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Publicly Available Specification

TETRAPOL Specifications
Part 6: Line Connected Terminal interface

Reference

Keywords

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Foreword

This document is the Publicly Available Specification (PAS) of the TETRAPOL land mobile radio system, which shall provide digital narrow band voice, messaging, and data services. Its main objective is to provide specifications dedicated to the more demanding PMR segment: the public safety. These specifications are also applicable to most PMR networks.

This PAS is a multipart document which consists of:

Part 1 General Network Design

Part 2 Radio Air interface

Part 3 Air Interface Protocol

Part 4 Gateway to X.400 MTA

Part 5 Dispatch Centre interface

Part 6 Line Connected Terminal interface

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Part 8 Radio conformance tests

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Part 10 Inter System Interface

Part 11 Gateway to PABX, ISDN, PDN

Part 12 Network Management Centre interface

Part 13 User Data Terminal to System Terminal interface

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Part 15 Gateway to External Data Terminal

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TTR 1 Guide to TETRAPOL features

Part 18 Base station to Radioswitch interface

Part 19 Stand Alone Dispatch Position interface

1. Scope

This PAS describes the physical Radio Switch-Line Connected Terminal interface.

This interface is located on the LCT side and does not deal with remote LCT connection with LABS via modems and multiplexers. For remote LCT units, the clock described in the present PAS is offset to match the transmission time between LABS and LCT.

The air interface transport and application protocol described respectively in PAS 0001-3-3 [5] and PAS 0001-3-1 [3] are applicable to line connected terminals.

The possible interface types are: 64 Kbit/s or 19,2 Kbit/s V.11 [6] synchronous local link.

2. Normative References

This PAS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this PAS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] PAS 0001-1-1: "TETRAPOL Specifications; General Network Design; Reference Model".

[2] PAS 0001-2: "TETRAPOL Specifications; Radio Air Interface".

[3] PAS 0001-3-1: "TETRAPOL Specifications; Air Interface Protocol; Air Interface Application Protocol".

[4] PAS 0001-3-2: "TETRAPOL Specifications; Air Interface Protocol; Air Interface Application Messages".

[5] PAS 0001-3-3: "TETRAPOL Specifications; Air Interface Protocol; Air Interface Transport Protocol".

[6] ITU-T Recommendation V.11/X.27 (1988): "Electrical characteristics of symmetrical connector circuits for transmission by double current up to 10 Mbit/s".

[7] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit terminating equipment (DCE)".

[8] ITU-T Recommendation V.28: "Electrical characteristics of asymmetric connector circuits for transmission by double current".

[9] ISO 3309: "High level data link control (HDLC) procedures; Frame structure".

[10] ISO 4335: "Information processing systems; Data communication; High-level data link control elements of procedures".

3. Definitions, abbreviations

3.1. Definitions

For the purposes of this PAS, the following definitions apply:

Data segment: A data segment is a set of 64+2 data bits coming from the transport level. The 160-bit data frame results from the coding of a data segment and the 2 associated signalling bits. Most often, a segment is assumed to be a data segment.

Frame: A frame is a set of 160 bits, which is transmitted during a 20 ms time interval. There are 6 different kinds of frames: data frames, voice frames, random access frames, training frames, SCH/TI frames and Direct Mode Emergency Frames.

Line Access Base Station (LABS): network interface to Line Connected Terminals and SADPs, also known as line Connection Interface Unit (LCIU).

Logical channel: A logical channel is a subset of the superframe. Logical channels are mapped to the superframe depending on the frame numbers.

Speech segment: A speech segment is a set of 120 bits coming from the CODEC. The 160-bit voice frame results from the coding of a speech segment and the 2 associated signalling bits.

Superframe: A superframe is a set of 200 consecutive frames, numbered from 0 to 199. It lasts 4 seconds.

Time interval: A time interval is a physical structure of 20 ms period of time, corresponding to 160 modulation symbols.

3.2. Abbreviation

For the purposes of this PAS, the following abbreviations apply:

CCH	Control CHannel
DCE	Data Circuit terminating Equipment
DTE	Data Terminating Equipment
FCS	Frame Check Sum
HDLC	High Level Data Link Control
ISDN	Integrated Service Digital Network
LABS	Line Access Base Station
LCT	Line Connected Terminal
LCIU	line Connection Interface Unit
PAS	Publicly Available Specification
PMR	Private Mobile Radiocommunications
RSW	Radio SWitch
RT	Radio Terminal
SCH/TI	Stealing CHannel/Transmitter Interruption
SP	Signal Processing
TCH	Traffic CHannel
TTI	Temporary Terminal Identifier
U	Unnumbered HDLC frame
VCH	Voice Channel

4. Functional interface

The interface between the radio switch and the line connected terminal includes three signals:

- LABS to LCT data link: RX.

- The clock (central frequency precision 5 x 10^{-7}) in the LABS to LCT direction. LABS has its frequency set at either 19,2 kHz or 64 kHz.

- LCT to LABS data link: TX.

4.1. Summary of LCT features

An LCT is connected to a Line Access Base Station (LABS). An LABS is a virtual entity whose functions are based on radio base station functions. An LABS manages a Control Channel (CCH) and several traffic channels (TCHs).

To select the radio channel a radio terminal tunes its frequency synthesiser, whereas the LCT selects the CCH or TCH number X and sends frames to LABS every 20 ms containing the selected channel number. The LCT can therefore change channels by changing the channel number in the frames sent to the LABS. The LABS detects the change of channel and sends the corresponding frames back to LCT. By default (for example: if the LCT doesn't send any frame), the LABS sends the control channel. In the brief interval between LCT asking the LABS to change channels (new channel number) and receiving frames on the new channel, LCT ignores received frames and does not return an alarm.

Moreover, the LCT not only controls channel selection, but may also ask the LABS to broadcast the CCH in every frame it sends, in addition to the selected channel.

This allows the radio protocols to be used for line connections as defined in the air interface transport and application protocol described respectively in PAS 0001-3-3 [5] and PAS 0001-3-1 [3].

4.2. Synchronisation

The reference clock of LABS is the master clock.

The reference for the HDLC frames, sent every 20 ms in each direction, is a 20 ms timing signal sent by the LABS, synchronous with the reference clock, not sent onto the interface.

The last bit of the HDLC frame opening flag on the RX link (LABS to LCT) is sent in the [WD_1 WD_2] window after the reference signal (brought to interface level).

The last bit of the HDLC frame opening flag on the TX link (LCT to LABS) is sent in the [WD_1 WD_2] window after the reference signal (brought to interface level).

	WD1	WD2
From LCT to LABS	0	3,5 ms
From LABS to LCT	0	1 ms

Table 1: Synchronisation window values

5. Data links

A bidirectional data link (RX, TX) connects the LABS to each line connected terminal.

The LABS and LCT dialogue by exchanging frames every 20 ms. The frames are in HDLC format and contain status and monitoring field, a message type field and a parameter field.

5.1. Control field

The physical message envelope type is High Level Data Link Control.

The HDLC format control field contains an acknowledgment bit for the last received frame in each direction. This bit is only used for link monitoring.

5.2. Status and management field

The status field contains:

LABS → LCT:

- Frame number: 0 to 199
- CCH Broadcast state
- Changing channel acknowledgment /channel number
- Interface version number

LCT → LABS:

- Frame number: 0 to 199. It is updated for each received frame
- CCH Broadcast command
- Channel number / changing channel indication
- LCT state: alarms indication and value

5.3. LABS -LCT dialogue

5.3.1. LCT states

The LCT states, as seen from LABS point of view, are :

- Not initialised state : it is the state at the start up of the LCT. This state permits LABS to control that the LCT owns the subscriber address dedicated to this line access. At the end of this phase, the LABS gives the dialogue authorization. Il the dialogue is authorized, the LABS ends the initialisation phase in order that the LCT changes to the operational state. The LCT shall acknowledge each message from the LABS.
- Operational state : it is the normal LCT working state after the the dialogue authorization given by the LATC. In this state, the LABS and LCT shall exchange operational messages every 20ms.

The LCT is supervised in exactly the same way as radio terminal.

5.3.2. Messages between LCT and LABS

From LABS to LCT, the messages are :

- NINIT message : this message permits the LABS to give or not the dialogue authorization , the LABS asks in this message the LCT to give its subscriber address. The LCT shall acknowledge this message with WAIT message.
- FINIT message : this message ends the initialisation phase after the dialogue. The LCT shall acknowledge this message with OPERR message
- OPERE message : the LABS sends the LCT an operational frame.

From LCT to LABS, the messages are :

- WAIT message : this message is a waiting indication, it is an acknowledgement of NINIT message.
- OPERR. : the LCT sends the LABS an operational frame.

The LCT shall send an OPERR frame every 20 ms. Empty OPERR frames shall be used for stuffing.

5.4. Message format

5.4.1. List of messages

Table 1 summarises the LABS-LCT messages.

MESSAGES	LABS → LCT	LCT → LABS
NINIT	X	
FINIT	X	
OPERE	X	
WAIT		X
OPERR		X

Table 1: Message list

5.4.2. General rules

HDLC format is used as described in ISO 3309 [8].

- 1 flag octet
- 1 adress octet LCT→ LABS address 1 1 1 0 0 1 1 1
  LABS→ LCT address 1 1 0 0 0 0 1 1
- 1 control octet
- 1 information field, defined below.
- Field length:
  - From LABS to LCT:
    - 22 octets without CCH broadcast
    - 26 octets with CCH broadcast
  - From LCT to LABS: 24 octets:
- 1 Frame Control Sequence (FCS) in 2 octets
- 1 flag octet.

The spaces between frames are filled with "1".

The order in which bits are transmitted is defined in ISO 3309 [9].

The control field is maintained according to ISO 4335 [10].

The following convention is used to describe octets:

b_7 : Most significant bit

b_0 : Least significant bit.

5.4.3. Control field

The control field is compliant with ISO 4335 [9].

	b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0
This field contains one octet:	A	0	0	1	0	0	1	1

All the frames exchanged by LCT and LABS are U frames.

Information A is used as follows:

A = 1 : Acknowledgment of last received frame.

A = 0 : Last expected frame not received.

5.4.4. LABS -> LCT frame information field except for message OPERE with CCH broadcast

The information field contains:

- A status and monitoring field;
- A message type field;
- A parameter field.

  For parameter field, the padding shall be done with 0.

5.4.4.1. Status and monitoring field

Octet 1 : Frame number

$\{b_7, ..., b_0\}$ from 0 to 199.

Octet 2 : Channel management

b_7 : CCH broadcast state

= 0 : not active

b_6 : channel changing acknowledgment (copy of the changing channel bit in the LCT to LABS direction).

$\{b_5, ..., b_0\}$ = reserved

Octet 3 : Channel number (significant only for OPERE message)

Channel number in 8 bits, from 0 to 255, see format defined in PAS 0001-3-2 [4]

Octet 4 : Interface version number

= 2 : Version 2

5.4.4.2. Message type field

Octet 5: Message type

NINIT message :

$\{b_7 .... b_0\} = \{00000001\}$

FINIT message :

$\{b_7 .... b_0\} = \{00000011\}$

OPERE message without CCH broadcast :

$\{b_7 .... b_0\} = \{00000100\}$

5.4.4.3. Parameter field

NINIT message

Octet 6 : dialogue authorization

$\{b_7 ,..., b_0\} = \{00000000\}$: dialogue is authorised (the dialogue is authorized at the beginning of the dialogue to allow the LCT to give a response)

$\{b_7 ,..., b_0\} = \{00000001\}$: dialogue is not authorised

Octet 7 : cause of dialogue failure

$\{b_7 ,..., b_0\} = \{00000001\}$: subscriber address not authorised on this access

$\{b_7 ,..., b_0\} = \{00000010\}$: too important transmission delay

Octet 8 to 22: Reserved for future use.

FINIT message

Octet 6 : not used

Octet 7 to 22: Reserved for future use.

OPERE message without CCH broadcast

Octet 6 : b_7 : not used

$\{b_6 , b_5\}$: associated signalling bits (ASB) with the speech or data segment (b_6: ASB(Y), b_5 : ASB(X), see PAS 0001-3-3 [5]).

$\{b_4 , b_2\}$: not used

$\{b_1, b_0\}$: frame type

b_0 = 1 (data frame) or 0 (voice frame)

b_1 = 0 (see b_0) or 1 (SCH/TI frame)

Octets 7 to 21: frame content

Voice frame : Speech segment= 120 bits in octets 7 to 21;

Data frame : Data segment = 66 right aligned bits :$\{b_1, b_0\}$ octet 13 + octets 14 to 21;

SCH/TI frame : SCH/TI segment = 16 bits, octets 20 and 21 contains the TTI field whose format is defined in PAS 0001-3-2 [4];

Bit 7 in octet 20 is not significant.

Octet 22: Scrambling parameter from LABS to LCT (as described in PAS 000 1-3-2 [4]).

5.4.5. LABS -> LCT frame information field for message OPERE with CCH broadcast

5.4.5.1. Status and monitoring field

Octet 1: Frame number

$\{b_7, ..., b_0\}$ from 0 to 199

Octet 2: Channel management

b_7 : CCH broadcast state

= 1 : active

b_6 : acknowledgment of channel changing (copy of the changing channel bit in the LCT to LABS direction).

$\{b_5, b_4\}$ = not used

5.4.5.2. Message type field

The implicit message type is the message type in the OPERE message.

5.4.5.3. Parameter field

Octet 2: $\{b_3, b_2\}$: associated signalling bits (ASB) with the speech or data segment (b_3 : ASB(Y), b_2 : ASB(X), see PAS 0001-3-3 [5]).

$\{b_1, b_0\}$: frame type

b_0 = 1 (data frame) or 0 (voice frame).

b_1 = 0 (see b_0) or 1 (SCH/TI frame).

Octets 3 to 17 : frame contents correspond to the channel number

Voice frame : Speech segment = 120 bits in octets 3 to 17

Data frame : Data segment = 66 right aligned bits: $\{b_1, b_0\}$ in octet 9 + octets 10 to 17;

SCH/TI frame : SCH/TI segment = 16 bits octets 16 and 17 correspond to the TTI field whose format is defined in PAS 0001-3-2 [4]. Bit 7 in octet 16 is not significant.

Octets 18 to 26: content of data frame on CCH

Frame: 66 right aligned bits: $\{b_1, b_0\}$ in octet 18 + octets 19 to 26,

$\{b_7, b_6\}$ in octet 18: associated signalling bits (ASB) with the frame (b_7: ASB (Y), b_6: ASB (X), see PAS 0001-3-3 [5]).

5.4.6. LCT -> LABS frame information field

The information field contains:

- A status and management field;
- A message type field;
- A parameter field;

For parameter field, the padding shall be done with 0.

5.4.6.1. Status and monitoring field

Octet 1: Frame number from 0 to 199

Octet 2: Channel management

$b_{7:}$ CCH broadcast command

0 inactive

1 active

b_6: changing channel indicator to apply in the LABS to LCT direction.

$\{b_5,.., b_3\}$ = not used

$\{b_2,b_1,b_0\}$ = LCT state

{0,0,1} Not initialised

{0,1,0} Operational state

Octet 3: Channel number in 8 bits, from 0 to 255, see format defined in PAS 0001-3-2 [4]

Octet 4: Alarms

$\{b_7,..,b_0\} = \{0\}$ no alarms.

$b_7 = 0$ and $\{b_6,...,b_0\} \neq \{0\}$ software alarm type, whose value is given by $\{b_6,...,b_0\}$.

$b_7 = 1$: "error in message received from LABS " alarm, where $\{b_6,...,b_0\}$ alarm code.

5.4.6.2. Message type field

Octet 5: Message type

WAIT message :

$\{b_7 .... b_0\} = \{00000000\}$

OPERR message :

$\{b_7 ... b_0\} = \{00000001\}$

5.4.6.3. Parameters field

WAIT message

Octet 6 : always equal to 0

Octets 7 to 11: Individual subscriber address in RFSI format

$\{b_7,b_6,b_5,b_4\}$ of octet 7: not used

For individual subscriber address format, see PAS 0001-3-2 [4]).

Octet 12 to 24: Reserved for future use.

OPERR message

Octet 6 : Frame type

{b_6,b_5}: associated signalling bits (ASB) with the speech or data segment (b_6: ASB(Y), b_5: ASB(X), see PAS 0001-3-3 [5]).

{b_4,b_1,b_0} : frame type

b_0 = 1 (data frame) or 0 (voice frame)

b_1 = 0 see (b_0) or 1 (RACH frame)

b_4= 1 see b_0, b_1

= 0 : empty frame; octets 7 to 24 are not, therefore significant, giving the following table:

	b_0	b_1	b_4
data frame	1	0	1
voice frame	0	0	1
RACH frame	X	1	1
empty frame	X	X	0

Octets 7 to 21: Received segment

- Voice frame : speech segment = 120 bits in octets 7 to 21
- Data frame : data segment =66 right aligned bits: {b_1, b_0} in octet 13 + octets 14 to 21;
- RACH frame : The 14 RACH access bits as defined in PAS 0001-3-3 [5] are encoded in 14 right-aligned bits (most significant in octet 20 {$b_{5...}$ b_0}, least significant in octet 21 {$b_{7...}$ b_0}).

Octet 22: scrambling parameter used in LCT to LABS direction (as described in PAS 000 1-3-2 [4]).

Octet 23 and 24: Reserved for future use.

5.5. Message Numbering

Each "frame" (as defined in PAS 0001-2 [2] and PAS 0001-3-3 [5]) is assigned a modulo 200 number in the 4-second superframe, defined by LABS. To determine this number, LABS selects an arbitrary phase in relation to its own local clock (not sent to LCT). The number is then forwarded in the status and monitoring field of each LABS → LCT message.

The number of the frame in the LCT → LABS direction, is selected so that frames with identical numbers in each direction are almost simultaneously present on the link.

A clock signal is given as the LABS message number N sent in [WD_1 WD_2] crosses the interface, and the corresponding message number N leaves LCT in [WD_1 WD_2].

In case on clock interruption of more than 10 ms, the LCT returns in initialisation phase.

History

Document history

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31 July 1996	Corrections after review	Version 0.1.0
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