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Contents

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

Part 7 Codec

Part 8 Radio conformance tests

Part 9 Air interface protocol conformance tests

Part 10 Inter System Interface

Part 11 Gateway to PABX, PDN

Part 12 Network Management Centre interface

Part 13 User Data Terminal to System Terminal interface

Part 14 System Simulator

Part 15 Gateway to External Data Terminal

Part 16 Security

Part 17 Guide to TETRAPOL features

Part 18 Base station to Radio switch interface

Part 19 Stand Alone Dispatch Position interface

1. Scope

This part defines the TETRAPOL gateway to a digital PABX at the reference point S and specifies the interworking with TETRAPOL PABX call service.

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] CCITT Recommendation I.451 / Q.931 (1988): "ISDN User-Network interface; Layer 3 specification for basic call control". [ETS 300 125]

[3] ITU-T Recommendation Q.921: "ISDN User-Network interface; Data Link Layer specification".

[4] ITU-T Recommendation I.430: "Integrated Services Digital Network (ISDN); Basic User-Network interface; Layer 1 specification".

Dedicated references in annexes.

3. Abbreviations

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

PABX	Private Automatic Branch eXchange
PAS	Publicly Available Specification
PMR	Private Mobile Radiocommunications
RSW	Radio SWitch
TDX	Telephone and Data exchange

4. Description

4.1. General description

The TETRAPOL gateway enables point-to-point calls to be set-up from a TETRAPOL user to a PABX subscriber and from a PABX subscriber to a TETRAPOL user.

A PABX subscriber is defined as a subscriber connected on the PABX itself of a subscriber connected to an external network that transits through the PABX on any kind of interface supported by the PABX.

The TETRAPOL gateway detects an outgoing PABX call from a TETRAPOL user to be routed over the gateway, or an incoming PABX call to be routed as a PABX call to the TETRAPOL user.

The gateway shall be seen as a set of TETRAPOL subscribers from the SwMI point of view. The gateway shall be seen as ISDN S0 subscribers from the PABX point of view.

The gateway shall provide an interworking service between a TETRAPOL SwMI and an external network for TETRAPOL PABX.

4.2. Qualification on applicability to telecommunication services

The gateway service shall be applicable to TETRAPOL PABX calls connected to one basic rate ISDN channel as the transport medium for ISDN circuit mode basic service [2] [3] [4].

4.3. National specificity's

TETRAPOL PABX access should be available in national ISDN typical versions, described in the following annexes:

Annex A: EURO - ISDN, in conformance with ETSI recommendation

Annex B: NUMERIS, conform to French France Telecom recommendation

Others will be later available.

5. Procedures

5.1. Provision/withdrawal

The gateway service shall be permanently provided to the TETRAPOL terminals allowed to set up PABX calls.

5.2. Normal procedures

5.2.1. Activation, deactivation, registration, interrogation

The gateway service shall be permanently activated.

5.2.2. Invocation and operation

The gateway shall provide a service and protocol mapping between a TETRAPOL SwMI and a PABX subscriber.

When a PABX call set-up request is received by the SwMI from a TETRAPOL user, it shall route the PABX call to a gateway. The gateway shall establish a call to the PABX and connect both calls. If a sub-address is provided to the gateway when the PABX call is established between the TETRAPOL user and the gateway, it shall be used as the called PABX subscriber address.

When a call set-up request is received by the SwMI from the external network, it shall set up a PABX call to the TETRAPOL SwMI and connect both calls.

The gateway service shall remain operational for the duration of the call, handling internally the appropriate interworking between :

- the half duplex call between the TETRAPOL user and the gateway
- the full duplex call between the gateway and the PABX subscriber.

5.3. Exceptional procedures

5.3.1. Activation, deactivation, registration, interrogation

Not applicable

5.3.2. Invocation and operation

The gateway may reject the call request with appropriate failure indication for any of the following causes:

Failure indication to the SwMI:

- Gateway busy;
- Gateway-SwMI link failure / recovered.

Failure indication to the external network:

- Call rejected;
- Normal release.

5.3.3. Call contention and pre-emption

- Incoming calls from the PABX are assigned ROUTINE priority in the TETRAPOL network.

- Outgoing PABX calls from a TETRAPOL user may have a FLASH or ROUTINE priority.

- An outgoing FLASH PABX call overrides a ROUTINE call (incoming or outgoing).

5.4. Interaction with supplementary services

The service interworking with ISDN supplementary services is out of the scope of this specification.

There shall be not interaction with supplementary services related to TETRAPOL PABX calls.

6. Functional description

6.1. Functional model

6.1.1. Functional model description

The functional model shall comprise the following functional entities:

FE1 SwMI call control functional entity
FE2 Gateway functional entity
FE3 External (PABX) network functional entity

The following functional relationships shall exist between these functional entities:

rInternal between the SwMI and the gateway
rPABX between the gateway and the PABX

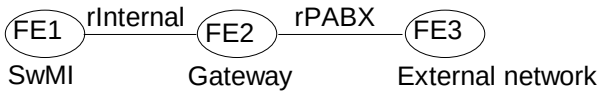

Figure 1: Functional model for the gateway

6.1.2. Description of functional entities

6.1.2.1. SwMI call control, FE1

This functional entity shall be able to:

- detect an outgoing TETRAPOL call set-up request from a TETRAPOL user;
- detect an incoming TETRAPOL cell set-up request from the gateway;
- route an outgoing TETRAPOL call to the gateway;
- route an incoming Tetrapol call from the gateway to the called TETRAPOL user.

6.1.2.2. Gateway, FE2

This functional entity shall be able to:

- set-up call to PABX when it receives a call set-up request from TETRAPOL;
- set-up a call to TETRAPOL when it receives a call set-up request from PABX;
- connect an established TETRAPOL call and an established PABX call;
- perform the interworking between half duplex part and full duplex part of the call.

6.1.2.3. PABX external network, FE3

This functional entity shall be able to:

- set-up a call to the gateway;
- receive call set-up requests from the gateway;
- send announcements to PABX subscribers..

6.1.3. Relationship of the functional model to basic call functional model

The following figure provides the mapping of the functional entities over the basic call models.

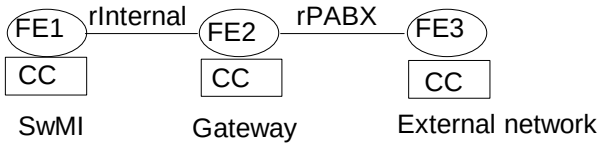

Figure 2: Relationship between models for PABX gateway

6.2. Information flow

6.2.1. Information flows diagrams

6.2.1.1. Successful call set-up from PABX to SwMI

The following figure shows the information flow sequence for a call set up from a PABX to the TETRAPOL SwMI

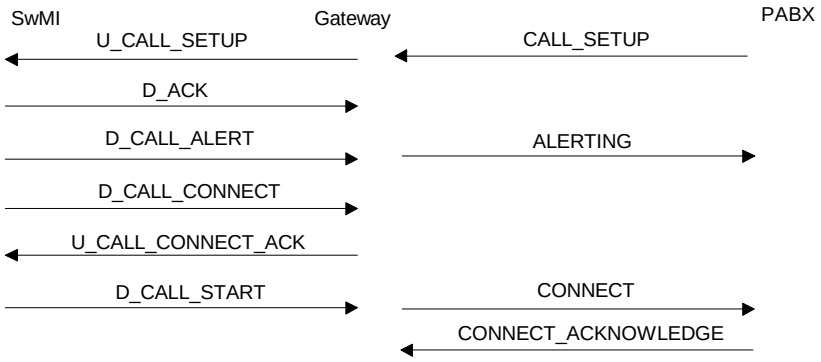

Figure 3: Successful call set-up from PABX to SwMI

6.2.1.2. Unsuccessful call set-up from PABX to SwMI

The following figure shows the information flow sequence for an unsuccessful call set-up as a result of a call set-up abort from the PABX.

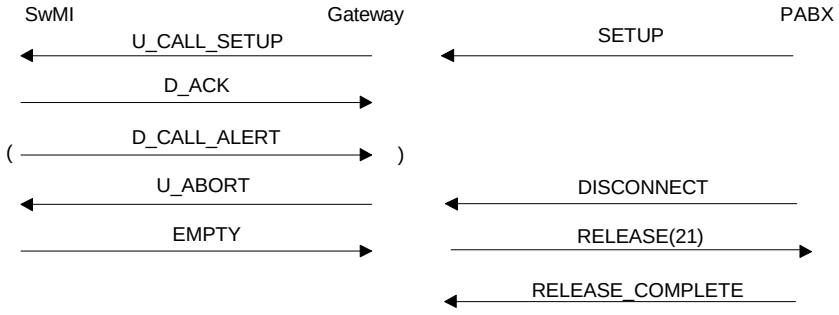

Figure 4: Unsuccessful call set-up from PABX to SwMI

The cause for ABORT should be one of the following ones:

- "cleared by user" when the requested TETRAPOL user has cleared the call;
- "application event" due to application protection T712 time-out;
- "TRU-PABX / IPABX link fault" when the SwMI-to-gateway link has a failure;
- "IPABX / PABX link fault" when the gateway has an internal failure or the gateway-to-PABX link has a failure.

6.2.1.3. Successful call set-up from SwMI to PABX

The following figure shows the information flow sequence for call set-up from the SwMI to the PABX.

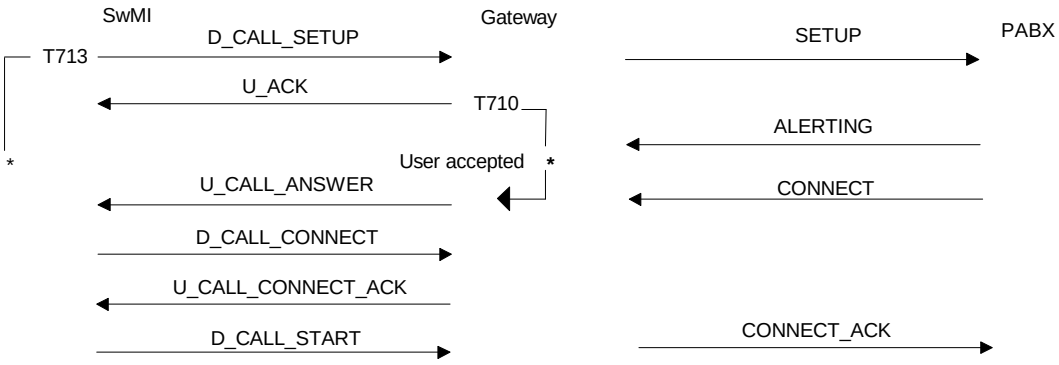

Figure 5: Unsuccessful call set-up from PABX to SwMI

6.2.1.4. Unsuccessful call set-up from SwMI to PABX

The following figure shows the information flow sequence for an unsuccessful call set-up rejected by the SwMI.

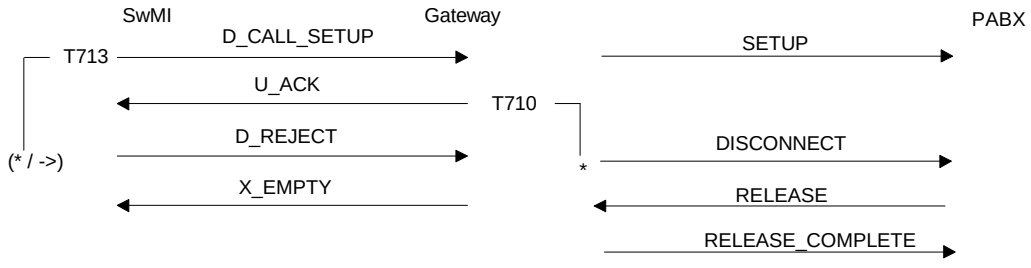

Figure 6: Unsuccessful call set-up from SwMI to PABX

6.2.1.5. Unsuccessful call set-up from SwMI to PABX

The following figure shows the information flow sequence for a call set-up aborted from the PABX.

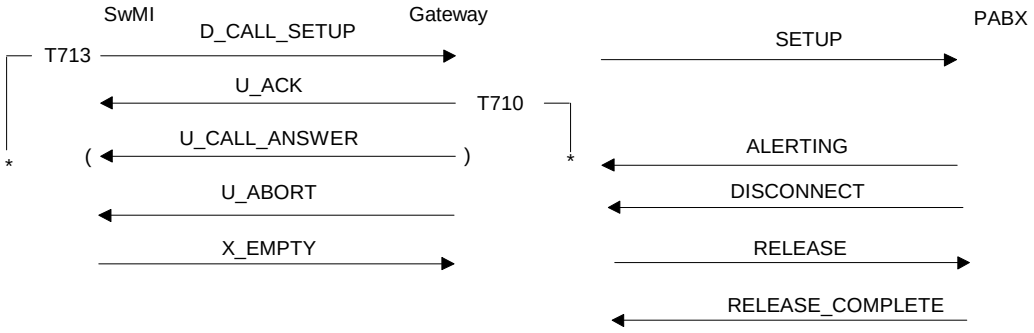

Figure 7: Unsuccessful call set-up from SwMI to PABX

6.2.2. Definition of information flows

The information flows between the gateway and the PABX shall be those defined in ISDN [3].

6.3. Functional entities behaviours and actions

From the SwMI point of view, the gateway functional entity shall behave as a set of TETRAPOL subscribers.

From the PABX point of view, the gateway shall behave as an ISDN subscriber.

6.4. Allocation of functional entities to physical equipment

The SwMI functional entity and the gateway functional entity are within the TETRAPOL network.

The PABX functional entity is external to the TETRAPOL system.

6.5. Interworking considerations

All specific features of the PABX subscriber, such as DTMF tones, shall be handled by the PABX and shall be unknown from the gateway.

7. Description of the TETRAPOL PABX gateway interface

7.1. Architecture

The interface between a TETRAPOL network and an external PABX is a Telephone and Data Exchange (TDX) in the TETRAPOL network. The TDX is the gateway to the PABX at reference point R7 as defined in PAS 0001-1-1 [1].

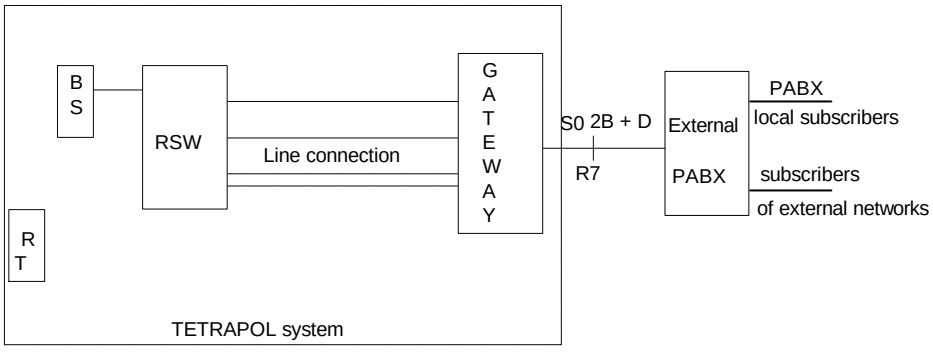

Figure 8: Architecture

A gateway is equipped with S0 interfaces:

- Each S0 interface is connected in point- to-point topology on a passive S0 bus;
- Several line connections with a RSW in the TETRAPOL SwMI may be provided.

For each gateway S0 base rate interface:

- the 16 kbits/s D channel carries standard signalling traffic;
- the traffic channel is a 64 kbits/s B channel ;
- a TETRAPOL line connection interface unit is assigned to each B channel.

The S0 interface may support different ISDN protocol variants as defined in annex A and B.

7.2. Basic principles

For the TETRAPOL PABX interface, the following principles are used in accordance with ISDN [2]:

- The TETRAPOL SwMI and the PABX are considered as two independent networks, each with its own numbering plan and associated routing plan; a called address shall be provided in the called addressing plan, either TETRAPOL RFSI or PABX addressing plan;

- A call set-up procedure between a TETRAPOL terminal and PABX user is considered as two calls which are through-connected by the gateway;

- The only resources shared by RSW and PABX are the S0 basic accesses that connect one to the other. The junctions are bi-directional (not dedicated to incoming or outgoing calls);

- The gateway is configured as a terminal equipment (TE1), the PABX is the network termination (NT2).

- For an outgoing TETRAPOL call:

    - The gateway uses en-bloc dialling

    - The gateway locally simulates off hook when the PABX called party terminal goes off hook;

- For an outgoing PABX call, the gateway simulates the hook off of the PABX subscriber when the called party TETRAPOL terminal goes off hook.

- Outgoing TETRAPOL PABX calls are subject to the same pre-emption rules as TETRAPOL individual calls. The pre-emption mechanism is dealt with by the SwMI, in which case the gateway is informed in order to release the PABX part of the call. The priority of a PABX call may be provided by the calling party;

  TETRAPOL assigns ROUTINE priority to outgoing PABX calls when entering the TETRAPOL system.

8.Protocol items

8.1. Messages for connections in circuit mode

The following messages shall be exchanged on the gateway/PABX interface:

- ALERTING

- CALL PROCEEDING

- CONNECT

For an incoming call, the call is through-connected only when the off-hook indication is received by the gateway from the called TETRAPOL terminal.

For an outgoing call, the gateway simulates the hook off of the TETRAPOL user for the PABX side.

- CONNECT ACKNOWLEDGE

For an outgoing call: the CONNECT message received by the calling party (gateway) is sufficient to change the call into active state. The gateway does not return a connect ACKNOWLEDGE message.

- DISCONNECT

When the gateway receives this message, it releases the call on the TETRAPOL network side.

The gateway sends this message when it receives a call release indication on the TETRAPOL network side.

- PROGRESS

The message concerns outgoing calls. The PABX may send it to inform the calling party (gateway):

  - that a tone or recorded announcement will be sent, during the set up (Cause = 126);
  - that the other party is connected to a non ISDN network (Cause = 114).

The gateway shall not inform the TETRAPOL network side of message delivery, to avoid premature calling party Terminal connection. The terminal remains in alerting phase until the gateway receives the CONNECT message.

If, during this time, the PABX sends a voice announcement or a tone on the connected channel, none is delivered to the TETRAPOL network side. If the PABX user does not answer, the call is aborted by the TETRAPOL network when the no-answer time-out expires.

- RELEASE

For an incoming call, this message is sent during the ALERTING phase:

- by the gateway if the call cannot be set up on the TETRAPOL network (Cause = 21 "call rejected");
- by PABX if the call is released prematurely (calling party hook on, Cause = "normal release").

- RELEASE COMPLETE

This message shall be returned in reply to RELEASE.

It may also be returned in reply to SET UP:

- for an outgoing call, if the PABX refuses the gateway request. The message shall then include the Cause information element;
- for an incoming call, if PABX presents the TETRAPOL network with a call containing a "no free channel" indication (gateway does not reply with ALERTING) or bearer service other than "Speech".

- SET UP

For an outgoing call: message sent by the gateway when one of the TETRAPOL network side forwards a call SET UP command. Specific gateway message information elements are:

- Bearer capability: is set to "Speech" bearer service;

- Called party number: this information element contains in blocked form: a called number supplied by TETRAPOL line connection or a default number supplied by the gateway. Sending complete is included;

For an incoming call: message received by the gateway. Specific information elements are:

- Bearer capability: if the element does not indicate a "Speech" bearer service the call is rejected (gateway sends RELEASE COMPLETE).
  If "no free channel" is received, the call is rejected (the gateway sends RELEASE COMPLETE):

- A progress indicator notifies inter working (call originating from a non ISDN network), the gateway ignores it;

- The called party sub-address, if received, contains the TETRAPOL network terminal address requested by the PABX user.

- The gateway checks any received High layer compatibility to determine whether the requested teleservice is "speech" or "unknown", otherwise the call is rejected;

8.2. Messages Structure

Only the minimal set of information elements contained in messages exchanged on the gateway/PABX are described thereafter.

Protocol discriminator, call reference, message type are coded in compliance with ST/CSE P22-30A [B3].

Non-locking shift: always precedes User capability, sent by the gateway in a SET UP message.

Bearer capability

information transfer capability = Speech
transfer mode = Circuit
transfer rate = 64 kbits/s
level 1 protocol 1 = G.711 A-law

Called party number:
type of number = on block dialling
numbering plan reference = unknown

In the SET UP message sent by TETRAPOL network, the "dialled digit" fields contain information interpreted by PABX according to its own numbering plan (including the PSTN and ISDN access code). The gateway does not check the called number validity. Any call restrictions are enabled by the gateway subscriber line configuration in PABX.

The gateway ignores this information element in SET UP messages sent by PABX.

Cause: Coded according to specifications.

Channel identification:

Coded in 3 octets, according to the specification (basic access)

Low layer compatibility:

The gateway never sends this information element.
When received, the gateway checks the following field contents:
information transfer capability = Speech
transfer mode = Circuit
transfer rate = 64 kbits/s
structure = default or 8 khz integrity
level 1 protocol 1 = G.711 A-law

Sending complete:

The gateway includes this information element in the SET UP message it sends, to indicate that dialled address overlap sending is not used.

User capability: contains "network specific terminal" information

8.3. Supplementary Service Control

The gateway does not request any supplementary service request.

8.4. User to user signalling.

The gateway does, not transmit user to user information element in set-up message, in order to advice that user to user feature is not supported.

Annex A (normative): TETRAPOL access to Euro ISDN interface variant

A.1 Scope

The ISDN S0 interface between the gateway and the external PABX may comply with Euro ISDN as defined in ETSI 300 102-1 and 300 102 -2 [A.1], 300 125 [A.2] and 300 012 [A.3].

A.2 Normative references

This Annex 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.

[A1] ETS 300 102-1 (1990) and 300 102-2: "Integrated Services Digital Network (ISDN); User-network interface layer 3; Specifications for basic call control".

[A2] ETS 300 125 (1990): "Integrated Services Digital Network (ISDN); User-network interface data link layer specifications; Application of CCITT Recommendations Q.920/I.440 and Q.921/I.441".

[A3] ETS 300 012 (1991): "Integrated Services Digital Network (ISDN); Basic user-network interface Layer 1 specification and test principles".

Annex B (normative): TETRAPOL access to FRENCH NUMERIS ISDN VN3 interface

B.1 Scope

The ISDN S0 interface between the gateway and the external PABX may comply with Numeris as defined in France Telecom CNET recommendations.

This annex applies to any TETRAPOL network interfacing with an external network compliant with NUMERIS VN3 standard.

B.2 Normative and informative references

This Annex 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.

[B1] ST/LAA/RSM/131: Niveau 1 de l'accès au débit de base I.430 et compléments.

[B2] ST/LAA/RSM/132: Niveau 2 du protocole D.

[B3] ST/CSE P22-30A (édition 1) Juillet 1992: Niveau 3 du protocole D de commande d'appel à l'interface usager-réseau RNIS pour l'étape VN3.

B.3 Physical layer

The physical layer is defined in ST/LAA/RSM/131 [B1].

B.4 Data Link layer

The LAP D protocol is defined in ST/LAA/RSM/132 [B2].

The following set of parameters may be used by the gateway:

TEI = 2: fixed value.

SAPI = 0

SAPI = 63 (LAP D management SAPI) can be received by the gateway and is ignored

Level 2 parameter negotiation is not supported

T200 = [1s]
T203 = [10s]
N200 = [3]
N201 = [260]
N202 not implemented
K = [1]

B.5 Network layer

The terms "incoming" and "outgoing" are relative to TETRAPOL.

- incoming: call issued from the PABX, addressed to a TETRAPOL network subscriber.

- outgoing: call issued from a TETRAPOL subscriber, addressed to an external subscriber.

This clause focuses on to the "user" side, i.e. the gateway. The PABX is assumed to enable adequate "network" functions.

B.5.1 Timer on gateway side

VN3 recommended time-out values shall apply, including

T303 = [10] s
T305 = [4] s
T308 = [4] s
T309 = [3] mn (see note)
T310 = [1] mn
T313 = [4] s

NOTE: A layer 2 release does not prevent an on-going call to continue on traffic channel.

History

Document history		
Date	**Status**	**Comment**
04 June 1996	First Version	Version 0.0.1
18 June 1996	Update before review	Version 0.0.2
25 June 1996	Update before review	Version 0.0.3
08 July 1996	Update following review	Version 0.1.0
31 July 1996	TETRAPOL forum approval	Version 1.0.0
25 September 1996	Edition	Version 1.0.1
30 September 1996	Remove redundancies with ISDN and VN3 standards	Version 1.0.2
20 November 1996	Corrections	Version 1.0.3
16 December 1996	Edition	Version 1.0.4
26 June 1998	Alignment corrections	Versions 1.0.5