D200	ctype0	n+	Channel 0 Type
D201	ctype1	n+	Channel 1 Type
D202	ctype2	n+	Channel 2 Type
D203	ctype3	n+	Channel 3 Type

C.4.8 Manufacturer-specific coding

Each manufacturer can use this region in the code space for their own purposes. The manufacturer is free with regard to coding and data format.

Code (binary)

1111 xxxx xxxx xxxx

C.5 Formatted execution (command E2)

Formatted execution allows the user to request that a device executes a predefined function, such as season change or cold start. The coding method allows for parameters to be passed using the data field. When the command requires no parameters then the parentheses are left empty. The code categories are shown below.

Code	category
0xxx	Execute
1xxx	RESERVED
:	
Exxx	
Fxxx	Manufacturer-specific

C.5.1 Execute coding

The Execute category defines codes that cause the unit to perform a specific function. The coding is as follows:

Code (binary)

```
0000   ssss   xxxx   xxxx   ssss = Execution SET
                                   0000 = General commands
                                   0001 = Test/calibration
                                   0010 = RESERVED
                                     :
                                   1111 = RESERVED
0000   xxxx   cccc   cccc   cccc cccc = Execution COMMAND
```

Execution examples

Code	*Mnemonic*	*Data*	*Function and data form*
0000	long_readout	0000	Long Readout
0000	short_readout	0001	Short Readout
0000	register_readout	0002	Register Readout
0000	season_readout	0003	Season Readout
0000	lp_readout	0004	Load Profile Readout
0000	var_readout	0005	Variable Readout
0000	par_readout	0006	Parameter Readout
0001	season_change	-	Perform a season change (cumulation)
0002	cold_start	-	Perform a cold start (initialise)
0003	cum_input_reset	-	Neutralize Cumulation Inputs

0100	rcr_test	-	Activate Ripple-Control-Unit Self-Test
0101	cal_on	-	Calibration Mode On
0102	cal_off	-	Calibration Mode Off

In the above table, many different readouts are defined. They contain information based on the following five data areas as defined in this annex: Register, Season, Load Profile, Variable and Parameter. The following table indicates which data categories are transmitted in response to which commands.

Long Readout	Register + Season + Load Profile
Short Readout	Register + Season
Register Readout	Register
Season Readout	Season
Load Profile Readout	Load Profile
Variable Readout	Variable
Parameter Readout	Parameter

The Long Readout corresponds to the data that would be sent in a Data Readout "data message" for a meter with load profile. The Short Readout corresponds to the data that would be sent in a Data Readout "data message" for a meter without load profile. In all readouts, the data which the meter sends is identified using the formatted codes as defined in this annex.

In order to ensure that the readouts are self-contained, that is, all the relevant information is present in order to uniquely identify and understand the data, the meter shall include the channel type record for all channels present. For an electricity meter with only one channel (channel 0), the data set "D200(x)" shall be present in the readout where x represents the channel type designation for electricity. For example, in a meter with a gas channel (on channel 1) and a heat channel (on channel 5), the data set would contain the channel type identification "D201(y)" and the channel type identification "D205(z)" where y and z represent the channel type designation for gas and heat respectively.

C.5.2 Manufacturer-specific coding

Each manufacturer can use this region in the code space for their own functions. The manufacturer is free with regard to coding and data format.

Code (binary)

1111 xxxx xxxx xxxx

C.6 Electricity metering: channel type 0

The following definitions are for the electricity metering channel type.

Code (binary)

0ccc xxxx xxxx xxxx ccc = CHANNEL (000 = channel 0)

0xxx ddxx xxxx xxxx dd = DATA TYPE

00 = Current Value = Energy
(i.e. Energy-Tariff 1 with units kWh)

01 = Integrated = Demand
(i.e. Demand-Tariff1 with units kW)

10 = Sum of Integrated = Cumulative Demand
(i.e. Cumulative Demand 1 with units kW)

11 = RESERVED

0xxx	xxr r	r r r r	xxxx	r r r r r r = REGISTER see below
0xxx	xxxx	xxxx	t t t t	t t t t = TARIFF 0000 = Total 0001 = Tariff 1 0010 = Tariff 2 : 1111 = Tariff 15

REGISTER coding (binary):

00 0000 = Register 0 = |+Ai| + |+Ac|

00 0001 = Register 1 = |–Ai| + |–Ac|

00 0010 = Register 2 = |+Rc|

00 0011 = Register 3 = |–Rc|

00 0100 = Register 4 = |+Ri|

00 0101 = Register 5 = |–Ri|

00 0110 = Register 6 = (|+Ai| +|+Ac|) + (|–Ai| + |–Ac|)

00 0111 = Register 7 = (|+Ai| + |+Ac|) – (|–Ai| + |–Ac|)

00 1000 = Register 8 = |+Ri| + |+Rc|

00 1001 = Register 9 = |–Ri| + |–Rc|

00 1010 = Register 10 = |+Ri| + |–Rc|

00 1011 = Register 11 = |+Ri| – |–Rc|

00 1100 = Register 12 = |–Ri| + |+Rc|

00 1101 = Register 13 = |–Ri| – |+Rc|

00 1110 = Register 14 = |+Ri| + |–Ri|

00 1111 = Register 15 = |+Ri| – |–Ri|

01 0000 = Register 16 = |+Rc| + |–Rc|

01 0001 = Register 17 = |+Rc| – |–Rc|

01 0010 = Register 18 = |+Ri| + |–Ri| + |+Rc| + |–Rc|

01 0011 = Register 19 = |+Ri| – |–Ri| + |+Rc| – |–Rc|

01 0100 = Register 20 = |+Ri| – |–Ri| – |+Rc| + |–Rc|

01 0101 = Register 21 = sqrt($(|+Ai| + |+Ac|)^2 + |+Ri|^2$)

01 0110 = Register 22 = sqrt($(|-Ai| + |–Ac|)^2 + |+Rc|^2$)

01 0111 = Register 23 = sqrt($(|-Ai| + |–Ac|)^2 + |–Ri|^2$)

01 1000 = Register 24 = sqrt($(|+Ai| + |+Ac|)^2 + |VRc|^2$)

01 1001 = Register 25 = sqrt($(|+Ai| + |+Ac|)^2 + (|+Ri| + |–Rc|)^2$)

01 1010 = Register 26 = sqrt($(|-Ai| + |–Ac|)^2 + (|+Rc| + |–Ri|)^2$)

01 1011 = Register 27 = sqrt($(|+Ai| + |+Ac| + |–Ai| + |–Ac|)^2$
 $+ (|+Ri| + |+Rc| + |–Ri| + |–Rc|)^2$)

01 1100 = Register 28 = sqrt($(|+Ai| + |+Ac|)^2 + (|+Ri| + |–Rc|)^2$)
 – sqrt($(|–Ai| + |–Ac|)^2 – (|+Rc| + |–Ri|)^2$)

01 1101 RESERVED

:

11 1111 RESERVED

For the description in this clause, the measurement plane is considered to have two axes, real and imaginary. The real axis is denoted A and the imaginary axis R. Positive (+) is considered to the right or up and negative (–) considered to the left or down. The reference for the measurement plane is considered the current vector which is fixed on the +A half axis. The momentary voltage vector is used to designate the current energy transfer and has phase angle ϕ in relation to the current vector. Phase angle ϕ is zero when the current and voltage are coincident, and is positive in the counter clockwise direction. The four quadrants are numbered 1 to 4 counterclockwise from the positive real axis.

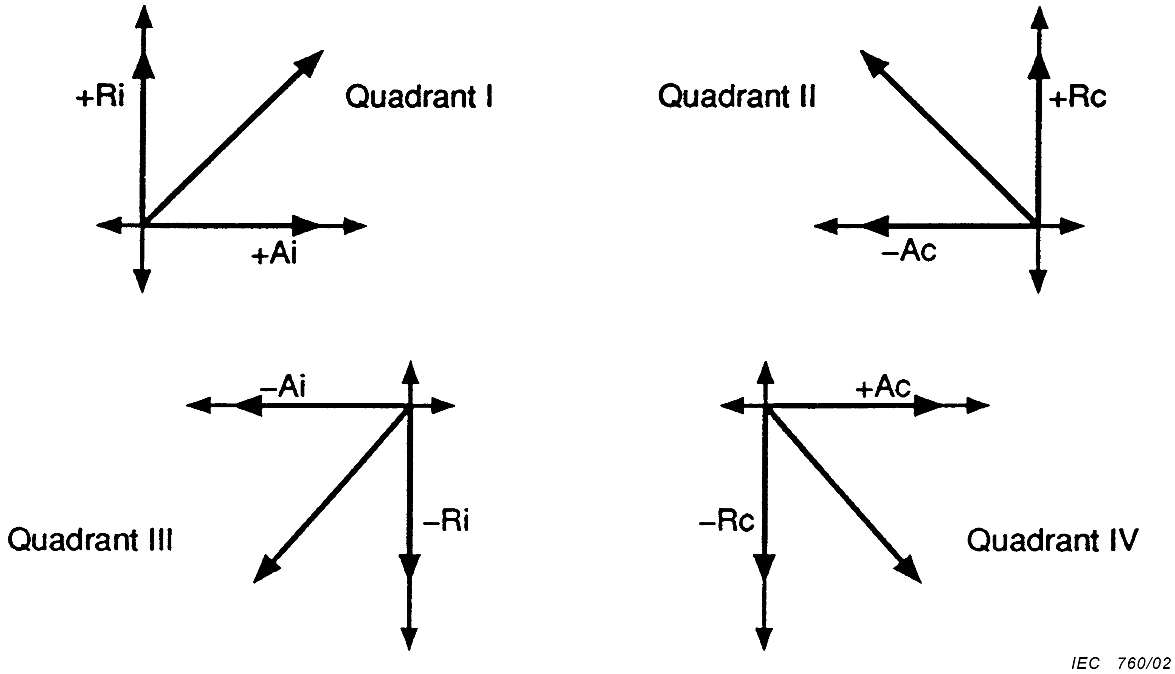
When the vector denoting the momentary voltage in relation to the momentary current is in the first quadrant, +Ai represents the real component of energy consumption and +Ri the imaginary or reactive component of energy consumption.

When the voltage vector is in the second quadrant, –Ac represents the real component of energy consumption and +Rc the imaginary or reactive component of energy consumption.

When the voltage vector is in the third quadrant, –Ai represents the real component of energy consumption and –Ri the imaginary or reactive component of energy consumption.

When the voltage vector is in the fourth quadrant, +Ac represents the real component of energy consumption and –Rc the imaginary or reactive component of energy consumption.

When the voltage vector is coincident with the +R or –R half-axes, then no real component is present, and the imaginary or reactive component of the energy consumption is considered to be of the same type as the last measured reactive component. Note that all measurement components are functions of time and could therefore be designated as such, i.e. +Ai(t). As such, the equations for the vector sums are only correct for instantaneous values. The individual register values cannot be used at a later point in time to calculate other register totals, i.e. Register-X <> sqrt(Register-Y^2 + Register-Z^2).



Quadrant	Real component	Reactive component
1	+Ai	+Ri
2	–Ac	+Rc
3	–Ai	–Ri
4	+Ac	–Rc

NOTE For reference vector, see previous page.

Figure C.4 – Vector diagrams for quadrants I to IV

Annex D
(informative)

Levels of access – system security

In order to restrict access to the tariff device, different levels of security are defined. Any or all of these may be used by a tariff device.

Access level 1

Requires only a knowledge of this protocol to gain access.

Access level 2

Requires one or more passwords to be correctly entered.

Access level 3

Requires operation of a sealable button or manipulation of certain data with a secret algorithm to gain access.

Access level 4

Requires physical entry into the case of the tariff device and effecting a physical change, such as making/breaking a link or operation of a switch, before further communications access is allowed.

Annex E
(normative)

METERING HDLC protocol using protocol mode E for direct local data exchange

The protocol stack as described in IEC 62056-42, IEC 62056-46 and IEC 62056-53 shall be used.

The switch to the baud rate Z shall be at the same place as for protocol mode C. The switch confirm message, which has the same structure as the acknowledgement/option select message, is therefore at the new baud rate, but still with parity (7E1). After the acknowledgement, the binary mode (8N1) will be established.

As the server acknowledgement string is a constant in the server's program, it could be easily possible to switch to the baud rate and the binary mode (Z Bd. 8N1) at the same time. The characters ACK 2 Z 2 CR LF shall be replaced by their 8 bit equivalents by adding the correct parity bit in order to simulate their 7E1 equivalents. This alternative method is not visible to the client, both have an equivalent behaviour (see also Figure E.4).

A client which is not able to support protocol HDLC mode E (W=2) will answer in a protocol mode as defined by Y (normally protocol mode C).

The enhanced capability of the server (tariff device) is communicated with the escape sequence "\W" which is part of the meter identification string (see items 14), 23) and 24) in 6.3.14).

E.1 Overview

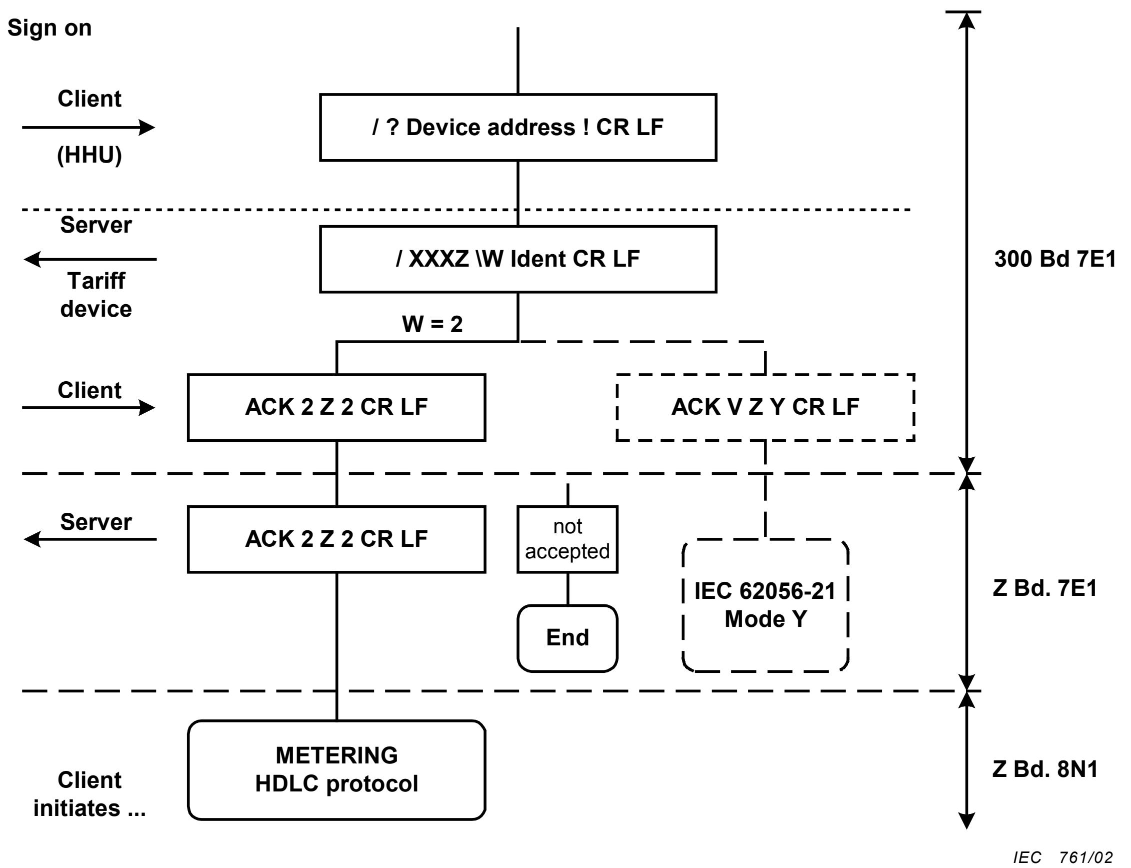


Figure E.1 – Entering protocol mode E (HDLC)

E.2 Readout mode and programming mode

These modes are handled within the higher layers of the protocol. After having established a transparent channel, the "METERING HDLC protocol" takes care of the correct data handling, and a DLMS based application handles access rights, read only or read/write access, etc. Necessary procedures are described in IEC 62056-42, IEC 62056-46 and IEC 62056-53. The flow chart and the changeover to HDLC for the direct local data exchange protocol, protocol mode E, is shown below.

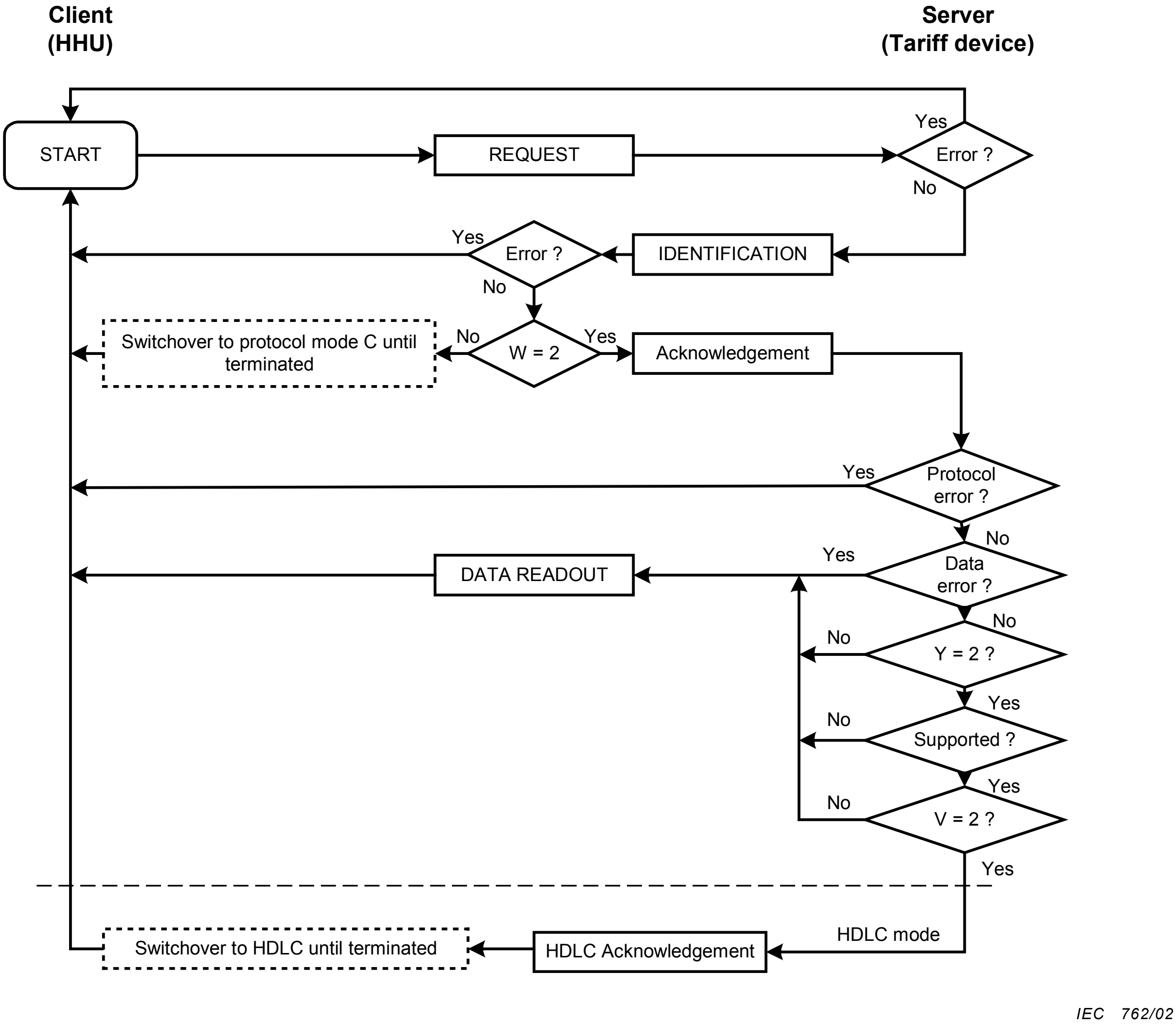


Figure E.2 – Flow chart and switchover to METERING HDLC in protocol mode E

E.3 Key to protocol mode E flow diagram

Message formats

REQUEST	/ ? Device Address ! CR LF
IDENTIFICATION	/ XXX Z Ident CR LF
Acknowledgement	ACK 2 Z 2 CR LF
DATA READOUT (fall back data readout mode A)	STX DATA ! CR LF ETX BCC

NOTE The inactivity time-out period for the tariff device is 60 s to 120 s after which the operation moves from any point to the start.

E.4 Physical layer – Introduction

The framework is equivalent to "Physical layer services and procedures for connection oriented asynchronous data exchange" (see IEC 62056-42).

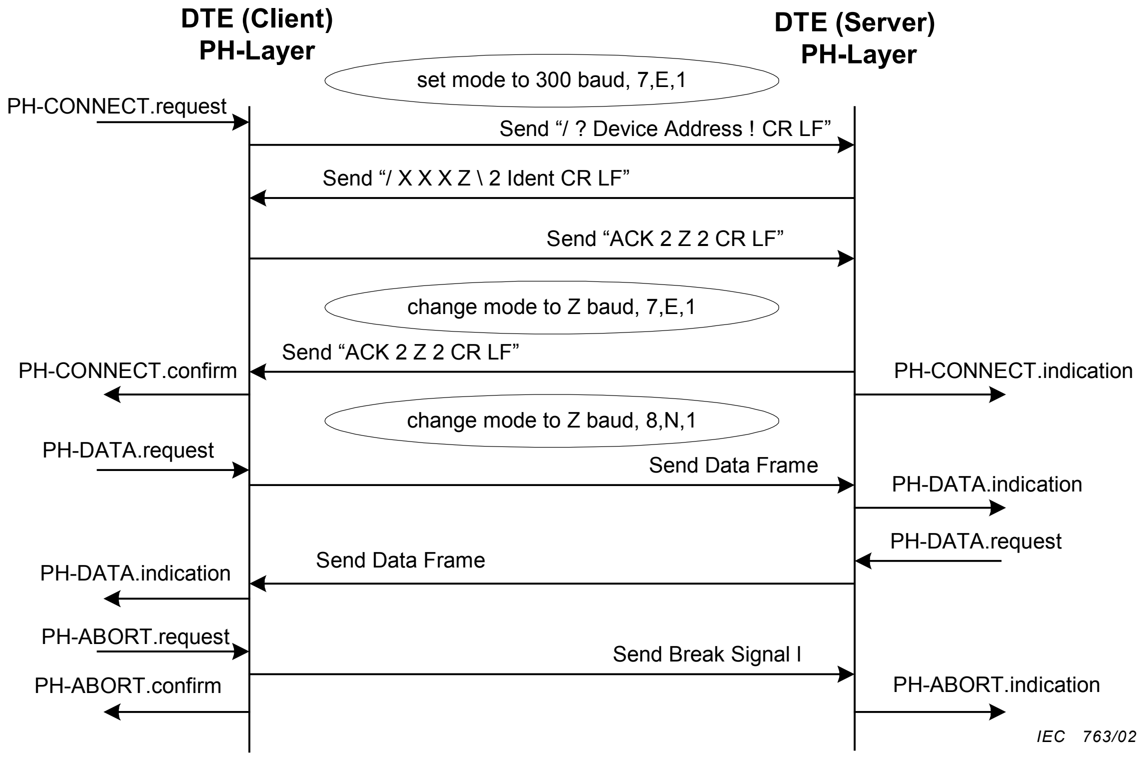


Figure E.3 – Physical layer primitives

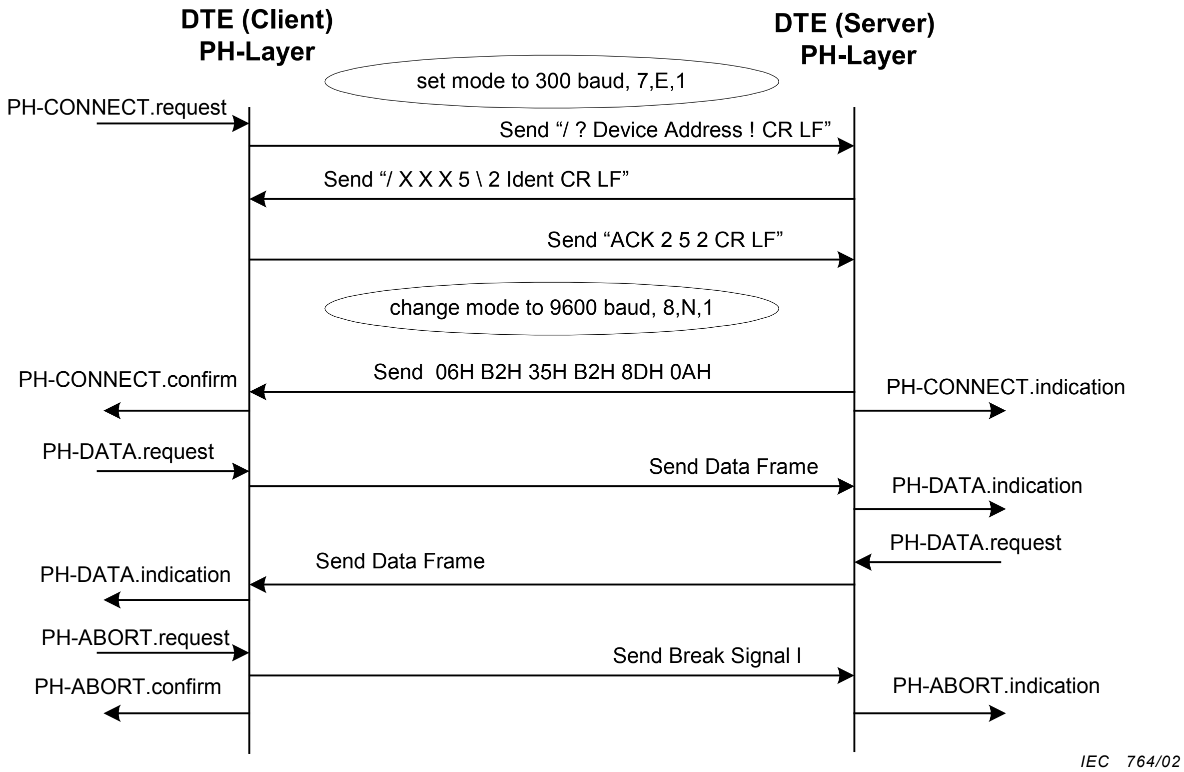


Figure E.4 – Physical layer primitives, simplified example with one mode change only

E.5 Physical layer primitives

PH-CONNECT.request

Once the PH-CONNECT.request primitive has been invoked with this connection type, the PH-Layer entity will start to establish the connection according to the procedure described above. The device address is passed via the PhConnType parameter. For this purpose, a mapping of the Lower MAC address to the device address (item 22), 6.3.14) has to be specified. Note, that a PH-CONNECT.request cannot be initiated by the server (tariff device).

PH-CONNECT.confirm

After receiving the ACK 2 Z 2 CR LF or other, for example NAK message from the server (tariff device), the PH-CONNECT.confirm primitive is invoked with the appropriate result parameter.

Messages:

ACK 2 Z 2 CR LF	the metering device has entered the METERING HDLC protocol mode E
Other response	the PH-CONNECT.request failed

PH-CONNECT.indication

After the server's PH-Layer has acknowledged the METERING HDLC protocol mode E, it indicates this to the MAC-sublayer by invoking the PH-CONNECT.indication primitive. During HDLC operation, timeouts, etc. are following HDLC rules.

PH-ABORT.request

The PH-Layer entity aborts the connection.

NOTE BREAK is only local to the client, the server does not respond, timeout is used. Timeouts for HDLC are defined in IEC 62056-46.

PH-ABORT.confirm

Since the client will never receive a response from the server, the PH-Layer entity always has to confirm the PH-ABORT.request.

NOTE BREAK is only local to the client, the server does not respond, timeout is used. Timeouts for HDLC are defined in IEC 62056-46.

PH-ABORT.indication

Detecting BREAK, the server PH-Layer entity resets its state machine to the initial state and invokes the PH-ABORT.indication service to indicate the termination of the connection.

E.6 Data link layer

The details are defined in IEC 62056-46.

Bibliography

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