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Information technology — Telecommunications and information exchange between systems — Private Integrated Services Network — Circuit mode bearer services — Inter-exchange signalling procedures and protocol

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d'information entre systèmes — Réseau privé avec intégration de
services — Services porteurs en mode circuit — Procédures et
protocoles de signalisation d'interéchange*



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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 11572 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

Annex A forms an integral part of this International Standard. Annexes B, C, D, E, F and G are for information only.

Introduction

Private Signalling System Number 1 (PSS1) is a set of standards produced by ISO for the purpose of defining the signalling procedures and protocol for the interconnection of Private Integrated Services Network Exchanges (PINXs) to form Private Integrated Services Networks (PISNs).

PSS1 is independent of the scenario used to interconnect the PINXs.

This International Standard is part of PSS1 and defines the signalling procedures and protocol for circuit-switched Call Control between PISN exchanges (PINXs), i.e., for the support of circuit-mode basic bearer services used either on their own or in support of teleservices.

The circuit mode basic services for (PISNs) specified in this International Standard complement, and are compatible with, the corresponding services for public ISDNs as specified by CCITT.

Information technology — Telecommunications and information exchange between systems — Private Integrated Services Network — Circuit mode bearer services — Inter-exchange signalling procedures and protocol

1 Scope

This International Standard defines the signalling procedures and protocol for the purpose of circuit-switched Call Control at the Q-reference point between Private Integrated Network Exchanges (PINXs) connected together within a Private Integrated Services Network (PISN). This standard is part of PSS1, being defined by ISO for PISNs.

This International Standard is based upon that described in CCITT recommendations Q.930 and Q.931 (Blue Book, 1988), including the provisions for symmetrical operation described in annex D of that recommendation.

NOTE — The signalling procedures and protocol defined in this International Standard satisfies the requirements identified in ISO/IEC11574.

2 Field of Application

This International Standard is applicable to PINXs which interconnect to form a PISN.

The protocol at the Q-reference point applies to interconnection scenarios which satisfy the performance requirements for Inter-PINX connections.

3 Normative references

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

ISO/IEC 8886:1992, *Information technology - Telecommunications and information exchange between systems - Data link service definition for Open Systems Interconnection*.

ISO/IEC 9646-1:1992, *Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General Concepts*.

ISO/IEC11579:¹, *Information technology - Telecommunications and information exchange between systems - Reference configuration for Private Integrated Services Networking (PISN) exchanges*

CCITT Rec. E.164, *Numbering plan for the ISDN era [Blue Book, Volume II, Fascicle II.2]*

CCITT Rec. I.112, *Vocabulary of terms for ISDNs [Blue Book, Volume III, Fascicle III.7]*

CCITT Rec. I.330, *ISDN numbering and addressing principles [Blue Book, Volume III, Fascicle III.8]*

CCITT Rec. T.50, *International Alphabet No. 5 [Blue Book, Volume VII, Fascicle VII.3]*

CCITT Rec. Q.931, *ISDN user-network interface layer 3 specification for basic call control [Blue Book, Volume VI, Fascicle VI.11]*

4 Definitions

4.1 Private Integrated Services Network (PISN)

An ISDN providing services to a specific set of users (contrary to a public ISDN which provides services to the general public).

NOTE — This definition does not include legal and regulatory aspects and does not indicate any aspects of ownership.

¹ To be published

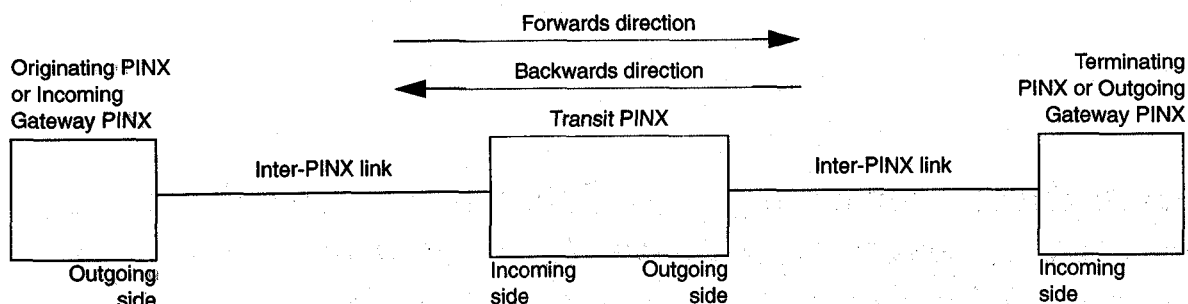


Figure 1 — Illustration of terminology through example of a call routed over two Inter-PINX links employing PSS1.

4.2 Private Integrated Network Exchange (PINX)

A PISN nodal entity which provides automatic connection handling functions used for the provision of telecommunication services based on the definitions of the public ISDN services.

A PISN nodal entity consists of one or more nodes.

4.3 Side, Incoming Side and Outgoing Side

The term Side is used to describe either of the two PINXs at each end of an Inter-PINX link, and in particular to describe the PSS1 Protocol entity within a PINX.

In the context of a call, the Outgoing Side is the Side which routes the call over the Inter-PINX link and the Incoming Side is the Side which receives the call.

See figure 1.

4.4 Outgoing Call and Incoming Call

From the point of view of the Outgoing Side a call is an Outgoing Call.

From the point of view of the Incoming Side a call is an Incoming Call.

4.5 Originating PINX, Terminating PINX and Transit PINX

Within the context of a call, the PINX to which the calling user is attached is known as the Originating PINX.

Within the context of a call, the PINX to which the called user is attached is known as the Terminating PINX.

Within the context of a call, any PINX through which the call passes, excluding the Originating PINX the Terminating PINX, an Incoming gateway PINX and an Outgoing gateway PINX, is known as a Transit PINX.

See figure 1.

4.6 Gateway PINX, Incoming Gateway PINX and Outgoing Gateway PINX

Within the context of a call, a PINX which performs inter-

working between PSS1 and another signalling system, either ISDN or non-ISDN, is known as a Gateway PINX.

A Gateway PINX which routes an incoming call from a route employing another signalling system on to an Inter-PINX link employing PSS1 signalling is known as an Incoming Gateway PINX.

A Gateway PINX which routes an incoming call from an Inter-PINX link employing PSS1 signalling on to a route employing another signalling system is known as an Outgoing Gateway PINX.

See figure 1.

4.7 Preceding PINX and Subsequent PINX

Within the context of a call, from the point of view of a PINX acting as the Incoming Side of an Inter-PINX link, the PINX at the other end of the link, acting as the Outgoing Side, is known as the Preceding PINX.

Within the context of a call, from the point of view of a PINX acting as the Outgoing Side of an Inter-PINX link, the PINX at the other end of the link, acting as the Incoming Side, is known as the Subsequent PINX.

4.8 Inter-PINX link

The totality of a signalling channel connecting two PINXs and the user information channels under the control of that signalling channel, as seen by each PINX.

NOTE — An Inter-PINX link can be provided by various types of Signalling Carriage Mechanism involving different types of physical interface. The signalling and user information channels referred to in this International Standard are independent of the channels or timeslots at a physical interface.

4.9 Unrecognised message

An unrecognised message is defined as a message which is not specified in clause 13 or in any other International Standard relating to PSS1 Protocol to which the PINX claims conformance (e.g., a International Standard specifying generic procedures for supplementary services).

NOTE — The handling of national/private messages is outside the scope of this standard (see annex D).

4.10 Unexpected message

Within the context of a particular Protocol Control state, an unexpected message is a message which is recognised, but for which no procedures are defined in clauses 9.3 and 10 (or in any other International Standard relating to PSS1 Protocol to which the PINX claims conformance) for receipt in that Protocol Control state.

4.11 Unrecognised information element

An unrecognised information element is defined as an information element received in a particular message which is not specified as part of that message in clause 13 or in any other International Standard relating to PSS1 Protocol to which the PINX claims conformance (e.g., a International Standard specifying generic procedures for supplementary services).

NOTE — The handling of national/private information elements is outside the scope of this standard (see annex D).

4.12 Information elements with invalid contents

An information element with invalid contents is defined as an information element which is recognised, but whose contents cannot be interpreted as valid using the rules specified in clause 14 of this International Standard, or contains field values which are marked as "reserved" in clause 14.

NOTE — The receipt of reserved codepoints in octets 5, 6, and 7 of a Bearer Capability information element, shall not be treated as having invalid contents (see 14.5.5)

5 List of acronyms

ANF	Additional Network Feature
DSS1	Digital Subscriber Signalling System Number 1
IE	Information Element
ISDN	Integrated Services Digital Network
MP	Mapping (functional grouping)
PICS	Protocol Implementation Conformance Statement
PISN	Private Integrated Services Network
PINX	Private Services Network Exchange
PSS1	Private Integrated Signalling System Number 1
SCM	Signalling Carriage Mechanism
TE	Terminal Equipment

6 General principles

The Basic Call is a single invocation of a basic service. This International Standard specifies the signalling procedures for establishing, maintaining and clearing a circuit-mode Basic Call at an interface between two PINXs. These signalling procedures are defined in terms of messages exchanged over a Signalling Carriage Mechanism (SCM) connection within the signalling channel of the Inter-PINX link. The result of successful Basic Call establishment is a connection for the purpose of user information transfer. This connection uses a user information channel of the

Inter-PINX link.

Throughout this International Standard, the term user information channel is used to indicate any channel other than the signalling channel.

Conceptually, an Inter-PINX link is attached to a PINX at the Q-reference point, and comprises a signalling channel and one or more user information channels. In practice, these channels are provided by bearer services of an intervening network (ISDN or non-ISDN).

6.1 Protocol model

Figure 2 shows the relationship, within the Control Plane, between the signalling procedures and protocol at Q, PSS1, and the adjacent layers.

The PSS1 Protocol Control entity provides services to Call Control. Call Control corresponds to the Call Control functional entity identified for the Basic Call at Stage 2 (see ISO/IEC 11574). Primitives exchanged across the boundary between Call Control and Protocol Control correspond to the information flows exchanged between the Call Control functional entities, as identified at Stage 2. PSS1 Protocol Control provides the mapping between these primitives and the messages transferred across the Inter-PINX link.

In order to transfer messages, PSS1 Protocol Control uses the services of the Signalling Carriage Mechanism. The actual protocols visible at the C-reference point (see ISO/IEC 11579) are dependent upon the PINX interconnection scenario.

6.2 Services provided to Call Control

PSS1 Protocol Control provides services to Call Control whereby Call Control can send information flows to and receive information flows from the peer Call Control. A primitive from Call Control to PSS1 Protocol Control of type "request" or "response" normally results in the associated information flow being presented to the peer Call Control as a primitive of type "indication" or "confirmation" respectively. The following primitives are used:

- SETUP-REQUEST/INDICATION/RESPONSE/CONFIRMATION for the establishment of a call;
- MORE_INFORMATION-REQUEST/INDICATION for requesting more destination addressing information during call establishment;
- INFORMATION-REQUEST/INDICATION for providing more destination addressing information during call establishment;
- PROCEED-REQUEST/INDICATION for indicating that sufficient destination addressing information has been received and call establishment is proceeding;
- ALERTING-REQUEST/INDICATION for indicating that the destination user is being alerted;
- PROGRESS-REQUEST/INDICATION for indicating interworking conditions and/or the availability of in-band patterns;
- REJECT-REQUEST/INDICATION for the immedi-

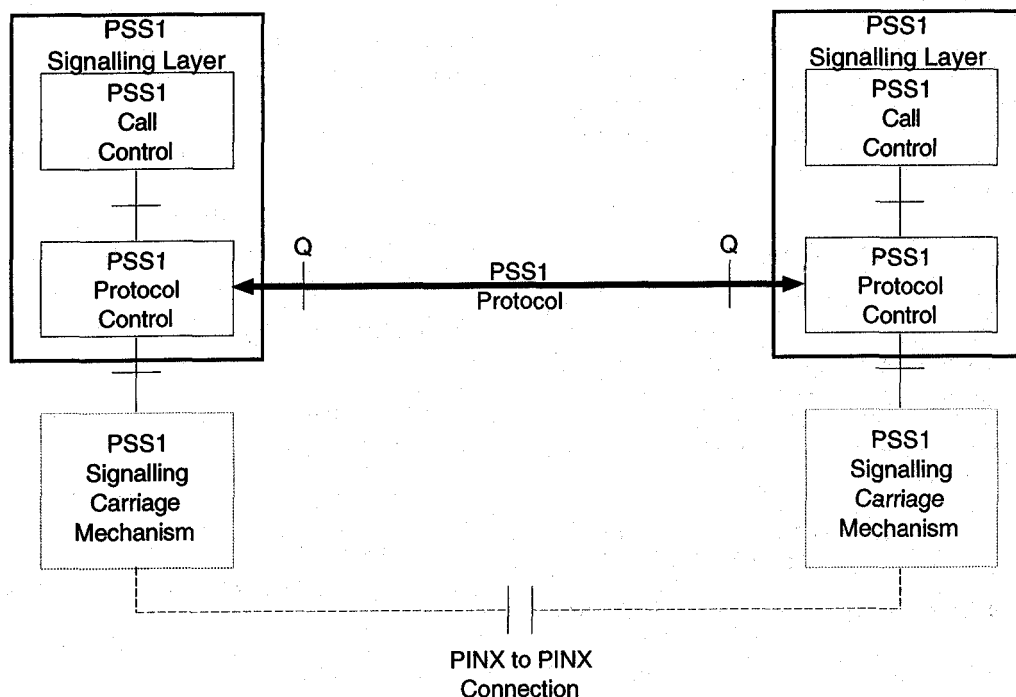


Figure 2 — Control Plane Protocol Model

- ate rejection of a call;
- DISCONNECT-REQUEST/INDICATION for the initiation of call release;
- RELEASE-REQUEST/INDICATION for the completion of call release.
- DL_RESET-INDICATION for indicating to Call Control that a SCM reset has occurred.

6.3 Services required of the Signalling Carriage Mechanism

The services required of the Signalling Carriage Mechanism can be defined in terms of the services provided by ISO/IEC 8886. PSS1 Protocol Control uses the following acknowledged information transfer services and their associated primitives:

- Data transfer (i.e. PSS1 Protocol Message transfer), using the DL-DATA-REQUEST/INDICATION primitives;
- Establishment, using the DL-ESTABLISH-REQUEST/INDICATION/CONFIRM primitives;
- Termination, using the DL-RELEASE-REQUEST/INDICATION primitives.

NOTE — An implementation is not constrained to use the ISO/IEC 8886 Protocol in order to provide these primitives

7 Protocol Control states

PSS1 Protocol Control procedures for calls and layer management are specified in terms of:

- a) messages which are transferred across the Inter-PINX link,

- b) the primitives to and from Call Control at each PINX,
- c) the information processing and actions that take place within PSS1 Protocol Control at each PINX, and
- d) the states that can exist within PSS1 Protocol Control at each PINX.

State machines are deemed to exist for each circuit-mode call. Further state machines are deemed to exist for layer management.

7.1 States for circuit-mode Call Control

The states below are used in association with call references other than the global call reference.

7.1.1 Null State (0)

No call exists.

7.1.2 Call Initiated (1)

This state exists for an outgoing call when the Outgoing Side has sent a request for call establishment to the Incoming Side but has not yet received a response.

7.1.3 Overlap Sending (2)

This state exists for an outgoing call when the Outgoing Side has received acknowledgement that the Incoming Side is able to receive additional call information in overlap mode.

7.1.4 Outgoing Call Proceeding (3)

This state exists for an outgoing call when the Outgoing Side has received acknowledgement that the Incoming

Side has received all call information necessary to effect call establishment.

7.1.5 Call Delivered (4)

This state exists for an outgoing call when the Outgoing Side has received from the Incoming Side an indication that the called user is being alerted.

7.1.6 Call Present (6)

This state exists for an incoming call when the Incoming Side has not yet responded to the request from the Outgoing Side for call establishment.

7.1.7 Call Received (7)

This state exists for an incoming call when the Incoming Side has indicated to the Outgoing Side that the called user is being alerted.

7.1.8 Connect Request (8)

This state exists for an incoming call when the Incoming Side has indicated to the Outgoing Side that the called user has answered the call.

NOTE — "answered" is the act of the end user accepting the call.

7.1.9 Incoming Call Proceeding (9)

This state exists for an incoming call when the Incoming Side has sent to the Outgoing Side acknowledgement that it has received all call information necessary to effect call establishment.

7.1.10 Active (10)

This state exists for an incoming call when the Incoming Side has received from the Outgoing Side an acknowledgement of the indication that the called user has answered the call. This state exists for an outgoing call when the Outgoing Side has received from the Incoming Side an indication that the called user has answered the call.

NOTE — "answered" is the act of the end user accepting the call.

7.1.11 Disconnect Request (11)

This state exists when a Side has sent to the other Side a request to disconnect the user information connection and is waiting for a response.

7.1.12 Disconnect Indication (12)

This state exists when a Side has received from the other Side a request to disconnect the user information connection and has not yet responded.

7.1.13 Release Request (19)

This state exists when a Side has sent to the other Side a request to release the call and has not yet received a response.

7.1.14 Overlap Receiving (25)

This state exists for an incoming call when the Incoming Side has sent acknowledgement to the Outgoing Side that it is able to receive additional call information in overlap mode.

7.2 States for layer management

The states below are used in association with the global call reference.

7.2.1 Null State (Rest 0)

No transaction exists.

7.2.2 Restart Request (Rest 1)

This state exists for a restart transaction when the Side has sent a restart request to the other Side but has not yet received an acknowledgment.

7.2.3 Restart (Rest 2)

This state exists for a restart transaction when the Side has received a restart request from the other Side but has not yet sent an acknowledgment.

8 Call Control

In addition to specifying PSS1 Protocol Control, this International Standard also specifies those aspects of Call Control which are necessary for PINXs to cooperate in the control of calls through a PISN. Although the behaviour of a PSS1 Protocol Control entity with respect to a call is dependent on whether the PINX is the Outgoing Side or the Incoming Side of the Inter-PINX link, its behavior is independent of whether the PINX is a Transit PINX, an End (Originating or Terminating) PINX, or a Gateway PINX. Call Control requirements, on the other hand, are dependent on whether the PINX is a Transit PINX, an Originating PINX, a Terminating PINX, an Incoming Gateway PINX or an Outgoing Gateway PINX.

Subclause 10.4 specifies the special Call Control requirements of a Transit PINX for coordinating the two PSS1 Protocol Control entities. The requirements of 10.4 are in addition to the requirements of PSS1 Protocol Control, which are to be satisfied for both the Incoming Inter-PINX link and the Outgoing Inter-PINX link. An SDL representation of Call Control for a Transit PINX appears in annex F.

Subclause 10.5 specifies the special Call Control requirements for Originating PINXs. The requirements of 10.5 are in addition to the requirements of PSS1 Protocol Control, which are to be satisfied on the Outgoing Inter-PINX link.

Subclause 10.6 specifies the special Call Control requirements for Terminating PINXs. The requirements of 10.6 are in addition to the requirements of PSS1 Protocol Control, which are to be satisfied on the Incoming Inter-PINX link.

Subclause 10.7 specifies the special Call Control requirements for Incoming Gateway PINXs. The requirements of 10.7 are in addition to the requirements of PSS1 Protocol

Control, which are to be satisfied on the Outgoing Inter-PINX link.

Subclause 10.8 specifies the special Call Control requirements for Outgoing Gateway PINXs. The requirements of 10.8 are in addition to the requirements of PSS1 Protocol Control, which are to be satisfied on the Incoming Inter-PINX link.

8.1 States for Transit PINX Call Control

The states below are used in association with calls in Call Control of a Transit PINX.

NOTE — These states are used in order to describe the behavior of the Transit PINX Call Control function. These internal states are a descriptive tool and are not intended to constrain implementations.

8.1.1 TCC_Idle (0)

No call exists.

8.1.2 TCC_Await Digits (1)

This state exists when Call Control has received a request for call establishment from the Preceding PINX and is awaiting additional call information in order to select a route to the Subsequent PINX.

8.1.3 TCC_Await Additional Digits (2)

This state exists when Call Control has sent a request for call establishment to the Subsequent PINX and is awaiting possible additional call information from the Preceding PINX.

8.1.4 TCC_Overlap (3)

This state exists when Call Control is awaiting possible additional call information from the Preceding PINX, having received acknowledgement that the Subsequent PINX is able to receive additional call information in overlap mode.

8.1.5 TCC_Incoming Call Proceeding (4)

This state exists when Call Control has determined that it has received all call information necessary to effect call establishment and has informed the Preceding PINX, but no response to the request for call establishment has been received from the Subsequent PINX.

8.1.6 TCC_Transit Call Proceeding (5)

This state exists when Call Control has received from the Subsequent PINX a response to the request for call establishment and is no longer expecting additional call information to pass to the Subsequent PINX in overlap mode.

8.1.7 TCC_Call Alerting (6)

This state exists when Call Control has received from the Subsequent PINX an indication that the called user is being alerted and has relayed the indication on to the Preceding PINX.

8.1.8 TCC_Call Active (7)

This state exists when Call Control has received from the Subsequent PINX and relayed on to the Preceding PINX an indication that the called user has answered the call.

NOTE — "answered" is the act of the end user accepting the call.

8.1.9 TCC_Await Incoming Release (8)

This state exists when Call Control has initiated call clearing towards the Preceding PINX and is awaiting an acknowledgement.

8.1.10 TCC_Await Outgoing Release (9)

This state exists when Call Control has initiated call clearing towards the Subsequent PINX and is awaiting an acknowledgement.

8.1.11 TCC_Await Two-Way Release (10)

This state exists when Call Control has initiated call clearing towards the Preceding PINX and towards the Subsequent PINX and is awaiting an acknowledgement from each.

8.1.12 TCC_Await Incoming Disconnect (11)

This state exists when Call Control has applied an in-band tone or announcement towards the Preceding PINX and is awaiting the initiation of clearing procedures.

8.1.13 TCC_Await Outgoing Disconnect (12)

This state exists when Call Control has applied an in-band tone or announcement towards the Subsequent PINX and is awaiting the initiation of clearing procedures.

8.1.14 TCC_Await Two-Way Disconnect (13)

This state exists when Call Control has applied an in-band tone or announcement towards both the Preceding PINX and the Subsequent PINX and is awaiting the initiation of clearing procedures.

9 General procedures

9.1 Use of the services of Signalling Carriage Mechanism

This clause specifies the use by PSS1 of the services of the Signalling Carriage Mechanism.

NOTE — The SCM provides a defined service of quality.

9.1.1 Establishment of a Signalling Carriage Mechanism connection

Before the procedures for Call Control, layer management or any of the general procedures in 9.2 and 9.3 can be performed, a SCM connection shall be established. If a SCM connection has not already been established, PSS1 Protocol Control shall request establishment by sending a DL-ESTABLISH-REQUEST primitive to the Signalling Carriage

Mechanism. Receipt of a DL-ESTABLISH-CONFIRMATION primitive or a DL-ESTABLISH-INDICATION primitive from the Signalling Carriage Mechanism indicates that a SCM connection has been established.

9.1.2 Transfer of data

A PSS1 message (or message segment) is transmitted by including it with a DL-DATA-REQUEST primitive to the Signalling Carriage Mechanism.

A PSS1 message (or message segment) appears included with a DL-DATA-INDICATION primitive from the Signalling Carriage Mechanism.

9.1.3 Signalling Carriage Mechanism reset

Receipt of a DL-ESTABLISH-INDICATION primitive from the Signalling Carriage Mechanism subsequent to establishment of the SCM connection indicates a spontaneous SCM reset. The procedures specified in 9.2.8 shall apply.

9.1.4 Signalling Carriage Mechanism failure

Receipt of a DL-RELEASE-INDICATION primitive from the SCM indicates a SCM malfunction. The procedures specified in 9.2.9 shall apply.

9.2 Handling of protocol error conditions

The procedures of 9.3, 10, 11 and 12 of this specification are applicable only to those messages which pass the checks described in 9.2.1 through 9.2.7.

Subclauses 9.2.1 through 9.2.7 are listed in order of precedence.

9.2.1 Protocol discriminator error

When a message is received with a protocol discriminator not in accordance with 14.2, that message shall be ignored. "Ignore" means to do nothing, as if the message had never been received.

9.2.2 Message too short

When a message is received that is too short to contain a complete message type information element, that message shall be ignored.

9.2.3 Call reference error

9.2.3.1 Invalid call reference format

If the Call reference information element octet 1, bits 5 through 8 do not equal "0000", then the message shall be ignored.

If octet 1, bits 1 through 4 of the call reference information element indicates a length greater than the maximum length supported by the receiving equipment, then the message shall be ignored.

If a message containing the Dummy call reference is received, except when used in the context of other Standards which define its use, the message shall be ignored.

9.2.3.2 Call reference procedural errors

Whenever any message except SETUP, STATUS, RELEASE or RELEASE COMPLETE is received specifying a call reference (other than the global call reference) which is not recognised as relating to an active call or to a call in progress, the receiving entity shall send a RELEASE COMPLETE message and remain in the null state. The RELEASE COMPLETE message shall contain the call reference of the received message and cause number 81, "invalid call reference value".

Alternatively, the receiving entity may send a RELEASE message (in place of the RELEASE COMPLETE message) in this situation, but this is not the preferred option. The RELEASE message shall contain the call reference of the received message and cause number 81, "invalid call reference value".

When a SETUP message is received specifying a call reference which is not recognised as relating to an active call or to a call in progress, and with a call reference flag incorrectly set to ONE, this message shall be ignored.

When a STATUS message is received specifying a call reference which is not recognised as relating to an active call or to a call in progress, the procedures of 9.3.2 shall apply.

When a RELEASE message is received specifying a call reference which is not recognised as relating to an active call or to a call in progress, the receiving entity shall send a RELEASE COMPLETE message. The RELEASE COMPLETE message shall contain the call reference of the received message and cause number 81, "invalid call reference value".

When a RELEASE COMPLETE message is received specifying a call reference which is not recognised as relating to an active call or to a call in progress, no action shall be taken.

When a SETUP message is received specifying a call reference which is recognised as relating to an active call or to a call in progress, this SETUP message shall be ignored.

When any message except RESTART, RESTART ACKNOWLEDGE or STATUS is received specifying the global call reference, no action shall be taken on this message and a STATUS message specifying the global call reference with cause number 81 "invalid call reference value" shall be returned.

9.2.4 Message type or message sequence errors

Whenever an unrecognised or unexpected message is received in any state other than the Null state, a STATUS message shall be returned with a cause information element. The cause value used shall be number 98 "message not compatible with call state or message type non-existing or not implemented". If the receiving entity can distinguish between unimplemented (or non-existing) message types and implemented message types which are incompatible with the call state, then the cause used shall be:

- cause number 97 "message type non-existing or not implemented"; or

- cause number 101 "message type not compatible with the call state"

Alternatively, a STATUS ENQUIRY message may be sent requesting the Protocol Control state of the peer entity.

There are two exceptions where a STATUS or STATUS ENQUIRY message shall not be sent. The first exception is when the outgoing or incoming side receives an unexpected RELEASE message (e.g., if the DISCONNECT message was corrupted by undetected transmission errors). In this case the receiving entity shall: disconnect and release the information channel; return RELEASE COMPLETE message to the originator; release the call reference; stop all timers; enter the Null state; and inform Call Control.

The second exception is when the outgoing or incoming side receives an unexpected RELEASE COMPLETE message. In this case, the receiving entity shall: disconnect and release the information channel; release the call reference; stop all timers; enter the Null state; and inform Call Control.

9.2.5 General information element errors

9.2.5.1 Duplicated information elements

If an information element is repeated in a message more times than is permitted for that particular message, only the contents of the occurrences of that information element up to the limit of repetitions shall be handled. All subsequent occurrences of the element shall be ignored.

9.2.5.2 Information elements exceeding maximum length

Information elements with a length exceeding the maximum length (given in clause 14) shall be treated as information elements with content error.

9.2.5.3 Information elements out of sequence

If a variable length information element is received out of sequence (i.e. its code value is lower than that of the previous variable length information element) the receiving entity may ignore this information element and continue to process the message.

NOTE — If the information element is mandatory and the receiver chooses to ignore the element, the error handling procedures of 9.2.6.1 will be followed. If the ignored information element is non-mandatory, the receiver will continue to process the message.

Some implementations may choose to process all the information elements received, regardless of the order in which they are received.

9.2.6 Mandatory information element errors

9.2.6.1 Mandatory information element missing

When a message other than SETUP, DISCONNECT, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements missing, no action shall be taken on the message and no state change shall occur. A STATUS message shall then be

returned with cause number 96 "mandatory information element is missing".

When a SETUP message is received which has one or more mandatory information elements missing, a RELEASE COMPLETE message with cause number 96 "mandatory information element is missing" shall be returned.

When a DISCONNECT message is received with one or more mandatory information elements missing, the actions taken shall be the same as if a DISCONNECT message with cause number 31 "normal, unspecified" was received (see 10.2), with the exception that the RELEASE message returned shall contain cause number 96 "mandatory information element missing".

When a RELEASE message is received as the first clearing message with one or more mandatory information elements missing the actions taken shall be the same as if a RELEASE message with cause number 31 "normal, unspecified" was received (see 10.2), except that if a RELEASE COMPLETE message is sent it shall contain cause number 96 "mandatory information element is missing".

When a RELEASE COMPLETE message is received as the first clearing message, with one or more mandatory information elements missing, it shall be assumed that a RELEASE COMPLETE message was received with cause number 31 "normal, unspecified".

9.2.6.2 Mandatory information element content error

When a message other than SETUP, DISCONNECT, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements with invalid content, no action shall be taken on the message and no state change shall occur. A STATUS message shall then be returned with cause number 100 "invalid information element contents".

When a SETUP message is received which has one or more mandatory information elements with invalid content, a RELEASE COMPLETE message with cause number 100 "invalid information element contents" shall be returned.

When a DISCONNECT message is received with invalid content of the cause information element, the actions taken shall be the same as if a DISCONNECT message with cause number 31 "normal, unspecified" was received (see 10.2), with the exception that the RELEASE message returned shall contain cause number 100 "invalid information element contents".

When a RELEASE message is received with invalid content of the cause information element, the actions taken shall be the same as if a RELEASE message with cause number 31 "normal, unspecified" was received (see 10.2), except that if a RELEASE COMPLETE message is sent, it shall contain cause number 100 "invalid information element contents".

When a RELEASE COMPLETE message is received with invalid content of the cause information element, it shall be

assumed that a RELEASE COMPLETE message was received with cause number 31 "normal, unspecified".

9.2.7 Non-mandatory information element errors

9.2.7.1 Non-mandatory information element not recognised

When a message is received which has one or more non-mandatory information elements which are unrecognised, the receiving entity shall check whether they indicate "comprehension required" (refer to Table 22 for the information element identifiers reserved with this meaning). If any information element is encoded to indicate "comprehension required" then the procedures in 9.2.6.1 shall apply.

If all unrecognised information elements are not encoded to indicate "comprehension required", the following actions shall apply:

- The receiving entity shall take action on the message and on those information elements which are recognised and have valid content;
- When the received message is other than a DISCONNECT, RELEASE or RELEASE COMPLETE, a STATUS message may be returned containing one Cause information element. The Cause information element shall contain cause number 99 "information element non-existent or not implemented", and the diagnostic field, if present, shall contain the unrecognised information element identifier for each information element that is unrecognised. The STATUS message shall indicate the call state which the receiving entity enters after processing the message in which the unrecognised information element was received.
- If a DISCONNECT message is received with one or more unrecognised information elements, the actions taken shall be the same as if a DISCONNECT message was received without these unrecognised information elements (see 10.2) with the exception that the RELEASE message returned shall contain cause number 99 "information element non-existent or not implemented". This cause information element may contain a diagnostic field which shall contain the information element identifier for each unrecognised information element.
- If a RELEASE message is received with one or more unrecognised information elements, the actions taken shall be the same as if a RELEASE message was received without these unrecognised information elements (see 10.2) with the exception that the RELEASE COMPLETE message returned shall contain cause number 99 "information element non-existent or not implemented". This cause information element may contain a diagnostic field which shall contain the information element identifier for each unrecognised information element.
- If a RELEASE COMPLETE message is received with one or more unrecognised information elements, the actions taken shall be the same as if a RELEASE COMPLETE message was received without those unrecognised information elements was received.

9.2.7.2 Non-mandatory information element content error

When a message other than DISCONNECT, RELEASE or RELEASE COMPLETE is received which has one or more non-mandatory information elements with invalid content, action shall be taken on the message and those information elements which are recognised and have valid content. A STATUS message may be returned containing a cause information element with cause number 100 "invalid information element contents", and the diagnostic field, if present, shall contain the information element identifier for each information element with invalid content. The STATUS message shall indicate the call state which the receiving entity enters after processing the message in which the information element content error was received.

If a DISCONNECT, RELEASE or RELEASE COMPLETE message is received which has one or more non-mandatory information elements with invalid content, normal call clearing procedures (defined in 10.2) shall apply.

9.2.8 Signalling Carriage Mechanism reset

Whenever a PSS1 entity is informed of a spontaneous SCM reset by means of the DL-ESTABLISH-INDICATION primitive, the following procedures shall apply:

- for calls in the Overlap Sending state and the Overlap Receiving state, the entity shall initiate clearing by sending a DISCONNECT message with cause number 41 "Temporary Failure", and following the procedures of 10.2.
- for calls in the disestablishment phase (states 11, 12, and 19) no action shall be taken.
- calls in the establishment phase (states 1, 3, 4, 6, 7, 8, and 9) and in the Active state shall be maintained. Optionally, a STATUS message may also be sent to report the current Protocol Control state to the peer entity or a STATUS ENQUIRY message may be sent to verify the Protocol Control state of the peer entity.

9.2.9 Signalling Carriage Mechanism failure

Whenever a PSS1 entity is notified by its Signalling Carriage Mechanism entity via the DL-RELEASE-INDICATION primitive that there is a SCM malfunction, the following procedure shall apply:

- any calls not in the active state shall be cleared internally. For any call in the active state, timer T309 shall be started.
If timer T309 is already running, it shall not be restarted.
- the PSS1 entity shall request SCM re-establishment by sending a DL-ESTABLISH-REQUEST primitive.

When informed of SCM re-establishment by means of the DL-ESTABLISH-CONFIRMATION primitive, the following procedure shall apply, for each active call:

- timer T309 shall be stopped;
- either: the PSS1 entity shall send a STATUS message to report the current Protocol Control state to the peer entity, or the PSS1 entity shall perform the

status enquiry procedure to verify the Protocol Control state of the peer entity.

Cause number 31 "normal, unspecified" is recommended to be used in the STATUS message.

If timer T309 expires prior to SCM re-establishment, Protocol Control shall: release all resources; release the call reference; and enter the Null state. Call Control shall be informed of the failure of the call.

9.3 Status and status enquiry protocol procedures

9.3.1 Status enquiry procedure

Whenever a PSS1 entity wants to check the correctness of a Protocol Control state at a peer PSS1 entity, a STATUS ENQUIRY message may be sent requesting the Protocol Control state.

Upon sending the STATUS ENQUIRY message, timer T322 shall be started in anticipation of receiving a STATUS message. While timer T322 is running, only one outstanding request for Protocol Control state shall exist. Therefore if timer T322 is already running, it shall not be restarted. If a clearing message is received before timer T322 expires, timer T322 shall be stopped, and the call clearing shall continue.

Upon receipt of a STATUS ENQUIRY message, the receiving entity shall respond with a STATUS message, reporting the current Protocol Control state and containing cause number 30 "responding to STATUS ENQUIRY". Receipt of the STATUS ENQUIRY message shall not result in a state change.

The sending or receipt of the STATUS message in such a situation will not directly affect the Protocol Control state of either the sending or receiving entity. The side having received the STATUS message shall inspect the cause information element. If the STATUS message contains any cause other than cause number 30 "responding to STATUS ENQUIRY", timer T322 shall continue to time for an explicit response to the STATUS ENQUIRY message.

If a STATUS message is received that contains cause number 30 "response to STATUS ENQUIRY" the timer T322 shall be stopped, and the "appropriate actions" shall be taken.

These "appropriate actions" are implementation dependent. However, the actions prescribed in 9.3.2 below shall apply.

If the sender's Protocol Control state changes after STATUS ENQUIRY has been sent, this shall be taken into account when checking for a compatible Protocol Control state in the received STATUS message.

If timer T322 expires, and no STATUS message was received, the STATUS ENQUIRY message may be transmitted a number of times until a response is received.

The number of times the STATUS ENQUIRY message may be retransmitted is a implementation dependent value. If

the limit is exceeded, that call shall be cleared. The cause that should be used when clearing in this situation is cause number 41 "temporary failure". Call Control shall be notified of the failure of the call.

If T322 expires and a STATUS message, with a cause value other than number 30 "response to STATUS ENQUIRY", was received the actions taken shall be an implementation option, which may be to process the received Protocol Control state in the same way as if the cause in the received STATUS message was number 30 "response to STATUS ENQUIRY".

9.3.2 Receiving a STATUS message

On receipt of a STATUS message containing a call reference value other than the Global Call Reference, the receiving entity shall check whether the Protocol Control state reported in the STATUS message is compatible with the state associated with that call reference internally. Table 1 indicates which Protocol Control states shall be considered compatible

9.3.2.1 Receipt of a STATUS message reporting an incompatible Protocol Control state

On receipt of a STATUS message reporting an incompatible Protocol Control state, the receiving entity shall either: clear the call by sending an appropriate clearing message with cause number 101 "message not compatible with call state"; or, take other actions which attempt to recover from a mismatch. These actions are an implementation decision.

Table 1 — Compatible Protocol Control states

Internal Protocol Control state associated with call reference	Reported Protocol Control state in STATUS message
0 Null	0 Null
1 Call Initiated	6 Call Present
2 Overlap Sending	25 Overlap Receiving
3 Outgoing Call Proceeding	9 Incoming Call Proceeding
4 Call Delivered	7 Call Received
6 Call Present	1 Call Initiated
7 Call Received	4 Call Delivered
8 Connect Request	10 Active
9 Incoming Call Proceeding	3 Outgoing Call Proceeding
10 Active	10 Active 8 Connect Request
11 Disconnect Request	11 Disconnect Request 12 Disconnect Indication
12 Disconnect Indication	11 Disconnect Request
19 Release Request	19 Release Request
25 Overlap Receiving	2 Overlap Sending

The following rules shall, however, apply:

- if a STATUS message indicating any Protocol Con-

trol state except the Null state is received in the Null state, then a RELEASE COMPLETE message shall be sent.

Alternatively, in this case a RELEASE message may be sent in place of the RELEASE COMPLETE message, but this is not the recommended option.

- if a STATUS message indicating any Protocol Control state except the Null state is received in the Release Request state, no action shall be taken.
- if a STATUS message, indicating the Null state, is received in any state except the Null state, the receiver shall release all resources and move into the Null state. Call Control shall be informed of the failure of the call.

When in the Null state, the receiver of a STATUS message indicating the Null state shall take no action other than to discard the message and shall remain in the Null state.

9.3.2.2 Receipt of a STATUS message reporting a compatible Protocol Control state

No action shall normally be taken on receipt of a STATUS message indicating a compatible Protocol Control state except where the STATUS message contains one of the following causes:

- cause number 96 "mandatory information element is missing";
- cause number 97 "message type non-existent or not implemented";
- cause number 99 "information element non-existent or not implemented"; or,
- cause number 100 "invalid information element contents".

In these cases, the actions to be taken are an implementation option. The receiving entity should attempt to analyse the contents of the received STATUS message considering the current stage of the call in order to determine whether or not the call can continue. If successful analysis and recovery are not possible, the call may be cleared as described in 10.2.

9.3.2.3 Receiving a STATUS message containing the global call reference

On receipt of a STATUS message containing the Global Call Reference, the receiving entity shall check whether the reported layer management state is compatible with its own internal layer management state, according to table 2. Layer management shall be informed if the STATUS mes-

Table 2 — Compatible layer management states

Internal layer management state associated with global call reference	Reported layer management state in STATUS message
0 Null	0 Null
1 Restart Request	2 Restart
2 Restart	1 Restart Request

sage reports an incompatible state in Restart or Restart Request states (1 or 2), otherwise no action shall be taken.

NOTE — The Call Reference flag of the Global Call Reference applies to the Restart procedures. As a result, the state received in a STATUS message containing the Global call reference shall be compared with the layer management state of the specific Global Call Reference identified by the setting of the Call Reference flag.

10 Circuit-switched Call Control procedures

The specification of the procedures for the control of circuit-switched calls across the network is contained in four parts.

- The first part (10.1 - 10.3) specifies the procedures and message flows over a symmetrical interface between two peer PINXs.

Detailed specification and description language (SDL) diagrams for the procedures specified in these clauses are contained in annex E.

- The second part (10.4) specifies how the procedures and message flows over either side of a Transit PINX are interrelated.

Detailed specification and description language (SDL) diagrams for the procedures specified in this clause are contained in annex F.

- The third part (10.5 and 10.6) specifies the requirements for Call Control at an End PINX.
- The fourth part (10.7 and 10.8) specifies the requirements for Call Control at a Gateway PINX.

10.1 Call establishment

10.1.1 Call request

Call establishment shall be initiated by the Outgoing Side sending a SETUP message, and starting T303. The Outgoing Side shall select a channel (not known to be busy) for use by the call and indicate this in the channel identification information element. If the Outgoing Side knows all appropriate channels controlled by the signalling channel are in use, it shall not send a SETUP message.

If no response (as prescribed in 10.1.4) is received from the Incoming Side before timer T303 expires, the SETUP message may optionally be retransmitted and timer T303 restarted.

If no response is received before timer T303 expires for a second time, the Outgoing Side shall send a RELEASE COMPLETE message to the Incoming Side. This message should contain Cause number 102 "recovery on timer expiry". Call Control shall be notified of the failure of the call.

The SETUP message shall always contain a call reference, selected according to the procedures given in 14.3. It shall also contain all the information required by the Incoming Side to process the call. The number digits within the Called party number information element may optionally be incomplete, thus requiring the use of overlap sending (see

10.1.3). The SETUP message may optionally contain the Sending complete information element in order to indicate that the number is complete.

NOTE — If enbloc signalling only is used between two adjacent PINXs, overlap receiving procedures need not be tested.

Following the transmission of the SETUP message, the Outgoing Side shall enter the Call Initiated state. On receipt of the SETUP message the Incoming Side shall enter the Call Present state.

10.1.2 Information channel selection

In the SETUP message, the Outgoing Side shall indicate one of the following in the channel identification information element, in addition to the selected channel number:

- a) channel is indicated, no acceptable alternative; or,
- b) channel is indicated, any alternative is acceptable.

In both cases, if the indicated channel is available, the Incoming Side shall reserve it for the call.

In case b) if the indicated channel is not available, the Incoming Side shall reserve any available information channel associated with the signalling channel.

The selected information channel shall be indicated in the first message returned by the Incoming Side in response to the SETUP message (i.e. a SETUP ACKNOWLEDGE or CALL PROCEEDING message). The receipt of an ALERTING or CONNECT message as the first response to SETUP shall not Cause a protocol error, even though they would not normally be sent as the first responding message by a PSS1 entity.

In case a) if the specified channel is not available, or, in case b) if no channel is available, a RELEASE COMPLETE message containing a Cause information element shall be sent by the Incoming Side as described in 10.2. Cause number 44 "requested circuit/channel not available" shall be the Cause sent in case a) and Cause number 34 "no circuit/channel available" shall be the Cause sent in case b). Call Control shall be informed of the failure of the call.

In case b) if the channel indicated in the CALL PROCEEDING or SETUP ACKNOWLEDGE message is unacceptable to the Outgoing Side, the call shall be cleared in accordance with 10.2. Cause number 6 "channel unacceptable" should be the Cause used here. Call Control shall be informed of the failure of the call.

10.1.3 Overlap sending

NOTE — If enbloc signalling only is used between two adjacent PINXs, overlap receiving procedures need not be tested.

If the received SETUP message does not contain a Sending complete information element, and contains either:

- incomplete called number information; or,
- called number information which the Incoming Side cannot determine to be complete

The Incoming Side shall start timer T302, send a SETUP ACKNOWLEDGE message to the Outgoing Side, and enter the Overlap Receiving state.

When the SETUP ACKNOWLEDGE message is received, the Outgoing Side shall enter the Overlap Sending state, stop T303, and start timer T304.

After receiving the SETUP ACKNOWLEDGE message, the Outgoing Side shall send the remainder of the Called party number digits (if any) in one or more INFORMATION messages.

The Outgoing Side shall restart timer T304 when each INFORMATION message is sent.

The INFORMATION message which completes the information sending may contain a "Sending complete" information element. The Incoming Side shall restart timer T302 on the receipt of every INFORMATION message not containing a Sending complete indication if it cannot determine that the Called party number is complete.

If timer T304 expires the Outgoing Side shall initiate call clearing using the procedures in 10.2. The Cause that should be used towards the calling user is Cause number 28 "invalid number format"; towards the called user, the Cause used should be Cause number 102 "recovery on timer expiry". Call Control shall be informed of the failure of the call.

At the expiry of timer T302, the Incoming Side shall:

- if it determines that the call information is incomplete, initiate call clearing in accordance with 10.2 with Cause number 28 "invalid number format";
- otherwise send a CALL PROCEEDING message and enter the Incoming Call Proceeding state.

10.1.4 Call proceeding

10.1.4.1 Call proceeding, enbloc sending

If enbloc sending is used (i.e. the Incoming Side can determine it has received sufficient information in the SETUP message from the Outgoing Side to establish the call) the Incoming Side shall send a CALL PROCEEDING message to the Outgoing Side to acknowledge the SETUP message and to indicate that the call is being processed. Upon receipt of the CALL PROCEEDING message, the Outgoing Side shall enter the Outgoing Call Proceeding state, stop timer T303 and, if applicable, start T310. After sending the CALL PROCEEDING message, the Incoming Side shall enter the Incoming Call Proceeding state.

NOTE — T310 is optional in the case of a Transit PINX and mandatory in the case of an Originating PINX (see clause 12).

If, following the receipt of a SETUP message, the Incoming Side determines that for some reason the call cannot be supported, then the Incoming Side shall initiate call clearing as defined in 10.2. Some of the Causes that may be used are given in 10.1.8. This is not exhaustive.

10.1.4.2 Call proceeding, overlap sending

NOTE 1 — If enbloc signalling only is used between two adjacent PINXs, overlap receiving procedures need not be tested.

Following the occurrence of one of these conditions:

- the receipt by the Incoming Side of a Sending complete indication; or,
- analysis by the Incoming Side that all call information necessary to effect call establishment has been received;

and if the Incoming Side can determine that access to the requested service is available, the Incoming Side shall: send a CALL PROCEEDING message to the Outgoing Side; stop timer T302; and enter the Incoming Call Proceeding state.

If, following the receipt of a SETUP message or during overlap sending the Incoming Side determines that for some reason the call cannot be supported, then the Incoming Side shall initiate call clearing as defined in 10.2. Some of the Causes that may be used are given in clause 10.1.8. This list is not exhaustive.

NOTE 2 — The CALL PROCEEDING message is sent to indicate that the requested call establishment has been initiated, and no more call establishment information will be accepted.

When the Outgoing Side receives the CALL PROCEEDING message it shall enter the Outgoing Call Proceeding state, stop timer T304 and if applicable, start timer T310.

NOTE 3 — T310 is optional in the case of a Transit PINX and mandatory in the case of an Originating PINX (see clause 12).

Upon receiving an indication that the called party is alerting or that the call has been answered, the incoming side shall stop timer T302 and send an ALERTING or CONNECT message, respectively, to the Outgoing Side. When the Outgoing Side receives a CONNECT or an ALERTING message, timer T304 shall be stopped.

Any INFORMATION message received by the Incoming side, after having sent a CALL PROCEEDING, ALERTING or CONNECT message to the Outgoing side, shall be discarded and no further action shall be taken.

10.1.4.3 Expiry of timer T310

On expiry of T310 (i.e. if the Outgoing Side does not receive an ALERTING, CONNECT, DISCONNECT or PROGRESS message [containing CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available"]) the Outgoing Side shall initiate clearing procedures as described in 10.2. The clearing Cause sent to the Incoming Side should be Cause number 102 "Recovery On Timer Expiry". Call Control shall be notified of the failure of the call.

10.1.5 Call confirmation indication

Upon receiving an indication that the called party is alerting, the Incoming Side shall send an ALERTING message to the Outgoing Side and enter the Call Received state. The ALERTING message shall only be sent after a SETUP ACKNOWLEDGE or a CALL PROCEEDING message has been sent across the interface. When the Outgoing Side receives the ALERTING message it shall enter the Call Delivered state, stop T310, if running, and optionally start T301.

Any INFORMATION message received by the Incoming side, after having sent a CALL PROCEEDING, ALERTING or CONNECT message to the Outgoing side, shall be discarded and no further action shall be taken.

If T301 expires prior to the receipt of a CONNECT message then the Outgoing Side shall clear the call in accordance with the procedures contained in 10.2. The clearing Cause used should be Cause number 19 "No answer from user (user alerted)".

10.1.6 Call connected

Upon receiving an indication from Call Control that the call has been answered and requires through connection in both the backward and forward directions, the Incoming Side shall send a CONNECT message to the Outgoing Side and either: start timer T313 and enter the Connect Request state; or enter the Active state. The CONNECT message shall not be sent before a SETUP ACKNOWLEDGE or a CALL PROCEEDING message has been sent across the interface.

The CONNECT message indicates to the Outgoing Side that a connection has been established through the network and stops a possible local indication of alerting.

On receipt of the CONNECT message, the Outgoing Side shall: stop T310, T301 or T304 (if running), send a CONNECT ACKNOWLEDGE message to the Incoming Side and enter the Active state.

If, on receipt of the CONNECT ACKNOWLEDGE message the Incoming Side is in the Connect Request state, it shall enter the Active state and cancel timer T313. If the Incoming Side is in the Active state when a CONNECT ACKNOWLEDGE message is received, the message shall be ignored.

Any INFORMATION message received by the Incoming side, after having sent a CALL PROCEEDING, ALERTING or CONNECT message to the Outgoing side, shall be discarded and no further action shall be taken.

If T313 expires prior to the receipt of a CONNECT ACKNOWLEDGE message, then the Incoming Side shall initiate call clearing procedures by sending a DISCONNECT message to the Outgoing Side, as described in clause 10.2. The Cause value used in this situation should be number 102 "recovery on timer expiry".

NOTE — If by mutual agreement T313 is not implemented, the sending of CONNECT ACKNOWLEDGE message is

optional.

10.1.7 Use of the PROGRESS message

10.1.7.1 During call establishment

During call establishment, the call may leave the PISN environment (e.g. because of interworking with another network). When this situation occurs, a Progress indicator information element containing the appropriate progress description value may be sent over the PISN in the direction of the calling user.

Where this indication cannot be sent in a Call Control message (e.g. ALERTING) it shall be sent in a PROGRESS message. On receipt of a PROGRESS message, no state change shall occur, but timer T310 (if running) should be stopped when CCITT progress description number 1 "call is not end to end ISDN, further progress information may be available in-band", number 2 "destination address is non-ISDN", or number 8 "in-band information or appropriate pattern now available" is received.

10.1.7.2 During call failure

If an in-band tone or announcement is to be applied to indicate to the calling user failure of a call which has not yet reached the active state, the Incoming Side shall send a PROGRESS message to ensure that the information channel is through connected from the provider of the tone to the calling user. If an in-band tone or announcement is applied to indicate to a user failure of a call that has reached the Active state, the in-band tone or announcement may be applied without sending a PROGRESS message, as the information channel would already be through connected in both directions.

If used, the PROGRESS message shall contain CCITT progress description number 8 "in-band information or appropriate pattern now available" and a Cause information element indicating the failure Cause value.

NOTE — Normal call clearing will follow later, initiated either by the user receiving the in-band tone or announcement (potentially during the tone or announcement) or by the entity providing the tone or announcement if no clearing indication is received by the user within an appropriate time.

10.1.8 Failure of call establishment

In the Call Present, Overlap Receiving, Incoming Call Proceeding or Call Received states, the Incoming Side may initiate clearing as described in 10.2 with Cause. Examples of some of the Causes that may be used to clear the call, when the Incoming Side is in the Call Present, Overlap Receiving, or Incoming Call Proceeding state are as follows:

- number 1 "unassigned (unallocated) number"
- number 3 "no route to destination"
- number 17 "user busy"
- number 18 "no user responding"
- number 22 "number changed"
- number 28 "invalid number format"
- number 34 "no circuit channel available"

- number 44 "requested circuit channel not available"
- number 58 "bearer capability not presently available"
- number 65 "bearer capability not implemented"

Examples of two of the Causes that may be used to clear the call when the Incoming Side is in the Call Received state are as follows:

- number 19 "no answer from user (user alerted)"
- number 21 "call rejected by user"

10.2 Call clearing

10.2.1 Terminology

The following terms are used in this International Standard in the description of clearing procedures:

- A channel is "connected" when the channel is part of a PISN connection established according to this International Standard.
- A channel is "disconnected" when the channel is no longer part of a PISN connection, but is not yet available for use in a new connection.
- A channel is "released" when the channel is not part of a PISN connection and is available for use in a new connection.

Similarly, a call reference that is "released" is available for reuse.

10.2.2 Exception conditions

Apart from the exceptions listed below, call clearing shall be initiated when the Outgoing Side or the Incoming Side sends a DISCONNECT message and follows the procedures defined in 10.2.3. The exceptions to the above rule are as follows:

- The rejection of a SETUP message by the Incoming Side when no responding message has previously been sent (e.g. because of the unavailability of a suitable information channel) shall be accomplished by returning a RELEASE COMPLETE message, releasing the call reference, and entering the null state.
- Unsuccessful termination of the information channel selection procedure by the side offering the call shall be accomplished by sending a RELEASE message to the other side. The RELEASE message shall contain Cause number 6 "channel unacceptable".
- During call establishment, call clearing may be initiated towards the called user before a information channel has been agreed between the Outgoing and Incoming Sides. In this case, clearing shall be accomplished by sending either a DISCONNECT or a RELEASE message containing a Cause information element to the Incoming Side. The Cause value used shall be appropriate to the clearing circumstances. For example, if the failure was due to the calling user clearing before the call reaches its destination node, the Cause value would be the value supplied by the calling user, e.g. Cause number 31 "normal, unspecified".

10.2.3 Clearing

Apart from the exceptions identified in 10.2.2 and 9.2, the clearing procedures are symmetrical and may be initiated by either the Outgoing or the Incoming Side. In the interest of clarity, the following procedures describe only the case where the Outgoing Side initiates clearing.

On sending or receiving any call clearing message, any protocol timer other than T305 or T308 shall be terminated.

The Outgoing Side shall initiate clearing by: sending a DISCONNECT message; starting timer T305; disconnecting the information channel; and entering the Disconnect Request state. Following the receipt of the DISCONNECT message, the Incoming Side shall consider the call to be in the Disconnect Indication state.

On receipt of the DISCONNECT message the Incoming Side shall: disconnect the information channel used in the call; send a RELEASE message to the Outgoing Side; start timer T308; and enter the Release Request state.

On receipt of the RELEASE message the Outgoing Side shall: cancel timer T305; release the information channel; send a RELEASE COMPLETE message; release the call reference; and return to the Null state.

On receipt of a RELEASE COMPLETE message from the Outgoing Side, the Incoming Side shall: stop timer T308; release both the information channel and the call reference; and return to the Null state.

If the Outgoing Side does not receive a RELEASE message in response to the DISCONNECT message before timer T305 expires, it shall send a RELEASE message to the Incoming Side with the Cause number originally contained in the DISCONNECT message, start timer T308 and enter the Release Request state.

If in the Release Request state, a RELEASE COMPLETE message is not received before the first expiry of timer T308, the RELEASE message shall be retransmitted and timer T308 shall be restarted. If no RELEASE COMPLETE message is received before timer T308 expires a second time, the side that expected the message shall: place the information channel in a maintenance condition; release the call reference; and return to the Null state.

10.2.4 Clear collision

Clear Collision occurs when both the Incoming and Outgoing Sides simultaneously transfer DISCONNECT messages specifying the same call reference value. When either side receives a DISCONNECT message whilst in the Disconnect Request state, the side shall stop timer T305; disconnect the information channel (if not already disconnected); send a RELEASE message to the other side; start timer T308 and enter the Release Request state.

Clear collision can also occur when both sides simultaneously transfer RELEASE messages related to the same call reference value. The receiving side shall (on receiving such a RELEASE message in the Release request state) stop T308; release the call reference and information chan-

nel; and enter the null state (without sending a RELEASE COMPLETE message).

10.3 Call collisions

In symmetric arrangements, call collisions can occur when both sides simultaneously transfer a SETUP message indicating the same channel. One side shall be designated side "A" and the other side "B" at the time the network is provisioned. Each side shall have knowledge of whether it has been designated "A" or "B". In the three possible scenarios where the same channel has been indicated by both sides, the following procedure shall apply:

- "A" side preferred, "B" side preferred: The "A" side shall be awarded the channel, and an alternative channel (if a free channel exists) shall be indicated in the first response to the SETUP message sent from side "B".
- "A" side exclusive, "B" side exclusive: The "A" side shall be awarded the channel, and the call establishment attempt at side "B" shall be cleared with a RELEASE COMPLETE message. The Cause used shall be Cause number 44 "requested circuit/channel not available".
- "A" side exclusive, "B" side preferred; or "A" side preferred, "B" side exclusive: The side with an exclusive channel indicator in a SETUP message shall be awarded the channel and an alternative channel (assuming a free channel exists) shall be indicated in the first response to the side that used a preferred indicator in the SETUP message.

In order to minimise the chances of call collisions, it is recommended that side "A" assign the lowest available channel number and that side "B" assign the highest available channel number.

10.4 Transit PINX Call Control requirements

NOTE — The provision of transit PINX functionality is an option. When provided, the procedures contained herein are mandatory.

This clause specifies those aspects of call control at a Transit PINX that are necessary for coordinating the incoming side and outgoing side protocol entities.

These procedures refer to the Preceding PINX and the Subsequent PINX. These PINX's are either side of Transit PINX. This terminology is used in order to clarify the text. The adjectives (Preceding/Subsequent) only have meaning when used in the context of a particular call. The call attempt will have passed from the Preceding PINX, through the Transit PINX, to the Subsequent PINX.

Figure 3 shows the conceptual relationship between the Call Control and Incoming and Outgoing Protocol Control within a Transit PINX.

The Transit PINX's Call Control states used in this clause are a different set of states from the Protocol States described in earlier clauses. The Transit PINX's Call Control states are marked as such by "TCC_" in front of their names. These states are conceptual and used only as an

aid to description of the actions required at a Transit PINX. As such, they are not directly visible in the protocol and cannot be tested directly. A short description of each of the states is given in 7.1.

On receipt of a SETUP message (possibly followed by one or more INFORMATION messages containing additional Called party number information) if the Call Control of the PINX chooses to route the call onwards on a further inter-PINX link employing PSS1 signalling, it shall conform to the procedures for a Transit PINX contained in this clause. The procedures defined in this clause show how the message flows of the two interfaces either side of a Transit PINX are interrelated.

Detailed specification and description language (SDL) diagrams for the procedures specified in this clause are contained in annex F.

10.4.1 Receipt of address information

On receipt of a SETUP message from the Preceding PINX, the call request shall be processed.

If the call processing is successful, and the Transit PINX determines that all the address information has been received in the SETUP message, a CALL PROCEEDING message shall be sent to the Preceding PINX, a SETUP message shall be sent to the Subsequent PINX, and the Transit PINX shall enter the TCC_Incoming_Call_Proceeding State.

If the call processing is successful, and the Transit PINX determines that not all the address information has been received in the SETUP message or cannot determine that the address information is complete, a SETUP ACKNOWLEDGE message shall be sent to the Preceding PINX. If enough digits have been received to route the call a SETUP message shall be sent by the Transit PINX to the subsequent PINX and the Transit PINX shall enter the TCC_Await_Additional_Digits state; else the Transit PINX shall enter the TCC_Await_Digits state.

NOTE — The method by which the Transit PINX determines that the address information is adequate for the particular use is beyond the scope of this International Standard.

If the call processing is not successful, then a RELEASE COMPLETE message shall be sent to the Preceding PINX,

and the Transit PINX shall remain in the TCC_Idle state.

10.4.2 State TCC_Await_Digits

Additional address information is received in INFORMATION messages. Once enough address information has been received in order to route the call, a SETUP message shall be sent to the Subsequent PINX. If, on analysis of the digits, the Transit PINX identifies that there are no more digits expected, a CALL PROCEEDING message shall be sent to the preceding PINX and the Transit PINX shall enter the TCC_Incoming_Call_Proceeding state; otherwise the Transit PINX shall enter the TCC_Await_Additional_Digits state.

NOTE — The method by which the Transit PINX determines that the address information is adequate for the particular use is beyond the scope of this standard.

If a DISCONNECT message is received from the Preceding PINX, the call shall be cleared as described in 10.4.10. If a RELEASE or RELEASE COMPLETE message is received from the Preceding PINX, the call shall be cleared as described in 10.4.10.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call by sending a DISCONNECT message to the Preceding PINX and continuing normal clearing procedures as described in 10.4.10.

If the Protocol Control of the Incoming Side of the interface notifies the Transit Call Control that T302 has expired, then the PINX may either clear the call by sending DISCONNECT to the Preceding PINX, or attempt some other (unspecified) procedure.

10.4.3 State TCC_Await_Additional_Digits

Any additional address information which is received in INFORMATION messages shall be buffered in the Transit PINX whilst waiting for a response to the SETUP message that has been sent to the Subsequent PINX. If the Transit PINX determines that the address information it has received is complete, a CALL PROCEEDING message shall be sent to the preceding PINX and the Transit PINX shall enter the TCC_Incoming_Call_Proceeding state; otherwise it shall remain in the TCC_Await_Additional_Digits state.

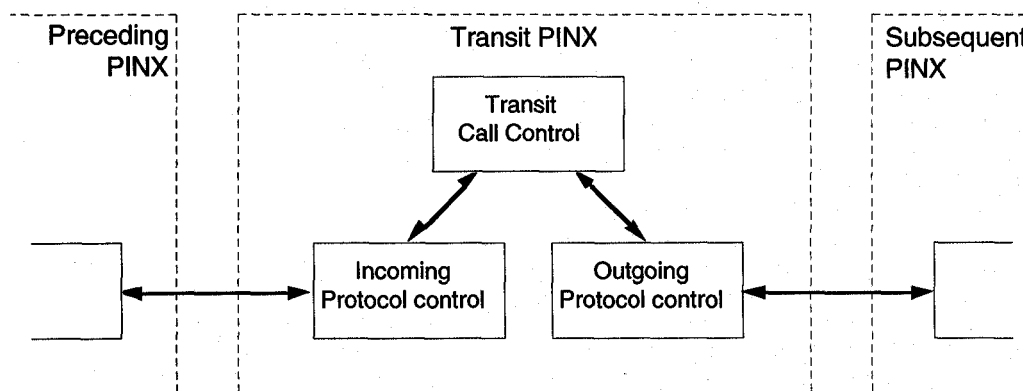


Figure 3 — Conceptual relationship of Call Control to Protocol Control.

If a SETUP ACKNOWLEDGE message is received from the Subsequent PINX, and the channel indicated is acceptable, then the Transit PINX shall enter the TCC_Overlap state and may through connect the information channel. Any buffered address information shall be forwarded to the subsequent PINX in an INFORMATION message. If the channel indicated is not acceptable the call shall be cleared towards the Subsequent PINX using a RELEASE message and the PINX shall either clear the call towards the Preceding PINX using a DISCONNECT message, or may attempt some other (unspecified) procedure.

If a RELEASE COMPLETE message is received from the Subsequent PINX the call may either be cleared as described in 10.4.10, or the PINX may attempt some other (unspecified) procedure.

If a CALL PROCEEDING message is received from the Subsequent PINX and the channel indicated is acceptable, no more address information shall be sent to the Subsequent PINX, and the Transit PINX shall enter the TCC_Transit_Call_Proceeding state and may through connect the information channel. Any buffered address information shall be discarded and any further INFORMATION messages received shall be ignored. If the channel indicated is not acceptable the call shall be cleared towards the Subsequent PINX using a RELEASE message and the PINX shall either clear the call towards the Preceding PINX using a DISCONNECT message, or may attempt some other (unspecified) procedure.

If a DISCONNECT message is received from the Preceding PINX, the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Preceding PINX, the call shall be cleared as described in 10.4.10.

If an ALERTING message is received from the Subsequent PINX and the channel indicated is acceptable, the transit node may through connect the information channel. An ALERTING message shall be sent to the Preceding PINX and the Transit PINX shall enter the TCC_Call_Alerting state. If the received ALERTING message contained CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available", the information channel shall be through connected in the backward direction, if this has not already occurred. If the channel indicated is not acceptable the call shall be cleared towards the Subsequent PINX using a RELEASE message and the PINX shall either clear the call towards the Preceding PINX as described in 10.4.10, or may attempt some other (unspecified) procedure.

If a CONNECT message is received from the Subsequent PINX and the channel indicated is acceptable, the transit node shall through connect the information channel (in both directions) - if not already connected - send an CONNECT message to the Preceding PINX and enter the TCC_Call_Active state. If the channel indicated is not acceptable the call shall be cleared towards the Subsequent PINX using a RELEASE message and the PINX shall either clear the call towards the Preceding PINX

as described in 10.4.10, or may attempt some other (unspecified) procedure.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call in both directions as described in 10.4.10.

If the Protocol Control of the Incoming Side of the interface notifies Transit Call Control that T302 has expired, then the PINX shall either send a CALL PROCEEDING message to the Preceding PINX and enter the TCC_Incoming_Call_Proceeding state, or may attempt some other (unspecified) procedure.

10.4.4 State TCC_Overlap

Any additional address information which is received in INFORMATION messages shall be sent on to the Subsequent PINX in INFORMATION messages. If it is known that the address information is complete, a Sending complete information element may optionally be sent in an INFORMATION message.

If a CALL PROCEEDING message is received from the Subsequent PINX, no more address information shall be sent to the Subsequent PINX, and the Transit PINX shall enter the TCC_Transit_Call_Proceeding state.

If the Transit PINX determines that it has received all the address information (e.g. on receipt of CALL PROCEEDING from the Subsequent PINX, on receipt of a Sending complete information element from the Preceding PINX, or by digit analysis) a CALL PROCEEDING message shall be sent to the Preceding PINX, and the Transit PINX shall enter the TCC_Transit_Call_Proceeding state; else it shall stay in the TCC_Overlap state.

If a PROGRESS message is received from the Subsequent PINX, a PROGRESS message shall be sent to the Preceding PINX. If this message contains CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available", the information channel shall be through connected in the backward direction, if this has not already occurred.

If an ALERTING message is received from the Subsequent PINX an ALERTING message shall be sent to the Preceding PINX, and the Transit PINX shall enter the TCC_Call_Alerting state. If this message contains CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available", the information channel shall be through connected in the backward direction, if this has not already occurred.

If a CONNECT message is received from the Subsequent PINX, a CONNECT message shall be sent to the Preceding PINX and the PINX shall through connect the information channel in both directions (unless it has already done so) and enter the TCC_Call_Active state.

If a DISCONNECT message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a DISCONNECT message is received from the Subsequent PINX the call may either be cleared as described in 10.4.10, or other procedures may be attempted by the Transit PINX; however, the clearing sequence with the subsequent PINX shall be completed as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Subsequent PINX's the call may either be cleared using procedures as described in 10.4.10, or other procedures may be attempted by the Transit PINX.

If the Protocol Control of the Incoming Side of the interface notifies the Transit Call Control that T302 has expired, then the PINX shall either send a CALL PROCEEDING message to the Preceding PINX and enter the TCC_Transit_Call_Proceeding state, or attempt some other (unspecified) procedure.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call in both directions as described in 10.4.10.

10.4.5 Channel through connection procedures

During call setup, the Transit PINX shall through connect the agreed information channel to the Subsequent PINX as outlined below.

The earliest point at which through connection may occur (in either forward, backward or both directions) is when the Transit PINX receives the first response to an outgoing SETUP message.

The latest point that through connection in the backward direction shall occur is on receipt of ALERTING or PROGRESS message (with CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available") or CONNECT from the Subsequent PINX. The latest point that through connection in the forward direction shall occur is on the receipt of a CONNECT message from the subsequent PINX.

NOTE — It is recommended that through connection in both directions is achieved as early as possible during call set up. This is particularly appropriate for services providing the conveyance of speech information. Delaying through connection, particularly in the backward direction, to a later stage during call setup may lead to "speech clipping".

10.4.6 State TCC_Incoming_Call_Proceeding

If a SETUP ACKNOWLEDGE message is received from the Subsequent PINX and the channel indicated is acceptable, the Transit PINX may through connect the information channel and shall enter the TCC_Transit_Call_Proceeding state. If the channel indicated is not acceptable, the call shall be cleared towards the Subsequent PINX using a RELEASE message and the PINX shall either clear the call towards the Preceding PINX using a DISCONNECT message, or may attempt some other (unspecified) procedure.

If a RELEASE COMPLETE message is received from the Subsequent PINX the call shall either be cleared using procedures as described in 10.4.10, or other procedures may be attempted by the Transit PINX.

If a CALL PROCEEDING message is received from the Subsequent PINX and the channel indicated is acceptable, the Transit PINX may through connect the information channel and shall enter the TCC_Transit_Call_Proceeding state. If any further INFORMATION messages are received they shall be ignored. If the channel indicated is not acceptable, the call shall be cleared towards the Subsequent PINX using a RELEASE message. The PINX shall either clear the call towards the Preceding PINX using a DISCONNECT message, or may attempt some other (unspecified) procedure.

If an ALERTING message is received from the subsequent PINX and, if a channel number is included in the ALERTING message, the indicated channel number is acceptable, an ALERTING message shall be sent to the Preceding PINX. The Transit PINX shall enter the TCC_Call_Alerting state. If the received ALERTING message contains CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available", the information channel should be through connected in the backward direction if this has not already occurred. If a channel number is indicated and it is not acceptable, the call shall be cleared towards the Subsequent PINX using a RELEASE message. The PINX shall either clear the call towards the Preceding PINX as described in 10.4.10, or may attempt some other (unspecified) procedure.

If a CONNECT message is received from the subsequent PINX and, if a channel number is included in the CONNECT message, the indicated channel number is acceptable, a CONNECT message shall be sent to the Preceding PINX. The Transit PINX shall through connect the information channel in both directions (unless it has already done so) and enter the TCC_Call_Active state. If a channel number is indicated and it is not acceptable, the call shall be cleared towards the Subsequent PINX using a RELEASE message. The PINX shall either clear the call towards the Preceding PINX as described in 10.4.10, or may attempt some other (unspecified) procedure.

If a DISCONNECT message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call in both directions as described in 10.4.10.

10.4.7 State TCC_Transit_Call_Proceeding

If a PROGRESS message is received from the Subsequent PINX a PROGRESS message shall be sent to the Preceding PINX. If this message contains CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band

information or appropriate pattern now available", the information channel shall be through connected in the backward direction if this has not already occurred.

If a CALL PROCEEDING message is received from the Subsequent PINX, the Transit PINX shall remain in the TCC_Transit_Call_Proceeding state. If any further INFORMATION messages are received they shall be ignored.

If an ALERTING message is received from the Subsequent PINX an ALERTING message shall be sent to the Preceding PINX, and the Transit PINX shall enter the TCC_Call_Alerting state. If this message contains CCITT progress description number 1 "call is not end to end ISDN, further information may be available in band" or number 8 "in band information or appropriate pattern now available", the information channel shall be through connected in the backward direction, if this has not already occurred.

If a CONNECT message is received from the Subsequent PINX, a CONNECT message shall be sent to the Preceding PINX and the Transit PINX shall through connect the information channel in both directions (unless it has already done so) and enter the TCC_Call_Active state.

If a DISCONNECT message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a DISCONNECT message is received from the Subsequent PINX, the call shall either be cleared using procedures as described in 10.4.10, or other procedures may be attempted by the Transit PINX.

If a RELEASE or RELEASE COMPLETE message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Subsequent PINX the call shall either be cleared using procedures as described in 10.4.10, or other procedures may be attempted by the Transit PINX.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call in both directions as described in 10.4.10.

10.4.8 State TCC_Call_Alerting

If a PROGRESS message is received from the Subsequent PINX a PROGRESS message shall be sent to the Preceding PINX. If this message contains CCITT progress description number 1 or number 8, the information channel shall be through connected in the backward direction if this has not already occurred.

If a CONNECT message is received from the Subsequent PINX a CONNECT message shall be sent to the Preceding PINX and the Transit PINX shall through connect the information channel in both directions (unless it has already done so) and enter the TCC_Call_Active state.

If a DISCONNECT message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a DISCONNECT message is received from the Subse-

quent PINX the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Preceding PINX the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from the Subsequent PINX the call shall be cleared as described in 10.4.10.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call in both directions as described in 10.4.10.

10.4.9 State TCC_Call_Active

If a DISCONNECT message is received from either the Preceding or Subsequent PINX's, the call shall be cleared as described in 10.4.10.

If a RELEASE or RELEASE COMPLETE message is received from either the Preceding or Subsequent PINX's, the call shall be cleared as described in 10.4.10.

If a PROGRESS message is received from the Subsequent PINX a PROGRESS message shall be sent to the Preceding PINX.

NOTE 1 — As an alternative procedure, the Transit PINX may discard a PROGRESS message received from the Subsequent PINX without sending a PROGRESS message to the Preceding PINX. However, this procedure is not recommended.

If a PROGRESS message is received from the Preceding PINX a PROGRESS message shall be sent to the Subsequent PINX.

NOTE 2 — As an alternative procedure, the Transit PINX may discard a PROGRESS message received from the Preceding PINX without sending a PROGRESS message to the Subsequent PINX. However, this procedure is not recommended.

If, for any reason, the Transit PINX decides to abort the call, it shall clear the call in both directions as described in 10.4.10.

10.4.10 Call clearing at a Transit PINX

10.4.10.1 Call clearing not initiated by the Transit PINX

On receipt of a DISCONNECT, RELEASE or RELEASE COMPLETE message from the Preceding PINX, the Transit PINX shall:

- if the information channel to be used has been agreed between the Outgoing Side of the Transit PINX and the Incoming Side of the Subsequent PINX, disconnect the appropriate information channel, and send a DISCONNECT message to the Subsequent PINX. If a DISCONNECT message was received from the Preceding PINX, a RELEASE message shall be sent to the Preceding PINX.

The Transit PINX shall enter the TCC_Await_Outgoing_Release state. When a RELEASE message is

received from the Subsequent PINX the Transit PINX shall release any assigned resources and revert to the TCC_Idle state.

- if the information channel to be used has not been agreed between the Outgoing Side of the Transit PINX and the Incoming Side of the Subsequent PINX (i.e. the first response to an outgoing SETUP message has not been received), proceed according to the current Call Control state:
 - i) If Call Control is in either of the TCC_Await_Additional_Digits or TCC_Incoming_Call_Proceeding states, the Transit PINX shall either send:
 - a RELEASE message to the Subsequent PINX. If DISCONNECT was received from the Preceding PINX, a RELEASE message shall be sent to the Preceding PINX. The Transit PINX shall enter the TCC_Idle state; or,
 - a DISCONNECT message to the Subsequent PINX. If DISCONNECT was received from the Preceding PINX, a RELEASE message shall be sent to the Preceding PINX. The Transit PINX shall enter the TCC_Await_Outgoing_Release state.
 - ii) if Call Control is in the TCC_Await_Digits state, the Transit PINX shall send a RELEASE message to the Preceding PINX (if DISCONNECT was received from the Preceding PINX) and enter the TCC_Idle state.

On receipt of a DISCONNECT, RELEASE or RELEASE COMPLETE message from the Subsequent PINX, the Transit PINX shall disconnect the appropriate information channel and send a DISCONNECT message to the Preceding PINX. Alternatively, during call establishment, if the call has not yet reached the TCC_Call_Alerting state, the Transit PINX may attempt some other (unspecified) procedure instead of sending DISCONNECT to the Preceding PINX. If a DISCONNECT message was received from the Subsequent PINX, the Transit PINX shall send a RELEASE message to the Subsequent PINX.

If a DISCONNECT message was sent to the Preceding PINX, the Transit PINX shall enter the TCC_Await_Incoming_Release state. When a RELEASE message is received from the Preceding PINX, the Transit PINX shall release any assigned resources and revert to the TCC_Idle state.

10.4.10.2 Call clearing initiated by the Transit PINX

If a Transit PINX decides to abort a call it may send, in both directions, a clearing message appropriate to the current Protocol Control state. Each side of the PINX shall then continue normal clearing procedures independently of the other.

Alternatively, where an in-band tone or announcement is appropriate (i.e. if it conveys information which is not conveyable by PSS1), the Transit PINX, instead of sending a clearing message, may connect an in-band tone or announcement to either (or both) sides of the PINX and transmit a PROGRESS message, containing CCITT

progress description number 8 "in band information or appropriate pattern now available" and an appropriate Cause. If Call Control is in the TCC_Call_Active state, the announcement may optionally be applied without sending a PROGRESS message, as the information channel will be through connected in both directions at this stage.

Call Control of the Transit PINX shall ensure that, for each side, if an indication of clearing has not been received by the time the tone or announcement is complete (or has been applied for sufficient time), normal clearing procedures (described in 10.4.10) shall be invoked.

10.4.11 Handling of Basic Call information elements at a Transit PINX

This clause applies only to information elements which are contained within messages and which may (but need not) be passed on by a Transit PINX. (Examples of these messages are SETUP, INFORMATION, ALERTING, CONNECT, PROGRESS and DISCONNECT).

10.4.11.1 Mandatory information elements

All mandatory information elements will (by definition) appear in messages on both sides of the Transit PINX. Where necessary they will be processed within Transit PINX and may be different either side of the PINX.

10.4.11.2 Non-mandatory information elements

Non-mandatory information elements fall into three categories:

- Category 1: If they are present, they shall be processed in the Transit PINX and shall be passed on to the next PINX if the message is passed on. They may be locally generated.
- Category 2: If they are present, they shall not be processed at a Transit PINX and shall be passed transparently onto the next PINX.
- Category 3: If they are present, they shall be processed at the Transit PINX and may be passed on to the next PINX. They may be locally generated.

The three categories are identified using their information element identifiers. Refer to table 3 for listing which of the three categories each of the non-mandatory information

Table 3 — Non-mandatory information element categories

Information Element	Category 1	Category 2	Category 3	Notes
Called party number	•			May be modified
Called party subaddress		•		
Calling party number	•			May be modified
Calling party subaddress		•		
Cause (in PROGRESS)	•			
Connected number	•			May be modified
Connected subaddress		•		
High layer compatibility		•		
Low layer compatibility		•		note 1
Progress indicator	•			
Sending complete			•	

NOTES

- 1: When received in a CONNECT message, this information element may be discarded by a Transit PINX that does not support LLC negotiation capabilities.

elements are in.

10.5 Originating PINX Call Control requirements

This clause specifies requirements for Call Control at an Originating PINX on the Outgoing Side of an Inter PINX link employing PSS1. These requirements are additional to the Protocol Control procedures specified in clauses 9, 10.1 to 10.3 and 12.

The following requirements apply when an Originating PINX chooses to route a call over an Inter PINX link employing PSS1 signalling and has selected a information channel to be used.

Any reference to messages received shall be interpreted as meaning a message which has passed the validation checks of Protocol Control and which has therefore resulted in a notification being given to Call Control.

10.5.1 Transmission of the SETUP message

The Originating PINX shall transmit a SETUP message. The SETUP message shall include optional information elements according to the following rules.

- Sending complete. The Originating PINX may optionally send this information element if it can determine that the number in the Called party number information element is complete or if this has been indicated by the calling terminal.
- Progress indicator. The Originating PINX shall pass on, by means of the Progress indicator information element, progress information received from the calling user.

The Originating PINX may insert a Progress indicator information element containing CCITT progress description 3 "Origination address is non-ISDN" if neither the calling terminal nor the combination of the PINX and the calling terminal has the functionality of an ISDN terminal.

- Calling party number. The Originating PINX shall include the calling party number information element

identifying the calling user. The presentation indicator shall have the value "presentation restricted" if supplementary service Calling/Connected Line Identification Restriction has been invoked at the calling user. Otherwise the presentation indicator, if present, shall have the value "presentation allowed".

- Calling party subaddress. The Originating PINX shall include the calling party subaddress information element if a calling party subaddress is available.
- Called party subaddress. The Originating PINX shall include the called party subaddress information element if a called party subaddress is available.
- Low layer compatibility. The Originating PINX shall include the low layer compatibility information element if low layer compatibility information is available.
- High layer compatibility. The Originating PINX shall include the high layer compatibility information element if high layer compatibility information is available.

10.5.2 Agreement of the information channel

On receipt of a SETUP ACKNOWLEDGE, CALL PROCEEDING, ALERTING or CONNECT message agreeing the channel proposed in the SETUP message or suggesting an alternative channel which the Originating PINX finds acceptable, the Originating PINX may optionally connect the information channel in the forward direction, in the backward direction or in both directions.

NOTE 1 — It is recommended that the information channel is connected in both directions at this stage, particularly for services involving the conveyance of speech information. Leaving the information channel unconnected until a later stage, particularly in the backward direction, may lead to the "clipping" of speech. However, there may be reasons for delaying connection, particularly in the forward direction, e.g., to avoid the onward transmission of in-band signalling information from the user's access.

NOTE 2 — If the received message is an ALERTING or CONNECT message, 10.5.4 or 10.5.5 shall apply, respectively.

10.5.3 Receipt of Progress Indicators

Information received in a Progress indicator information element in a PROGRESS message, an ALERTING message or a CONNECT message, shall be conveyed to the calling user - dependent on the ability of the calling user's equipment to receive such information.

On receipt of a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" or CCITT progress description number 1 "call is not end-to-end ISDN, further call progress information may be available in-band" the Originating PINX shall connect the information channel in the backward direction if it has not already done so.

10.5.4 Receipt of ALERTING message

On receipt of an ALERTING message, an indication of alerting may be given to the calling user.

Through connection may occur at this point. If the received message contains a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" or CCITT progress description number 1 "call is not end-to-end ISDN, further call progress information may be available in-band" the Originating PINX shall connect the information channel in the backward direction if it has not already done so.

10.5.5 Receipt of CONNECT message

On receipt of a CONNECT message, the Originating PINX shall connect the information channel in both directions, if it has not already done so, and shall indicate connection to the calling user.

If the CONNECT message contains a Connected number information element and/or a Connected subaddress information element, this information may be used for purposes such as the provision of the Connected Line Identification Presentation supplementary service to the calling user.

If the CONNECT message contains a Low Layer Compatibility information element, the information may be passed on to the calling user.

10.5.6 Call clearing initiated by the Originating PINX

The Originating PINX may initiate clearing on the inter-PINX link employing PSS1 signalling if a clear request is received from the calling user or if a failure condition occurs. Clearing is initiated by informing Protocol Control and supplying a Cause.

Alternatively, for services for which an in-band tone or announcement is appropriate, the Originating PINX may connect an in-band tone or announcement to the outgoing information channel and may optionally transmit a PROGRESS message containing a Progress indicator information element with CCITT progress description 8 "in-

band information or appropriate pattern now available" and an appropriate Cause. If an indication of clearing has not been received from Protocol Control by the time the tone or announcement is complete or has been applied for sufficient time, the Originating PINX shall instruct Protocol Control to initiate clearing.

NOTE — It is recommended that an in-band tone or announcement be provided by the Originating PINX only if it conveys call failure information which is not conveyable by PSS1.

10.5.7 Receipt of an indication of call clearing

On receipt of an indication of call clearing from Protocol Control, the Originating PINX shall either indicate to the calling user that the call has cleared or take some other implementation dependent action.

10.6 Terminating PINX Call Control requirements

This clause specifies requirements for Call Control at a Terminating PINX on the Incoming Side of an inter-PINX link employing PSS1. These requirements are additional to the Protocol Control procedures specified in clauses 9, 10.1 to 10.3 and 12.

If enbloc signalling only is used between two adjacent PINXs, overlap receiving procedures need not be tested.

The following requirements apply when a PINX receives a SETUP message, possibly followed by one or more INFORMATION messages conveying additional Called party number information, and determines that the destination is a user on that PINX. The PINX therefore becomes a Terminating PINX.

Any reference to messages received shall be interpreted as meaning a message which has passed the validation checks of Protocol Control and which has therefore resulted in a notification being given to Call Control.

10.6.1 Receipt of the SETUP message

Optional information elements in the received SETUP message shall be used as follows.

- a) Progress indicator. If the SETUP message contains a Progress indicator information element, the information therein may optionally be passed on to the called user.
- b) Low layer compatibility, high layer compatibility and called party subaddress. If the SETUP message contains one or more of these information elements, and if the user is connected by means of an ISDN interface at the S reference point, the information element(s) shall be conveyed to the called user and the user may act upon the information therein. If the user is connected by means of a non-ISDN interface, conveyance of the information to the user depends on the user's ability to receive it.
- c) Calling party number and calling party subaddress. Information in the calling party number information element, and also in the optional calling party sub-

address information element, may be used for purposes such as the provision of the Calling Line Identification Presentation supplementary service to the called user.

10.6.2 Transmission of ALERTING message

The Terminating PINX shall transmit an ALERTING message when it is aware that the called user is being alerted.

For services which require an in-band tone or announcement to be supplied to the calling user during the period of alerting, the Terminating PINX is responsible for connecting the appropriate tone or announcement to the information channel in the backwards direction. If a tone or announcement is connected, the Terminating PINX shall include a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" in the ALERTING message.

10.6.3 Transmission of Progress indicators

The Terminating PINX shall pass on, by means of the Progress indicator information element, progress information received from the called user, either before or after the transmission of an ALERTING message.

The Terminating PINX may send a Progress indicator information element containing CCITT progress description number 2 "Destination address is non-ISDN" if neither the called terminal nor the combination of the PINX and the called terminal has the functionality of an ISDN terminal.

A Progress indicator information element shall be transmitted in an ALERTING message or a CONNECT message if an ALERTING message or a CONNECT message is being sent at the time. Otherwise it shall be transmitted in a PROGRESS message.

10.6.4 Transmission of CONNECT message

When the Terminating PINX is aware that the called user has accepted the call, it shall connect the information channel in both directions and send a CONNECT message. Any in-band tone or announcement shall be disconnected.

The Terminating PINX shall include in the CONNECT message the Connected number information element. The presentation indicator shall have the value "presentation restricted" if supplementary service Calling/Connected Line Identification Restriction has been invoked at the called user. Otherwise the presentation indicator, if present, shall have the value "presentation allowed".

The Terminating PINX shall include in the CONNECT message the Connected subaddress information element if a Connected subaddress is available.

The Terminating PINX may include in the CONNECT message the low layer compatibility information element if low layer compatibility information has been supplied by the called terminal.

10.6.5 Call clearing initiated by the Terminating PINX

The Terminating PINX may initiate clearing on the inter-PINX link employing PSS1 signalling if it is not able to proceed with call establishment, if a failure condition occurs after the call has been established, or if a clear request is received from the called user. Clearing is initiated by informing Protocol Control and supplying a Cause.

Alternatively, for services for which an in-band tone or announcement is appropriate, the Terminating PINX may connect an in-band tone or announcement to the incoming information channel and transmit a PROGRESS message containing a Progress indicator information element with CCITT progress description 8 "in-band information or appropriate pattern now available" and an appropriate Cause. If an indication of clearing has not been received from Protocol Control by the time the tone or announcement is complete or has been applied for sufficient time, the Terminating PINX shall instruct Protocol Control to initiate clearing. The sending of the PROGRESS message is optional in the Active state but mandatory in other states.

NOTE — It is recommended that an in-band tone or announcement be provided by the Terminating PINX only if it conveys call rejection or failure information which is not conveyable by PSS1.

10.6.6 Receipt of an indication of call clearing

On receipt of an indication of call clearing from Protocol Control, the Terminating PINX shall either indicate to the called user that the call has cleared or take some other implementation dependent action.

10.7 Incoming Gateway PINX Call Control requirements

This clause specifies requirements for Call Control at an Incoming Gateway PINX on the Outgoing Side of an inter-PINX link employing PSS1. These requirements are additional to the Protocol Control procedures specified in clauses 9, 10.1 to 10.3 and 12.

The following requirements apply when a call entering the PISN is routed, by the Incoming Gateway PINX, over an inter-PINX link employing PSS1 signalling, an information channel on that link having been selected.

Any reference to messages received shall be interpreted as meaning a message which has passed the validation checks of Protocol Control and which has therefore resulted in a notification being given to Call Control.

10.7.1 Transmission of the SETUP message

The Incoming Gateway PINX shall transmit a SETUP message. The SETUP message shall include optional information elements according to the following rules.

- Sending complete. The Incoming Gateway PINX may optionally send this information element if it can determine that the number in the Called party number information element is complete or if this has been indicated by the other network.
- Progress indicator. The inclusion of a Progress indi-

cator information element by the Incoming Gateway PINX shall be in accordance with clause 10.7.2.

- c) Calling party number. If the other network has supplied a calling party number with or without an indication that presentation is restricted or a restriction indication only, the Incoming Gateway PINX shall include this information in the SETUP message within the calling party number information element. Otherwise the calling party number information element shall either contain the presentation indicator value "number not available due to interworking" or be omitted.
- d) Calling party subaddress. If the other network is a public ISDN and supplies a calling party subaddress information element, the Incoming Gateway PINX shall pass on the information element unchanged in the SETUP message. The Incoming Gateway PINX may also include a calling party subaddress information element in the SETUP message if calling party subaddress information has been supplied by a non-ISDN.
- e) Called party subaddress. If the other network is a public ISDN and supplies a called party subaddress information element, the Incoming Gateway PINX shall pass on the information element unchanged in the SETUP message. The Incoming Gateway PINX may also include a called party subaddress information element in the SETUP message if called party subaddress information has been supplied by a non-ISDN.
- f) Low layer compatibility. If the other network is a public ISDN and supplies a low layer compatibility information element, the Incoming Gateway PINX shall pass on the information element unchanged in the SETUP message. The Incoming Gateway PINX may also include a low layer compatibility information element in the SETUP message if low layer compatibility information has been supplied by a non-ISDN.
- g) High layer compatibility. If the other network is a public ISDN and supplies a high layer compatibility information element, the Incoming Gateway PINX shall pass on the information element unchanged in the SETUP message. The Incoming Gateway PINX may also include a high layer compatibility information element in the SETUP message if high layer compatibility information has been supplied by a non-ISDN.

10.7.2 Interworking indications in the SETUP Message

The inclusion of the Progress indicator information element in the SETUP message shall be as specified below. If none of the specified conditions apply, no Progress indicator information element shall be included.

10.7.2.1 Interworking indications received from a public ISDN

If the call has arrived from a public ISDN and a Progress indicator information element containing one of the follow-

ing CCITT progress descriptions has been received from the public ISDN, that information element shall be passed on:

- 1 "call is not end-to-end ISDN, further call progress information may be available in-band"
- 3 "origination address is non-ISDN"

10.7.2.2 Interworking with a non-ISDN

If the call has entered the PISN from a network (public or private) which is not ISDN, a Progress indicator information element may be sent containing CCITT progress description number 1 "call is not end-to-end ISDN, further call progress information may be available in-band".

NOTE — Terminals in the PISN that support only the "Speech" bearer capability can only accept calls indicating either "Speech" bearer capability or "3.1kHz audio" bearer capability together with progress indicator containing CCITT progress description number 1 "call is not end to end ISDN, further call progress information may be available in-band". It is recommended that this is taken into account when providing an incoming gateway function to a non-ISDN network supporting speech based telephony.

10.7.3 Agreement of the information channel

On receipt of a SETUP ACKNOWLEDGE, CALL PROCEEDING, ALERTING or CONNECT message agreeing the channel proposed in the SETUP message or suggesting an alternative channel which the Incoming Gateway PINX finds acceptable, the Incoming Gateway PINX may optionally connect the information channel in the forward direction, in the backward direction or in both directions.

NOTE — It is recommended that the information channel is connected in both directions at this stage, particularly for services involving the conveyance of speech information. Leaving the information channel unconnected until a later stage, particularly in the backward direction, may lead to the "clipping" of speech. However, there may be reasons for delaying connection, particularly in the forward direction, e.g., to avoid the onward transmission of in-band signalling information from the other network.

10.7.4 Receipt of Progress indicators

Information received in a Progress indicator information element in a PROGRESS message, an ALERTING message, or a CONNECT message shall be passed on to the other network if the signalling system permits and if relevant.

On receipt of a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" or CCITT progress description number 1 "call is not end-to-end ISDN, further call progress information may be available in-band" the Incoming Gateway PINX shall connect the information channel in the backward direction if it has not already done so.

10.7.5 Receipt of ALERTING message

On receipt of an ALERTING message, an indication of alerting may be given to the other network if the signalling

system permits.

If the ALERTING message contains a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" or CCITT progress description number 1 "call is not end-to-end ISDN, further call progress information may be available in-band" the Incoming Gateway PINX shall connect the information channel in the backward direction if it has not already done so.

10.7.6 Receipt of CONNECT message

On receipt of a CONNECT message, the Incoming Gateway PINX shall connect the information channel in both directions, if it has not already done so, and shall indicate connection to the other network if the signalling system permits.

If the CONNECT message contains a low layer compatibility information element, the information element shall be conveyed unchanged to the other network if that network is a public ISDN. Where the other network is non-ISDN, low layer compatibility information may be conveyed to the other network if the signalling system permits.

If the CONNECT message contains a Connected number information element, conveyance of the information therein to the other network depends on the capability of the signalling system and whether the Connected number has significance in the other network. Translation of a number into the numbering plan of the other network may be performed in order to yield a number which has significance in the other network.

If the CONNECT message contains a Connected subaddress information element, the information element shall be conveyed unchanged to the other network if that network is a public ISDN. Where the other network is non-ISDN, Connected subaddress information may be conveyed to the other network if the signalling system permits.

If the received Connected number information element has the presentation indicator value "presentation restricted", no Connected number or subaddress information other than the presentation indicator shall be presented to the other network.

10.7.7 Call clearing initiated by the Incoming Gateway PINX

The Incoming Gateway PINX may initiate clearing on the inter-PINX link employing PSS1 signalling if a clear request is received from other network or if a failure condition occurs. Clearing is initiated by informing Protocol Control and supplying a Cause.

Alternatively, for services for which an in-band tone or announcement is appropriate, the Incoming Gateway PINX may connect an in-band tone or announcement to the outgoing information channel and may optionally transmit a PROGRESS message containing a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" and an appropriate Cause. In cases where the other

network indicates that it is providing an in-band tone or announcement in preparation for clearing, the Incoming Gateway PINX may transmit a PROGRESS message containing a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available".

In all the above cases:

- if an indication of clearing has not been received from Protocol Control by the time the tone or announcement is complete or has been applied for sufficient time, the Incoming Gateway PINX shall instruct Protocol Control to initiate clearing.
- the sending of the PROGRESS message is optional in the Active state, but mandatory in other call states.

NOTE — It is recommended that an in-band tone or announcement be provided by the Incoming Gateway PINX only if it conveys call failure information which is not conveyable by PSS1.

10.7.8 Receipt of an indication of call clearing

On receipt of an indication of call clearing from Protocol Control, the Incoming Gateway PINX shall either indicate to the other network that the call has cleared or take some other implementation dependent action.

10.8 Outgoing Gateway PINX Call Control requirements

This clause specifies requirements for Call Control at an Outgoing Gateway PINX on the Incoming Side of an inter-PINX link employing PSS1. These requirements are additional to the Protocol Control procedures specified in clauses 9, 10.1 to 10.3 and 12.

The following requirements apply when a PINX receives a SETUP message, possibly followed by one or more INFORMATION messages conveying additional Called party number information, and determines that the call is to be routed directly (not via any further PINX) to another network. The PINX therefore becomes an Outgoing Gateway PINX.

Any reference to messages received shall be interpreted as meaning a message which has passed the validation checks of Protocol Control and which has therefore resulted in a notification being given to Call Control.

10.8.1 Receipt of the SETUP message

Information elements in the received SETUP message shall be used as follows.

- a) Progress indicator. If the SETUP message contains a Progress indicator information element, the information therein shall be passed on to the other network if the signalling system permits and if relevant.
- b) Low layer compatibility, high layer compatibility, called party subaddress and calling party subaddress. If the SETUP message contains one or more of these information elements, the information element(s) shall be conveyed unchanged to the other

network if that network is a public ISDN. Where the other network is non-ISDN, information from these elements may be conveyed to the other network if the signalling system permits. However, the calling party subaddress information element shall not be sent to the network if the presentation indicator in the received calling party number information element has the value "presentation restricted".

- c) **Calling party number.** If the SETUP message contains a calling party number information element, conveyance of the information therein to the other network depends on the capability of the signalling system and whether the calling party number has significance in the other network. Translation of a number into the numbering plan of the other network may be performed in order to yield a number which has significance in the other network. If the received calling party number information element has the presentation indicator value "presentation restricted", presentation of the number to the other network is outside the scope of this International Standard, but will depend on such factors as the other network's commitment to honour the restriction.

10.8.2 Connection of the information channel

The Outgoing Gateway PINX may optionally connect the information channel in the forward direction, in the backward direction or in both directions as soon as the channel to the other network has been agreed.

NOTE — It is recommended that the information channel is connected in both directions at this stage, particularly for services involving the conveyance of speech information. Leaving the information channel unconnected until a later stage, particularly in the backward direction, may lead to the "clipping" of speech or the loss of in-band tones or announcements. However, there may be reasons for delaying connection, particularly in the forward direction, e.g., while transmitting in-band signalling information.

10.8.3 Transmission of interworking indications

The Outgoing Gateway PINX shall transmit Progress indicator information elements as specified below. A Progress indicator information element shall be transmitted in a PROGRESS message, an ALERTING message or a CONNECT message as soon as the information becomes available, subject to a SETUP ACKNOWLEDGE or CALL PROCEEDING message having already been sent. A PROGRESS message shall be used unless an ALERTING or CONNECT message is to be sent at the time. All appropriate interworking indications shall be transmitted by the Outgoing Gateway PINX.

10.8.3.1 Interworking indications received from a public ISDN

If the call has entered a public ISDN and a Progress indicator information element containing one of the following CCITT progress descriptions has been received from the public ISDN, that information element shall be passed on:

- 2 "destination address is non-ISDN"
- 4 "call has returned to the ISDN"
- 8 "in-band information or appropriate pattern now available"

In the case of progress description number 1 "call is not end to end ISDN, further information may be available in band" and number 8 "in band information or appropriate pattern now available", the Outgoing Gateway PINX shall connect the information channel in the backward direction if it has not already done so.

10.8.3.2 Interworking with a non-ISDN

If the call is to enter a network (public or private) which is not ISDN, a progress indicator information element may be sent containing CCITT progress description number 1 "call is not end-to-end ISDN, further call progress information may be available in-band". If this Progress indicator information element is sent, the Outgoing Gateway PINX shall connect the information channel in the backward direction if it has not already done so.

10.8.4 Transmission of ALERTING message

The Outgoing Gateway PINX shall transmit an ALERTING message when it receives an indication from the other network that the called user is being alerted. Some other networks may be unable to indicate alerting.

For services which require an in-band tone or announcement to be supplied to the calling user during the period of alerting, the Outgoing Gateway PINX is responsible for connecting the appropriate tone or announcement to the information channel in the backwards direction, unless an appropriate tone or announcement is being provided by the other network. If a tone or announcement is being provided either by the Outgoing Gateway PINX or by the other network, the Outgoing Gateway PINX shall include a Progress indicator information element with CCITT progress description 8 "in-band information or appropriate pattern now available" in the ALERTING message.

10.8.5 Transmission of CONNECT message

When the Outgoing Gateway PINX receives an answer signal from the other network, it shall connect the information channel in both directions, if it has not already done so, and send a CONNECT message.

If the other network is not always able to supply an indication of call acceptance, the Outgoing Gateway PINX shall connect the information channel in both directions and send a CONNECT message when a suitable time interval has elapsed following the sending of call information to the other network. The time interval chosen should take account of the shortest likely time to indicate the call acceptance. If, subsequent to sending a CONNECT message, an indication of call acceptance is received from the other network, the Outgoing Gateway PINX shall not send a second CONNECT message.

If the other network has supplied a Connected number with or without an indication that presentation is restricted or a

restriction indication only, the Outgoing Gateway PINX shall include this information in the CONNECT message within the Connected number information element. Otherwise the Connected number information element shall either contain the presentation indicator value "number not available due to interworking" or be omitted.

If the other network is a public ISDN and supplies a Connected subaddress information element, the Outgoing Gateway PINX shall pass the information element on unchanged in the CONNECT message. The Outgoing Gateway PINX may also include a Connected subaddress information element in the CONNECT message if Connected subaddress information has been supplied by a non-ISDN.

If the other network is a public ISDN and supplies a low layer compatibility information element, the Outgoing Gateway PINX may pass the information element on unchanged in the CONNECT message. The Outgoing Gateway PINX may also include a low layer compatibility information element in the CONNECT message if low layer compatibility information has been supplied by a non-ISDN.

10.8.6 Call clearing initiated by the Outgoing Gateway PINX

The Outgoing Gateway PINX may initiate clearing on the inter-PINX link employing PSS1 signalling if it is not able to proceed with call establishment, if a failure condition occurs after the call has been established, or if a clear request is received from the other network. Clearing is initiated by informing Protocol Control and supplying a Cause.

Alternatively, for services for which an in-band tone or announcement is appropriate, the Outgoing Gateway PINX may connect an in-band tone or announcement to the incoming information channel and transmit a PROGRESS message containing a Progress indicator information element with CCITT progress description 8 "in-band information or appropriate pattern now available" and an appropriate Cause. A PROGRESS message containing a Progress indicator information element with CCITT progress description number 8 "in-band information or appropriate pattern now available" may also be sent in cases where the other network indicates that it is providing an in-band tone or announcement in preparation for clearing.

In all of the above cases:

- If an indication of clearing has not been received from Protocol Control by the time the tone or announcement is complete or has been applied for sufficient time, the Outgoing Gateway PINX shall instruct Protocol Control to initiate clearing.
- The sending of the PROGRESS message is optional in the Active state but mandatory in other states.

NOTE — It is recommended that an in-band tone or announcement be provided by the Outgoing Gateway PINX only if it conveys call rejection or failure information which is not conveyable by PSS1.

10.8.7 Receipt of an indication of call clearing

On receipt of an indication of call clearing from Protocol Control, the Outgoing Gateway PINX shall either indicate to the other network that the call has cleared or take some other implementation dependent action.

11 Procedures for layer management

11.1 Restart procedures

The restart procedure may be used to return a single channel, or all channels associated with the signalling channel, to the idle condition and calls associated with these channels to the Null state. The procedure may be invoked when the adjacent PINX does not respond to Call control messages, a failure has occurred or a maintenance action has taken place or for some other (unspecified) reason (e.g. following a SCM failure; or following the second expiry of timer T308 due to the absence of response to a clearing message).

11.1.1 Sending RESTART

A RESTART message may be sent by either side in order to return a channel or all channels associated with the signalling channel to the idle state. The Restart indicator information element shall be present in the RESTART message to indicate whether an indicated channel or all channels are to be restarted. If the Restart indicator is coded as "indicated channel", then the Channel identification information element shall be present to indicate which channel is to be returned to the idle condition. If the Restart indicator information element is coded "all channels", then the Channel identification information element shall not be included.

Upon transmitting the RESTART message the sending entity shall enter the Restart Request state, start timer T316, and wait for a RESTART ACKNOWLEDGE message. No further RESTART messages shall be sent until a RESTART ACKNOWLEDGE message is received or timer T316 expires.

Receipt of a RESTART ACKNOWLEDGE message shall stop timer T316, free the channels and Call reference values (associated with the channels identified by the RESTART message) for reuse, and cause the receiving entity to enter the Null state.

If a RESTART ACKNOWLEDGE message is not received prior to expiry of timer T316 one or more subsequent RESTART messages may be sent until a RESTART ACKNOWLEDGE message is returned - the limit of the number of times RESTART may be sent is implementation dependent.

Meanwhile, no calls shall be placed or accepted on the channels identified in the RESTART message by the originator of the message. When the limit for the number of restarts is reached, the originator shall make no further restart attempts. An indication shall be provided to the appropriate maintenance entity. The channels identified shall be considered to be in an out-of-service condition until maintenance action has been taken.

The RESTART and RESTART ACKNOWLEDGE messages shall contain the Global call reference value with which the Restart Request state is associated.

11.1.2 Receipt of RESTART

Upon receiving a RESTART message the recipient shall enter the Restart state associated with the Global call reference. It shall then initiate the appropriate internal actions to return the specified channels to the idle condition and call reference(s) to the Null state. Upon completion of internal clearing a RESTART ACKNOWLEDGE message shall be transmitted to the originator, and the transmitting entity shall enter the Null state.

Even if all Call references are in the Null state and all channels are in the idle condition, the receiving entity shall transmit a RESTART ACKNOWLEDGE message to the originator on receiving a RESTART message.

If the Restart indicator information element is coded as "indicated channel" and the Channel identification information element is not included, the procedures of 9.2.6.1 shall apply.

11.1.3 Restart collision

Restart collision occurs at Inter-PINX link when both sides of the inter-PINX link simultaneously transmit a RESTART message. The Call reference flag of the Global call reference applies to the restart procedures. In the case when both sides on an inter-PINX link initiate simultaneous restart requests, they shall be handled independently. In the case when the same channel(s) are specified, they shall not be considered for re-use until all the relevant restart procedures are completed.

12 Protocol timers

The protocol timers are defined in table 4. All timer values given in this table have a tolerance of 10%.

Legend to Table 4, columns 7 and 8:

- MThe timer is mandatory
- OThe timer is optional
- M(I)The timer is mandatory if the associated procedures are implemented.

Table 4 — Protocol timer definitions (Sheet 1 of 2)

Timer Number	Timer Value	Call State	Cause For Start	Normally terminated (note 1, note 2)	Action To Be Taken When Timer Expires	Incoming side	Outgoing side
T301	note 3	Call Delivered	ALERTING received	On CONNECT received	Clear Call as specified in clause 10.1.5		O
T302	Minimum 14 s, Maximum 16 s	Overlap Receiving	Sending of SETUP ACKNOWLEDGE Restarted on receipt of INFORMATION message	On the sending of CALL PROCEEDING, ALERTING or CONNECT	Clear call if information is definitely incomplete (as specified in clause 10.1.4.2) else send CALL PROCEEDING	M	
T303	Minimum 4 s, Maximum 6 s	Call Initiated	On Sending SETUP	On receipt of CALL PROCEEDING, CONNECT, ALERTING, SETUP ACK. or RELEASE COMPLETE	Retransmit SETUP and restart T303 or clear the call as specified in clause 10.1.1		M
Second T303	Minimum 4 s, Maximum 6 s	Call Initiated	On retransmission of SETUP	On receipt of CALL PROCEEDING, CONNECT, ALERTING, SETUP ACK. or RELEASE COMPLETE	Clear Call as specified in clause 10.1.1		O
T304	Minimum 20 s	Overlap Sending	Receipt of SETUP ACK. Retransmission of INFORMATION restarts T304	Receiving CALL PROCEEDING, ALERTING or CONNECT	Clear the call using procedures specified in clause 10.1.3		M
T305	Minimum 4 s, Maximum 30 s	Disconnect Request	On Sending DISCONNECT	Receipt of RELEASE or DISCONNECT	Send RELEASE, start T308	M	M
T308	Minimum 4 s, Maximum 6 s	Release Request	On Sending RELEASE	On Receiving RELEASE or RELEASE COM.	Retransmit RELEASE, restart T308	M	M
Second T308	Minimum 4 s, Maximum 6 s	Release Request	On retransmission of RELEASE	On receiving RELEASE or RELEASE COMPLETE	Release Call Reference; place info-channel in maintenance condition. (optionally initiate RESTART procedures)	M	M
T309	90 s note 4	Any State	SCM disconnection. Calls in Stable states are not lost	On SCM re-establishment	Clear connection, release call reference and info channel	M	M
T310	note 5	Outgoing Call Proceeding	On receipt of CALL PROCEEDING	On Receipt of ALERTING, CONNECT, PROGRESS (#1, #2 or #8), DISCONNECT or RELEASE	Clear the call as specified in clause 10.1.4.3		M (Optional for a Transit PINX)
T313	Minimum 4 s, Maximum 6 s	Connect Request	On sending CONNECT	On receipt of CONNECT ACKNOWLEDGE	Clear call as specified in 10.1.6	O	