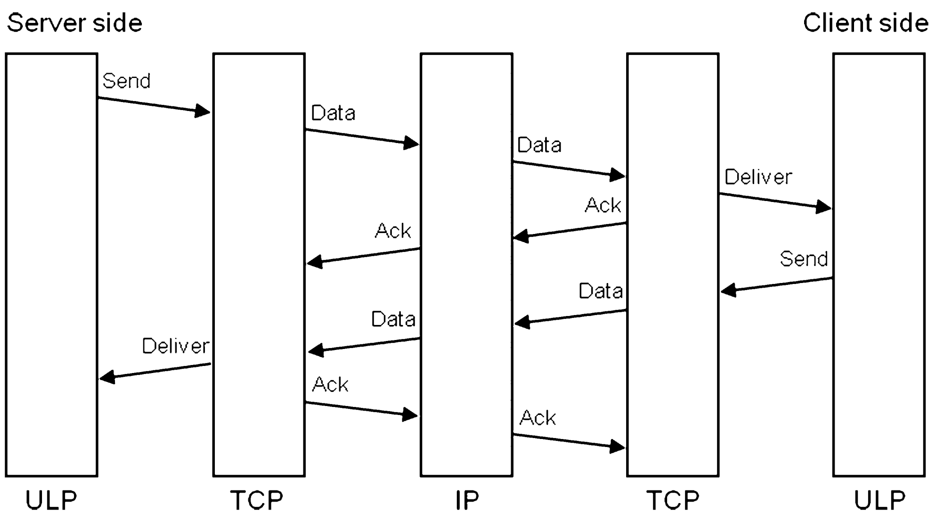


Figure 24 – Data exchange

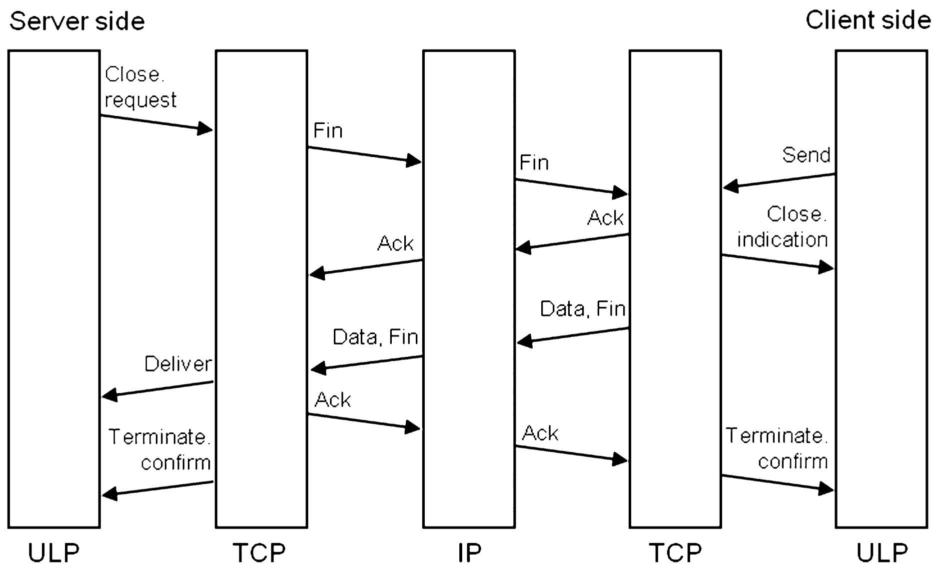


Figure 25 – Connection Closing

6.5 Application layer

The SMITP Application layer is described in Clause 9.

It provides the set of messages exchanged between AMM system and the Concentrator, through the public telecommunication networks (GSM, DCS, PSTN, GPRS etc).

The SMITP Application layer provides the services to handle LV network pattern and Concentrator management.

These services are:

– Requests to Concentrators to manage meters and end customer devices (programming, data exchange, software download, etc.);
– Concentrator and network management (programming, synchronization, software download, command execution, acknowledgements, events handling, etc).

6.6 SMITP Data model

The SMITP Data model is described in Clause 10.

By an abstract point of view, the SMITP Data Model consists of data grouped in tables, each table representing an homogeneous set of parameters (registers). Each parameter can be accessed with specific rights (writable/not writable and readable/not readable) depending of the nature of the data.

These data can be retrieved individually, in set of logically bound data (entire tables) or by user defined sets of data (Custom tables), allowing a fast and flexible scheme of data access.

Data retrieving is possible through Table ID, which is used to identify uniquely a SMITP table, and Register ID, which is used to identify uniquely a register inside a SMITP table.

7 Original-SMITP Local Optical interface profile

7.1 Overview

It is possible to operate on a meter through an HHU and a SMITP protocol based communication that uses an asynchronous serial port with optical coupling.

With reference to the base model specified in the ISO 7498 (OSI basic reference model) standard, the layered model of the telecommunication link involves only three layers, as described in Figure 26:

– Application (layer 7);

– Data Link (layer 2);

– Physical (layer 1).

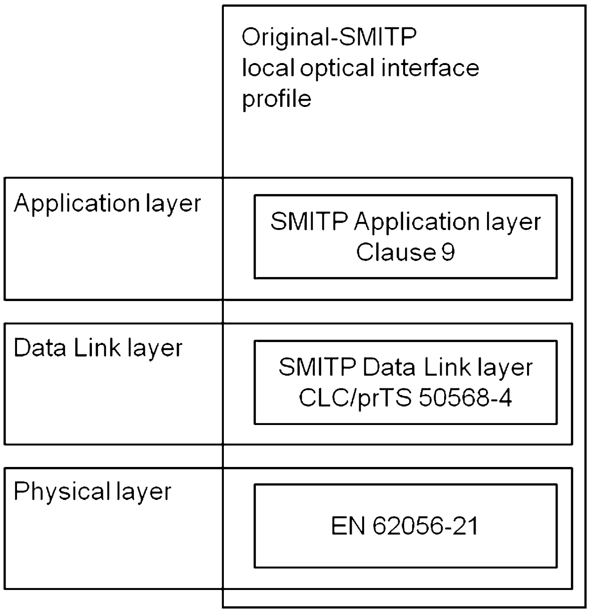


Figure 26 – Optical interface protocl stack

For Physical layer the specification has been drawn up with conformity to EN 62056-21 standard, in the suggested option for temporary link, with optical coupling at least.

For Data Link layer the specification has been drawn up in accordance with the CLC/TS 50568-4:2015 SMITP protocol. The format of MAC frames and the management of timers are described in this document.

For Application layer the communication follows the rules described in 9.1 for messages exchanged in distribution line networks.

7.2 Physical layer

7.2.1 Physical Support

The physical support used for the connection between HHU and meter is conformed to EN 62056-21 standard in the suggested option for temporary link, with optical coupling at least.

The interface is composed at meter level, by a transmission and reception optical device.

The HHU connection cable, on meter side, is endowed of a termination device with a head containing similar optical devices. This device allows the communication with the meter interface.

Type of transmission is asynchronous serial bit (Start - Stop) with parity bit, initial baud rate 300 up to 19200. The standard default baud rate is 9600.

The optical device uses the same wavelength for both connection directions; that involves a half duplex connection.

7.2.2 Character format

The character format used for the communication prologue is in accordance with EN 62056-21 standard, corresponding with ISO 1177 standard (1 Start bit, 7 data bit, 1 parity bit, 1 Stop bit).

All the exchanged characters are coded in accordance with ASCII standard.

Once the prologue is ended the communication between the subtended physical layer and Data Link layer of SMITP protocol is based on a transparent character interface.

The physical layer prepares the transmission formatting and checks the reception correctness: the received characters containing error are rejected and the data link timeout expiration is communicated to the protocol upper layers as described in CLC/TS 50568-4:2015.

7.3 Data transmission protocol

7.3.1 Introduction

The connection between HHU and meter is opened by the communication prologue. Once the baud rate and communication mode are correctly chosen meter and HHU are able to exchange messages using SMITP protocol specified in Clause 9 for Application Layer and in CLC/TS 50568-4:2015 for LLC and MAC layers.

7.3.2 Prologue

The communication prologue allows the meter to define the baud rate, and the HHU the communication mode to use during the communication. The whole prologue phase takes place at 300 baud speed.

The prologue procedure is ended after these choices have been taken. From this moment, the communication allows the SMITP Application Layer protocol defined in Clause 9, and the SMITP Data Link layer defined in CLC/TS 50568-4:2015 to use the transmission baud rate chosen during the prologue phase.

At the end of the communication session, an automatic return to initial state takes place, regardless of the mode or exit condition.

7.3.3 Connection procedure

The prologue procedure is correctly started when the line protocol on the HHU is waiting for the connection request made by its own local application process, and the meter is waiting to receive the request message from line. In this state both of them detect the connection “not available”. When the request message sent by HHU is received, the meter responds by sending the identification message that indicates the supported communication mode and the proposed baud rate.

The message sequence in case of correct procedure is showed in .

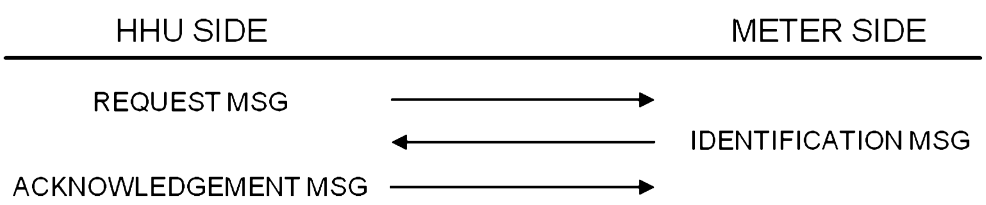


Figure 27 – Messages sequence in connection procedure between meter and HHU

HHU considers correctly closed the connection procedure after sending the acknowledgement message that confirms the baud rate, while meter declares available the connection at reception of the same message.

The procedure has to be considered closed with negative result on any of both stations in case of not receiving the expected message in the defined maximum time or in case of receiving the expected message in a not valid time. In case of procedure failure, HHU and meter have to be set in condition to handle a new connection procedure.

At the end of communication session, the devices shall return to the initial state after the local connection agents have delivered the abort event (see details in E.2.3).

7.3.4 Prologue's timers

The following timers are used during the prologue phase:

tr: the time between the reception of a message and the transmission of an answer. HHU uses this value between the reception of the identification message and the transmission of the acknowledgement message. Meter uses this value between the reception of the request message and the transmission of the identification message;

ta: maximum time elapsing between two characters of the same message.

The above values are so defined:

tr = from 20 ms to 1500 ms;

ta = 200 ms maximum.

7.4 Packet's protocol format

7.4.1 Introduction

The packet format of the prologue phase, used for the connection opening, is derived from EN 62056-21 standard. For the communication and the connection closing, the packet format is derived from ISO 1745 standard.

7.4.2 Packet's format for the prologue

7.4.2.1 General

Next, the packet's format used for the opening connection between HHU and meter is defined.

The communication sequence organization is based on the use of standard ASCII control characters shown in Table 3.

Table 3 – Standard ASCII control characters

Character	Meaning	Hex code
/	Start character	2F
!	End character	21
?	Transmission request	3F
CR	Carriage return	0D
LF	Line feed	0A
ACK	Acknowledge	06

The meaning of every field different from those showed above is specified for each single message below. If it is not differently specified, the packet's content has to be understood as ASCII character sequence.

All the packets that belong to the prologue procedure are sent at 300 bps baud rate.

7.4.2.2 Request message

Function:

The “request message” represents the packet that HHU sends to meter to execute a connection request.

Transmission speed: 300 Baud.

Structure:

/	?	Device address	!	CR	LF

Figure 28 – Connection request message

Coding:

Device address: optional field, manufacturer specific, 32 characters maximum.

7.4.2.3 Identification message

Function:

The “identification message” represents the packet that the meter sends to answer a request message. Within this message the meter’s identification code and the transmission speed are specified.

Transmission speed: 300 Baud.

Structure:

/	X	X	X	Z	\	W	Identification	CR	LF

Figure 29 – Identification response message

Coding:

XXX: manufacturer's identification code (three alphabetic capital characters). The third letter shall be transmitted in lower case to set the timeout tr at the minimum value, as defined in 7.3.4.

These letters shall be registered with the administrator: The FLAG Association.

Z: baud rate identification code. Baud rate proposed from meter in accordance with the values shown in Table 4.

Table 4 – Baud Rate coded values

Code Value	Baud Rate (bps)
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6	19200

Identification: meter identifier. It represents a string with a printable 16 characters maximum length, defined from the meter manufacturer. In this string cannot be inserted neither the "/" character, nor the "!" character. Within this ID field, the value of optional sub field "W" (enhanced baud rate and mode identification character), shall be 3 (see Annex D for further details).

7.4.2.4 Acknowledgement message

Function:

The "acknowledgement message" is the packet that HHU sends to quit the prologue phase and to ask the communication to switch to the Z baud rate. With this packet, HHU defines the new connection speed to be used.

Transmission speed: 300 Baud.

Structure:

ACK	V	Z	Y	CR	LF

Figure 30 – Acknowledgement message

Coding:

V: protocol control character, it shall be 3 to indicates SMITP protocol procedure.

Z: baud rate identification code (see Table 4).

Y: mode control character, it shall be 3, identifying SMITP binary mode.

7.5 Data Link Layer

During the communication in binary mode, the Data Link protocol specified in CLC/TS 50568-4:2015 is used, according with the following recommendations:

– the transmitted MAC frame is composed as follows:

LT	ADDR	CTL	RP	NB	INF	SVT

Figure 31 – MAC frame structure

Where:

LT: frame length (1 byte);

ADDR: MAC address (6 bytes); the allocation and the maintenance of the MAC addresses is in charge of Meters and More Association. The Association will supply pools of MAC addresses to the manufacturers that will request.

CTL: control (1 byte);

RP: repetition parameters (empty field);

NB: 1 byte field (not used);

INF: information field, MAC-sdu (min. 4, max. 130 bytes);

SVT: frame checking sequence (CRC of 4 bytes). This field contains the remainder, complemented to ones, of the division (modulo 2) of the bits sequence contained between the fields LT and INF (both included, considering, in this sequence, the first 32 bits starting from LT as complemented to ones) for the following generator polynomial:

$$g(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1$$

– HHU device sends to meter the above mentioned frame. The meter reads the ADDR field and:

- if the value is equal to its own address, the meter manages the frame according with CLC/TS 50568-4:2015;
- if the value is not equal to its own address, it sends the frame to logical component that directs it towards the PLC network, carrying out the feature called Optical Powerline Access (OPA). Via OPA is possible to reach through PLC network a remote meter by connecting a HHU to the optical port of another (neighbour) meter. In this case the meter takes care of rebuild the correct frame sequence recalculating SVT field, according with CLC/TS 50568-4:2015. Obviously when a meter takes on the PLC network a frame to return to HHU via optical interface, it shall recalculate SVT field.

8 Discovery and registration services

8.1 DLMS/COSEM over B-PSK discovery and registration services

The Discovery and Registration services provide facilities for:

- discovering meters which are in an unconfigured state or in alarm state (see 4.7.2);
- registering meters which are in an unconfigured state;
- check the state of the communication link with the concentrator;

The primitives required by the Discovery and Registration services are:

- Discover.request (.indication)
- DiscoverReport.response (.confirm)
- Register.request (.indication)
- RegisterReport.response (.confirm)
- TCTset.request (.indication)
- DiscoverForward.request (.indication)
- DiscoverForwardReport.response (.confirm)
- Status.response (.confirm)
- Deregister.request (.indication)
- Ping.request (.indication)

These application primitives uses the data link layer DL_Data services defined in CLC/TS 50568-4:2015 and Disciplines as described for each service.

The discovery and registration procedures for DLMS/COSEM over B-PSK are described in 4.7.13

Status service shall be used as a response for the following services: DiscoverForward, TCTset, Deregister and Ping, as described in 8.1.1.6.

8.1.1 Primitives description

8.1.1.1 General

The Discovery and Registration services use ASN.1 abstract syntax. All the DR-PDUs shall imperatively be sent in only one PHY-frame.

The DR-PDUs are encoded in A-XDR (EN 61334-6) and described as follows:

DR-PDU::= **CHOICE** {

discoverPDU	[90]	**IMPLICIT** DiscoverPDU,
discoverReportPDU	[91]	**IMPLICIT** DiscoverReportPDU,
tctSetPDU	[92]	**IMPLICIT** TCTSetPDU,
discoverForwardPDU	[94]	**IMPLICIT** DiscoverForwardPDU,
discoverForwardReportPDU	[95]	**IMPLICIT** DiscoverForwardReportPDU,

```
    registerRequestPDU      [96]    IMPLICIT RegisterRequestPDU,
    registerReportPDU       [97]    IMPLICIT RegisterReportPDU,
    deregisterRequestPDU    [98]    IMPLICIT DeregisterPDU,
    pingRequestPDU          [99]    IMPLICIT PingRequestPDU,
    statusPDU               [247]   IMPLICIT StatusPDU,
    }
DiscoverPDU::= SEQUENCE {
    phase           INTEGER (1..2),
    tcr             INTEGER (0..255),
    addToAddress    INTEGER (0..255),
    rightShiftAdd   INTEGER (0..255)
    }
DiscoverReportPDU::= SEQUENCE {
    aca             OCTET STRING (6),
    av_SIG          INTEGER (0..255),
    av_SNR          INTEGER (0..255),
    av_TX           INTEGER (0.255),
    reserved        OCTET STRING (3)
    }
RegisterRequestPDU::= SEQUENCE {
    sca             OCTET STRING (6)
    }
RegisterReportPDU::= SEQUENCE {
    errorCode       INTEGER (0..255)
    }
TCTSetPDU::= SEQUENCE {
    tct             INTEGER (0..255)
    }
DiscoverForwardPDU ::= SEQUENCE {
    phase           INTEGER (1..2),
    tcr             INTEGER (0..255),
    addToAddress    INTEGER (0..255),
```

```
        rightShiftAdd           INTEGER (0..255)
        }
DiscoverForwardReportPDU::= SEQUENCE {
        foundNodes              INTEGER (0..255)
        SEQUENCE OF SEQUENCE {
                aca                     OCTET STRING (6),
                av_SIG                  INTEGER (0..255),
                av_SNR                  INTEGER (0..255),
                av_TX                   INTEGER (0.255),
                reserved                OCTET STRING (3)
                }
        }
StatusPDU::= SEQUENCE {
        errorCode               INTEGER (0..255),
        av_SIG                  INTEGER (0..255),
        av_SNR                  INTEGER (0..255),
        av_TX                   INTEGER (0..255),
        }
DeregisterRequestPDU::= SEQUENCE {
        sca                     OCTET STRING (6)
        }
PingRequestPDU::= SEQUENCE {
        aca                     OCTET STRING (6)
}
```

8.1.1.2 Discover.request (.indication)

The Discover service is invoked by the Concentrator in order to find new meters that are directly reachable without the help of repeaters. As a consequence of the invocation of a Discover.request primitive, a DiscoverPDU is issued, having the the parameters specified in Table 5.

Table 5 – Discover service

	Discover	
	.request	**(.indication)**
Argument		
Phase	M	M (=)
TCR	M	M (=)
AddToAddress	M	M (=)
RightShiftAdd	M	M (=)
NOTE Multicast address and RCx service class without repeaters are used.		

Table 6 – Discover service arguments

Argument	Size	Value	Meaning
Phase	1 byte	1	In phase; The interrogated node shall respond only if it is “in phase” with the requester node.
		2	In any case; the interrogated node shall respond in any case, without discrimination of the phase differences.
TCR	1 byte	0..255	TCR, threshold of request. The interrogated node shall respond only if its TCT ≥ TCR.
AddToAddress	1 Byte	0..255	Parameters used together to filter the address. Use: the receiver adds to its address (last byte of its address) the parameter AddToAddress, then it shifts to the right “RightShiftAdd” times (right shift is a simple way to perform a division by 2). If the remainder of the operation is 0, then it is enabled to respond, otherwise it is not enabled to do.
RightShiftAddress	1 Byte	0.255	

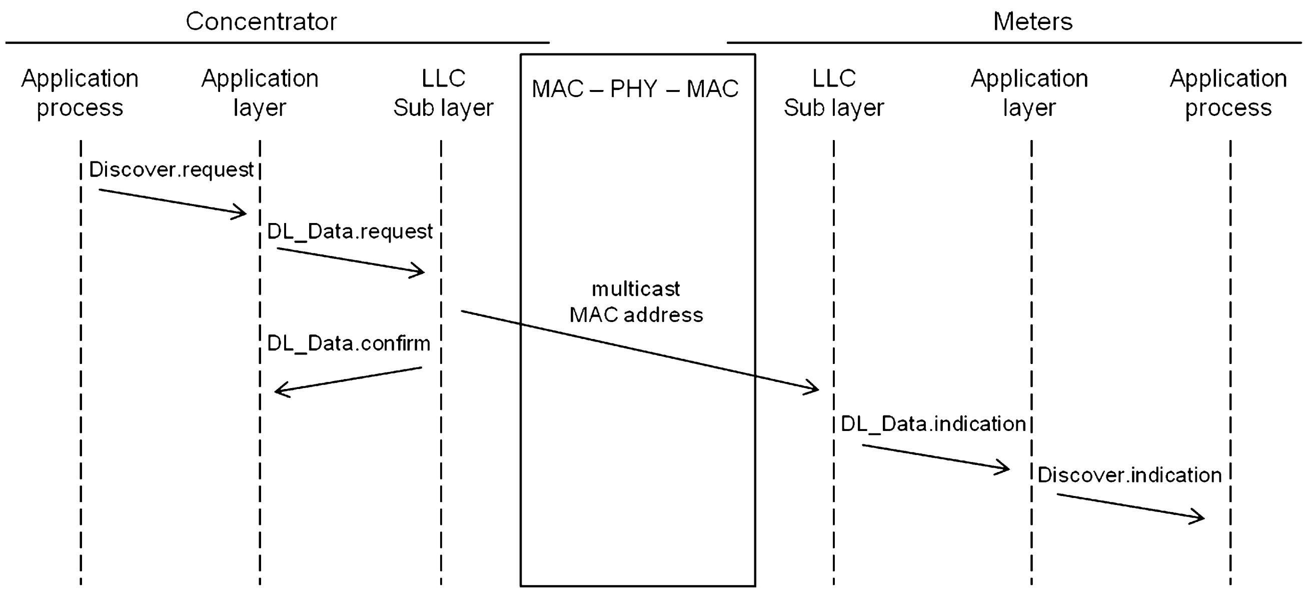


Figure 32 – Discover messages exchange

8.1.1.3 DiscoverReport.response (.confirm)

The DiscoverReport service is invoked by the meters as response to a Discover.indication primitive previously received in order to inform their identity and signal quality. As a consequence of the invocation of a DiscoverReport.response primitive, a DiscoverReportPDU is issued, having the the parameters specified in Table 7.

A meter which receives a malformed DiscoverPDU shall discard it without issuing any response.

Table 7 – DiscoverReport service

	DiscoverReport	
	.response	**(.confirm)**
Argument		
ACA	M	M (=)
Av_SIG	M	M (=)
Av_SNR	M	M (=)
Av_TX	M	M (=)
Reserved (FFh)	M	M (=)
NOTE Unicast address and SAx service class are used		

Table 8 – DiscoverReport service arguments

Argument	**Size**	**Value**	**Meaning**
ACA	6 bytes	-	ACA of the sender node.
Av_SIG	1 byte	0..255	Instantaneous signal level in the RX messages (if the device is not able to provide this information, it shall set 255 value).
Av_SNR	1 byte	0..255	Instantaneous SNR in the RX messages (if the device is not able to provide this information, it shall set 255 value).
Av_TX	1 byte	0..255	Impedance value of the communication media (if the device is not able to provide this information, it shall set FF value).
Reserved	3 bytes	FFFFFFh	Reserved field.

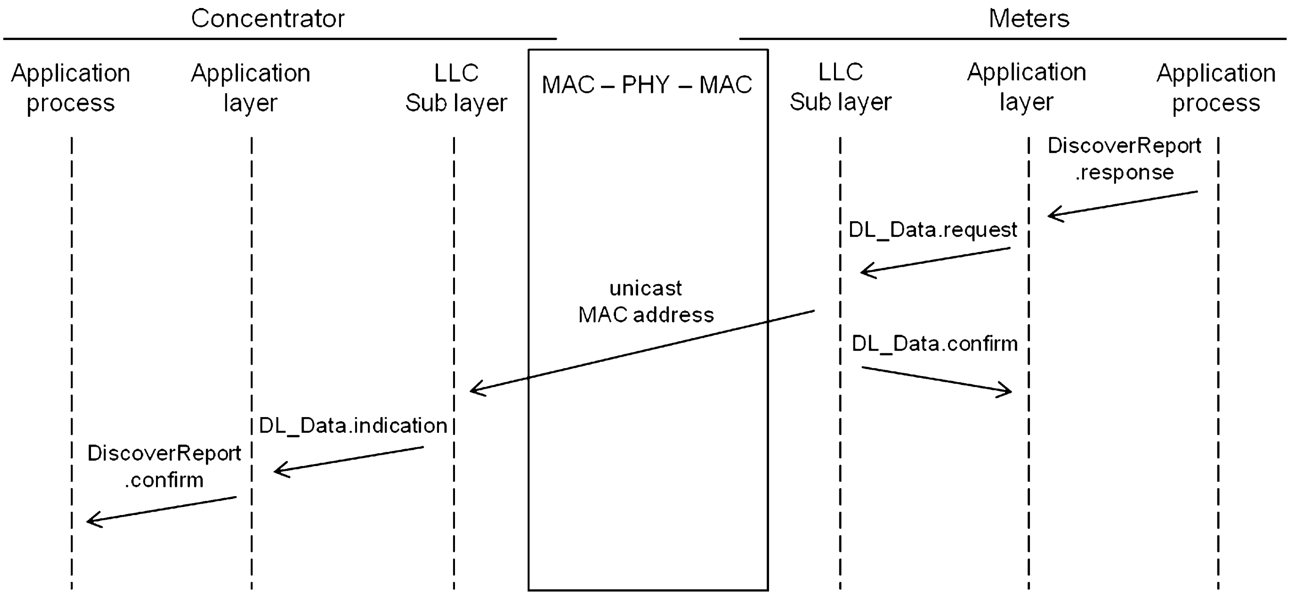


Figure 33 – DiscoverReport messages exchange

8.1.1.4 TCTset.request (.indication)

The TCTset service is invoked by the DLMS/COSEM concentrator in order to filter and select the meters previously reached for the discovery procedure. As a consequence of the invocation of a TCTset.request primitive, a TCTsetPDU is issued, having the the parameters specified in Table 9.

Table 9 – TCTset service

	TCTset	
	.response	**(.confirm)**
Argument		
TCT	M	M (=)
NOTE Unicast address and RAx service class are used		

Table 10 – TCTSet service arguments

Argument	Size	Value	Meaning
TCT	1 byte	0..255	Value of TCT to set.

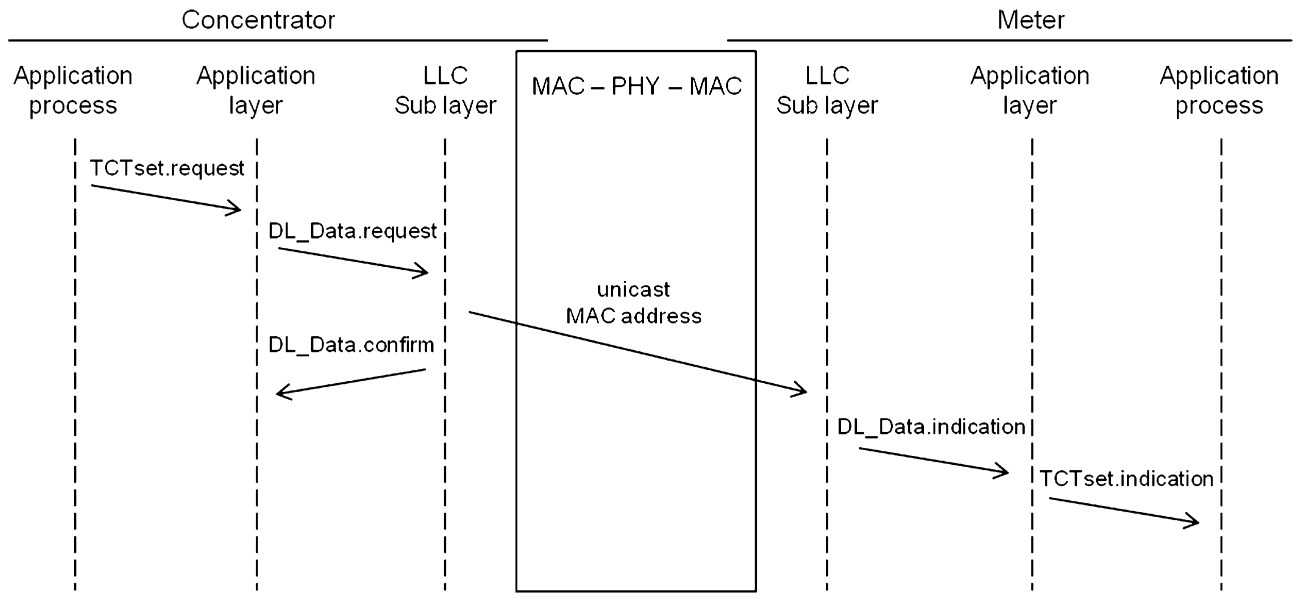


Figure 34 – TCTset messages exchange

8.1.1.5 DiscoverForward.request (.indication)

The DiscoverForward service is invoked by the DLMS/COSEM concentrator in the meters already discovered that act as nth level repeaters, in order to forward the Discover service to n+1th level meters. As a consequence of the invocation of a DiscoverForward.request primitive, a DiscoverForwardPDU is issued, having the the parameters specified in Table 11.

- The meter receiving a DiscoverForward.indication will issue:A Status.response to acknowledge the DiscoverForward service to the concentrator;
- A Discover.request to poll the n+1th meters level, with the parameters specified in the DiscoverForward.indication;
- A DiscoverForwardReport.response with the collection of data sent by the nodes who responded to the Discover service.

Table 11 – DiscoverForward service

	DiscoverForward	
	.request	**(.indication)**
Argument		
Phase	M	M (=)
TCR	M	M (=)
AddToAddress	M	M (=)
RightShiftAdd	M	M (=)
NOTE Unicast address of the receiver node as last repeater, multicast address as final node and RCx service class with repeaters are used		

Table 12 – DiscoverForward service arguments

Argument	Size	Value	Meaning
Phase	1 byte	1	In phase; The interrogated node shall respond only if it is "in phase" with the requester node.
		2	In any case; the interrogated node shall respond in any case, without discrimination of the phase differences.
TCR	1 byte	0..255	TCR, threshold of request. The interrogated node shall respond only if its TCT ≥ TCR.
AddToAddress	1 Byte	0..255	Parameters used together to filter the address. Use: the receiver adds to its address (last byte of its address) the parameter AddToAddress, then it shifts to the right "RightShiftAdd" times (right shift is a simple way to perform a division by 2). If the remainder of the operation is 0, then it is enabled to respond, otherwise it is not enabled to do.
RightShiftAddress	1 Byte	0..255	

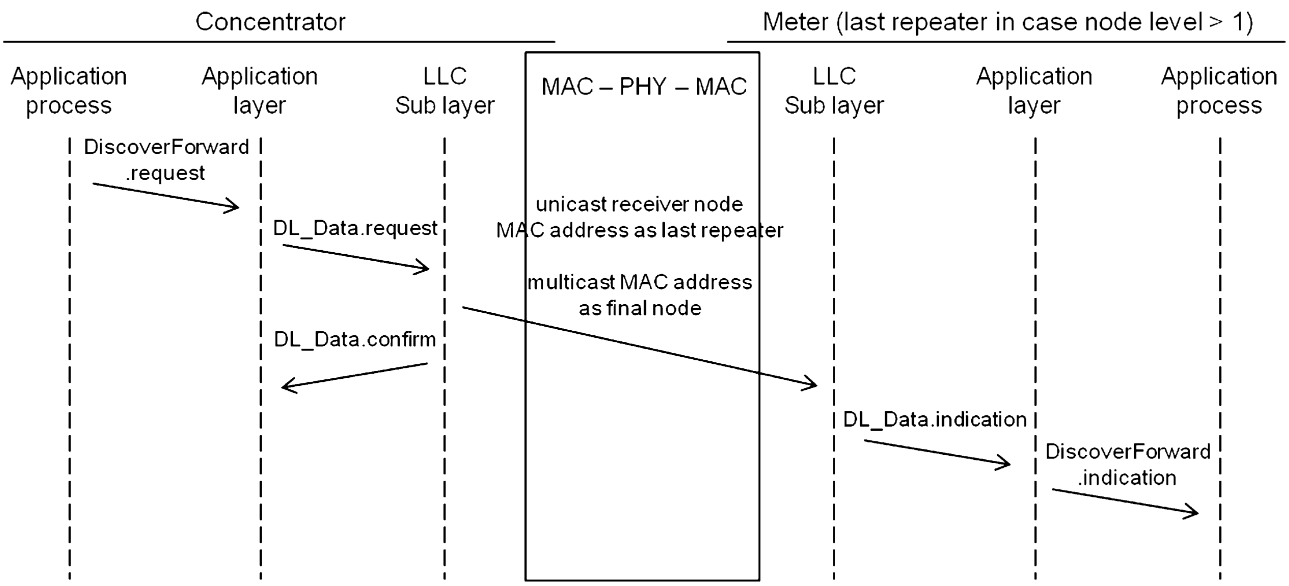


Figure 35 – DiscoverForward messages exchange

8.1.1.6 DiscoverForwardReport.response (.confirm)

The DiscoverForwardReport service is invoked by the n^{th} level meters as response to the DiscoverForward.indication primitive sent by concentrator and transports network parameters received from n+1th level meters. As a consequence of the invocation of a DiscoverForwardReport.response primitive, a DiscoverForwardReportPDU is issued, having the the parameters specified in Table 13.

Table 13 – DiscoverForwardReport service

	DiscoverForwardReport	
	.response	**(.confirm)**
Argument		
Found nodes	M	M (=)
NodeInfo ACA Av_SIG Av_SNR Av_TX Reserved (FFh)	S M M M M M	S (=) M (=) M (=) M (=) M (=) M (=)
NodeInfo	S	S (=)
NodeInfo	S	S (=)
NodeInfo	S	S (=)
NOTE Unicast address and SAx service class are be used		

Table 14 – DiscoverForwardReport service arguments

Argument	Size	Value	Meaning
FoundNodes	1 byte	0..255	Number of found nodes. If the number is 4 or less, only the found nodes' NodeInfo Structs shall be sent. If the number is more than 4, only the first 4 NodeInfo Structs are associated to the message, the first ones received. If no node is found, then value 0 shall be sent with no Structs associated.
NodeInfo structure			
ACA	6 bytes	-	ACA of the sender node.
Av_SIG	1 byte	0..255	Instantaneous signal level in the RX messages (if the device is not able to provide this information, it shall set 255 value).
Av_SNR	1 byte	0..255	Instantaneous SNR in the RX messages (if the device is not able to provide this information, it shall set 255 value).
Av_TX	1 byte	0..255	Impedance value of the communication media (if the device is not able to provide this information, it shall set FF value).
Reserved	3 bytes	FFFFFFh	Reserved field.

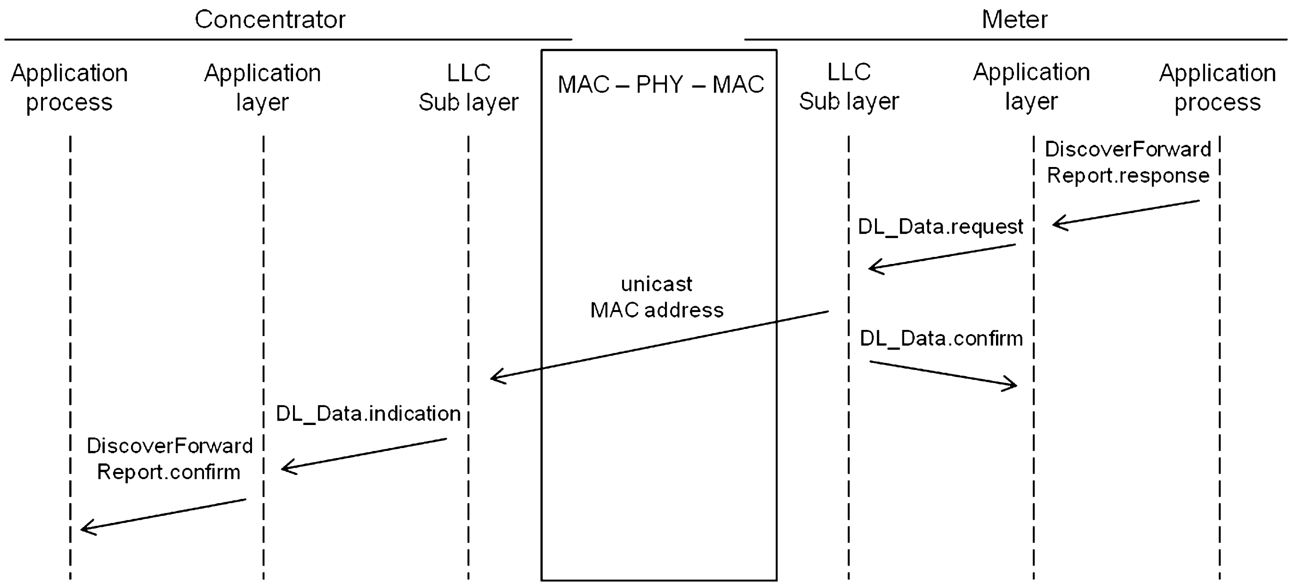


Figure 36 – DiscoverForwardReport messages exchange

8.1.1.7 Status.response (.confirm)

The Status service is invoked by meters as response to DiscoverForward.indication, TCTset.indication, Deregister.indication and Ping.indication primitives received from the concentrator. As a consequence of the invocation of a Status.response primitive, a StatusPDU is issued, having the the parameters specified in Table 15.

Table 15 – Status service

	Status	
	.response	**(.confirm)**
Argument		
Error code	M	M (=)
Av_SIG	M	M (=)
Av_SNR	M	M (=)
Av_TX	M	M (=)
NOTE Unicast address and SAx service class are used		

Table 16 – Status service arguments

Argument	Size	Value	Meaning
ErrorCode	1 byte	0	No error
		1	Data field not correct / bad length
		2..255	Reserved
Av_SIG	1 byte	0..255	Instantaneous signal level in the RX messages (if the device is not able to provide this information, it shall set 255 value).
Av_SNR	1 byte	0..255	Instantaneous SNR in the RX messages (if the device is not able to provide this information, it shall set 255 value).
Av_TX	1 byte	0..255	Impedance value of the communication media (if the device is not able to provide this information, it shall set FF value).

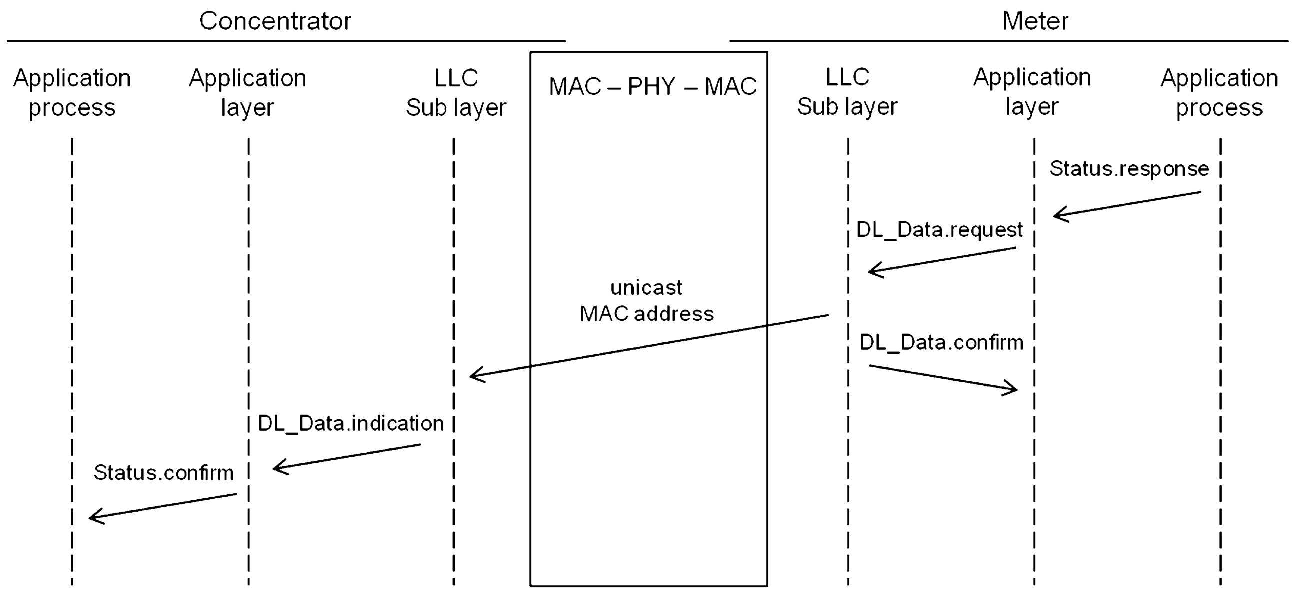


Figure 37 – Status messages exchange

8.1.1.8 Register.request (.indication)

The Register service is invoked by the Concentrator in order to set the new MAC section communication address into meters. As a consequence of the invocation of a Register.request primitive, a RegisterPDU is issued, having the the parameters specified in Table 17.

Table 17 – Register service

	Register	
	.request	**(.indication)**
Argument		
SCA	M	M (=)
NOTE Unicast address and RAx service class are used		

Table 18 – Register service arguments

Argument	**Size**	**Value**	**Meaning**
SCA	6 bytes	-	SCA assigned to the meter.

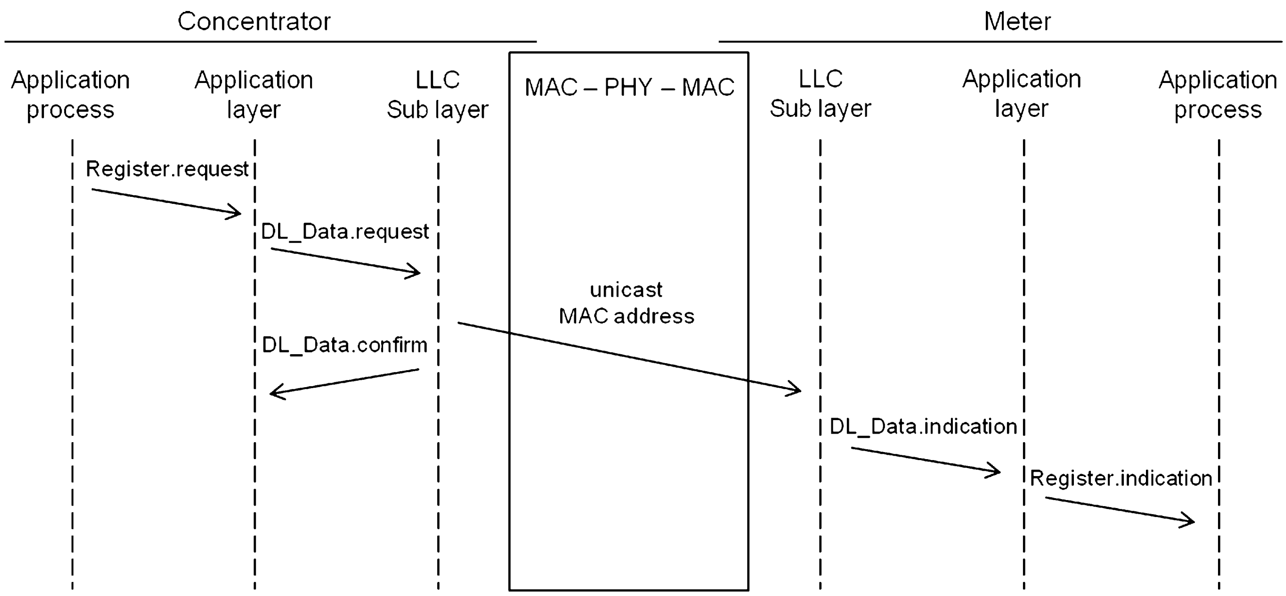


Figure 38 – Register messages exchange

8.1.1.9 RegisterReport.response (.confirm)

The RegisterReport service is invoked by server nodes as response to the Register.indication primitive received from the concentrator. As a consequence of the invocation of a RegisterReport.response primitive, a RegisterReportPDU is issued, having the the parameters specified in Table 19.

Table 19 – RegisterReport service

	RegisterReport	
	.response	**(.confirm)**
Argument		
Error code	M	M (=)
NOTE Unicast address and SAx service class are used		

Table 20 – RegisterReport service arguments

Argument	**Size**	**Value**	**Meaning**
ErrorCode	1 byte	0	No error
		1	Data field not correct / bad length
		2..255	Reserved

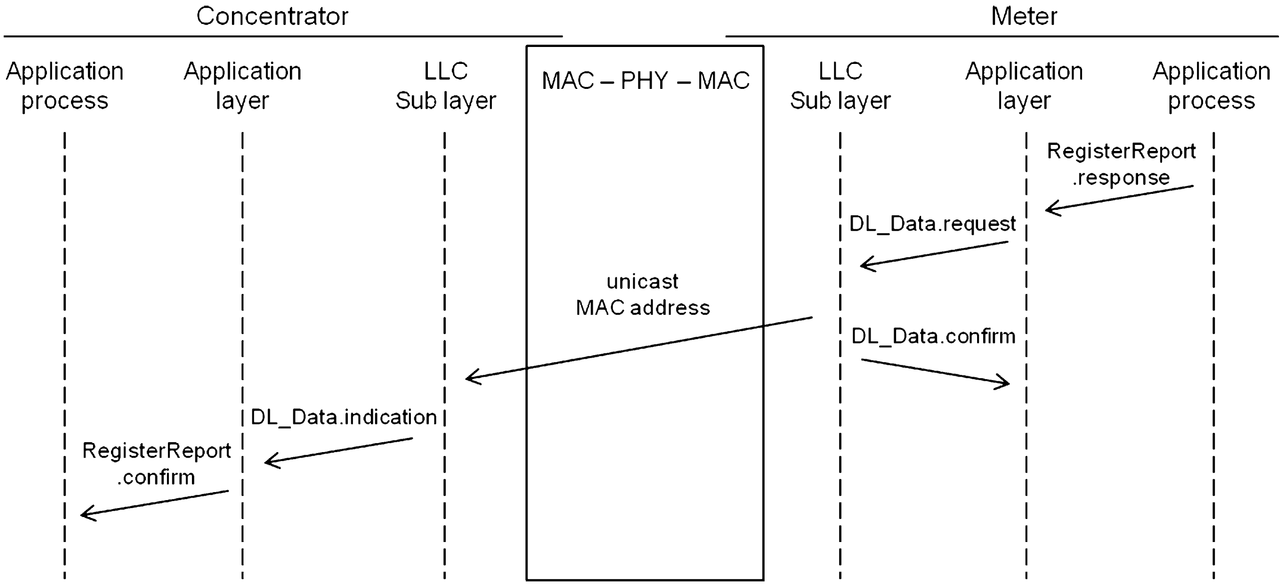


Figure 39 – RegisterReport messages exchange

8.1.1.10 Deregister.request (.indication)

The Deregister service is invoked by the concentrator in order to deregister a previously registered meter. The meter goes into unregistered state only if ACA field of the DR-PDU matches with its ACA. As a consequence of the invocation of a Deregister.request primitive,a DeregisterPDU is issued, having the the parameters specified in Table 21.

Table 21 – Deregister service

	Deregister	
	.request	**(.indication)**
Argument		
ACA	M	M (=)
NOTE Unicast address and RAx service class are used		

Table 22 – Deregister service arguments

Argument	**Size**	**Value**	**Meaning**
ACA	6 bytes	-	ACA of the meter for which deregistration has been requested.

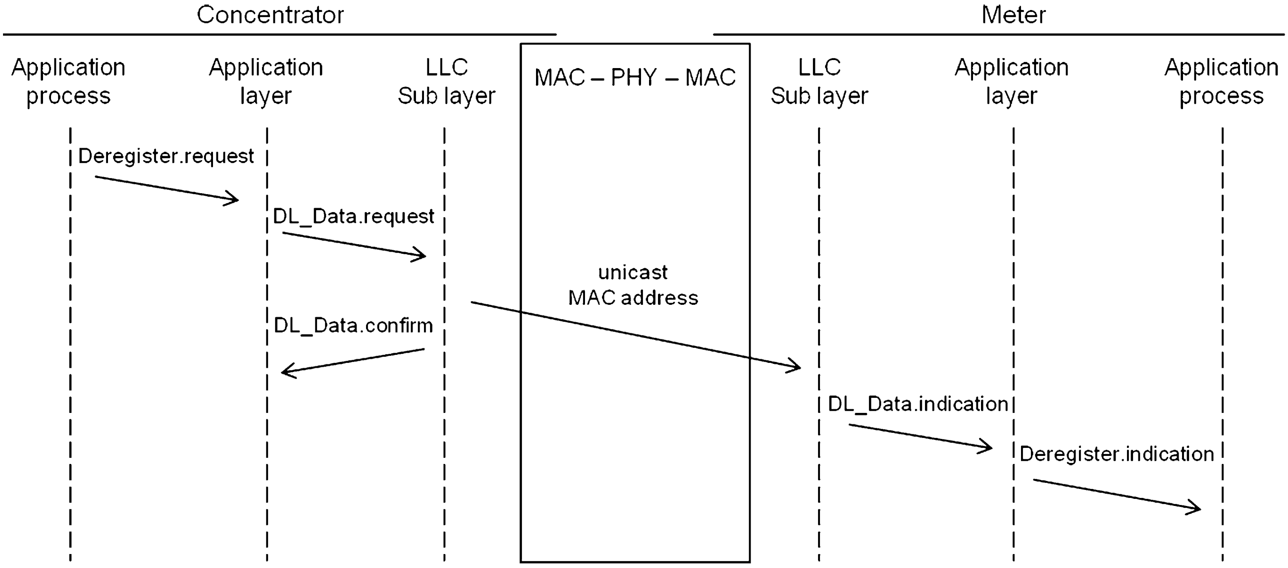


Figure 40 – Deregister messages exchange

8.1.1.11 Ping.request (.indication) and Ping response (.confirm)

The Ping service is invoked by the concentrator in order to check the communication link with the meter, and by the meter as a response to an incoming Ping.indication. As a consequence of the invocation of a Ping.request (Ping.response) primitive, a PingPDU is issued, having the the parameters specified in Table 23.

Table 23 – Ping service

	Ping	
	.request .response	**(.indication) (.confirm)**
Argument		
ACA	M	M (=)
NOTE Unicast address and RAx service class are used		

Table 24 – Ping service arguments

Argument	Size	Value	Meaning
ACA	6 bytes	-	ACA of the meter to be pinged.

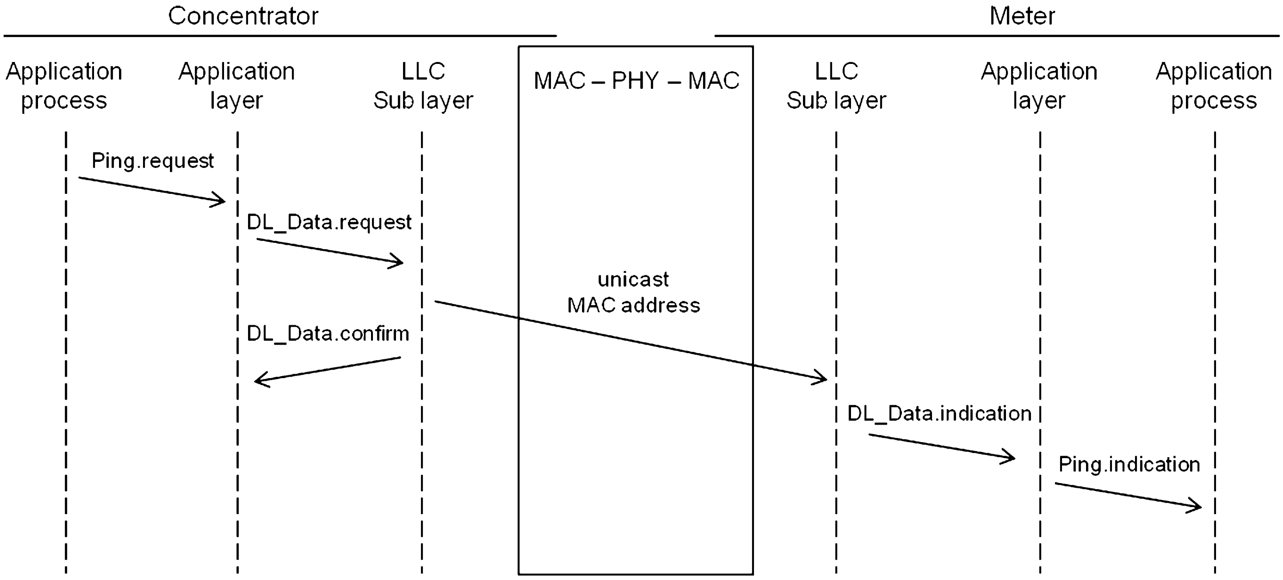


Figure 41 – Ping.request messages exchange

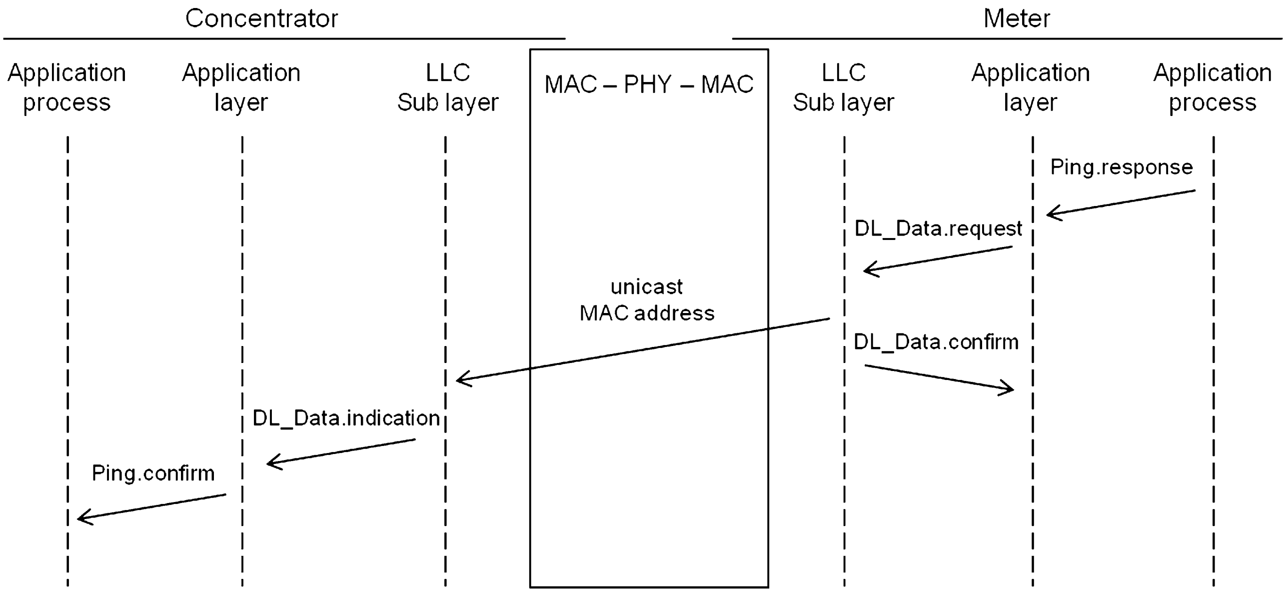


Figure 42 – Ping.response messages exchange

8.2 Original-SMITP over B-PSK discovery and registration services

8.2.1 Introduction

The discovery and registration procedures for the Origina-SMITP over B-PSK are described 5.7. The following primitives are needed.

8.2.2 Messages for LMON synchronization

The following messages are used to synchronize the Concentrator to the LMON (Last Message Order Number) of the A-Node (see 9.3.6).

8.2.2.1 Challenge Request

Function:

See 9.3.

Structure:

Table 25 – Chl.Req 112 message

	Value
MESSAGE CODE – **CHL.REQ**	112
T	xxxx
Random number	data

Coding:

xxxx: shall be zero (2 bytes field, reserved for future use)

data: random and unpredictable number (16 bytes “N” value, see 9.3.6.2)

Controls: NOT APPLICABLE

Activity: see 9.3.6

8.2.2.2 Challenge Response

Function:

See 9.3.

Structure:

Table 26 – Chl.Resp 113 message

	Value
MESSAGE CODE – **CHL.RESP**	113
T	xxxx
Encrypted sequence	data

Coding:

xxxx: shall be zero (2 bytes field, reserved for future use)

data: result of the AES-ECB encryption (16 bytes “ETs” value, see)

Controls: NOT APPLICABLE

Activity: see 9.3.6.

8.2.3 Network management commands

8.2.3.1 Introduction

The following commands are used for network management purposes.

In order to correctly execute the commands below described, it is mandatory that the values of sub field ECTL are properly set in the lower level frame (see CLC/TS 50568-4:2015)

8.2.3.2 ACA Request

Function:

This command is sent by the Concentrator or an A-Node, to one A-Node or a group of A-Nodes, without repeaters, to execute the automatic node discovery feature.

Structure:

Table 1 – Address.Req 090 message

	IDEN	Value
MESSAGE CODE – **ADDRESS.REQ**	090	
PARAMETER 1: Phase/any	data 1	
PARAMETER 2: TCR	data 2	
PARAMETER 3: AddToAddress	data 3	
PARAMETER 4: RightShiftAdd	data 4	

Coding:

data 1: [1 byte]

1 = In Phase. The interrogated node shall respond only if it is "in phase" with the requester node.

2 = In any case. The interrogated node shall respond in any case, without discrimination of the phase differences.

data 2: [1 byte]min. 0, max. 255

TCR, threshold of request. The interrogated node shall respond only if its TCT ≥ TCR (see 8.2.3.3).

data 3 - 4: [1byte + 1 byte]

Parameters used together to filter the address.

Use: the receiver adds to its address (last byte of its address) the parameter AddToAddress, then it shifts to the right "RightShiftAdd" times (right shift is a simple way to perform a division by 2).

If the remainder of the operation is 0, then it is enabled to respond, otherwise it is not enabled to do.

Example:

- to respond only if address is odd, AddToAddress = 1, RightShiftAdd = 1:
  - if address ending is 0x04 = 4; 04 + 1 = 05; 05/2 = 2 remainder = 1, it does not respond
  - if address ending is 0x0D = 13; 13 + 1 = 14; 14/2 = 7 remainder = 0, it responds
- to respond only if address is even, AddToAddress = 0, RightShiftAdd = 1:
  - if address ending is 0x04 = 04; 04 + 0 = 04; 04/2 = 2 remainder = 0, it responds
  - if address ending is 0x0D = 13; 13 + 0 = 13; 13/2 = 6 remainder = 1, it does not respond

Controls:

data: suitable/congruence

Activity:

If the request is received and the node is enabled to respond (after elaboration of Phase, TCT, AddToAddress and RightShiftAdd parameters), it shall respond using message ADDRESS.RESP (091, see 8.2.3.5). Otherwise or in case of error the node does not respond.

8.2.3.3 TCT Setting

Function:

The command is sent by the Concentrator to a node to define the Silencing Level (TCT) of the node.

When a node receives the message ADDRESS.REQ (090), it shall compare its TCT value with the TCR threshold set in the message 090. If its TCT ≥ TCR and the other conditions indicated in the message 090 are fulfilled (see 8.2.3.2), it is enabled to respond (using message 091).

The command should be sent in Request-Respond mode (Discipline R, see 4.4.3.2 in CLC/TS 50568-4:2015.

Structure:

Table 2 – TCT_Set.Req 092 message

	IDEN	Value
MESSAGE CODE – **TCT_SET.REQ**	092	
PARAMETER 1: TCT	data	

Coding:

data: [1 byte]min. 1, max. 255.

The value of TCT to set.

Controls:

data: suitable/congruence

Activity:

If the node receives this command, it sets its TCT to the received value and responds with an ACK (message 247 with ERROR code set to 00, see 8.2.3.7). In case of error it responds with a NACK (message 247 with ERROR code set to 01, see 8.2.3.7).

8.2.3.4 Request of ACA Request

Function:

The command is sent by the Concentrator to a node that was previously reached (directly or through one or more repeaters). Then this node sends via multicast the message ADDRESS.REQ (090) using the parameters contained in the message REQADDR.REQ (094) to discover nodes that was not reached by the Concentrator yet.

At data link layer, in the MAC frame of this message the node which this message is sent to shall be handled as last repeater, and a multicast address shall be put as final destination address. So, the ADDR, CTL and RP fields of the MAC frame shall be set accordingly (see 6.2 in CLC/TS 50568-4:2015).

Structure:

Table 3 – ReqAddr.Req 094 message

	IDEN	Value
MESSAGE CODE – **REQADDR.REQ**	094	
PARAMETER 1: Phase/any	data 1	
PARAMETER 2: TCR	data 2	
PARAMETER 3: AddToAddress	data 3	
PARAMETER 4: RightShiftAdd	data 4	

Coding:

See Coding in 8.2.3.2.

Controls:

data: suitable/congruence

Activity:

The node shall send the message ADDRESS.REQ (090) on the PLC with the parameters (Phase/any, TCR, AddToAddress, RightShiftAdd) indicated by message REQADDR.REQ (094). In case of error, if the node is not able to compose correctly the message 090 to be sent on the PLC, it responds with a NACK (message 247 with ERROR code set to 01, see 8.2.3.7).

8.2.3.5 Response of ACA

Function:

This message is sent as response of the message ADDRESS.REQ (090).

Structure:

Table 4 – Address.Resp 091 message

	IDEN	Value
MESSAGE CODE – **ADDRESS.RESP**	091	
PARAMETER 1: ACA of the node	data 1	
PARAMETER 2: Av_SIG	data 2	
PARAMETER 3: Av_SNR	data 3	
PARAMETER 4: Av_TX	data 4	
PARAMETER 5: Reserved	data 5	

Coding:

data 1: [6 bytes Hex]

ACA of the sender node.

data 2: [1 byte]

Instantaneous signal level in the RX messages (if the device is not able to provide this information, it shall set FF value).

data 3: [1 byte]

Instantaneous SNR in the RX messages (if the device is not able to provide this information, it shall set FF value).

data 4: [1 byte]

Impedance value of the communication media (if the device is not able to provide this information, it shall set FF value).

data 5: [3 bytes]

Reserved field (it shall be set to FF value).

Controls:

data: suitable/congruence

Activity: NOT APPLICABLE

8.2.3.6 Response of several ACA

Function:

The message is sent as response to the Concentrator by the node was requested to send the message REQADDR.REQ (094).

Structure:

Table 5 – ReqAddr.Resp 095 message

	IDEN	Value
MESSAGE CODE – **REQADDR.RESP**	095	
PARAMETER 1: Number of found nodes	data	
PARAMETER 2: Struct ADDRESS.RESP	STR 1	
PARAMETER 3: Struct ADDRESS.RESP	STR 2	
PARAMETER 4: Struct ADDRESS.RESP	STR 3	
PARAMETER 5: Struct ADDRESS.RESP	STR 4	

Table 6 – Structure of Struct Address.Resp

PARAMETER 1: ACA of the node
PARAMETER 2: Av_SIG
PARAMETER 3: Av_SNR
PARAMETER 4: Av_TX
PARAMETER 5: Reserved

Coding:

data: [1 byte]

Number of found nodes. If the number is 4 or less, only the found nodes' Structs shall be sent. If the number is more than 4, only the first 4 Structs are associated to the message, the first ones received.

If no node is found, then value 0 shall be sent with no Structs associated.

STR: [12 bytes] see Table 32 and 8.2.3.5 for parameters coding.

Data sent by first nodes that responded to the node that had sent the message ADDRESS.REQ (090).

Controls:

data: suitable

STR: suitable/congruence

Activity: NOT APPLICABLE

8.2.3.7 ACK/NACK Response

Function:

The message is sent as response to the messages TCT_SET.REQ (092) and REQADDR.REQ (094).

Structure:

Table 7 – NACK.RESP 247 message

	IDEN	Value
MESSAGE CODE – **NACK.RESP**	247	
PARAMETER 1: ERROR code	data 1	
PARAMETER 2: Av_SIG	data 2	
PARAMETER 3: Av_SNR	data 3	
PARAMETER 4: Av_TX	data 4	

Coding:

data 1: [1 byte] codes of the errors

- 00: no error, ACK
- 01: data field not correct / bad length

data 2: [1 byte]

Instantaneous signal level in the RX messages (if the device is not able to provide this information, it shall set FF value).

data 3: [1 byte]

Instantaneous SNR in the RX messages (if the device is not able to provide this information, it shall set FF value).

data 4: [1 byte]

Impedance value of the communication media (if the device is not able to provide this information, it shall set FF value).

<u>Activity:</u> NOT APPLICABLE

9 The Original-SMITP AL Services

9.1 Application messages exchanged in distribution line networks

9.1.1 Management of reserved elements

The management of the following elements of the technical specification described in this document is reserved to Meters and More Association:

– field "T" in PLC messages Chl.Req (112) and Chl.Resp (113), see 8.2.2.1 and 8.2.2.2;

– code values of PLC messages A-Node NACK (255 and authenticated version 245) not indicated in Table 73, see 9.1.7.3.3;

– code values of PLC messages B-Node NACK (249 and authenticated version 239) not indicated in Table 79, see 9.1.7.3.5;

– values 11÷14 of action code in PLC messages Command (018 and authenticated version 118), see 9.1.7.2.2 and 9.1.7.2.3;

– PARAMETER 5 of PLC message Address.Resp (091), 8.2.3.5.

9.1.2 Overview

This part of the document describes the application messages exchanged between the nodes present on the distribution line network.

Three different types of nodes are foreseen within the network:

– Concentrator: is the Master of the net; there is always one and only one Concentrator for each section of the network.

– A-Node: is a peripheral unit which can communicate with the Concentrator (in this case it acts as Slave) or with an associated B-Node (in this case it acts as Master).

– B-Node: is a peripheral unit which can communicate (directly or through the associated A-Node) with the Concentrator or with the associated A-Node; it always acts as Slave.

A section of the network corresponds to a network domain that includes one Concentrator and all the A-Nodes and B-Nodes the Concentrator controls. From the communication point of view, each section of the distribution line network is organized in two different subnets depending on the type of interconnected nodes, as showed in the following figure:

Sub net	Master	Slave
A	Concentrator	A-Node and/or B-Node
B	A-Node	B-Node

Figure 43 – Subnets of the network

For each upstream message received, the node performs the following controls:

5) expected message code;
6) the encrypted message is decrypted and its authenticity is checked;
7) manageable message.

If a message is not accepted for negative result of check, the node shall answer with a downstream message NACK.

In the following subclauses, each message is described using the following sections:

– **Function:** it describes the functionality associated with the message;

– **Structure:** it highlights in graphic form the message structure;

– **Coding:** it shows the contents of each field;

– **Controls:** it indicates all the controls performed on the field for the acceptance of the message and its correspondent error code inserted in a NACK message. The following controls are foreseen:

  - Coincidence: the field shall be equal to a reference value.
  - Congruence: the field shall contain a value coherent with the meaning of the field itself (e.g. 31st of April is not a congruent date).
  - Range: values of the field shall be in the admitted range.
  - Suitable: the field shall contain an expected value.

– **Activity:** it describes all the activities that the node shall perform upon reception of the message.

9.1.3 Application messages protection

The protection of application messages data shall be accomplished by means of encryption (AES-ECB or AES-CTR), authentication (AES-CMAC Message Authentication Code) and protection against playback attacks (Messages Implied Numbering).

At lower level is mandatory to build the LLC frame specifying the correct value for ECTL field related to a specific data protection to employ (see Clause 5 in CLC/TS 50568-4:2015)Authenticated messages are ended by an 8 byte field for the time stamp (DATE-TIME), and an 8 byte field for the least significant 64 bits of the message authentication code (TMAC, see 9.3).

SMITP foresees the use of two protection keys, one for reading operations and other one for writing operations (in the following called K1 and K2). Each key is used for both encryption and authentication algorithms.

For SMITP PLC protection method described in 9.3 shall be applied.

9.1.4 Data access rights

SMITP allows clients having two different access rights which can also be combined: one gives permissions to read registers and the other one gives permissions to write registers. The information about register access capability (Read only, Write only, Read and Write) is embedded in the data model and is known a priori by the master side of the communication.

9.1.5 List of messages

In the following table all the messages described in next subclauses are listed. For each message it is indicated if the authenticated version is provided. The use of authenticated commands ensures a higher security level of data exchange.

Table 8 – Application messages in distribution line network

Message	ATTR	
	Not Authenticated	Authenticated
Writing operations		
WRITE.REQ	004	104
WRITETAB.REQ	010	110
SETTAB.REQ	014	114
RESETTAB.REQ	016	116
SETIC.REQ	040	140
WRITETABIC.REQ	042	142
Reading operations		
READ.REQ	002	102
READ.RESP	003	103
READTAB.REQ (with selection)	006	106
READTAB.RESP (with selection)	007	107
READTAB.REQ (block read)	008	108
READTAB.RESP (block read)	009	109
GETTAB.REQ	030	130
GETTAB.RESP	031	131
MAC synchronization		
CHL.REQ	112	
CHL.RESP	113	
Software download		
REPROG (local programming)	100	
REPROG (broadcast programming)	101	
Acknowledgements		
A-Node ACK	253	243
A-Node NACK	255	245
B-Node ACK	251	241
B-Node NACK	249	239
Special message		
COMMAND	018	118
Network Management		
ADDRESS.REQ	090	
ADDRESS.RESP	091	
TCT_SET.REQ	092	
REQADDR.REQ	094	
REQADDR.RESP	095	
NACK.RESP	247	

9.1.6 SMITP primitives

9.1.6.1 Preliminary remarks

9.1.6.1.1 General

Each message starts with an attribute (ATTR) that contains the command code of the message. The length of this field is 1 byte. The code of the message is specified in decimal format.

If not differently indicated, all the elements of a message are represented in hexadecimal format. The coordinates of registers automatically identify the measurement unit and the scaler of any managed measurement data.

No meta-information on the data is transmitted. The type, length, etc. of each data value are in accordance to the corresponding registers, attributes or method parameters of the data model.

When data to be transmitted is composed by more than one byte, big-endian convention is used (most significant value in the sequence is sent first).

9.1.6.1.2 Access to SMITP data model

A SMITP data table is a set of data registers. Each table of a generic device connected to the network (A-Node, B-Node, etc.) is identified by 1 byte coordinate called Table ID (Tab_ID), and each row belonging to a table is identified by 1 byte coordinate called Row ID (Row_ID).

Each data register is also identified by the two byte field Register ID (Reg_ID), composed by the couple of coordinates Tab_ID.Row_ID.

In the message structure described in 9.1.6.2, 9.1.6.3 and 9.1.6.4, the identifiers Tab_ID, Row_ID and Reg_ID are indicated in the identification column (IDEN) by respectively XX, yy and xx.yy. The content of requested parameters to be written or read and pointed by the register identifiers, is indicated in the Value column.

9.1.6.2 Parameters programming activity (distribution line network)

9.1.6.2.1 Introduction

Parameter's programming activity is one of the main activities for the customer's contract management. It allows to activate customer's supply, to customize its parameters (tariff, time, etc.) and to stop customer's supply. Furthermore this activity allows to manage the field device's configuration to optimize the execution of service routines (virtual data set creation etc.).

It is possible to perform this activity in both authenticated and non authenticated way.

9.1.6.2.2 Non authenticated single parameter programming

Function:

This message is used to perform non authenticated writing operations, and to update the node clock/calendar in the following cases:

– the node clock has never been synchronized;

– node lost temporal reference (i.e. power fail, HW fail, …);

– the deviation between the Concentrator time and the node time is smaller than a predetermined value.

Otherwise, time synchronization should be performed through authenticated message (see 9.1.6.2.3)

Node clock/calendar updating should be the only case when a non authenticated writing, by the message Write.Req (004), is allowed.

Structure:

Table 9 – Write.Req 004 message for clock synchronization

	IDEN	Value
MESSAGE CODE – **WRITE.REQ**	004	
Year, Month, Day, Hours, Minutes, Seconds, Type of Date	xx.yy	clk

Table 10 - Write.Req 004 message for general parameter writing

	IDEN	Value
MESSAGE CODE – **WRITE.REQ**	004	
PARAMETER	xx.yy	data

Coding:

xx.yy: Reg_ID of the clock or the parameter to be written

clk: clock coding according to SMITP data model

data: parameter to be written

Controls:

clk

DATE range/congruence

TIME range

Activity:

If the programming is accepted, the node transmits the ACK message (253) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (255) with the proper error code indicated (see 9.1.7.3.3) is sent.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.3 Authenticated single parameter programming

Function:

This message allows to set a single parameter within the data model in the register specified by the coordinates xx.yy. If more than one parameter has to be set at the same time also in different SMITP Tables, one message should be used (see following tables). The authentication procedure is described in detail in 9.3.

Structure:

Table 37a – Write.Req 104 message – single parameter writing

	IDEN	Value
MESSAGE CODE – **WRITE.REQ**		104
PARAMETER	xx.yy	data
DATE-TIME for authentication		DATE-T
TMAC		MM

Table 37b – Write.Req 104 message – multiple parameters writing

	IDEN	Value
MESSAGE CODE – WRITE.REQ		104
PARAMETER 1	xx.yy	data
…	…	…
PARAMETER n	xx.yy	data
DATE-TIME for authentication		DATE-T
TMAC		MM

Coding:

xx.yy: Reg_ID of the parameters

data: values of the parameters to be written

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

xx.yy: suitable

data: range

MM: coincidence

In case of error detection in one or more parameters of the control function, the message shall be refused (see 0).

Activity:

– the programming overwrites the previous one;

– if the programming is accepted, the node transmits the ACK message (243) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (245) with the proper error code indicated (see 9.1.7.3.3) is sent;

– if an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (245) for that parameter with the proper error code indicated (see 9.1.7.3.3), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.4 Non authenticated block programming

Function:

Using the message WRITETAB.REQ (010) it is possible to write several parameters sharing the same coordinate XX, in non authenticated way.

Structure:

Table 38 – WriteTab.Req 010 message

	IDEN	Value
MESSAGE CODE – **WRITETAB.REQ**	010	
TABLE	XX	
PARAMETER 1	yy	data
PARAMETER 2	yy	data
…	…	…
PARAMETER X	yy	data

Coding:

XX: Tab_ID

yy: Row_ID where the parameters are written in

data: values of the parameters

Controls:

XX: suitable

yy: suitable

data: range

In case of error detection in one or more parameters of the control function, the message shall be refused (see 0).

Activity:

- the programming overwrites the previous one;
- if the programming is accepted, the node transmits the ACK message (253) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (255) with the proper error code indicated (see 9.1.7.3.3) is sent;
- if an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (255) for that parameter with the proper error code indicated (see 9.1.7.3.3), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.5 Authenticated block programming

Function:

Authenticated version of the message WRITETAB.REQ (010).

Structure:

Table 39 – WriteTab.Req 110 message

	IDEN	Value
MESSAGE CODE – **WRITETAB.REQ**	110	
TABLE	XX	
PARAMETER 1	yy	data
PARAMETER 2	yy	data
…	…	…
PARAMETER X	yy	data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

XX: Tab_ID

yy: Row_ID where the parameters are written in

data: values of the parameters

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

yy: suitable

data: range

MM: coincidence

In case of error detection in one or more parameters of the control function, the message shall be refused (see 0).

Activity:

– the programming overwrites the previous one;

– if the programming is accepted, the node transmits the ACK message (243) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (245) with the proper error code indicated (see 9.1.7.3.3) is sent;

– if an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (245) for that parameter with the proper error code indicated (see 9.1.7.3.3), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.6 Non authenticated Custom table set

Function:

This message is used to configure Custom tables in non authenticated way. Custom tables are created by the user and contain pointers to parameters stored in other tables of an A-Node (or B-Node).

Structure:

Table 40 – SetTab.Req 014 message

	IDEN	Value
MESSAGE CODE – **SETTAB.REQ**	014	
TABLE ID	XX	
REGISTER 1 REGISTER 2 … REGISTER n	xx.yy xx.yy … xx.yy	RN 1 RN 2 … RN n

Coding:

XX: Custom table identifier

xx.yy: coordinates (pointers) of registers that belong to other tables. They are the contents to be written in the Custom table.

RN: row number of the Custom table where the pointers are written in

Controls:

XX: suitable

xx.yy: suitable

RN: suitable

In case of error detection in one or more parameters of the control function, the message shall be refused (see 0).

Activity:

- the programming overwrites the previous one;
- if the programming is accepted, the node transmits the ACK message (253) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (255) with the proper error code indicated (see 9.1.7.3.3) is sent;
- if an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (255) for that parameter with the proper error code indicated (see 9.1.7.3.3), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.7 Authenticated Custom table set

9.1.6.2.7.1 General

Function:

Authenticated version of the message SETTAB.REQ (014).

Structure:

Table 41 – SetTab.Req 114 message

	IDEN	Value
MESSAGE CODE – **SETTAB.REQ**	114	
TABLE ID	XX	
REGISTER 1	xx.yy	RN 1
REGISTER 2	xx.yy	RN 2
…	…	…
REGISTER n	xx.yy	RN n
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

XX: Custom table identifier

xx.yy: coordinates (pointers) of registers that belong to other tables. They are the contents to be written in the Custom table.

RN: row number of the Custom table where the pointers are written in

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

xx.yy: suitable

RN: suitable

MM: coincidence

In case of error detection in one or more parameters of the control function, the message shall be refused (see 0).

Activity:

– the programming overwrites the previous one;

– if the programming is accepted, the node transmits the ACK message (243) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (245) with the proper error code indicated (see 9.1.7.3.3) is sent;

– if an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (245) for that parameter with the proper error code indicated (see 9.1.7.3.3), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.7.2 Example of setting a Custom table

After this command is executed, a new Custom table is created in the addressed node. In this way it is possible to collect all the data in the example using a single ReadTab Request message. Otherwise several Read Requests with the identification codes of all these parameters would be needed.

For example, using this message a Custom data table (numbered 32, 0x20 in hexadecimal format) is configured in the node.

Table 42 – Example of a table set command

	IDEN	Value
MESSAGE CODE – **SETTAB.REQ**	114	
TABLE ID	0x20	
NORMAL STATUS WORD	0x1602	0x01
EXTENDED STATUS WORD	0x1701	0x02
USER IDENTIFICATION NUMBER	0x0D13	0x03
TARIFF PROGRAMS	0x0F01	0x04
END DATE BILLING	0x0B03	0x05
ACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	0x4520	0x06
REACTIVE ENERGY IN T3 OF THE PREVIOUS PERIOD	0x4527	0x07
NUMBER OF PROGRAMMING PARAMETERS VARIATIONS IN THE PREVIOUS BILLING PERIOD	0x1503	0x08
NUMBER COUNTER OF METER POWER FAIL IN THE PREVIOUS PERIOD	0x1322	0x09
DATE-TIME for authentication	DATE-T	
TMAC	MM	

9.1.6.2.8 Non authenticated default values reset

Function:

This message is used to reset to default values all data present in a Table of a node (default values are coded within the data model). It can be used only for setting parameters (not for historical data).

Structure:

Table 43 – ResetTab.Req 016 message

	IDEN	Value
MESSAGE CODE – **RESETTAB.REQ**	016	
TABLE	XX	

Coding:

XX: Tab_ID

Controls:

XX: suitable

Activity:

If the programming is accepted, the node transmits the ACK message (253) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (255) with the proper error code indicated (see 9.1.7.3.3) is sent.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.2.9 Authenticated default values reset

Function:

Authenticated version of the message RESETTAB.REQ (016).

Structure:

Table 44 – ResetTab.Req 116 message

	IDEN	Value
MESSAGE CODE – **RESETTAB.REQ**	116	
TABLE	XX	
DATE-TIME for authentication TMAC	DATE-T MM	

Coding:

XX: Tab_ID

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

MM: coincidence

Activity:

If the programming is accepted, the node transmits the ACK message (243) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (245) with the proper error code indicated (see 9.1.7.3.3) is sent.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.6.3 Data exchange activity

9.1.6.3.1 Introduction

Data reading through the use of Register ID for operation Mode is performed using the message READ.REQ (002) as request, and the message READ.RESP (003) as response. More than one parameter, also belonging to different SMITP Tables, may be requested using the same message.

It is possible to request several parameters belonging to the same Table using the message READTAB.REQ (006) and specifying the row number ; in this case the node responds with the message READTAB.RESP (007).

All the parameters that belong to the same may be read using the shorter message READTAB.REQ (block read, 008); in this case the node responds with the message READTAB.RESP (009).

9.1.6.3.2 Single parameter data exchange

9.1.6.3.2.1 Non authenticated Read Request

Function:

Data reading is carried out directly by the coordinates of the parameters Register ID.

Structure:

Table 45 – Read.Req 002 message

	IDEN	Value
MESSAGE CODE – **READ.REQ**	002	
PARAMETER 1	xx.yy	
PARAMETER 2	xx.yy	
…	…	
PARAMETER n	xx.yy	

Coding:

xx.yy: Reg_ID of parameters to be read

data: input arguments for selective access

Controls:

xx.yy: suitable

Activity:

If the command is accepted, the node transmits the message READ.RESP (003) with the data corresponding to the transmitted identifiers; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (255) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.2.2 Non authenticated Read Response

Function:

Data related to the requested identifier specified in the message READ.REQ (002) are sent.

Structure:

Table 46 – Read.Resp 003 message

	IDEN	Value
MESSAGE CODE – **READ.RESP**	003	
PARAMETER 1		data
PARAMETER 2		data
…		…
PARAMETER n		data

Coding:

data: values of the requested parameters

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.3 Block data exchange

9.1.6.3.3.1 Non authenticated ReadTab Request (with selection)

Function:

Using the message READTAB.REQ (006), several parameters belonging to the same table addressed by Tab_ID are requested at the same time.

Structure:

Table 47 – ReadTab.Req 006 message

	IDEN	Value
MESSAGE CODE – **READTAB.REQ**	006	
TABLE	XX	
PARAMETER 1	yy	
…	…	
PARAMETER n	yy	

Coding:

XX: Tab_ID

yy: Row_ID of the requested parameters

Controls:

XX: suitable

yy: suitable

Activity:

If the command is accepted, the node transmits the message READTAB.RESP (007) with the data corresponding to the transmitted identifiers; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (255) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.3.2 Non authenticated ReadTab Response (with selection)

Function:

Using the message READTAB.RESP (007), the data related to the identifiers requested in the message READTAB.REQ (006) are sent.

Structure:

Table 48 – ReadTab.Resp 007 message

	IDEN	Value
MESSAGE CODE – **READTAB.RESP**	007	
TABLE	XX	
PARAMETER 1		data
PARAMETER 2		data
…		…
PARAMETER n		data

Coding:

XX: Tab_ID

data: values of the requested parameters

<u>Controls</u>: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.3.3 Non authenticated ReadTab Request (block read)

Function:

Using the message READTAB.REQ (008), the node transmits all the parameters belonging to the requested table .

Structure:

Table 49 – ReadTab.Req 008 message (block read)

	IDEN	Value
MESSAGE CODE – READTAB.REQ	008	
TABLE	XX	

Coding:

XX: Tab_ID

Controls:

XX: suitable

Activity:

If the command is accepted, the node transmits the message READTAB.RESP (009) with all the parameters corresponding to the transmitted identifiers; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (255) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.3.4 Non authenticated ReadTab Response (block read)

Function:

Using the message READTAB.RESP (009), all the parameters related to the requested Table ID are sent.

Structure:

Table 50 – ReadTab.Resp 009 message (block read)

	IDEN	Value
MESSAGE CODE – **READTAB.RESP**	009	
TABLE	XX	
PARAMETER 1 PARAMETER 2 ... PARAMETER n		data data ... data

Coding:

XX: Tab_ID

data: values of the requested parameters

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.4 Non authenticated Custom table Get

9.1.6.3.4.1 General

Configuratioin of Custom tables can be got using GETTAB.REQ message (030). Custom tables are created using the SETTAB.REQ message (014, see 9.1.6.2.6).

9.1.6.3.4.2 Request

Function:

Using the message GETTAB.REQ it is possible to read some or all the registers of a Custom table pointed by Table ID (see example in Table 42 for how a Custom table may be created). Registers of Custom tables contain pointers to the coordinates (Table ID and Row ID) of registers stored in other tables. In this way it is possible to get the configuration of a Custom table.

Structure:

Table 51 – GetTab.Req 030 message

	IDEN	Value
MESSAGE CODE – **GETTAB.REQ**	030	
TABLE ID	XX	
ROW 1 ROW 2 … ROW n	yy yy … yy	

Coding:

XX: Tab_ID

yy: Row_ID

Controls:

XX: suitable

yy: suitable

Activity:

If the command is accepted, the node transmits the message GETTAB.RESP (031) with data corresponding to the transmitted identifiers; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (255) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.4.3 Non authenticated Response

Function:

The message GETTAB.RESP provides the configuration of the Custom table requested by the message GETTAB.REQ (030).

Structure:

Table 52 – GetTab.Resp 031 message

	IDEN	Value
MESSAGE CODE – **GETTAB.RESP**	031	
TABLE ID	XX	
ROW 1		data
ROW 2		data
…		…
ROW n		data

Coding:

XX: Tab_ID

data: Reg_ID

NOTE In this case SMITP identifiers are the content of requested data.

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.5 Authenticated data exchange

9.1.6.3.5.1 General

Data may be requested from a node using the authentication procedure described in detail in 9.3.

9.1.6.3.5.2 Authenticated Read Request

Function:

Authenticated version of the message READ.REQ (002), see 9.1.6.3.2.1.

Structure:

Table 53 – Authenticated Read.Req 102 message

	IDEN	Value
MESSAGE CODE – **READ.REQ**	102	
PARAMETER 1	xx.yy	
PARAMETER 2	xx.yy	
…	…	
PARAMETER n	xx.yy	
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

xx.yy: Reg_ID of parameters to be read

data: input arguments for selective access

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

xx.yy: suitable

MM: coincidence

Activity:

If the request is accepted, the node transmits the message READ.RESP (103) containing the requested parameters and the authentication fields; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (245) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.5.3 Authenticated Read Response

Function:

Authenticated version of the message READ.RESP (003), see 9.1.6.3.2.2.

Structure:

Table 54 – Authenticated Read.Resp 103 message

	IDEN	Value
MESSAGE CODE – **READ.RESP**	103	
PARAMETER 1		data
PARAMETER 2		data
…		…
PARAMETER n		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

data: values of the requested parameters

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.5.4 Authenticated ReadTab Request (with selection)

Function:

Authenticated version of the message READTAB.REQ (006), see 9.1.6.3.3.1.

Structure:

Table 55 – Authenticated ReadTab.Req 106 message

	IDEN	Value
MESSAGE CODE – **READTAB.REQ**	106	
TABLE	XX	
PARAMETER 1 … PARAMETER n	yy … yy	
DATE-TIME for authentication TMAC	DATE-T MM	

Coding:

XX: Tab_ID

yy: Row_ID of the requested parameters

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

yy: suitable

MM: coincidence

Activity:

If the request is accepted, the node transmits the message READTAB.RESP (107) containing the requested parameters and the authentication fields; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (245) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.5.5 Authenticated ReadTab Response (with selection)

Function:

Authenticated version of the message READTAB.RESP (007), see 9.1.6.3.3.2.

Structure:

Table 56 – Authenticated ReadTab.Resp 107 message

	IDEN	Value
MESSAGE CODE – **READTAB.RESP**	107	
TABLE	XX	
PARAMETER 1 PARAMETER 2 … PARAMETER n		data data … data
DATE-TIME for authentication TMAC	DATE-T MM	

Coding:

XX: Tab_ID

data: values of requested parameters

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.5.6 Authenticated ReadTab Request (block read)

Function:

Authenticated version of the message READTAB.REQ (008), see 9.1.6.3.3.3.

Structure:

Table 57 – Authenticated ReadTab.Req 108 message (block read)

	IDEN	Value
MESSAGE CODE – **READTAB.REQ**	108	
TABLE	XX	
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

XX: Tab_ID

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

MM: coincidence

Activity:

If the request is accepted, the node transmits the message READTAB.RESP (109) containing the requested parameters and the authentication fields; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (245) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.5.7 Authenticated ReadTab Response (block read)

Function:

Authenticated version of the message READTAB.RESP (009), see 9.1.6.3.3.4.

Structure:

Table 58 – Authenticated ReadTab.Resp 109 message (block read)

	IDEN	Value
MESSAGE CODE – **READTAB.RESP**	109	
TABLE	XX	
PARAMETER 1		data
PARAMETER 2		data
…		…
PARAMETER n		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

XX: Tab_ID

data: value of requested parameters

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.3.5.8 Authenticated Custom table Get Request

Function:

Authenticated version of the message GETTAB.REQ (030), see 9.1.6.3.4.2.

Structure:

Table 59 – Authenticated GetTab.Req 130 message

	IDEN	Value
MESSAGE CODE – **GETTAB.REQ**	130	
TABLE ID	XX	
ROW 1	yy	
ROW 2	yy	
…	…	
ROW n	yy	
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

XX: Tab_ID

yy: Row_ID

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

yy: suitable

MM: coincidence

Activity:

If the command is accepted, the node transmits the message GETTAB.RESP (131) with data corresponding to the transmitted identifiers; otherwise, even if only one of the requested parameters is not available, it responds with a NACK message (245) with the proper error code indicated (see 9.1.7.3.3).

9.1.6.3.5.9 Authenticated Custom table Get Response

Function:

Authenticated version of the message GETTAB.RESP (031), see 9.1.6.3.4.3.

Structure:

Table 60 – Authenticated GetTab.Resp 131 message

	IDEN	Value
MESSAGE CODE – **GETTAB.RESP**	131	
TABLE ID	XX	
ROW 1		data
ROW 2		data
…		…
ROW n		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

XX: Tab_ID

data: Reg_ID

NOTE In this case SMITP data identifiers are the content of requested data.

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls: NOT APPLICABLE

Activity: NOT APPLICABLE

9.1.6.4 Messages updating B-Node with A-Node data

9.1.6.4.1 Introduction

This class of messages is used to exchange data between an A-Node and the associated B-Node.

9.1.6.4.2 Request A-Node to transmit data to B-Node

Function:

The Concentrator sends this message to an A-Node to request the programming of one or more parameters in a particular Table.

Structure:

Table 61 – SetIC.Req 040 message

	IDEN	Value
MESSAGE CODE – **SETIC.REQ**	040	
TABLE	XX	
ROW 1	yy	
…	…	
ROW n	yy	

Coding:

XX: Table ID of an A-Node

yy:

– if the value of ROW 1, the A-Node shall send to the B-Node all the parameters related to the specified Table ID;

– otherwise the A-Node shall send to the B-Node the values stored in the parameters selected.

Controls:

XX: suitable

yy: suitable

Activity:

The A-Node transmits to the B-Node the message WRITETABIC.REQ (042) containing the data to be programmed (see 9.1.6.4.4).

If the request is accepted and executed by the B-Node, the A-Node receives as response the message B-Node ACK (251) and transmits to the Concentrator the message B-Node ACK (251), as showed in the Figure 44.

If an error occurs during the transaction between the A-Node and the B-Node, the A-Node receives as response the message B-Node NACK (249) and transmits to the Concentrator the message B-Node NACK (249) with the proper error code indicated (see 9.1.7.3.5), as showed in the Figure 44.

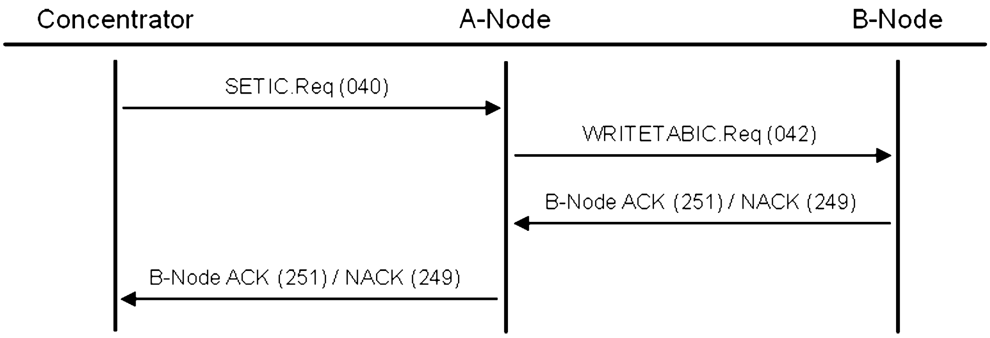


Figure 44 – Request A-Node to transmit data to B-Node

If the A-Node does not receive any response from the B-Node, it sends to the Concentrator the message A-Node NACK (255) with code "B-Node does not answer" (see 9.1.7.3.3), as showed in the Figure 45.

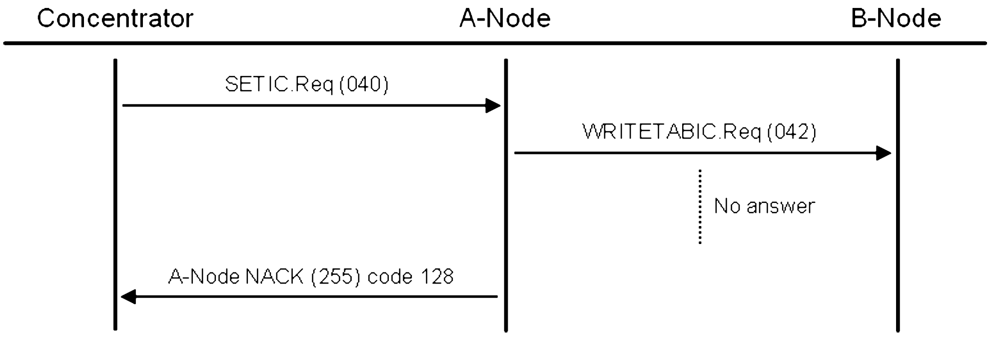


Figure 45 – Request A-Node to transmit data to B-Node: B-Node does not answer

9.1.6.4.3 Authenticated Request A-Node to transmit data to B-Node

Function:

Authenticated version of the message SETIC.REQ (040), see 9.1.6.4.2.

Structure:

Table 62 – Authenticated SetIc.Req 140 message

	IDEN	Value
MESSAGE CODE – **SETIC.REQ**	140	
TABLE ID	XX	
ROW/REFERENCE 1 … ROW/REFERENCE n	yy … yy	
DATE-TIME for authentication TMAC	DATE-T MM	

Coding:

XX: Table ID

yy:

– if the value of ROW 1 are set to 0, the A-Node shall send to the B-Node all the parameters related to the specified Table;

– otherwise the A-Node shall send to the B-Node the values stored in the parameters selected.

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

yy: suitable

MM: coincidence

Activity:

See 9.1.6.4.2, authenticated version of B-Node acknowledgment messages (241 and 239) shall be used in this case.

9.1.6.4.4 Sending data from A-Node to B-Node

Function:

This message is used by the A-Node to transmit to the B-Node a particular set of data selected through the message SETIC.REQ (040) sent from the Concentrator.

Two different scenarios are possible:

– the Concentrator requests the A-Node to send an entire SMITP Table (normal or Custom) to the B-Node, using message 040 with the first ROW set to 0; the A-Node sends the message 042 to the B-Node with all the parameters of the table indicated;

– the Concentrator sends to the B-Node the format of the data (using a specific message according to B-Node's data structure) it will receive from the associated A-Node; in this way the B-Node is able to correctly interpret the data that will receive through the message 042, even if the A-Node does not specify the identifiers of the parameters.

Structure:

Table 63 – WriteTabIC.Req 042 message

	IDEN	Value
MESSAGE CODE – **WRITETABIC.REQ**	042	
TABLE ID	XX	
PARAMETER 1		data
PARAMETER 2		data
…		…
PARAMETER n		data

Coding:

Data are associated with the programmed set on the A-Node. The same message could be used, in case there were no data to send, to produce a response message B-Node ACK (251).

XX: Table ID of the B-Node

data: values of the requested parameters

Controls:

XX: suitable

data: suitable

Activity:

If the B-Node is correctly updated with the data received, it transmits the message B-Node ACK (251) as response; otherwise it transmits the message B-Node NACK (249) with the proper error code indicated (see 9.1.7.3.5) as response.

If an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (249) for that parameter with the proper error code indicated (see 9.1.7.3.5), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

9.1.6.4.5 Authenticated Sending data from A-Node to B-Node

Function:

Authenticated version of message WRITETABIC.REQ (042), see 9.1.6.4.4.

Structure:

Table 64 – Authenticated WriteTablc.Req 142 message

	IDEN	Value
MESSAGE CODE – **WRITETABIC.REQ**	142	
TABLE ID	XX	
PARAMETER 1		data
PARAMETER 2		data
…		…
PARAMETER n		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

Data are associated with the programmed set on the A-Node. The same message could be used, in the case there were no data to send, to produce a response message B-Node ACK (241).

XX: Table ID

data: values of the requested parameters

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

XX: suitable

data: suitable

MM: coincidence

Activity:

If the B-Node is correctly updated with the data received, it transmits the message B-Node ACK (241) as response; otherwise it transmits the message B-Node NACK (239) with the proper error code indicated (see 9.1.7.3.5) as response.

If an error occurs during one of parameter writings, the node sends to the Concentrator the NACK message (239) for that parameter with the proper error code indicated (see 9.1.7.3.5), and stops the writing operation. It will be AMM system care, through the Concentrator, to rollback the writing operations already done successfully, or to perform again the writing operations starting from that parameter that had an error.

9.1.7 Network primitives

9.1.7.1 Software download messages

9.1.7.1.1 Introduction

Software update of A-Nodes and B-Nodes shall be available using some dedicated types of message. Such messages are explained below.

9.1.7.1.2 Local programming

Function:

This message is used to send all the packets of the SW applications in case of local programming of a node (i.e. via optical serial interface).

Structure:

Table 65 – Reprog 100 message (local programming)

MESSAGE CODE – **REPROG**	100
N° OF PACKET	NPDWj
PACKET	PDWj

Coding:

NPDWj: sequential number of the transmitted packet

PDWj: real portion of downloading software

Controls: NOT APPLICABLE

Activity:

If the packet is accepted, the node transmits the ACK message (253) with the status word in a normal format (see 9.1.7.3.2); otherwise the NACK message (255) with the proper error code indicated (see 9.1.7.3.3) is sent.

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic.

9.1.7.1.3 Broadcast programming

Function:

This message is used to send all the packets of the SW applications in case of broadcast programming of several nodes (i.e. via power line).

Structure:

Table 66 – Reprog 101 message (broadcast programming)

MESSAGE CODE – **REPROG**	101
N° OF PACKET	NPDWj
PACKET	PDWj

Coding:

NPDWj: sequential number of the transmitted packet

PDWj: the real portion of downloading software

Controls: NOT APPLICABLE

Activity:

In case of message code equal to 101, the node does not transmit the response message.

9.1.7.2 Special messages

9.1.7.2.1 Introduction

The following messages are used to send commands from the Concentrator to A-Nodes and B-Nodes in authenticated or in non authenticated way.

9.1.7.2.2 Sending a command to a node

Function:

With this message the Concentrator performs special operations into a node, in non authenticated mode.

Structure:

Table 67 – Command 018 message

	IDEN	Value
MESSAGE CODE – **COMMAND**	018	
ACTION CODE		data

Coding:

data: Type of command [1 byte]

- 1 = reset A-Node's Normal Status Word
- 2 = reset A-Node's Extended Status Word
- 3 = reset both A-Node's Status Words
- 4 = reset A-Node's ΔK2
- 5 = reset A-Node's ΔK1
- 6 = Power control actuation simulation (this command, used for diagnostic operations, simulates an overpower that causes the opening of the cutoff device)
- 11÷14 = reserved to actions on B-Node, not used

NOTE Normal Status Word and Extended Status Word are registers of the A-Node's data structures used for diagnostic. ΔK1 and ΔK2 are parameters used to get modified versions of authentication keys K1 and K2.

Controls:

data: suitable

Activity:

If the command is accepted, the node transmits the ACK message (253 or 251) with the status word in a normal format (see 9.1.7.3.2 and 9.1.7.3.4); otherwise the NACK message (255 or 249) with the proper error code indicated (see 9.1.7.3.3 and 9.1.7.3.5) is sent.

9.1.7.2.3 Authenticated Sending a command to a node

Function:

With this message the Concentrator performs special operations into a node, in authenticated mode.

Structure:

Table 68 – Authenticated Command 118 message

	IDEN	Value
MESSAGE CODE – **COMMAND**	118	
ACTION CODE		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

data: Type of command [1 byte]

- 1 = reset A-Node's Normal Status Word

– 2 = reset A-Node’s Extended Status Word
– 3 = reset both A-Node’s Status Words
– 4 = reset A-Node’s ΔK2
– 5 = reset A-Node’s ΔK1
– 6 = Power control actuation simulation (this command, used for diagnostic operations, simulates an overpower that causes the opening of the cutoff device)
– 11÷14 = reserved to actions on B-Node, not used

NOTE Normal Status Word and Extended Status Word are registers of the A-Node’s data structures used for diagnostic. ΔK1 and ΔK2 are modified versions of authentication keys K1 and K2.

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

data: suitable

MM: coincidence

Activity:

If the command is accepted, the node transmits the ACK authenticated message (243 or 241) with the status word in a normal format (see 9.1.7.3.2 and 9.1.7.3.4); otherwise the NACK authenticated message (245 or 239) with the proper error code indicated (see 9.1.7.3.3 and 9.1.7.3.5) is sent.

9.1.7.3 Acknowledgements (distribution line networks)

9.1.7.3.1 Introduction

The following downstream messages are used by the nodes to communicate to the Concentrator that the received command has been correctly (or incorrectly) received and executed.

9.1.7.3.2 A-Node Ack

Function:

These downstream messages are used by the A-Nodes to communicate with the Concentrator that the received command has been correctly received and executed. They are used in particular as response after a programming parameter message (i.e. Write Request). This message shall be authenticated if, and only if, the relative received message was authenticated.

Structure:

Table 69 – A-Node ACK 253 message

	IDEN	Value
MESSAGE CODE – **ACK**	253	
ACK		data

Table 70 – Authenticated A-Node ACK 243 message

	IDEN	Value
MESSAGE CODE – **ACK**	243	
ACK		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

data: Normal Status Word of the A-Node that sends the Ack

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

NOTE Normal Status Word and Extended Status Word are registers of the A-Node's data structures used for diagnostic.

Controls:

DATE-T: congruence

MM: coincidence

Activity: NOT APPLICABLE

9.1.7.3.3 A-Node Nack

Function:

These downstream messages are used by A-Nodes to inform of anomalies about the received message. A NACK message shall be authenticated if, and only if, the relative received message was authenticated.

Structure:

Table 71 – A-Node NACK 255 message

	IDEN	Value
MESSAGE CODE – **NACK**	255	
NACK		code

Table 72 – Authenticated A-Node NACK 245 message

	IDEN	Value
MESSAGE CODE – **NACK**	245	
NACK		code
AUTHENTICATION	data	

Coding:

code: one byte as coded in the following table (all not coded values are reserved for future use)

Table 73 – Coding of field Value in A-Node Nack messages

Value (decimal)	Meaning
1	Coordinates of data not correct
2	Data not coherent
4	Programming not yet ended
8	Buffer full
10	TMAC not correct
16	Authentication error
128	B-Node does not answer

Meaning of error codes is described below:

– Coordinates of data not correct: value out of range or inconsistent (reading or writing request involves a register not present);

– Data not coherent: message formally correct but not manageable because data are not coherent with the requested operation (i.e. values out of admitted range);

– Programming not yet ended: the node receives a request during the swap operation to the new firmware version;

– TMAC not correct: the TMAC computed in encryption, authentication and playback attacks protection procedure is not correct;

NOTE in case a Concentrator receives a NACK message with Value = 10 from the inquired A-Node, it has to re-send the message using the LMON value received in the AUTHENTICATION field (see 9.3.6.5, step 5).

– Authentication error: the requested level of authentication is not accomplished (read key provided for a writing operation or no authentication performed in authenticated command).

data: (16 bytes), the meaning of this field is related to SSAP value of LLC level frame (see CLC/TS 50568-4:2015)as showed in the following table:

Table 74 – Coding of sub field SSAP in LLC frame

SSAP bit 0	SSAP bit 1	Contents of AUTHENTICATION field
0	0	DATE-T (8 bytes) TMAC (8 bytes)
1	0	LMON (8 bytes) (if NACK Value = 10)
0	1	TMAC (8 bytes)

Controls:

data: congruence/coincidence

Activity: NOT APPLICABLE

9.1.7.3.4 B-Node Ack

Function:

These downstream messages are used by the B-Nodes to communicate with the Concentrator that the received command has been correctly received and executed. They are used in particular as response after a programming parameter message. This message shall be authenticated if, and only if, the relative received message was authenticated.

Structure:

Table 75 – B-Node ACK 251 message

	IDEN	Value
MESSAGE CODE – **ACK**	251	
ACK		data

Table 76 – Authenticated B-Node ACK 241 message

	IDEN	Value
MESSAGE CODE – **ACK**	241	
ACK		data
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

data: Normal Status Word of the B-Node that sends the Ack

DATE-T: time stamp sent in a not encoded way

MM:

NOTE Normal Status Word and Extended Status Word are registers of the B-Node's data structures used for diagnostic.

Controls:

DATE-T: congruence

MM: coincidence

Activity: NOT APPLICABLE

9.1.7.3.5 B-Node Nack

Function:

These downstream messages are used by the B-Nodes to inform of anomalies about the received message. A NACK message shall be authenticated if, and only if, the relative received message was authenticated.

Structure:

Table 77 – B-Node NACK 249 message

	IDEN	Value
MESSAGE CODE – **NACK**	249	
NACK		code

Table 78 – Authenticated B-Node NACK 239 message

	IDEN	Value
MESSAGE CODE – **NACK**	239	
NACK		code
DATE-TIME for authentication	DATE-T	
TMAC	MM	

Coding:

code: one byte as coded in the following table (all not coded values are reserved for future use)

Table 79 – Coding of field Value in B-Node Nack messages

Value (decimal)	Meaning
1	Coordinates of data not correct
2	Data not coherent
4	Programming not yet ended
8	Buffer full
16	Authentication error

Meaning of error codes are described below:

- Coordinates of data not correct: value out of range or inconsistent (reading or writing request involves a register not present);
- Data not coherent: message formally correct but not manageable because data are not coherent with the requested operation (i.e. values out of admitted range);
- Programming not yet ended: downloading and updating of the firmware is still running;
- Authentication error: the requested level of authentication is not accomplished (read key provided for a writing operation or no authentication performed in authenticated command).

DATE-T: time stamp sent in a not encoded way

MM: TMAC calculated from the algorithm described in 9.3.5 and in 9.3.6

Controls:

DATE-T: congruence

MM: coincidence

Activity: NOT APPLICABLE

9.2 Application messages exchanged in telecommunication public networks

9.2.1 Object

This part of the document describes the structure of the messages exchanged between the AMM system and the Concentrator, through the telecommunication networks (GSM, DCS, PSTN, GPRS etc…).

The messages described in the following subclauses, defined as TB messages, allow to perform reading and writing operations decided by the AMM system on A-Nodes/B-Nodes data structures.

9.2.2 Management of reserved elements

The management of the following elements of the technical specification described in this document is reserved to Meters and More Association:

– values 1 and 7 of field "Message Type" (TM) within the Message Header of TB messages, see 9.2.4.2;

– field "Number of transactions" in TB messages TrapeId.Req (042) and Reset.Req (032), see 9.2.6.2 and 9.2.6.3;

– Ack code value of message TB_BO_ACK (000), see 9.2.6.5.2;

– Ack code value of message TB_ACK_REQ (001), see 9.2.6.5.3;

– Message code, Error code and Offset field in error values of message TB_BO_NACK (254), see 9.2.6.5.5;

– Message code value of message TB_NACK (255), see 9.2.6.5.6;

– values 3, 9, 10, 13, 19, 22 of error code within the message TB_ACK_STS (251), see Table 110 in 9.2.6.5.7;

– values 00÷03, 05÷09, 11÷14, 16÷22, 24÷26, 28, 2B÷2D, 32÷3E, 40÷46 of error code within the message TB_NACK (255), see Table 111 in 9.2.6.5.8.

9.2.3 Terms

In the following subclauses, each message is described using the following sections:

– **Function**: it describes the functionality associated with the message;

– **Structure**: it highlights in graphic form the message structure;

– **Coding**: it shows the contents of each field;

– **Activity**: it describes all the activities that the node shall perform upon reception of the message.

9.2.4 Messages general architecture

9.2.4.1 Introduction

The structure of the messages exchanged between AMM system and Concentrator (where otherwise specified, AMM system is HHU as well) is showed in the following figure:

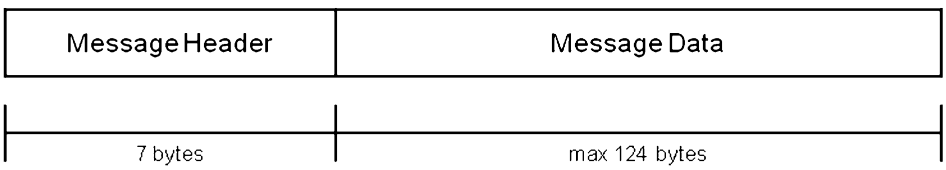


Figure 46 – Structure of messages exchanged in telecommunication networks

Following the details of each section and field.

9.2.4.2 Message Header

The message header is composed by the following fields:

TM	CM	LCD	IT
1 byte	1 byte	2 bytes	3 bytes

Figure 47 – Structure of Message Header

TM: Message Type [1 byte] containing the identifier (from 0 to 255) of the overall service typology in which the message is used:

00000000:	Not used	
00000001:	Reserved	
00000010:	Reserved to LV electricity metering	(TB-Electricity Meters)
00000011:	Reserved to Gas metering	(TB-Gas Meters)
00000100:	Reserved to LV B-Nodes management	(B-nodes)
00000101:	Reserved to Public Lighting management	(PL)
00000110:	Reserved to Power Quality management	(PQ)
00000111:	Reserved	
00001000:	Reserved to Water metering	(TB-Water Meters)
00001001:	Reserved to Heating metering	(TB-Heating Meters)

In the following it is simply indicated as Message.

CM: Message Code [1 byte] containing the identifier (from 0 to 255) of the semantics, the message content and the exchange procedure where it is inserted.

LCD: Data Field Length [2 bytes] containing the length in byte of the whole Message Data field.

IT: Transaction ID [3 bytes] stating the transaction number (see 9.2.4.6).

9.2.4.3 Message Data

It consists of the information carried by the message, e.g. IDs of Tables, IDs of Registers and data value, as well as additional fields for the handling of the communication towards the LV Nodes (protection, addressing, action identification). Maximum size of Message Data field is 124 bytes.

Prot	Meter ID	Action	Data
1 byte	6 bytes	1 byte	max 116 bytes

Figure 48 – Structure of Message Data

Prot: Protection [1 byte] stating the kind/level of protection recommended for the messages to be sent on the PLC network, according with the following values:

0: no protection required

1: the message shall be authenticated

2: the message shall be encrypted

3: the message shall be authenticated and encrypted

NOTE See 9.3 for authentication and encryption algorithms used.

There is a relationship, handled at AMM system level, between the Message Code (CM), the Prot and the Action values:

Table 80 – Relationship between Message Code, Prot and Action fields

Message Code	Prot	Action	Remarks
0nn	0	**0**nn	None
	1	1nn	Authentication on PLC NTW
	2	0nn	Encryption on PLC NTW
	3	1nn	Authentication + Encryption on PLC NTW

The coherence control between Prot and Action values, like the use of the encryption, is matter of implementation of the Concentrator (not mandatory).

Meter ID: Meter Identifier/Address [6 bytes]

Action: Command code [1 byte]: it is set by the AMM system and indicates which PLC message the Concentrator shall send toward the nodes of PLC network in order to accomplish the AMM system request.

Data: Set of parameters to be read or modified in the registers of the node's data structures, optionally with a preliminary field indicating the coordinates of the registers within the node's data structures. Maximum size of Data field is 116 bytes.

According with the above mentioned description, in the following sub clauses the request messages will be described with these general structures:

Table 81 – General description of a message using SMITP references

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
.REQ / .RESP	xxx	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table ID							XX
Register ID 1							xx.yy
Parameter description 1							value 1
…							…
Register							xx.yy
Parameter description n							value n

SMITP fields Table ID, Register ID (xx.yy) are defined in par. 9.1.6.1. The length of parameter values is automatically determined by SMITP references within the PLC node data model.

9.2.4.4 Protocol translation

The Concentrator translates messages coming from the AMM system in messages to be sent on the PLC network towards a node or a group of nodes. Below the rules that the Concentrator has to follow to implement this activity are indicated.

Starting from the general structure (see Table 81), the Concentrator shall:

– hold the transaction Id (this value is needed to elaborate in correct way the responses to a transaction, see 9.2.4.6);

– analyze the Prot value in order to send to lower layers the correct information about the requested protection level of PLC message;

– analyze the Meter ID to send to the lower layers;

– build the PLC message:

- writing the TB message Action value inside the message code field;
- writing the TB message data values inside the message data;
- If an authenticated message is requested, writing the coherent values of Date-T and TMAC fields.

Examples of translation using SMITP identifiers:

Table 82 – TB Message example 1

Message Code	Data Field Length	Transaction ID	Prot	Meter ID	Action	Data
004	4	0	3	M_ID	104	0x1C03 0x1234

Table 83 – PLC translation of previous TB message

ATTR	Data	Date-T	TMAC
104	0x1C03 0x1234	XXXXXXXX	XXXXXXXX

Table 84 – TB Message example 2

Message Code	Data Field Length	Transaction ID	Prot	Meter ID	Action	Data
004	4	0	0	M_ID	004	0x1C03 0x1234

Table 85 – PLC translation of previous TB message

ATTR	Data
004	0x1C03 0x1234

9.2.4.5 List of messages

In the following table all the TB messages described in next sub clauses are listed.

Table 86 – TB application messages in telecommunication public network

TB Message	Message code
Writing operations	
WRITE.REQ	004
WRITETAB.REQ	010
SETTAB.REQ	014
RESETTAB.REQ	016
RESET.REQ	032
SINC.REQ	034
Reading operations	
READ.REQ	002
READ.RESP	003

READTAB.REQ (with selection)	006
READTAB.RESP (with selection)	007
Reading operations (continued)	
READTAB.REQ (block read)	008
READTAB.RESP (block read)	009
GETTAB.REQ	030
GETTAB.RESP	031
TRAPEID.REQ	042
Special message	
COMMAND	018
Software download	
TB_REPROG	100
Acknowledgements	
TB_BO_ACK	000
TB_ACK_REQ	001
TB_ACK_STS	251
TB_BO_NACK	254
TB_NACK	255

9.2.4.6 TB messages flow diagrams

9.2.4.6.1 Introduction

Hereafter the main scenarios of TB messages exchange between the AMM system and the Concentrator for the execution of a transaction are described.

A transaction corresponds to a procedure started by the AMM system that involves the Concentrator and the nodes of the PLC network (e.g. closing customer contract). It is defined by one or more TB request messages, and it is executed by the Concentrator that sends one or more PLC messages to perform writing or reading operations on A-Nodes or B-Nodes. A transaction is identified by the Transaction ID in the IT field and may be composed by one or more steps. The number of transaction's steps is also indicated in the IT field.

A transaction may be performed by the Concentrator in two way: the "On-Line" one and the "Off-Line" one. The AMM system should decide which way to implement and, in case of Off-Line one, when the transaction result has to be recovered.

9.2.4.6.2 "On-Line" transaction scenario

In the On-Line transaction the Concentrator starts sending PLC messages as soon as it has received successfully from the AMM system the TB request messages, and it has sent to the AMM system the message TB_ACK_REQ (001). If a problem occurs during the TB request messages exchange, the Concentrator sends to the AMM system a message TB_NACK (255) and the transaction is aborted.

If the transaction execution finishes successfully, the Concentrator sends to the AMM system a message TB_ACK_STS (251) in case of writing operations performed in the PLC network, or a TB response message containing data in case of reading operations performed in the PLC network. At the end, if the AMM system receives these messages successfully, it sends to the Concentrator a message TB_BO_ACK (000), otherwise it sends a message TB_BO_NACK (254).

The On-Line transaction flow diagrams is showed in Figure 49, where:

– TB-aaa: TB request message for transaction opening;
– TB_ACK_REQ (001): acknowledgement message upon TB-aaa request;

- TB_NACK (255): acknowledgement message upon TB-aaa request if an error condition happened during the request;
- TB_ACK_STS (251): general acknowledgement message about the status of the transaction;
- TB-XXX: specific TB response message about reading operations performed on PLC nodes;
- TB_BO_ACK (000): acknowledgment message upon TB_ACK_STS and TB response received;
- TB_BO_NACK (254): acknowledgment message upon TB_ACK_STS and TB response received if an error condition happened.

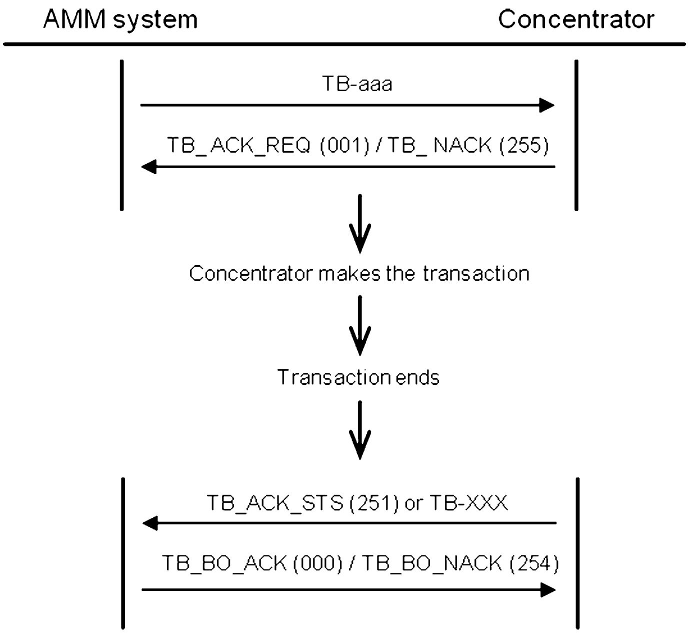


Figure 49 – TB messages exchange in the On-Line transaction

If the transaction execution does not finish successfully, e.g. a problem occurs in one of the steps that compose the transaction, the Concentrator sends to the AMM system the message TB_ACK_STS (251) for the step that was not correctly executed and for each next step the Concentrator has not received the PLC ACK message yet, as showed in Figure 50. Then the transaction is aborted by the AMM system and it will be AMM system care to rollback the steps already performed before the error condition and to restart the transaction.

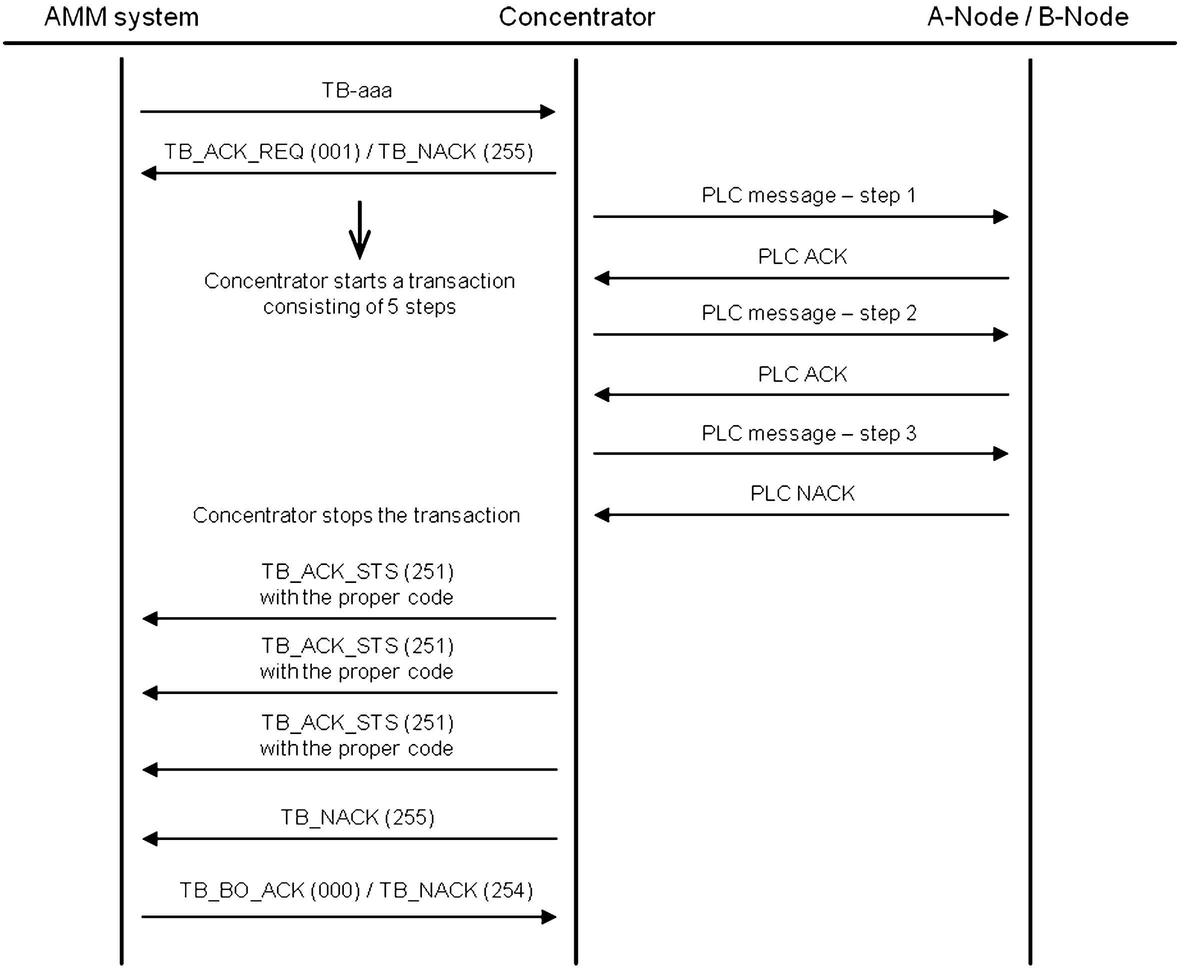


Figure 50 – Error condition during the transaction

9.2.4.6.3 "Off-Line" transaction scenario

If the Concentrator is busy because it is executing other activities, or the AMM system has the receptions buffer full, the transaction may be performed in the Off-Line way. In this case the Concentrator stores all the TB request messages received from the AMM system, starts executing the transaction when it has finished other activities and stores the results and the responses of the transaction in its buffer. It will be AMM system care to get the transaction results sending the TB message TRAPEID.REQ (042, see 9.2.6.1) to the Concentrator, as showed in the following figure, where:

- TB-aaa: request message for a transaction opening between AMM system and Concentrator;
- TB_ACK_REQ (001): acknowledgement message upon TB-aaa request;
- TB_NACK (255) acknowledgement message upon TB-aaa request if an error condition happened during the request;
- TRAPEID.REQ (042): request message to Concentrator for getting results and responses of the transaction;
- TB_ACK_STS (251): general acknowledgement message about the status of the transaction;
- TB-XXX: specific TB response message about reading operations performed on PLC nodes;

– TB_BO_ACK (000): acknowledgment message upon TB_ACK_STS and TB response received;

– TB_BO_NACK (254): acknowledgment message upon TB_ACK_STS and TB response received if an error condition happened.

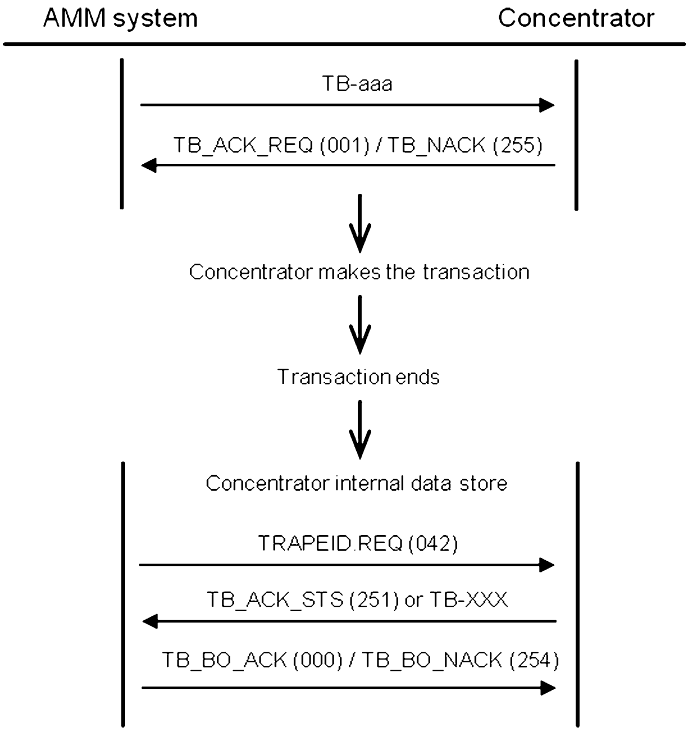


Figure 51 – TB messages exchange in the Off-Line transaction

9.2.4.6.4 Transaction deleting

It shall be possible, for a transaction previously required by the AMM system, to cancel it through the TB message RESET.REQ (032, see 9.2.6.3), as showed in the Figure 52. If the transaction could be cancelled, the Concentrator transmits the acknowledge message (TB_ACK_REQ 001); otherwise if the transaction cannot be cancelled the Concentrator transmits the message TB_NACK (255), with the proper code.

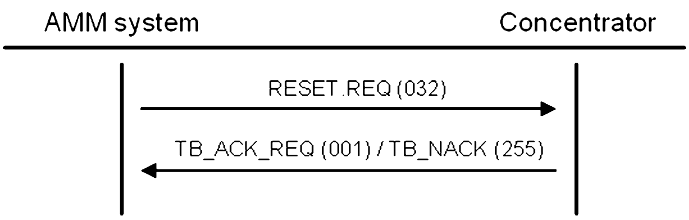


Figure 52 – Messages to cancel a transaction required by AMM system

9.2.5 SMITP primitives

9.2.5.1 Parameters programming activity (telecommunication public networks)

9.2.5.1.1 Introduction

The AMM system uses the following messages to configure parameters inside data model of A-Nodes/B-Nodes for the customer’s contract management.

9.2.5.1.2 Single parameter programming

Function:

Using the TB message WRITE.REQ (004) it is possible to write a single parameter inside the register. If an authenticated writing operation is requested, the field Action shall be set to the PLC message code 104; otherwise it shall be set to the PLC message code 004

.

Structure:

Table 87 – TB Write.Req 004 message (single programming of one parameter)

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
WRITE.REQ	004	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Register							xx.yy
Parameter to be written							value

If more than one of parameters that belong also to different SMITP tables have to be programmed, one message should be used, as showed in the following table.

Table 88 – TB Write.Req 004 message (single programming of more parameters)

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
WRITE.REQ	004	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Register							xx.yy
Parameter 1 to be written							value
…							…
Register							xx.yy
Parameter n to be written							value

Coding:

Action: 004 / 104

xx.yy: Reg_ID

value: parameters to be written

Activity:

– the programming overwrites the previous one;

– if the programming is accepted by the Concentrator, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the acknowledge message TB_ACK_STS (251, see 9.2.6.5.4). If the request does not succeed correctly, the Concentrator sends to the AMM system a message TB_ACK_STS (251) with the proper error code to indicate that an error occurs on the PLC network.

9.2.5.1.3 Meter clock synchronization

Function:

The TB message SINC.REQ (034) is used to synchronize the meter’s clock. It may be used instead of the TB message WRITE.REQ (004).

Structure:

Table 89 – TB Sinc.Req 034 message

<table>
<tr><th>Message Type</th><th>Message Code</th><th>Data Field Length</th><th>Transaction ID</th><th colspan="4">Message Data</th></tr>
<tr><td>SINC.REQ</td><td>034</td><td>LCD value</td><td>IT value</td><td>Prot</td><td>Meter ID</td><td>Action</td><td>Data</td></tr>
<tr><td colspan="7" rowspan="2">CLK</td><td>xx.yy</td></tr>
<tr><td>value</td></tr>
</table>

Coding:

Action: 004 / 104

xx.yy: Clock Reg_ID

value: 8 byte field encoded as follows.

– Year [2 bytes]
– Month [1 byte]
– Day [1 byte]
– Hours [1 byte]
– Minutes [1 byte]
– Seconds [1 byte]
– Type of date [1 byte]0=STD, 1=DST

Activity:

– the programming overwrites the previous one;

– if the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the acknowledge message TB_ACK_STS (251, see 9.2.6.5.4). If the request does not succeed correctly, the Concentrator sends to the AMM system a message TB_ACK_STS (251) with the proper error code to indicate that an error occurs on the PLC network.

9.2.5.1.4 Block programming

Function:

Using the TB message WRITETAB.REQ (010) it is possible to write several parameters which belong to the same SMITP Table, specifying Table ID and the Row ID.

Structure:

Table 90 – TB WriteTab.Req 010 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
WRITETAB.REQ	010	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table ID							XX
Row 1							yy
Parameter 1 to be written							value
Row 2							yy
Parameter 2 to be written							value
…							…
Row n							yy
Parameter n to be written							value

Coding:

Action: 010 / 110

XX: Tab_ID

yy: Row_ID

value: parameter to be written

Activity:

– the programming overwrites the previous one;

– if the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the acknowledge message TB_ACK_STS (251, see 9.2.6.5.4). If the request does not succeed correctly, the Concentrator sends to the AMM system a message TB_ACK_STS (251) with the proper error code to indicate that an error occurs on the PLC network.

9.2.5.1.5 Custom table set

Function:

The TB message SETTAB.REQ (014) is used to define the structure of a Custom table stored inside a given node on the PLC network.

Structure:

Table 91 – TB SetTab.Req 014 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
SETTAB.REQ	014	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table ID							XX
Parameter 1 to be set							xx.yy
Row number 1							yy
Parameter 2 to be set							xx.yy
Row number 2							yy
…							…
…							…
Parameter n to be set							xx.yy
Row number n							yy

Coding:

Action: 014 / 114

XX: Table ID of the Custom table to be defined

xx.yy: coordinates of the pointers (to registers that belong to other tables) to be set in the Custom table

yy: row numbers of the Custom table where the pointers are set

Activity:

If the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the acknowledge message TB_ACK_STS (251, see 9.2.6.5.4). If the request does not succeed correctly, the Concentrator sends to the AMM system a message TB_ACK_STS (251) with the proper error code to indicate that an error occurs on the PLC network.

9.2.5.1.6 Block Reset

Function:

The TB message RESETTAB (016) is used to reset data belonging to a SMITP Table inside a given node of the PLC network, using the Table ID.

Structure:

Table 92 – TB ResetTab 016 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
RESETTAB	016	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table							XX

Coding:

Action: 016 / 116

XX: Tab_ID

Activity:

If the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the acknowledge message TB_ACK_STS (251, see 9.2.6.5.4). If the request does not succeed correctly, the Concentrator sends to the AMM system a message TB_ACK_STS (251) with the proper error code to indicate that an error occurs on the PLC network.

9.2.5.1.7 Custom table get request

Function:

The TB message GETTAB.REQ (030) is used to read the configuration of a Custom table inside a given node on the PLC network, specifying the Row IDs to be read.

Structure:

Table 93 – TB GetTab.Req 030 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
GETTAB.REQ	030	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table ID							XX
Row 1							yy
Row 2							yy
…							…
Row n							yy

Coding:

Action: 030 / 130

XX: Tab_ID

yy: Row_ID of Custom table

If RowID 1 = 0 the command reads all the registers of the Custom table.

Activity:

If the request is accepted and succeeds correctly, the Concentrator replies with the TB message GETTAB.RESP (031) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if no error occurs, the AMM system delivers the acknowledge message TB_BO_ACK (000, see 9.2.6.5.2); otherwise it delivers NACK message TB_BO_NACK (254, see 9.2.6.5.5).

9.2.5.1.8 Table Get response

Function:

The TB message GETTAB.RESP (031) is delivered by the Concentrator as reply to the TB message GETTAB.REQ (030).

Structure:

Table 94 – TB GetTab.Resp 031 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
GETTAB.RESP	031	LCD value	IT value	-	-	-	**Data**
Table ID							XX
Row 1							value
Row 2							value
…							…
Row n							value

Coding:

XX: Tab_ID

value: content of the requested Custom table (Reg_ID)

Activity:

Using this message the Concentrator replies to the TB message GETTAB.REQ (030); then, if the request succeeds correctly, the AMM system delivers to the Concentrator the acknowledge message TB_BO_ACK (000, see 9.2.6.5.2); otherwise it delivers NACK message TB_BO_NACK (254, see 9.2.6.5.5).

9.2.5.2 Data read activity

9.2.5.2.1 Introduction

Data reading through the use of Register ID is performed using the TB message READ.REQ (002) as request, and the TB message READ.RESP (003) as response. More than one parameter, also belonging to different SMITP Tables may be requested using the same message.

It is possible to request several parameters belonging to the same using the TB message READTAB.REQ (006) and specifying the row number ; in this case the Concentrator responds with the TB message READTAB.RESP (007).

All the parameters that belong to the same Table may be read using the shorter TB message READTAB.REQ (block read, 008); in this case the Concentrator responds with the TB message READTAB.RESP (009).

9.2.5.2.2 Data read by Register ID

9.2.5.2.2.1 Read Request

Function:

Data reading is carried out directly by the identifiers of the parameters Register ID

Structure:

Table 95 – TB Read.Req 002 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
READ.REQ	002	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Parameter 1							xx.yy
Parameter 2							xx.yy
…							…
Parameter n							xx.yy

Coding:

Action: 002 / 102

xx.yy: coordinates of the registers to be read [2 bytes]

data: input arguments for selective access

Activity:

If the programming is accepted, and the request succeeds correctly, the Concentrator delivers the TB message READ.RESP (003) with the data requested; otherwise a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8) is sent.

9.2.5.2.2.2 Read Response

Functions:

Data related to the requested identifier specified in the TB message READ.REQ (002) are sent.

Structure:

Table 96 – TB Read.Resp 003 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
READ.RESP	003	LCD value	IT value	**-**	**Meter ID**	**Action**	**Data**
Parameter 1							value
Parameter 2							value
…							…
Parameter n							value

Coding:

Action: 003 / 103 (in case of TB response messages, the field Action contains the message code of the PLC message received by the Concentrator)

value: contents of the requested parameters

Activity:

Using this message the Concentrator replies to a TB message READ.REQ (002); then, if the request succeeds correctly, the AMM system delivers to the Concentrator the acknowledge message TB_BO_ACK (000, see 9.2.6.5.2); otherwise it delivers the NACK message TB_BO_NACK (254, see 9.2.6.5.5).

9.2.5.2.3 Block data exchange ID

9.2.5.2.3.1 ReadTab Request (with selection)

Function:

Using the TB message READTAB.REQ (006), several parameters belonging to the same table addressed by Tab_ID are requested at the same time.

Structure:

Table 97 – TB ReadTab.Req 006 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
READTAB.REQ	006	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table							XX
Parameter 1							yy
							yy
…							…
Parameter n							yy

Coding:

Action: 006 / 106

XX: Table ID

yy: Row_ID of the requested parameters

Activity:

If the command is accepted, the node transmits the TB message READTAB.RESP (007) with the data corresponding to the transmitted identifiers; otherwise, it replies with a NACK message (TB_NACK 255) with a proper error code (see 9.2.6.5.8).

9.2.5.2.3.2 ReadTab Response (with selection)

Function:

Using the TB message READTAB.RESP (007) the data related to the the identifiers specified in the TB message READTAB.REQ (006) are sent.

Structure:

Table 98 – TB ReadTab.Resp 007 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
READTAB.RESP	007	LCD value	IT value	**-**	**Meter ID**	**Action**	**Data**
Table							XX
Parameter 1							value
Parameter 2							value
…							…
Parameter n							value

Coding:

Action: 007 / 107 (in case of TB response messages, the field Action contains the message code of the PLC message received by the Concentrator)

XX: Table ID

value: contents of the requested parameters

Activity:

Using this message the Concentrator replies to the TB message READTAB.REQ (006); then, if the request succeeds correctly, the AMM system delivers to the Concentrator the acknowledge message

TB_BO_ACK (000, see 9.2.6.5.2); otherwise it delivers the NACK message TB_BO_NACK (254, see 9.2.6.5.5).

9.2.5.2.3.3 ReadTab Request (block read)

Function:

Using the TB message READTAB.REQ (008) the node transmits all the parameters belonging to the requested table.

Structure:

Table 99 – TB ReadTab.Req 008 message (entire table)

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
READTAB.REQ	008	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Table ID							XX

Coding:

Action: 008 / 108

XX: Table ID

Activity:

If the command is accepted, the node transmits the TB message READTAB.RESP (009) with the registers corresponding to the transmitted identifiers; otherwise, it responds with the NACK message TB_NACK (255), with a proper error code (see 9.2.6.5.8).

9.2.5.2.3.4 ReadTab Response (block read)

Function:

Using the TB message READTAB.RESP (009) all the parameters related to the requested table are sent.

Structure:

Table 100 – TB ReadTab.Resp 009 message (entire table)

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
READTAB.RESP	009	LCD value	IT value	**-**	**Meter ID**	**Action**	**Data**
Table							XX
Parameter 1							value
Parameter 2							value
…							…
Parameter n							value

Coding:

Action: 009 /109 (in case of TB response messages, the field Action contains the message code of the PLC message received by the Concentrator)

XX: Table ID

value: data of the requested parameters

Activity:

Using this message the Concentrator replies to the TB message READTAB.REQ (008); then, if the request succeeds correctly, the AMM system delivers to the Concentrator the acknowledge message TB_BO_ACK (000, see 9.2.6.5.2); otherwise it delivers the NACK message TB_BO_NACK (254, see 9.2.6.5.5).

9.2.6 Network primitives

9.2.6.1 Commands delivery

9.2.6.1.1 Introduction

The TB message COMMAND (018) allows the AMM system to set and to handle meter's parameters. The functionality this message is able to activate is defined by the values of the command code.

9.2.6.1.2 Generic command

Function:

This message is used to deliver a command to a node belonging to the PLC network.

Structure:

Table 101 – TB Command 018 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
COMMAND	018	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Command code							value

Coding:

Action: 018 / 118

value: command code [1 byte]

Field coded as follows:

- 1 = reset Normal Status Word
- 2 = reset Extended Status Word
- 3 = reset both Status Words
- 4 = restore the original value of ΔK2

NOTE Normal Status Word and Extended Status Word are registers of the nodes' data structures used for diagnostic. ΔK2 is a parameter used to get a modified version of authentication key K2 for data reading operations.

Activity:

- the programming resets the meter's parameters managed by the command;
- if the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the acknowledge message TB_ACK_STS (251, see 9.2.6.5.4). If the request does not succeed correctly, the Concentrator sends to the AMM system a message TB_ACK_STS (251) with the proper error code to indicate that an error occurs on the PLC network.

9.2.6.2 Transaction result reading

Function:

This TB message is used by the AMM system to read the result of the transaction stored inside the Concentrator.

Structure:

Table 102 – TB TrapeId.Req 042 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TRAPEID.REQ	042	LCD value	IT value	-	-	-	**Data**
Number of transactions							value 1
Transaction ID							value 2

Coding:

value 1: number of transactions can be read [2 bytes]

This field shall be set to 1 (reserved for future use).

value 2: ID of the transaction to be read [3 bytes]

Activity:

If the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001) otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8); then, if the request succeeds correctly, the Concentrator delivers the result of the transaction stored inside the Concentrator.

9.2.6.3 Transaction deleting

Function:

The TB message RESET.REQ (032) is used to delete a transaction stored inside the Concentrator.

Structure:

Table 103 – TB Reset.Req 032 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
RESET.REQ	032	LCD value	IT value	-	-	-	**Data**
Number of transactions to be deleted							value 1
Transaction ID to be deleted							value 2

Coding:

value 1: number of transactions to be deleted [2 bytes]

This field shall be set to 1 (reserved for future use).

value 2: ID of the transaction to be deleted [3 bytes]

Activity:

If the programming is accepted, the Concentrator replies with the acknowledge message TB_ACK_REQ (001); otherwise with a NACK message (TB_NACK 255), with a proper error code (see 9.2.6.5.8).

9.2.6.4 Software download

9.2.6.4.1 Introduction

The AMM system starts the software download procedure performing a specific writing operation on the involved PLC node using an authenticated writing message. Then it sends all the packets of the software to the Concentrator using the message TB_REPROG (100). The Concentrator receives each packet and forwards it to the node using the PLC message REPROG (101).

9.2.6.4.2 TB Reprog

Function:

Using the TB message TB_REPROG (100) the AMM system sends to the Concentrator each packet of software addressed to the node specified in the Meter ID field.

Structure:

Table 104 – TB_REPROG 100 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TB_REPROG	100	LCD value	IT value	**Prot**	**Meter ID**	**Action**	**Data**
Number of packet							value 1
Packet							value 2

Coding:

Action: 101

value 1: number of the firmware's packet to be transmitted to the Concentrator

value 2: packet of the firmware to be transmitted to the Concentrator

Activity:

The Concentrator forwards the received packet to the node addressed by the Meter ID field using the PLC message REPROG (101).

9.2.6.5 Acknowledgements (telecommunication public networks)

9.2.6.5.1 Introduction

These messages are used by the Concentrator and AMM system to communicate that a command has been correctly/incorrectly received and executed. They are used in particular to obtain a feedback after a parameter programming message (i.e. Write.Req), or command message.

9.2.6.5.2 AMM system TB Ack

Function:

This message is delivered by the AMM system after receiving a TB message from the Concentrator in order to notify the Concentrator that the transaction succeeded.

Structure:

Table 105 – TB_BO_ACK 000 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TB_BO_ACK	000	LCD value	IT value	-	-	-	**Data**
Ack code							value

Coding:

value: code of the Ack [1 byte](reserved for future use)

Activity: NOT APPLICABLE

9.2.6.5.3 TB Ack Req (request reception)

Function:

This message is delivered by the Concentrator to the AMM system in order to notify the transaction request reception.

Structure:

Table 106 – TB_ACK_REQ 001 message (request reception)

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TB_ACK_REQ	001	LCD value	IT value	-	-	-	**Data**
Ack code							value

Coding:

value: transaction request result [1 byte](reserved for future use)

Activity: NOT APPLICABLE

9.2.6.5.4 TB Ack Sts (transaction status)

Function:

This message is delivered by the Concentrator to the AMM system in order to notify the transaction status or if the meter is reachable.

Structure:

Table 107 – TB_ACK_STS 251 message (transaction status)

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TB_ACK_STS	251	LCD value	IT value	-	-	-	**Data**
Ack code							value

Coding:

value: transaction status [1 byte]

(see Table 110 in 9.2.6.5.7)

Activity: NOT APPLICABLE

9.2.6.5.5 AMM system TB Nack

Function:

This message is delivered by the AMM system to the Concentrator in order to notify the error condition occurred in the previous exchange.

Structure:

Table 108 – TB_BO_NACK 254 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TB_BO_NACK	254	LCD value	IT value	-	-	-	**Data**
Message code							value 1
Error code							value 2
Offset field in error							value 3

Coding:

value 1: [1 byte] (reserved for future use)

value 2: [1 byte] (reserved for future use)

value 3: [2 bytes] (reserved for future use)

Activity: NOT APPLICABLE

9.2.6.5.6 TB Nack

Function:

This message is delivered by the Concentrator to the AMM system in order to notify the error condition occurred in the transaction running.

Structure:

Table 109 – TB_NACK 255 message

Message Type	Message Code	Data Field Length	Transaction ID	Message Data			
TB_NACK	255	LCD value	IT value	-	-	-	**Data**
Message code							value 1
Error code							value 2
Offset field in error							value 3

Coding:

value 1: [1 byte] (reserved for future use)

value 2: [1 byte] see the coding table in 9.2.6.5.8

value 3: [2 bytes] field index for which an error is found

Activity: NOT APPLICABLE

9.2.6.5.7 TB Ack Sts (transaction status) Error Codes table

Table 110 – Error codes of transaction status indicated in TB_ACK_STS 251 message

Error code ID	Error Description
0	OK
1	Bad Field
2	Not implemented
3	Reserved
4	Buffer Full
5	Protection request failure
8	B-Node not reachable
9 – 10	Reserved
11	Target disabled
12	Address Error
13	Reserved
15	A-Node not reachable
16	Protection response failure
17	Response is stale
18	Response not protected
19	Reserved
20	Response failure
21	Target does not answer the repeater
22	Reserved
40	Repeater 1 failure
41	Repeater 2 failure
42	Repeater 3 failure
43	Repeater 4 failure
44	Repeater 5 failure
45	Repeater 6 failure
46	Repeater 7 failure
47	Repeater 8 failure
48	The meter can’t detect phase information

9.2.6.5.8 TB Nack Error Codes Table

Table 111 – Error codes indicated in TB_NACK 255 message

Error code ID (Hex)	Error Description
00 ÷ 03	Reserved
04	Indicates that the transaction ID specified is invalid. For example, this is returned if the AMM system submits a request with a transaction ID in the HHU transaction space.
05 ÷ 09	Reserved
10	TB procedure not enabled
11 ÷ 14	Reserved
15	Transaction number > max number of allowed open transactions
16 ÷ 22	Reserved
23	Wrong length
24 ÷ 26	Reserved
27	Step cancelled due to error
28	Reserved
29	Transaction ID (to be transmitted) already present in Concentrator buffer
2A	ID transaction not existing
2B ÷ 2D	Reserved
2E	Meter not present in the Concentrator's database
2F	Concentrator INTERNAL ERROR
30	Error in the FIELD function
31	Indicates that an invalid table specification was made.
32 ÷ 3E	Reserved
3F	An attempt was made to remove a transaction that was in progress
40 ÷ 46	Reserved
47	DST_BLACKOUT (request not allowed within 15 minutes of DST switchover)
4D	BAD_MODE (request not compatible with current stand-alone / remote mode)

9.3 Encryption, Authentication and Playback Attacks Protection

9.3.1 Application fields

The content of this subclause applies to Concentrators and HHU, called Master along this clause without distinction, and to A-Nodes and B-Nodes.

9.3.2 Introduction

The messages "to be protected" shall be encrypted, authenticated and protected against "playback attack". Encryption, authentication and "playback attack" protection are accomplished and managed by using the following algorithms and predispositions.

9.3.3 AES-ECB encryption

It shall be used a "Block" (128 bits) encryption by AES-ECB algorithm, using a key "K" of 128 bits, as described in NIST SP 800-38A.

9.3.4 AES-CTR encryption

9.3.4.1 Introduction

It shall be used a “Stream” encryption by AES-CTR algorithm, using a key “K” of 128 bits, as described in NIST SP 800-38A. In this case the “Counter Block” (128 bits) composition shall be modified as follows:

– the first most significant 48 bits shall correspond to the 48 bits of ACA (A-Node/B-Node identifier, see the details later on);

– the successive 64 bits shall correspond to the 64 bits of CMON or LMON (see the details later on);

– the remaining least significant 16 bits represent the value of the Block Counter (16 bits in this case); it begins with the value of one and it is incremented to generate subsequent portions of the “key stream”.

This kind of encryption allows to avoid the “text padding”.

9.3.4.2 Generation of encryption and authentication key “K”

This key of 128 bits shall be composed as follows:

– the first most significant 32 bits shall correspond to the last least significant 32 bits of K1 or K2;

– the remaining 96 bits shall correspond to the 96 bits of K1 or K2.

NOTE K1 and K2 are authentication keys for respectively data writing and data reading operations.

9.3.5 AES-CMAC authentication

It shall be used a text authentication by AES-CMAC algorithm, using a key “K” of 128 bits, as described in NIST SP 800-38B. AES-CMAC generates a fixed length MAC of 128 bits. Generation of key “K” is explained above 9.3.4.2.

9.3.6 Last Message Order Number (LMON)

9.3.6.1 Introduction

A-Node/B-Node shall be provided with a counter “modulo 2^{64}“ dedicated to totalize the number of the valid received protected messages. The value of this counter represents the order number LMON of the last valid received protected message. This counter shall not be clearable and it shall be readable just by the exchange of specific protected messages (see the details later on). When a A-Node/B-Node receives a protected message, it shall process this message as if its order number were “LMON + 1”; in this way we realize a message’s implied numbering feature (see the details later on). The initial value of this counter is not significant, so it may be configured to a “random” and “unpredictable” initial value during the manufacturing process. The LMON is principally used to perform the “playback attack” protection. A distinct LMON counter shall be foreseen and used in case of first installation; this “Provisional” LMON counter is used paired with Provisional Key. The "Provisional" LMON counter could be clearable; its initial value is not significant and may be simply configured to "zero".

9.3.6.2 Generation of random and unpredictable numbers N

For the “LMON Recovery” procedure (see details later on), LV Concentrator shall generate random and unpredictable numbers of 128 bits. Each number shall be the result of an AES-ECB encryption (see also 5.2 of RFC 4086) of the sequence [DATETIME, C] by using a key “K” composed by the sequence [P], where:

– DATETIME (64 bits) is the Master date-time;

– C (64 bits) is the value of a counter “modulo 2^{64}” that increases of 1 its value when a number N is generated;

– P (16 bytes) is the Concentrator's "PPP password" or a stated unambiguous identifier in case of HHU.

The counter shall not be clearable and readable; its initial value is not significant, so it may be configured to a "random" and "unpredictable" initial value during the manufacturing process.

9.3.6.3 Storage of the last valid received protected message

The A-Node/B-Node shall store (overwrite) the last valid received protected message, to manage the Master data-link "retries" of this kind of messages. If the A-Node/B-Node receives a protected message identical to the stored one, it sends again the response message already associated to this message.

9.3.6.4 LMON Recovery

The LMON of each A-Node/B-Node shall be initially recovered (or successively recovered, when necessary) as follows.

1) The Master generates, for each A-Node/B-Node, a "random" and "unpredictable" number N (128 bits) and sends the following "challenge" request message to A-Node/B-Node:

ATTR	T	N

Figure 53 – LMON Recovery: challenge request message

where:

– ATTR (1 byte) is the "challenge" request message header in plain text (code 112);

– T (2 bytes) shall be 0;

– N is the "random" and "unpredictable" number of 128 bits in plain text.

2) If an A-Node/B-Node receives this message, it sends the following protected response message to the Master:

ATTR	T	ETs

Figure 54 – LMON Recovery: challenge response message

where:

– ATTR (1 byte) is the response message header in plain text (code 113);

– T (2 bytes) shall be 0;

– ETs (Encrypted Text; 128 bits) is the result of AES-ECB encryption of the sequence [LMON, d]:

  - LMON (Last Message Order Number) is the order number (64 bits) of the last valid protected message received by A-Node/B-Node;
  - d corresponds to the least significant 64 bits of D (TMAC);
  - D is the AES-CMAC MAC (128 bits) of the sequence [ATTR, ACA(first 3 bytes), LMON, CRC(ACA, N)]:
    - ACA (48 bits) is the A-Node/B-Node identifier;
    - N is the received "random" and "unpredictable" number of 128 bits;
    - CRC is a function that computes the standard 32bit CRC.

3) If Master receives this message, it decrypts ETs and:

– if d is ok, it accepts and stores LMON as reference number to use for the next protected message to send to that A-Node/B-Node;

– if d is not ok, it refuses the received message and aborts the procedure.

9.3.6.5 Use of LMON

The use of the LMON, in Master – A-Node/B-Node protected messages exchange, is organised as follows.

The Master has recovered (so knows) the LMON of each A-Node/B-Node and then performs the following steps.

1) The Master, when requested, sends the following request message to a A-Node/B-Node:

ATTR	ETm

Figure 55 – LMON use: request message

where:

– ATTR (1 byte) is the request message header in plain text;

– ETm (Encrypted Text) is the result of AES-CTR encryption (with CMON as Counter Block component) of the sequence [DATA, d]:

- CMON (Current Message Order Number) is the order number (64 bits) of this protected message sent to A-Node/B-Node (CMON = LMON + 1);
- DATA field contains the data of the Master request;
- d corresponds to the least significant 64 bits of D (TMAC);
- D is the AES-CMAC MAC (128 bits) of the sequence [ATTR, ACA (first 3 bytes), CMON, CRC (ACA, DATA)]:
  - ACA (48 bits) is the A-Node/B-Node identifier;
  - CRC is a function that computes the standard 32bit CRC.

2) If A-Node/B-Node receives this message, it decrypts ETm and if d is ok, it accepts DATA, increases of 1 the value of LMON (LMON = LMON + 1) and sends the following response message to Master:

ATTR	ETs

Figure 56 – LMON use: response message

where:

– ATTR (1 byte) is the response message header in plain text;

– ETs (Encrypted Text) is the result of AES-CTR encryption (with LMON as Counter Block component) of the sequence [DATA, d]:

- LMON (Last Message Order Number) is the order number (64 bits) of the last valid protected message received by A-Node/B-Node;

- DATA field contains the data of the A-Node/B-Node response;
- d corresponds to the least significant 64 bits of D (TMAC);
- D is the AES-CMAC MAC (128 bits) of the sequence [ATTR, ACA (first 3 bytes), LMON, CRC (ACA, DATA)]:
  - ACA (48 bits) is the A-Node/B-Node identifier;
  - CRC is a function that computes the standard 32bit CRC.

3) If Master receives this message, it decrypts ETs and:

– if d is ok, it accepts DATA and increases of 1 the value of LMON (LMON = LMON + 1); in this way, for each A-Node/B-Node, the LMON is always aligned in both Master and A-Node/B-Node;

– if d is not ok, it refuses the received message and restarts the Recovery procedure described in 9.3.6.4, step 1.

4) If d is not ok in step 2, A-Node/B-Node refuses the received message, keeps the same LMON it previously had and sends the following NACK response message:

ATTR	PAR1	ETs

Figure 57 – LMON use: Nack response message

where:

– ATTR (1 byte) is the NACK response message header in plain text (code 245);

– PAR1 (1 byte) is the error code in plain text (decimal value = 10);

– ETs (Encrypted Text; 128 bits) is the result of AES-ECB encryption of the sequence [LMON, d]:

- LMON (Last Message Order Number) is the order number (64 bits) of the last valid protected message received by A-Node/B-Node;
- d corresponds to the least significant 64 bits of D (TMAC);
- D is the AES-CMAC MAC (128 bits) of the sequence [ATTR, ACA(first 3 bytes), LMON, CRC(PAR1, ACA, Etm*)]:
  - ACA (48 bits) is the A-Node/B-Node identifier;
  - Etm* represents last 8 bytes of the encoded received message;
  - CRC is a function that computes the standard 32bit CRC.

5) If Master receives this message, it decrypts ETs and:

– if d is ok, it accepts and stores LMON as reference number to use for the next protected message to send to that A-Node/B-Node;

– if d is not ok, it refuses the received message and restarts the Recovery procedure described in, 9.3.6.4 step 1.

9.4 Enconding examples

9.4.1 Introduction

Since the document describes application procedures, frames related to Application level will be analysed in detail. For the rest of frames related to lower layers, structure is described in CLC/TS 50568-4:2015.

Enconding examples has been retrieved from the Concentrator log, then bits and bytes have been included following the transmission order CLC/TS 50568-4:2015.

CE acronym refers to meter.

9.4.2 Meter's discovery procedure

```
2011-04-13 08:57:26.338       To CE:
      7E 03 12 01 81 13 FF FF FF FF FF 03 F1 00 13 20
      5A 01 81 00 00 65
                        -- Explanation:
```

Concentrator sends a broadcast message (03 FF FF FF FF FF) to all nodes:

5A= 090 message code. ADDRESS.Req

01= condition to respond. The interrogate node will response only if it is "in phase" with the requester node.

81= TCR (level of request). The interrogate node will response only if its TCT is: TCT >= TCR

00= AddToAddress.

00= RightShiftAdd

```
2011-04-13 08:57:36.279  From CE:
      7E 03 1A 01 81 17 FF FF FF FF FF 03 05 05 13 20
      5B 86 02 16 02 71 FB 05 16 00 5A 01 81 CA
                        --- Explanation
```

All the meter that receive the 090 message, if message parameters enable their response, respond with an ADDRESS.RESP (091) message.

5B: 091 message code. REQADDR.Res

86 02 16 02 71 FB: Physical address of the meter that responds.

05 : signal level.

16 : SNR.

00 : impedance value.

5A 01 81: Available fields.

```
      2011-04-13 08:57:36.285 analyse recovery sub packet
      7E 03 1A 01 81 17 FF FF FF FF FF 03 05 05 13 20
      5B 86 02 16 02 71 FB 05 16 00 5A 01 81 CA
2011-04-13 08:57:36.289 recovery found ce:
      86 02 16 02 71 FB
2011-04-13 08:57:36.291       found ce list, found_ce_idx:0, ceidx_to_silence:0
2011-04-13 08:57:36.293 [1] found ce list, ceid:8602160271FB, curr_idx:0
```

```
2011-04-13 08:57:36.296 [2] path: directly reachable
2011-04-13 08:57:37.839       From CE:
      7E 03 1A 01 81 17 FF FF FF FF FF 03 05 04 13 20
      5B 86 02 16 02 71 45 05 15 00 5A 01 81 76
                        --- Explanation
5B: 091 message code. REQADDR.Res
86 02 16 02 71 45: Physical address of the meter that responds.
05 : signal level.
15 : SNR.
00 : impedance value.
5A 01 81: Available fields.
---
2011-04-13 08:57:37.845 analyse recovery sub packet
      7E 03 1A 01 81 17 FF FF FF FF FF 03 05 04 13 20
      5B 86 02 16 02 71 45 05 15 00 5A 01 81 76
2011-04-13 08:57:37.849  recovery found ce:
      86 02 16 02 71 45
2011-04-13 08:57:37.851 found ce list,found_ce_idx:1, ceidx_to_silence:0
2011-04-13 08:57:37.854 [1] found ce list,ceid:860216027145,curr_idx:1
2011-04-13 08:57:37.856 [2] path: directly reachable.
2011-04-13 08:57:42.319       From CE:
      7E 03 1A 01 81 17 FF FF FF FF FF 03 05 82 13 20
      5B 86 02 14 00 63 B6 05 04 00 5A 01 81 00
--- Explanation
                        5B: 091 message code. REQADDR.Res
86 02 14 00 63 B6: Physical address of the meter that responds.
05 : signal level.
04 : SNR.
00 : impedance value.
5A 01 81: Available fields.
---
2011-04-13 08:57:42.325       analyse recovery sub packet
      7E 03 1A 01 81 17 FF FF FF FF FF 03 05 82 13 20
      5B 86 02 14 00 63 B6 05 04 00 5A 01 81 00
2011-04-13 08:57:42.328 recovery found ce:
      86 02 14 00 63 B6
2011-04-13 08:57:42.331       found ce list,found_ce_idx:2, ceidx_to_silence:0
2011-04-13 08:57:42.336 [1] found ce list,ceid:8602140063B6,curr_idx:2
2011-04-13 08:57:42.338 [2] path:directly reachable.
2011-04-13 08:57:46.341       recovery ce found 3 CEs.
2011-04-13 08:57:46.349  found ce list,found_ce_idx:2, ceidx_to_silence:0
2011-04-13 08:57:46.351 [1] found ce list,ceid:8602160271FB,curr_idx:0
2011-04-13 08:57:46.354 [2] path:directly reachable.
```

2011-04-13 08:57:46.356 process found ce list, need_update_phase=0, need_silence=1

2011-04-13 08:57:46.358 silence ce sub comm, ceid: 8602160271FB, tct=128

2011-04-13 08:57:46.758 To CE:

7E 03 0F 01 03 10 FB 71 02 16 02 86 81 00 13 20

5C 80 69

--- Explanation

The Concentrator sends the message TCT_SET.REQ (092) to silent the node avoiding a new response from a meter that already responds to a previous ADDRESS.REQ (090)

5C: 092 message code. TCT_SET.REQ

80: 128 Value of TCT to set.

2011-04-13 08:57:47.128 From CE:

7E 03 12 01 03 0F FB 71 02 16 02 86 05 04 13 20

F7 00 05 15 15 C5

---Explanation

When the node receives the previous command sets its TCT to the received value and responds with an Acknowledge command (code 247) with appropriates codes.

F7: 247 message code ACK: Acknowledge message.

00: error code (no error)

05: Signal Level in the RX messages.

15: SNR in the RX messages (if the value is FF, data is not available)

15: Impedance value of the communication media.

2011-04-13 08:57:47.153 Proc: 26/RECOVERY_CE is scheduled

2011-04-13 08:57:47.156 Last Proc: 26/RECOVERY_CE type:CE

2011-04-13 08:57:47.158 found ce list,found_ce_idx:2, ceidx_to_silence:1

2011-04-13 08:57:47.161 [1]found ce list,ceid:860216027145,curr_idx:1

2011-04-13 08:57:47.163 [2]path:directly reachable.

2011-04-13 08:57:47.165 process found ce list, need_update_phase=0, need_silence=1

2011-04-13 08:57:47.167 silence ce sub comm, ceid:860216027145, tct=128

2011-04-13 08:57:47.558 To CE:

7E 03 0F 01 04 10 45 71 02 16 02 86 81 00 13 20

5C 80 D0

--- Explanation

5C: 092 message code. TCT_SET.REQ

80: 128 Value of TCT to set.

2011-04-13 08:57:47.941 From CE:

7E 03 12 01 04 0F 45 71 02 16 02 86 05 04 13 20

F7 00 05 17 15 7D 5E

--- Explanation

F7: 247 message code ACK: Acknowledge message.

00: error code (no error)

05: Signal Level in the RX messages.

17: SNR in the RX messages (if the value is FF, data is not available)

15: Impedance value of the communication media.

```
2011-04-13 08:57:47.959 Proc: 26/RECOVERY_CE is scheduled
2011-04-13 08:57:47.962 Last Proc: 26/RECOVERY_CE     type:CE
2011-04-13 08:57:47.964       found ce list, found_ce_idx:2, ceidx_to_silence:2
2011-04-13 08:57:47.967 [1] found ce list, ceid: 8602140063B6, curr_idx:2
2011-04-13 08:57:47.969 [2] path: directly reachable.
2011-04-13 08:57:47.971       process found ce list, need_update_phase=0,
need_silence=1
2011-04-13 08:57:47.974       silence ce sub comm, ceid:8602140063B6, tct=128
2011-04-13 08:57:48.178  To CE:
      7E 03 0F 01 05 10 B6 63 00 14 02 86 81 00 13 20
      5C 80 30
```

-- Explanation

5C: 092 message code. TCT_SET.REQ

80: 128 Value of TCT to set.

```
2011-04-13 08:57:48.561       From CE:
      7E 03 12 01 05 0F B6 63 00 14 02 86 05 81 13 20
      F7 00 06 04 15 0B
```

---Explanation

F7: 247 message code ACK: Acknowledge message.

00: error code (no error)

06: Signal Level in the RX messages.

04: SNR in the RX messages (if the value is FF, data is not available)

15: Impedance value of the communication media.

```
2011-04-13 08:57:48.580  Proc: 26/RECOVERY_CE is scheduled
2011-04-13 08:57:48.586       Last Proc: 26/RECOVERY_CE type:CE
2011-04-13 09:10:28.939 To CE:
7E 02 18 01 DE 19 C2 5E 00 14 02 86 D0 FF FF FF
FF FF 03 00 13 20 5E 01 67 00 00 F5
```

---Explanation

Concentrator sends a REQADDR.REQ (094 message) to each meter already discovered in a previous step, to ask it to act as repeater towards any meter that the Concentrator is not able to reack in direct way.

5E: 094 message code

01: Condition to respond. The interrogate node will response only if it is “in phase” with the requester node.

67: TCR (level of request)

00: AddToAddress.

00: RightShiftAdd.

2011-04-13 09:10:34.279 From CE:

7E 02 1B 01 DE 18 C2 5E 00 14 02 86 05 7B 13 20

5F 01 86 02 14 00 5E 9D 02 0D 15 5A 01 67 B6

---Explanation

Meter sends a REQADDR.RESP message to the Concentrator with the total number of responses received by the meters.

5f: 095 Message code REQADDR.resp

01: Number of Found Nodes

86 02 14 00 5E 9D: Physical address of the node

02: Av_SIG

0D: AV_SNR

15: Av_TX

5A 01 67: Available byte

9.4.3 Writing and reading examples

2011-04-13 12:35:13.725 To CE:

7E 0B 3B 81 3C 64 71 02 16 02 86 CE 07 00 00 00

00 00 00 B0 7D 5D 95 31 7F E3 96 A9 82 9F 20 A3

00 00 00 00 1E 0B 02 1C 02 41 03 41 00 13 05 68

0A 23 4C AA F7 20 01 00 00 00 00 00 00 00 00 F3

---Explanation

68(104): message code WRITE.REQ: authenticated writing

0A: Table number

23: register number

4C AA F7 20 01: date/time value in Posix format

00 00 00 00 00 00 00 00: date/time for authentication

2011-04-13 12:35:14.901 From CE:

7E 0B 18 E1 3C 15 0B 02 1C 02 41 03 05 02 13 05

F3 84 C0 00 00 00 00 00 00 00 00 23

---Explanation

If the programming is accepted, the node transmits the message with the status word value

F3 (243) message code

84 C0: status word value

00 00 00 00 00 00 00 00: date and time for authentication

2011-04-13 12:35:15.100 To CE:

7E 0B 10 01 3D 11 0B 02 1C 02 41 03 81 00 13 00

```
      02 00 3F C7
---Explanation
Read request
02 Message code: Data reading READ.REQ
00 data table number
3F data register
---
2011-04-13 12:35:15.501  From CE:
      7E 0B 16 01 3D 13 0B 02 1C 02 41 03 05 03 13 00
      03 84 C0 80 1C 00 08 00 01 AB
---Explanation
03: Message code: Read Response
84 C0 80 1C 00 08 00 01: Value of the requested data
---
```

9.5 TCP/IP encapsulation example of SMITP TB Application layer message

9.5.1 Overview

In this clause the log of a reading operation that the AMM system performed on a specified meter through public communication network is shown. AMM system requested Concentrator to read the meter's status word and the TCP/IP packets, containing the TB messages, exchanged between AMM system and Concentrator are detailed. See STD0007 for TCP header format and see STD0005 for IP header format. See CLC/TS 50568-4:2015 for SMITP TB Application layer messages format.

9.5.2 AMM to Concentrator message

The reading operation of the meter's status word is performed through a READTAB.REQ command sent from AMM to the Concentrator. Below the entire hexadecimal coding of the TCP/IP part of the message is shown with a detailed explanation of each information element:

45|00|00|3a|dd|8c|40|00|80|06|c8|c9|0a|49|34|17|0a|3b|0b|cd|08|b6|c3|50|ac|87|b4|fd|fb|9b|bf|ee|50|18|ff|ed|24|ae|00|00|02|06|00|0b|08|01|01|00|a8|04|0a|1e|89|53|06|*16*|*01*|*02*|

Byte explanation of the IP Header section:

45| Version + IHL

00| Type of Service

00|3a| Total Length

dd|8c| Identification

40|00| Flags + Fragment Offset

80| Time to Live

06| Protocol

c8|c9| Header Checksum

0a|49|34|17| Source Address (10.73.52.23)

0a|3b|0b|cd| Destination Address (10.59.11.205)

Below the byte explanation of the TCP Header section is shown:

08|b6| Source Port (2230)

c3|50| Destination Port (50000)

ac|87|b4|fd| Sequence Number

fb|9b|bf|ee| Acknowledgment Number

50|18| Data offset – Reserved – Control bits

ff|ed| Window

24|ae| Checksum

00|00| Urgent Pointer

Below the byte explanation of the TB application message section is shown:

02| TM (Message type)

06| CM (Message code)

00|0b| LCD (Data Field Length)

08|01|01| Transaction ID

00| Prot

a8|04|0a|1e|89|53| Meter ID

06| Action

16|01|02| Data:

16| Table ID

01| Register1 ID

02| Register2 ID

9.5.3 Concentrator to AMM message

The Concentrator responds to AMM sending a message READTAB.RESP carrying the requested data. The following hexadecimal coding represents the entire TCP/IP part of the received message:

45|00|00|3b|b9|1c|00|00|37|06|76|39|0a|3b|0b|cd|0a|49|34|17|c3|51|08|b5|fb|ae|95|9c|43|b0|08|eb|50|
18|16|d0|45|fc|00|00|02|07|00|0c|08|01|01|a8|04|0a|1e|89|53|07|*16*|*80*|*c0*|*c0*|*fc*

Byte explanation of the IP Header section:

45| Version + IHL

00| Type of Service

00|3b| Total Length

b9|1c| Identification

00|00| Flags + Fragment Offset

37| Time to Live

06| Protocol

76|39| Header Checksum

0a|3b|0b|cd| Source Address (10.59.11.205)

0a|49|34|17| Destination Address (10.73.52.23)

Below the byte explanation of the TCP Header section is shown:

c3|51| Source Port (50001)

08|b5| Destination Port (2229)

fb|ae|95|9c Sequence Number

43|b0|08|eb Acknowledgment Number

50|18| Data offset – Reserved – Control bits

16|d0| Window

45|fc| Checksum

00|00| Urgent Pointer

Below the byte explanation of the TB application message section is shown:

02| TM (Message type)

07| CM (Message code)

00|0c| LCD (Data Field Length)

08|01|01| Transaction ID

a8|04|0a|1e|89|53| Meter ID

07| Action

16|80|c0|c0|fc Data:

16| Table ID

80|c0| Register1 value (Status Word byte 1 and 2)

c0|fc| Register2 value (Status Word byte 3 and 4)

10 The Original-SMITP Data model

10.1 Introduction

In the following tables, the objects contained inside an electricity meter database are described. Each table groups homogeneous data parameters.

In case of polyphase meter, if per phase quantities are foreseen, one table for each phase is provided.

Columns description:

– Register: parameter's mnemonic ID; it has not any implementation use;

– Len: parameter's length (in byte);

– Range: parameter's value range, usually indicated as an interval between a minimum and a maximum value, in hexadecimal format;

– MU: parameter's measurement unit;

– ID: parameter ID in hexadecimal format; this attribute is used to identify the parameter in reading/writing activities.

  This is a 2 byte field and represents the coordinate xx.yy of a register: the most significant byte indicates the table ID and the least significant byte indicates the row number of the table.

– WrRe: this field indicates if a parameter is writable, readable, writable and readable or neither of them:

  - : not readable and not writable;

  RO: readable only;

  WO: writable only;

  RW: readable and writable.

– Description: description of the parameter's functionality with, when needed, default and admitted values.

10.2 Internal parameters

10.2.1 Object

For each customer two different contracts can be defined, e.g. a contract for imported energy and another one for exported energy (see 10.11 for details on types of contract). These contracts are managed by the same meter.

Virtual registers are defined in runtime in order to provide additional data computed on the base of original/pre-defined registers. In the following table all the virtual registers of the meter are managed using Flag fields.

Table 112 – Internal parameters

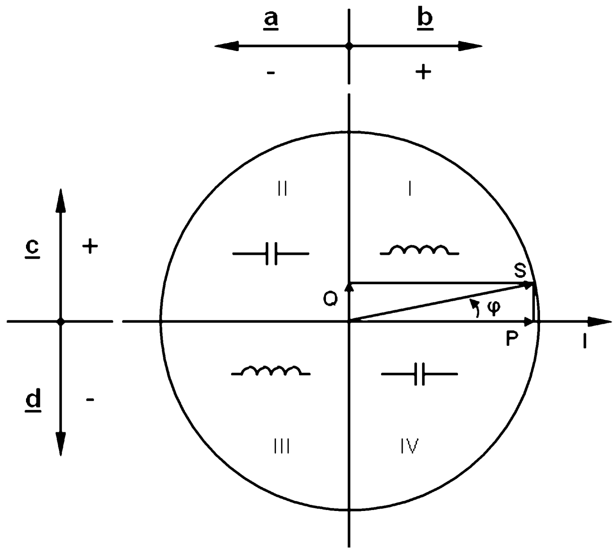
Register	Len	Range	MU	ID	WrRe	Description
TarAt_C1	1	0x00 – 0xFF	NA	0x0002	RO	Active tariff in actual moment for contract #1.
TarAt_C2	1	0x00 – 0xFF	NA	0x003C	RO	Active tariff in actual moment for contract #2.
Def_Tariff_C1	1	0x00 – 0x06	NA	0x0028	RW	It defines the default tariff for contract #1.
Def_Tariff_C2	1	0x00 – 0x06	NA	0x003D	RW	It defines the default tariff for contract #2.
V_A_Flag	1	0x00 – 0x03	NA	0x002F	RW	Register to control the content of the virtual active energy registers. See coding values in Table 113. Default value: 0x03.
V_R_Flag	1	0x00 – 0x0F	NA	0x0030	RW	Register to control the content of the virtual reactive energy registers. See coding values in Table 113. Default value: 0x0F.
V_W_Flag	1	0x00 – 0x03	NA	0x0031	RW	Register to control the content of the virtual active power registers. See coding values in Table 113. Default value: 0x03.
V_Q_Flag	1	0x00 – 0x0F	NA	0x0032	RW	Register to control the content of the virtual reactive power registers. See coding values in Table 113. Default value 0x0F.
Quad_Displ	1	0x00 – 0x01	NA	0x0033	RW	Register to control quadrant icons on the display. 0x00 = quadrant icons not active.
SW_READR	8	NA	NA	0x003F	RO	This register indicates changes in Normal and Extended Status Word. Status words contain 32 flags organized in 4 groups. Each byte of the register is associated to one group and each bit is associated to one flag (1 = active flag, 0 = not active flag). When a flag changes its status, the corresponding bit and the decimal value of the associated byte change too. See working example in 10.2.2.
NOAL_FLAG	1	NA	NA	0x0040	RO	This register indicates that the following alarms are not active: INTA, CAPE, BAT_LOW, SGR. 0x0001 = alarms are not active. NOTE If the system can't read this register, the meter will send a NACK response message.

Energy and power registers are named in according with IEC 62053-23 (see Figure 58 below).

Table 113 – Coding of virtual registers' flags

Virtual register	Flag	Control bits	Content of the virtual register
Active energy VA(t)	V_A_Flag	x x x x x x 0 1	|A+|
		x x x x x x 1 0	|A-|
		x x x x x x 1 1	|A+| + |A-|
Reactive energy VR(t)	V_R_Flag	x x x x 0 0 0 1	$\|R+_L\|$
		x x x x 0 0 1 0	$\|R+_C\|$
		x x x x 0 1 0 0	$\|R-_L\|$
		x x x x 1 0 0 0	$\|R-_C\|$
		x x x x 0 0 1 1	$\|R+_L\| + \|R+_C\|$
		x x x x 0 1 0 1	$\|R+_L\| + \|R-_L\|$
		x x x x 1 0 0 1	$\|R+_L\| + \|R-_C\|$
		x x x x 1 1 0 0	$\|R-_L\| + \|R-_C\|$
		x x x x 1 0 1 0	$\|R+_C\| + \|R-_C\|$
		x x x x 0 1 1 0	$\|R+_C\| + \|R-_L\|$
		x x x x 0 1 1 1	$\|R+_L\| + \|R+_C\| + \|R-_L\|$
		x x x x 1 0 1 1	$\|R+_L\| + \|R+_C\| + \|R-_C\|$
		x x x x 1 1 0 1	$\|R+_L\| + \|R-_L\| + \|R-_C\|$
		x x x x 1 1 1 0	$\|R+_C\| + \|R-_L\| + \|R-_C\|$
		x x x x 1 1 1 1	$\|R+_L\| + \|R+_C\| + \|R-_L\| + \|R-_C\|$
Active power V_W(t)	V_W_Flag	x x x x x x 0 1	|W+|
		x x x x x x 1 0	|W-|
		x x x x x x 1 1	|W+| + |W-|
Reactive power V_Q(t)	V_Q_Flag	x x x x 0 0 0 1	$\|Q+_L\|$
		x x x x 0 0 1 0	$\|Q+_C\|$
		x x x x 0 1 0 0	$\|Q-_L\|$
		x x x x 1 0 0 0	$\|Q-_C\|$
		x x x x 0 0 1 1	$\|Q+_L\| + \|Q+_C\|$
		x x x x 0 1 0 1	$\|Q+_L\| + \|Q-_L\|$
		x x x x 1 0 0 1	$\|Q+_L\| + \|Q-_C\|$
		x x x x 1 1 0 0	$\|Q-_L\| + \|Q-_C\|$
		x x x x 1 0 1 0	$\|Q+_C\| + \|Q-_C\|$
		x x x x 0 1 1 0	$\|Q+_C\| + \|Q-_L\|$
		x x x x 0 1 1 1	$\|Q+_L\| + \|Q+_C\| + \|Q-_L\|$
		x x x x 1 0 1 1	$\|Q+_L\| + \|Q+_C\| + \|Q-_C\|$
		x x x x 1 1 0 1	$\|Q+_L\| + \|Q-_L\| + \|Q-_C\|$
		x x x x 1 1 1 0	$\|Q+_C\| + \|Q-_L\| + \|Q-_C\|$
		x x x x 1 1 1 1	$\|Q+_L\| + \|Q+_C\| + \|Q-_L\| + \|Q-_C\|$

NOTE Virtual registers VA(t) and VR(t) are stored in the table "Total energy registers" (see 11.3). Virtual registers V_W(t) and V_Q(t) are stored in the tables "Measurand register" (see 15.3).



a: Export active power
b: Import active power
c: Import reactive power
d: Export reactive power

Figure 58 – Geometric representation of active and reactive power

10.2.2 SW_READR working example

In Table 114 the value of SW_READR register is showed at instant t_0 when flag 1, flag 3 and flag 4 are active.

Table 114 – Working example of register SW_READR at instant t_0

Normal Status Word											Extended Status Word			
Group 1								Group 2	Group 3	Group 4	G 1	G 2	G 3	G 4
Flag 1	Flag 2	Flag 3	Flag 4	Flag 5	Flag 6	Flag 7	Flag 8	…	…	…	…			
1	0	1	1	0	0	0	0	…	…	…	…			
SW_READR (8 bytes) = 176 X X X X X X X														

At instant $t_0+\Delta t$ only flag 1 is active; the new value of SW_READR register is showed in Table 115.

Table 115 – Working example of register SW_READR at instant $t_0+\Delta t$

Normal Status Word											Extended Status Word			
Group 1								Group 2	Group 3	Group 4	G 1	G 2	G 3	G 4
Flag 1	Flag 2	Flag 3	Flag 4	Flag 5	Flag 6	Flag 7	Flag 8	…	…	…	…			
1	0	0	0	0	0	0	0	…	…	…	…			
SW_READR (8 bytes) = 128 X X X X X X X														

10.3 Total energies

The registers of the following table contain values of active and reactive energies measured by the meter from the first day it started to work till the actual moment. The first two registers are virtual and are controlled by the virtual registers' flags defined in Table 112.

Table 116 – Total energy registers

Register	Len	Range	MU	ID	WrRe	Description
VA(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x0101	RO	Virtual register containing total values of active energy computed by the meter from the starting day until the current moment. The content of this register depends on the value of the flag V_A_Flag of Table 112.

Table 116 – Total energy registers (continued)

Register	Len	Range	MU	ID	WrRe	Description
VR(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x0102	RO	Virtual register containing total values of reactive energy computed by the meter from the starting day until the current moment. The content of this register depends on the value of the flag V_R_Flag of Table 112.
A+(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x0150	RO	Total values of positive active energy computed by the meter from the start day until the current moment.
A-(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x015A	RO	Total values of negative active energy computed by the meter from the start day until the current moment.
$R+_L(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x0164	RO	Total values of positive reactive inductive energy computed by the meter from the start day until the current moment.
$R-_L(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x016E	RO	Total values of negative reactive inductive energy computed by the meter from the start day until the current moment.
$R+_C(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x0178	RO	Total values of positive reactive capacitive energy computed by the meter from the start day until the current moment.
$R-_C(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x0182	RO	Total values of negative reactive capacitive energy computed by the meter from the start day until the current moment.

10.4 Daily energies

The registers of the following table contain values of active and reactive energies measured by the meter in the current day and in the previous day.

Table 117 – Daily energy registers

Register	Len	Range	MU	ID	WrRe	Description
$e_{T+}(t-g)$	4	0x0…0 – 0x3B9AC9FF	Wh	0x0405	RO	Total value of positive active energy computed by meter on the current day, starting from 00:00 to current moment.
$r_{T+}(t-g)$	4	0x0…0 – 0x3B9AC9FF	varh	0x0406	RO	Total value of $\|R+_L\|+\|R-_C\|$ reactive energy computed by meter on the current day, starting from 00:00 to current moment.
$e_{T+}(g-gp)$	4	0x0…0 – 0x3B9AC9FF	Wh	0x0407	RO	Total value of positive active energy computed by meter on the previous day, starting from 00:00 to 23:59.
$r_{T+}(g-gp)$	4	0x0…0 – 0x3B9AC9FF	varh	0x0408	RO	Total value of $\|R+_L\|+\|R-_C\|$ reactive energy computed by meter on the previous day, starting from 00:00 to 23:59.

Table 117 – Daily energy registers (continued)

Register	Len	Range	MU	ID	WrRe	Description
e_{T-}(t-g)	4	0x0…0 – 0x3B9AC9FF	Wh	0x0409	RO	Total value of negative active energy computed by meter on the current day, starting from 00:00 to current moment.
r_{T-}(t-g)	4	0x0…0 – 0x3B9AC9FF	varh	0x040A	RO	Total value of $\|R+_C\|+\|R-_L\|$ reactive energy computed by meter on the current day, starting from 00:00 to current moment.
e_{T-}(g-gp)	4	0x0…0 – 0x3B9AC9FF	Wh	0x040B	RO	Total value of negative active energy computed by meter on the previous day, starting from 00:00 to 23:59.
r_{T-}(g-gp)	4	0x0…0 – 0x3B9AC9FF	varh	0x040C	RO	Total value of $\|R+_C\|+\|R-_L\|$ reactive energy computed by meter on the previous day, starting from 00:00 to 23:59.

Legend

– t: current moment;

– g: current day;

– gp: previous day.

10.5 Load profiles and setting parameters

10.5.1 Object

In the following tables six load profiles and their setting parameters are defined for these quantities:

– Active energy A+ (registers V_W(T) in Table 118);

– Reactive energy $R+_L$ (registers V_Qa(T) in Table 118);

– Negative active energy A- (registers W-(T) in Table 119);

– Negative inductive reactive energy R-L (registers Q-La(T) in Table 119);

– Positive capacitive reactive energy $R+_C$ (registers $Q+_C a(T)$ in Table 122.

– Negative capacitive reactive energy $R-_C$ (registers $Q-_C a(T)$ in Table 122.

Each load profile is composed by up to 3660 samples of 2 bytes. Each sample represents an average value measured in the period T_{LP} defined in Table 118. Only valid samples are used to compose the load profile. An invalid sample occurs when a clock synchronization is made within a period T_{LP}. Starting from the reference time of the youngest sample (stored in the sub field TimeEnd in the register Prof_Buff in Table 118) and using the time information contained in register T_{LP}, the time instants of all the previous samples can be achieved.

Further three load profiles are available in Table 167 “Measurand profiles and parameters” (see 10.25).

Table 118 – Load profile for "A+" and "R+$_L$" and setting parameters

Register	Len	Range	MU	ID	WrRe	Description	
V_W$_i$(T) (i=1,…,122)	30*2	0x0000 – 0x7FFF (each sample)	Wh	From 0x0504 To 0x057D	RO	Virtual register that contains the value measured in period T (1' ≤ T ≤ 60') of active energy A+. Each sample's size is 2 Bytes. Up to 30 samples are stored in each register. Up to 122 registers are used to store a maximum of 3660 samples.	
V_Qa$_i$(T) (i=1,…,122)	30*2	0x0000 – 0x7FFF (each sample)	varh	From 0x057E To 0x05F7	RO	Virtual register that contains the value measured in period T (1' ≤ T ≤ 60') of reactive energy R+$_L$. Each sample's size is 2 Bytes. Up to 30 samples are stored in each register. Up to 122 registers are used to store a maximum of 3660 samples.	
Prof_Buff	1	0x00 – 0x17	NA	0x0503	RO	hh: hour	TimeEnd: time and date at which the buffer ends for the current profile.
	1	0x00 – 0x3B	NA			mm: minute	
	1	0x01 – 0x1F	NA			DD: day	
	1	0x01 – 0x0C	NA			MM: month	
	1	0x00 – 0x63	NA			YY: year	
	2	0x0000 – 0xFFFF	NA			Index: index to the next sample to be stored.	
	2	0x0000 – 0xFFFF	NA			NumVal: number of valid samples.	
T$_{LP}$	1	0x01 – 0x3C	NA	0x05F8	RW	Time period, in minutes, between two consecutive samples. Admitted values: 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x0A, 0x0C, 0x0F, 0x14, 0x1E, 0x3C. Default value: 0x0F.	
SS_VW	4	0x0…0 – 0x3B9AC9FF	Wh	0x05F9	RO	Snapshot of the specific virtual active energy register V_W taken at the beginning of the youngest sample's period of the load profile.	
SS_VQ	4	0x0…0 – 0x3B9AC9FF	varh	0x05FA	RO	Snapshot of the specific virtual reactive energy register V_Qa taken at the beginning of the youngest sample's period of the load profile.	
Prof_Buff_POSIX	4	0x0…0 – 7FFFFFFF	s	0x05FB	RO	TimeEnd: time and date at which the buffer ends for the current profile in POSIX notation (Epoch time: 1st January 1970) with reference to local time.	
	2	0x0000 – 0xFFFF	NA			Index: index to the next sample to be stored.	
	2	0x0000 – 0xFFFF	NA			NumVal: number of valid samples.	

Table 119 – Load profile for “A-” and “R-$_L$”

Register	Len	Range	MU	ID	WrRe	Description
W-$_i$(T) (i=1,…,122)	30*2	0x0000 – 0x7FFF	Wh	From 0x1201 To 0x127A	RO	Value measured in period T (1’ ≤ T ≤ 60’) of negative active energy A-. Each sample's size is 2 Bytes. Up to 30 samples are stored in each register. Up to 122 registers are used to store a maximum of 3660 samples.
Q-$_L$a$_i$(T) (i=1,…,122)	30*2	0x0000 – 0x7FFF	varh	From 0x127B To 0x12F4	RO	Value measured in period T (1’ ≤ T ≤ 60’) of negative inductive reactive energy R-$_L$. Each sample's size is 2 Bytes. Up to 30 samples are stored in each register. Up to 122 registers are used to store a maximum of 3660 samples.
SS_W-	4	0x0…0 – 0x3B9AC9FF	Wh	0x12F5	RO	Snapshot of the specific negative active energy register W- taken at the beginning of the youngest sample’s period of the load profile.
SS_Q-$_L$	4	0x0…0 – 0x3B9AC9FF	varh	0x12F6	RO	Snapshot of the specific negative inductive reactive energy register Q-$_L$a taken at the beginning of the youngest sample’s period of the load profile.

Table 120 – Load profile for “R+$_C$” and “R-$_C$”

Register	Len	Range	MU	ID	WrRe	Description
Q+$_C$a$_i$(T) (i=1,…,122)	30*2	0x0000 – 0x7FFF	Wh	From 0x1D01 To 0x1D7A	RO	Value measured in period T (1’ ≤ T ≤ 60’) of positive capacitive reactive energy R+$_C$. Each sample's size is 2 Bytes. Up to 30 samples are stored in each register. Up to 122 registers are used to store a maximum of 3660 samples.
Q-$_C$a$_i$(T) (i=1,…,122)	30*2	0x0000 – 0x7FFF	varh	From 0x1D7B To 0x1DF4	RO	Value measured in period T (1’ ≤ T ≤ 60’) of negative capacitive reactive energy R-$_C$. Each sample's size is 2 Bytes. Up to 30 samples are stored in each register. Up to 122 registers are used to store a maximum of 3660 samples.
SS_Q+C	4	0x0…0 – 0x3B9AC9FF	Wh	0x1DF5	RO	Snapshot of the specific positive capacitive reactive energy register Q+Ca taken at the beginning of the youngest sample’s period of the load profile.
SS_Q-$_C$	4	0x0…0 – 0x3B9AC9FF	varh	0x1DF6	RO	Snapshot of the specific negative capacitive reactive energy register Q-$_C$a taken at the beginning of the youngest sample’s period of the load profile.

10.6 Communication address and keys of authentication

The following table contains the addresses of the node (ACA and SCA addresses, see structures in Table 122 and Table 123 below), the authentication keys for reading and writing operations, and parameters that are used for network management.

Table 121 – Communication address and keys of authentication

Register	Len	Range	MU	ID	WrRe	Description
ACA[1]	1	NA	NA	0x0601	RO	Apparatus Type. Most significant bit has to be fixed to 1.
	1	NA	NA			Manufacturer.
	1	NA	NA			Manufacturing Year.
	3	NA	NA			Meter serial number.
A-Node SCA[2]	1	NA	NA	0x0602	RW	Length of the Concentrator section sub field (see Table 123). Default value: 0x03.
	5	NA	NA	0x0603		A-Node address.
B-Node SCA[2]	1	NA	NA	0x0604		Length of the Concentrator section sub field (see Table 123). Default value: 0x03.
	5	NA	NA	0x0605		B-Node address.
K1	16	NA	NA	0x0625	-	Key for authentication of write data communication sessions.

[1] Programmable by manufacturer

[2] Programmable by Concentrator

Table 121 – Communication address and keys of authentication (continued)

Register	Len	Range	MU	ID	WrRe	Description
K2	16	NA	NA	0x0626	-	Key for authentication of read data communication sessions.
Δ KEY 1	16	NA	NA	0x0627	WO*	Δ Key for KEY 1. Δ value for modified KEY 1 (it forms a modified KEY 1).
Δ KEY 2	16	NA	NA	0x0628	WO*	Δ Key for KEY 2. Δ value for modified KEY 2 (it forms a modified KEY 2).
ADKp	1	0x00 – 0x01	NA	0x0615	RW	ENABLE or DISABLE to use the Provisional Key (Kp). 0x00 = Enable 0x01 = Disable Kp is the provisional Key used to open write/read data communication sessions. When the use of Kp is enabled the operator is allowed to open a write/read data communication session only by means this key, otherwise the use of K1 and/or K2 is required.
OPA_ACT	1	0x00 – 0x01	NA	0x0617	RW	It defines the status of activation of the OPA function. 0x00 = Disabled 0x01 = Enabled
CREAD_EN	1	0x00 – 0x01	NA	0x061A	RW*	It defines the status of activation of the register read access without protection. 0x00 = The read access without protection is disabled 0x01 = The read access without protection is enabled
CWRITE_EN	1	0x00 – 0x01	NA	0x061B	RW*	It defines the status of activation of the register write access without protection. 0x00 = The write access without protection is disabled 0x01 = The write access without protection is enabled
AV_SIG	1	0x00 – 0xFF	NA	0x061C	RO	It indicates the level of the signal received from the Concentrator.
AV_SNR	1	0x00 – 0xFF	NA	0x061D	RO	It indicates the noise level measured in the communication media.
AV_TX	1	0x00 – 0xFF	NA	0x061E	RO	It indicates the impedance level measured in the communication media.
Field_1	1	NA	NA	0x061F	RO	Reserved for future use.
Field_2	1	NA	NA	0x0620	RO	Reserved for future use.
Field_3	1	NA	NA	0x0621	RO	Reserved for future use.

Table 121 – Communication address and keys of authentication (continued)

Register	Len	Range	MU	ID	WrRe	Description
TCT	1	0x01 – 0xFF	NA	0x0622	RW*	It indicates the level of silencing of the meter. This value indicates if the meter is enabled to respond network management messages (see details in 4.11.3 in CLC/TS 50568-4:2015). This register shall not accept a value of 0x00.
P_LCK_SCA	2	0x0000 – 0xFFFF	NA	0x0623	RW*	It indicates the period of time, in minutes, with no unicast messages received from the Concentrator after which the meter has to reset the “Concentrator section” sub field of SCA: all bytes to 0x0000 (see Table 123).
P_LCK_TCT	2	0x0000 – 0xFFFF	NA	0x0624	RW*	It indicates the period of time, in minutes, with no unicast messages received from the Concentrator after which the meter has to reset the TCT to 0xFF.

Table 122 – ACA (Absolute Communication Address) structure

LSB

Meter Serial Number			Year	Manufacturer	Apparatus Type
			Fixed bit: 0	Fixed bit: 0	Fixed bits: 0 0 .. ..
LSb	LSb	LSb	LSb	LSb	LSb
First trans. bit	First trans. bit	First trans. bit	First trans. bit	First trans. bit	First trans. bit
First transmitted byte	2nd byte	3rd byte	4th byte	5th byte	Last transmitted byte

Table 123 – SCA (Section Communication Address) structure

LSB

Node address					Concentrator section length
Concentrator section			Node subsection	Node progressive	
			Values: from 0 to 255	Values: from 0 to 255	Fixed bits: 1 1 .. ..
LSb	LSb	LSb	LSb	LSb	LSb
First trans. bit	First trans. bit	First trans. bit	First trans. bit	First trans. bit	First trans. bit
First transmitted byte	2nd byte	3rd byte	4th byte	5th byte	Last transmitted byte

NOTE If a broadcast communication is requested to run on a given subsection, it is possible to do it by properly setting the bits of the “Node subsection” sub field and by setting = 1 all the bits of the “Node progressive” sub field.

10.7 Meter identification information

The following table contains information about working parameters, version and manufacturer of the meter.

Table 124 – Meter identification parameters

Register	Len	Range	MU	ID	WrRe	Description
ADD_INFO	1	NA	NA	0x0803	RO	Nameplate voltage (V). Default value: 0x20.
	1					Characteristics of the current. This 1 byte sub field may be used to indicate the current values of the meter (minimum, maximum, nominal, etc.). Default value: 0x20.
	2					Meter constant for both active and reactive energy (pulses/kWh). Default value: 0x2020.
	2					Year of manufacture. Default value: 0x2020.
NPRA	9	NA	NA	0x0804	RO	Serial number (same value as sub field “Meter serial number” in ACA register, see 10.6) in ASCII coding. Default value: 0x202020202020202020.
PROD_MOD	1	NA	NA	0x0805	RO	Manufacturer. Default value: 0x20.
	2					Model identification code. Default value: 0x2020.
MSN	17	NA	NA	0x0806	RO	Manufacturing identification code (available to the Manufacturer).
NOTE PROD_MOD and NPRA registers represent the unique identification code of the meter						

10.8 Temporal information

10.8.1 Object

Two types of clock can be provided inside the meter: a hardware counter (HW RTC) and a backup software clock (SW RTC). The backup software clock can be implemented in order to provide time/date information (with the same accuracy as the hardware counter) when the main hardware counter is damaged or failed. The backup software clock will not provide time keeping functionalities during power off periods.

A flag register (SWRTC) can be implemented in order to be able to manually switch from SW RTC mode to HW RTC mode. Such flag will also control the automatic switching from HW RTC to SW RTC mode when a hardware failure occurs.

It is also implemented a register which represents the daylight saving time status (DSTADJ). If bit0 of DSTADJ register is 1, it means that the meter is running in DST, otherwise it is working in solar time. The start date and the final date of DST period are indicated in the DIOL and DFOL registers, which are coded in accordance with the Table 126. If the parameters for daylight saving time are not programmed, the meter shall manage the DST according with current European standards (start date = March, last sunday; end date = October, last sunday).

Table 125 – Temporal parameters

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td rowspan="3">DATE</td><td>1</td><td>0x01 – 0x1F</td><td rowspan="3">NA</td><td rowspan="3">0x0A01</td><td rowspan="3">RO</td><td colspan="2">DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td colspan="2">MM: month</td></tr>
<tr><td>1</td><td>0x00 – 0x63</td><td colspan="2">YY: year</td></tr>
<tr><td rowspan="3">TIME</td><td>1</td><td>0x00 – 0x17</td><td rowspan="3">NA</td><td rowspan="3">0x0A02</td><td rowspan="3">RO</td><td colspan="2">hh: hour</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td colspan="2">mm: minute</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td colspan="2">ss: second</td></tr>
<tr><td>SCOR(t-p)</td><td>2</td><td>0x0000 – 0xFFFF</td><td>s</td><td>0x0A03</td><td>RO</td><td colspan="2">Shift performed in the current period.
The register has to be updated each time the meter performs a time compensation. If it performs a time adjustment more than ADJ_ST s, it has to update the SCOR(t-p) register with the value of each partial compensations.
See 10.4.</td></tr>
<tr><td>SCOR(p-a)</td><td>2</td><td>0x0000 – 0xFFFF</td><td>s</td><td>0x0A04</td><td>RO</td><td colspan="2">Shift performed in the previous period.</td></tr>
<tr><td rowspan="2">DIOL</td><td>1</td><td>0x00 – 0x20</td><td rowspan="2">NA</td><td rowspan="2">0x0A05</td><td rowspan="2">RW</td><td>DD: day</td><td rowspan="2">Start date daylight saving time.
Default value: 0x00 0x00.</td></tr>
<tr><td>1</td><td>0x00 – 0x0D</td><td>MM: month</td></tr>
<tr><td rowspan="2">DFOL</td><td>1</td><td>0x00 – 0x20</td><td rowspan="2">NA</td><td rowspan="2">0x0A06</td><td rowspan="2">RW</td><td>DD: day</td><td rowspan="2">Final date daylight saving time.
Default value: 0x00 0x00.</td></tr>
<tr><td>1</td><td>0x00 – 0x0D</td><td>MM: month</td></tr>
<tr><td rowspan="2">LST</td><td>1</td><td>0x00 – 0x17</td><td rowspan="2">NA</td><td rowspan="2">0x0A07</td><td rowspan="2">RW</td><td>hh: hour</td><td rowspan="2">DST start time, specified in local time.
Default value: 0x02 0x00.</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td>mm: minute</td></tr>
<tr><td rowspan="2">LET</td><td>1</td><td>0x00 – 0x17</td><td rowspan="2">NA</td><td rowspan="2">0x0A08</td><td rowspan="2">RW</td><td>hh: hour</td><td rowspan="2">DST end time, specified in local time.
Default value: 0x03 0x00.</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td>mm: minute</td></tr>
<tr><td>DSMIN</td><td>1</td><td>0x00 – 0xF0</td><td>NA</td><td>0x0A09</td><td>RW</td><td colspan="2">DST correction value in minutes.
Default value: 0x3C.</td></tr>
<tr><td>DSTADJ</td><td>1</td><td>0x00 – 0x01</td><td>NA</td><td>0x0A0A</td><td>RO</td><td colspan="2">DST correction has been performed.
0x01 = Correction to be performed.</td></tr>
</table>

Table 125 – Temporal parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description	
IORL	1	0x00 – 0x17	NA	0x0A0B	RO	hh: hour	Time and date of synchronization.
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
	1	0x01 – 0x1F				DD: day	
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
Tmaxdrift	1	0x00 – 0xFF	s	0x0A0C	RW	Maximum drift time admitted for synchronisation.	
Daydrift	1	0x00 – 0xFF	s	0x0A0D	RW	Maximum day drift admitted for synchronisation	
SWRTC	1	NA	NA	0x0A0E	RW	Bit0 = 1: enables SW RTC. Bit0 = 0: disables SW RTC. Bit2 = 1: disables automatic switching to SW RTC (when the meter has lost any time reference). Bit2 = 0: enables automatic switching to SW RTC (when the meter has lost any time reference).	
SW_ACC_CAL	1	0x00 – 0x64	NA	0x0A0F	RW	A value in percent for the rate at which the automatic calibration will be applied. E.g.: if set to 100 (100%) the meter will attempt to fully correct the calibration value. If a value of 50 (50%) is used then the calibration value will be modified to half the error.	
SW_CALWORD	2	0x0000 – 0xFFFF	NA	0x0A10	RW	This value is the current calibration value of SWRTC.	
CLK	2	0x0000 – 0x0BB8	NA	0x0A20	WO	YY: year	Clock synchronization data to update current time and date.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x1F				DD: day	
	1	0x00 – 0x17				hh: hour	
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
	1	0x00 – 0x01				DST information. 0x00 = No DST 0x01 = DST	

Table 125 – Temporal parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description
ADJ_ST	1	0x01 – 0x3C	s	0x0A21	RW	It defines the number of seconds to be adjusted for each minute during a step-by-step synchronization.
IORL_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0A22	RO	Time and date of synchronization in POSIX notation with reference to local time.
CLK_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0A23	RW	Clock synchronization date, to update current time and date, in POSIX notation with reference to local time.
	1	0x00 – 0x01	NA			DST information. 0x00 = No DST 0x01 = DST

Legend

– t: current moment;

– p: end moment of previous billing period;

– a: end moment of the last but one billing period.

Table 126 – DIOL and DFOL values coding table

DIOL		DFOL		Description
Start day	Start month	Final day	Final month	
DD	MM	DD	MM	It doesn't use European standards programming dates (0x01 ≤ MM ≤ 0x0C).
0x00	MM	0x00	MM	Start day = Last sunday of MM month (0x01 ≤ MM ≤ 0x0C). Final day = Last sunday of MM month (0x01 ≤ MM ≤ 0x0C).
DD	0x00	DD	0x00	Start month = March. End month = October.
0x00	0x00	0x00	0x00	Start date = March, last sunday. End date = October, last sunday.
0x1F	0x00	0x1F	0x0D	It doesn't execute DST.
DD	MM	DD	0x0D	It activates DST at start date. As the activation as taken place, final day is set to 0x20 (32) and the meter does not come back to solar time (final day ≠ 31 conditions have to be fulfilled, as well).

10.9 Billing period information

Temporal references of the current, the last, the second last and the third last billing periods for contract #1 and contract #2 are provided in the following table.

Table 127 – Billing period identification parameters for contract #1

Register	Len	Range	MU	ID	WrRe	Description	
C1_DIPF	1	0x01 – 0x1F	NA	0x0B01	RW	DD: day	Initial date. Default value: 0x02 0x01.
	1	0x01 – 0x0C				MM: month	
C1_PPDF	1	0x01 – 0x0C	month	0x0B02	RW	Number of months of the periodicity. Admitted values are: 0x01, 0x02, 0x03, 0x04, 0x06, 0x0C. Default value: 0x02.	
C1_DATE_F	1	0x00 – 0x17	NA	0x0B03	RO	hh: hour	End time and date of the last billing period.
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
	1	0x01 – 0x1F				DD: day	
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
C1_DATE_F(a)_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0B04	RO	End date of the second last billing period in POSIX notation with reference to local time.	
C1_DATE_F(b)_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x0B05	RO	End date of the third last billing period in POSIX notation with reference to local time.	
C1_DT_CLOSE_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x0B06	RW	Time/Date at which the meter has to close the billing period in POSIX notation with reference to local time.	
C1 DATE_F_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0B07	RO	End date of the last billing period in POSIX notation with reference to local time.	
C1_BP_VALID	1	NA	NA	0x0B08	RO	It indicates if a billing period data set results valid due to a closure of a contract or to an activation of a new contract. The first bit starting from LSb is related to the previous billing period. The second bit starting from LSb is related to the second last billing period. The third bit starting from LSb is related to the third last billing period. Bit = 0: the billing period data set is valid. Bit = 1: the billing period data set is invalid.	

Table 128 – Billing period identification parameters for contract #2

Register	Len	Range	MU	ID	WrRe	Description	
C2_DIPF	1	0x01 – 0x1F	NA	0x0B11	RW	DD: day	Initial date. Default value: 0x02 0x01.
	1	0x01 – 0x0C				MM: month	
C2_PPDF	1	0x01 – 0x0C	NA	0x0B12	RW	Number of months of the periodicity. Admitted values are: 0x01, 0x02, 0x03, 0x04, 0x06, 0x0C. Default value: 0x02.	
C2_DATE_F_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x0B13	RO	End date of the last billing period in POSIX notation with reference to local time.	
C2_DATE_F(a)_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x0B14	RO	End date of the second last billing period in POSIX notation with reference to local time.	
C2_DATE_F(b)_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x0B15	RO	End date of the third last billing period in POSIX notation with reference to local time.	
C2_DT_CLOSE_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x0B16	RW	Time/Date at which the meter has to close the billing period in POSIX notation with reference to local time.	
C2_BP_VALID	1	NA	NA	0x0B18	RO	It indicates if a billing period data set results valid due to a closure of a contract or to an activation of a new contract. The first bit starting from LSb is related to the previous billing period. The second bit starting from LSb is related to the second last billing period. The third bit starting from LSb is related to the third last billing period. Bit = 0: the billing period data set is valid. Bit = 1: the billing period data set is invalid.	

10.10 Software, Hardware and Security information

The following table contains information about the hardware and the software used in the meter, like the version, the date/time of the last update and the number of updates. The structure of this table takes into account the organization of the storage dedicated for the meter’s software. The storage is divided in four parts: the first one contains the not downloadable portion of the software. The second and the third parts contain the downloadable portion of the software. The fourth part contains the new downloaded portion of the software that will be overwritten on the second or the third part of the storage. This organization is not mandatory. It represents one of the possible solution that should be implemented. Further information about how the software is stored in the meter are described in the table “Download parameters” in 10.24.1.

Information about security, like phase shift on the communication line, the behaviour of the cut-off device and digital signatures, are also contained in the following table.

Table 129 – Software, Hardware and Security parameters

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td>FI(k)</td><td>1</td><td>0x01 – 0x06</td><td>NA</td><td>0x0C01</td><td>RO</td><td colspan="2">Phase shift on the communication line between the Concentrator and the meter. This register may be used by a phase detection algorithm implemented by the manufacturer.</td></tr>
<tr><td>MTP</td><td>12</td><td>NA</td><td>NA</td><td>0x0C0A</td><td>RO</td><td colspan="2">Digital signature of the downloadable portion of the software currently running in APP1 FLASH area (12 ASCII alphanumeric characters).</td></tr>
<tr><td>NDWL</td><td>1</td><td>0x00 – 0xFF</td><td>NA</td><td>0x0C03</td><td>RO</td><td colspan="2">Number of software updates executed by meter. It has to rollover when maximum value has been reached.</td></tr>
<tr><td>VRHW</td><td>6</td><td>NA</td><td>NA</td><td>0x0C04</td><td>RO</td><td colspan="2">Hardware version (6 ASCII alphanumeric characters).</td></tr>
<tr><td rowspan="2">VRSW</td><td>1</td><td>0x00 – 0xFF</td><td rowspan="2">NA</td><td rowspan="2">0x0C05</td><td rowspan="2">RO</td><td colspan="2" rowspan="2">Software version of APP1 (2 ASCII alphanumeric characters).</td></tr>
<tr><td>1</td><td>0x00 – 0xFF</td></tr>
<tr><td rowspan="6">DTSW</td><td>1</td><td>0x00 – 0x17</td><td rowspan="6">NA</td><td rowspan="6">0x0C06</td><td rowspan="6">RO</td><td>hh: hour</td><td rowspan="6">Download last updating date (it has to be updated only after the SWOT date, see Table 165).</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td>mm: minute</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td>ss: second</td></tr>
<tr><td>1</td><td>0x01 – 0x1F</td><td>DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>MM: month</td></tr>
<tr><td>1</td><td>0x00 – 0x63</td><td>YY: year</td></tr>
<tr><td>TSEN</td><td>1</td><td>0x00 – 0xFF</td><td>NA</td><td>0x0C07</td><td>RW</td><td colspan="2">It defines the behaviour of the meter’s cut-off device in case of tampering detection. For example the cut-off device could be opened when a fraud attempt is detected by the meter.
The meter’s cut-off device behaviour depends on utility needs.
Admitted values: 0x00, 0x01, 0x40, 0x80, 0xFF.
See Table 130.</td></tr>
<tr><td rowspan="2">SWVRFixed</td><td>1</td><td>0x00 – 0xFF</td><td rowspan="2">NA</td><td rowspan="2">0x0C08</td><td rowspan="2">RO</td><td colspan="2" rowspan="2">Version of the not downloadable portion of the software (2 ASCII alphanumeric characters).</td></tr>
<tr><td>1</td><td>0x00 – 0xFF</td></tr>
<tr><td>FRAD_NDLSW</td><td>16</td><td>NA</td><td>NA</td><td>0x0C09</td><td>RO</td><td colspan="2">Digital signature of the not downloadable portion of the software (16 ASCII alphanumeric characters).</td></tr>
<tr><td>MTP_LOW</td><td>6</td><td>NA</td><td>NA</td><td>0x0C0B</td><td>RO</td><td colspan="2">It indicates the least significant 6 bytes of the MTP field.</td></tr>
<tr><td>MTP_HIGH</td><td>6</td><td>NA</td><td>NA</td><td>0x0C0C</td><td>RO</td><td colspan="2">It indicates the most significant 6 bytes of the MTP field.</td></tr>
</table>

Table 129 – Software, Hardware and Security parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description
DTSW_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0C0D	RO	Download last updating date/time in POSIX notation with reference to local time for APP1 FLASH area (it has to be updated only after the SWOT).
Total_SWVer	1	0x00 – 0xFF	NA	0x0C0E	RO	It indicates the total software version running into the meter. It is composed by the following fields: SWVRFixed + VRSW + VRSW2
	1	0x00 – 0xFF				
	1	0x00 – 0xFF				
	1	0x00 – 0xFF				
	1	0x00 – 0xFF				
	1	0x00 – 0xFF				
MTP2	12	NA	NA	0x0C0F	RO	Digital signature of the downloadable portion of the software currently running in APP2 FLASH area (12 ASCII alphanumeric characters).
MTP2_LOW	6	NA	NA	0x0C10	RO	It indicates the least significant 6 bytes of the MTP2 field.
MTP2_HIGH	6	NA	NA	0x0C11	RO	It indicates the most significant 6 bytes of the MTP2 field.
DTSW2_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0C12	RO	Download last updating date/time in POSIX notation with reference to local time for APP2 FLASH area (it has to be updated only after the SWOT).
VRSW2	1	0x00 – 0xFF	NA	0x0C13	RO	Software version of APP2 (2 ASCII alphanumeric characters).
	1	0x00 – 0xFF				
VRSW_MODEM	1	0x00 – 0xFF	NA	0x0C14	RO	Software version of the modem (2 ASCII alphanumeric characters).
	1	0x00 – 0xFF				
DTSW_MODEM_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0C15	RO	Download last updating date/time in POSIX notation with reference to local time for MODEM FLASH area (it has to be updated only after the SWOT).

Table 130 – TSEN coding table

<table>
<tr><th>TSEN value</th><th colspan="2">Cut-off device behaviour</th></tr>
<tr><td>0x00</td><td colspan="2">No tamper detection: NO CAPE (see Extended Status Word in 10.21) and NO OPEN BREAKER COMMAND in any case.</td></tr>
<tr><td rowspan="3">0x01</td><td rowspan="2">Case BATTERY DISCHARGED</td><td>At boot: if tamper is detected CAPE is raised (alarm to Central System to signal a possible tampering has been detected) while breaker is not opened (the user shall not be disconnected because battery could be failing).</td></tr>
<tr><td>At runtime: the tampering signal is accurate (because the tamper circuit is powered from the mains at least), so CAPE is raised and the breaker is opened (and SHALL STAY OPEN UNTIL CAPE is reset).</td></tr>
<tr><td>Case BATTERY NOT DISCHARGED</td><td>The tampering signal is accurate (because the tamper circuit has power from battery and the mains), so CAPE is raised and the breaker is opened (and SHALL STAY OPEN UNTIL CAPE is reset).</td></tr>
<tr><td>0x40</td><td colspan="2">Tamper detection (both at boot or runtime) always raise the CAPE bit and breaker always opened (and SHALL STAY OPEN UNTIL CAPE is reset).</td></tr>
<tr><td rowspan="3">0x80</td><td rowspan="2">Case BATTERY DISCHARGED</td><td>At boot: tamper is simply ignored (we don't want the Central System to receive an alarm for a known battery problem) neither the breaker is opened (the user shall not be disconnected because battery could be failing).</td></tr>
<tr><td>At runtime: the tampering signal is accurate (because the tamper circuit is powered from the mains at least), so CAPE is raised and the breaker is opened (and SHALL STAY OPEN UNTIL CAPE is reset).</td></tr>
<tr><td>Case BATTERY NOT DISCHARGED</td><td>The tampering signal is accurate (because the tamper circuit is powered from battery and the mains) so CAPE is raised and the breaker is opened (and SHALL STAY OPEN UNTIL CAPE is reset).</td></tr>
<tr><td>0xFF</td><td colspan="2">Tamper detection (both at boot or runtime) always raise the CAPE bit but the breaker is never opened.</td></tr>
</table>

10.11 Supply contract information

10.11.1 Object

The meter implements two different contracts that can be activated independently. A contract may be configured for the following purposes, indicated in the register TYPE_C:

– Disabled (TYPE_C = 0x00): the contract shall be disabled even if the current time is within start and end date of the contract. It means that the related billing data registers shall not be incremented and/or managed.

– Import only (TYPE_C = 0x01): the meter shall store measurements related only to import active energy into related registers and totalizers.

– Export only (TYPE_C = 0x02): the meter shall store measurements related only to export active energy into related registers and totalizers.

– Import and Export (TYPE_C = 0x03): the meter shall store measurements related to import and export active energy into import and export registers and totalizers respectively.

– Import always (TYPE_C = 0x04): import and export energy shall be considered as import only energy. The meter shall store measurements related to import and export active energy into import registers and totalizers.

Each contract is composed by two different parameter schemes: "Future Contract" and "In Force Contract".

The "Future Contract" scheme can be programmed by the operator in all its fields. It represents the contract scheme ready to be activated according with its validity and start date.

The "In Force Contract" scheme represents the contract that is currently active if all its fields are valid and the current date is prior to its end date. The parameters of this contract shall not be programmable, apart from "DISI" and "CF".

10.11.2 Supply contract information for contract #1

Table 131 – Supply contract identification parameters for contract #1 – In Force

Register	Len	Range	MU	ID	WrRe	Description	
C1_CI	1	0x01 – 0x1F	NA	0x0D11	RO	DD: day	Start date.
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
C1_CF	1	0x01 – 0x1F	NA	0x0D18	RW	DD: day	End date.
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
CCCN	16	NA	NA	0x0D12	RO	Customer information (16 ASCII alphanumeric characters).	
CODU	16	NA	NA	0x0D13	RO	User identification number (16 ASCII alphanumeric characters).	
TYPE_C	1	0x00 – 0x04	NA	0x0D1A	RO	Type of contract.	
DISI	1	0x00 – 0x81	NA	0x0D16	RW	Flag of disconnectivity. Admitted values: 0x00, 0x01, 0x80, 0x81.	
PLIM	2	0x0000 – 0xFFFF	W	0x0D17	RO	Power limit.	
C1_CI_POSIX	4	0x0...0 – 0x7FFFFFFF	s	0x0D1D	RO	Start date in POSIX notation with reference to local time.	
C1_CF_POSIX	4	0x0...0 – 0xFFFFFFFF	s	0x0D1E	RW	End date in POSIX notation with reference to local time.	

Table 132 – Supply contract identification parameters for contract #1 – Future

Register	Len	Range	MU	ID	WrRe	Description	
C1_CI	1	0x01 – 0x1F	NA	0x0D01	RW	DD: day	Start date.
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
C1_CF	1	0x01 – 0x1F	NA	0x0D08	RW	DD: day	End date.
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
CCCN	16	NA	NA	0x0D02	RW	Customer name (16 ASCII alphanumeric characters).	
CODU	16	NA	NA	0x0D03	RW	User identification number (16 ASCII alphanumeric characters).	
TYPE_C	1	0x00 – 0x04	NA	0x0D19	RW	Type of contract.	
DISI	1	0x00 – 0x81	NA	0x0D06	RW	Flag of disconnectivity. Admitted values: 0x00, 0x01, 0x80, 0x81.	
PLIM	2	0x0000 – 0xFFFF	W	0x0D07	RW	Power limit.	
C1_CI_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0D1B	RW	Start date in POSIX notation with reference to local time.	
C1_CF_POSIX	4	0x0…0 – 0xFFFFFFFF	s	0x0D1C	RW	End date in POSIX notation with reference to local time.	

10.11.3 Supply contract information for contract #2

Table 133 – Supply contract identification parameters for contract #2 – In Force

Register	Len	Range	MU	ID	WrRe	Description
C2_CI_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0D31	RO	Start date in POSIX notation with reference to local time.
C2_CF_POSIX	4	0x0…0 – 0xFFFFFFFF	s	0x0D38	RW	End date in POSIX notation with reference to local time.
CCCN	16	NA	NA	0x0D32	RO	Customer name (16 ASCII alphanumeric characters).
CODU	16	NA	NA	0x0D33	RO	User identification number (16 ASCII alphanumeric characters).
TYPE_C	1	0x00 – 0x04	NA	0x0D34	RO	Type of contract.
DISI	1	0x00 – 0x81	NA	0x0D36	RW	Flag of disconnectivity. Admitted values: 0x00, 0x01, 0x80, 0x81.
PLIM	2	0x0000 – 0xFFFF	W	0x0D37	RO	Power limit.

Table 134 – Supply contract identification parameters for contract #2 – Future

Register	Len	Range	MU	ID	WrRe	Description
C2_CI_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0D21	RW	Start date in POSIX notation with reference to local time.
C2_CF_POSIX	4	0x0…0 – 0xFFFFFFFF	s	0x0D28	RW	End date in POSIX notation with reference to local time.
CCCN	16	NA	NA	0x0D22	RW	Customer name (16 ASCII alphanumeric characters).
CODU	16	NA	NA	0x0D23	RW	User identification number (16 ASCII alphanumeric characters).
TYPE_C	1	0x00 – 0x04	NA	0x0D24	RW	Type of contract.
DISI	1	0x00 – 0x81	NA	0x0D26	RW	Flag of disconnectivity. Admitted values: 0x00, 0x01, 0x80, 0x81.
PLIM	2	0x0000 – 0xFFFF	W	0x0D27	RW	Power limit.

10.12 Weekly tariff information

10.12.1 Object

For each contract, the meter shall manage two sets of tariff structures. Each set contains three schemes (IPRE1, IPRE2, IPRE3: in the following table they are not registers but only three column identifiers, so they are not coded).

Each scheme represents a complete weekly tariff structure (7 days + 1 public holiday). Each day can be split in a maximum of 8 temporal bands which could have a duration equal to multiples of 15 minutes. Each temporal band can be programmed with any of the 6 available tariffs T_j (j=1,...,6).

The first set contains the three weekly tariff structures that are in force. The second set contains the three future weekly tariff structures that will come into effect in accordance with the activation date of the future annual tariff structure.

PTF is a 16 bytes register logically divided in 8 couples of 2 bytes. In each couple the first byte contains the number of quarters of hour that indicates the duration of the temporal intervals F_i, F_k, F_h, F_y (i, k, h, y = 1,...,8); the second byte indicates the associated tariff T_j.

10.12.2 Weekly tariff information for contract #1

Table 135 – Weekly tariff structure parameters for contract #1 – In Force

Register	Len		Range	MU	ID			WrRe	Description	
					IPRE1	IPRE2	IPRE3		Weekly tariff structure identifiers.	
PTF_1	8*	1	0x00 – 0x60	NA	0x0E02	0x0E12	0x0E22	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Monday profile. Default value (for F_1): 0x 60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_2	8*	1	0x00 – 0x60	NA	0x0E03	0x0E13	0x0E23	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Tuesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_3	8*	1	0x00 – 0x60	NA	0x0E04	0x0E14	0x0E24	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Wednesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	

Table 135 – Weekly tariff structure parameters for contract #1 – In Force (continued)

Register	Len		Range	MU	ID			WrRe	Description	
PTF_4	8*	1	0x00 – 0x60	NA	0x0E05	0x0E15	0x0E25	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Thursday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_5	8*	1	0x00 – 0x60	NA	0x0E06	0x0E16	0x0E26	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Friday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
SATPR	8*	1	0x00 – 0x60	NA	0x0E07	0x0E17	0x0E27	RO	Number of quarters of hour finding out the terms of band F_k starting from 00:00.	Saturday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_k time band.	
SUNPR	8*	1	0x00 – 0x60	NA	0x0E08	0x0E18	0x0E28	RO	Number of quarters of hour finding out the terms of band F_h starting from 00:00.	Sunday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_h time band.	
PUBHO	8*	1	0x00 – 0x60	NA	0x0E09	0x0E19	0x0E29	RO	Number of quarters of hour finding out the terms of band F_y starting from 00:00.	Public holidays. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_y time band.	
$PICT_1$	1		0x00 – 0xFFFF	W	0x0EA1	0x0EB1	0x0EC1	RO	$PICT_j$: power available in each tariff T_j. This is the subscribed demand of imported power.	
$PICT_2$	1		0x00 – 0xFFFF		0x0EA3	0x0EB3	0x0EC3			
$PICT_3$	1		0x00 – 0xFFFF		0x0EA5	0x0EB5	0x0EC5			
$PICT_4$	1		0x00 – 0xFFFF		0x0EA7	0x0EB7	0x0EC7			
$PICT_5$	1		0x00 – 0xFFFF		0x0EA9	0x0EB9	0x0EC9			
$PICT_6$	1		0x00 – 0xFFFF		0x0EAB	0x0EBB	0x0ECB			

Table 135 – Weekly tariff structure parameters for contract #1 – In Force (continued)

Register	Len	Range	MU	ID			WrRe	Description
$PDIT_1$	1	0x00 – 0xFFFF	W	0x0EA2	0x0EB2	0x0EC2	RO	$PDIT_j$: contractual power supplied in each tariff T_j. This is the maximum available demand of imported power. This value may be bigger than PICT one.
$PDIT_2$	1	0x00 – 0xFFFF		0x0EA4	0x0EB4	0x0EC4		
$PDIT_3$	1	0x00 – 0xFFFF		0x0EA6	0x0EB6	0x0EC6		
$PDIT_4$	1	0x00 – 0xFFFF		0x0EA8	0x0EB8	0x0EC8		
$PDIT_5$	1	0x00 – 0xFFFF		0x0EAA	0x0EBA	0x0ECA		
$PDIT_6$	1	0x00 – 0xFFFF		0x0EAC	0x0EBC	0x0ECC		

Table 136 – Weekly tariff structure parameters for contract #1 – Future

Register	Len		Range	MU	ID			WrRe	Description	
					IPRE1	**IPRE2**	**IPRE3**		Weekly tariff structure identifiers.	
PTF_1	8*	1	0x00 – 0x60	NA	0x0E32	0x0E42	0x0E52	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Monday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_2	8*	1	0x00 – 0x60	NA	0x0E33	0x0E43	0x0E53	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Tuesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_3	8*	1	0x00 – 0x60	NA	0x0E34	0x0E44	0x0E54	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Wednesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_4	8*	1	0x00 – 0x60	NA	0x0E35	0x0E45	0x0E55	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Thursday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	

Table 136 – Weekly tariff structure parameters for contract #1 – Future (continued)

Register	Len		Range	MU	ID			WrRe	Description	
PTF_5	8*	1	0x00 – 0x60	NA	0x0E36	0x0E46	0x0E56	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Friday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
SATPR	8*	1	0x00 – 0x60	NA	0x0E37	0x0E47	0x0E57	RW	Number of quarters of hour finding out the terms of band F_k starting from 00:00.	Saturday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_k time band.	
SUNPR	8*	1	0x00 – 0x60	NA	0x0E38	0x0E48	0x0E58	RW	Number of quarters of hour finding out the terms of band F_h starting from 00:00.	Sunday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_h time band.	
PUBHO	8*	1	0x00 – 0x60	NA	0x0E39	0x0E49	0x0E59	RW	Number of quarters of hour finding out the terms of band F_y starting from 00:00.	Public holidays. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_y time band.	
$PICT_1$	1		0x00 – 0xFFFF	W	0x0ED1	0x0EE1	0x0EF1	RW	$PICT_j$: power available in each tariff T_j. This is the subscribed demand of imported power.	
$PICT_2$	1		0x00 – 0xFFFF		0x0ED3	0x0EE3	0x0EF3			
$PICT_3$	1		0x00 – 0xFFFF		0x0ED5	0x0EE5	0x0EF5			
$PICT_4$	1		0x00 – 0xFFFF		0x0ED7	0x0EE7	0x0EF7			
$PICT_5$	1		0x00 – 0xFFFF		0x0ED9	0x0EE9	0x0EF9			
$PICT_6$	1		0x00 – 0xFFFF		0x0EDB	0x0EEB	0x0EFB			
$PDIT_1$	1		0x00 – 0xFFFF	W	0x0ED2	0x0EE2	0x0EF2	RW	$PDIT_j$: contractual power supplied in each tariff T_j. This is the maximum available demand of imported power. This value may be bigger than PICT one.	
$PDIT_2$	1		0x00 – 0xFFFF		0x0ED4	0x0EE4	0x0EF4			
$PDIT_3$	1		0x00 – 0xFFFF		0x0ED6	0x0EE6	0x0EF6			
$PDIT_4$	1		0x00 – 0xFFFF		0x0ED8	0x0EE8	0x0EF8			
$PDIT_5$	1		0x00 – 0xFFFF		0x0EDA	0x0EEA	0x0EFA			
$PDIT_6$	1		0x00 – 0xFFFF		0x0EDC	0x0EEC	0x0EFC			

10.12.3 Weekly tariff information for contract #2

Table 137 – Weekly tariff structure parameters for contract #2 – In Force

Register	Len		Range	MU	ID			WrRe	Description	
					IPRE1	IPRE2	IPRE3		Weekly tariff structure identifiers.	
PTF_1	8*	1	0x00 – 0x60	NA	0x4302	0x4312	0x4322	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Monday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_2	8*	1	0x00 – 0x60	NA	0x4303	0x4313	0x4323	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Tuesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_3	8*	1	0x00 – 0x60	NA	0x4304	0x4314	0x4324	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Wednesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_4	8*	1	0x00 – 0x60	NA	0x4305	0x4315	0x4325	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Thursday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_5	8*	1	0x00 – 0x60	NA	0x4306	0x4316	0x4326	RO	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Friday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
SATPR	8*	1	0x00 – 0x60	NA	0x4307	0x4317	0x4327	RO	Number of quarters of hour finding out the terms of band F_k starting from 00:00.	Saturday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_k time band.	

Table 137 – Weekly tariff structure parameters for contract #2 – In Force (continued)

Register	Len		Range	MU	ID			WrRe	Description	
SUNPR	8*	1	0x00 – 0x60	NA	0x4308	0x4318	0x4328	RO	Number of quarters of hour finding out the terms of band F_h starting from 00:00.	Sunday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_h time band.	
PUBHO	8*	1	0x00 – 0x60	NA	0x4309	0x4319	0x4329	RO	Number of quarters of hour finding out the terms of band F_y starting from 00:00.	Public holidays. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_y time band.	
$PICT_1$	1		0x00 – 0xFFFF	W	0x43A1	0x43B1	0x43C1	RO	$PICT_j$: power available in each tariff T_j. This is the subscribed demand of imported power.	
$PICT_2$	1		0x00 – 0xFFFF		0x43A3	0x43B3	0x43C3			
$PICT_3$	1		0x00 – 0xFFFF		0x43A5	0x43B5	0x43C5			
$PICT_4$	1		0x00 – 0xFFFF		0x43A7	0x43B7	0x43C7			
$PICT_5$	1		0x00 – 0xFFFF		0x43A9	0x43B9	0x43C9			
$PICT_6$	1		0x00 – 0xFFFF		0x43AB	0x43BB	0x43CB			
$PDIT_1$	1		0x00 – 0xFFFF	W	0x43A2	0x43B2	0x43C2	RO	$PDIT_j$: contractual power supplied in each tariff T_j. This is the maximum available demand of imported power. This value may be bigger than PICT one.	
$PDIT_2$	1		0x00 – 0xFFFF		0x43A4	0x43B4	0x43C4			
$PDIT_3$	1		0x00 – 0xFFFF		0x43A6	0x43B6	0x43C6			
$PDIT_4$	1		0x00 – 0xFFFF		0x43A8	0x43B8	0x43C8			
$PDIT_5$	1		0x00 – 0xFFFF		0x43AA	0x43BA	0x43CA			
$PDIT_6$	1		0x00 – 0xFFFF		0x43AC	0x43BC	0x43CC			

Table 138 – Weekly tariff structure parameters for contract #2 – Future

Register	Len		Range	MU	ID			WrRe	Description	
					IPRE1	IPRE2	IPRE3		Weekly tariff structure identifiers.	
PTF_1	8*	1	0x00 – 0x60	NA	0x4332	0x4342	0x4352	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Monday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	

Table 138 – Weekly tariff structure parameters for contract #2 – Future (continued)

Register	Len		Range	MU	ID			WrRe	Description	
PTF_2	8*	1	0x00 – 0x60	NA	0x4333	0x4343	0x4353	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Tuesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_3	8*	1	0x00 – 0x60	NA	0x4334	0x4344	0x4354	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Wednesday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_4	8*	1	0x00 – 0x60	NA	0x4335	0x4345	0x4355	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Thursday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
PTF_5	8*	1	0x00 – 0x60	NA	0x4336	0x4346	0x4356	RW	Number of quarters of hour finding out the terms of band F_i starting from 00:00.	Friday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_i time band.	
SATPR	8*	1	0x00 – 0x60	NA	0x4337	0x4347	0x4357	RW	Number of quarters of hour finding out the terms of band F_k starting from 00:00.	Saturday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_k time band.	
SUNPR	8*	1	0x00 – 0x60	NA	0x4338	0x4348	0x4358	RW	Number of quarters of hour finding out the terms of band F_h starting from 00:00.	Sunday profile. Default value (for F_1): 0x60-03-00-00-00-00-00-00-00-00-00-00-00-00-00-00.
		1	0x01 – 0x06						Tariff T_j associated to F_h time band.	
PUBHO	8*	1	0x00 – 0x60	NA	0x4339	0x4349	0x4359	RW	Number of quarters of hour finding out the terms of band F_y starting from 00:00.	Public holidays. Default value (for F_1): 0x60-03-00-00-00-00-

Register	Len		Range	MU	ID			WrRe	Description	
		1	0x01 – 0x06						Tariff T_j associated to F_y time band.	00-00-00-00-00-00-00-00-00-00.
$PICT_1$	1		0x00 – 0xFFFF	W	0x43D1	0x43E1	0x43F1	RW	$PICT_j$: power available in each tariff T_j. This is the subscribed demand of imported power.	
$PICT_2$	1		0x00 – 0xFFFF		0x43D3	0x43E3	0x43F3			
$PICT_3$	1		0x00 – 0xFFFF		0x43D5	0x43E5	0x43F5			
$PICT_4$	1		0x00 – 0xFFFF		0x43D7	0x43E7	0x43F7			
$PICT_5$	1		0x00 – 0xFFFF		0x43D9	0x43E9	0x43F9			
$PICT_6$	1		0x00 – 0xFFFF		0x43DB	0x43EB	0x43FB			
$PDIT_1$	1		0x00 – 0xFFFF	W	0x43D2	0x43E2	0x43F2	RW	$PDIT_j$: contractual power supplied in each tariff T_j. This is the maximum available demand of imported power. This value may be bigger than PICT one.	
$PDIT_2$	1		0x00 – 0xFFFF		0x43D4	0x43E4	0x43F4			
$PDIT_3$	1		0x00 – 0xFFFF		0x43D6	0x43E6	0x43F6			
$PDIT_4$	1		0x00 – 0xFFFF		0x43D8	0x43E8	0x43F8			
$PDIT_5$	1		0x00 – 0xFFFF		0x43DA	0x43EA	0x43FA			
$PDIT_6$	1		0x00 – 0xFFFF		0x43DC	0x43EC	0x43FC			

10.13 Annual tariff information

10.13.1 Object

For the period of a year, eight different temporal intervals can be defined. In each interval only one of the three weekly structures (IPRE1, IPRE2, IPRE3) can be active.

For example:

Jan, 1st– Mar, 20th: IPRE1
Mar, 21st – Jun, 20th: IPRE2
Jun, 21st – Aug, 15th: IPRE1 …

10.13.2 Annual tariff information for contract #1

Table 139 – Annual tariff structure parameters for contract #1 – In Force

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td>IPTS</td><td>1</td><td>0x00 – 0xFF</td><td>NA</td><td>0x0F01</td><td>RO</td><td colspan="2">Annual tariff structure identifier.
Default value: 0x01.</td></tr>
<tr><td rowspan="2">$PDAT_j$
(j=1,…,8)</td><td>1</td><td>0x01 – 0x1F</td><td rowspan="2">NA</td><td rowspan="3">(j=1) 0x0F02
(j=2) 0x0F03
(j=3) 0x0F04
(j=4) 0x0F05
(j=5) 0x0F06
(j=6) 0x0F07
(j=7) 0x0F09
(j=8) 0x0F0A</td><td rowspan="2">RO</td><td>DD: day</td><td rowspan="2">Day and month of end use.
Default value (for j=1):
0x1F 0x0C.</td></tr>
<tr><td>1</td><td>0x01 – 0x0D</td><td>MM: month</td></tr>
<tr><td>$IPRE_j$
(j=1,…,8)</td><td>1</td><td>0x01 – 0x03</td><td>NA</td><td>RO</td><td colspan="2">Identifier of weekly tariff profile.
Default value (for j=1): 0x01.</td></tr>
<tr><td rowspan="3">C1_DEPA</td><td>1</td><td>0x01 – 0x1F</td><td rowspan="3">NA</td><td rowspan="3">0x0F08</td><td rowspan="3">RO</td><td>DD: day</td><td rowspan="3">Start date of effective annual program.</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>MM: month</td></tr>
<tr><td>1</td><td>0x00 – 0x63</td><td>YY: year</td></tr>
<tr><td>C1_DEPA_POSIX</td><td>4</td><td>0x0…0 – 0x7FFFFFFF</td><td>s</td><td>0x0F0B</td><td>RO</td><td colspan="2">Start date of effective annual program in POSIX notation with reference to local time.</td></tr>
</table>

Table 140 – Annual tariff structure parameters for contract #1 – Future

Register	Len	Range	MU	ID	WrRe	Description	
IPTS	1	0x00 – 0xFF	NA	0x0F11	RW	Annual tariff structure identifier. Default value: 0x01.	
$PDAT_j$ (j=1,…,8)	1	0x01 – 0x1F	NA	(j=1) 0x0F12 (j=2) 0x0F13 (j=3) 0x0F14 (j=4) 0x0F15 (j=5) 0x0F16 (j=6) 0x0F17 (j=7) 0x0F19 (j=8) 0x0F1A	RW	DD: day	Day and month of end use. Default value (for j=1): 0x1F 0x0C.
	1	0x01 – 0x0D				MM: month	
$IPRE_j$ (j=1,…,8)	1	0x01 – 0x03	NA		RW	Identifier of weekly tariff profile. Default value (for j=1): 0x01.	
C1_DEPA	1	0x01 – 0x1F	NA	0x0F18	RW	DD: day.	Start date of effective annual program.
	1	0x01 – 0x0C				MM: month	
	1	0x00 – 0x63				YY: year	
C1_DEPA_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0F1B	RW	Start date of effective annual program in POSIX notation with reference to local time.	

10.13.3 Annual tariff information for contract #2

Table 141 – Annual tariff structure parameters for contract #2 – In Force

Register	Len	Range	MU	ID	WrRe	Description	
IPTS	1	0x00 – 0xFF	NA	0x0F21	RO	Annual tariff structure identifier. Default value (for j=1): 0x01.	
$PDAT_j$ (j=1,…,8)	1	0x01 – 0x1F	NA	(j=1) 0x0F22 (j=2) 0x0F23 (j=3) 0x0F24 (j=4) 0x0F25 (j=5) 0x0F26 (j=6) 0x0F27 (j=7) 0x0F29 (j=8) 0x0F2A	RO	DD: day	Day and month of end use. Default value (for j=1): 0x1F 0x0C.
	1	0x01 – 0x0D				MM: month	
$IPRE_j$ (j=1,…,8)	1	0x01 – 0x03	NA		RO	Identifier of weekly tariff profile. Default value (for j=1): 0x01.	
C2_DEPA_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x0F28	RO	Start date of effective annual program in POSIX notation with reference to local time.	

Table 142 – Annual tariff structure parameters for contract #2 – Future

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td>IPTS</td><td>1</td><td>0x00 – 0xFF</td><td>NA</td><td>0x0F31</td><td>RW</td><td colspan="2">Annual tariff structure identifier.
Default value (for j=1): 0x01.</td></tr>
<tr><td rowspan="2">PDAT$_j$
(j=1,…,8)</td><td>1</td><td>0x01 – 0x1F</td><td rowspan="2">NA</td><td rowspan="3">(j=1) 0x0F32
(j=2) 0x0F33
(j=3) 0x0F34
(j=4) 0x0F35
(j=5) 0x0F36
(j=6) 0x0F37
(j=7) 0x0F39
(j=8) 0x0F3A</td><td rowspan="2">RW</td><td>DD: day</td><td rowspan="2">Day and month of end use.
Default value (for j=1):
0x1F 0x0C.</td></tr>
<tr><td>1</td><td>0x01 – 0x0D</td><td>MM: month</td></tr>
<tr><td>IPRE$_j$
(j=1,…,8)</td><td>1</td><td>0x01 – 0x03</td><td>NA</td><td>RW</td><td colspan="2">Identifier of weekly tariff profile.
Default value (for j=1): 0x01.</td></tr>
<tr><td>C2_DEPA_POSIX</td><td>4</td><td>0x0…0 – 0x7FFFFFFF</td><td>s</td><td>0x0F38</td><td>RW</td><td colspan="2">Start date of effective annual program in POSIX notation with reference to local time.</td></tr>
</table>

10.14 Public holidays programming

In the following table up to 20 public holidays can be defined. For each public holiday, the tariff profile to be adopted (defined in 10.12 "Weekly tariff information") is indicated.

Table 143 – Public holidays parameters

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">PH_PROG$_h$
(h=1,…,20)</td><td>1</td><td>0x00 – 0x63</td><td>NA</td><td rowspan="4">From 0x1001
To 0x1014</td><td>RW</td><td colspan="2">YY: year.
YY = 0x00: public holiday is disabled.
YY = 0x01: public holiday is enable for every years.
YY > 0x01: public holiday is enable for one specific year.</td></tr>
<tr><td>1</td><td>0x01 – 0x20</td><td rowspan="2">NA</td><td rowspan="2">RW</td><td>DD: day</td><td rowspan="2">PH: public holiday.
(DD = 0x20 refers to Easter Monday)</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>MM: month</td></tr>
<tr><td>1</td><td>0x00 – 0x07</td><td>NA</td><td>RW</td><td colspan="2">TF: tariff profile (defined in 10.12) to be used in the day specified by PH and YY.
TF = 0x00: Monday profile (see PTF$_1$ in Table 135 to Table 138)
TF = 0x01: Tuesday profile (see PTF$_2$ in Table 135 to Table 138)
TF = 0x02: Wednesday profile (see PTF$_3$ in Table 135 to Table 138)
TF = 0x03: Thursday profile (see PTF$_4$ in Table 135 to Table 138)
TF = 0x04: Friday profile (see PTF$_5$ in Table 135 to Table 138)
TF = 0x05: Saturday profile (see SATPR in Table 135 to Table 138)
TF = 0x06: Sunday profile (see SUNPR in Table 135 to Table 138)
TF = 0x07: Public holiday profile (see PUBHO in Table 135 to Table 138)</td></tr>
</table>

10.15 Load modulation parameters

The following tables contain parameters that manage a load modulation. The modulation coefficient is programmed in the register KF in Table 145, and it will be written in the register K_INFORCE of Table 144 when it will become in force. The register K_INST of Table 144 indicates the actual percentage value of power provided to the customer.

Table 144 – Load modulation parameters – In Force

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td>K_INST</td><td>1</td><td>0x00 – 0x64</td><td>NA</td><td>0x1101</td><td>RO</td><td colspan="2">Instantaneous load modulation coefficient in force. It indicates the value of K applied by the meter at the current time, taking into account the configuration of DISI parameter.
K indicates the provided percentage of the available power (from 0% to 100% of PDIT).
Default value: 0x64 (100%).
NOTE If the end date has passed, K_INST is automatically set to default value. This value could be not equal to K_INFORCE (see register K_INFORCE below).</td></tr>
<tr><td rowspan="3">DKI</td><td>1</td><td>0x01 – 0x30</td><td>NA</td><td rowspan="3">0x1106</td><td rowspan="3">RO</td><td>Hh: half hour</td><td rowspan="3">Start activation date of K_INFORCE parameter.
MM bit0-3: start month.
MM bit7 = 0: the K procedure has to be activated the same year as the one in which a new procedure has been programmed.
MM bit7 = 1: the K procedure has to be activated the year after the one in which a new procedure has been programmed.
Default value: 0x01 0x01 0x01.</td></tr>
<tr><td>1</td><td>0x01 – 0x1F</td><td>NA</td><td>DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>NA</td><td>MM: month</td></tr>
</table>

Table 144 – Load modulation parameters – In Force (continued)

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td rowspan="3">DKF</td><td>1</td><td>0x01 – 0x30</td><td>NA</td><td rowspan="3">0x1107</td><td rowspan="3">RO</td><td>Hh: half hour</td><td rowspan="3">End activation date of K_INFORCE parameter.

MM bit0-3: end month.
MM bit7 = 0: the K procedure has to be deactivated the same year as the one in DKI.
MM bit7 = 1: the K procedure has to be deactivated the year after the one in DKI.

Default value: 0x02 0x01 0x01.</td></tr>
<tr><td>1</td><td>0x01 – 0x1F</td><td>NA</td><td>DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>NA</td><td>MM: month</td></tr>
<tr><td rowspan="2">TK</td><td rowspan="2">1</td><td>bit0-bit1:
00 – 10</td><td rowspan="2">NA</td><td rowspan="2">0x1108</td><td rowspan="2">RO</td><td colspan="2">Type of reduction.
01 = load shedding
10 = for bad payer
Default value: 00.</td></tr>
<tr><td>bit2-bit7:
000000 – 111111</td><td colspan="2">Not used (reserved for future use).
Default value: 000000.</td></tr>
<tr><td>KST_I_POSIX</td><td>4</td><td>0x0…0 – 0x7FFFFFFF</td><td>s</td><td>0x1109</td><td>RO</td><td colspan="2">Start time for the application of the load modulation in POSIX notation with reference to local time.</td></tr>
<tr><td>KET_I_POSIX</td><td>4</td><td>0x0…0 – 0x7FFFFFFF</td><td>s</td><td>0x110A</td><td>RO</td><td colspan="2">End time for the application of the load modulation in POSIX notation with reference to local time.</td></tr>
<tr><td>K_INFORCE</td><td>1</td><td>0x00 – 0x64</td><td>NA</td><td>0x110D</td><td>RO</td><td colspan="2">Programmed value of load modulation coefficient in force. It indicates the value of K that has been programmed for In Force modulation.
NOTE If the breaker is not active, K_INFORCE value could be not equal to K_INST one. Even if a modulation is running, the value of K_INST register is 100%.</td></tr>
<tr><td>DKI_POSIX</td><td>4</td><td>0x0…0 – 0x7FFFFFFF</td><td>s</td><td>0x110E</td><td>RO</td><td colspan="2">Start activation date of K_INFORCE parameter in POSIX notation with reference to local time.</td></tr>
<tr><td>DKF_POSIX</td><td>4</td><td>0x0…0 – 0xFFFFFFFF</td><td>s</td><td>0x1110</td><td>RO</td><td colspan="2">End activation date of K_INFORCE parameter in POSIX notation with reference to local time.</td></tr>
</table>

Table 145 – Load modulation parameters – Future

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td>KF</td><td>1</td><td>0x00 – 0x64</td><td>NA</td><td>0x1102</td><td>RW</td><td colspan="2">Load modulation coefficient.
Default value: 0x64.</td></tr>
<tr><td rowspan="3">DKI_F</td><td>1</td><td>0x01 – 0x30</td><td>NA</td><td rowspan="3">0x1103</td><td rowspan="3">RW</td><td>Hh: half hour</td><td rowspan="3">Start activation date of K parameter.
MM bit0-3: start month.
MM bit7 = 0: the K procedure has to be activated the same year as the one in which a new procedure has been programmed.
MM bit7 = 1: the K procedure has to be activated the year after the one in which a new procedure has been programmed.
Default value: 0x01 0x01 0x01.</td></tr>
<tr><td>1</td><td>0x01 – 0x1F</td><td>NA</td><td>DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>NA</td><td>MM: month</td></tr>
<tr><td rowspan="3">DKF_F</td><td>1</td><td>0x01 – 0x30</td><td>NA</td><td rowspan="3">0x1104</td><td rowspan="3">RW</td><td>Hh: half hour</td><td rowspan="3">End activation date of K parameter.
MM bit0-3: end month.
MM bit7 = 0: the K procedure has to be deactivated the same year as the one in DKI.
MM bit7 = 1: the K procedure has to be deactivated the year after the one in DKI.
Default value: 0x02 0x01 0x01.</td></tr>
<tr><td>1</td><td>0x01 – 0x1F</td><td>NA</td><td>DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>NA</td><td>MM: month</td></tr>
</table>

Table 145 – Load modulation parameters – Future (continued)

Register	Len	Range	MU	ID	WrRe	Description
TK_F	1	bit0-bit1: 00 – 10	NA	0x1105	RW	Type of reduction. 01 = load shedding 10 = for bad payer Default value: 00.
		bit2-bit7: 000000 – 111111				Not used (reserved for future use). Default value: 000000.
KST_F_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x110B	RW	Start time for the application of the load modulation in POSIX notation with reference to local time.
KET_F_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x110C	RW	End time for the application of the load modulation in POSIX notation with reference to local time.
DKI_F_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x110F	RW	Start activation date of KF parameter in POSIX notation with reference to local time.
DKF_F_POSIX	4	0x0…0 – 0xFFFFFFFF	s	0x1111	RW	End activation date of KF parameter in POSIX notation with reference to local time.

10.16 Voltage interruption information

In the following tables temporal references of voltage interruptions are provided for the current and the last billing period, and for single-phase and polyphase meters. The threshold value of voltage under which an interruption occurs is indicated in the register THVI. Time information and duration of the last 20 interruptions or power fails are stored in the registers SQ_BUF_I_j (j=1,…,20).

Table 146 – Voltage interruption parameters (single-phase meter)

Register	Len	Range	MU	ID	WrRe	Description
THVI	1	0x01 – 0x32	NA	0x1301	RW	Threshold of voltage for interruption measurement. An interruption happens when the voltage is under this threshold. It represents the percentage value of the register UC_INFORCE in Table 150 in 10.18.
TSI	2	0x0000 – 0xFFFF	s	0x1302	RW	Threshold duration for transient voltage interruptions. Default value: 0x01.
TLI	2	0x0000 – 0xFFFF	s	0x1303	RW	Threshold duration for short voltage interruptions. Default value: 0xB4.

Table 146 – Voltage interruption parameters (single-phase meter) (continued)

Register	Len	Range	MU	ID	WrRe	Description
TW	1	0x02 – 0xFF	NA	0x1304	RW	Period of time, expressed in 15ms intervals, devoted to measure the voltage for interruptions. Minimum value: 0x02 (30ms).
TSHV (t-p) TSHV_R (t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1317	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the current billing period.
TSHV (p-a) TSHV_R (p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x131A	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the previous billing period.
TAVV (t-p) TAVV_R (t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1318	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the current billing period.
TAVV (p-a) TAVV_R (p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x131B	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the previous billing period.
TLOV (t-p) TLOV_R (t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1319	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the current billing period.
TLOV (p-a) TLOV_R (p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x131C	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the previous billing period.
NSHV (t-p) NSHV_R (t-p)	1	0x00 – 0xFF	NA	0x1314	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the current billing period.
NSHV (p-a) NSHV_R (p-a)	1	0x00 – 0xFF	NA	0x1334	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the previous billing period.
NAVV (t-p) NAVV_R (t-p)	1	0x00 – 0xFF	NA	0x1315	RO	Counter that indicates the number of voltage interruptions from TSI to TLI seconds in the current billing period.
NAVV (p-a) NAVV_R (p-a)	1	0x00 – 0xFF	NA	0x1335	RO	Counter that indicates the number of voltage interruptions from TLI to TLI seconds in the previous billing period.
NLOV (t-p) NLOV_R (t-p)	1	0x00 – 0xFF	NA	0x1316	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the current billing period.
NLOV (p-a) NLOV_R (p-a)	1	0x00 – 0xFF	NA	0x1336	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the previous billing period.

Table 146 – Voltage interruption parameters (single-phase meter) (continued)

Register	Len	Range	MU	ID	WrRe	Description
NTVD (t-p)	1	0x00 – 0xFF	NA	0x1321	RO	Counter that indicates the number of meter power fails in the current billing period.
NTVD (p-a)	1	0x00 – 0xFF	NA	0x1322	RO	Counter that indicates the number of meter power fails in the previous billing period.
$SQ\_BUF\_I_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x13C1 To 0x13D4	RO	ITIME_POSIX: time and date of the last 20 interruptions or power fails in POSIX notation with reference to local time.
	4	0x0…0 – 0x7FFFFFFF	s			D_ITIME: duration of the last 20 interruptions or power fails.

Table 147 – Voltage interruption parameters (polyphase meter) – R Phase

Register	Len	Range	MU	ID	WrRe	Description
THVI	1	0x00 – 0x32	%	0x1301	RW	Threshold of voltage for interruption measurement. An interruption happens when the voltage is under this threshold. It represents the percentage value of the register UC_INFORCE in Table 151 in 10.18.
TSI	2	0x0000 – 0xFFFF	s	0x1302	RW	Threshold duration for transient voltage interruptions. Default value: 0x01.
TLI	2	0x0000 – 0xFFFF	s	0x1303	RW	Threshold duration for short voltage interruptions. Default value: 0xB4.
TW	1	0x02 – 0xFF	NA	0x1304	RW	Period of time, expressed in 15ms intervals, devoted to measure the voltage for interruptions. Minimum value: 0x02 (30ms).
TSHV (t-p) TSHV_R (t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1317	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the current billing period.
TSHV (p-a) TSHV_R (p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x131A	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the previous billing period.
TAVV (t-p) TAVV_R (t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1318	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the current billing period.
TAVV (p-a) TAVV_R (p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x131B	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the previous billing period.

Table 147 – Voltage interruption parameters (polyphase meter) – R Phase (continued)

Register	Len	Range	MU	ID	WrRe	Description
TLOV (t-p) TLOV_R (t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1319	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the current billing period.
TLOV (p-a) TLOV_R (p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x131C	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the previous billing period.
NSHV (t-p) NSHV_R (t-p)	1	0x00 – 0xFF	NA	0x1314	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the current billing period.
NSHV (p-a) NSHV_R (p-a)	1	0x00 – 0xFF	NA	0x1334	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the previous billing period.
NAVV (t-p) NAVV_R (t-p)	1	0x00 – 0xFF	NA	0x1315	RO	Counter that indicates the number of voltage interruptions from TSI to TLI seconds in the current billing period.
NAVV (p-a) NAVV_R (p-a)	1	0x00 – 0xFF	NA	0x1335	RO	Counter that indicates the number of voltage interruptions from TSI to TLI seconds in the previous billing period.
NLOV (t-p) NLOV_R (t-p)	1	0x00 – 0xFF	NA	0x1316	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the current billing period.
NLOV (p-a) NLOV_R (p-a)	1	0x00 – 0xFF	NA	0x1336	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the previous billing period.
NTVD (t-p)	1	0x00 – 0xFF	NA	0x1321	RO	Counter that indicates the number of meter power fails (per phase interruption) in the current billing period. The phase that had a power fail is indicated in registers SQ_BUF_IR, SQ_BUF_IS, SQ_BUF_IT (see next tables).
NTVD (p-a)	1	0x00 – 0xFF	NA	0x1322	RO	Counter that indicates the number of meter power fails (per phase interruption) in the previous billing period.
$SQ\_BUF\_IR_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	sec	From 0x13C1 To 0x13D4	RO	ITIME_R_POSIX: time and date of the last 20 interruptions or power fails for R phase in POSIX notation with reference to local time.
	4	0x0…0 – 0x7FFFFFFF	sec			DITIME_R: duration of the last 20 interruptions or power fails for R phase.

Table 148 – Voltage interruption parameters (polyphase meter) – S Phase

Register	Len	Range	MU	ID	WrRe	Description
TSHV_S(t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1357	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the current billing period for the Phase S.
TSHV_S(p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x135A	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the previous billing period for the Phase S.
TAVV_S(t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1358	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the current billing period for the Phase S.
TAVV_S(p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x135B	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the previous billing period for the Phase S.
TLOV_S(t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1359	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the current billing period for the Phase S.
TLOV_S(p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x135C	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the previous billing period for the Phase S.
NSHV_S(t-p)	1	0x00 – 0xFF	NA	0x1354	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the current billing period for the Phase S.
NSHV_S(p-a)	1	0x00 – 0xFF	NA	0x1374	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the previous billing period for the Phase S.
NAVV_S(t-p)	1	0x00 – 0xFF	NA	0x1355	RO	Counter that indicates the number of voltage interruptions from TSI to TLI seconds in the current billing period for the Phase S.
NAVV_S(p-a)	1	0x00 – 0xFF	NA	0x1375	RO	Counter that indicates the number of voltage interruptions from TLI to TLI seconds in the previous billing period for the Phase S.
NLOV_S(t-p)	1	0x00 – 0xFF	NA	0x1356	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the current billing period for the Phase S.
NLOV_S(p-a)	1	0x00 – 0xFF	NA	0x1376	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the previous billing period for the Phase S.
$SQ\_BUF\_IS_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x13D5 To 0x13E8	RO	ITIME_S_POSIX: time and date of the last 20 interruptions or power fails for S phase in POSIX notation with reference to local time.
	4	0x0…0 – 0x7FFFFFFF	s			DITIME_S: duration of the last 20 interruptions or power fails for S phase.

Table 149 – Voltage interruption parameters (polyphase meter) – T Phase

Register	Len	Range	MU	ID	WrRe	Description
TSHV_T(t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1397	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the current billing period for the Phase T.
TSHV_T(p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x139A	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions till TSI seconds in the previous billing period for the Phase T.
TAVV_T(t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1398	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the current billing period for the Phase T.
TAVV_T(p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x139B	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions from TSI to TLI seconds in the previous billing period for the Phase T.
TLOV_T(t-p)	4	0x0…0 – 0xFFFFFFFF	s	0x1399	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the current billing period for the Phase T.
TLOV_T(p-a)	4	0x0…0 – 0xFFFFFFFF	s	0x139C	RO	Cumulative totalizer that indicates the duration, in seconds, of voltage interruptions over TLI seconds in the previous billing period for the Phase T.
NSHV_T(t-p)	1	0x00 – 0xFF	NA	0x1394	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the current billing period for the Phase T.
NSHV_T(p-a)	1	0x00 – 0xFF	NA	0x13B4	RO	Counter that indicates the number of voltage interruptions till TSI seconds in the previous billing period for the Phase T.
NAVV_T(t-p)	1	0x00 – 0xFF	NA	0x1395	RO	Counter that indicates the number of voltage interruptions from TSI to TLI seconds in the current billing period for the Phase T.

Table 149 – Voltage interruption parameters (polyphase meter) – T Phase (continued)

Register	Len	Range	MU	ID	WrRe	Description
NAVV_T(p-a)	1	0x00 – 0xFF	NA	0x13B5	RO	Counter that indicates the number of voltage interruptions from TLI to TLI seconds in the previous billing period for the Phase T.
NLOV_T(t-p)	1	0x00 – 0xFF	NA	0x1396	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the current billing period for the Phase T.
NLOV_T(p-a)	1	0x00 – 0xFF	NA	0x13B6	RO	Counter that indicates the number of voltage interruptions over TLI seconds in the previous billing period for the Phase T.
$SQ\_BUF\_IT_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x13E9 To 0x13FC	RO	ITIME_T_POSIX: time and date of the last 20 interruptions or power fails for T phase in POSIX notation with reference to local time.
	4	0x0…0 – 0x7FFFFFFF	s			DITIME_T: duration of the last 20 interruptions or power fails for T phase.

Legend

– t: current moment;

– p: end moment of previous billing period;

– a: end moment of the second last billing period.

10.17 Voltage variation information

The following tables contain information about voltage variations in the current and in the last billing period, for single-phase and polyphase meters. The threshold values used to evaluate the voltage variation are indicated in the registers $S+_{\Delta VT}$ and $S-_{\Delta VT}$. Time information and duration of the last 20 voltage variations are stored in the registers $SQ\_BUF\_V_j$ (j=1,…,20).

Table 150 – Voltage variation parameters (single-phase meter)

Register	Len	Range	MU	ID	WrRe	Description	
T_{VT}	2	0x003C – 0x0E10	s	0x1401	RW	Duration of time intervals in which meter has to calculate the average of voltage values in order to evaluate the voltage variations in P_{VT} period, compared with thresholds $S+_{\Delta VT}$ and $S-_{\Delta VT}$. Admitted values: 0x003C, 0x0078, 0x00B4, 0x00F0, 0x012C, 0x0168, 0x0258, 0x02D0, 0x0384, 0x04B0, 0x0708, 0x0E10.	
P_{VT}	1	0x01 – 0xFF	NA	0x1402	RW	Time period (in days) in which voltage variations have to be observed. This period is divided by time intervals having duration of T_{VT}, starting from 00:00 of $Date_{VT}$.	
$S+_{\Delta VT}$	1	0x01 – 0x64	NA	0x1403	RW	Percentage threshold of upper voltage limit. Default value: 0x0A.	
$S-_{\Delta VT}$	1	0x01 – 0x64	NA	0x1404	RW	Percentage threshold of lower voltage limit. Default value: 0x0A.	
ΔTx	2	0x0001 – 0xFFFF	s	0x1405	RW	Time period for the evaluation of the average voltage value of Vmis(t). Default value: 0x0A.	
$Date_{VT}$	1	0x01 – 0x1F	NA	0x1406	RW	DD: day	Starting date of voltage variation parameter evaluation. Default value: 0x01 0x01 0x01.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x63				YY: year	
DateVT_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x140B	RW	Starting date of voltage variation parameter evaluation in POSIX notation with reference to local time. Default value: corresponding to 2001 January, 1st.	
$\Sigma VT_{OK}(t)$ $\Sigma VT\_R_{OK}(t)$	2	0x0000 – 0xFFFF	NA	0x1410	RO	Counter of intervals (T_{VT}) with voltage variations within the limit [$S+_{\Delta VT}$, $S-_{\Delta VT}$] in current period P_{VT}.	
$\Sigma VT_{KO}(t)$ $\Sigma VT\_R_{KO}(t)$	2	0x0000 – 0xFFFF	NA	0x1411	RO	Counter of intervals (T_{VT}) with voltage variations out of the limit [$S+_{\Delta VT}$, $S-_{\Delta VT}$] in current period P_{VT}.	

Table 150 – Voltage variation parameters (single-phase meter) (continued)

Register	Len	Range	MU	ID	WrRe	Description
$\Sigma VT_{OK}(p)$ $\Sigma VT\_R_{OK}(p)$	2	0x0000 – 0xFFFF	NA	0x1420	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit [S+$_{\Delta VT}$, S-$_{\Delta VT}$] in previous period P_{VT}.
$\Sigma VT_{KO}(p)$ $\Sigma VT\_R_{KO}(p)$	2	0x0000 – 0xFFFF	NA	0x1421	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit [S+$_{\Delta VT}$, S-$_{\Delta VT}$] in previous period P_{VT}.
Vmis(t) V_Rmis(t)	2	0x0000 – 0xFFFF	V	0x1407	RO	Instantaneous value of the voltage measured during ΔTx.
Vmin(t) V_Rmin(t)	2	0x0000 – 0xFFFF	V	0x1412	RO	Minimum value of the voltage in the current period measured over a time interval ΔTx. It is the minimum value of V_Rmis_Tmis(t) in the current period P_{VT}.
Vmax(t) V_Rmax(t)	2	0x0000 – 0xFFFF	V	0x1413	RO	Maximum value of the voltage in the current period measured over a time interval ΔTx. It is the maximum value of V_Rmis(t) in the current period P_{VT}.
Vmin(p) V_Rmin(p)	2	0x0000 – 0xFFFF	V	0x1422	RO	Minimum value of the voltage in the previous period measured over a time interval ΔTx. It is the minimum value of V_Rmis(t) in the previous period P_{VT}.
Vmax(p) V_Rmax(p)	2	0x0000 – 0xFFFF	V	0x1423	RO	Maximum value of the voltage in the previous period measured over a time interval ΔTx. It is the maximum value of V_Rmis(t) in the previous period P_{VT}.
$SQ\_BUF\_V_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x1470 To 0x1483	RO	VTIME_POSIX: time and date of the last 20 voltage variations in POSIX notation with reference to local time.
	2	0x0000 – 0xFFFF	s		RO	D_VTIME: duration of the last 20 voltage variations expressed as the number of T_{VT} periods.
Uc_SET	1	0x00 – 0xE6	V	0x14C4	RW	It indicates the configuration for the evaluation of declared voltage. This value doesn’t represent the supplied voltage, but it indicates the voltage by the which variations are computed. 0x00 = declared voltage has to be evaluated by the meter itself 0x7F = declared voltage equal to 127V 0xE6 = declared voltage equal to 230V
Uc_INFORCE	1	0x00 – 0xE6	V	0x14C5	RO	It indicates the declared supply voltage applied by the meter according with the configuration of Uc_SET register.

Table 151 – Voltage variation parameters (polyphase meter) – R Phase

Register	Len	Range	MU	ID	WrRe	Description	
T_{VT}	2	0x003C – 0x0E10	s	0x1401	RW	Duration of time intervals in which meter has to calculate the average of voltage values in order to evaluate the voltage variations in P_{VT} period, compared with thresholds $S+_{\Delta VT}$ and $S-_{\Delta VT}$. Admitted values: 0x003C, 0x0078, 0x00B4, 0x00F0, 0x012C, 0x0168, 0x0258, 0x02D0, 0x0384, 0x04B0, 0x0708, 0x0E10.	
P_{VT}	1	0x01 – 0xFF	NA	0x1402	RW	Time period (in days) in which voltage variations have to be observed. This period is divided by time intervals having duration of T_{VT}, starting from 00:00 of $Date_{VT}$.	
$S+_{\Delta VT}$	1	0x01 – 0x64	NA	0x1403	RW	Percentage threshold of voltage limit. Default value: 0x0A.	
$S-_{\Delta VT}$	1	0x01 – 0x64	NA	0x1404	RW	Percentage threshold of voltage limit. Default value: 0x0A.	
ΔTx	2	0x0001 – 0xFFFF	s	0x1405	RW	Period time devoted to measure the voltage value of Vmis(t). Default value: 0x0A.	
$Date_{VT}$	1	0x01 – 0x1F	NA	0x1406	RW	DD: day	Starting date of voltage variation parameter evaluation. Default value: 0x01 0x01 0x01.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x63				YY: year	
DateVT_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x140B	RW	Starting date of voltage variation parameter evaluation in POSIX notation with reference to local time. Default value: corresponding to 2001 January, 1st.	
$\Sigma VT_{OK}(t)$ $\Sigma VT\_R_{OK}(t)$	2	0x0000 – 0xFFFF	NA	0x1410	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit in current period P_{VT}.	
$\Sigma VT_{KO}(t)$ $\Sigma VT\_R_{KO}(t)$	2	0x0000 – 0xFFFF	NA	0x1411	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit in current period P_{VT}.	
$\Sigma VT_{OK}(p)$ $\Sigma VT\_R_{OK}(p)$	2	0x0000 – 0xFFFF	NA	0x1420	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit in previous period P_{VT}.	
$\Sigma VT_{KO}(p)$ $\Sigma VT\_R_{KO}(p)$	2	0x0000 – 0xFFFF	NA	0x1421	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit in previous period P_{VT}.	

Table 151 – Voltage variation parameters (polyphase meter) – R Phase (continued)

Register	Len	Range	MU	ID	WrRe	Description
Vmis(t) V_Rmis(t)	2	0x0000 – 0xFFFF	V	0x1407	RO	Instantaneous value of the voltage measured during ΔTx.
Vmin(t) V_Rmin(t)	2	0x0000 – 0xFFFF	V	0x1412	RO	Minimum value of the voltage in the current period measured over a time interval ΔTx. It is the minimum value of V_Rmis_Tmis(t) in the current period P_{VT}.
Vmax(t) V_Rmax(t)	2	0x0000 – 0xFFFF	V	0x1413	RO	Maximum value of the voltage in the current period measured over a time interval ΔTx. It is the maximum value of V_Rmis(t) in the current period P_{VT}.
Vmin(p) V_Rmin(p)	2	0x0000 – 0xFFFF	V	0x1422	RO	Minimum value of the voltage in the previous period measured over a time interval ΔTx. Is the minimum value of V_Rmis(t) in the previous period P_{VT}.
Vmax(p) V_Rmax(p)	2	0x0000 – 0xFFFF	V	0x1423	RO	Maximum value of the voltage in the previous period measured over a time interval ΔTx. It is the maximum value of V_Rmis(t) in the previous period P_{VT}.
$SQ\_BUF\_VR_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x1470 To 0x1483	RO	VTIME_POSIX: time and date of the last 20 voltage variations for R phase in POSIX notation with reference to local time.
	2	0x0000 – 0xFFFF	s		RO	DVTIME: duration of the last 20 voltage variations for R phase expressed as the number of T_{VT} periods.
Uc_SET	1	0x00 – 0xE6	V	0x14C4	RO	It indicates the configuration for the evaluation of declared voltage. This value doesn’t represent the supplied voltage, but it indicates the voltage by the which variations are computed. 0x00 = declared voltage has to be evaluated by the meter itself 0x7F = declared voltage equal to 127V 0xE6 = declared voltage equal to 230V
Uc_INFORCE	1	0x00 – 0xE6	V	0x14C5	RO	It indicates the declared supply voltage applied by the meter according with the configuration of Uc_SET register.

Table 152 – Voltage variation parameters (polyphase meter) – S Phase

Register	Len	Range	MU	ID	WrRe	Description
$\Sigma VT\_S_{OK}(t)$	2	0x0000 – 0xFFFF	NA	0x1430	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit in current period P_{VT}.
$\Sigma VT\_S_{KO}(t)$	2	0x0000 – 0xFFFF	NA	0x1431	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit in current period P_{VT}.
$\Sigma VT\_S_{OK}(p)$	2	0x0000 – 0xFFFF	NA	0x1440	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit in previous period P_{VT}.
$\Sigma VT\_S_{KO}(p)$	2	0x0000 – 0xFFFF	NA	0x1441	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit in previous period P_{VT}.
V_Smis(t)	2	0x0000 – 0xFFFF	V	0x1408	RO	Instantaneous value of the voltage measured during ΔTx.
V_Smin(t)	2	0x0000 – 0xFFFF	V	0x1432	RO	Minimum value of the voltage in the current period measured over a time interval ΔTx. It is the minimum value of V_Smis(t) in the current period P_{VT}.
V_Smax(t)	2	0x0000 – 0xFFFF	V	0x1433	RO	Maximum value of the voltage in the current period measured over a time interval ΔTx. It is the maximum value of V_Smis(t) in the current period P_{VT}.
V_Smin(p)	2	0x0000 – 0xFFFF	V	0x1442	RO	Minimum value of the voltage in the previous period measured over a time interval ΔTx. It is the minimum value of V_Smis(t) in the previous period P_{VT}.
V_Smax(p)	2	0x0000 – 0xFFFF	V	0x1443	RO	Maximum value of the voltage in the previous period measured over a time interval ΔTx. It is the maximum value of V_Smis(t) in the previous period P_{VT}.
$SQ\_BUF\_VS_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x1490 To 0x14A3	RO	ITIME_POSIX: time and date of the last 20 voltage variations for S phase in POSIX notation with reference to local time.
	2	0x0000 – 0xFFFF	s		RO	DITIME: duration of the last 20 voltage variations for S phase expressed as the number of T_{VT} periods.

Table 153 – Voltage variation parameters (polyphase meter) – T Phase

Register	Len	Range	MU	ID	WrRe	Description
$\Sigma VT\_T_{OK}(t)$	2	0x0000 – 0xFFFF	NA	0x1450	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit in current period P_{VT}.
$\Sigma VT\_T_{KO}(t)$	2	0x0000 – 0xFFFF	NA	0x1451	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit in current period P_{VT}.
$\Sigma VT\_T_{OK}(p)$	2	0x0000 – 0xFFFF	NA	0x1460	RO	Counter for number of intervals (T_{VT}) with voltage variations within the limit in previous period P_{VT}.
$\Sigma VT\_T_{KO}(p)$	2	0x0000 – 0xFFFF	NA	0x1461	RO	Counter for number of intervals (T_{VT}) with voltage variations out of the limit in previous period P_{VT}.
V_Tmis(t)	2	0x0000 – 0xFFFF	V	0x1409	RO	Instantaneous value of the voltage measured during ΔTx.
V_Tmin(t)	2	0x0000 – 0xFFFF	V	0x1452	RO	Minimum value of the voltage in the current period measured over a time interval ΔTx. It is the minimum value of V_Tmis(t) in the current period P_{VT}.
V_Tmax(t)	2	0x0000 – 0xFFFF	V	0x1453	RO	Maximum value of the voltage in the current period measured over a time interval ΔTx. It is the maximum value of V_Tmis(t) in the current period P_{VT}.
V_Tmin(p)	2	0x0000 – 0xFFFF	V	0x1462	RO	Minimum value of the voltage in the previous period measured over a time interval ΔTx. It is the minimum value of V_Tmis(t) in the previous period P_{VT}.
V_Tmax(p)	2	0x0000 – 0xFFFF	V	0x1463	RO	Maximum value of the voltage in the previous period measured over a time interval ΔTx. It is the maximum value of V_Tmis(t) in the previous period P_{VT}.
$SQ\_BUF\_VT_j$ (j=1,…,20)	4	0x0…0 – 0x7FFFFFFF	s	From 0x14B0 To 0x14C3	RO	ITIME_POSIX: time and date of the last 20 voltage variations for T phase in POSIX notation with reference to local time.
	2	0x0000 – 0xFFFF	s		RO	DITIME: duration of the last 20 voltage variations for T phase expressed as the number of T_{VT} periods.
VMIS(t)	2	0x0000 – 0xFFFF	V	0x140A	RO	Instantaneous value of the three lines to neutral voltage measured during ΔTx.

Legend

– t: current moment;

– p: end moment of previous period.

10.18 Control information

The following table provides information about variations of programming parameters (for the current and the last billing period), number of executions of the cut-off device open command (for the current and the last billing period), and number of bad authentications occurred via PLC interface and optical interface. Parameters to manage the locking of PLC interface and optical interface due to failed authentication are also provided.

Table 154 – Control information parameters

Register	Len	Range	MU	ID	WrRe	Description
VPP(t-p)	1	0x00 – 0xFF	NA	0x1501	RO	Number of programming parameters variations in the current billing period. The billing period to be taken into account for the storage of data has to be indicated by PC_CONTRACT register stored in “Cut-off device control parameters” table. This register has not to perform the rollover when the maximum value is reached.
VPP(p-a)	1	0x00 – 0xFF	NA	0x1503	RO	Number of programming parameters variations in the previous billing period. The billing period to be taken into account for the storage of data has to be indicated by PC_CONTRACT register stored in “Cut-off device control parameters” table. This register has not to perform the rollover when the maximum value is reached.
NCA(t-p)	1	0x00 – 0xFF	NA	0x1502	RO	Number of commands to open circuit-breaker in the current billing period (incremented only when the open circuit-breaker command is due to an overload condition). The billing period to be taken into account for the storage of data has to be indicated by PC_CONTRACT register stored in “Cut-off device control parameters” table. This register has not to perform the rollover when the maximum value is reached.
NCA(p-a)	1	0x00 – 0xFF	NA	0x1504	RO	Number of commands to open circuit-breaker in the previous billing period. The billing period to be taken into account for the storage of data has to be indicated by PC_CONTRACT register stored in “Cut-off device control parameters” table. This register has not to perform the rollover when the maximum value is reached.

Table 154 – Control information parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description	
DL_VPP	1	0x00 – 0x63	NA	0x1505	RO	YY: year	Date and time of the last programming parameters variation.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x1F				DD: day	
	1	0x00 – 0x17				hh: hour	
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
DL_VPP_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x150D	RO	Date and time of the last programming parameters variation in POSIX notation with reference to local time.	
N_PWD_KO_PLC	2	0x0000 – 0xFFFF	NA	0x1506	RO	Number of bad authentication via powerline.	
DL_PWD_KO_PLC	1	0x00 – 0x63	NA	0x1507	RO	YY: year	Date and time of last bad authentication via PLC.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x1F				DD: day	
	1	0x00 – 0x17				hh: hour	
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
DL_PWD_KO _PLC_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x150E	RO	Date and time of last bad authentication via PLC in POSIX notation with reference to local time.	
N_PWD_KO_HHU	2	0x0000 – 0xFFFF	NA	0x1508	RO	Number of bad authentication by HHU.	
DL_PWD_KO_HHU	1	0x00 – 0x63	NA	0x1509	RO	YY: year	Date and time of last bad authentication by HHU.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x1F				DD: day	
	1	0x00 – 0x17				hh: hour	
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
DL_PWD_KO _HHU_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x150F	RO	Date and time of last bad authentication by HHU in POSIX notation with reference to local time.	
BAD_AUTH_HHU	1	0x01 – 0xFF	NA	0x150A	RW	Number of failed authentication attempts after which the meter has to lock the local optical communication interface. Default value: 0x03.	

Table 154 – Control information parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description
UNLOCK_TO_HHU	1	0x01 – 0xFF	NA	0x150B	RW	It defines the duration of timeout, in hours, starting from the lock instant, at the end of which the meter has to unlock the optical interface.
NUM_OPA_PLC	2	0x0000 – 0xFFFF	NA	0x150C	RO	It indicates the total number of OPA sessions that have been activated.
PLC_LOCK_EN	1	0x00 – 0x01	NA	0x1510	RW	It indicates if the functionality to lock the PLC interface, when an auxiliary switch (e.g. anti-tamper) has been activated, is enabled or not.
PLC_LOCK_TO	2	0x0001 – 0xFFFF	s	0x1511	RW	It indicates the time-out after which the PLC interface has to be enabled even if an auxiliary switch (e.g. anti-tamper) has not been reactivated.

Legend

- t: current moment;
- p: end moment of previous billing period;
- a: end moment of the last but one billing period.

10.19 Normal Status Word

10.19.1 Object

The Normal Status Word is composed by four bytes. The first two bytes are coded with the identifier 0x1601 and the other two bytes are coded with the identifier 0x1602. Each bit of the Normal Status Word represents a flag. Bit = 1 means that the flag is active and bit = 0 means that the flag is not active.

Table 155 – Normal Status Word: byte 1 and 2

ID	0x1601															
bit	0[#]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15[#]
Flag	PUP	ORD	ONSI	AFC	PIC	SGR	C1_SCE		-	ALL	PAD	CPF1_1	CPF2_1	CPF3_1	CPF4_1	FVP

- PUP: It shall be set active after a voltage interruption within the category TLI (long interruption), see “Voltage interruption parameters” table in 10.17.
- ORD: Clock not aligned. This bit is active when the daily clock delay is bigger than the value set in the register Daydrift in the Table 125 “Temporal parameters”. See 5.7.3 for details on clock synchronization procedure.
- ONSI: Meter without temporal reference. It shall be set active if the meter does not have correct time and date information. This flag shall be set active if the RTC date information is not legal.
- AFC: Alarm on communication line. It shall be set active if the phase of the transfer from the Concentrator and the phase of the meter are not equal.
- PIC: Download in progress. It shall be set active once the process of transferring a new firmware from the Concentrator to the meter begins. Cleared only once the process of flash program update is fully complete. See 5.7.5 for details on download procedure.
- SGR: Data segregated. It shall be set active if the meter detects internal errors that will corrupt the meter data base. These errors are DRAM, DEEP, DMIS, DFLA. They are extremely serious and if they are present the meter will suspend all the normal operations. However, the

meter will still respond to communication protocol messages, if possible (e.g. firmware of the meter still working).

- C1_SCE: Meter state for contract #1. See values in Table 157.
- Bit 8: Reserved for future use.
- ALL: Current load modulation. It shall be set active if TK = 1, else clear.
- PAD: Presence of diagnostic alarms. It shall be set active if any of the other status words bits have been changed. This bit has to be reset reading the status words by means of the register with coding “0x003F”.
- CPF1_1: End billing period for tariff #1 in contract #1. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the tariff #1.
- CPF2_1: End billing period for tariff #2 in contract #1. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the tariff #2.
- CPF3_1: End billing period for tariff #3 in contract #1. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the tariff #3.
- CPF4_1: End billing period for tariff #4 in contract #1. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the tariff #4.
- FVP: Programming parameter variations. It shall be set active if the VPP value in “Control information” table changes. The VPP field in that table changes if a parameter requiring the use of the password is updated.

Table 156 – Normal Status Word: byte 3 and 4

ID	**0x1602**															
bit	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Flag	-	-	EG1_F	EG2_F	ELI_F	SMST	NPR	NPW	CPF1_2	CPF2_2	CPF3_2	CPF4_2	-	-	C2_SCE	

- Bit 0: Reserved for future use.
- Bit 1: Reserved for future use.
- EG1_F: E-G1 event register alarm. It has to be set active when the E-G1 event register has reached the 70% of capacity.
- EG2_F: E-G2 event register alarm. It has to be set active when the E-G2 event register has reached the 70% of capacity.
- ELI_F: E-LI event register alarm. It has to be set active when the E-LI event register has reached the 70% of capacity.
- SMST: Synchronized Measurands Snapshot. It shall be set active when the measurand snapshot has been taken in Table 169 and Table 170 “Synchronized measurand registers” (see details in 10.26), at time indicated by the value in the register SYNC_TD_POSIX. It has to be kept set active till the end of the day next to the one in which the snapshot has been taken.
- NPR: Non-protected Read enabled. It has to be set active when the non-protected read operations have been enabled.
- NPW: Non-protected Write enabled. It has to be set active when the non-protected write operations have been enabled.

– CPF1_2: End billing period for tariff #1 in contract #2. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the related tariff.
– CPF2_2: End billing period for tariff #1 in contract #2. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the related tariff.
– CPF3_2: End billing period for tariff #1 in contract #2. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the related tariff.
– CPF4_2: End billing period for tariff #1 in contract #2. It shall be set active on the last day of the current billing period as appropriate, even if the meter has collected no consumption in the related tariff.
– Bit 12: Reserved for future use.
– Bit 13: Reserved for future use.
– C2_SCE: Meter state for Contract #2. See values in Table 157.

Table 157 – Meter state coding table

Cx_SCE		Status	Description
0	0	Not active and not programmed.	Meter has not completed the production process. Calibration, programmable parameters and default values are not in a known state. The state remains until the production software indicates that all production tasks are complete.
0	1	Not active and programmed.	Meter operating with contract disabled.
1	0	Active with reduced functionality.	Meter operating with a tariff error, or any other major error condition (synchronization or tariff structure error).
1	1	Active and programmed.	Normal meter operation.
NOTE # bit can be reset by mean the normal status word reset command.			

10.20 Extended Status Word

10.20.1 Object

It is composed by four bytes. The first two bytes are coded with the identifier 0x1701 and the other two bytes are coded with the identifier 0x1702. Each bit of the Normal Status Word represents a flag. Bit = 1 means that the flag is active and bit = 0 means that the flag is not active.

Table 158 – Extended Status Word: byte 1 and 2

ID	**0x1701**															
bit	**0#**	**1#**	**2**	**3#**	**4#**	**5#**	**6#**	**7#**	**8**	**9#**	**10**	**11#**	**12**	**13#**	**14**	**15**
Flag	WDOG	INTA	-	CAPE	DRAM	DEEP	DFLA	DZCR	-	DMIS	UNLOCKED	DDSP	-	OLU	KP_ON	-

– WDOG: Watch dog alarm. It shall be set active by an irregular reset, not power-fail.
– INTA: Consumption with circuit-breaker open. It shall be set active when the circuit breaker is open and impulses greater than 10Wh are measured.
– Bit 2: Reserved for future use.
– CAPE: Meter case opening. It shall be set active if the meter case is opened.
– DRAM: RAM Diagnostics. It shall be set active if an error is detected within critical data areas. These areas include meter calibration values and total energy registers. The checksum for the meter calibration area is compared to a checksum value generated during manufacture. For the

energy register area the sum of “T1 + T2 + T3 + T4 + T5 + T6” is compared against the total value for both active and reactive power. These tests are performed every second.

- DEEP: EEPROM Diagnostics. It shall be set active if the EEPROM meter does not acknowledge communications correctly. The EEPROM response is tested each time the EEPROM is accessed.
- DFLA: FLASH Diagnostics. It shall be set active if the meter can not reprogram flash memory correctly.
- DZCR: Zero crossing circuit diagnostic. It shall be set active if the device detects an error with the zero crossing signal.
- Bit 8: Reserved for future use.
- DMIS: Measurer circuit diagnostic. It shall be set active if the meter detects an anomaly in the metering system’s diagnostic.
- UNLOCKED: Lock. It shall be set active if the Meter results to be unlocked.
- DDSP: Display circuit diagnostic. It shall be set active if the meter display does not acknowledge data correctly.
- Bit 12: Reserved for future use.
- OLU: Optical interface locked out due failed password attempts. It shall be reset on date change.
- KP_ON: It shall be set active when Kp results to be still set active.
- Bit 15: Reserved for future use.

Table 159 – Extended Status Word: byte 3 and 4

ID	0x1702															
bit	**0**	**1**	**2**	**3#**	**4#**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Flag	ICP	NCO	-	BAT_LOW	TC_REM	-	-	-	-	-	-	-	-	-	-	-

- ICP: It has to be set active when the Power Control actuation function results enabled and all the related parameters are correctly programmed.
- NCO: It has to be set active when the non cut-off functionality results enabled and when the DISI value is 0.
- Bit 2: Reserved for future use.
- BAT_LOW: Battery alarm. It has to be set active when the meter detects a failure of the internal backup battery.
- TC_REM: Terminal cover removed. It has to be set active when the terminal cover results removed from the meter.
- Bit 5: Reserved for future use.
- Bit 6: Reserved for future use.
- Bit 7: Reserved for future use.
- Bit 8: Reserved for future use.
- Bit 9: Reserved for future use.
- Bit 10: Reserved for future use.
- Bit 11: Reserved for future use.
- Bit 12: Reserved for future use.
- Bit 13: Reserved for future use.
- Bit 14: Reserved for future use.
- Bit 15: Reserved for future use.

NOTE # bit can be reset by mean the extended status word reset command.

10.21 Cut-off device control information

The following table contains parameters used to manage the cut-off device.

Table 160 – Cut-off device control parameters

Register	Len	Range	MU	ID	WrRe	Description
Cust_Type	1	0x00 – 0x02	NA	0x1A12	RW	Customer type: this information should be used by the manufacturer to compute the nominal current for the power control algorithm. Default value = 0x00.
ICP_In	2	0x0000 – 0xFFFF	A	0x1A13	RW	Expressed in 0.1 Amp unit. Nominal current value programmable by the operator. If this value is set to 0, the nominal current is computed by the available power of the active tariff corresponding to the contract indicated in the register PC_CONTRACT (see below in this table).
In_inForce	2	0x0000 – 0xFFFF	A	0x1A14	RO	Expressed in 0.1Amp unit. ICP nominal current In_inForce.
ICP_9In_Tbl	2	0x0000 – 0xFFFF	s	0x1A22	RW	When the nominal current is 9 times In_inForce and the standing time is over this register value seconds, the meter has to deliver the cut-off command. Default value: 0x0002.
ICP_3In_Tbl	2	0x0000 – 0xFFFF	s	0x1A23	RW	When the nominal current is 3 times In_inForce and the standing time is over this register value seconds, the meter has to deliver the cut-off command. Default value: 0x000A.

Table 160 – Cut-off device control parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description
ICP_2_5In_Tbl	2	0x0000 – 0xFFFF	s	0x1A24	RW	When the nominal current is 2,5 times In_inForce and the standing time is over this register value seconds, the meter has to deliver the cut-off command. Default value: 0x0032.
ICP_2In_Tbl	2	0x0000 – 0xFFFF	s	0x1A25	RW	When the nominal current is 2 times In_inForce and the standing time is over this register value seconds, the meter has to deliver the cut-off command. Default value: 0x0118.
ICP_1_5In_Tbl	2	0x0000 – 0xFFFF	s	0x1A26	RW	When the nominal current is 1,5 times In_inForce and the standing time is over this register value seconds, the meter has to deliver the cut-off command. Default value: 0x0384.
ICP_1_2In_Tbl	2	0x0000 – 0xFFFF	s	0x1A27	RW	When the nominal current is 1,2 times In_inForce and the standing time is over this register value seconds, the meter has to deliver the cut-off command. Default value: 0x0BB8.
IRms	2	0x0000 – 0xFFFF	A	0x1A28	RO	Expressed in 0.01Amp. Instantaneous value of current measured.
PC_CONTRACT	1	0x00 – 0x02	NA	0x1A29	RW	It indicates the contract from which the meter has to get the available power in order to perform the power control algorithm.
CAR_EN	1	0x00 – 0x01	NA	0x1A2A	RW	It indicates the status of the automatic closure function of cut-off device. 0x00 = Disabled 0x01 = Enabled
INST_CLOSURE	4	0x0…0 – 0x7FFFFFFF	s	0x1A2B	RW*	It indicates the time stamp of the command issued to the meter in order to perform the closure of the cut-off device.
ITH_NoCutoff	2	0x0000 – 0xFFFF	A	0x1A2C	RW	Expressed in 0.1Amp unit. It indicates the current threshold beyond which the meter has not to send cut-off commands to relay due to power control function.

10.22 Display management

10.22.1 Object

The following table manages the message to be showed on the meter display. Messages automatically flow on the display or they are manually showed at every meter's button pushing. Four timeout values may be defined in the registers TMSTBY, RM_TO, FREEZE_TO and CIC_ST, to specify the time interval between two messages that flow automatically. See more details in 5.7.6.

Table 161 – Display management parameters

Register	Len	Range	MU	ID	WrRe	Description
DSP_i (i=1,…,240, maximum value of message can be showed)	2	0x0000 – 0FFFF	NA	From 0x1B01 To 0x1BF0	RW	DSP_SYM: a set of flags corresponding to each special symbol to be displayed. When a flag bit is 1, the associated symbol is displayed.
	2	0x0000 – 0xFFFF	NA			DSP_CODING: code number of the meter register to be displayed.
	1	0x00 – 0xC8	NA			MSG_ID: an unique message identification code assigned by the Back Office to each message structure in the table.
	16	Full range	NA			DSP_TEXT: contains the actual text to be displayed and it is comprised of 16 ASCII characters. A special character '}' is used to indicate where in the message the selected register has to be placed.
	1	0x00 – 0xFF	NA			DSP_SM: if non-zero, it gives the number of one of the 104 special messages. They are pre-defined messages that are used in order to optimize the visualization of data related to measurements of different tariffs. An example would be a message to display the active tariff in conjunction with its associated total consumption register. See how a special message can be display in 10.23.3.
	1	0x00 – 0x10	NA			DSP_DIVIDE: number (power of 10) by which the absolute value held in the register is divided for.
	1	0x00 – 0xFF	NA			DSP_SI: set of flags indicating special instructions for the message. These may include instructions to display the specified register as text or maybe to display leading zeroes. See values below in Table 162.
TMSTBY	1	0x00 – 0xFF	s	0x1BF1	RW	It is a programmable timeout that defines the time interval between messages showed by the display. It is configured in the CTRL sub field of RMML register in Table 179 (see 10.32).

Table 161 – Display management parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description
BUTTON_MSG_1	32*1	0x00 – 0xFF	NA	0x1BF2	RW	A list of 32 MSG_ID that identify the messages which can be moved through each time the push button is activated. The list is split into two table registers because the maximum message payload is 64 bytes including message descriptors and digest.
BUTTON_MSG_2	32*1	0x00 – 0xFF	NA	0x1BF3	RW	See BUTTON_MSG_1 definition.
NL_TO	1	0x00 – 0xFF	NA	0x1BF4	RW	It indicates the amount of seconds of no load condition after that the meter has to lit up the related pulse emitter (active and/or reactive energy).
PE_REACTIVE	1	0x00 – 0x01	NA	0x1BF5	RW	This register is used to switch the active pulse emitter to the visualization of reactive energy instead of active energy. 0x00 = The active pulse emitter has to show active energy 0x01 = The active pulse emitter has to show reactive energy
WI_CONF	8	NA	NA	0x1BF6	RW	Each bit of this register is associated to one flag of the two status words. These bits indicate which flags have to be evaluated. If one flag of the status words is set active, the warning icon of the LCD has to be activated.
RM_TO	1	0x00 – 0xFF	s	0x1BF7	RW	It is a programmable timeout that defines the time interval between messages showed by the display. It is configured in the CTRL sub field of RMML register in Table 179 (see 10.32).
FREEZE_TO	1	0x00 – 0xFF	s	0x1BF8	RW	It is a programmable timeout that defines the time interval between messages showed by the display. It is configured in the CTRL sub field of RMML register in Table 179 (see 10.32).
CIC_ST	1	0x00 – 0xFF	s	0x1BF9	RW	It is a programmable timeout that defines the time interval between messages showed by the display. It is configured in the CTRL sub field of RMML register in Table 179 (see 10.32).
NNM_TO	1	0x00 – 0xFF	NA	0x1BFA	RW	It defines the timeout, in minutes, after which the meter has to switch off the blinking “Communication Icon” due to detection of no new messages to other meters or no new messages addressed to itself sent by the Concentrator.
The maximum message length is 16 characters. Longer messages shall be split up and placed into multiple table entries.						

Table 162 – DSP_SI coding table

Flag	Instruction
0x01	The message to be displayed is text only (also numbers are managed as text).
0x02	The register is a sequence of bytes. A byte-to-text conversion is needed before displaying.
0x04	Show leading zeros. A zero padding is used if the number of digits is lower than the size of the field to be displayed.
0x08	Start from tail end (used in conjunction with 0x02 byte sequence).
0x10	Replace ‘?’ with indicator ‘-‘ or ‘ ‘ for signed register values.
0x20	The value of the register is shown in HEX format.
0x40	The meter shows “ON” if the register results ≠ 0; the meter shows “OFF” if the register results = 0.
0x80	The meter shows time/date fields of a POSIX time/date stamp in the following readable format “hhmmssDDMMYY”.

10.22.2 Message displaying example

To display the RMS value of the voltage for a single-phase meter (RMS_V(t) register in Table 177 “Measurand register”, see 10.31), the DSP configuration, in message #1, is the following:

Table 163 – Example of message

DSP_1						
DSP_SYM	**DSP_CODING**	**MSG_ID**	**DSP_TEXT**	**DSP_SM**	**DSP_DIVIDE**	**DSP_SI**
0x0000	0x4909	0x01	V o l t a g e = } } } , } V	0x00	0x00	0x04

The display will show: “**Voltage=231,1 V**”.

10.22.3 Special message example

The following DSP configuration shows the special message #35, “For the previous billing period, the virtual power maximum demand C1V_PMD(p-a) has to be shown for those tariffs that are held in the weekly tariff structure of contract #1”:

Table 164 – Example of special message

DSP_1						
DSP_SYM	**DSP_CODING**	**MSG_ID**	**DSP_TEXT**	**DSP_SM**	**DSP_DIVIDE**	**DSP_SI**
0x1000	0x472B	0x01	P w M x D e m 1 p = } } } } } }	0x23	0x03	0x04

The display will show: “**PwMxDem1p=005996**” and the “**kW**” icon is displayed.

10.23 Download parameters

10.23.1 Object

The following table contains information and parameters used for the download, the storage and the activation of a new version of the meter’s firmware.

The meter’s firmware should be composed by the following parts:

– Boot-Loader: this part of software is fixed and is programmed into the meter FLASH memory during the manufacturing process;

– APP1: this part of software is downloadable and is stored in the FLASH memory portion of the meter dedicated to APP1. It shall store the firmware code that implements the functionalities of the meter;

– APP2: this part of software is downloadable and is stored in the FLASH memory portion of the meter dedicated to APP2. It shall store the firmware code that implements the functionalities of the meter;

– MODEM: this part of software is downloadable and is stored in the FLASH memory of the modem. It shall store the firmware code that implements the functionalities of the modem.

Table 165 – Download parameters

<table>
<tr><th>Register</th><th>Len</th><th>Range</th><th>MU</th><th>ID</th><th>WrRe</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">SWOT</td><td>1</td><td>0x00 – 0x17</td><td rowspan="6">NA</td><td rowspan="6">0x1C01</td><td rowspan="6">RW*</td><td>hh: hour</td><td rowspan="6">Time and Date of the new firmware switchover.</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td>mm: minute</td></tr>
<tr><td>1</td><td>0x00 – 0x3B</td><td>ss: second</td></tr>
<tr><td>1</td><td>0x01 – 0x1F</td><td>DD: day</td></tr>
<tr><td>1</td><td>0x01 – 0x0C</td><td>MM: month</td></tr>
<tr><td>1</td><td>0x00 – 0x63</td><td>YY: year</td></tr>
<tr><td>SWOT_POSIX</td><td>4</td><td>0x0...0 – 0x7FFFFFFF</td><td>s</td><td>0x1C0A</td><td>RW*</td><td colspan="2">Switchover date in POSIX notation with reference to local time.</td></tr>
</table>

Table 165 – Download parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description	Register
FRAD	2	0x0000 – 0x0BB8	NA	0x1C02	RW*	YY: year	Starting date of the firmware download and digital sign of the firmware image. The Back Office (through the Concentrator) sends these information to communicate when the reprogramming of the meter has to be performed, and to allow the meter to check the correctness of the downloaded image.
	1	0x01 – 0x0C				MM: month	
	1	0x01 – 0x1F				DD: day	
	1	0x00 – 0x17				hh: hour	
	1	0x00 – 0x3B				mm: minute	
	1	0x00 – 0x3B				ss: second	
	1	0x00 – 0x01				DST flag 0 = DST not active 1 = DST active	
	8	0x0…0 – 0xF…F				Digital sign of the sent binary image.	
FRAD_POSIX	4	0x0…0 – 0x7FFFFFFF	NA	0x1C0B	RW*	Reprogramming date in POSIX notation with reference to local time.	
	1	0x00 – 0x01				DST flag. 0 = DST not active 1 = DST active	
	8	0x0…0 – 0xF…F				Digital sign of the sent binary image.	
FRCW	2	0x0000 – 0xFFFF	NA	0x1C03	RW*	Control word. It indicates the status of downloading process. See coded values in Table 166.	
FRFPN	2	0x0000 – 0x0400	NA	0x1C04	RW*	Total number of packet to be received for new firmware version.	
$PSTTS_1$	32	Full range	NA	0x1C05	RO	This block of status flags is available for the implementation of retransmission management functionalities. Each bit of the registers is associated to a firmware's packet. Bit = 1: packet is received Bit = 0: packet is not received	
$PSTTS_2$	32	Full range		0x1C06			
$PSTTS_3$	32	Full range		0x1C07			
$PSTTS_4$	32	Full range		0x1C08			

Table 165 – Download parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description	Register
APP1_SW_DEP	2	NA	NA	0x1C0C	RO	Version number for APP1 FW	It indicates the pointers for APP1 SW portion.
	2	NA				Parameter that points at APP2 FW	
	2	NA				Parameter that points at MODEM FW	
APP2_SW_DEP	2	NA	NA	0x1C0D	RO	Parameter that points at APP1 FW	It indicates the pointers for APP2 SW portion.
	2	NA				Version number for APP2 FW	
	2	NA				Parameter that points at MODEM FW	
MODEM_SW_DEP	2	NA	NA	0x1C0E	RO	Parameter that points at APP1 FW	It indicates the pointers for MODEM SW portion.
	2	NA				Parameter that points at APP2 FW	
	2	NA				Version number for MODEM FW	

Table 166 – FRCW register values

FRCW	Status	Description
0x01	INPROGRESS	The meter has started the download process (the meter has received a correct start-load command).
0x02	RECEIVEDALL	The meter has received all the packets of the new firmware.
0x04	DIGESTERR	The meter has verified that the digest of the new firmware is not correct.
0x08	SWITCHREADY	The meter has verified that the digest of the new firmware is correct.
0x10	SWITCHDONE	The meter has performed the reboot for swapping to the new firmware and it has verified that the firmware is correct for 5 seconds.
0x20	SWITCHFAIL	The meter has performed the reboot for swapping to the new firmware and has verified that the firmware is not correct.
0x40	SWITCHNOW	The meter has received the command for swapping to the new firmware version but the reboot has not performed yet.
0x1234	ABORTLOAD	The meter has to abort the download process.

10.24 Measurand profiles and parameters

10.24.1 Object

In the tables “Load profile for A+ and R+$_L$ and setting parameters”, “Load profile for A- and R-$_L$” and “Load profile for R+$_C$ and R-$_C$” (see 10.5) six load profiles are available in the registers V_W, V_Qa, W-, Q-$_L$a, Q+$_C$a and Q-$_C$a.

In the following table, further three load profiles may be stored setting the values of registers MSR_TYPx (x=1, 2, 3), that indicates (see Table 168 below) which kind of measurand shall be store in register MSR_x (x=1, 2, 3).

Table 167 – Measurand profiles and parameters

Register	Len	Range	MU	ID	WrRe	Description
MSR_1$_i$(T$_{MP}$) (i=1,…,28)	30*2	0x0000 – 0xFFFF	NA	From 0x4101 To 0x411C	RO	Measurand profile #1 circular buffer (28 registers containing 30 samples of 2 bytes).
MSR_2$_i$(T$_{MP}$) (i=1,…,28)	30*2	0x0000 – 0xFFFF	NA	From 0x411D To 0x4138	RO	Measurand profile #2 circular buffer (28 registers containing 30 samples of 2 bytes).
MSR_3$_i$(T$_{MP}$) (i=1,…,28)	30*2	0x0000 – 0xFFFF	NA	From 0x4139 To 0x4154	RO	Measurand profile #3 circular buffer (28 registers containing 30 samples of 2 bytes).
MSR_Buff	4	0x0…0 – 0x7FFFFFFF	s	0x4155	RO	TimeEnd: time and date at which the buffer ends for all the profiles in POSIX notation with reference to local time.
	2	0x0000 – 0xFFFF	NA			Index: index to the next sample to be stored for all the profiles.
	2	0x0000 – 0xFFFF	NA			NumVal: number of valid samples for all the profiles.

Table 167 – Measurand profiles and parameters (continued)

Register	Len	Range	MU	ID	WrRe	Description
T_{MP}	1	0x01 – 0x09	NA	0x4156	RW	Time period from 1 minute to 24 hours. 0x01 = 1 minute 0x02 = 5 minutes 0x03 = 10 minutes 0x04 = 15 minutes 0x05 = 1 hour 0x06 = 2 hours 0x07 = 4 hours 0x08 = 12 hours 0x09 = 24 hours
MSR_TYP1	1	0x00 – 0x11	NA	0x4157	RW	It indicates the measurand that has to be stored into measurand profile #1. See coded values below in Table 168.
MSR_TYP2	1	0x00 – 0x11	NA	0x4158	RW	It indicates the measurand that has to be stored into measurand profile #2. See coded values below in Table 168.
MSR_TYP3	1	0x00 – 0x11	NA	0x4159	RW	It indicates the measurand that has to be stored into measurand profile #3. See coded values below in Table 168.
SS_MSR1	4	0x0…0 – 0x3B9AC9FF	Wh/varh	0x415A	RO	Snapshot of the instantaneous totalizer of the specific energy instantaneous register taken at the beginning of the youngest sample of the measurand profile. The energy instantaneous register is evaluated in coherence with the measurand indicated by MSR_TYP1 (only energy values, from 0x01 to 0x06). MU depends on the measurand type.
SS_MSR2	4	0x0…0 – 0x3B9AC9FF	Wh/varh	0x415B	RO	Snapshot of the instantaneous totalizer of the specific energy instantaneous register taken at the beginning of the youngest sample of the measurand profile. The energy instantaneous register is evaluated in coherence with the measurand indicated by MSR_TYP2 (only energy values, from 0x01 to 0x06). MU depends on the measurand type.
SS_MSR3	4	0x0…0 – 0x3B9AC9FF	Wh/varh	0x415C	RO	Snapshot of the instantaneous totalizer of the specific energy instantaneous register taken at the beginning of the youngest sample of the measurand profile. The energy instantaneous register is evaluated in coherence with the measurand indicated by MSR_TYP3 (only energy values, from 0x01 to 0x06). MU depends on the measurand type.

Table 168 – MSR_TYPx register coding table

MSR_TYPx	Description
0x01	Positive active energy A+(t)
0x02	Negative active energy A-(t)
0x03	Positive inductive reactive energy $R+_L(t)$
0x04	Positive capacitive reactive energy $R+_C(t)$
0x05	Negative inductive reactive energy $R-_L(t)$
0x06	Negative capacitive reactive energy $R-_C(t)$
0x07	Positive active power W+(t)
0x08	Negative active power W-(t)
0x09	Positive inductive reactive power $Q+_L(t)$
0x0A	Positive capacitive reactive power $Q+_C(t)$
0x0B	Negative inductive reactive power $Q-_L(t)$
0x0C	Negative capacitive reactive power $Q-_C(t)$
0x0D	RMS line-phase voltage RMS_V(t)
0x0E	RMS line-phase current RMS_I(t)
0x0F	Power factor COS_PHI(t)
0x10	Last quarter of hour mean positive active power LQM_W+(t)
0x11	Last quarter of hour mean negative active power LQM_W-(t)

The most significant bit of each value is encoded as follows:

– 0 = period data logged OK;
– 1 = unreliable data (due to clock not valid [ORD] and/or critical alarm [SGR]).

10.25 Synchronized measurand registers

The registers of the following tables (single-phase and polyphase ones) contain snapshot values of the measurands stored in tables “Total energy registers” (Table 116) and “Measurand register” (Table 177 and Table 178). These snapshots are taken at time specified in the register SYNC_TD_POSIX. The time information about the last taken snapshot values are available in the register SYNC_TS_POSIX.

Table 169 – Synchronized measurand registers (single-phase meter)

Register	Len	Range	MU	ID	WrRe	Description
VA(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4201	RO	Snapshot of the virtual register containing the total values of active energy computed by the meter from the starting day until the current moment.
VR(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4202	RO	Snapshot of the virtual register containing the total values of reactive energy computed by the meter from the starting day until the current moment.
A+(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4203	RO	Snapshot of the register containing the total values of positive active energy computed by the meter from the start day until the current moment.
A-(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4204	RO	Snapshot of the register containing the total values of negative active energy computed by the meter from the start day until the current moment.
$R+_L(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x4205	RO	Snapshot of the register containing the total values of positive reactive inductive energy computed by the meter from the start day until the current moment.
$R+_C(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x4206	RO	Snapshot of the register containing the total values of positive reactive capacitive energy computed by the meter from the start day until the current moment.
$R-_L(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x4207	RO	Snapshot of the register containing the total values of negative reactive inductive energy computed by the meter from the start day until the current moment.
$R-_C(t)$	4	0x0…0 – 0x3B9AC9FF	varh	0x4208	RO	Snapshot of the register containing the total values of negative reactive capacitive energy computed by the meter from the start day until the current moment.
V_W(t)	2	0x0000 – 0xFFFF	W	0x4209	RO	Snapshot of the virtual register containing the active mean power evaluated in 1 second.
V_Q(t)	2	0x0000 – 0xFFFF	var	0x420A	RO	Snapshot of the virtual register containing the reactive mean power evaluated in 1 second.
W+(t)	2	0x0000 – 0xFFFF	W	0x420B	RO	Snapshot of the register containing the active positive mean power evaluated in 1 second.

Table 169 – Synchronized measurand registers (single-phase meter) (continued)

Register	Len	Range	MU	ID	WrRe	Description
W-(t)	2	0x0000 – 0xFFFF	W	0x420C	RO	Snapshot of the register containing the active negative mean power evaluated in 1 second.
$Q+_{L}(t)$	2	0x0000 – 0xFFFF	var	0x420D	RO	Snapshot of the register containing the reactive positive inductive mean power evaluated in 1 second.
$Q+_{C}(t)$	2	0x0000 – 0xFFFF	var	0x420E	RO	Snapshot of the register containing the reactive positive capacitive mean power evaluated in 1 second.
$Q-_{L}(t)$	2	0x0000 – 0xFFFF	var	0x420F	RO	Snapshot of the register containing the reactive negative inductive mean power evaluated in 1 second.
$Q-_{C}(t)$	2	0x0000 – 0xFFFF	var	0x4210	RO	Snapshot of the register containing the reactive negative capacitive mean power evaluated in 1 second.
RMS_V(t)	2	0x0000 – 0xFFFF	V	0x4211	RO	Snapshot of the register containing the mean value of RMS voltage of low voltage network evaluated in 1 second.
RMS_I(t)	2	0x0000 – 0xFFFF	dA	0x4212	RO	Snapshot of the register containing the mean value of RMS line current evaluated in 1 second.
COS_PHI(t)	2	0x0000 – 0x0001	NA	0x4213	RO	Snapshot of the register containing the mean value of Cos(phi) evaluated in 2 seconds.
LQM_VW(t)	2	0x0000 – 0xFFFF	W	0x4214	RO	Snapshot of the register containing the last quarter of hour mean virtual active power.
LQM_W+(t)	2	0x0000 – 0xFFFF	W	0x4215	RO	Snapshot of the register containing the last quarter of hour mean positive active power.
LQM_W-(t)	2	0x0000 – 0xFFFF	W	0x4216	RO	Snapshot of the register containing the last quarter of hour mean positive active power.
SYNC_TS_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4217	RO	It indicates the time-stamp of the last synchronized snapshot of measurands in POSIX notation with reference to local time.
SYNC_TD_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4218	RW	It indicates the time and date at which the snapshot of measurands have to be taken in POSIX notation with reference to local time.
SYNC_Period	1	0x00 – 0x1F	NA	0x4219	RW	DD: day — It indicates the periodicity of the snapshots, if any. See Table 171.
	1	0x00 – 0x0C	NA			MM: month

Table 170 – Synchronized measurand register (polyphase meter)

Register	Len	Range	MU	ID	WrRe	Description
VA(t)	4	0x00 – 0x3B9AC9FF	Wh	0x4201	RO	Snapshot of the virtual register containing the total values of active energy computed by the meter from the starting day until the current moment.
VR(t)	4	0x00 – 0x3B9AC9FF	varh	0x4202	RO	Snapshot of the virtual register containing the total values of reactive energy computed by the meter from the starting day until the current moment.
A+(t)	4	0x00 – 0x3B9AC9FF	Wh	0x4203	RO	Snapshot of the register containing the total values of positive active energy computed by the meter from the start day until the current moment.
A-(t)	4	0x00 – 0x3B9AC9FF	Wh	0x4204	RO	Snapshot of the register containing the total values of negative active energy computed by the meter from the start day until the current moment.
$R+_L(t)$	4	0x00 – 0x3B9AC9FF	varh	0x4205	RO	Snapshot of the register containing the total values of positive reactive inductive energy computed by the meter from the start day until the current moment.
$R+_C(t)$	4	0x00 – 0x3B9AC9FF	varh	0x4206	RO	Snapshot of the register containing the total values of positive reactive capacitive energy computed by the meter from the start day until the current moment.
$R-_L(t)$	4	0x00 – 0x3B9AC9FF	varh	0x4207	RO	Snapshot of the register containing the total values of negative reactive inductive energy computed by the meter from the start day until the current moment.
$R-_C(t)$	4	0x00 – 0x3B9AC9FF	varh	0x4208	RO	Snapshot of the register containing the total values of negative reactive capacitive energy computed by the meter from the start day until the current moment.
V_W(t)	2	0x00 – 0xFFFF	W	0x4209	RO	Snapshot of the virtual register containing the active mean power evaluated in 1 second.
V_Q(t)	2	0x00 – 0xFFFF	var	0x420A	RO	Snapshot of the virtual register containing the reactive mean power evaluated in 1 second.
W+(t)	2	0x00 – 0xFFFF	W	0x420B	RO	Snapshot of the register containing the active positive mean power evaluated in 1 second.
W-(t)	2	0x00 – 0xFFFF	W	0x420C	RO	Snapshot of the register containing the active negative mean power evaluated in 1 second.
$Q+_L(t)$	2	0x00 – 0xFFFF	var	0x420D	RO	Snapshot of the register containing the reactive positive inductive mean power evaluated in 1 second.

Table 170 – Synchronized measurand register (polyphase meter) (continued)

Register	Len	Range	MU	ID	WrRe	Description
$Q+_C(t)$	2	0x00 – 0xFFFF	var	0x420E	RO	Snapshot of the register containing the reactive positive capacitive mean power evaluated in 1 second.
$Q-_L(t)$	2	0x00 – 0xFFFF	var	0x420F	RO	Snapshot of the register containing the reactive negative inductive mean power evaluated in 1 second.
$Q-_C(t)$	2	0x00 – 0xFFFF	var	0x4210	RO	Snapshot of the register containing the reactive negative capacitive mean power evaluated in 1 second.
$RMS\_V_R(t)$	2	0x00 – 0xFFFF	V	0x4211	RO	Snapshot of the register containing the mean value of RMS voltage of R phase evaluated in 1 second.
$RMS\_V_S(t)$	2	0x00 – 0xFFFF	V	0x421B	RO	Snapshot of the register containing the mean value of RMS voltage of S phase evaluated in 1 second.
$RMS\_V_T(t)$	2	0x00 – 0xFFFF	V	0x421C	RO	Snapshot of the register containing the mean value of RMS voltage of T phase evaluated in 1 second.
$RMS\_I_R(t)$	2	0x00 – 0xFFFF	dA	0x4212	RO	Snapshot of the register containing the mean value of RMS R-line line current evaluated in 1 second.
$RMS\_I_S(t)$	2	0x00 – 0xFFFF	dA	0x421D	RO	Snapshot of the register containing the mean value of RMS S-line line current evaluated in 1 second.
$RMS\_I_T(t)$	2	0x00 – 0xFFFF	dA	0x421E	RO	Snapshot of the register containing the mean value of RMS T-line line current evaluated in 1 second.
COS_PHI(t)	2	0x00 – 0x01	NA	0x4213	RO	Snapshot of the register containing the mean value of Cos(phi) evaluated in 2 seconds.
LQM_VW(t)	2	0x00 – 0xFFFF	W	0x4214	RO	Snapshot of the register containing the last quarter of hour mean virtual active power.
LQM_W+(t)	2	0x00 – 0xFFFF	W	0x4215	RO	Snapshot of the register containing the last quarter of hour mean positive active power.
LQM_W-(t)	2	0x00 – 0xFFFF	W	0x4216	RO	Snapshot of the register containing the last quarter of hour mean positive active power.
SYNC_TS_POSIX	4	0x00 – 0x7FFFFFFF	s	0x4217	RO	It indicates the time-stamp of the last synchronized snapshot of measurands in POSIX notation with reference to local time.

Table 170 – Synchronized measurand register (polyphase meter) (continued)

Register	Len	Range	MU	ID	WrRe	Description	
SYNC_TD_POSIX	4	0x00 – 0x7FFFFFFF	s	0x4218	RW	It indicates the time and date at which the snapshot of measurands have to be taken in POSIX notation with reference to local time.	
SYNC_Period	1	0x01 – 0x1F	NA	0x4219	RW	DD: day	It indicates the periodicity of the snapshots, if any. See Table 171.
	1	0x01 – 0x0C	NA			MM: month	

Legend

– t: current moment.

Table 171 – SYNC_Period coding table

DD	MM	Description
0x00	0x00	The meter has to perform the snapshot only once at programmed time and date.
0x01 to 0x1F	0x00	The meter has to perform the snapshot every DD days starting from the programmed date and at programmed time.
0x00	0x01 to 0x0C	The meter has to perform the snapshot every MM months starting from the programmed date and at programmed time and day indicated by SYNC_TD_POSIX register.
0x01 to 0x1F	0x01 to 0x0C	The meter has to reject this configuration by answering with a NACK message.

10.26 Event log management

The following table contains the parameters used to manage the log of events. Three levels of event are foreseen and for each level a log is defined in the table “Event logger registers”: EG1, EG2 and ELI. A log can contain up to 30 events. An event is composed by the following four fields stored in registers EG1_log, EG2_log and ELI_log:

– ID: it is the sequential number used to sort the events within the log;
– TS_POSIX: it is the time stamp at which the event has been added in the log;
– COD: it is the identification code of the event;
– STATUS: it contains the status and information related to the event.

A possible list of events and actions that occur within the meter is described in Table 181.

Table 172 – Event logger registers

Register	Len	Range	MU	ID	WrRe	Description
$EG1\_log_i$ (i=1,…,30)	2	0x0000 – 0xFFFF	NA	From 0x4401 To 0x441E	RO	ID: it indicates the index number of the event. It has to roll-over when its value reaches 65535.
	4	0x0…0 – 0x7FFFFFFF	s		RO	TS_POSIX: it indicates the time and date (time stamp) at which the event has been added to the log in POSIX notation with reference to local time.
	1	0x00 – 0xFF	NA		RO	COD: it indicates the identification code of the event.
	10	0x0…0 – 0xF…F	NA		RO	STATUS: it indicates the status codes and/or information related to the event.
G1_log	1	0x00 – 0x1D	NA	0x441F	RO	IndexG1: index to the last event stored and not yet read.
	1	0x00 – 0x1E	NA			NumValG1: number of events not yet read.
POP_EG1	17	NA	NA	0x4420	RO	It provides the oldest event stored into the $EG1\_log_i$ register and not yet read, then it is removed from $EG1\_log_i$ and the NumValG1 value in G1_log register is reduced by 1 unit.
$EG2\_log_j$ (j=1,…,60)	2	0x0000 – 0xFFFF	NA	From 0x4421 To 0x445C	RO	ID: it indicates the index number of the event. It has to roll-over when its value reaches 65535.
	4	0x0…0 – 0x7FFFFFFF	s		RO	TS_POSIX: it indicates the time and date (time stamp) at which the event has been added to the log in POSIX notation with reference to local time.
	1	0x00 – 0xFF	NA		RO	COD: it indicates the identification code of the event.
	10	0x0…0 – 0xF…F	NA		RO	STATUS: it indicates the status codes and/or information related to the event.
G2_log	1	0x00 – 0x1D	NA	0x445F	RO	IndexG2: index to the last event stored and not yet read.
	1	0x00 – 0x1E	NA			NumValG2: number of events not yet read.
POP_EG2	17	NA	NA	0x4460	RO	It provides the oldest event stored into the $EG2\_log_i$ register and not yet read, then it is removed from $EG2\_log_i$ and the NumValG2 value in G2_log register is reduced by 1 unit.

Table 172 – Event logger registers (continued)

Register	Len		Range	MU	ID	WrRe	Description
ELI_log$_i$ (i=1,…,30)	2		0x0000 – 0xFFFF	NA	From 0x4461 To 0x447E	RO	ID: it indicates the index number of the event. It has to roll-over when its value reaches 65535.
	4		0x0…0 – 0x7FFFFFFF	s		RO	TS_POSIX: it indicates the time and date (time stamp) at which the event has been added to the log in POSIX notation with reference to local time.
	1		0x00 – 0xFF	NA		RO	COD: it indicates the identification code of the event.
	10		0x0…0 – 0xF…F	NA		RO	STATUS: it indicates the status codes and/or information related to the event.
LI_log	2		0x0000 – 0xFFFF	NA	0x447F	RO	IndexLI: index to the last event stored and not yet read.
	2		0x0000 – 0xFFFF	NA			NumValLI: number of events not yet read.
POP_ELI	17		NA	NA	0x4480	RO	It provides the oldest event stored into the ELI_log$_i$ register and not yet read, then it is removed from ELI_log$_i$ and the NumValLI value in LI_log register is reduced by 1 unit.
EVE_BLIST	8*	1	NA	NA	0x4481	RW	COD: code of the event to be included in the blacklist. The blacklist contains events generated by the meter that have to be discarded.
		1	NA	NA		RW	It indicates the table coding stored into the event STATUS sub field of the event entry to be included in the blacklist.

10.27 Billing data information

The following tables contain data needed for the billing, both for contract #1 and contract #2. Registers are divided in two groups of values: the first one is related to quantities evaluated for a contract with import configuration and the second one is related to quantities evaluated for a contract with export configuration (see 10.11 for types of contract). For each kind of measure, a per-tariff value and the corresponding total value (sum of the six tariffs values) are stored in the registers.

The excess energy value is the amount of energy measured by the meter when the power absorbed by the customer is higher than the contractual power.

Table 173 – Billing data registers for contract #1

Register	Len	Range	MU	ID	WrRe	Description
C1I_A(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4501	RO	Total active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C1I_A$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4502 To 0x4507		Per-tariff active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C1I_R(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4508	RO	Total reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C1I_R$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4509 To 0x450E		Per-tariff reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C1I_PMD(t-p)	2	0x0000 – 0xFFFF	W	0x450F	RO	Total power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “p” (see below in Legend) until the current moment.
C1I_PMD$_{Tj}$(t-p) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4510 To 0x4515		Per-tariff power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1I_Exc(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4516	RO	Total excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C1I_Exc$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4517 To 0x451C		Per-tariff excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C1I_A(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x451D	RO	Total active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
C1I_A$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x451E To 0x4523		Per-tariff active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1I_R(p)	4	0x0…0 – 0x3B9AC9FF	varh	0x4524	RO	Total reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
$C1I\_R_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4525 To 0x452A		Per-tariff reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C1I_PMD(p-a)	2	0x0000 – 0xFFFF	W	0x452B	RO	Total power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
$C1I\_PMD_{Tj}(p-a)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x452C To 0x4531		Per-tariff power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C1I_Exc(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4532	RO	Total excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
$C1I\_Exc_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4533 To 0x4538		Per-tariff excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
C1I_A(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4539	RO	Total active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
$C1I\_A_{Tj}(a)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x453A To 0x453F		Per-tariff active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1I_R(a)	4	0x0…0 – 0x3B9AC9FF	varh	0x4540	RO	Total reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C1I_R$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4541 To 0x4546		Per-tariff reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C1I_PMD(a-b)	2	0x0000 – 0xFFFF	W	0x4547	RO	Total power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C1I_PMD$_{Tj}$(a-b) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4548 To 0x454D		Per-tariff power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C1I_Exc(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x454E	RO	Total excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C1I_Exc$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x454F To 0x4554		Per-tariff excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C1I_A(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4555	RO	Total active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C1I_A$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4556 To 0x455B		Per-tariff active energy evaluated only for contract #1 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1I_R(b)	4	0x0…0 – 0x3B9AC9FF	varh	0x455C	RO	Total reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C1I_R$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x455D To 0x4562		Per-tariff reactive energy evaluated only for contract #1 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C1I_PMD(b-d)	2	0x0000 – 0xFFFF	W	0x4563	RO	Total power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C1I_PMD$_{Tj}$(b-d) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4564 To 0x4569		Per-tariff power maximum demand evaluated only for contract #1 with import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C1I_Exc(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x456A	RO	Total excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
C1I_Exc$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x456B To 0x4570		Per-tariff excess active energy evaluated only for contract #1 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
C1E_A(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4571	RO	Total active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the current moment.
C1E_A$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4572 To 0x4577		Per-tariff active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the current moment.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1E_R(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4578	RO	Total reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
$C1E\_R_{Tj}(t)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4579 To 0x457E		Per-tariff reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C1E_PMD(t-p)	2	0x0000 – 0xFFFF	W	0x457F	RO	Total power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
$C1E\_PMD_{Tj}(t-p)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4580 To 0x4585		Per-tariff power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1E_Exc(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4586	RO	Total excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
$C1E\_Exc_{Tj}(t)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4587 To 0x458C		Per-tariff excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C1E_A(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x458D	RO	Total active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
$C1E\_A_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x458E To 0x4593		Per-tariff active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1E_R(p)	4	0x0…0 – 0x3B9AC9FF	varh	0x4594	RO	Total reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
$C1E\_R_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4595 To 0x459A		Per-tariff reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C1E_PMD(p-a)	2	0x0000 – 0xFFFF	W	0x459B	RO	Total power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
$C1E\_PMD_{Tj}(p-a)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x459C To 0x45A1		Per-tariff power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C1E_Exc(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x45A2	RO	Total excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
$C1E\_Exc_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x45A3 To 0x45A8		Per-tariff excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
C1E_A(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x45A9	RO	Total active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
$C1E\_A_{Tj}(a)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x45AA To 0x45AF		Per-tariff active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1E_R(a)	4	0x0…0 – 0x3B9AC9FF	varh	0x45B0	RO	Total reactive energy evaluated according with contract #1 for export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C1E_R$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x45B1 To 0x45B6		Per-tariff reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C1E_PMD(a-b)	2	0x0000 – 0xFFFF	W	0x45B7	RO	Total power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C1E_PMD$_{Tj}$(a-b) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x45B8 To 0x45BD		Per-tariff power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C1E_Exc(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x45BE	RO	Total excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C1E_Exc$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x45BF To 0x45C4		Per-tariff excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C1E_A(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x45C5	RO	Total active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C1E_A$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x45C6 To 0x45CB		Per-tariff active energy evaluated only for contract #1 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.

Table 173 – Billing data registers for contract #1 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1E_R(b)	4	0x0…0 – 0x3B9AC9FF	varh	0x45CC	RO	Total reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
$C1E\_R_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x45CD To 0x45D2		Per-tariff reactive energy evaluated only for contract #1 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C1E_PMD(b-d)	2	0x0000 – 0xFFFF	W	0x45D3	RO	Total power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
$C1E\_PMD_{Tj}(b\text{-}d)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x45D4 To 0x45D9		Per-tariff power maximum demand evaluated only for contract #1 with export-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C1E_Exc(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x45DA	RO	Total excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
$C1E\_Exc_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x45DB To 0x45E0		Per-tariff excess active energy evaluated only for contract #1 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.

Table 174 – Billing data registers for contract #2

Register	Len	Range	MU	ID	WrRe	Description
C2I_A(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4601	RO	Total active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C2I_A$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4602 To 0x4607		Per-tariff active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C2I_R(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4608	RO	Total reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C2I_R$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4609 To 0x460E		Per-tariff reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C2I_PMD(t-p)	2	0x0000 – 0xFFFF	W	0x460F	RO	Total power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “p” (see below in Legend) until the current moment.
C2I_PMD$_{Tj}$(t-p) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4610 To 0x4615		Per-tariff power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C2I_Exc(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4616	RO	Total excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C2I_Exc$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4617 To 0x461C		Per-tariff excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C2I_A(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x461D	RO	Total active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
C2I_A$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x461E To 0x4623		Per-tariff active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2I_R(p)	4	0x0…0 – 0x3B9AC9FF	varh	0x4624	RO	Total reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
$C2I\_R_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4625 To 0x462A		Per-tariff reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C2I_PMD(p-a)	2	0x0000 – 0xFFFF	W	0x462B	RO	Total power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
$C2I\_PMD_{Tj}(p-a)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x462C To 0x4631		Per-tariff power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2I_Exc(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4632	RO	Total excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
$C2I\_Exc_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4633 To 0x4638		Per-tariff excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
C2I_A(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4639	RO	Total active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
$C2I\_A_{Tj}(a)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x463A To 0x463F		Per-tariff active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2I_R(a)	4	0x0…0 – 0x3B9AC9FF	varh	0x4640	RO	Total reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
$C2I\_R_{Tj}(a)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4641 To 0x4646		Per-tariff reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C2I_PMD(a-b)	2	0x0000 – 0xFFFF	W	0x4647	RO	Total power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
$C2I\_PMD_{Tj}(a-b)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4648 To 0x464D		Per-tariff power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2I_Exc(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x464E	RO	Total excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
$C2I\_Exc_{Tj}(a)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x464F To 0x4654		Per-tariff excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C2I_A(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4655	RO	Total active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
$C2I\_A_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4656 To 0x465B		Per-tariff active energy evaluated only for contract #2 with import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2I_R(b)	4	0x0…0 – 0x3B9AC9FF	varh	0x465C	RO	Total reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
$C2I\_R_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x465D To 0x4662		Per-tariff reactive energy evaluated only for contract #2 with import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C2I_PMD(b-d)	2	0x0000 – 0xFFFF	W	0x4663	RO	Total power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
$C2I\_PMD_{Tj}(b\text{-}d)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4664 To 0x4669		Per-tariff power maximum demand evaluated only for contract #2 with import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2I_Exc(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x466A	RO	Total excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
$C2I\_Exc_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x466B To 0x4670		Per-tariff excess active energy evaluated only for contract #2 with import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
C2E_A(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4671	RO	Total active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the current moment.
$C2E\_A_{Tj}(t)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4672 To 0x4677		Per-tariff active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the current moment.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2E_R(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4678	RO	Total reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C2E_R$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4679 To 0x467E		Per-tariff reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C2E_PMD(t-p)	2	0x0000 – 0xFFFF	W	0x467F	RO	Total power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C2E_PMD$_{Tj}$(t-p) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4680 To 0x4685		Per-tariff power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C2E_Exc(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4686	RO	Total excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C2E_Exc$_{Tj}$(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4687 To 0x468C		Per-tariff excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C2E_A(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x468D	RO	Total active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
C2E_A$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x468E To 0x4693		Per-tariff active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2E_R(p)	4	0x0…0 – 0x3B9AC9FF	varh	0x4694	RO	Total reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C2E_R$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4695 To 0x469A		Per-tariff reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C2E_PMD(p-a)	2	0x0000 – 0xFFFF	W	0x469B	RO	Total power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2E_PMD$_{Tj}$(p-a) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x469C To 0x46A1		Per-tariff power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2E_Exc(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x46A2	RO	Total excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
C2E_Exc$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x46A3 To 0x46A8		Per-tariff excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
C2E_A(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x46A9	RO	Total active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
C2E_A$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x46AA To 0x46AF		Per-tariff active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2E_R(a)	4	0x0…0 – 0x3B9AC9FF	varh	0x46B0	RO	Total reactive energy evaluated according with contract #2 for export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C2E_R$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x46B1 To 0x46B6		Per-tariff reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C2E_PMD(a-b)	2	0x0000 – 0xFFFF	W	0x46B7	RO	Total power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2E_PMD$_{Tj}$(a-b) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x46B8 To 0x46BD		Per-tariff power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2E_Exc(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x46BE	RO	Total excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C2E_Exc$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x46BF To 0x46C4		Per-tariff excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C2E_A(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x46C5	RO	Total active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C2E_A$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x46C6 To 0x46CB		Per-tariff active energy evaluated only for contract #2 with export-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.

Table 174 – Billing data registers for contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2E_R(b)	4	0x0…0 – 0x3B9AC9FF	varh	0x46CC	RO	Total reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
$C2E\_R_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x46CD To 0x46D2		Per-tariff reactive energy evaluated only for contract #2 with export-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C2E_PMD(b-d)	2	0x0000 – 0xFFFF	W	0x46D3	RO	Total power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
$C2E\_PMD_{Tj}(b-d)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x46D4 To 0x46D9		Per-tariff power maximum demand evaluated only for contract #2 with export-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2E_Exc(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x46DA	RO	Total excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
$C2E\_Exc_{Tj}(b)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x46DB To 0x46E0		Per-tariff excess active energy evaluated only for contract #2 with export-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.

Legend

- t: current moment;
- p: end moment of previous billing period;
- a: end moment of the second last billing period;
- b: end moment of the third last billing period;
- d: start moment of the third last billing period.

10.28 Virtual billing data registers

The registers of the following table contain further information that may be used for billing. These registers are virtual and their content depends on the value of the virtual registers’ flags defined in Table 112 and Table 113 (see 10.2.1).

Table 175 – Virtual billing data registers for contract #1 and contract #2

Register	Len	Range	MU	ID	WrRe	Description
C1V_A(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4701	RO	Virtual total active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the current moment.
$C1V\_A_{Tj}(t)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4702 To 0x4707		Virtual per-tariff active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C1V_R(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4708	RO	Virtual total reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
$C1V\_R_{Tj}(t)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4709 To 0x470E		Virtual per-tariff reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C1V_PMD(t-p)	2	0x0000 – 0xFFFF	W	0x470F	RO	Virtual total power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
$C1V\_PMD_{Tj}(t-p)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4710 To 0x4715		Virtual per-tariff power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1V_Exc(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4716	RO	Virtual total excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
$C1V\_Exc_{Tj}(t)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4717 To 0x471C		Virtual per-tariff excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1V_A(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x471D	RO	Virtual total active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
$C1V\_A_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x471E To 0x4723		Virtual per-tariff active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
C1V_R(p)	4	0x0…0 – 0x3B9AC9FF	varh	0x4724	RO	Virtual total reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
$C1V\_R_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4725 To 0x472A		Virtual per-tariff reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C1V_PMD(p-a)	2	0x0000 – 0xFFFF	W	0x472B	RO	Virtual total power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment "a" until the moment "p".
$C1V\_PMD_{Tj}(p-a)$ (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x472C To 0x4731		Virtual per-tariff power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment "a" until the moment "p".
C1V_Exc(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4732	RO	Virtual total excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
$C1V\_Exc_{Tj}(p)$ (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4733 To 0x4738		Virtual per-tariff excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1V_A(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4739	RO	Virtual total active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
C1V_A$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x473A To 0x473F		Virtual per-tariff active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
C1V_R(a)	4	0x0…0 – 0x3B9AC9FF	varh	0x4740	RO	Virtual total reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C1V_R$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4741 To 0x4746		Virtual per-tariff reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C1V_PMD(a-b)	2	0x0000 – 0xFFFF	W	0x4747	RO	Virtual total power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C1V_PMD$_{Tj}$(a-b) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4748 To 0x474D		Virtual per-tariff power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C1V_Exc(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x474E	RO	Virtual total excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C1V_Exc$_{Tj}$(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x474F To 0x4754		Virtual per-tariff excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1V_A(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4755	RO	Virtual total active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C1V_A$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4756 To 0x475B		Virtual per-tariff active energy evaluated according with contract #1 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C1V_R(b)	4	0x0…0 – 0x3B9AC9FF	varh	0x475C	RO	Virtual total reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C1V_R$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x475D To 0x4762		Virtual per-tariff reactive energy evaluated according with contract #1 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C1V_PMD(b-d)	2	0x0000 – 0xFFFF	W	0x4763	RO	Virtual total power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".
C1V_PMD$_{Tj}$(b-d) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4764 To 0x4769		Virtual per-tariff power maximum demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".
C1V_Exc(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x476A	RO	Virtual total excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
C1V_Exc$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x476B To 0x4770		Virtual per-tariff excess active energy evaluated according with contract #1 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2V_A(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4771	RO	Virtual total active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C2V_A_{Tj}(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4772 To 0x4777		Virtual per-tariff active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the current moment.
C2V_R(t)	4	0x0…0 – 0x3B9AC9FF	varh	0x4778	RO	Virtual total reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C2V_R_{Tj}(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4779 To 0x477E		Virtual per-tariff reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the current moment.
C2V_PMD(t-p)	2	0x0000 – 0xFFFF	W	0x477F	RO	Virtual total power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "p" until the current moment.
C2V_PMD_{Tj}(t-p) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x4780 To 0x4785		Virtual per-tariff power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "p" until the current moment.
C2V_Exc(t)	4	0x0…0 – 0x3B9AC9FF	Wh	0x4786	RO	Virtual total excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.
C2V_Exc_{Tj}(t) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x4787 To 0x478C		Virtual per-tariff excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the current moment, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2V_A(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x478D	RO	Virtual total active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
C2V_A$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x478E To 0x4793		Virtual per-tariff active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the end of the previous billing period.
C2V_R(p)	4	0x0…0 – 0x3B9AC9FF	varh	0x4794	RO	Virtual total reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C2V_R$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x4795 To 0x479A		Virtual per-tariff reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the previous billing period.
C2V_PMD(p-a)	2	0x0000 – 0xFFFF	W	0x479B	RO	Virtual total power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2V_PMD$_{Tj}$(p-a) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x479C To 0x47A1		Virtual per-tariff power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2V_Exc(p)	4	0x0…0 – 0x3B9AC9FF	Wh	0x47A2	RO	Virtual total excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.
C2V_Exc$_{Tj}$(p) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x47A3 To 0x47A8		Virtual per-tariff excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the previous billing period, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2V_A(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x47A9	RO	Virtual total active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
C2V_A_{Tj}(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x47AA To 0x47AF		Virtual per-tariff active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but one billing period.
C2V_R(a)	4	0x0…0 – 0x3B9AC9FF	varh	0x47B0	RO	Virtual total reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C2V_R_{Tj}(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x47B1 To 0x47B6		Virtual per-tariff reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but one billing period.
C2V_PMD(a-b)	2	0x0000 – 0xFFFF	W	0x47B7	RO	Virtual total power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2V_PMD_{Tj}(a-b) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x47B8 To 0x47BD		Virtual per-tariff power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2V_Exc(a)	4	0x0…0 – 0x3B9AC9FF	Wh	0x47BE	RO	Virtual total excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.
C2V_Exc_{Tj}(a) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x47BF To 0x47C4		Virtual per-tariff excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but one billing period, and for power levels upper than contract power.

Table 175 – Virtual billing data registers for contract #1 and contract #2 (continued)

Register	Len	Range	MU	ID	WrRe	Description
C2V_A(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x47C5	RO	Virtual total active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C2V_A$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x47C6 To 0x47CB		Virtual per-tariff active energy evaluated according with contract #2 for import-related configurations. It is the active energy register evaluated from the start day until the end of the last but two billing period.
C2V_R(b)	4	0x0…0 – 0x3B9AC9FF	varh	0x47CC	RO	Virtual total reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C2V_R$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	varh	From 0x47CD To 0x47D2		Virtual per-tariff reactive energy evaluated according with contract #2 for import-related configurations. It is the reactive energy register evaluated from the start day until the end of the last but two billing period.
C2V_PMD(b-d)	2	0x0000 – 0xFFFF	W	0x47D3	RO	Virtual total power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2V_PMD$_{Tj}$(b-d) (j=1,…,6)	2	0x0000 – 0xFFFF	W	From 0x47D4 To 0x47D9		Virtual per-tariff power maximum demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2V_Exc(b)	4	0x0…0 – 0x3B9AC9FF	Wh	0x47DA	RO	Virtual total excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
C2V_Exc$_{Tj}$(b) (j=1,…,6)	4	0x0…0 – 0x3B9AC9FF	Wh	From 0x47DB To 0x47E0		Virtual per-tariff excess active energy evaluated according with contract #2 for import-related configurations. It is the excess active energy register evaluated from the start day until the end of the last but two billing period, and for power levels upper than contract power.
NOTE The virtual registers of this table are configured taking into account registers of the table “Billing data registers for contract #1” and “Billing data registers for contract #2” (see 10.28).						

Legend

– t: current moment;

– p: end moment of previous billing period;

– a: end moment of the second last billing period;

– b: end moment of the third last billing period;

– d: start moment of the third last billing period.

10.29 Time stamp of maximum power demand

The following table contains the time instants when the meter measures the maximum values of absorbed power during the time interval indicated in the register T_{MD}. The power values stored in the table “Billing data registers for contract #1”, “Billing data registers for contract #2” and “Virtual billing data registers for contract #1 and contract #2” (see 10.28 and 10.29) are used to evaluate the maximum values of absorbed power.

Table 176 – Time stamp of maximum power demand

Register	Len	Range	MU	ID	WrRe	Description
C1I_PMD_TS(t-p)_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4801	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1I_PMD_TS$_{Tj}$(t-p)_POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4802 To 0x4807		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1I_PMD_TS(p-a)_POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4808	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C1I_PMD_TS$_{Tj}$(p-a)_POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4809 To 0x480E		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.

Table 176 – Time stamp of maximum power demand (continued)

Register	Len	Range	MU	ID	WrRe	Description
C1I_PMD_TS(a-b) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x480F	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C1I_PMD_TS$_{Tj}$(a-b) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4810 To 0x4815		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C1I_PMD_TS(b-d) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4816	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C1I_PMD_TS$_{Tj}$(b-d) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4817 To 0x481C		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C1E_PMD_TS(t-p) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x481D	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1E_PMD_TS$_{Tj}$(t-p) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x481E To 0x4823		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C1E_PMD_TS(p-a) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4824	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C1E_PMD_TS$_{Tj}$(p-a) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4825 To 0x482A		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.

C1E_PMD_TS(a-b) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x482B	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C1E_PMD_TS$_{Tj}$(a-b) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x482C To 0x4831		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C1E_PMD_TS(b-d) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4832	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".
C1E_PMD_TS$_{Tj}$(b-d) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4833 To 0x4838		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #1 for export-related configurations. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".
C2I_PMD_TS(p-a) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4840	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "a" until the moment "p".
C2I_PMD_TS$_{Tj}$(p-a) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4841 To 0x4846		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "a" until the moment "p".
C2I_PMD_TS(a-b) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4847	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C2I_PMD_TS$_{Tj}$(a-b) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4848 To 0x484D		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C2I_PMD_TS(b-d) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x484E	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".

C2I_PMD_TS_{Tj}(b-d) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x484F To 0x4854		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for import-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2E_PMD_TS(t-p) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4855	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C2E_PMD_TS_{Tj}(t-p) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4856 To 0x485B		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C2E_PMD_TS(p-a) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x485C	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2E_PMD_TS_{Tj}(p-a) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x485D To 0x4862		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2E_PMD_TS(a-b) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4863	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2E_PMD_TS_{Tj}(a-b) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4864 To 0x4869		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2E_PMD_TS(b-d) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x486A	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2E_PMD_TS_{Tj}(b-d) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x486B To 0x4870		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff maximum power demand evaluated according with contract #2 for export-related configurations. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.

C1V_PMD_TS(t-p) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4871	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "p" until the current moment.
C1V_PMD_TS$_{Tj}$(t-p) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4872 To 0x4877		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "p" until the current moment.
C1V_PMD_TS(p-a) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4878	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "a" until the moment "p".
C1V_PMD_TS$_{Tj}$(p-a) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4879 To 0x487E		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "a" until the moment "p".
C1V_PMD_TS(a-b) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x487F	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C1V_PMD_TS$_{Tj}$(a-b) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4880 To 0x4885		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "b" until the moment "a".
C1V_PMD_TS(b-d) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4886	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".
C1V_PMD_TS$_{Tj}$(b-d) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4887 To 0x488C		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #1. It is the active power maximum demand register evaluated from the moment "d" until the moment "b".
C2V_PMD_TS(t-p) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x488D	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment "p" until the current moment.

C2V_PMD_TS$_{Tj}$(t-p) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x488E To 0x4893		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “p” until the current moment.
C2V_PMD_TS(p-a) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x4894	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2V_PMD_TS$_{Tj}$(p-a) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x4895 To 0x489A		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “a” until the moment “p”.
C2V_PMD_TS(a-b) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x489B	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2V_PMD_TS$_{Tj}$(a-b) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x489C To 0x48A1		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “b” until the moment “a”.
C2V_PMD_TS(b-d) _POSIX	4	0x0…0 – 0x7FFFFFFF	s	0x48A2	RO	It indicates the date/time (in POSIX notation with reference to local time) of the total virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.
C2V_PMD_TS$_{Tj}$(b-d) _POSIX (j=1,…,6)	4	0x0…0 – 0x7FFFFFFF	s	From 0x48A3 To 0x48A8		It indicates the date/time (in POSIX notation with reference to local time) of the per-tariff virtual maximum power demand evaluated according with contract #2. It is the active power maximum demand register evaluated from the moment “d” until the moment “b”.

T_{MD}	1	0x00 – 0x3C	NA	0x48FF	RW	It indicates the period of time by which the meter has to evaluate the average power; this value has to be used in order to identify maximum power demands. Admitted values: 0x00, 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x0A, 0x0C, 0x0F, 0x14, 0x1E, 0x3C.

Legend

- t: current moment;
- p: end moment of previous billing period;
- a: end moment of the second last billing period;
- b: end moment of the third last billing period;
- d: start moment of the third last billing period.

10.30 Measurand information

In the following tables power values are stored both for single-phase meter and polyphase meter. The first two registers are virtual and they are controlled by the virtual registers' flags V_W_Flag and V_Q_Flag defined in Table 112.

Table 177 – Measurand register (single-phase meter)

Register	Len	Range	MU	ID	WrRe	Description
V_W(t)	2	0x0000 – 0xFFFF	W	0x4901	RO	Virtual active mean power evaluated in 1 second.
V_Q(t)	2	0x0000 – 0xFFFF	var	0x4902	RO	Virtual reactive mean power evaluated in 1 second.
W+(t)	2	0x0000 – 0xFFFF	W	0x4903	RO	Active positive mean power evaluated in 1 second.
W-(t)	2	0x0000 – 0xFFFF	W	0x4904	RO	Active negative mean power evaluated in 1 second.
$Q+_L(t)$	2	0x0000 – 0xFFFF	var	0x4905	RO	Reactive positive inductive mean power evaluated in 1 second.
$Q+_C(t)$	2	0x0000 – 0xFFFF	var	0x4906	RO	Reactive positive capacitive mean power evaluated in 1 second.
$Q-_L(t)$	2	0x0000 – 0xFFFF	var	0x4907	RO	Reactive negative inductive mean power evaluated in 1 second.
$Q-_C(t)$	2	0x0000 – 0xFFFF	var	0x4908	RO	Reactive negative capacitive mean power evaluated in 1 second.
RMS_V(t)	2	0x0000 – 0xFFFF	V	0x4909	RO	This register stores the mean value (expressed in 1/10V) of RMS voltage of low voltage network evaluated in 1 second.
RMS_I(t)	2	Negative values: 0xFFFF – 0x8001 Positive values: 0x0000 – 0x7FFF	dA	0x490A	RO	This register stores the mean value of RMS line current evaluated in 1 second. It has to be designed as a signed register.
COS_PHI(t)	2	Negative values: 0x8064 – 0x8001 Positive values: 0x0000 – 0x0064	NA	0x490B	RO	This register stores the mean value of Cos(phi) evaluated in 2 seconds. It has to be designed as a signed register.
LQM_VW(t)	2	0x0000 – 0xFFFF	W	0x490C	RO	Last quarter of hour mean virtual active power.
LQM_W+(t)	2	0x0000 – 0xFFFF	W	0x490D	RO	Last quarter of hour mean positive active power.
LQM_W-(t)	2	0x0000 – 0xFFFF	W	0x490E	RO	Last quarter of hour mean negative active power.

Table 178 – Measurand register (polyphase meter)

Register	Len	Range	MU	ID	WrRe	Description
V_W(t)	2	0x0000 – 0xFFFF	W	0x4901	RO	Virtual active mean power evaluated in 1 second.
V_Q(t)	2	0x0000 – 0xFFFF	var	0x4902	RO	Virtual reactive mean power evaluated in 1 second.
W+(t)	2	0x0000 – 0xFFFF	W	0x4903	RO	Active positive mean power evaluated in 1 second.
W-(t)	2	0x0000 – 0xFFFF	W	0x4904	RO	Active negative mean power evaluated in 1 second.
$Q+_L(t)$	2	0x0000 – 0xFFFF	var	0x4905	RO	Reactive positive inductive mean power evaluated in 1 second.
$Q+_C(t)$	2	0x0000 – 0xFFFF	var	0x4906	RO	Reactive positive capacitive mean power evaluated in 1 second.
$Q-_L(t)$	2	0x0000 – 0xFFFF	var	0x4907	RO	Reactive negative inductive mean power evaluated in 1 second.
$Q-_C(t)$	2	0x0000 – 0xFFFF	var	0x4908	RO	Reactive negative capacitive mean power evaluated in 1 second.
$RMS\_V_R(t)$	2	0x0000 – 0xFFFF	V	0x4909	RO	This register stores the mean value of RMS voltage (expressed in 1/10V) of R phase, evaluated in 1 second.
$RMS\_V_S(t)$	2	0x0000 – 0xFFFF	V	0x490F	RO	This register stores the mean value of RMS voltage (expressed in 1/10V) of S phase, evaluated in 1 second.
$RMS\_V_T(t)$	2	0x0000 – 0xFFFF	V	0x4910	RO	This register stores the mean value of RMS voltage (expressed in 1/10V) of T phase, evaluated in 1 second.
$RMS\_I_R(t)$	2	Negative values: 0xFFFF – 0x8001 Positive values: 0x0000 – 0x7FFF	dA	0x490A	RO	This register stores the mean value of RMS R-line current evaluated in 1 second. It has to be designed as a signed register.
$RMS\_I_S(t)$	2	Negative values: 0xFFFF – 0x8001 Positive values: 0x0000 – 0x7FFF	dA	0x4911	RO	This register stores the mean value of RMS S-line current evaluated in 1 second. It has to be designed as a signed register.
$RMS\_I_T(t)$	2	Negative values: 0xFFFF – 0x8001 Positive values: 0x0000 – 0x7FFF	dA	0x4912	RO	This register stores the mean value of RMS T-line current evaluated in 1 second. It has to be designed as a signed register.
COS_PHI(t)	2	Negative values: 0x8064 – 0x8001 Positive values: 0x0000 – 0x0064	NA	0x490B	RO	This register stores the mean value of Cos(phi) evaluated in 2 seconds. It has to be designed as a signed register.
LQM_VW(t)	2	0x0000 – 0xFFFF	W	0x490C	RO	Last quarter of hour mean virtual active power.
LQM_W+(t)	2	0x0000 – 0xFFFF	W	0x490D	RO	Last quarter of hour mean positive active power.
LQM_W-(t)	2	0x0000 – 0xFFFF	W	0x490E	RO	Last quarter of hour mean negative active power.

Legend

– t: current moment.

10.31 Reading mode management

The following table contains parameters to manage the messages to be displayed and stored in Table 161 “Display management parameters” (see 10.23.1).

Table 179 – Reading mode management parameters

Register	Len	Range	MU	ID	WrRe	Description
$RMML_i$ (i=1,…,254)	1	0x00 – 0xFF	NA	From 0x4A01 To 0x4AFE	RW	MSG_ID: it indicates the identification code of the message stored in Table 161 that has to be shown.
	1	0x00 – 0xFF	NA		RW	E_LP: it indicates the row ID of DSP register in Table 161 which the long pressure event points to.
	1	0x00 – 0xFF	NA		RW	E_SP: it indicates the row ID of DSP register in Table 161 which the short pressure event points to.
	1	0x00 – 0xFF	NA		RW	E_TIMEOUT: it indicates the row ID of DSP register in Table 161 which the TIMEOUT event (specified by CTRL sub field) points to.
	1	NA	NA		RW	CTRL: it indicates the control information for the management of the menu item. See coded values in Table 180
PB_LP	1	0x00 – 0xFF	NA	0x4AFF	RW	It indicates the duration of a front panel button long pressure. It is expressed as a multiple of 100 msec. If the button press duration is lower than the value indicated in this register, the meter detects a short pressure.

Table 180 – Values of CTRL sub field

CTRL bits	Description
xxxx xx00	No action.
xxxx xx01	This setting has to be used with messages related to contract #1 or #2. The menu item has to be shown only if the previous billing period data of the related contract is available and valid.
xxxx xx10	This setting has to be used with messages related to contract #1 or #2. The menu item has to be shown only if the last but one billing period data of the related contract is available and valid.
xxxx xx11	This setting has to be used with messages related to contract #1 or #2. The menu item has to be shown only if the last but two billing period data of the related contract is available and valid.
xx00 00xx	No service function has to be applied.
xx00 01xx	Reactive pulse emitter: the service function, that changes the value of PE_REACTIVE register in Table 161, has to be activated.
xx00 10xx	Power control actuation simulation: the service function, that issues an action corresponding to the "COMMAND(118, 6)" message (9.1.7.2.3), has to be activated. As soon as the operator issues this command, the meter has to exit from Reading Mode and set "Power Control Actuation" alarm.
xx00 11xx	Ignore alarm: when the meter displays this message, the jump to specific row of "Reading mode management parameters" table due to any alarms is disabled.
xx01 00xx	Show alarm: when the meter displays this message, the jump to specific row of "Reading mode management parameters" table due to any alarms is enabled.
xx01 01xx	Closure of cut-off device: when the meter displays this message, the cut-off device has to be closed.
xx01 10xx	Message disabled: this message is disabled. The meter has to jump to the row pointed by propagating the last action to next message until displayable message will be reached.
xx01 11xx	Enable export: it indicates that the message has to be shown only if the contract has been configured in order to manage import related registers.
xx10 00xx	Enable import: it indicates that the message has to be shown only if the contract has been configured in order to manage export related registers.
00xx xxxx	CIC_ST timeout of Table 161 activated.
01xx xxxx	TMSTBY timeout of Table 161 activated.
10xx xxxx	RM_TO timeout of Table 161 table activated.
11xx xxxx	FREEZE_TO timeout of Table 161 table activated.

10.32 Management of log's events

10.32.1 List of events

The following table describes a possible list of events that may be generated by the meter due to specific activities. Each event is identified by an identification code, and the activities are described in the column "Description" of the table.

Table 181 – List of events

Event identification code	Event name	Description
0x01	Parameter programming	It has to be generated when a parameter of the following tables is modified by Concentrator/HHU: • Internal parameters • Load profiles and parameter registers • Communication address and keys of authentication • Temporal parameters • Billing period identification parameters • Supply contract identification parameters • Weekly tariff structure parameters • Annual tariff structure parameters • Public holidays parameters • Load modulation parameters • Voltage interruption parameters • Voltage variation parameters • Control information parameters • Cut-off device control parameters • Display management parameters • Download parameters • Measurand profiles and parameters • Synchronized measurand registers • Time stamp of maximum power demand • Reading mode management parameters
0x02	Receive and accept a new non-authenticated synch	It has to be generated when the meter receives and accepts a new non-authenticated synch message.
0x03	End of soft synch more than 3 minutes	It has to be generated when the meter has completed the soft synch (step-by-step) of the RTC for a drift more than 3 minutes.
0x04	Receive and accept a new authenticated synch	It has to be generated when the meter receives and accepts a new authenticated synch message.
0x05	Consumption with breaker open detected	It has to be generated when the INTA flag of extended status word is activated due to the detection of energy consumption with a permanent open command to the cut-off device.
0x07	Export, when in "Import always", starts/ends	It has to be generated when the meter detects and stores export energy and an Import always contract results activated (see 10.11.1). One entry has to be generated at the start of detection and one at end.
0x08	Activation of a new contract	It has to be generated when a new contract results activated.

Event identification code	Event name	Description
0x09	Activation of a new annual tariff structure	It has to be generated when a new annual tariff structure has been activated.

Table 181 – List of events (continued)

Event identification code	Event name	Description
0x0A	Load profile lost	It has to be generated when load profiles have been lost and/or reset (e.g. authenticated synch, T_{LP} update).
0x0B	Measurand profile lost	It has to be generated when measurand profiles have been lost and/or reset (e.g. authenticated synch, T_{MP} update).
0x0C	Snapshot storage	It has to be generated when the meter stores the snapshot of measurands.
0x0E	OPA to remote CE	It has to be generated when the HHU sends a message to a remote meter on PLC. Consecutive messages to the same remote meter have to be ignored until the OPA session has been closed for timeout. An OPA session is identified as the meter processes the first OPA message and lasts after 60 seconds from the last OPA message.
0x0F	Optical port lockout	It has to be generated when the optical port has been locked out due to failed authentication attempts.
0x10	New bad authentication attempts in current day	It has to be generated when more than 15 bad authentication attempts in current day have been occurred.
0x11	Successful Authentication CE	It has to be generated when a new authentication session has been performed with success. A session is identified as the meter processes the first successful authenticated message and lasts after 60 seconds from the last authenticated message.
0x12	Start of a new download	It has to be generated when a new download procedure is started.
0x13	Download aborted due to error, timeout or operator	It has to be generated when a new download procedure has been performed without success or a switch-fail has occurred due to wrong matching between fixed FW and downloadable FW portions.
0x14	Download performed with success	It has to be generated when a new download procedure has been performed with success.
0x15	Activation of new downloaded software	It has to be generated when the new downloaded software is activated.
0x16	Delayed Activation of a new K procedure	It has to be generated when the meter activates a delayed load modulation procedure (see 10.16).
0x17	Open of cut-off device not performed due to DISI	It has to be generated when the meter does not perform the opening of the cut-off device, according with load modulation procedure, due to DISI configuration.
0x18	Instantaneous deactivation of a K procedure (setting DKF_POSIX “in force” to 0xFFFFFFFF)	It has to be generated when the meter deactivates an “in force” load modulation procedure instantaneously due to the programming of DKF_POSIX of IN FORCE portion of “Load modulation parameters” table to 0xFFFFFFFF.
0x19	Instantaneous activation of a new K procedure	It has to be generated when the meter activates instantaneously a new load modulation procedure.

Table 181 – List of events (continued)

Event identification code	Event name	Description
0x1A	Open command to cut-off device due to power control actuation	It has to be generated when the meter issue an opening command to the cut-off device due to power control function (power overload, service function, protocol command).
0x1B	Close command to cut-off device	It has to be generated when the meter issue a closure command to the cut-off device (front panel button, protocol command, automatic procedure).
0x1C	Automatic closure procedure blocked *	It has to be generated when the meter blocks the automatic closure procedure due to number of attempts bigger than foreseen ones (to be defined) *.
0x1D	Cut-off device not opened due to high current	It has to be generated when the meter does not issue an open command to the cut-off device, triggered by a power control actuation, due to a current higher than the nominal current of the cut-off device installed into the meter.
0x1E	Power-off start/end	It has to be generated when the meter detects a power-off. One entry has to be generated at the power-off of the meter and another one, with the same ID, at start-up but with a different status value.
0x1F	Status word variation	It has to be generated when a flag of Normal and Extended status words, that generates a normal event, is varied.
0x20	Reset of status word from PLC	It has to be generated when a status word has been reset by means of an authenticated message sent by PLC interface.
0x21	Reset of status word from HHU	It has to be generated when a status word has been reset by means of an authenticated message sent by HHU.
0x22	Line Voltage below threshold computed from nominal voltage.	It has to be generated when the meter detects a voltage below a pre-programmed threshold on the phase lines of the meter.
0x23	Line Voltage above threshold computed from nominal voltage.	It has to be generated when the meter detects a voltage above a pre-programmed threshold on the phase lines of the meter.

Annex A
(informative)

Node discovery procedure example using the DLMS/COSEM SMITP B-PSK PLC profile

A.1 Node Discovery

A.1.1 Discover nodes directly accessible from the Concentrator

Concentrator starts the procedure invoking the Discover service. It can decide, using message parameters (connection phase, silencing level of the node and address filters), how many responses it will manage at time (in terms of percentage of installed meters).

All the meters that receive this message with parameters that enable the meter to reply, respond invoking the DiscoverReport service. If the Concentrator uses any filter to select the percentage of responses to be received (in order to decrease the number of meters that respond simultaneously and the probability of collisions), it can iterate this step in order to cover 100 % of the meters directly reached (using no repeaters).

Collisions of the response messages are managed indirectly; the Concentrator will try to reach the meters again in the next round of Discover or DiscoverForward services (see figure below).

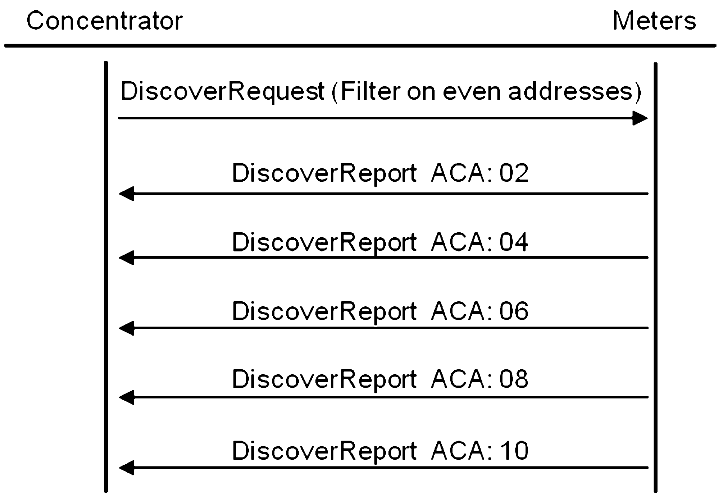


Figure A.1 – Discover service (even addresses)

The Concentrator issues a Discover service primitive, requiring a response only to the meters having even addresses; five meters respond with their ACA address (only last digits).

Meters addresses list
02
04
06
08
10

Figure A.2 – First step discovered meters

Figure A.2 shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the first sub-step.

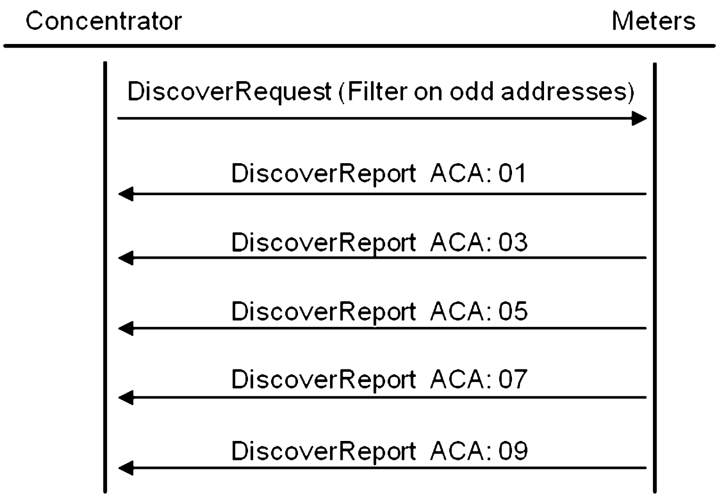


Figure A.3 – Discover service (odd addresses)

The Concentrator issues message, requiring a response only to the meters having odd address; five meters respond with their ACA address.

Meters addresses list
02
04
06
08
10
01
03
05
07
09

Figure A.4 – Discovered meters at the end of the first step

Figure A.4 shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the second sub-step.

Invoking the Discover service generates a broadcast message in the sense that it is used in an addressing mode that all nodes are able to respond, but no retransmission of this message is sent by nodes to spread the message. There are several ways to issue the Discover service depending on Concentrator section used (0xFFFFFF = All nodes, 0x000000 = Not registered meters, 0xNNNNNN = all nodes registered on NNNNNN section).Concentrator section is specified in the first 3 bytes of the SCA.

The Concentrator can also use the service TCTset to silent a node, avoiding a new response from a meter that already responded to a previous Discover.indication event. TCT level of the nodes is reset after timeouts P-LCK-TCT register in the meter, so it is enabled again to respond to Discover.indication event if other conditions and filters match. The DiscoverReport primitive has, among the other parameters, some communication quality information (Signal level, SNR) are available.

At the end of the first step, the Concentrator knows the addresses of all the meters installed that it can reach using no repeaters (L1 meters).

A.1.2 Enable L1 meters to discover nodes not directly accessible from the Concentrator

Concentrator issues a DiscoverForward service primitive to each meter already discovered in the first step (called L1 meters, so they are in the first level of a tree topology) to ask it to act as repeater towards any meter that the Concentrator is not able to reach in direct way (if any). The L1 meter that receives this message is authorized to send on the network a Discover.request primitive and to gather the StatusReport responses from any meter.

A.1.3 Gathering discovered nodes from L1 meters

Once the level 1 meter received the StatusReport response from the meters below, it prepares a DiscoverForwardReport representing the total number of responses received by the meters below and the data that each one of the first four meters sent to it. Then it sends the response to the Concentrator.

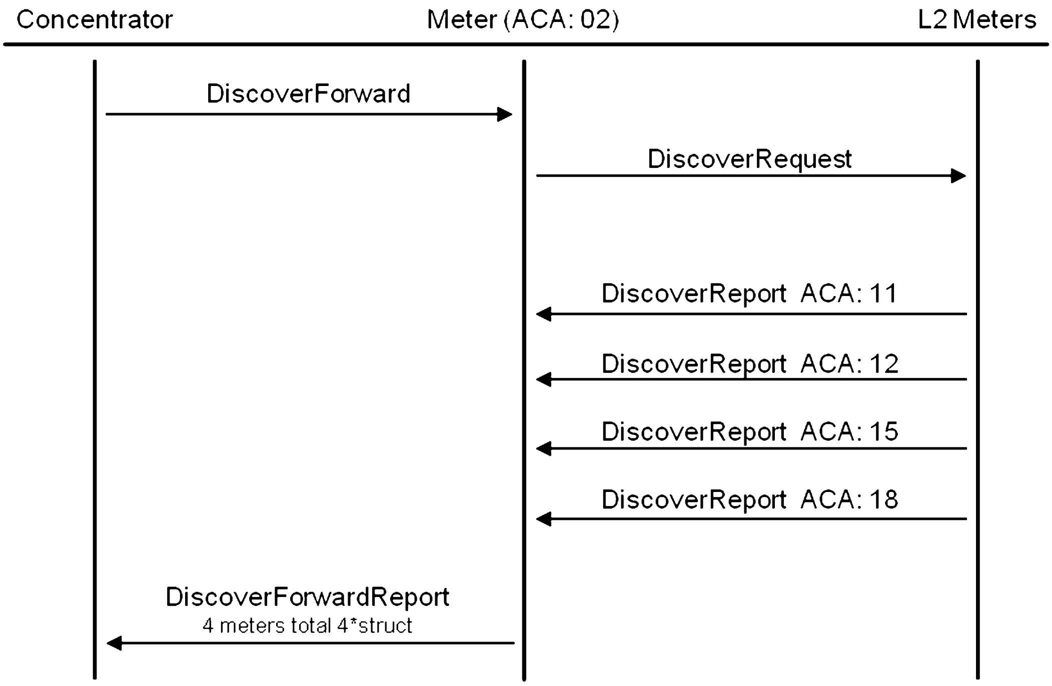


Figure A.5 – REQADDR.REQ message

The Concentrator sends a DiscoverForward.request to the L1 meter and enables it to send an Discover.request to discover new nodes not accessible directly from Concentrator.

Meters addresses list	
Address	Path
02	
04	
06	
08	
10	
01	
03	
05	
07	
09	
11	02
12	02
15	02
18	02

Figure A.6 – Second step discovered meters

Figure A.6 shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the step 3. In the rows containing the addresses of the meters reached using one repeater, the address of repeater is present.

A.1.4 Repeating the process with L1 meters until no new meters are discovered

The Concentrator receives the DiscoverForwardReport messages from the L1 meters and, in accordance with the number of new meters discovered by each L1 meters, decide whether to re-issue a DiscoverForward to the L1 meters, until no new meters are found. The Concentrator can also use the TCTset service to avoid a new response from a L1 meter that already responded to a previous DiscoverForward using a DiscoverForwardReport reporting no new meters.

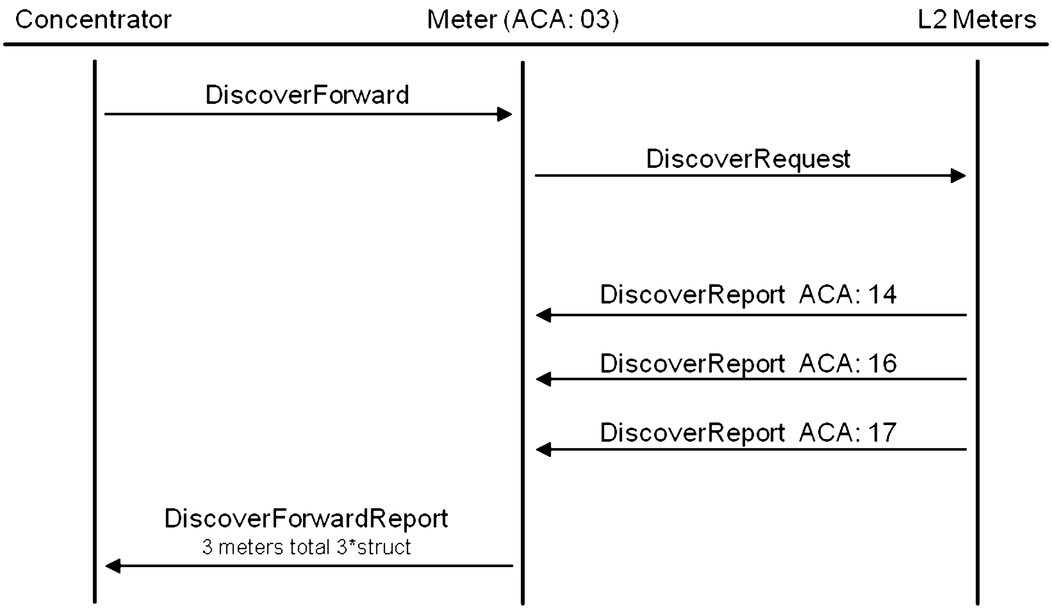


Figure A.7 – Repeating procedure with all L1 meters until no new meters are found

Meters addresses list	
Address	Path
02	
04	
06	
08	
10	
01	
03	
05	
07	
09	
11	02
12	02
15	02
18	02
14	03
16	03
17	03

Figure A.8 – Discovered meters at the end of the second step

Figure A.8 shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the step 4. In the rows containing the addresses of the meters reached using one repeater, the address of repeater is present.

At the end of the fourth step, the Concentrator knows the addresses of all the meters installed that it can reach using no repeaters (L1 meters), and one only repeater (L2 meters).

The previous procedure will be iterated until no more meters are discovered, bearing in mind the fact that a repetition chain cannot be longer than 8 nodes. Below an example of an iteration of the procedure in case a Level n meter is reached (n<=8).

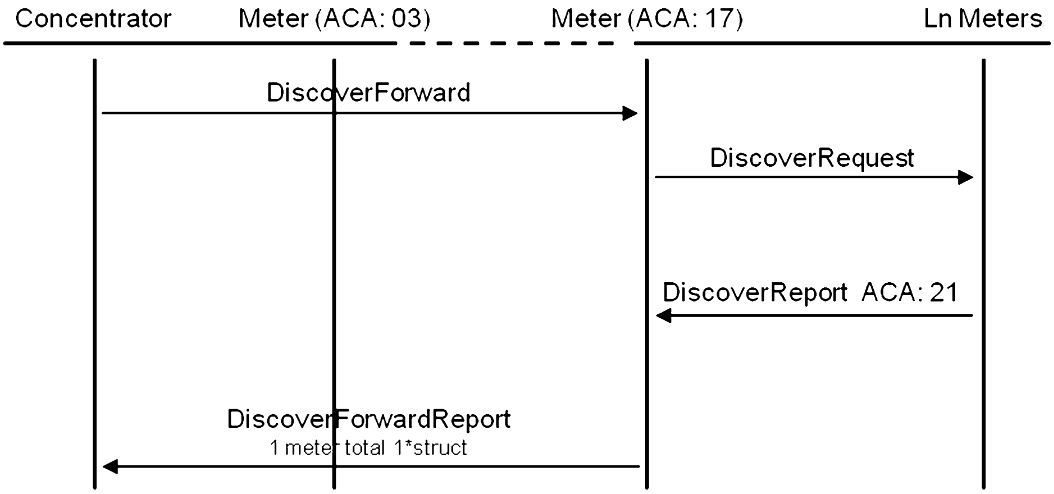


Figure A.9 – Repeating procedure increasing repetition level while n ≤ 8

Meters addresses list			
Address	Path		
02			
04			
06			
08			
10			
01			
03			
05			
07			
09			
11	02		
12	02		
15	02		
18	02		
14	03		
16	03		
17	03		
21	03	…	17

Figure A.10 – Discovered meters at the end of the procedure

Figure A.10 shows the snapshot of the Concentrator's table containing the addresses of discovered meters at the end of the procedure with the complete repeater chain of each meter.

A.2 Registration and routing management

Once the Concentrator has finished meter discovery (see previous clause), it communicates to the AMM system the list of meters that it can reach, sending the meter addresses table that it has built. The AMM system responds to the Concentrator sending a list of meters addresses that it has to manage (two or more nearby Concentrators could have discovered the same meter). Using this list, the Concentrator register all the meters, issuing a Register.request command specifying the SCA address. A routing table contains, for each meter that the Concentrator manages:

– its ACA address (physical addressing, 6 bytes long, fixed for that meter and related to device serial number);

– its SCA address (Concentrator section plus logical addressing, 3+2 bytes long, assigned by the concentrator);

– a list of ACA or SCA addresses of the meters that compose the complete routing path needed to reach the meter.

A meter can be accessed with ACA or SCA addressing. The difference is the length of the repeater chain in the message sent to the meter. In case of ACA addressing there are 6 bytes for each node of the chain. In SCA addressing there are 3 bytes due to Concentrator section and two bytes for each node of the repeater chain.

An example of routing table is drafted below:

Table 182 – Example of routing table A

ACA	SCA	R1	R2	R3	R4	R5	R6	R7
0x111111111111	0x0203	0x0307						
0x333333333333	0x0307							
0x777777777777	0x020A	0x0307	0x0203					
…	…	…	…	…	…	…	…	…
0x999999999999	0x070F	0x0307	0x0203	0x020A				

Annex B
(informative)

Node discovery procedure example using the Original-SMITP over B-PSK PLC profile

B.1 Node Discovery

B.1.1 Discover nodes directly accessible from the Concentrator

Concentrator starts the procedure sending on the network the broadcast message ADDRESS.REQ. It can decide, using message parameters (connection phase, silencing level of the node and address filters), how many responses it will manage at time (in terms of percentage of installed meters). All the meters that receive this message with parameters that enable the meter to reply, respond with an ADDRESS.RESP message, sending their addresses to the Concentrator. If the Concentrator uses any filter to select the percentage of responses to be received (in order to decrease the number of meters that respond simultaneously and the probability of collisions), it can iterate this step in order to cover 100 % of the meters directly reached (using no repeaters).

Collisions of the response messages are managed indirectly; the Concentrator will try to reach the meters again in the next round of ADDRESS.REQ or REQADDR.REQ messages (see figure below).

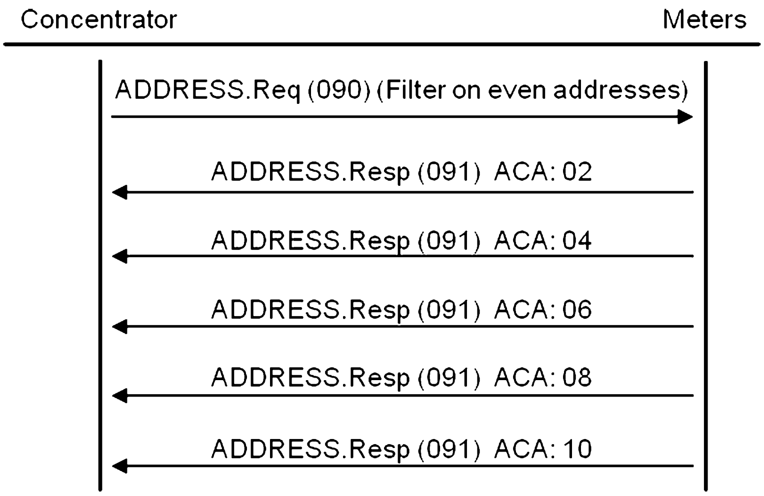


Figure B.1 – ADDRESS.REQ message (even addresses)

The Concentrator sends an ADDRESS.REQ message, requiring a response only to the meters having even addresses; five meters respond with their ACA address (only last digits).

Meters addresses list
02
04
06
08
10

Figure B.2 – First step discovered meters

shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the first sub-step.

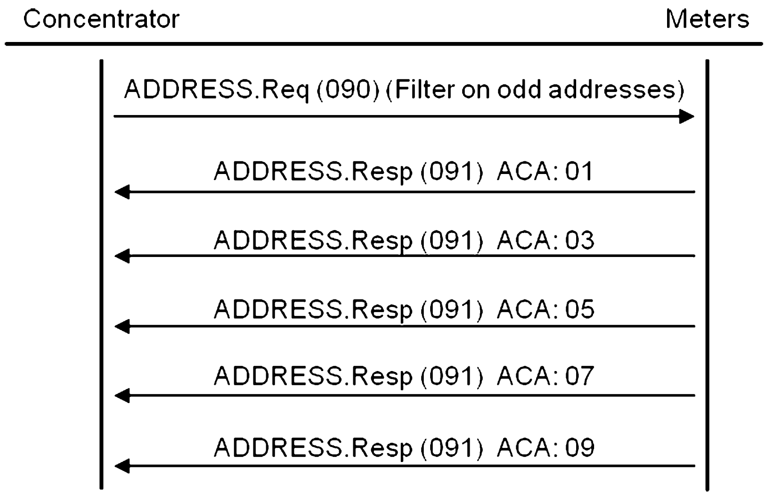


Figure B.3 – ADDRESS.REQ message (odd addresses)

The Concentrator sends an ADDRESS.REQ message, requiring a response only to the meters having odd address; five meters respond with their ACA address.

Meters addresses list
02
04
06
08
10
01
03
05
07
09

Figure B.4 – Discovered meters at the end of the first step

Figure B.4 shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the second sub-step

ADDRESS.REQ is a broadcast message in the sense that it is used in an addressing mode that all nodes are able to respond, but no retransmission of this message is sent by nodes to spread the message. There are several ways to send ADDRESS.REQ messages depending on Concentrator section used (0xFFFFFF = All nodes, 0x000000 = Not registered meters, 0xNNNNNN = all nodes registered on NNNNNN section).

The Concentrator can also use the message TCT_SET.REQ to silent a node, avoiding a new response from a meter that already responded to a previous ADDRESS.REQ. TCT level of the nodes is reset after timeouts P-LCK-TCT register in the meter, so it is enabled again to respond to ADDRESS.REQ if other conditions and filters match. Inside ADDRESS.RESP payload there is communication quality information (Signal level, SNR) so it can be used to discard low quality and prevent silencing those nodes.

At the end of the first step, the Concentrator knows the addresses of all the meters installed that it can reach using no repeaters (L1 meters).

B.1.2 Enable L1 meters to discover nodes not directly accessible from the Concentrator

Concentrator sends a REQADDR.REQ message to each meter already discovered in the first step (called L1 meters, so they are in the first level of a tree topology) to ask it to act as repeater towards any meter that the Concentrator is not able to reach in direct way (if any). The L1 meter that receives this message is authorized to send on the network an ADDRESS.REQ message and to gather the ADDRESS.RESP responses from any meter.

B.1.3 Gathering discovered nodes from L1 meters

Once the level 1 meter received the ADDRESS.RESP response from the meters below, it prepares a REQADDR.RESP message representing the total number of responses received by the meters below and the data that each one of the first four meters sent to it. Then it sends the response to the Concentrator.

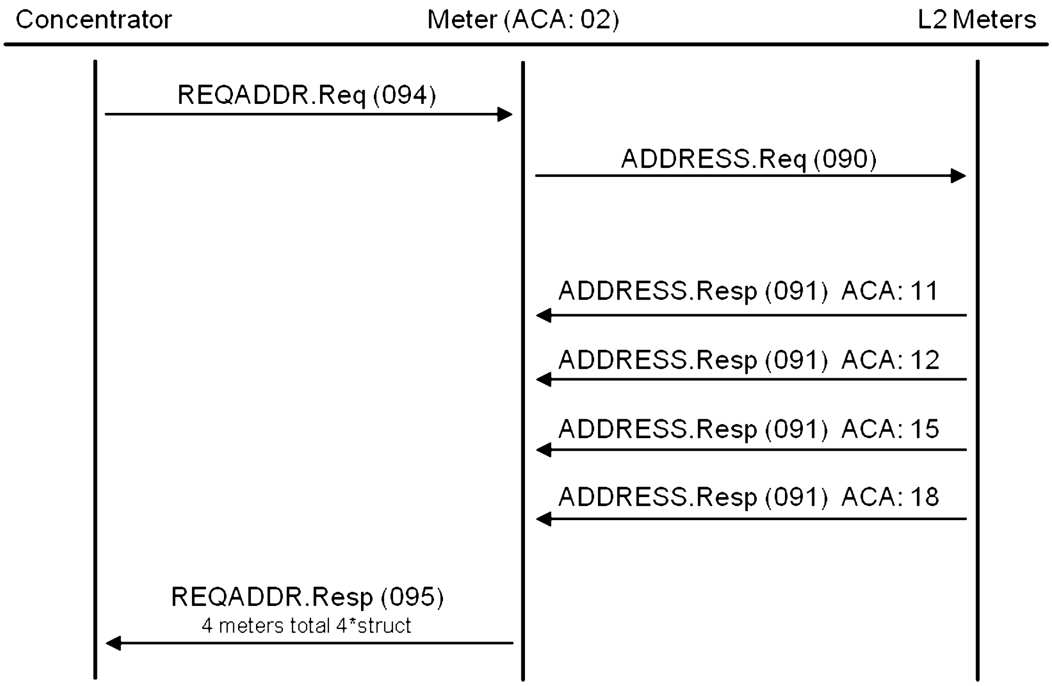


Figure B.5 – REQADDR.REQ message

The Concentrator sends a REQADDR.REQ to the L1 meter and enables it to send an ADDRESS.REQ to discover new nodes not accessible directly from Concentrator.

Meters addresses list	
Address	Path
02	
04	
06	
08	
10	
01	
03	
05	
07	
09	
11	02
12	02
15	02
18	02

Figure B.6 – Second step discovered meters

Figure above shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the step 3. In the rows containing the addresses of the meters reached using one repeater, the address of repeater is present.

B.1.4 Repeating the process with L1 meters until no new meters are discovered

The Concentrator receives the REQADDR.RESP messages from the L1 meters and, in accordance with the number of new meters discovered by each L1 meters, decide to re-send a REQADDR.REQ to the L1 meters, until no new meters are found. The Concentrator can also use the message TCT_SET.REQ to avoid a new response from a L1 meter that already responded to a previous REQADDR.REQ using a REQADDR.RESP carrying no new meters.

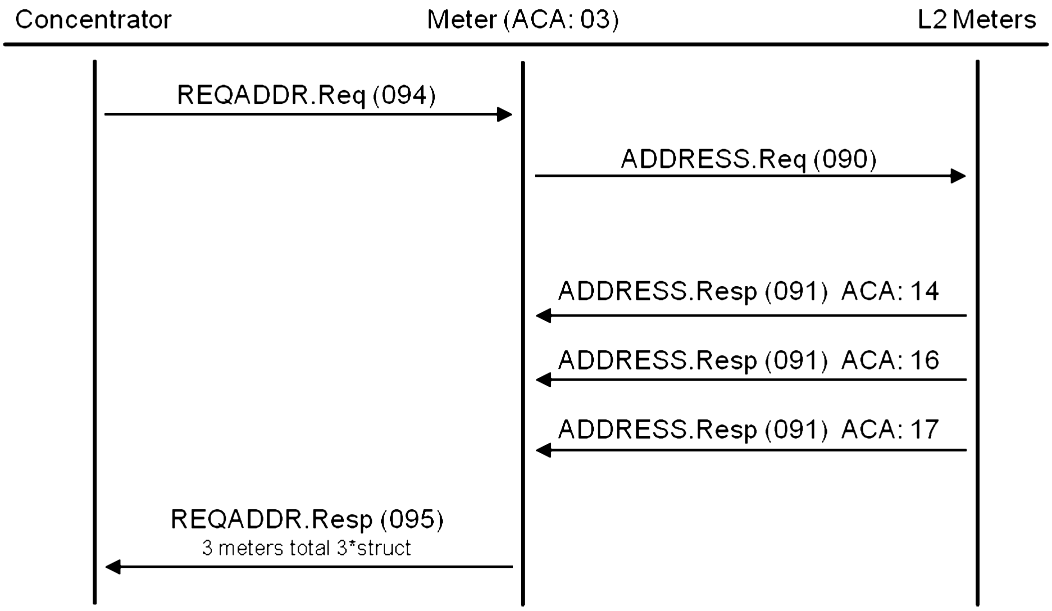


Figure B.7 – Repeating procedure with all L1 meters until no new meters are found

Meters addresses list	
Address	Path
02	
04	
06	
08	
10	
01	
03	
05	
07	
09	
11	02
12	02
15	02
18	02
14	03
16	03
17	03

Figure B.8 – Discovered meters at the end of the second step

Figure above shows the snapshot of the Concentrator's table containing the addresses of discovered meters after the step 4. In the rows containing the addresses of the meters reached using one repeater, the address of repeater is present.

At the end of the fourth step, the Concentrator knows the addresses of all the meters installed that it can reach using no repeaters (L1 meters), and one only repeater (L2 meters).

The previous procedure will be iterated until no more meters are discovered, bearing in mind the fact that a repetition chain cannot be longer than 8 nodes. Below an example of an iteration of the procedure in case a Level n meter is reached (n<=8).

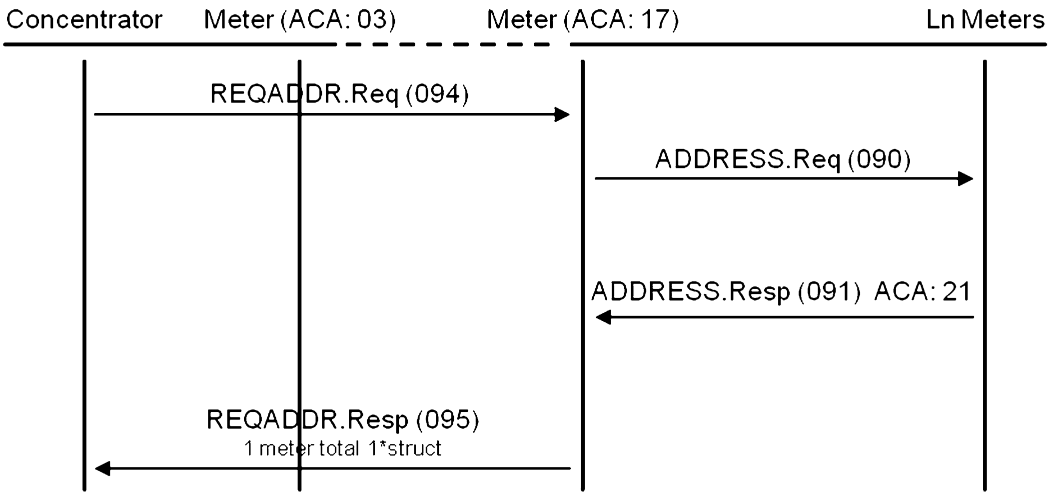


Figure B.9 – Repeating procedure increasing repetition level while n ≤ 8

Meters addresses list			
Address	Path		
02			
04			
06			
08			
10			
01			
03			
05			
07			
09			
11	02		
12	02		
15	02		
18	02		
14	03		
16	03		
17	03		
21	03	…	17

Figure B.10 – Discovered meters at the end of the procedure

Figure above shows the snapshot of the Concentrator's table containing the addresses of discovered meters at the end of the procedure with the complete repeater chain of each meter.

B.2 Registration and routing management

Once the Concentrator has finished meter discovery (see previous clause), it communicates to the AMM system the list of meters that it can reach, sending the meter addresses table that it has built. The AMM system responds to the Concentrator sending a list of meters addresses that it has to manage (two or more nearby Concentrators could have discovered the same meter). Using this list, the Concentrator contacts all the meters, writing on them the SCA address; this operation, actually binds a meter to it. A routing table contains, for each meter that the Concentrator manages:

– its ACA address (physical addressing, 6 bytes long, fixed for that meter and related to device serial number);

– its SCA address (Concentrator section plus logical addressing, 3+2 bytes long, assigned by the concentrator);

– a list of ACA or SCA addresses of the meters that compose the complete routing path needed to reach the meter.

A meter can be accessed with ACA or SCA addressing. The difference is the length of the repeater chain in the message sent to the meter. In case of ACA addressing there are 6 bytes for each node of the chain. In SCA addressing there are 3 bytes due to Concentrator section and two bytes for each node of the repeater chain.

An example of routing table is drafted below:

Table 183 – Example of routing table B

ACA	SCA	R1	R2	R3	R4	R5	R6	R7
0x111111111111	0x0203	0x0307						
0x333333333333	0x0307							
0x777777777777	0x020A	0x0307	0x0203					
…	…	…	…	…	…	…	…	…
0x999999999999	0x070F	0x0307	0x0203	0x020A				

Annex C
(informative)

SMITP specific definitions

C.1 Management of reserved elements

The management of the following elements of the technical specification described in this document is reserved to Meters and More Association:

- bit 2 and bit 3 of sub field DSAP in the LLC frame, see following C.2.

C.2 ECTL structure

ECTL consists of 1 byte divided in two Nibbles, identified as DSAP and SSAP (2 * 4 bits):

- DSAP (Destination Service Access Point):
    - Bit 0-1 used to identify the transported frame
        - 00 Upper layer data (CL or SMITP AL)
        - 01 Network Management or Discovery and Registration
    - Bit 2-3 reserved
- ECC (Encryption Coding Control): it is used to discriminate what kind of encryption method is used to protect the payload field. The encryption functionality is available in both directions.

ECC coding:

- 0000 Encryption disabled
- xx10 Encryption AES ECB
- xx01 Encryption AES CTR
- x0xx Encryption uses READ key
- x1xx Encryption uses WRITE key.

Annex D
(normative)

MIB and COSEM Set-up class interface

D.1 General

This subclause describes the SMITP Management Information Base (MIB) which shall be implemented by a node implementing the DLMS/COSEM SMITP B-PSK PLC profile.

The MIB elements used in the original-SMITP profile are described in Clause 10.

D.2 Types definition

Table 184 – Definition of simple data types used in MIB description

Type	Size	Description
u8	8	Unsigned integer number ranging from 0 to 255.
s8	8	Signed integer number ranging from -128 to 127.
u16	16	Unsigned integer number ranging from 0 to 65535.
Note: size is given in bit.		

Table 185 – Definition of strucutred data types used in MIB description

Type	Size	Description
Enum	8	Enumeration type coded as u8, starting from 0 (first element), increasing by 1 at each enumerated item.
String:X	X * 8	String made by X elements of type u8.
Note: size is given in bit.		

D.3 SMITP configuration attributes

Table 186 – MIB variables related to PHY layer

Variable name	Type	R/W	Description

Pr_ch_mod	enum	R/W	Primary channel mopdulation (reception)
			Range: {
			Phase Shift Keying [default]
			}

Sec_ch_mod	enum	R/W	Secondary channel mopdulation (reception)
			Range: {
			Not used [default],
			Phase Shift Keying
			}

Pr_ch_freq	enum	R/W	Primary channel frequency (reception and transmission).
			Range: {
			86 kHz [default]
			}

Table 186 – MIB variables related to PHY layer (continued)

Variable name	Type	R/W	Description

Sec_ch_freq	enum	R/W	Secondary channel frequency (reception and transmission).
			Range: {
			Not Used [default]
			}

Tx_channel	enum	R/W	Transmission channel
			Range: {
			Primary channel [default],
			Secondary channel
			}

Tx_modulation	enum	R/W	Modulation used in transmission
			Range: {
			BPSK-CC [default]
			}

ZC_synchronized	enum	R/W	Transmission synchronized with zero crossing signal.
			Range: {
			Disabled [default],
			Enabled
			}

Pre_length	enum	R/W	Length of PHY layer preamble.
			Range: {
			16 bits,
			24 bits,
			32 bits [default],
			40 bits
			}

Rel_phase	enum	RO	Phase difference between the received signal and the mains connected to the node PLC.
			Range: {
			Not detected,
			0°,
			30°,
			60°,
			90°,
			120°,
			150°,
			180°,
			210°,
			240°,
			270°,
			300°,
			330°
			}

NOTE: R/W - Read and Write RO – Read Only			

Table 187 – MIB variables related to Data Link layer

Variable name	Type	R/W	Description
ACA	String:6	RO	Absolute Communication Address. Range: (see CLC/TS 50568-4:2015, Annex A)
SCA	String:6	R/W	Section Communication Address. Range: (see CLC/TS 50568-4:2015, Annex A)
Tel	u16	R/W	Elaboration time, expressed in ms, used to calculate the supervision timeout as specified in CLC/TS 50568-4:2015.
Delay	u16	R/W	Delay time, expressed in ms, used to calculate the supervision timeout as specified in CLC/TS 50568-4:2015.
Time_slot_duration	u16	R/W	Duration in ms of a single timeslot when service class RC is required to the Data Link (see CLC/TS 50568-4:2015). Range: {200 to 500} [default] = 250
NOTE 1: RO – Read Only R/W – Read and Write NOTE 2: Section communication address formed by all zeros means SCA not assigned.			

Table 188 – MIB variables related to convergence layer

Variable name	Type	R/W	Description
CL_mtu_size	u8	R/W	Maximum length, in bytes, of a CL segment sent. Range: {16 to 124} [default] = 124
NOTE: R/W – Read and Write			

Table 189 – MIB variables related to the system

Variable name	Type	R/W	Description
Serial_number	String:16	RO	Serial number assigned to the meter.
Activity_timeout	u16	R/W	Maximum time, expressed in ms, without communication on PLC line, before the meter considers itself as deregistered (see 4.7.13.2).
TCT	u8	R/W	Silencing level of the node (see 4.7.12)
NOTE: RO – Read Only			

D.4 SMITP statistical attributes

Table 190 – MIB statistical variables

Variable name	Type	R/W	Description
PHY Layer variables			
PL_RX_SNR	s8	RO	Signal to Noise Ratio measured over the last received PHY frame.

PL_RX_mod	enum	RO	Modulation of the last received PHY frame.
			Range: {
			BPSK-CC
			}

PL_RX_ch	enum	RO	Channel used for the last received PHY frame.
			Range: {
			Primary channel,
			Secondary channel
			}

PL_RX_cnt	u16	R/R	Number of receied PHY frames.
PL_RX_ZC_delay	s8	RO	Delay, in ms, of the last received PHY frame with respect to the mains zero crossing.
PL_TX_ZC_delay	s8	RO	Delay, in ms, of the next transmitted PHY frames with respect to the mains zero crossing (only used when ZC_synchronized is enabled).
PL_ZC_period	u8	RO	Period, in ms, of the mains based on amins zero crossing detections.
Data Link Layer variables			
DL_RX_SNR	s8	RO	Signal to Noise Ratio measured over the last received valid MAC frame.

DL_RX_mod	enum	RO	Modulation of the last received valid MAC frame.
			Range: {
			BPSK-CC
			}

DL_RX_ch	enum	RO	Channel used for the last received valid MAC frame.
			Range: {
			Primary channel,
			Secondary channel
			}

DL_RX_ZC_delay	s8	RO	Delay, in ms, of the last received valid MAC frame with respect to the mains zero crossing.
DL_RX_valid_cnt	u16	R/R	Number of received valid MAC frames.
DL_RX_discarded_cnt	u16	R/R	Number of received MAC frames discarded (either due to errors in the frame or MAC level busy).
DL_TX_cnt	u16	R/R	Number of transmitted MAC frames.
DL_TX_discarder_cnt	u16	R/R	Number of MAC frames not transmitted because the MAC level was busy.
NOTE: RO – Read Only R/R – Read / Reset			

Annex E
(informative)

Specification of communication mode F for direct local data exchange

E.1 Introduction

This annex contains a specification proposal for the communication mode F used by the SMITP protocol over the optical interface.

E.2 Mode F for direct local data exchange

E.2.1 General

The protocol mode F allows establishing a transparent connection in binary way for local data exchange that uses the SMITP protocol. Data Link layer defined in CLC/TS 50568-4:2015 and Application layer defined in Clause 9 shall be used, where the meter (also tariff device) represents the communication server and the HHU represents the communication client.

E.2.2 Sign-on flow

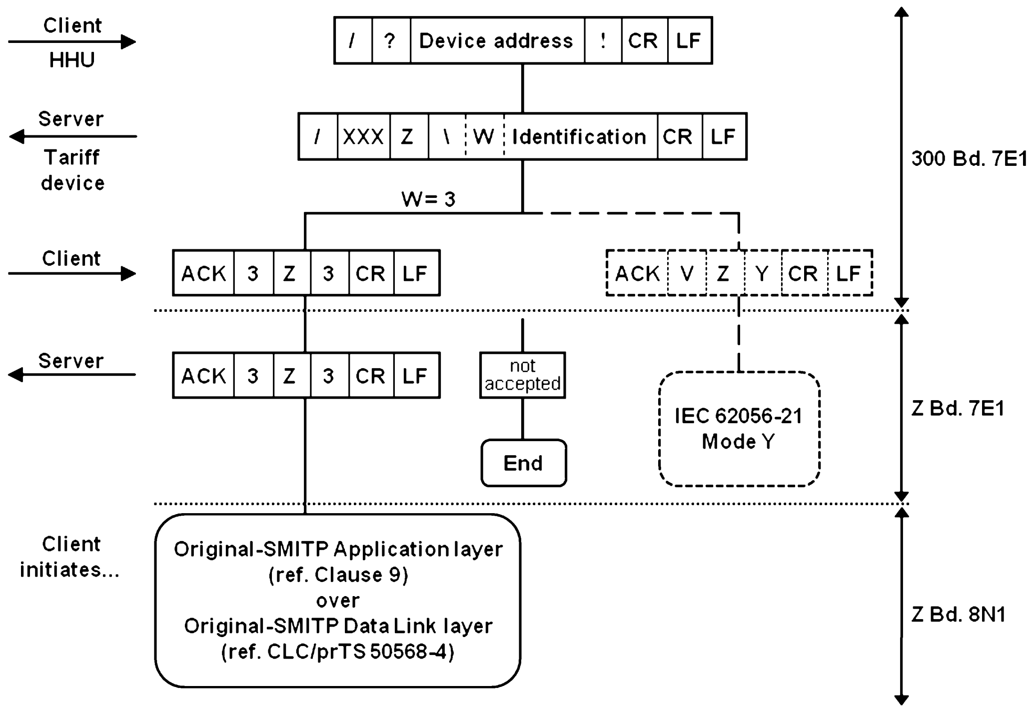


Figure E.1 – Sign-on messages sequence between meter and HHU

In the values of packets' characters, the transmission speed and the transmission type in the phases of mode F are described. The optional sub field "W" within the identification message sent by server device shall assume the value=3 in order to indicate the mode F.

Until the server sends back the acknowledgment message, the type of transmission is 7E1; after the client receives this last acknowledgment message, the binary transparent mode 8N1 is established. The baud rate value is always 300 bps in the prologue phase; after the client has sent the acknowledgement message, the baud rate specified in the character Z is used.

Until the end of communication session (due to an abort event or a timeout expiring, managed by metering device) the communication between HHU and meter is driven following the rules of the used protocol.

A client device that does not support the SMITP protocol chosen by mode F (W = 3) will send back the acknowledgment message where the character Y indicates a different protocol mode.

E.2.3 Physical layer primitives

The primitives of Physical layer used in communications between the meter and HHU are in accordance with EN 62056-42.

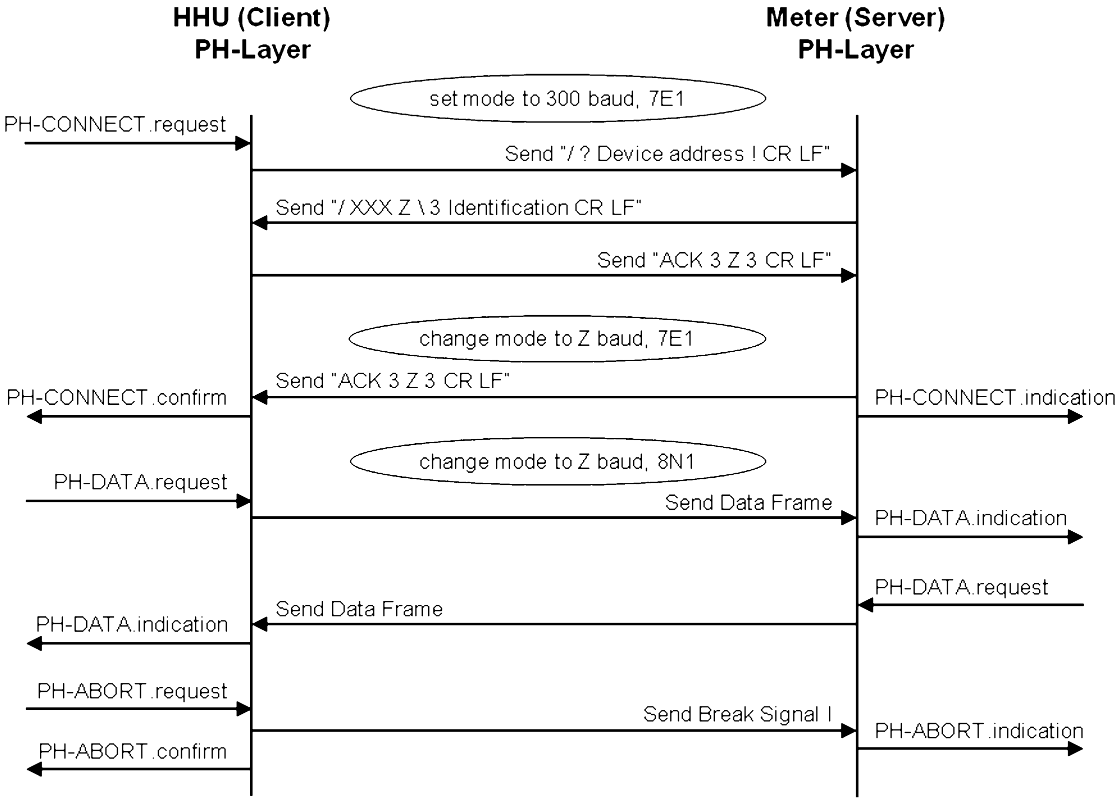


Figure E.2 – Physical layer primitives in local data exchange

As shown in Figure E.2, the request message is sent by the HHU to establish a connection with the meter after the Physical layer primitive PH-CONNECT.request has been invoked on the Physical layer entity of the HHU. In this phase the use of mode F is requested and the initial baud rate is used.

The new baud rate is used when the meter sends the message “ACK 3 Z 3 CR LF” to the HHU. After this message, the primitive PH-CONNECT.indication is invoked by the meter’s Physical layer to notify to the meter’s MAC sub layer that the mode F is accepted. On the client side, the primitive PH-CONNECT.confirm is invoked by the Physical layer to indicates that the mode F has been acknowledged.

MAC sub layer of transmitters invokes the primitive PH-DATA.request on the Physical layer entity to send data. Physical layer of receivers notifies that data have been received by invoking the primitive PH-DATA.indication.

A communication is aborted by the client MAC sub layer that invokes the primitive PH-ABORT.request on the Physical layer entity. On the server side, the communication is considered aborted when, after the break signal has been received, the Physical layer entity notifies it to the MAC sub layer by invoking the primitive PH-ABORT.indication. On the client side, the communication is considered aborted when the Physical layer entity notifies it to the MAC sub layer by invoking the PH-ABORT.confirm.

Timeouts defined in E.2.4 are used in the exchange of physical primitives between Physical layer and MAC sub layer.

E.2.4 Timers

The timers management is implemented according with CLC/TS 50568-4:2015, 4.4.2, and the following conditions:

– only the disciplines that involve A-Sub-net are implemented (*SAx* and *RAx* disciplines);

– the number (*r*) of repeaters is always set to 0.

A further delay of 150 ms is added due to optical section crossing (*delay* value in 4.4.2 of CLC/TS 50568-4:2015).

E.3 Sign on example

E.3.1 Identifier request -300 baud- (TP)

Table 191 – Connection request message example

Function:	sent from HHU, it requires meter identifier. The request of opening session takes place.
Structure:	
/	2Fh
?	3Fh
Device address	Optional
!	21h
CR	0Dh
LF	0Ah
Activity:	as received this message, meter responds with "identifier response".

E.3.2 Meter identifier response from meter -300 baud-

Table 192 – Identification response message example

Function:	meter responds to HHU with its own identifier and requests to commute data exchange speed to 19200 bps.	
Structure:		
/	2Fh	
xxx		Manufacturer identifier
Z = 6	36h	Baud rate proposed, 19200 bps
****	5Hh	
W = 3	33h	Meter is able to support SMITP transparent binary mode communication
Identification		14 ASCII character
CR	0Dh	
LF	0Ah	
Activity:	as received this message HHU responds with "ACK + work mode selection".	

E.3.3 Work mode selection -300 baud- (HHU)

Table 193 – Acknowledgement message example

Function:	HHU concludes 300 baud data exchange phase accepting the new requested baud rate and selecting data exchange in binary mode.	
Structure:		
ACK	06h	
V = 3	33h	SMITP Protocol procedure
Z = 6	36h	Baud rate, 19200 (for download procedure the speed is 9600 baud)
Y = 3	33h	SMITP transparent binary mode
CR	0Dh	
LF	0Ah	
Activity:	as received this message, meter verifies the speed data exchange field; if it is in accordance with that required, baud rate will be at 19200 bps, otherwise it leaves unaltered the 300 baud speed. Selecting "Y" field = 3, CLC/TS 50568-4:2015 Data Link and the Original-SMITP AL described in 9. Selecting "Z" field = 6, baud rate value of 19200 bps is used.	

Bibliography

[1] EN 61334-6:2000, *Distribution automation using distribution line carrier systems – Part 6: A-XDR encoding rule (IEC 61334-6:2000)*

[2] EN 62056-1-0, *Electricity metering data exchange - The DLMS/COSEM suite - Part 1-0: Smart metering standardization framework (IEC 62056-1-0)*

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

[4] STD0005 (1981) *Internet Protocol*. Also: RFC0791, RFC0792, RFC0919, RFC0922, RFC0950, RFC1112

[5] STD0006 (1980) *User Datagram Protocol*. Also: RFC0768

[6] STD0007 (1981) *Transmission Control Protocol*. Also: RFC0793

[7] RFC 4086, Eastlake, D., 3rd and J. Schiller and S. Crocker, *Randomness Requirements for Security, BCP 106, RFC 4086, June 2005*

[8] ISO/IEC/IEEE 9945, *Information technology — Portable Operating System Interface (POSIX®) Base Specifications, Issue 7*

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