

Electricity metering — Data exchange for meter reading, tariff and load control —

**Part 41: Data exchange using wide area
networks: Public switched telephone
network (PSTN) with LINK+ protocol**

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National foreword

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Echange de données sur réseaux larges:
Réseau téléphonique public commuté (RTPC)
avec protocole LIAISON+**

**Electricity metering – Data exchange for
meter reading, tariff and load control –**

**Part 41:
Data exchange using wide area networks:
Public switched telephone network (PSTN)
with LINK+ protocol**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICITY METERING – DATA EXCHANGE FOR METER READING,
TARIFF AND LOAD CONTROL –****Part 41: Data exchange using wide area networks: Public switched
telephone network (PSTN) with LINK+ protocol**

FOREWORD

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- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example “state of the art”.

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 62056-41, which is a technical report of type 2, has been prepared by IEC technical committee 13: Equipment for electrical energy measurement and load control.

The text of this technical report is based on the following documents:

Committee draft	Report on voting
13/1130/CDV	13/1166/RVC

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

This document is issued in the type 2 technical report series of publications (according to G.3.2.2 of part 1 of the IEC/ISO Directives) as a “prospective standard for provisional application” in the field of data exchange for meter reading, tariff and load control, because there is an urgent requirement for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an “International Standard”. It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to IEC Central Office.

A review of this type 2 technical report will be carried out not later than three years after its publication, with the options of either extension for a further three years or conversion to an International Standard or withdrawal.

Annexes A, B and D form an integral part of this technical report.

Annexes C, E and F are for information only.

ELECTRICITY METERING – DATA EXCHANGE FOR METER READING, TARIFF AND LOAD CONTROL –

Part 41: Data exchange using wide area networks: Public switched telephone network (PSTN) with LINK+ protocol

1 General

1.1 Scope

This technical report describes a three layer data exchange architecture used for communication with large industrial and commercial customers' metering equipment (aiming, in particular, at the remote reading of these meters for billing purposes). The public switched telephone network (PSTN) is used as a communication medium for this data exchange.

This technical report defines the protocols to be applied for each layer of the architecture (physical, data link and application), making use as far as possible of existing standards, such as

- ITU-T V.22, V.22bis, V.23, V.24, V.25, V.25bis, V.28, V.32, V.32bis and V.41 (ITU-T: telecommunication standardization sector of the International Telecommunication Union),
- IEC 61334-4-41 which describes the DLMS (Distribution Line Message Specification) model.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this technical report. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 62056-51:1998 *Electricity metering – Data exchange for meter reading, tariff and load control – Part 51: Application layer protocols for meter data exchange*

IEC 61334-4-41:1996, *Distribution automation using distribution line carrier systems – Part 4: Data communication protocols – Section 41: Application protocol – Distribution line message specification (DLMS)*

ITU-T V.22:1988, *1 200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point leased 2-wire telephone-type circuits*

ITU-T V.22bis:1988, *2 400 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point leased 2-wire telephone-type circuits*

ITU-T V.23:1988, *600/1 200 baud modem standardized for use in the general switched telephone network*

ITU-T V.24:1996, *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)*

ITU-T V.25:1996, *Automatic answering equipment and general procedures for automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls*

ITU-T V.25bis:1996, *Synchronous and asynchronous automatic dialling procedures on switched networks*

ITU-T V.28:1993, *Electrical characteristics for unbalanced double-current interchange circuits*

ITU-T V.32:1993, *A family of 2-wire, duplex modems operating at data signalling rates of up to 9 600 bit/s for use on the general switched telephone network and on leased telephone-type circuits*

ITU-T V.32bis:1991, *A duplex modem operating at data signalling rates of up to 14 400 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits*

ITU-T V.41:1972, *Code-independent error-control system*

ISO 2110:1989, *Information technology – Data communication – 25-pole DTE/DCE interface connector and contact number assignments*

2 General description

2.1 Basic vocabulary

All communications involve two sets of equipment represented by the terms Caller system and Called system. The Caller is the system that decides to initiate a communication with a remote system known as the Called party; these denominations remain valid throughout the duration of the communication.

A communication is broken down into a certain number of transactions. Each transaction is represented by a transmission from the Transmitter to the Receiver. During the sequence of transactions, the Caller and Called systems take turns to act as Transmitter and Receiver.

The terms Client and Server have the same meanings as in the DLMS model (see IEC 61334-4-41). The Server is the system that acts as a VDE (see IEC 61334-4-41) for the submission of all special service requests. The Client is the system that uses the Server for a specific purpose by means of one or more service requests.

The situation involving a Caller Client and a Called Server is undoubtedly the most frequent case, but a communication based on a Caller Server and a Called Client is also possible, in particular to report the occurrence of an urgent alarm.

2.2 Layers and protocols

The stack uses a breakdown into three layers: Physical, Data Link and Application. Each of these layers is the subject of a protocol whose name is given in table 1.

Table 1 – Names of protocols

Layer	Protocol
Application	DLMS+ Application+ Transport+
Data Link	Data Link+
Physical	Physical+

The Transport+ and Application+ protocols of the Transport and Application sublayers of the Application layer are described in IEC 62056-51.

The DLMS+ protocol of the DLMS sublayer of the Application layer is described in IEC 61334-4-41.

2.3 Specification language

In this technical report, the protocol of each layer is described by state transitions represented in the form of tables. The syntax used in making up these tables is defined by a specification language described in annex A.

In the event of a difference in interpretation between part of the text and a state transition table, the table is always taken as the reference.

3 Physical layer

The choice of the Physical layer (especially the timing diagram, the services and service primitives available, and the state transitions) is the subject of the present clause.

3.1 Physical+ protocol

The Physical+ protocol of the Physical layer is designed for half-duplex asynchronous operation and for full-duplex synchronous or asynchronous operation.

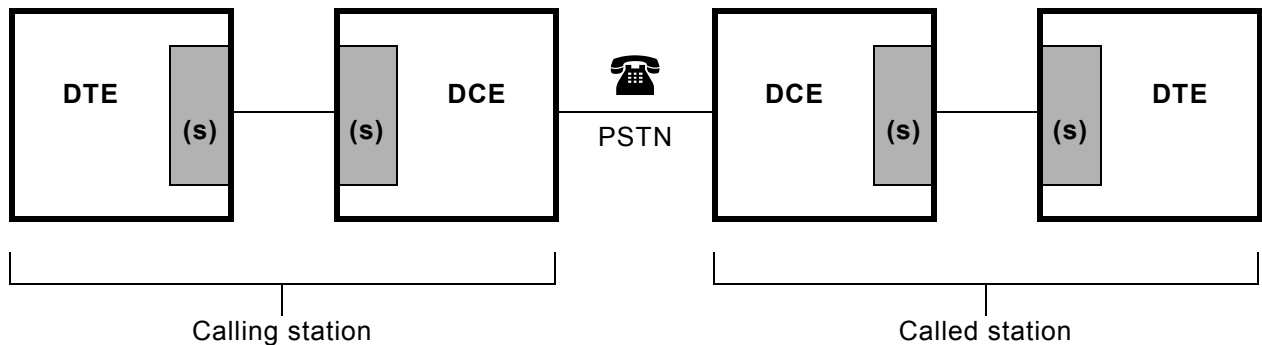
It is strictly identical for the Caller and for the Called party (completely symmetrical behaviour) and incorporates

- a communications interface complying with ITU-T V.24 and V.28, and with ISO 2110,
- an automatic call/answer procedure complying with ITU-T V.25 or V.25bis,
- a modem complying with either ITU-T V.23 (half-duplex mode), or ITU-T V.22, V.22bis, V.32 or V.32bis (full-duplex mode).

3.2 V.24/V.28 environment

A serial communication interface is used in compliance with ITU-T V.24 and V.28, and with ISO 2110.

A system communicating over the public switched telephone network can be modelled as shown in figure 1.



IEC 1 589/98

Figure 1 – Model of a system communicating over the public switched telephone network

DTE: Data Terminal Equipment (computers ²⁾, terminals or printers). A DTE is a system that sends or receives data.

DCE: Data Communication Equipment (communications interface or modem). A DCE is an equipment item used as interface on a communications network. Its role is to transfer data.

(s): Serializer. A serializer is usually an integrated circuit which synchronizes the transmission and reception of bits.

The transmitter function converts octets into a string of 8 serial bits. The receiver function converts a set of 8 bits into an octet.

²⁾ The term computer is used here in its wider sense.

Table 2 – Main circuits of the V.24 interface

Circuit	Designation	Abbreviation	DTE/DCE*
<i>Ground</i>			
101	Protective Ground	PG	–
102	Signal Ground	SG	–
<i>Data signals</i>			
103	Transmitted Data	TD	O/I
104	Received Data	RD	I/O
<i>Control signals</i>			
105	Request To Send	RTS	O/I
106	Clear To Send	CTS	I/O
107	Data Set Ready	DSR	I/O
108	Data Terminal Ready	DTR	O/I
<i>Other control signals</i>			
109	Data Carrier Detect	DCD	I/O
125	Ring Indicator	RI	I/O
<i>Clock signals</i>			
113	Transmitter signal element timing (DTE source)	–	O/I
114	Transmitter signal element timing (DCE source)	–	I/O
115	Receiver signal element timing (DCE source)	–	I/O
* O: output circuit I: input circuit			

3.3 Automatic call/answer: V.25/V.25bis environment

A station equipped for automatic calls in accordance with ITU-T V.25 or V.25bis consists of a modem fitted with an automatic dialling device.

ITU-T V.25 defines the automatic call procedures in parallel mode. The connection circuits comply with series 200.

ITU-T V.25bis defines the automatic call procedures in serial mode. The connection circuits used are those of series 100 (V.24 interface).

Table 3 – V.25 interface circuits

Circuit	Designation	DTE/DCE
201	Signal ground or common return	–
202	Call request	O/I
203	Data line occupied	I/O
204	Distant station connected	I/O
205	Abandon call	I/O
206	Digit signal (2 ⁰)	O/I
207	Digit signal (2 ¹)	O/I
208	Digit signal (2 ²)	O/I
209	Digit signal (2 ³)	O/I
210	Present next digit	I/O
211	Digit present	O/I
213	Power indication	I/O

Each digit of the number to be dialled is transmitted in parallel over the connection circuits 206 to 209.

In certain cases, the automatic dialling functions are incorporated into the modem. Series 100 circuits can then be used. The ITU-T has, therefore, defined a serial mode automatic call procedure: ITU-T V.25bis.

Table 4 – Circuits involved in the setting up of the V.25bis link

Circuit	Designation	Abbreviation	DTE/DCE
<i>Data signals</i>			
103	Transmitted Data	TD	O/I
104	Received Data	RD	I/O
<i>Control signals</i>			
106	Clear To Send	CTS	I/O
107	Data Set Ready	DSR	I/O
108	Data Terminal Ready	DTR	O/I
125	Ring Indicator	RI	I/O

The communication is set up by control signals 106 (CTS), 107 (DSR) and 108 (DTR) together with message exchanges over circuits 103 (TD) and 104 (RD). These messages contain commands or signals from one or the other of the equipments, possibly accompanied by parameters.

Each digit of the number to be dialled is transmitted serially over connection circuit 103 (TD).

The call indicator informs the DTE of an incoming call.

If the called terminal is switched on, so is the DTR, which enables the call to be answered: this is the *automatic answer*.

The tones exchanged over the line after the dialling of the number are identical to those defined in ITU-T V.25. Equipments that comply with ITU-T V.25bis are thus compatible with equipments that comply with ITU-T V.25.

3.4 General information

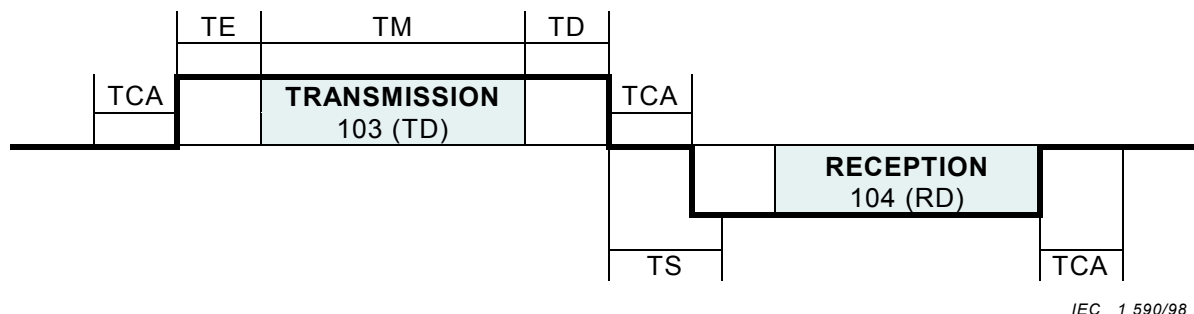
The Physical layer acts directly on the serializer linked to the modem. The terminal and the modem communicate via the V.24 interface. The minimal transmission rate is 1 200 bits/s.

When the chosen transmission technique is asynchronous, the transmitted bits are grouped in packets of eight, without parity (octets not encoded in ASCII). Each character is delimited by one *start* bit and one *stop* bit, which correspond respectively to a 0 reset and to the setting to 1 of the data signal at the serializer output. These two bits are used as "synchronization points". The *start* point is mainly used to synchronize the clocks, while the *stop* point leaves sufficient time for the receiver to convert the character to parallel before processing the next one.

Equipments supplied with ITU-T V.32/V.32bis modems can communicate with equipments supplied with ITU-T V.22/V.22bis modem, thanks to the connection autsetting procedure described in ITU-T V.32 and V.32bis.

3.5 Timing diagram: half-duplex mode

Figure 2 diagram can be used to define the wait-times and wakeups used to manage exchanges in continuous operation.



IEC 1 590/98

Figure 2 – Wait-times and wakeups to manage exchanges in continuous operation (half-duplex mode)

Half-duplex switching is performed by frame exchange after a stabilization time TCA. Each frame is marked by the transmission of an unmodulated carrier for a minimal duration TE, followed by transmission of a data block of delimited duration TM and a wait-time TD before the carrier is cut off (in order to avoid any risk of loss of the last octet transmitted).

On reception, TS is a safety wait-time during which carrier state changes and interference shall not be taken into account. TS is triggered as soon as the transmission carrier is cut off. When this time has elapsed, the line is considered as valid.

TCA: half-duplex carrier cut-off time. This time is controlled by a wakeup.
TCA = 40 ms

TE: unmodulated carrier transmission period. This period is a wait-time.
TE = 150 ms > TS – TCA

TM: modulation period for data transmission. This period depends on the size of the frame to be transmitted (between 4 octets and 127 octets) and the transmission rate.

TD: wait period before carrier cut-off. This period is a wait-time equivalent to the transmission of at least 2 octets.
TD = 20 ms

TS: safety period between transmission and reception. This period is a wait-time.
TS = 180 ms

There are also three wakeups (TI, TR1 and TR2) not shown in figure 2 diagram.

TI: maximum permitted time between the positive-going transition by the DCE of signals 107 (DSR) and 109 (DCD) at the start of the communication. This time is controlled by a wakeup.
TI = 15 s

TR1: maximum permitted response time between, on the one hand, the positive-going transition of signal 105 (RTS) by the DTE and the positive-going transition of signal 106 (CTS) by the DCE and, on the other hand, the negative-going transition of signal 108 (DTR) by the DTE and the negative-going transition of signal 107 (DSR) by the DCE. This time is controlled by a wakeup.
TR1 = 1 s

TR2: maximum permitted time between the positive-going transition by the DCE of signals 125 (RI) and 107 (DSR). This time is controlled by a wakeup.
TR2 = 60 s