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Metering Department

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Linky PLC profile specifications

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• Summary

This document deals with the retained normative items, and the proposed extension of the Linky PLC Profile. It concerned the programmers of "protocol items" (or "stack" protocol).

• Associated document(s) and appendix (appendices)

• Document history

Version	Application date	Type of modification	Cancels and replaces
V1.0	30/09/2009	Original document	

• Accessibility

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1 REFERENCES

1.1 Reference documents

[A1] ERDF-CPT-Linky-SPEC-FONC-CPL	Spécifications fonctionnelles du profil CPL Linky (Linky PLC profile functional specifications)
[A2] ERDF-CPT-Linky-SPEC-CON	Spécifications détaillées des concentrateurs Linky (Linky concentrator detailed specification)
[A3] ERDF-CPT-Linky-SPEC-FONC-CPT	Spécifications fonctionnelles des compteurs communicants Linky (Linky communicating meter functional specifications)

1.2 Normative references

The PLC system conforms to the following standards:

- [1] IEC 61334-4-1:1996, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 4: Protocoles de communication de données – Section 1: Modèle de référence du système de communication (Distribution automation using distribution line carrier systems – Part 4: Data communication protocols - Section 1: Reference model of the communication system)
- [2] IEC 61334-4-32:1996, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 4: Protocoles de communication de données – Section 32: Couche liaison de données – **Contrôle de liaison logique (LLC)** (Distribution automation using distribution line carrier systems – Part 4: Data communication protocols - Section 32: Data link layer - **Logical link control (LLC)**)
- [3] IEC 61334-4-41:1996, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 4: Protocoles de communication de données – Section 41: Protocoles d'application – **Spécification des messages de ligne de distribution** (Distribution automation using distribution line carrier systems – Part 4: Data communication protocols - Section 41: Application protocols - **Distribution line message specification**)
- [4] IEC 61334-4-42:1996, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 4: Protocoles de communication de données – Section 42: Protocoles d'application – **Couche application** (Distribution automation using distribution line carrier systems – Part 4: Data communication protocols - Section 42: Application protocols - **Application layer**)
- [5] IEC 61334-4-511:2000, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 4-511: Protocoles de communication de données – Administration de systèmes – **Protocole CIASE** (Distribution automation using distribution line carrier systems – Part 4-511: Data communication protocols - Systems management - **CIASE protocol**)
- [6] IEC 61334-4-512:2000, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 4-511: Protocoles de communication de données – Administration de systèmes – **Management Information Base(MIB)** (Distribution automation using distribution line carrier systems – Part 4-511: Data communication protocols – Systems management – **Management Information Base (MIB)**)
- [7] IEC 61334-5-1:2001, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 5-1: **Profils des couches basses** – Profil S-FSK (modulation pour saut de fréquences étalées) (Distribution automation using distribution line carrier systems – Part 5-1: **Lower layer profiles** - The spread-frequency shift keying (S-FSK) profile)
- [8] IEC 62056-53 Ed.2:200X, Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: **COSEM Application layer**
- [9] IEC 62056-61 Ed.2:200X, Electricity metering – Data exchange for meter reading, tariff and load control – Part 61: **OBIS Object identification system**
- [10] IEC 62056-62:200X Ed.2, Electricity metering – Data exchange for meter reading, tariff and load control – Part 62: **Interface objects**
- [11] IEC 61334-6:2000, Automatisation de la distribution à l'aide de systèmes de communication à courants porteurs – Partie 6: **Règles d'encodage A-XDR** (Distribution automation using distribution line carrier systems – Part 6: **A-XDR encoding rules**)

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- [12] CENELEC EN50065-1/A1 May 2002 Transmission de signaux sur les réseaux électriques basse-tension dans la bande de fréquences de 3kHz to 148 kHz. Partie 1: Règles générales, bandes de fréquences et perturbations électromagnétiques (Signalling on low-voltage electrical installation in the frequency range 3 kHz to 148 kHz. Part 1: General requirements, frequency bands and electromagnetic disturbances)
- [13] Cossem Blue Book DLMS UA 1000-1:2009 9th edition
- [14] Cossem Green Book DLMS UA 1000-2:2009 7th edition
- [15] IEC EN50065-7 Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz. Equipment impedance
- [16] IEC EN62056-31 Ed.1 Electricity metering - Data exchange for meter reading, tariff and load control

The English text applies.

2 INTRODUCTION

The aim of the PLC protocols implemented for the Linky project is to allow a Client device (the concentrator) to communicate with the Server devices (the meters) by using the services defined by the COSEM or DLMS application layer on a PLC network infrastructure.

- The COSEM application layer is defined by the IEC 62056 series of standards and its extensions described in the DLMS UA Books, [13] and [14].
- The DLMS application layer and the lower layers of the PLC protocol are defined by the subset of the IEC 61334 standards.
- This communication objective also includes network management, using the services provided by the CIASE layer described in IEC 61334-4-511.

The above-mentioned protocol base is supplemented by new services, which are deemed to be extensions to the standard.

The ERDF-CPT-Linky-SPEC-PROFIL-CPL ("Spécifications du profil CPL Linky"(Linky PLC profile specifications)) document describes the selected normative elements and the recommended extensions.

The ERDF-CPT-Linky-SPEC-FONC-CPL ("Spécifications fonctionnelles du profil CPL Linky"(Linky PLC profile functional specifications)) document describes how to use these elements and explains how they can be implemented by users (application developers and operators), as opposed to the previous document, which is of more interest to developers of "protocol elements" (or protocol "stacks").

2.1 PLC profiles

The Linky PLC LAN system consists of:

- Single-phase and three-phase meters with an integrated PLC communication interface,
- PLC modules with a Euridis interface for "Yellow tariff" meters
- PLC modules with a Euridis serial interface for PME/PMI type meters,
- Concentrators installed in the MV/LV transformer stations.

Each of these "PLC modules" has a different communication profile. These profiles are as follows:

- The Linky Server profile: integrated with the single-phase and three-phase meters.
- The PLC module Server profile: PLC modules with a Euridis interface.
- The PME/PMI Server profile: PLC modules with a serial interface for PME/PMI meters
- The concentrator Client profile.

In each Server profile, we distinguish between information which applies to the lower layers, Management-related services and Meter application-related services.

2.2 Document description

The following sections contain a layer-by-layer description of the individual elements of the reference specification that are used by the PLC profile for the Linky system.

Each specification consists of:

- The reference documents (IEC standards).
- The services used and those not used by the profile.
- A section-by-section description of the options.

2.3 Convention

The following conventions are used for the service fields in the services table:

- M = Mandatory.
- C = Conditional, its presence depends on another value.
- U = User, the presence of the parameter depends on the application.
- (dash): indicates that the parameter is not used

3 PHYSICAL LAYER

3.1 Reference document

- [7] IEC 61334-5-1: S-FSK profile

3.2 Description of the services used

- P_Data
- P_Sync

3.3 Section-by-section description of the options

Section 2.3 Frequency spread

- $f_M = 63.3$ kHz
- $f_S = 74$ kHz
- f_M, f_S transmission frequency tolerance = +/- 0.5%

Section 2.4.1 Performance test:

- It must be possible to detect the signal received for voltages between 2 mV rms and 2 V rms

Section 3.2.2 Bit repetition frequency:

- The transmission rate is 2400 bits/s.
- The bit transmission time is therefore: 416.625 μ s at 50Hz.
There will therefore be 24 bits in a time interval between two 50 Hz zero crossings.
- The deviation between the 50 Hz zero crossing and the beginning of the communication window is set to 120 μ s with a tolerance of +/-20 μ s. This deviation is independent of the transmission speed.

Section 3.4.1.1 P_Data services

Service	Primitives	.request	.confirm	.indication
P_Data		M	M	M
	All the parameters	M	M	M

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Section 3.4.1.2 P_Sync services

Service	Primitives	.request	.confirm	.indication
P_Sync		M	-	M
All the parameters		M	M	M

Section 7.5.4 Table 3.5.4

Amendment to the standard:

- The 6th transition includes (LFS or S_IDL to LFS); it only includes LFS in the initial state.
- The 15th transition (S_RPF_R) presents a Sync_conf variable. This should be disregarded.

4 MAC LAYER

4.1 Reference document

[7] IEC 61334-5-1: S-FSK profile, section 4

[1] IEC 61334-4-1: Reference model of the communication system.

4.2 Description of the services

- MA_Data
- MA_Sync

4.3 Section-by-section description of the options

Section 4.1.3.1 and Sections 4.1.4 to 4.1.6 MA_Data services

Service	Primitives	.request	.confirm	.indication
MA_Data		M	M	M
Destination_address		M	-	M
Source_address		-	-	M
M_sdu		M	-	M
Service_class*		Equal to 0	-	-
Transmission_status		-	M	-

* is not transmitted

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The following parameters can be selected:

Destination_address	See section 4.3.1
Source_address	See section 4.3.1
Service_class*	Equal to 0
Transmission_status	OK: no error detected; LM-TU: resources temporarily unavailable at the MAC sublayer; LM-NI: resources not implemented or deactivated at the MAC sublayer; LM-HF: equipment failure at the MAC sublayer; LM-SE: syntax error at the MAC sublayer; one of the possible values of the Transmission_status parameter returned by the physical layer.

* is not transmitted

Sections 4.1.3.2 and 4.1.7.2 MA_Sync services:

Service	Primitives	.request	.confirm	.indication
MA_Sync		-	-	M
Synchro State		-	-	M
Synchro Loss Cause		-	-	C
Source Address		-	-	C
Destination Address		-	-	C

O (optional) in the standard. In this case, C (conditional), as the values are only valid if the Synchro State value is Synchro Lost. As the service is local, it has no impact on the network.

The following parameters can be selected:

Synchro State	SYNCHRO_FOUND: the physical layer has found a synchronisation reference; SYNCHRO_LOSS: the physical layer has lost its synchronisation reference; SYNCHRO_CONF: as the characteristics of the received frame are appropriate, synchronisation is confirmed.
Synchro Loss Cause	synchronization-confirmation-time-out : loss of synchronisation is due to meter synchronisation-confirmation-time-out; time-out-not-addressed : loss of synchronisation is due to meter time-out-notaddressed;


```
    }  
  }  
  return (crcreg>>8);  
}
```

4.3.1 Address values

4.3.1.1 Individual addresses

The PLC meters will have a MAC address between 001h and BFFh (i.e. a maximum of 3071 addresses). The addresses are distributed by the Concentrator (known as the Initiator) in time order (the address of the first meter registered will be address 1, etc.).

The MAC addresses of the concentrators are between C00h and DFFh, i.e. a maximum of 511 concentrator addresses.

The way in which the MAC addresses of the concentrators are assigned depends on the concentrator application and not on the PLC profile; for example, the addresses can be assigned by the information system.

4.3.1.2 Group addresses

The NO-BODY address is the address of group 000.

The group addresses in the next range, F00h and FFBh, are reserved for use by ERDF.

The system group addresses are:

- The All-configured-address group address is set to FFCh.
- The All-physical-address-NEW group address is set to FFEh.
- The All-physical-address group address is set to FFFh.

5 SUBLAYER: LOGICAL LINK CONTROL

5.1 Reference document

[2] IEC 61334-4-32: Data Link Layer - Logical Link Control (LLC)

5.2 Services

The following service is used by the services of the Read, Write and UnconfirmedWrite Application layer.

- DL_Data: Main primitive used to send data from a Client to a Server.

The following services are not used.

- DL_Reply: Secondary primitive that tells the server to send pre-prepared data. The client processes the request when it so wishes, after the DL_UpdateReply has been received. The server sends the data in the response primitive.
- DL_Update Reply: Sets a request to pending. This indication is given in all the frames sent by the node and informs a Client that the node in question would like to be polled. This service is typically used for sending alarms.
- DL_Broadcast: Transmission of broadcast data

5.3 Section-by-section description of the options

Section 2.2 and following sections: DL_Data services:

Service	Primitives	.request	.confirm	.indication
DL_Data		M	M	M
Destination_LSAP		M	M	M
Source_LSAP		M	M	M
Destination_address		M	M	M
Source_address		-	-	M
L_SDU		M	-	M
Link_class		Reserved	Reserved	Reserved
Transmission_Status		-	M	

5.3.1 COSEM profile LSAP

The client (concentrator) LSAPs will be selected according to the uses required with the following recommendations:

- LSAP = 1 for the System Management Client
- LSAP = 2 for the Read/Write Client (authorised to read and write data crypted in point-to-point mode)
- LSAP = 8 for the Broadcast / Multicast Client (authorised to write data crypted in broadcast mode)
- LSAP = 16 for the Public Client

The following LSAPs will be used for the servers.

- LSAP = 0 for the system management server (CIASE)
- LSAP = 1 for the logical device Linky meter (Linky and management application)

The following LSAP is a group LSAP

- LSAP = 253 (FDh) used for a Discover Report

5.3.2 PME/PMI profile LSAP

The LSAPs for the PME/PMI meter are as follows:

- LSAP= 0 (VDEType= 0): Management
- LSAP= 1 (VDEType= 765): Supervision
- LSAP= 2 (VDEType= 775): Tariff application server
- LSAP= 4 (The VDEType depends on each manufacturer): Manufacturer

5.3.3 Yellow Meter profile LSAP

The LSAPs for the Yellow tariff meter are as follows:

- LSAP= 0 (VDEType = 0): Management
- LSAP= 1 (VDEType = 3074): Euridis

6 COSEM APPLICATION LAYER

This section applies only to the COSEM server profile.

6.1 Reference documents

- [8] IEC 62056-53: COSEM Application Layer
- [3] IEC 61334-4-41: DLMS Application layer
- [11] IEC 61334-6: A-XDR encoding.

6.2 Services specified in IEC 62056-53: COSEM Application Layer

The services described in the standard and used in this document are:

- the services used to establish and release the application association.
 - COSEM-OPEN
 - COSEM-RELEASE
 - COSEM-ABORT
- the services used to access the ShortName-referenced variables
 - Read service (.request,.confirm);
 - Write service (.request,.confirm);
 - UnconfirmedWrite

The service described in the standard but not used in this document is:

- the service used to access the ShortName-referenced variables
 - InformationReport

Note: the COSEM client uses only the Short Name, not the Logical Names when communicating with the Linky servers. It has an SN-wrapper to manage the API in the form of an LN.

To avoid ambiguity, the sections used are:

- Sections 6.5, from 6.5.1 to 6.5.3.2
- Sections 6.6, from 6.6.1 to 6.6.3 (except section 6.6.3.2)
- Section 7.
- Section 8: 8.1, 8.2, 8.3, 8.4 and 8.5
- Annex A: the xDLMS application service element.
- Annex C: C.2 (AARQ encoding of the Initiate service)

The following sections are not used:

- Section 6.6.3.2 (LN)
- Section 8.6
- Annex B.

6.3 Section-by-section description of the options specified in IEC 62056-53 (COSEM)

6.3.1 Section 6.5.1. Application association establishment

Service Primitives	.request	.confirm	.indication	.response
COSEM_OPEN	M	M	M	M
Protocol_Connection_Parameters	M	M(=)	M(=)	M
Dedicated_Key,	M	-	M(=)	-
Local_or_Remote,	-	M	-	-
Result,	-	M(=)	-	M
Failure_Type,	-	C(=)	-	C
DLMS_Version_Number,	M	M(=)	M(=)	M
DLMS_Conformance,	M	M(=)	M(=)	M
Client_Max_Receive_PDU_Size,	M	-	M(=)	-
Server_Max_Receive_PDU_Size,	-	M	-	M(=)
ACSE_Protocol_Version,	M	M(=)	M(=)	M
Application_Context_Name,	M	M	M	M
Application_Ids_and_Titles,	M	-	M	-
Security_Mechanism_Name,	M	M	M	M
Calling_Authentication_Value,	M	-	M(=)	-
Responding_Auth_Value,	-	C	-	C(=)
Implementation_Information,	-	-	-	-
User_Information,	Not used	-	Not used (=)	-
Service_Class	M	-	M(=)	-
QoS (1)	M	M(=)	M(=)	M(=)

- (1) This parameter is added to inform the server about the quality of service provided when the association is opened. QOS =1 corresponds to a maximum response preparation time of 300 ms. Its use is described in the following documents: [A1] and [A3].

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(2) Parameter values

Protocol_Connection_Parameters	This parameter contains the values identifying the connection being established. This parameter is not transmitted as such to the PDU. - Protocol Identifier Id (PLC profile for the Linky pilot), - Server SAP, - Server MAC Add, - Client SAP - Client MAC Add
Dedicated_Key,	The COMPANY will send the value at a later date when the equipment is manufactured.
DLMS_Version_Number,	6
DLMS_Conformance,	See Conformance block below
Client_Max_Receive_PDU_Size,	Value defined in [A2]
Server_Max_Receive_PDU_Size,	Value defined in [A3]
ACSE_Protocol_Version,	1 (default value)
Application_Context_Name,	See COSEM [8] section 7.3.7.1 Short_Name_Referencing_with_ciphering.
Application_Ids_and_Titles,	Called AP Title and calling AP title will be used. See [A2] and [A3].
Security_Mechanism_Name,	See COSEM [8] section 7.3.7.2 COSEM_high_level_security_mechanism_name_using_MD5
Calling_Authentication_Value,	The COMPANY will send the value at a later date when the equipment is manufactured.
User_Information,	Not used
Service_Class	Confirmed
QoS	1

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Section 8.5 Conformance Block

The 3 bytes in the Conformance block parameter are as follows: 1C 1A 20

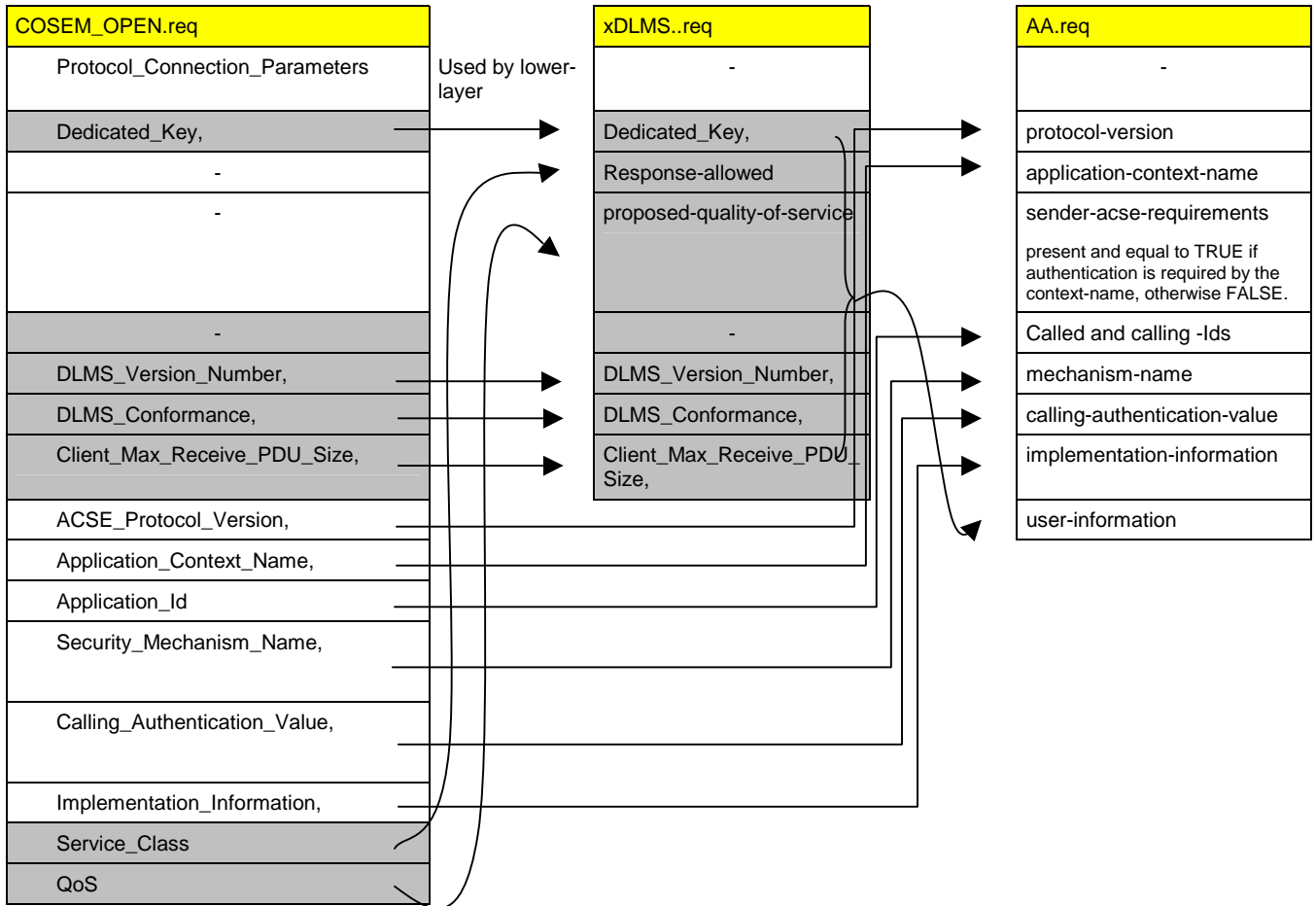
reserved (0) (0),	0
reserved (0) (1),	0
reserved (0) (2),	0
read (3),	1
write (4),	1
unconfirmed-write (5),	1
reserved (0) (6),	0
reserved (0) (7),	0
attribute0-supported-with-SET (8),	0
priority-mgmt-supported (9),	0
attribute0-supported-with-GET (10),	0
block-transfer-with-get-or-read (11),	1
block-transfer-with-set-or-write (12),	1
block-transfer-with-action (13),	0
multiple-references (14),	1
information-report (15),	0
reserved (0) (16),	0
reserved (0) (17),	0
parameterized-access (18),	1
get (19),	0
set (20),	0
selective-access (21),	0
event-notification (22),	0
action (23)	0

6.3.1.1 Mapping COSEM.OPEN service fields to xDLMS and AA services.

This section describes how the APDU is created for the COSEM_Open.req. service. As shown in the COSEM standard [8], COSEM_Open implements xDLMS.Initiate request followed by AA.request.

Only the parameters used are described.

- xDLMS.req is described in Annex A of [8] IEC 62056-53: COSEM Application Layer.
- AA is described in section 7 of [8] IEC 62056-53: COSEM Application Layer.



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Section 6.5.2.2 COSEM release

Service Primitives	.request	.confirm	.indication	.response
COSEM-Release	M	M	M	M
Result	-	M	-	M
Failure-type	-	C	-	-
User_Information	-	-	-	-
Use_RLRQ_RE	TRUE*	-	TRUE	TRUE

* indicates that the release.req primitive always uses an RL.req to create the PDU.

6.3.2 Section 6.5.2.4 COSEM abort

Service Primitives	.request	.confirm	.indication	.response
COSEM-Abort	M	M	M	M
Diagnostics	-	-	-	-

7 DLMS APPLICATION LAYER

This section applies only to the DLMS server profile

7.1 Reference documents

- [3] IEC 61334-4-41: DLMS Application layer
- [4] IEC 61334-4-42: Application layer
- [11] IEC 61334-6. A-XDR encoding.

7.2 Services specified in IEC 61334-4-41: DLMS Application Layer

The only services described in the standard and used in this document are

- context management services (section 5)

- Initiate
- Abort

services used to access the variables (Section 10).

- Read
- Write
- UnconfirmedWrite

The service described in the standard but not used in this document is

- InformationReport

To avoid ambiguity, the sections used are:

- Section 5: context management service
- Section 10: the services used to control access to the variables (except 10.8, GetVariableAttribute and InformationReport)
- Annex A applies to the PDUs related to the service described in section 10 and the Initiate service.

The following sections are not used:

- Section 6: VDE support service
- Section 7: data set service
- Section 8: VAA management service
- Section 9: task invocation management service

7.3 Services specified in IEC 61334-4-42: Application Layer

The only service described in the standard and used by the DLMS profile for the Application Association is as follows:

- A_Unit_Data

To avoid ambiguity, the sections used are:

- All sections

Info: the connection between the A_Unit_Data service and the higher layers is that only the DLMS InitiateRequest service is implemented by the A_Unit_Data service (described in section 8.2.1).

7.4 Section-by-section description of the options specified in IEC 61334-4-41 (DLMS)

7.4.1 Description of the Initiate services

Service	Primitives	.request	.confirm	.indication	Response
Initiate		M	M	M	M
Dedicated_Key,		M	-	M(=)	-
Response_allowed		M	-	M(=)	-
Proposed_quality of service (QoS)		M	-	M(=)	-
Proposed_DLMS_Version_Number		M	-	M(=)	-
Proposed_DLMS_Conformance		M	-	M(=)	-
Negotiated_quality of service		-	M(=)	-	M
Negotiated_DLMS_Version_Number		-	M(=)	-	M
Negotiated_DLMS_Conformance		-	M(=)	-	M
Proposed_Max_PDU_Size		M	-	M(=)	-
Negotiated_Max_PDU_Size		-	M(=)	-	M
Vaa-name		-	M(=)	-	FA 00
Error type		-	C(=)	-	C

Linky PLC profile specifications

Section 4.5.2: Conformance block (for the PME/PMI profile)

Bit	LSAP Management Value	LSAP Supervision Value	LSAP Tariff Application Value
get-data-set-attribute (0)	0	0	0
get-ti-attribute (1),	0	0	0
get-variable-attribute (2)	0	0	0
read (3)	1	1	1
write (4)	1	1	1
unconfirmedWrite (5)	1	0	0
change-scope (6)	0	0	0
start (7)	0	0	0
stop-resume (8)	0	0	0
make-usable (9)	0	0	0
data-set-load (10)	0	0	0
selection-in-get-name-list (11)	0	0	0
detailed-access-low-bit (12)	0	1	1
detailed-access-high-bit (13)	0	1	1
multiple-variable-list (14)	0	1	1
data-set-upload (15)	0	0	0

Section 4.5.2: Conformance block (for the yellow tariff meter PLC module profile)

Bit	LSAP Management Value	LSAP Euridis Value
get-data-set-attribute (0)	0	0
get-ti-attribute (1),	0	0
get-variable-attribute (2)	0	0
read (3)	1	1
write (4)	1	1
unconfirmedWrite (5)	1	1
change-scope (6)	0	0
start (7)	0	0
stop-resume (8)	0	0
make-usable (9)	0	0
data-set-load (10)	0	0
selection-in-get-name-list (11)	0	0
detailed-access-low-bit (12)	0	0
detailed-access-high-bit (13)	0	0
multiple-variable-list (14)	0	0
data-set-upload (15)	0	0

7.5 Section-by-section description of the options specified in IEC 61334-4-42 (Application Layer)

Section 6.4.2

Service	Primitive	.request	.indication
A_Unit_Data		M	M
Application Context Name		M	M(=)
User Information		M	M(=)
Calling AP Title		M	C(=)
Calling AE Qualifier		-	-
Calling AP Invocation Identifier		-	-
Calling AE Invocation Identifier		-	-
Called AP Title		M	M(=)
Called AE Qualifier		-	-
Called AP Invocation Identifier		-	-
Called AE Invocation Identifier		-	-
Quality of Service		-	-

8 NETWORK MANAGEMENT LAYER

8.1 Reference documents

- [5] IEC 61334-4-511: CIASE

8.2 Services specified in IEC 61334-4-511 (CIASE)

The only services described in the standard and used in this document are those which allow the **application association** to be established and released.

- Discover
- Register

To avoid ambiguity, the sections used are:

- All sections

8.3 Description of the options specified in IEC 61334-4-511 (CIASE)

Section 7.1

Service	Primitive	.request	.confirmation
Discover		M	M
Response Probability		M	-
Allowed Time Slots		M	-
DiscoverReport Credit		M	
ICEqualCredit		M	-
Result(+)			S
Number of received invalid frames			M

Linky PLC profile specifications

List of System Titles		M
List of States		M
Result(-)		S
Error		M

The System Title is the meter descriptor given to the concentrator when the response to the Discover service is received. It is specific to each implementation. It has a Euridis type structure [18].

Possible *Error* values (Section 7.3.3)

- other (0),
- Discover-probability-out-of-range (1),
- Discover-initial-credit-out-of-range (2),
- DiscoverReport-list-too-long (3),
- Register-list-too-long (4)
- ICEqualCredit-out-of-range (5)

Section 7.2

Service	Primitive	.request	.confirmation
Register		M	M
New System Title(s)		M	-
MAC Adress(es)		M	
Result(+)			S
Result(-)			S
Error			M

It is important to note that the MAC addresses must be assigned by the concentrator in ascending order starting with 1. This is required by the RepeaterCall mechanism calculation algorithm.

Possible *Error* values (Section 7.3.3)

- other (0),
- Register-mac-address-invalid (1),
- Register-system-title-invalid (2).

9 MANAGEMENT INFORMATION BASE

Two standards apply, depending on the Server profile.

- In the case of DLMS servers, the applicable standard is [6], IEC 61334-4-512: MIB.
- In the case of COSEM servers, the MIB variables are encoded in the form of OBIS objects via the interface classes 50, 51, 52, 53, 55 specified in the Blue Book [13]. See section 10.3.1

9.1 Reference documents

- [6] IEC 61334-4-512: MIB

9.2 Services specified in IEC 61334-4-512: MIB

To avoid ambiguity, the sections used are:

- All sections

10 EXTENSIONS TO THE STANDARD FOR THE LINKY SYSTEM

This part describes the new services and the extensions to the services that are available for all the profiles.

10.1 Physical Layer

10.1.1 Alarm management services

10.1.1.1 *P_Alarm service*

The alarm service allows a Linky server profile to inform the client profile that the server is in the alarm state. The client will have to poll the server to find out information or the corresponding alarm state. This polling mechanism is not within the scope of the physical layer; it is described in the *System Management AP* process.

The service primitives are:

- P_Alarm.request
- P_Alarm.confirm
- P_Alarm.indication

Service	Primitives	.request	.confirm	.indication
P_Alarm		M	M	M
Result		-	M	-

Possible Result values:

- OK
- NotOk (not synchronised with the electrical network)

10.1.1.2 *Linky Server profile protocol specification*

Processing the *P_Alarm* request

When a *P_Alarm* request is received, the physical layer of the server system performs the following operations:

- If the PLC module is not synchronised with the network, the alarm is not sent. The P_Alarm.confirm service primitive is returned with the "NotOk" error.
- If the PLC module is synchronised with the network but is processing an alarm or an alarm repetition (8 transmission TSlots plus the 9 wait TSlots, see below), the alarm is not sent. The P_Alarm.confirm service primitive is returned with an "OK" result.
- If the PLC module is synchronised with the network and is not processing an alarm, the alarm is sent as a fixed pattern 569E8Ah in the three subframe pause bytes.

Alarm repetition or transmission is independent of the state of the physical layer, i.e. the alarm is sent in all cases, irrespective of whether any communications are in progress.

The PLC module sends the alarm to the 8 timeslots (TSlots) according to the request.

Management of alarms from other servers

The server profile module must listen continuously for alarm information.

In receive and send mode, the first and last bits of the alarm pattern are not significant, in order to avoid any possible errors that may occur due to the technical problems of Send / Receive turnaround or conversely. To prevent repetition of false alarms (noise), the alarm information is only validated when two successive alarms are correctly received and not when alarms are received at the TSlot (window or timeslot) preceding the two alarms.

The alarms received by a server in repeater mode and from other servers are repeated in the next 8 timeslots (TSlots).

To prevent an echo phenomenon, when the alarm has been repeated, the PLC module will not repeat or transmit any other alarms to the next 9 TSlots.

10.1.1.3 Linky client profile protocol specification

The Client profile module must listen continuously for alarm information.

In receive mode, the first and last bits of the alarm pattern are not significant, in order to avoid any possible errors that may occur due to the technical problems of Send / Receive turnaround or conversely. To avoid detecting false alarms caused by noise, the alarm information will be validated when two successive alarms have been correctly received.

In this case, the client physical layer will invoke the P_Alarm.indication service primitive which will be processed by the *System Management AP*.

10.1.2 Repeater management services (RepeaterCall)

10.1.2.1 Purpose

The Repetition management service allows a client profile to configure the server repeater mode automatically.

The class_Id 50 defined in document [13] has two attributes that are used in this mechanism.

- *Repeater*, whose values allow or prevent the Repeater_Status attribute from being modified.
 - *Dynamic Repeater*: the PLC module can change its Repeater_Status in RepeaterCall mode.
 - *Always Repeater* or *Never Repeater*: the module cannot change its Repeater_Status in RepeaterCall mode.
- *Repeater_Status*
 - Specifies whether or not module repetition is required.

10.1.2.2 P_AskForRepeaterCall service

In *RepeaterCall* mode, the physical layer can no longer see the frames in the usual form. It breaks the PHY frame timeslot (TSlot) down into 21 sub-timeslots (SubTslot) with a duration equivalent to 2 bytes. As the pause time is not used by the RepeaterCall function, the alarms remain active during this period.

The service primitive is:

P_AskForRepeaterCall

Service	Primitives	.request	.conf
RepeaterCall		M	M
SubTslot Position		M (1)	-
ReceiveThreshold		U (1)	-
Result		-	M

(1) A more detailed description of the parameters can be found in section 10.4.3.1.

Result =

- Ok
- NotOk (not synchronised with the electrical network).

10.1.2.3 Client profile protocol specification

As soon as the request primitive is received from the MAC layer, the physical layer in the Client configuration performs the following actions:

- If the physical layer is synchronised,
 - It enters *RepeaterCall* mode and returns its *P_AskForRepeaterCall.conf* primitive with a Positive result.
 - It sends the fixed pattern 2E5Ch to the SubTslotPosition received as a parameter (which must be equal to 0, corresponding to the first SubTslot). When the pattern has been sent, the physical layer exits the *RepeaterCall* mode.
 - The client does not change the value of its *Repeater_Status*.
- If the physical layer is not synchronised,
 - it returns its *P_AskForRepeaterCall.conf* primitive with a Negative result ("NotOk").

10.1.2.4 Server profile protocol specification

When a *P_AskForRepeaterCall* request has been received, the physical layer of the server system checks that the arguments are correct and that it is synchronised. If this is not the case, it returns a negative confirmation. Otherwise, it performs the following actions:

For a server in *Dynamic Repeater* mode:

- It enters *RepeaterCall* mode and returns a positive confirmation.
- The reception gain is set to the minimum value (0 dB, i.e. no signal amplification) throughout the reception phase in *RepeaterCall* mode.
- The 2E5Ch pattern is detected if the sum of the signal $S = (S0+S1)/2$ is greater than
 - a *ReceiveThreshold* if it is provided in the parameters.
 - or the sum of the noises $N = (N0+N1)$.
- If a PLC server detects the fixed pattern 2E5Ch (sent by the Client or another Server) to a SubTslot lower than its SubTslot position (passed as a parameter), it is configured as "NoRepeater" and exits the *RepeaterCall* mode without sending anything.
- Otherwise, if the SubTslot position is reached and no fixed pattern has yet been detected, the PLC module sends the fixed pattern to this SubTslot and it is configured as "Repeater" and exits the *RepeaterCall* mode after the two bytes have been sent.

For a server in *Never Repeater* mode:

- The *RepeaterCall* mode is not activated and returns a positive confirmation.

For a server in *Always Repeater* mode:

- The *RepeaterCall* mode is activated and returns a positive confirmation.
- It sends the fixed pattern to its SubTslotPosition and does not change the value of its *Repeater_Status*.

The Maximum number of TSlots is calculated by the CIASE and is equivalent to the duration of the *RepeaterCall* mode.

10.2 MAC Layer

10.2.1 Repeater management service (RepeaterCall)

10.2.1.1 MA_AskForRepeaterCall service

In the *RepeaterCall*, mechanism, the MAC layer must manage the wait times required prior to entering the RepeaterCall mode for the physical layer, to ensure that the mechanism is synchronous between the client and the servers. See section 10.4.3 CIASE layer *RepeaterCall* for a full description of the mechanism.

The service primitive is:

MA_AskForRepeaterCall

Service	Primitives	.request	.conf
MA_RepeaterCall		M	M
SubTslot Position		M (1)	-
ReceiveThreshold		U (1)	-
Result		-	M

(1) A more detailed description of the parameters can be found in section 10.4.3.1.

Result =

- o Ok
- o NotOk (not synchronised with the electrical network).

10.2.1.2 Client and Server profile protocol specification

When the MAC layer receives the MA_AskForRepeaterCall.req request, it waits until the physical layer is available to accept the P.AskForRepeaterCall command. The wait time depends on the repetition credit of the current command. (End of repetition wait time = Current Credit * TSlot).

It returns a positive confirmation with a result that depends on that returned by the physical layer.

If the Repeater Call phase has already begun (end of repetition already reached) when the MAC layer receives the MA_AskForRepeaterCall.req request, the server plays no part in the Repeater Call phase (the P.AskForRepeaterCall command is not invoked). The MAC layer returns a negative confirmation.

10.2.2 Managing the Binding function

This function modifies the synchronisation algorithm already defined in the MAC layer to improve the synchronisation of a PLC module with respect to the client that is closest in terms of signal strength.

Description of the Client Binding algorithm

This algorithm applies only to server PLC modules that are not registered and not bound (NEW and UNLOCK) to a client.

When the MAC sublayer receives a P_Sync.indication (SYNCHRO FOUND) synchronisation indication, it registers in the list of candidate clients the signal level of the frame received by the P_Data.indication primitive. This list contains the MAC addresses of the clients. It must immediately inform the physical layer that it rejects the synchronisation by invoking the P_Sync.request (Rejected) primitive and wait for a new synchronisation indication.

Two parameters are used. These parameters can be modified by class_id 52 and 50 attributes.

- The Time Out Search Initiator (Class_id 52) (10 minutes by default) defines the maximum time during which the module remains in this mode. A value of 0 indicates that this synchronisation mode is not used on several concentrators and therefore that the meter has to synchronise with the first concentrator found.

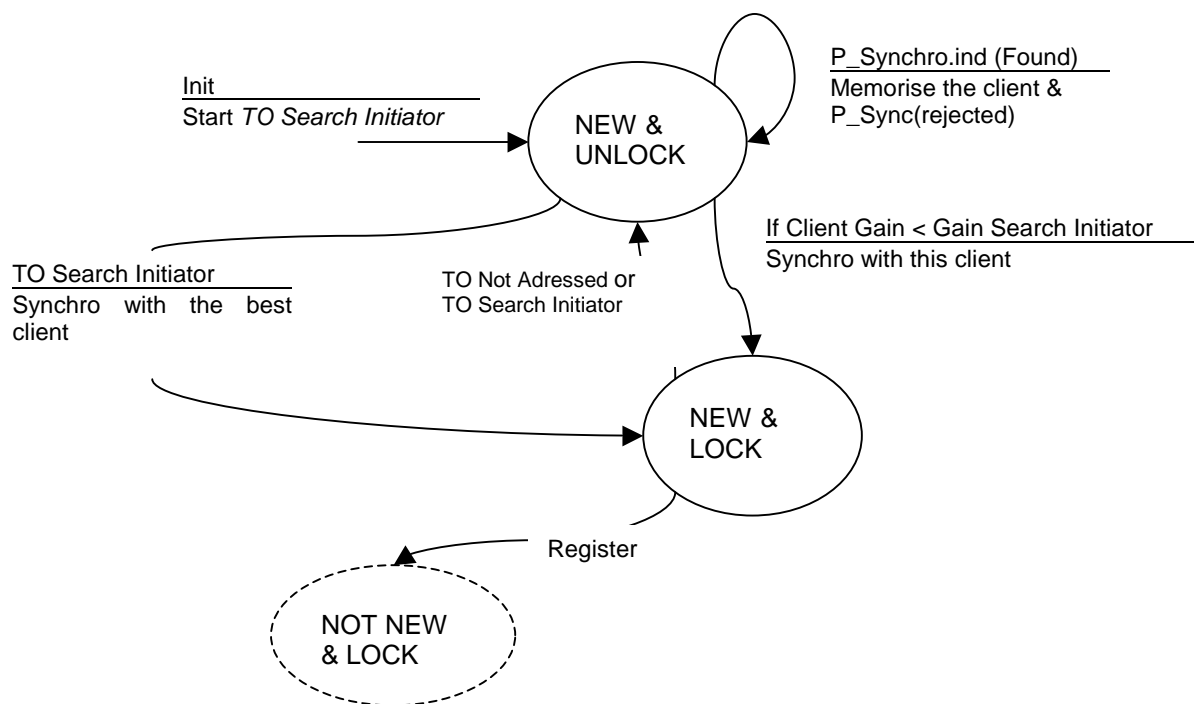
- The Gain Search Initiator (Class_Id 50) defines the maximum gain for which fast synchronisation is accepted. By default, this parameter is set to 6 dB.

When the *Time Out Search Initiator* expires, the module automatically binds itself to the concentrator with the best signal and gain level that it has heard (it changes to NEW and LOCK) and waits to be registered. If the module hears a concentrator with a gain that is lower than the Gain Search Initiator (corresponding to a strong signal) before this timeout expires, it automatically binds itself to this concentrator (changes to NEW and LOCK) and waits to be registered.

CLIENT registration pending phase

Once the module is bound to a concentrator (NEW and LOCK), it waits to receive a Register frame (from the correct concentrator) with its serial number to enable it to change to the registered state (Not NEW and LOCK). If the module does not receive a Register frame from the concentrator, it returns to the synchronisation search phase (NEW and UNLOCK) when *TO not Addressed* expires (6 hours by default). If the module does not receive a correct frame (CRC Ok) from the concentrator when *TO Frame NOK* expires, it returns to the synchronisation search phase (NEW and UNLOCK).

The following state machine describes the synchronisation mechanism. Transitions starting from the "NOT New & LOCK" state are not within the scope of this extension and are described in the specification [7]; they are not described in this document.



10.3 COSEM Application Layer

10.3.1 OBIS objects associated with the management of the PLC profile for Linky

The objects associated with the PLC profile for Linky are defined in COSEM ID Classes 50, 51, 52, 53, 55 described in the Blue Book [13].

The COSEM ID 56 class described in the Blue Book [13] is not used.

10.3.2 Variable management by data block services

This new COSEM Application layer function is used to send data from the COSEM application layer by *Data Blocks* in read or write mode. This function is useful when this data is longer than a MAC level frame.

This function is described in the Green Book [14].

The **Variable-Access-Specification** parameter for the ReadRequest and WriteRequest services can be modified by adding three new options:

- [5] block-number-access
Option used to access the next block when a block responds to a Read.Request.
- [6] data-block-access-read.
Option used to send a Read.Request with a sequence number requiring than 239 bytes.
- [7] data-block-access-write
Option used to send a Write.Request with a sequence number and a data number requiring more than 239 bytes.

The representation ASN.1 of the Variable-Access-Specification variable is as follows:

```
Variable-Access-Specification ::= CHOICE
{
    variable-name                [2] IMPLICIT ObjectName
    parameterized-access        [4] IMPLICIT SEQUENCE
    {
        variable-name            ObjectName,
        selector                 Unsigned8
        parameter                Data
    }
    block-number-access          [5] IMPLICIT SEQUENCE
    {
        block-number             Unsigned16
    }
    data-block-access-read       [6] IMPLICIT SEQUENCE
    {
        last-block               BOOLEAN
        block-number             Unsigned16,
        raw-data                 OCTET STRING
    }
    data-block-access-write      [7] IMPLICIT SEQUENCE
    {
        last-block               BOOLEAN
        block-number             Unsigned16,
    }
}
```

Linky PLC profile specifications

The ReadResponse and WriteResponse service primitives are modified:

```
ReadResponse ::= SEQUENCE OF CHOICE
{
  data [0] Data,
  data-access-error [1] IMPLICIT Data-Access-Result
  data-block-result [2] SEQUENCE
  {
    last-block BOOLEAN
    block-number Unsigned16
    raw-data OCTET STRING
  }
  block-number [3] Unsigned 16
}
```

```
WriteResponse ::= SEQUENCE OF CHOICE
{
  success [0] IMPLICIT NULL,
  data-access-error [1] IMPLICIT Data-Access-Result
  block-number [2] Unsigned16
}
```

10.4 Network Management Layer

10.4.1 Ping services

10.4.1.1 Purpose

The Ping service allows to send a confirmed request in point-to-point mode (i.e. non-connected). This service is used to check the system and specifically to check that a server module is always present on the network and to maintain the *TO Not Addressed* variable on each PLC module.

The service primitives are:

- Ping.request (Confirmed service addressed to a server device)
- Ping.confirm
- Ping.indication
- Ping.response

Service	Primitives	.request	.confirm	.indication	.response
Ping		M	M	M	-
System Title Server		M	M	M(=)	M(=)
Result		-	M	-	M(=)

Result has the following values:

- Ping_System_Title_OK
- Ping_No_response

Linky PLC profile specifications

The *System Title Server* parameter is used to identify unambiguously the server device concerned by the Ping request. It is used to supplement the Mac Destination address that appears in the MAC field and, at the same time, to ensure that the correct device is associated with the correct MAC address.

The *Result* (positive result) parameter indicates that the service requested has operated correctly. It is returned by the server system polled if the request is correct and its System Title corresponds to the one that appears in the Ping.Request primitive.

The *Result* (negative result) argument indicates that the service requested has failed. It is not sent by the server system if the request is incorrect. The .Cnf(-) primitive is generated by the client CIASE itself according to a time delay described below.

10.4.1.2 Client System service procedure

When the request primitive is invoked, if the System Title structure is not valid (structure error: size other than 6 bytes), a confirmation is returned immediately with a negative result indicating the problem encountered.

Otherwise, the CIASE creates a DL_Data request containing a CI_PDU Ping.Request comprising the System Title server requested. This request is sent to the server system to which the request applies.

When the Ping.Request has been sent, the CIASE waits for the DL_Data indication containing a CI_PDU Ping.Response from the server system polled during the time required according to the initial credit of the request. This time is equivalent to $(Initial\ Credit + 1) \times 2 + 1\ TSlot$.

- If the CIASE receives a DL_Data containing a CI_PDU Ping.Response before the end of this time and the System Title is the same as that of the transmission, it invokes the Ping.confirm primitive containing a positive result (Ping_System_Title_OK) and the System Title returned by the server system.
- Otherwise, the CIASE invokes the Ping.confirm primitive with a negative result (Ping_No_response) indicating that no response has been received.

10.4.1.3 Server System service procedure

When a DL_Data indication containing a CI_PDU Ping.indication is received, the server system CIASE concerned checks that its own System Title Server is indicated in the request.

If this is the case, it sends a DL_Data request containing a positive CI_PDU Ping.Response including the System Title Server and a Positive result.

If the parameter structure is incorrect, the DL_Data indication is ignored.

If the parameter is correct, but the System Title indicated in the request is not its own, it enters the NEW and LOCK state and does not respond.

10.4.2 Alarm management services

10.4.2.1 Purpose

In point-to-point or broadcast mode, the ClearAlarm service is used to remove the alarm information from a server.

10.4.2.2 Primitives

The service primitives are:

- ClearAlarm.request (Unconfirmed service addressed to devices registered on the Concentrator)
- ClearAlarm.indication
- ClearAlarm.confirmation

Service	Primitives	.request	.confirm	.indication
ClearAlarm		M	M	M
ListOfSystemTitle		C	-	C(=)
AlarmDescriptor		M		M(=)
Result		-	M	-

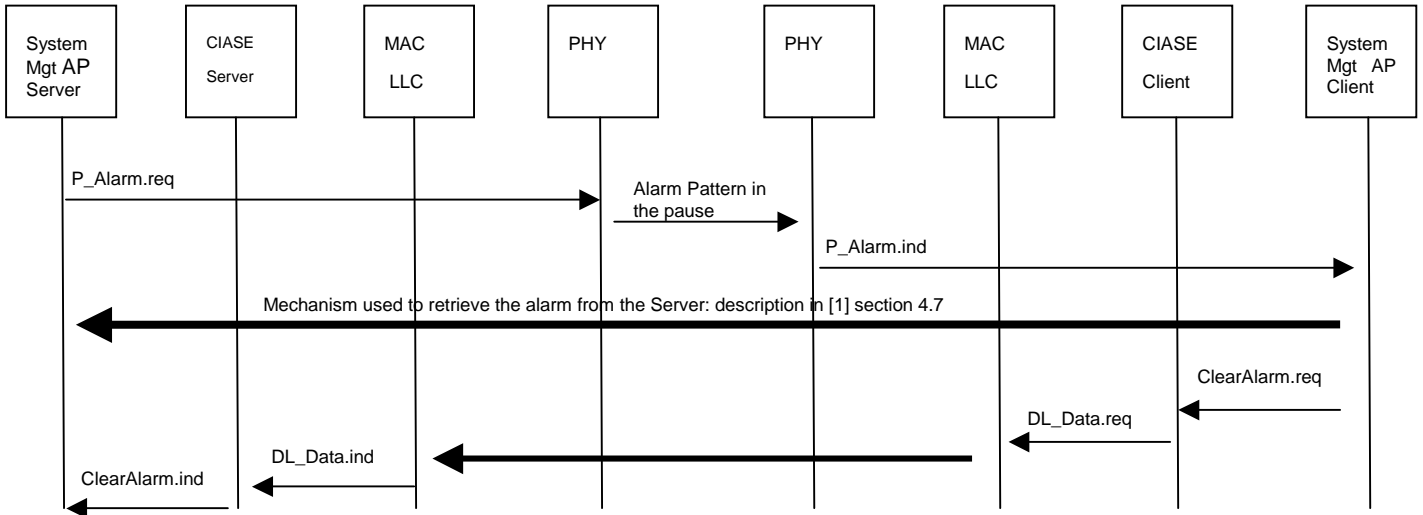
ListOfSystemTitle indicates the destination of the request.

If the ClearAlarm service is used for a server or a group of servers, the ListOfSystemTitle parameter will be used and will contain the System Title of each server.

Otherwise, the information is removed from all the devices connected (Non NEW Server) to this initiator without specifying a SystemTitle (this parameter will then not be present).

The *AlarmDescriptor* parameter is used to indicate the alarm number that the client wants to erase from one or more of the devices connected.

Diagram showing the relationship between the layers:



10.4.2.3 Client System Service procedure

The "SystemManagement AP" application process invokes the CIASE ClearAlarm service.

If one of the arguments is not valid, a confirmation is sent immediately with a negative result indicating the problem encountered.

Otherwise, the CIASE creates a DL_Data request containing a CI_PDU ClearAlarm including all the parameters requested. This request is sent to the server system to which the request applies. A positive confirmation is sent when a positive DL_Data.confirm confirmation is received.

10.4.2.4 Server System service procedure

When a CI_PDU ClearAlarm.indication is received, the server system CIASE concerned checks that the arguments are correct.

If they are correct, it removes the corresponding alarm from the alarm list.

If the arguments are not correct, the DL_Data indication is ignored.

10.4.3 Repeater management services (RepeaterCall)

10.4.3.1 Purpose

The Repetition management service allows a client profile to configure the server repeater mode automatically.

Note: when the client enters the Repeater Call mode, a Time-Out starts on the application layer to prevent it from sending any requests during this mode.

Primitives

The service primitives are:

- RepeaterCall.request
- RepeaterCall.confirm
- RepeaterCall.indication

Service	Primitives	.request	.confirm	.indication
RepeaterCall		M	M	M
MaxAdrMAC		M	-	M(=)
ReceiveThreshold		U		U(=)
NbTSlotforNew		M		M(=)
Result		-	M	-

The *MaxAdrMAC* is an integer between 0 and 65535. The *MaxAdrMAC* argument is used to define the number of *TSlots* used by the physical layer in RepeaterCall mode for the modules registered on the concentrator. It is equivalent to the highest MAC address of a PLC module stored in the concentrator. The number of *TSlots* is calculated from this information. This value is equal to $Nb_TSlotForReg = (MaxAdrMac / 21) + 1$.

The *ReceiveThreshold* argument is used to define the energy threshold of the signal to check that a physical pattern is received in a SubTslot in RepeaterCall mode in the physical layer. It is a number between 0 and 65535 (this value is the signal expressed in μV divided by a coefficient).

$$ReceiveThreshold = 10^{\frac{dB\mu V}{20} - 2,2}$$

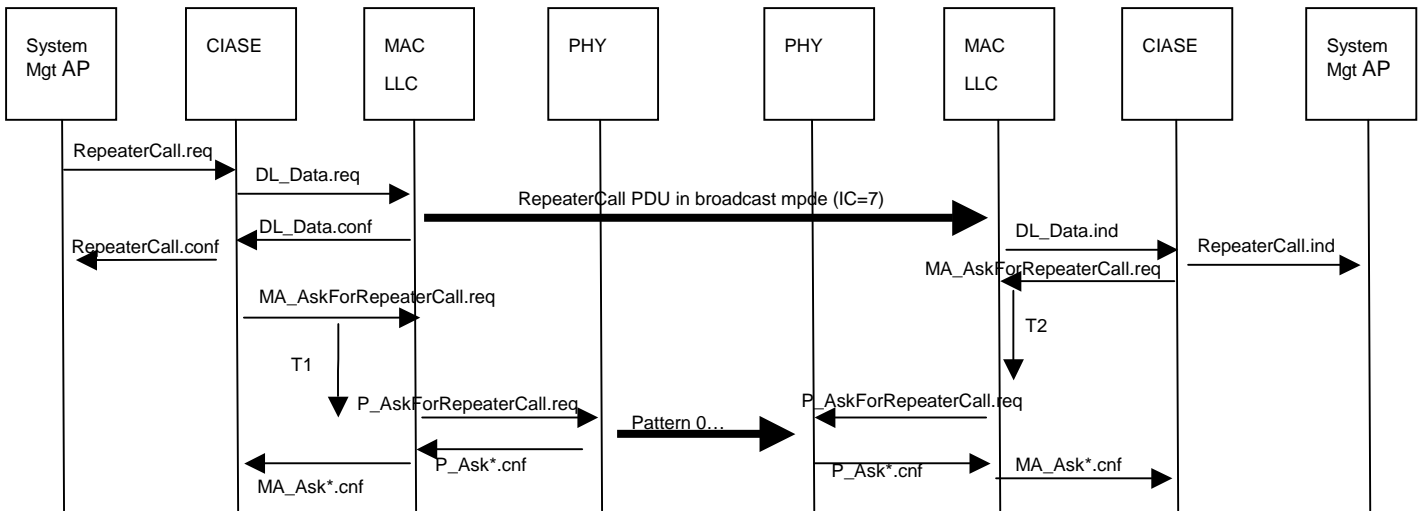
Its default value is 1000 (equivalent to 104 dB μV +/- 2 dB μV).

The *NbTSlotforNew* parameter is used to define a number of *TSlots* used by the physical layer in RepeaterCall mode for NEW state modules. The total number of *TSlots* used by the physical layer is equal to the sum of the number of *TSlots* used for the modules registered (*Nb_TSlotForReg*) and the number of *TSlots* used for the New state modules (*NbTSlotForNew*).

Result will have one of the following values:

- OK
- Error: transmission error
- Error: incorrect parameters

Diagram showing the relationship between the layers



T1: 8 TSlots (calculated by the MAC layer)

T2: CC * TSlot (calculated by the MAC layer)

10.4.3.2 Client profile protocol specification

When the RepeaterCall.request primitive is received from the *System Management AP*, the CIASE layer performs the following operations:

- If one of the parameters is not valid, a confirmation is sent immediately to the *System Management AP* with a negative result indicating the problem encountered.
- Otherwise, the CIASE layer issues a DL_Data request containing the PDU RepeaterCall.
 - If DL_Data.confirm is positive, an OK confirmation is returned to the *System Management AP*. The CIASE layer invokes the MA_AskFor RepeaterCall primitive with the SubTslot Position parameter equal to 0.
 - If DL_Data.confirm is negative, a negative confirmation (transmission error) is returned to the *System Management AP*

10.4.3.3 Linky server profile protocol specification

When the DL_Data.indication primitive containing the PDU RepeaterCall is received, the server system CIASE layer checks that the arguments are correct, returns a RepeaterCall.indication to the *System Management AP* and immediately invokes the MA_AskForRepeaterCall primitive with the following parameters if and only if the MAC address of the server is lower than MaxAdrMAC.

- *SubTslot position*

In the case of modules registered by a concentrator, the value of this variable is the value of their own MAC addresses.

In the case of non-registered modules, the value of this variable is a random value between MaxAdrMAC and MaxAdrMAC + (NB_TslotForNew*21).

- *ReceiveThreshold*

The value received in the PDU RepeaterCall.ind is used. If this value is not present, the default value is used (set to 1000).

10.5 CI_PDU description

```

CI_PDU ::= CHOICE
{
    Ping.RequestPDU          [25]IMPLICIT Ping.RequestPDU,
    Ping.ResponsePDU        [26]IMPLICIT Ping.ResponsePDU,
    reserved                 [27]
    RegisterPDU              [28]IMPLICIT RegisterPDU,
    DiscoverPDU              [29]IMPLICIT DiscoverPDU,
    DiscoverReportPDU        [30]IMPLICIT DiscoverReportPDU,
    RepeaterCallPDU         [31]IMPLICIT RepeaterCallPDU,
    ClearAlarmPDU           [57]IMPLICIT ClearALarmPDU
}
-- The CI_PDU values are greater than 24 corresponding to the last DLMS
unciphered APDU.

```

Ping.RequestPDU ::=

```

{
    System Title Server      System Title
}

```

Ping.ResponsePDU ::=

```

{
    System Title Server      System Title
}

```

RepeaterCall.RequestPDU ::=

```

{
    MaxAdrMac                IMPLICIT Unsigned16
    NbTslotForNew            IMPLICIT Unsigned8
    ReceiveThreshold         Optionnal IMPLICIT Unsigned16
}

```

Linky PLC profile specifications

```
ClearAlarm.RequestPDU ::=
{
    Choice {
        [0] AlarmDescriptor          IMPLICIT Unsigned32

        [1] ListOfModules           SEQUENCE OF SEQUENCE
            {
                System Title Server    System Title
                AlarmDescriptor        IMPLICIT Unsigned32
            }
    }
}
```

The following data is used as a CIASE error return value (see sections 7.3 and 10.4.1 of this document)

```
CIASERemoteError ::= ENUMERATED
{
    Other                (0),
    Register-mac-address-invalid (1),
    Register-system-title-invalid (2),
    Ping-system-title-nok (3),
}
```

```
CIASELocalError ::= ENUMERATED
{
    Other                (0)
    Discover-probability-out-of-range (1),
    Discover-initial-credit-out-of-range (2),
    Discover-Report-list-too-long (3),
    Register-list-too-long (4),
    ICEqualCredit-out-of-range (5),
    Ping-No-Response (6),
}
```