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Foreword

This European Telecommunication Standard (ETS) has been produced by the Paging Systems (PS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS comprises seven parts with the generic title "Paging Systems (PS); European Radio Message System (ERMES)". The title of each part is listed below:

- ETS 300 133-1: "Part 1: General aspects"
- ETS 300 133-2: "Part 2: Service aspects"
- ETS 300 133-3: "Part 3: Network aspects"
- ETS 300 133-4: "Part 4: Air interface specification"
- ETS 300 133-5: "Part 5: Receiver conformance specification"
- ETS 300 133-6: "Part 6: Base station specification"
- ETS 300 133-7: "Part 7: Operation and maintenance aspects"

This part, ETS 300 133-3, gives a system architecture description of the European Radio Message System (ERMES), including the numbering, addressing and identification of subscribers together with call processing. This part also gives specifications for:

- methods of access to the ERMES system;
- internal interfaces within the ERMES system;
- the paging network controller;
- the paging area controller.

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1 Scope

This part of the seven part European Telecommunication Standard (ETS) 300 133 describes the network aspects of the European Radio Message System (ERMES).

2 Normative references

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

[1] ETS 300 133-1: "Paging Systems (PS); European Radio Message System (ERMES) Part 1: General aspects".

[2] ETS 300 133-2: "Paging Systems (PS); European Radio Message System (ERMES) Part 2: Service aspects".

[3] ETS 300 133-4: "Paging Systems (PS); European Radio Message System (ERMES) Part 4: Air interface specification".

[4] ETS 300 133-5: "Paging Systems (PS); European Radio Message System (ERMES) Part 5: Receiver conformance specification".

[5] ETS 300 133-6: "Paging Systems (PS); European Radio Message System (ERMES) Part 6: Base station conformance specification".

[6] ETS 300 133-7: "Paging Systems (PS); European Radio Message System (ERMES) Part 7: Operation and maintenance aspects".

[7] CCITT Recommendation E.163: "PSTN international dialling numbers".

[8] CEPT Recommendation T/SF 31: "Services and facilities aspects of an Integrated Services Digital Network (ISDN)".

[9] CEPT Recommendation T/SF 31-07: "Operational requirements of ISDN supplementary services".

[10] ISO Standard 1073 parts 1 & 2: "Alphanumeric character sets for optical recognition".

[11] CCITT Recommendation F.69: "Plan for telex destination codes"

[12] CCITT Recommendation F.410: "Message handling services: The public message transfer service".

[13] CCITT Recommendation F.420: "Message handling services: The public interpersonal messaging service".

[14] CCITT Recommendation F.300: "Videotex service".

[15] CCITT Recommendation S.1: "International Telegraph Alphabet No. 2".

[16] CCITT Recommendation S.2: "Coding scheme using International Telegraph Alphabet No. 2 (ITA 2) to allow the transmission of capital and small letters".

[17] CCITT Recommendation X.400: "Message handling system and service overview".

[18] CCITT Recommendation X.21: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks".

[19] CCITT Recommendation X.25: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[20] CCITT Recommendation X.208: "Specification of abstract syntax notation one (ASN.1)".

[21] CCITT Recommendation X.209: "Specification of basic encoding rules for abstract syntax notation one (ASN.1)".

[22] CCITT Recommendation X.213: "Network service definition for open systems interconnection for CCITT applications".

[23] CCITT Recommendation X.214: "Transport service definition for open systems interconnection".

[24] CCITT Recommendation X.215: "Session service definition for open systems interconnection for CCITT applications".

[25] CCITT Recommendation X.217: "Association control service definition for open systems interconnection for CCITT applications".

[26] CCITT Recommendation X.219 "Remote operations: model, notation and service definition".

[27] CCITT Recommendation X.223: "Use of X.25 to provide the OSI connection-mode network service for CCITT Applications".

[28] CCITT Recommendation X.224: "Transport protocol specification for Open Systems Interconnection for CCITT Applications".

[29] CCITT Recommendation X.225: "Session protocol specification for Open Systems interconnection".

[30] CCITT Recommendation X.226: "Presentation protocol specification for Open Systems Interconnection for CCITT Applications".

[31] CCITT Recommendation X.227: "Association control protocol specification for Open Systems Interconnection for CCITT Applications".

[32] CCITT Recommendation X.121: "The International numbering plan for public data networks".

[33] CCITT Recommendation X.216: "Presentation service definition for Open Systems Interconnection for CCITT applications".

[34] CCITT Recommendation X.229: "Remote operations: Protocol specification".

[35] ISO Standard 7776: "Information processing systems - Data communications - High-level data link control procedures - Description of the X.25 LAPB-compatible DTE data link procedures".

[36] CCITT Recommendation X.135: "Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched services".

[37] CCITT Recommendation Z.100: "Specification and description language (SDL)".

3 Definitions

For the purposes of this part of ETS 300 133 the following definitions shall apply.

Address Code (AdC): identifies the RIC and alert signal indicator.

Access method: a combination of access terminal, access network, access mode and access type.

Access mode: the communication procedure between the calling party and the PNC. It may be interactive or non-interactive.

Access network: the telecommunications network to which the access terminal is connected.

Access service: a set of access methods provided to a user to access a service and/or a supplementary service in the ERMES network.

Access terminal: the terminal with which the user accesses the telecommunication network. It may be for example a telephone set, a telex, a videotex terminal, a PC with modem.

Access type: corresponds to the one-stage or two-stage selection.

Authentication code: a code used by a mobile or a fixed subscriber to allow the PNC to prove that the identity stated by this subscriber is true.

Basic kernel: the minimum of functionalities required for each I4 protocol layer.

Calling Party: a user entering paging tasks into the network.

Call acceptance: the response to the calling party determined by the PNC-H. This response indicates whether or not the call can be accepted.

Control section: functional part of the PAC which mainly converts the page message flow coming from the PNC in the page request operation to the flow directed to the BS.

CUG database: the database including the details on the membership of a CUG.

Divert AdC (DAdC): the AdC to which a mobile subscriber has diverted his paging messages.

External Interface: an interface that is not completely contained within an operator network.

External receiver: a receiver operating in a network which is not its home network.

Fixed Subscriber: a calling party who is registered in an operator network and has an account for sending messages and use of subscriber features.

Fixed subscriber records database: the database giving details of the features available to a particular fixed subscriber.

Fragmentation: service offered at OSI layer 4 which allows the splitting of an application packet into several smaller packets.

Geographical Area (GA): one or several paging areas in a telecommunication network. Defined by agreements between network operators. It is used for roaming and choice of destination supplementary services.

Group Address Code (GAdC): the address code with which a group is called.

Group database: the database giving information on the members of a mobile subscriber group.

Home PNC (PNC-H): the PNC holding the subscriber registration database for a particular mobile subscriber and to which all calls for this mobile subscriber are referred for processing.

Input PNC (PNC-I): PNC that is accessed by a calling party.

Internal Interface: an interface that is completely contained within an operator network.

Legitimisation code: a code stated by a calling party to prove that he is authorised to carry out a particular restricted operation (an operation which is not allowed to all calling parties).

Mobile Subscriber: a user who is registered in an operator network and receives paging messages or uses his subscriber features.

Mobile subscriber AdC records database: the database giving the required information on mobile subscribers for the processing of paging calls.

Mobile subscriber RIC message database: the database dealing with message numbering and storing.

Network status: an estimated value of the probability that the ERMES system will proceed successfully with the paging call. It shall be estimated on a per call basis and shall depend on the availability of all the elements of the system dealing with this call attempt and on message delivery time.

Network time slot: a particular configuration of an operator's network during a time slot which consists of only one PA comprising every BS of the network.

One-stage selection: access type with two phases, input AdC and input message.

Operator Network: all infrastructure which is the responsibility of the network operator.

Paging Area (PA): the area controlled by a PAC. It is the minimum area to which a mobile subscriber is permitted to subscribe in order to receive his paging messages.

Paging Area Controller (PAC): the functional entity controlling the BSs within one paging area.

Paging Network Controller (PNC): the central call processing unit associated with each operator's telecommunication network. It administers subscriber registrations and performs paging tasks.

PNC-H(FS): the PNC holding the subscriber registration database for a particular fixed subscriber and to which all calls of this fixed subscriber are referred for processing.

Protocol stack : a set of protocols defined to build up to the I4 interface.

Roaming test message: a paging message sent automatically by the PNC-H to the roaming area when the roaming is activated.

User: a person or a machine initiating an access to an operator network or receiving a message through the operator network. It includes mobile subscribers, fixed subscribers and non registered customers.

User defined text message: when acknowledging a demand from a calling party, the system may offer the possibility to send a customised message giving specific information from the called party.

Service identification code: a two digit code used for the identification of a supplementary service or a subscriber feature.

Service Number: the number used to gain access to a PNC in the two-stage selection procedure.

Standard text: a predefined text message associated with an identification number. The texts are defined by the network operator or may be defined by fixed subscribers.

Subscriber feature: service or supplementary service available to a subscriber according to his subscription. The feature may be activated on a registration basis or on demand. In this last case, it shall be activated by the subscriber, after authentication, for a specific period of time.

Telecommunication network: the telecommunication part of the operator network.

Three state status: the criteria for the call acceptance. If the network status is above a threshold **C** the call is accepted. If it is below a threshold **UC** the call is rejected. Between these two thresholds the calling party receives information that the transmission cannot be guaranteed with the full quality of service and a confirmation of the call attempt is demanded from the calling party.

Telecommunications Management Network : the operation and maintenance part of the operator network.

Transmit PNC (PNC-T): the PNC responsible for routing a particular paging message to the appropriate paging areas which are under its control.

Two-stage selection: access type with three phases, input service number, input Adc and input message.

4 Abbreviations

AC	Authentication code
ACK/NACK	Positive/Negative Acknowledgement
ACSE	Association Control Service Element
AdC	Address Code
ADF	Address Field
AH	Application Header
AIF	Additional Information Field
AII	Additional Information Indicator
AIN	Additional Information Number
AIT	Additional Information Type
ALERT	Alert Function for different types of alert
APT	Address Partition Terminator
ASN.1	Abstract Syntax Notation one
BAI	Border Area Indicator
BAL	Batch Length
BS	Base Station
BSA	BS address
CCITT	Comité Consultatif International Télégraphe et Téléphone
CHAN	Channel Number
CSPDN	Circuit Switched Packet Data Network
CTA	Common Temporary Address
CTAP	Common Temporary Address Pointer
CUG	Closed User Group
DAdC	Divert AdC
DCE	Data Communications Equipment
DD	Deferred Delivery
DL	Distribution List
DNIC	Data Network Identification Code
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency
EB	External Bit
ECC	Error Correcting Code
ECN	ERMES Code Number
EOM	End of Message
ERMES	European Radio Message System
ETI	External Traffic Indicator
FRN	Fragmentation Reference Number
FS	Fixed Subscriber
FSI	Frequency Subset Indicator
FSN	Frequency Subset Number
GA	Geographical Area
GAdC	Group AdC
HDLC	High Level Data Link Control
I2	Interface PAC-BS
I4	Interface PNC-PNC
IAB	Initial Address Buffer
IACP	Initial Address Confirmation Pointer
IASP	Initial Address Service Pointer
IDD	International Direct Dialling
IMI	Integral Message Indicator
IPM	Interpersonal Messaging
ISDN	Integrated Services Digital Network
ISO	International Standard Organisation
LAPB	Link Access Protocol Balanced
LID	List Identification (text list identification)
LSB	Least Significant Bit
MD	Mediation Device
MEF	Message Field

MEL	Message Length
MHS	Message Handling System
MS	Mobile Subscriber
MSB	Most Significant Bit
NIA	Number of Initial Address
NOP	Number of Packet
OMC	Operation and Maintenance Centre
O&M	Operation and Maintenance
OPID	Operator Identity (of the home operator)
ORI	Operation or Result Identification
OS	Operation System
OSI	Open System Interconnection
PAA	PAC Address
PA	Paging Area
PAC	Paging Area Controller
PAC-OS	The part of the PAC dealing with the O&M process
PDU	Protocol Data Unit
PN	Packet Number
PNC	Paging Network Controller
PNC-H	Home PNC
PNC-H(DIV)	Divert AdC's Home PNC
PNC-H(FS)	Fixed subscriber's Home PNC
PNC-I	Input PNC
PNC-T	Transmit PNC
PR	Priority
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
QOS	Quality of Service
RA	Roaming Area
RF	Radio Frequency
RIC	Radio Identity Code
ROSE	Remote Operation Service Element
RTSE	Reliable Transfer Service Element
SDL	Specification and Description Language
SDU	Service Data Unit
SA	Service Area
SF	Subscriber Feature
SI	Subscriber Identification
SIC	Service Identification Code
SN	Service Number
SRA	Status Request Acknowledge
SS	Supplementary Service
SSI	Supplementary System Information
SSN	Sub-Sequence Number
SYD	System Data
TD	Transparent Data
TMN	Telecommunications Management Network
TN	Telecommunication Network
TNO	Text number (number of selected text)
TRN	Transaction Reference Number
TPL	Transaction Packet Length
TX	Transmitter
UA	User Agent
UMI	Urgent Message Indicator
UTC	Universal Time Coordinated
UUI	User-to-User Information
UUS	User-to-User Signalling
VIF	Variable Information Field

5 System architecture

5.1 General

An operator network comprises two main components, the telecommunication network part and the operation and maintenance network part.

To satisfy the roaming requirements of the ERMES service aspects (ETS 300 133-2 [2]) the operator networks shall be connected together to provide extended coverage. Thus the composite ERMES system shall consist of two associated sets of networks, figure 1 illustrates this aspect.

In this part of ETS 300 133 the detailed organisation of the telecommunication network is be described and defined including all operational entities and interfaces. The overall operational aspects of the Operation and Maintenance (O&M) network is also considered in this part especially with respect to interfacing with the telecommunication network, but detailed internal operation of the O&M network part is addressed separately in ETS 300 133-7 [6].

In this Clause the network functional architecture is presented and described. The detailed description is considered in later Clauses.

5.2 Telecommunication network part

The telecommunication network part of the ERMES system is a set of telecommunication networks, as shown in figure 2, communicating with each other through the I4 interface.

The functional split between telecommunication network and O&M ERMES network is shown in figure 3.

Each telecommunication network is associated with a Paging Network Controller (PNC) that controls the network related features and manages the I3, I4 and I5 interfaces.

Each Paging Area Controller (PAC) is a functional block which manages one Paging Area (PA). The maximum number of PACs controlled by one PNC shall be 64.

Each PAC shall have responsibility for the Base Stations (BSs) giving the required PA radio coverage.

5.2.1 Functional description of PNC

The PNC may perform one or several of the following roles during call processing or internetworking:

PNC-I (input)	=	user's access through the telecommunication access network;
PNC-H (home)	=	management and control of the subscriber's data base (all calls to the subscriber are referred to PNC-H for processing);
PNC-T (transmit)	=	control of the radio transmission in the area(s) which is (are) under its responsibility.

Playing these roles, the PNC shall interact with other networks through the I4 interface. Any combination of roles may be performed in one PNC.

The other main functions of the PNC are management of the transmissions to paging areas and the dialogue, through the PNC-OS, with the O&M network.

5.2.2 Functional description of PAC

The main task of each PAC is to organise paging message queuing and batching, and to manage the priority of the paging messages which it delivers to the Base Stations (BSs) under its control via the I2 interface.

Each PAC receives information from the PNC through the I3 interface.

Each PAC has responsibility to manage its associated I2 interfaces.

Each PAC has responsibility to manage its database and to converse, through the PAC-OS, PNC-OS and relevant mediation functions, with the O&M network.

5.2.3 Functional description of BS

The main task of the BS is to manage the I1 interface through the transmitters. The I1 interface is described in ETS 300 133-4 [3]. The BS gives acknowledgements back to its associated PAC and provides status information through the Mediation Device (MD) to PAC-OS.

5.3 General description of network interfaces

Six system interfaces are shown in the network architecture given in figure 2. The network related interfaces I2 to I6 are the subject of this part of the ERMES specification and is defined in detail in subsequent Clauses. The I1 interface is defined in detail in ETS 300 133-4 [3].

To establish a functional description of these interfaces in line with the functional entities described previously, general descriptions of the network interfaces are given in subclauses 5.3.1 to 5.3.6.

5.3.1 I6 interface

This is the user interface. It is an external interface.

Access methods are divided in two categories; telephonic and non-telephonic. A detailed description is given in Clause 8.

5.3.2 I5 interface

The interface between the I6 telecommunications access network selected by the user and the operator network is the I5 interface. This is an external interface.

The I5 interface is described in Clause 9.

5.3.3 I4 interface

This is the interface between PNCs. The data connection uses a Packet Switched Public Data Network (PSPDN). A detailed description of this interface is given in Clause 10.

This is an external interface.

5.3.4 I3 interface

This is the interface between the PNC and the PAC. The interface is described in Clause 11.

This is an internal interface.

5.3.5 I2 interface

This is the interface between the PAC and the BS. The description of this interface is given in Clause 12.

This is an internal interface.

5.3.6 I1 interface

This is the radio air interface defined in ETS 300 133-4 [3]. It is an external interface.

5.4 Operation & maintenance network part

The functional network configuration for the Telecommunication Management Network (TMN) is included in figure 3.

Two types of operating system (OS) are depicted;

- a basic OS associated with a given network element (PAC,PNC etc), and

- a network OS called the operation and maintenance centre (OMC), which is responsible for the O&M at a network level.

A network management function is also included in the OMC for supervising the network interworking and also for harmonising the management choices among the operators.

In addition, the TMN contains a MD performing some decentralised functions to the BSs (data concentration and handling, protocol conversion, pre-processing).

The OMC is the centre of any network-oriented management action and it also plays an important role for co-ordinating the data exchanges between different operator networks. It implements the following higher level functions inside the O&M environment:

- network and system configuration management; software updating and back-up; operating and administrative functions;

- alarm management and synthesis; test handling; storage and processing of the alarms and test report;

- measurement of traffic data, network performance and Quality of Service (QOS) calculations, start of the management actions;

- handling of traffic records (which may be used for billing and accounting) and their routing among the operators.

5.5 General description of O&M interfaces

Figure 4 gives the O&M interfaces corresponding to the functional configuration of figure 3. It should be noted that the MD working to the BS has been directly associated with the PAC-OS so that there is no requirement to specify an interface.

All O&M activities are controlled by the OMC. The O&M messages related to the PAC-OS and BSs are carried by I3 and I2 interfaces as well as by the OMC-PNC interface. OMC-PNC and IOMC interfaces are specifically defined for O&M.

NOTE: IOMC is the interface between OMCs, described in ETS 300 133-7 [6]. It is an external interface.

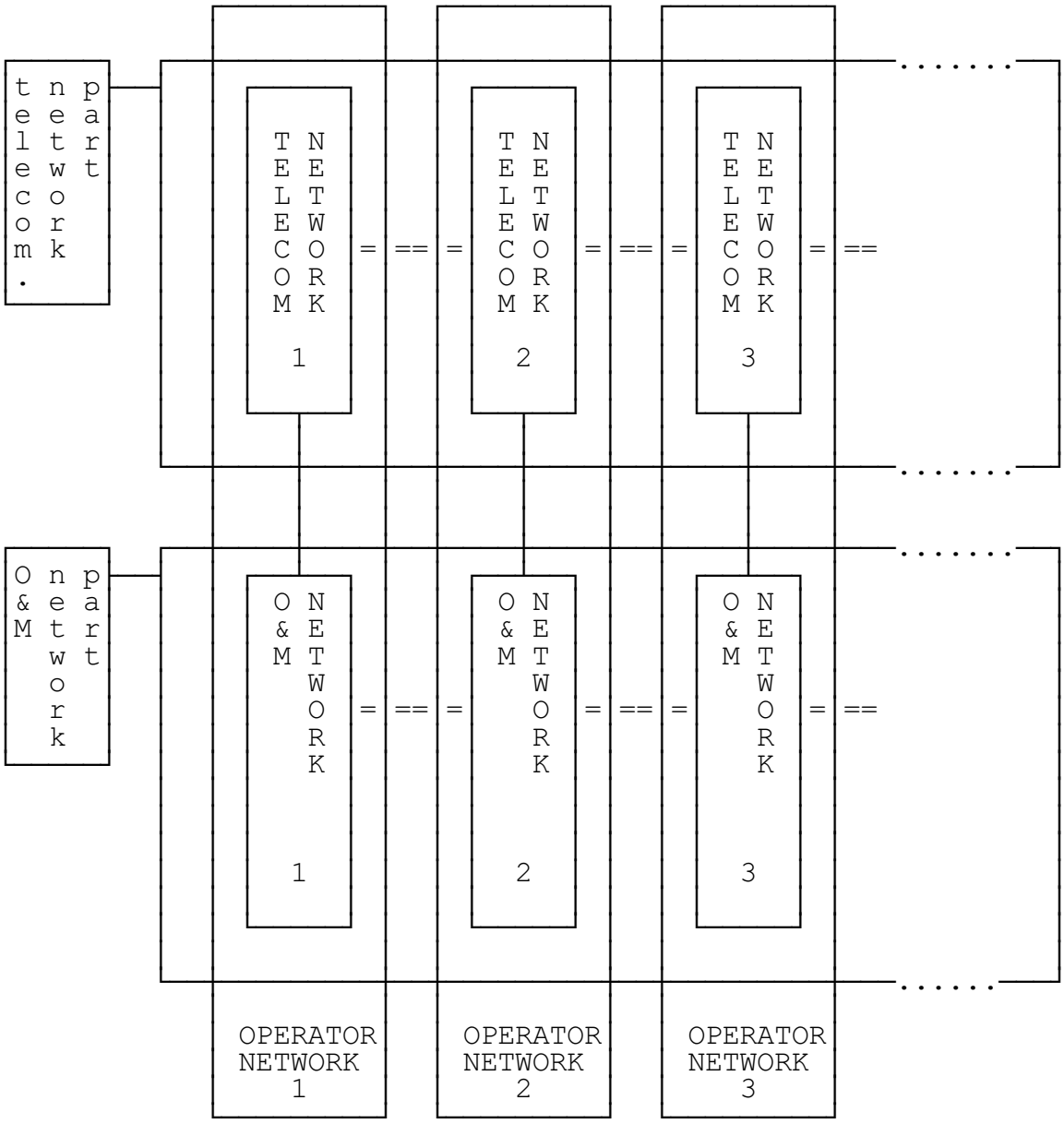


Figure 1. ERMES system architecture

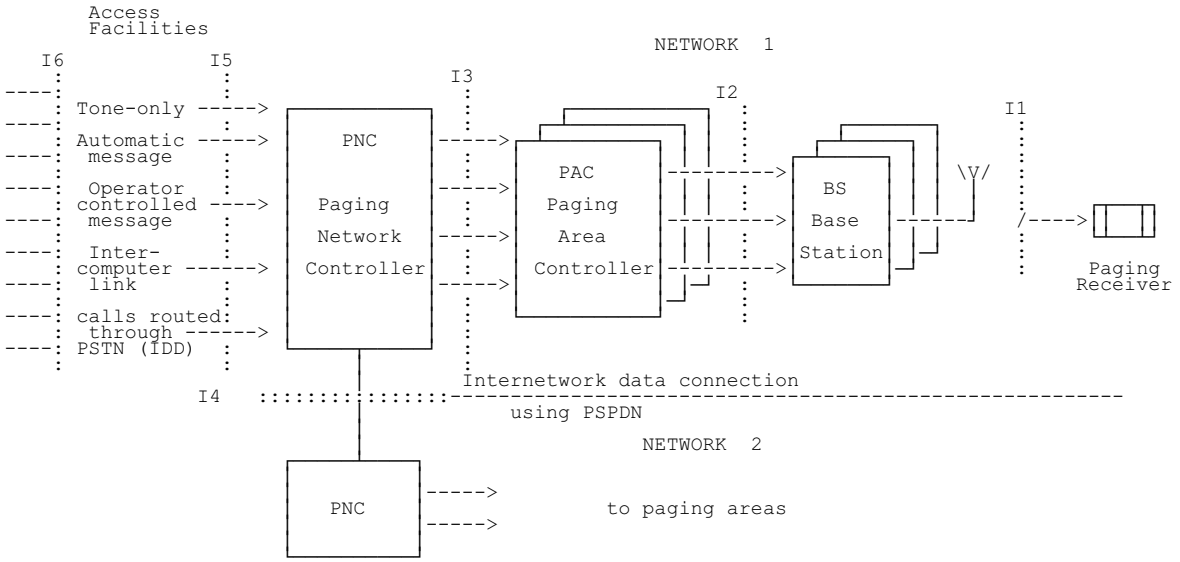


Figure 2 : Functional organisation of the telecommunication network architecture

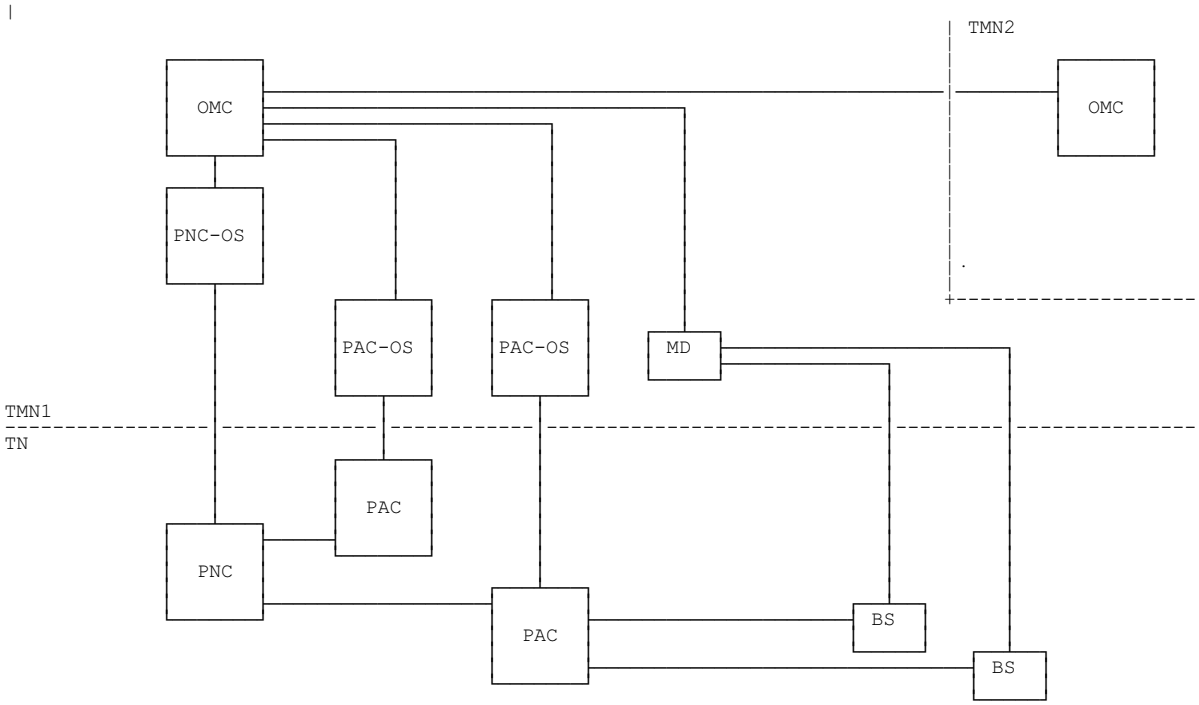


Figure 3: ERMES functional architecture

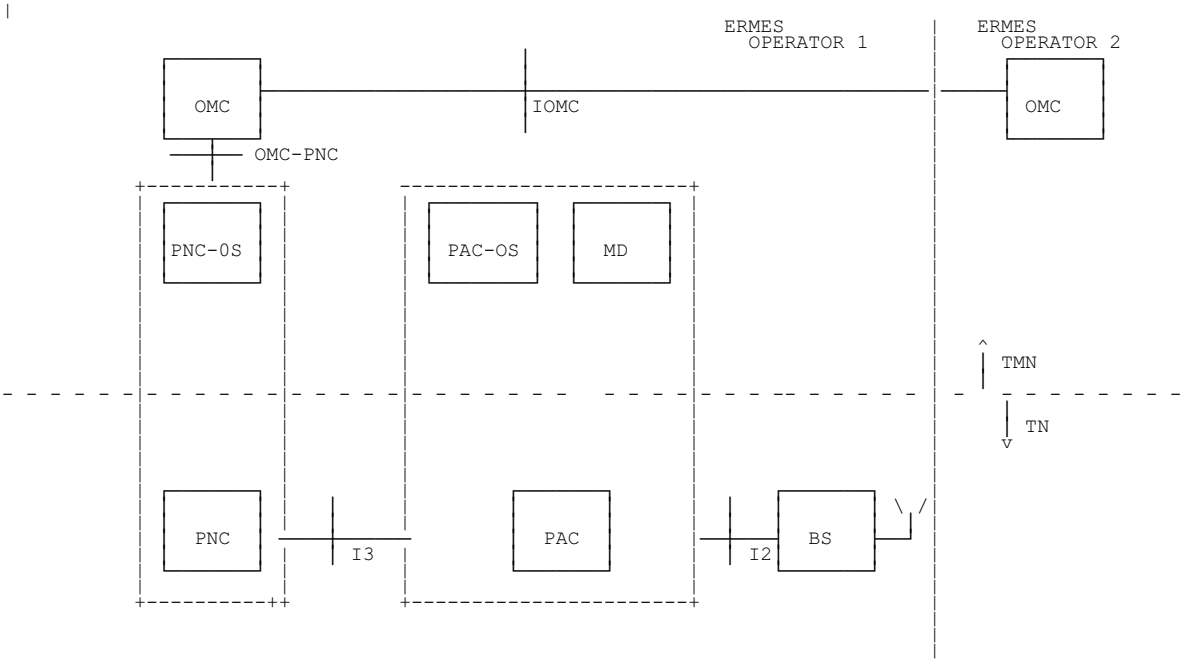


Figure 4: O & M Interfaces

6 Numbering, addressing and identification

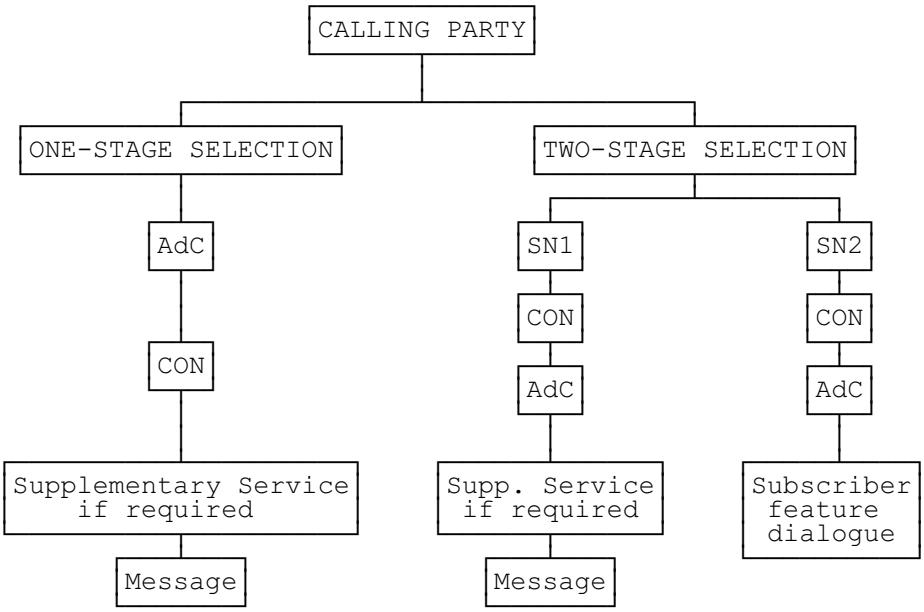
6.1 General

This subclause describes the main principles of numbering and addressing for Mobile Subscribers (MSs) and defines the elements used in identification of Fixed Subscribers (FSs). The relationship between the service demanded by the customer and the structure of the selection information when accessing the ERMES system is described.

Selection information is input to the access network by the calling party to gain access to the service. The calling party may be someone wishing to send a paging message to a MS or a subscriber wishing to access the system in order to change their Subscriber Features (SFs). One-stage and two-stage selection procedures are available to facilitate access.

In one-stage selection the call information input to the telecommunications network establishes connection to the PNC and also identifies the Address Code (AdC). In two-stage selection the calling party first calls the PNC using a Service Number (SN) and then, after the connection has been established, sends the AdC followed by message input or SF dialogue.

Figure 5 illustrates the links between access type and selection information.



KEY: SN1: service number for page input.

SN2: service number for subscriber features.

CON: connection established through the network access.

Figure 5: Selection information and access type

The structure of AdC is described in subclause 6.2 for both one-stage selection and two-stage selection access types. SN requirements are given in subclause 6.4.

6.2 Addressing and numbering

6.2.1 Mobile subscriber

6.2.1.1 Individual

All receivers shall be allocated at least one AdC.

6.2.1.1.1 One-stage selection

In one-stage selection the AdCs shall follow the numbering plan or the address structure of the access network. Addressing may take advantage of any special features of the access network. The use of prefixes shall be in accordance with national practice.

6.2.1.1.2 Two-stage selection

In two-stage selection the AdCs may be selected independently of the access network. Consequently the same AdC may be used throughout the ERMES system.

The AdCs for the two-stage procedure shall consist of three parts:

1) First part - country number.
   This part consists of two or three digits and is the same as the recognised country code for Public Switched Telephone Network (PSTN) use (see CCITT Recommendation E.163 [7]);

2) Second part - network identification.
   This part consists of several digits which identify the network operator within the country. The identification and number of digits will depend on national agreement. The network identification shall not include any prefix;

3) Third part - subscriber identification.
   This part consists of the remaining digits.

A two-stage selection AdC may have up to fifteen digits as provided by the I4 interface (see Clause 10).

Depending on the location of the calling party and on the access method chosen, all parts of the code may not be required.

The accessed Input PNC (PNC-I) shall differentiate, by the use of a prefix, between calls directed to receivers belonging to its own network and calls directed to receivers belonging to another network.

This prefix shall be 00 (double zero) if the called receiver belongs to a foreign network, and 0 (single zero) if the called receiver belongs to a network in the same country. In the first case, the AdC shall have all three parts, in the second case it shall have only the last two.

For access to the Home PNC (PNC-H) using the SN (see subclauses 6.1 and 6.4.1) of the PNC-H, only the third part of the numbering scheme shall be required.

The international access prefix (00) and the national access prefix (0) shall be uniform throughout the ERMES network.

Neither network identification nor subscriber identification shall begin with zero.

6.2.1.2 Group

A group of receivers shall be allocated at least one Group AdC (GAdC). This GAdC shall follow the same rules as the AdC and shall have the same structure (see subclause 6.2.1.1). A GAdC shall only be allocated to groups using individual Radio Identity Codes (RICs).

To identify a group (for called group indication service), a maximum of four digits shall be used for numeric messages and ten characters for alphanumeric messages. The called group indicator shall be included in the message itself.

6.2.2 Fixed subscribers

FSs shall only access their own PNC. Consequently numbering and addressing of FSs do not need to be harmonised.

A MS may be considered as a FS and an operator may decide whether the two numbering plans should be integrated.

6.3 Identification of network functional blocks

Each PNC shall be allocated an unambiguous PNC number. This number shall be composed of three parts:

zone code - as defined in ETS 300 133-4 [3], Annex A;

country code - as defined in ETS 300 133-4, [3] Annex A;

operator code - for network identification.

Other network functional entities do not require harmonised identification, but the following rules shall be observed:

- PA number shall be a two digits number;
- PAC number shall be a two digits number;
- BS number shall have three digits maximum.

6.4 Service access

6.4.1 Service numbers

In the two-stage selection procedure Service Numbers (SNs) provide access to basic and Supplementary Services (SSs).

The SN and its structure depend on the access network and the operator's policy, so it is possible to have several service numbers identifying the same service (or class of service) which is to be accessed through different access networks.

When using the telephonic access method (see Clause 8), there shall be a separate SN for page input and for SFs. When using a non-telephonic access method, there could be a single SN for all services, or a separate SN for page input, according to the network operator's policy.

6.4.2 Supplementary service identification codes

When accessing an operator network, the calling party wants either to send a paging message or to access his MS features. In the first case he may want to invoke a SS related to his paging message. For that he shall use the appropriate supplementary Service Identification Code (SIC) given in table 1. In the second case, every SN dedicated to the SFs gives access to a subset of SSs identified by a SIC defined in tables 2 and 3.

The SICs shall be the same in all PNC(s) and take the form shown in tables 1, 2 and 3.

Table 1: Call input related SICs

71	Choice of destination
72	Repetition
73	Prioritisation
74	multi-address call
75	Urgent message
76	Deferred delivery
77	Standard text from the PNC-H
78	Standard text from the PNC-I
79	Reverse charging

Table 2: supplementary service identification codes for fixed subscriber's features

82	Address list management
83	Advice of accumulated charges
84	Password management
85	Legitimisation code management
87	Standard text management

Table 3: supplementary service identification codes for MS's features

90	Roaming
91	Temporary barring
92	Diversion
93	Message retransmission
94	Password management
95	Legitimisation code management
96	Deferred delivery
99	All features

In some cases the SIC may be implicitly included in the selection information. For example, it should be the case for the basic services with a standard access method or if a dedicated SN is required to allow a certain level of charge for some SSs such as call with repetition requested by the calling party.

National characteristic mnemonics or other alphanumeric identifiers may be used with alphanumeric access in place of the above numeric identifiers. It is recommended that the mnemonics used with alphanumeric access be harmonised within a network (the same for every access method).

7 Call processing

7.1 Call processing for page input

7.1.1 General principles

A calling party should normally establish a connection to a PNC with SN1 for the purpose of inputting a call request.

The PNC to which he connects plays the role of PNC-I. This PNC-I determines the called MS's PNC-H from the AdC supplied by the calling party. The PNC-H determines from the MS's database in which PNC(s) the MS has asked for his messages to be transmitted. This PNC(s) then plays the role of PNC-T.

For every call there may only be one PNC-I, one PNC-H and one or several PNC-Ts. For a local call one PNC plays all three roles.

The methods of call processing specified in this Clause are normative only for those operations involving transactions over the I4 interface. The call processing for call input shall be independent of the access method of the calling party.

Depending on the access method (interactive or non-interactive) all the data linked with the call and used by the call processing are given to the PNC-I either one by one (interactive) or in one block (non-interactive). However, the call processing described below is the same for the two types of access except that some acknowledgements are not given to the calling party in case of non-interactive access. This does not affect transactions on the I4 interface.

In the following description each "demand" or "response" corresponds to one I4 operation when PNC-I does not equal PNC-H, or PNC-H does not equal PNC-T.

At first the PNC-I performs a syntax check on the AdC number.

The PNC-I transmits a "pager information" demand, including the AdC, to the PNC-H.

The PNC-H then refers to the MS's database and sends back to the PNC-I a response including parameters corresponding to the MS's database (such as receiver type, maximum message length). The results of the call acceptance calculation (described in Clause 13) given according to a three state status is also returned.

In case of interactive access the PNC-I sends an acknowledgement to the calling party.

The PNC-I compares the SSs requested with the call and the MS database information.

In the case of choice of destination requested by the calling party, the PNC-I sends a "choice of destination" demand to the PNC-H, in order to recalculate the call acceptance and the PNC-H sends back a response including the new call acceptance calculation.

In the case of interactive access the PNC-I then gives an acknowledgement to the calling party for all SSs (including the call acceptance for choice of destination). For non-interactive access the call shall be processed even if one or several of the SSs requested are not valid.

The PNC-I validates the message part to check the message length and validity of the characters. The PNC-I also converts the national character set to the ERMES character set (see subclauses 8.1.4 and 13.8) and sends back an acknowledgement to the calling party.

The PNC-I then sends a "page request" demand including all the parameters linked with the call to the PNC-H.

The PNC-H sends back a response to the PNC-I. The PNC-I then takes no further part in the processing of the call.

The PNC-H sends to each PNC-T a "transmit" demand including the message with all valid information such as the number of the message and the priority. Each PNC-T sends back a response to the PNC-H.

The following figures illustrate the principles of call processing. They do not give a full description of the I6 interface protocol (full details of which are given in Clause 8).

NOTE: This general description of the call processing for page input describes a normal case and does not take in account all the cases of faults which could arise during this processing. All these cases are described in the SLD description given in Annex B.

7.1.1.1 PNC-I processing

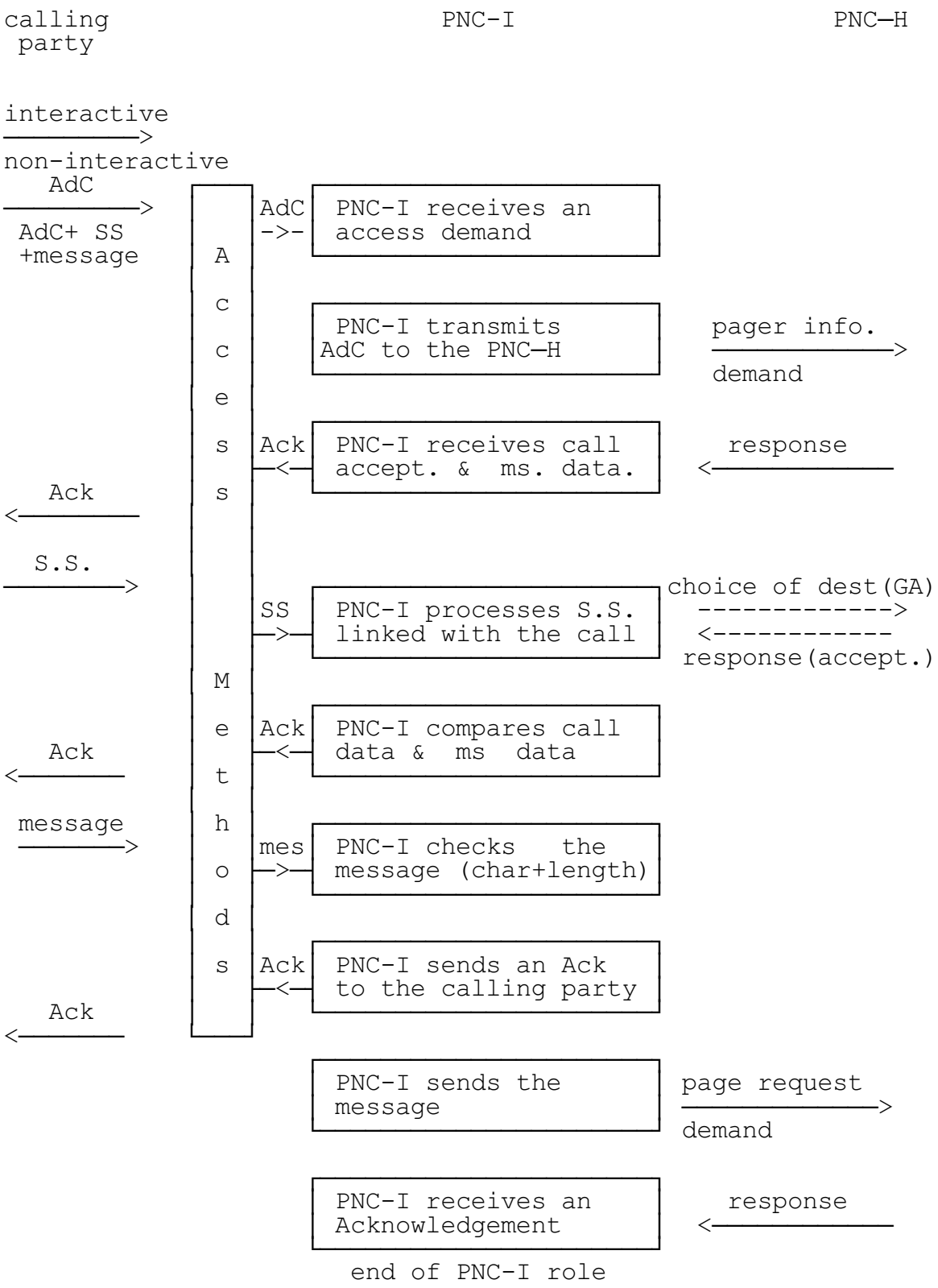


Figure 6: PNC-I processing

7.1.1.2 PNC-H processing

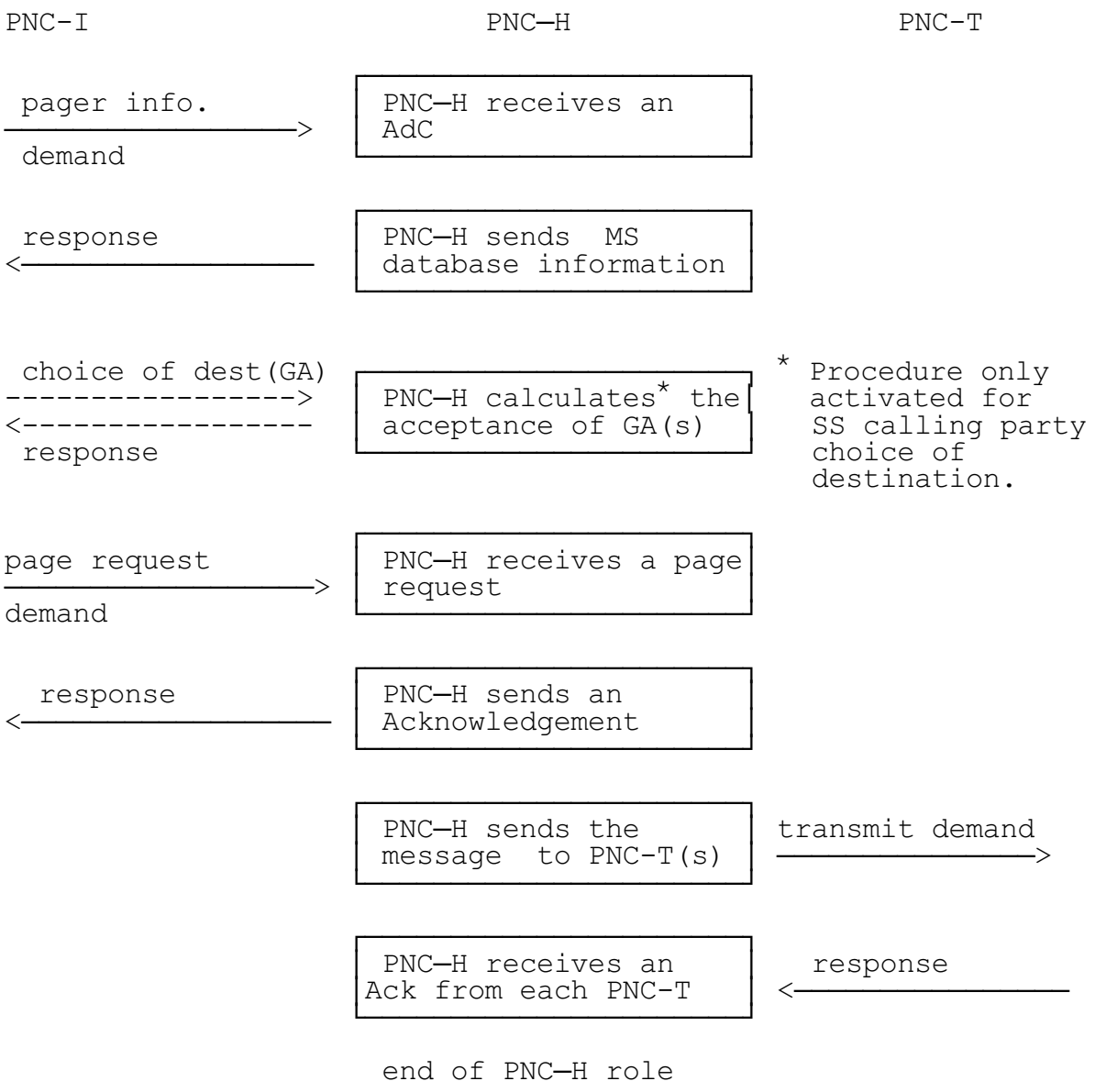


Figure 7: PNC-H processing

7.1.1.3 PNC-T processing

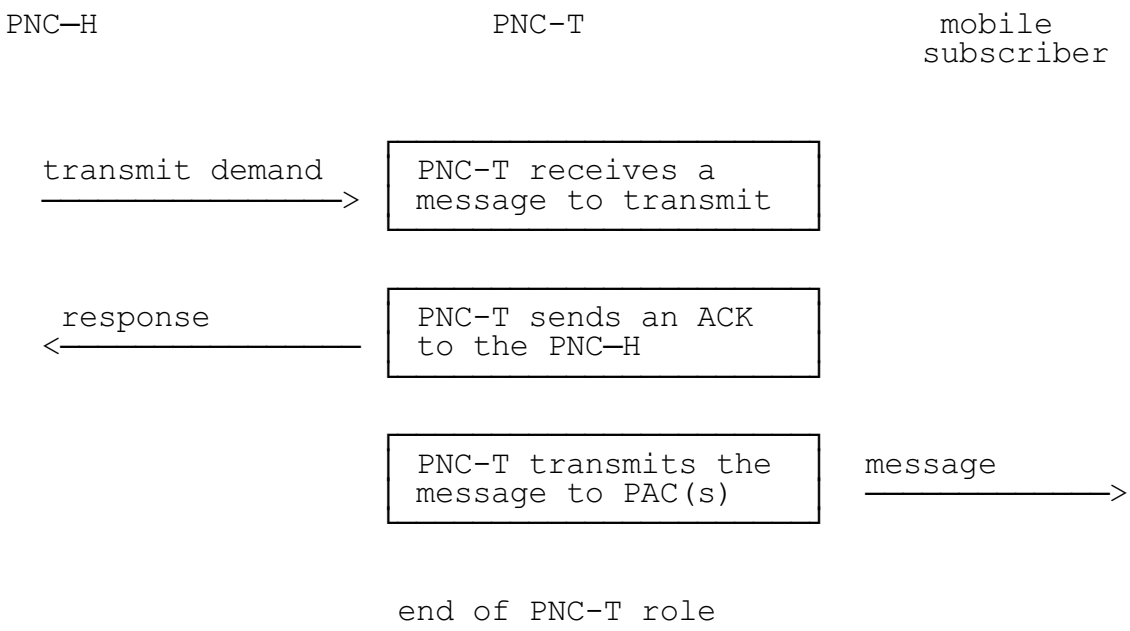


Figure 8: PNC-T processing

7.1.2 Supplementary services

7.1.2.1 General principle

SSs shall be requested by the calling party after inputting the AdC. The PNC-I compares the demand with all the SSs included in the MS database sent by the PNC-H and gives acknowledgement for these SSs. Incompatible combinations of SSs are given in Annex A.

7.1.2.2 Choice of destination

When the calling party enters the choice of destination he gives the GA(s) to where he requires his call to be sent. The PNC-I shall, in this case, send to the PNC-H these requested GA(s) in order to recalculate the call acceptance corresponding to this demand. The PNC-H sends back the call acceptance result to the PNC-I. Subsequently the call processing follows the general principle.

7.1.2.3 Repetition

The processing follows the general principle as for the call input but after receiving the page request including the repetition demand, the PNC-H sends two transmit requests to each PNC-T with an interval of five minutes between the transmit requests (with the same message number).

If the MS has also requested repetition the message shall only be repeated once.

7.1.2.4 Prioritisation

The priority provided follows the calling party demand (in some cases this demand could require a legitimisation code) and/or the MSs database information. In case of conflict the message priority is determined by the highest level of priority specifically requested by either the calling party or the MS.

Priority 1 is not compatible with deferred delivery, roaming, diversion, or choice of destination demand in case of demand outside of the home network.

7.1.2.5 Multi-address

On receiving this SS the PNC-I shall split the call into independent calls. Each call follows the general principle and the calling party may receive an acknowledgement for each AdC according to network operator policy. If the MS asked for other SSs these services shall be given according to the possibilities of each called MS database and the acknowledgements for these SSs shall also be given to the calling party according to the network operator policy .

7.1.2.6 Urgent message indication

The processing follows the general principle. The PNC-I on receiving the information from the MS database decides whether the service is possible or not and could also ask for legitimisation. The PNC-H sets the urgent message indication parameter before sending the message to the PNC-T(s).

7.1.2.7 Deferred delivery

The PNC-H shall store the message until the date and time specified by the calling party. This date and time shall be expressed according to the referenced date and time of the PNC-H. The number of the message shall be allocated when the message is sent to the PNC-T. Since the network status when the message is entered is not relevant to delivery, all calls should be accepted without call acceptance criteria.

If deferred delivery has been requested by both the calling party and the MS, the latest delivery time shall be used.

7.1.2.8 Standard texts

The calling party may only access standard texts defined by either;

a) The network operator of the PNC-I or a FS of the PNC-I, or

b) The network operator of the PNC-H.

7.1.2.9 Reverse charging

The processing follows the general principle. The PNC-I shall verify, using the database information of the MS, if this service is allowed or not and shall send an Ack/Nack to the calling party. This calling party may then have to provide a legitimisation code.

7.1.3 Subscriber features

7.1.3.1 General principle

SFs of the MS are in his AdC subscriber records database and, according to the general principle of the call processing for page input, are sent by the PNC-H to the PNC-I. The PNC-I and the PNC-H then have to take the demand of the calling party and the demand of the MS into account. The incompatible combinations of these SFs and the SSs requested by the calling party are given in Annex A.

7.1.3.2 Diversion

The PNC-I, on accessing the PNC-H of the AdC from which calls are being diverted, (using the I4 operation pager information if PNC-I does not equal PNC-H), shall be informed that diversion is in operation and the AdC of the divert receiver shall be passed to the PNC-I. The PNC-I shall then access the PNC-H of the divert AdC, (using the I4 operation pager information if PNC-I does not equal PNC-H), and process the call as a normal call to the divert AdC. Any SSs which are normally available for the divert AdC shall be available to the calling party, with the exception of the choice of destination SS, which shall not be made available.

All other SS requests by the calling party shall be accepted by the PNC-I, even if the SS is not available for the divert AdC. Only those SSs which are available to the divert AdC shall be included in the page request from the PNC-I to the PNC-H.

If, during the period of call diversion , the MS for the divert AdC invokes call diversion, then, for the period for which call diversion has been invoked, the call shall be rejected by the PNC-H of the divert AdC.

If, during the period of call diversion, the divert AdC is taken out of service, then, during the period for which the AdC is out of service, the call shall be rejected by the PNC-H of the divert AdC.

NOTE: In the case of diversion outside the ERMES system, the procedures are beyond the scope of this specification.

7.1.3.3 Repetition

The processing follows the general principle but after receiving the page request the PNC-H shall send to each PNC-T, two transmit requests with an interval of five minutes between the two transmit requests, with the same message number.

If the calling party also asks for repetition the message shall only be repeated once.

7.1.3.4 Message storing

The processing follows the general principle as for the call input. The PNC-H stores the message with its number, date and time of transfer to the PNC-T(s). In case of repetition the message shall be stored only once.

7.1.3.5 Prioritisation

According to the ETS 300 133-2 [2] the MS could ask for priority 1 or priority 3 (priority 2 implicit) for all messages or on a per call basis for each call.

The priority provided shall follow the calling party demand and/or the MS's database information (in some cases, e.g. requested by MS and activated by the calling party on a per call basis, this demand may require a legitimisation code). In case of conflict the message priority shall be determined by the highest level of priority specifically requested by either the calling party or by the MS.

Traffic having level 1 priority in the home network shall receive the level 2 priority when routed in a visited network.

7.1.3.6 Reverse charging

The processing follows the general principle. The PNC-I shall verify, using the database information of the MS, if this service is allowed or not and shall give this information back to the calling party. The calling party may have to input a legitimisation code.

7.1.3.7 Temporary barring

On receiving the AdC from the PNC-I, the PNC-H shall send back a response indicating that the temporary barring service is activated by the MS. This response may include the date and time for the de-activation of temporary barring or a user defined text message.

The PNC-I shall send to the calling party a standard system announcement or a standard text message (which should include details of the date and time of de-activation of temporary barring, if this information is supplied by the PNC-H), or the MS defined text message, in accordance with the information given by the PNC-H.

7.1.3.8 Deferred delivery

The PNC-H shall store the message until the date and time specified by the MS.

The message number shall be allocated when it is passed to the PNC-T(s).

The network status when the message is entered is not relevant, so all calls should be accepted without call acceptance criteria.

If deferred delivery has been requested by both the calling party and the MS, the latest delivery time shall be used.

7.1.3.9 Encryption

Encryption shall be done by the PNC-H before sending the message to the PNC-T(s).

7.1.3.10 Roaming

The processing follows the general principle as for the call input. The call acceptance shall be calculated by the PNC-H taking into account the Roaming Areas (RAs) stored in the MS database. The PNC-T(s) shall be determined taking in account the requested RAs.

7.1.3.11 Group call

MS groups may be formed either;

- by issuing each receiver with the appropriate common RIC, or

- by including the receiver's individual RIC in a group address list managed by the network operator or FS.

The FS may request that the PNC-H add a called group indicator to group messages (see subclause 6.2.1.2 and ETS 300 133-2 [2], subclause 5.3.3.4).

The first category of group call (called common RIC group call) shall be treated in every respect as an individual call. The second category (called individual RIC group call) shall be allocated a GAdC and the following call processing applied.

The PNC-I shall determine, using the GAdC, the PNC-H(FS) (PNC of the FS responsible for the called group management).

The PNC-I shall check with the PNC-H(FS) the validity of the syntax of the demand (GAdC and legitimisation code if required) in the same way as any other AdC. The PNC-H(FS) shall pass back to the PNC-I the subscriber details of the GAdC (this would include the legitimisation code itself and the SSs applicable to the group).

The calling party may request any SSs required and shall input the page message, in the same way as for any other call. After entry of all the call information the PNC-I shall pass the call details and message on to the PNC-H(FS).

The PNC-H(FS) shall then validate all the AdCs within the group (some of which may belong to other PNCs).

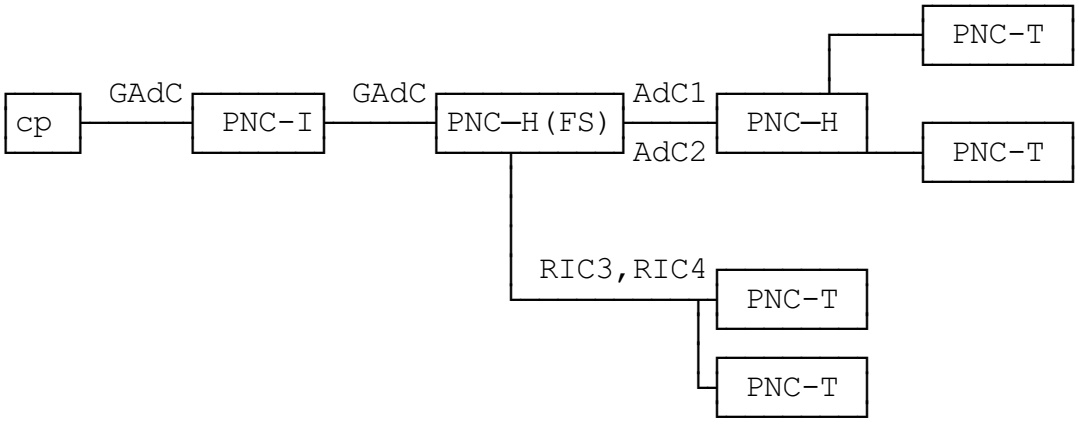
For those AdCs within the group belonging to the PNC-H(FS), the PNC-H(FS) shall pass the call on (as a group call with the called group indicator, if applicable) to the PNC-T(s) appropriate to each AdC (using an I4 group call transmit operation as necessary).

For AdCs within the group belonging on other PNCs the PNC-H(FS) shall pass the call details (including the called group indicator, if applicable) to the appropriate PNC-Hs using an I4 group call page request operation.

After the PNC-H(FS) has passed on the call details to all the PNC-Hs appropriate to the AdCs within the group, it will have validated all the AdCs within the group and have received acknowledgements(Nack) that all the SSs requested within the call are(are not) available. This information should be passed to the PNC-I, which may provide this information to the calling party (see NOTE 1).

NOTE 1: The normal call procedure is for the page accepted acknowledgement to be given to the calling party as soon as the message has been input. If a Nack of all the non-valid AdCs and SSs is to be given to the calling party then the page accepted acknowledgement would have to be delayed until Ack/Nacks had been received from the PNC-H(FS).

Example of group call processing:



NOTE: cp = calling party.

7.1.3.12 Automatic retransmission of the last message number

The message number shall be held in the MS's RIC database. If the automatic retransmission of the last message number SS is subscribed, a flag shall be set in the MS's AdC records database.

During low traffic time, the last message number may be automatically sent by the PNC-H to these MSs. Transmission intervals shall be determined by the network operator. The low traffic time shall be defined by the network operator and indicated by the OMC or the PNC themselves.

The call processing of this SS shall follow the general principles (see subclause 7.1.2.1).

This service shall not operate if either of diversion of traffic or temporary barring of incoming traffic SSs is activated.

7.1.3.13 Legitimisation of all calls

This SF enables the MS to restrict the input of calls to authorised calling parties only.

After input of the AdC the calling party shall be requested to input a legitimisation code.

The legitimisation code input by the calling party shall be checked against the legitimisation code stored in the MS database and, if valid, the call processing shall proceed according to the general principle.

7.2 Call processing for access to subscriber features

7.2.1 General principles

Normally, a subscriber establishes connection to a PNC via SN2 for the purpose of inputting a SF request.

The PNC to which he connects is defined as the PNC-I. The PNC which holds the database for the subscriber is defined as the PNC-H. For every call there shall only be one PNC-I and one PNC-H.

The call processing for SF requests shall be independent of the access method of the calling party. The methods of call processing specified are essential only for those operations involving transactions over the I4 interface.

7.2.2 Available to all calling parties

7.2.2.1 Subscriber directory

This optional facility is available to all calling parties and gives access to a catalogue or a database containing information about subscribers in the operator's network. Only information on subscribers belonging to the accessed PNC may be provided.

Since the method of implementation is left to the network operator, no harmonisation of call processing is required.

7.2.3 Available to fixed subscribers

The FS always accesses via the PNC-I which equals his PNC-H, where validation of authorisation may be performed.

7.2.3.1 Address list management

This optional SF gives the FS the possibility to programme lists identifying a number of MSs (who could have different PNC-H's) enabling them to receive the same calls. The members of the list shall be validated and the SSs which are to be made available shall be defined when the list is created.

7.2.3.2 Editing of standard text

This optional SF gives the FS the possibility to define and edit standard texts in a message bank. These messages are made available to authorised calling parties (by disclosure of the legitimisation code) by the FS.

No harmonisation is required for call processing.

7.2.3.3 Advice of accumulated call charges

This optional SF gives the FS the possibility to obtain the accumulated charges of his account in the operator's network.

No harmonisation is required for call processing.

7.2.3.4 Password management

The network shall provide a facility for the FS to manage the password (Authentication Code (AC)) using any appropriate access method defined by the network operator. The password shall be used for authentication purposes. This SF may only be accessed directly via the PNC which is the PNC-H of the FS (i.e. PNC-I = PNC-H).

The stages of call processing for password management shall be as detailed below:

a) The FS shall access his PNC-H using an access method on which SFs are supported.

b) The FS shall input his AdC and AC.

c) PNC-H shall authenticate the FS by comparing the AdC and the AC against the contents of the FS database.

d) The FS shall indicate a password management action to the PNC-H.

e) The PNC-H shall ask for a new password from the FS.

f) After checking the correctness of the new password, the PNC-H shall store the new password in the FS database.

g) The PNC shall send an appropriate SF acknowledgement to the FS.

7.2.3.5 Legitimisation code management

The use of a legitimisation code allows the PNC to ensure that a calling party is authorised to carry out a certain restricted operation (an operation which is not allowed to all calling parties). The calling party shall be authorised by a FS to carry out this restricted operation. The network shall provide a facility to enable the FS to manage the legitimisation code using any appropriate access method defined by the network operator. This SF may only be accessed directly via the PNC which is the PNC-H of the FS (i.e. PNC-I = PNC-H).

The stages of call processing for the management of a legitimisation code by a FS shall be as detailed below:

a) The FS shall access the PNC-H using an access method on which SFs are supported.

b) The FS shall input his AdC and AC.

c) PNC-H shall authenticate the FS by comparing the AdC and the AC against the contents of the FS database.

d) The FS identifies the SF and requests a change of legitimisation code.

e) The PNC shall ask for a new legitimisation code from the FS.

f) After checking the correctness of the new legitimisation code, the PNC-H shall store the new legitimisation code in the FS database.

g) The PNC shall send an appropriate SF acknowledgement to the FS.

7.2.4 Available to mobile subscribers

7.2.4.1 Roaming

7.2.4.1.1 General principles

The method of call processing specified in this subclause are normative only for those operations involving transactions over the I4 interface.

A MS establishes a connection to a PNC for the purpose of inputting a roaming demand which could be a roaming information demand or a roaming modification demand (activate, de-activate, modification of the existing situation). The PNC to which he connects is determined as PNC-I.

The PNC-I determines from the AdC supplied by the MS where his database is stored. The PNC which contains this database is determined as PNC-H.

In the following descriptions each "demand" or "response" corresponds to one I4 operation when PNC-I does not equal PNC-H.

7.2.4.1.2 PNC-I processing

Figure 9 gives an overview of PNC-I processing.
PNC-I receives the AdC and the password from the MS in the interactive mode in a first step, in the non-interactive mode with other information.

PNC-I performs a syntax check on these numbers and sends the roaming validation demand (including AdC) to the PNC-H.

Receiving the identification acknowledgement, the PNC-I transmits it to the MS in case of interactive mode.

The PNC-I then receives the roaming service identification with roaming data in case of roaming modification demand or without data in case of roaming reset or information demand and transmits them to the PNC-H using the corresponding I4 operation if necessary.

PNC-I receives information back which is sent to the MS. In the case of roaming information demand, this response contains roaming data of the subscriber's database and the process is terminated. In the case of change roaming demand, the response informs the MS of the effects of the changes requested.

Receiving confirmation from the subscriber (in the case of change roaming demand) the PNC-I transmits it to the PNC-H.

Finally, the PNC-I receives the feature acknowledgement from the PNC-H and transmits it to the subscriber.

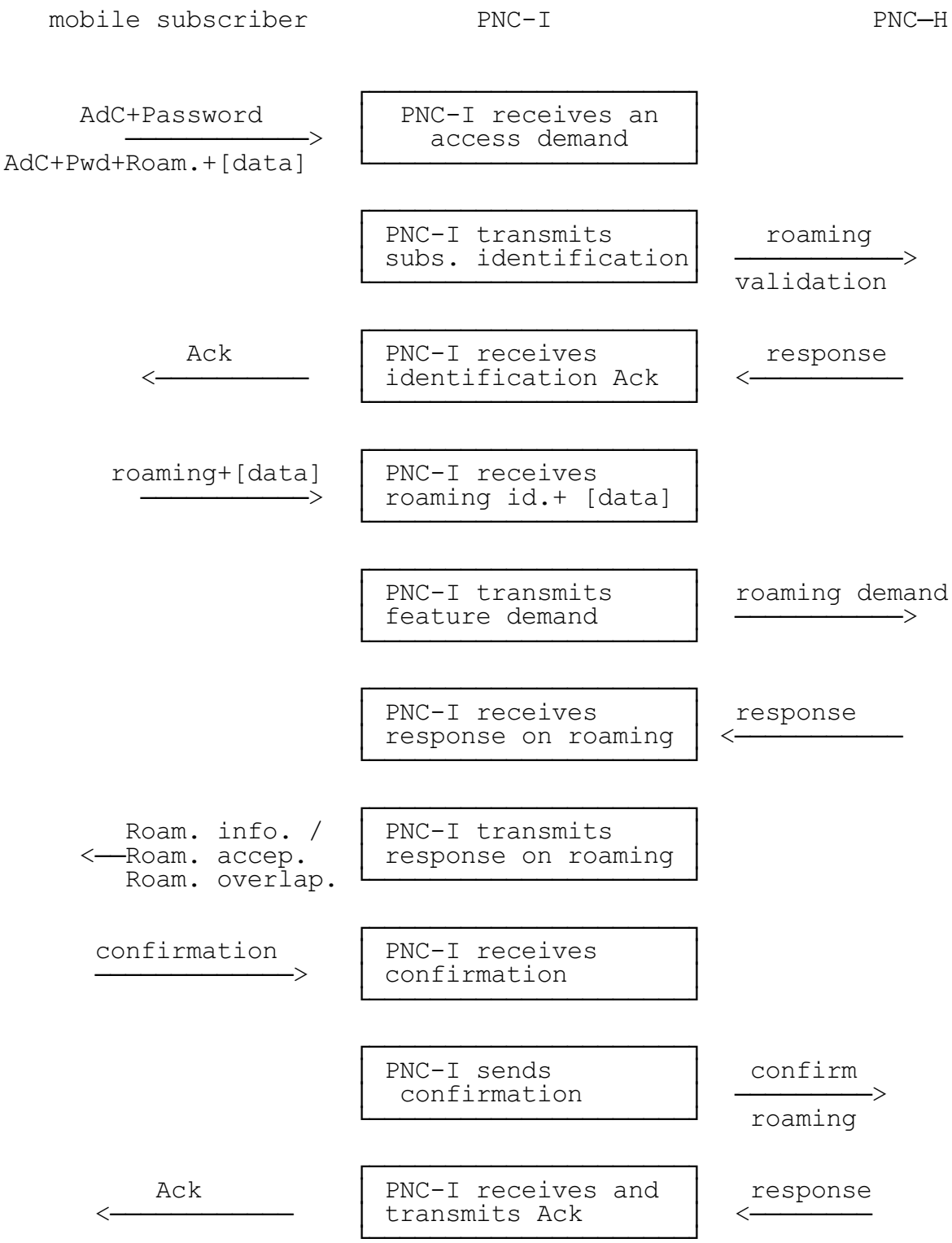


Figure 9: PNC-I processing

7.2.4.1.3 PNC-H processing

Figure 10 gives an overview of PNC-H processing.
PNC-H must act on the reception of the AdC and control the identification of the MS using the password sent by the PNC-I.

Then PNC-H sends the identification acknowledgement to the PNC-I.

After receiving the roaming demand the PNC-H consults the database of the subscriber and sends back information to the PNC-I. This response contains either all the roaming information of the database in the case of roaming information demand or information on correct demand and overlapping in the case of roaming modification demand.

Receiving the confirmation in the case of roaming modification demand the PNC-H updates the database and sends the acknowledgement to the PNC-I.

At the start of the roaming period the PNC-H may optionally send a paging message to the MS to confirm that roaming has been activated.

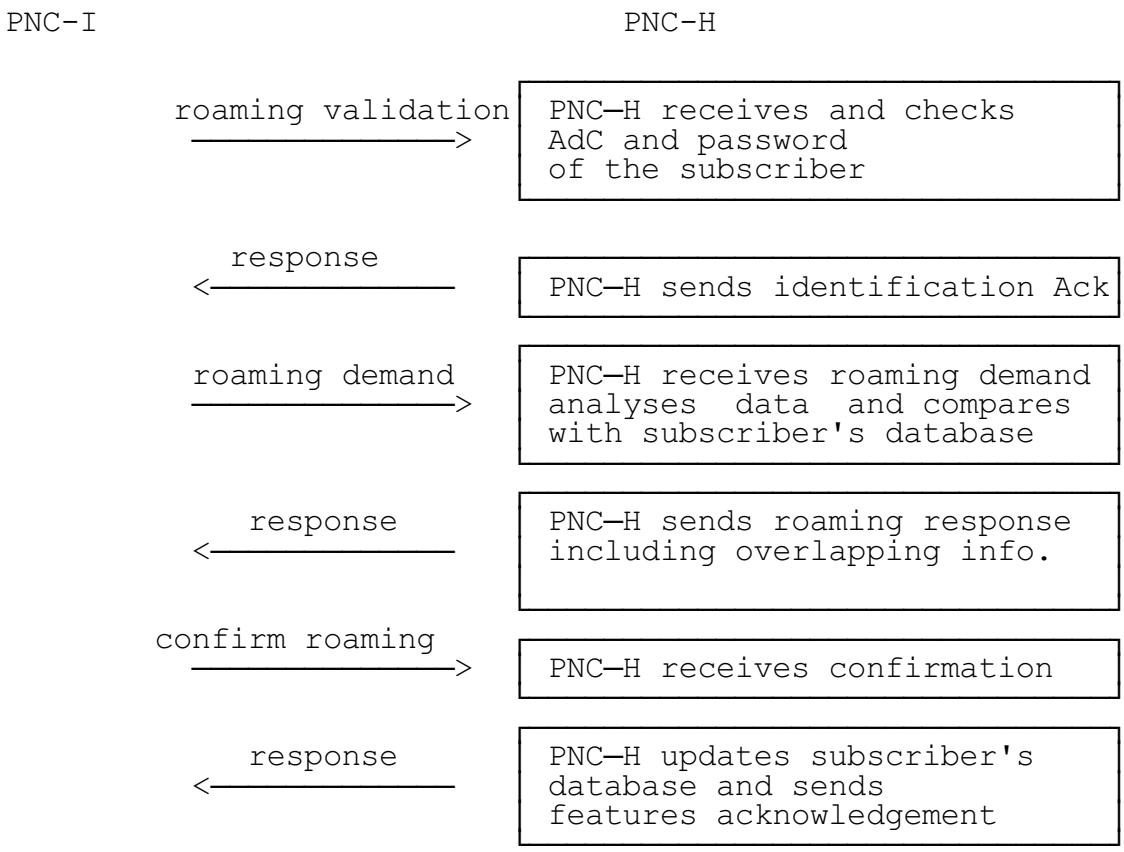


Figure 10: PNC-H processing

7.2.4.2 Temporary barring

This optional SF allows MSs to temporarily (for a specified time/date) prevent acceptance of any call, regardless of its origin. The system shall inform the calling party that temporary barring is activated and it shall offer a facility to give suitable information, e.g. duration of temporary barring of incoming traffic, to the calling party. This information may be a standard text message stored in the system or a text message programmed by the MS. This SF may only be accessed directly via the PNC, which is the PNC-H of the MS (i.e. PNC-I = PNC-H).

The MS when asking for activation of this SF shall be informed if any deferred calls are waiting to be delivered to him. These calls shall be delivered after the de-activation of the temporary barring.

Call processing of temporary barring activation (or MS initiated de-activation) shall follow the stages given below.

a) The MS accesses his PNC-H using an access method on which SFs are supported.

b) The MS inputs his AdC and AC.

c) The PNC-H authenticates the MS by checking the validity of the AdC and AC against the contents of the MS's database.

d) The MS inputs a temporary barring activation request (or a temporary barring de-activation request).

e) In the case of a temporary barring activation request, the PNC-H shall inform the MS if any deferred calls are waiting to be delivered to him.

f) In the case of a temporary barring activation request, the MS shall specify the duration of the barring of incoming calls and shall identify the message that shall be sent to a calling party in the case that temporary barring is active. If the MS wishes to define his own text message, suitable prompts should be provided.

g) In the case of a temporary barring activation request, the PNC-H shall check whether the specified duration and the identified text message are in accordance with the network operator's policy. The PNC-H shall activate temporary barring for the specified duration and it shall store the related information.

   In the case of a MS initiated temporary barring de-activation request, the PNC-H shall de-activate the temporary barring facility and shall start processing deferred calls (if any, and according to normal call processing for deferred calls) that were waiting to be transmitted to the MS at activation of the temporary barring facility and whose defined defer time is expired.

h) The PNC shall send an appropriate SF acknowledge to the MS.

7.2.4.3 Deferred delivery

This optional SF enables a MS to instruct the PNC that any message being submitted should be delivered no sooner than a specified date and time. The possibility to specify date and time for Deferred Delivery (DD) may be subject to limitations set by the network operator of the PNC-H of the MS. A MS may, when activating this SF, choose to program a text message containing information about this activation for a calling party. This SF may only be accessed directly via the PNC, which is the PNC-H of the MS (i.e. PNC-I = PNC-H).

When DD is activated, the priority 1 service cannot be activated by the calling party.

Call processing of a MS DD activation (or de-activation) request shall follow the stages detailed below:

a) The MS accesses his PNC-H using an access method on which SFs are supported.

b) The MS inputs his AdC and AC.

c) The PNC-H authenticates the MS by comparing the AdC and AC against the contents of the MS's database.

d) The MS inputs either a DD activation request or a DD de-activation request. Together with the DD activation request the MS shall input the date and time before which no calls should be transmitted and the MS may input a text message, that shall be sent to a calling party in the case that DD is active.

e) In the case of a DD activation request, the PNC-H shall check the validity of the request (i.e. is the request in accordance with the MS's database and are the specified date and time in accordance with the limitations set by the network operator). In the case of a positive check, the PNC-H shall activate the DD SF.

In the case of a DD de-activation request, the PNC-H shall compare the request with the information in the MS's database.

f) The PNC shall send an appropriate SF acknowledge to the MS.

7.2.4.4 Call diversion

This optional SF allows the MS to divert calls to another AdC on the PNC-H of the MS or to an AdC on another PNC within the ERMES system. This SF may only be accessed via the PNC which is the PNC-H of the MS (i.e. PNC-I = PNC-H). Call diversion to systems outside of the ERMES system is possible, but is outside of the scope of this specification.

Call diversion is applicable to an AdC.

Activation for a group using a common RIC shall affect the whole group.

For Closed User Groups (CUG) using individual RICs it is possible to divert the call only within the CUG.

Call processing of a MS call diversion request shall follow the stages detailed below:

a) The MS accesses his PNC-H using any of the access methods on which SFs are supported;

b) The MS inputs his AdC and AC;

c) The PNC-H validates the AdC and AC;

d) The MS identifies the SF required (call diversion);

e) The PNC-H validates that call diversion is subscribed to by the MS;

f) The MS inputs the AdC of the receiver to which calls are to be diverted (the divert AdC);

g) The PNC-H shall validate the divert AdC (using the I4 operation pager information if the divert AdC belongs to another PNC) and shall check that it is for the same category of receiver as the AdC from which calls are to be diverted, and that call diversion has not been activated on the divert AdC. If the paging categories are not compatible or if call diversion has been activated on the divert AdC the MS request for call diversion shall not be accepted.

Optionally, numeric calls may be diverted to an alpha-numeric AdC, the PNC-H providing translation of the character sets.

Optionally the PNC may inform the MS of the SSs normally available to him that are not subscribed to by the MS to which calls are to be diverted;

h) If the divert AdC is valid and is for the same category of receiver from which calls are to be diverted, the MS is requested by the PNC to input the start time and date for the diversion. The MS is then requested to input the stop time and date;

i) When all the necessary information has been entered and validated the PNC stores the divert AdC and the start and stop times and dates for the diversion, and sends an appropriate SF acknowledgement to the MS;

j) The MS may access his PNC-H at any time before or during the period of call diversion to cancel the diversion of calls;

k) At the commencement of the period of call diversion the PNC-H of the originating AdC accesses the PNC-H of the divert AdC (called PNC-H(DIV)) using the I4 Operation Call Diversion Start as required.

   If the divert AdC is no longer valid then all calls to the originating AdC shall be rejected. Call diversion remains available as a SF for the MS of the divert AdC for the period during which he is receiving calls on diversion. However, if he wishes to invoke call diversion then he shall be warned that to do so will suspend the diversion of calls to his AdC.

   If the MS to whom calls are being diverted invokes call diversion then, during this second period of call diversion, calls received as a result of the first diversion shall be rejected.

   For the period of call diversion the following SF are not available for the AdC from which calls are being diverted:

   - roaming;

   - storing of messages;

   - automatic re-transmission of the last message number;

l) At the end of call diversion, or if the MS requests call diversion to cease, the PNC-H shall access the PNC-H of the divert AdC using the I4 operation call diversion stop as required, and inform the PNC that call diversion from the indicated AdC is no longer in operation.

7.2.4.5 Message retrieval

This optional SF offers the MS the possibility to retrieve a lost message. The retrieved message shall be presented to the MS together with the message number and the stored date/time. The MS should have the possibility to choose the way of presenting the retrieved message (e.g. retransmission via the radio path, displaying on a specified terminal or retrieval by other means). This SF may only be accessed directly via the PNC, which is the PNC-H of the MS (i.e. PNC-I = PNC-H).

Call processing of a MS Message Retrieval request shall follow the stages described below:

a) the MS accesses his PNC-H using an access method on which SFs are supported;

b) the MS inputs his AdC and AC;

c) the PNC-H authenticates the MS by checking the validity of the AdC and AC;

d) the MS inputs a message retrieval request;

e) in the case of message retrieval with re-transmission via the radio path, the PNC-H shall process the request further in the same way as an ordinary page input that is accepted from a calling party and shall forward the message(s) using the original message number(s);

f) the PNC shall send an appropriate SF acknowledge to the MS.

7.2.4.6 Password management

The network shall provide the MS a facility to manage the password (Authentication Code) using any appropriate access method defined by the network operator. The password is used for authentication purposes. This SF may only be accessed directly via the PNC, which is the PNC-H of the MS (i.e. PNC-I = PNC-H).

The stages of call processing for password management shall be as detailed below:

a) The MS shall access his PNC-H using an access method on which SFs are supported;

b) The MS shall input his AdC and AC;

c) PNC-H shall authenticate the MS by comparing the AdC and the AC against the contents of the MS's database;

d) The MS shall indicate a password management action to the PNC-H;

e) The PNC-H shall ask for a new password from the MS;

f) After checking the correctness of the new password, the PNC-H shall store the new password in the MS's database;

g) The PNC shall send an appropriate SF acknowledge to the MS.

7.2.4.7 Legitimisation code management

The use of a legitimisation code allows the PNC to ensure that a calling party is authorised to carry out a certain restricted operation (an operation which is not allowed to all calling parties). The calling party shall be authorised by a MS to carry out this restricted operation by disclosure of the legitimisation code. The network shall provide a facility to enable the MS to manage the legitimisation code using any appropriate access method defined by the network operator. This SF may only be accessed directly via the PNC which is the PNC-H of the MS (i.e. PNC-I = PNC-H).

The stages of call processing for the management of a legitimisation code by a MS shall be as detailed below:

a) The MS shall access the PNC-H using an access method on which SFs are supported;

b) The MS shall input his AdC and AC;

c) PNC-H shall authenticate the MS by comparing the AdC and the AC against the contents of the MS's database;

d) The MS identifies the SF and requests a change of legitimisation code;

e) The PNC shall ask for a new legitimisation code from the MS;

f) After checking the correctness of the new legitimisation code, the PNC-H shall store the new legitimisation code in the MS's database;

g) The PNC shall send an appropriate SF acknowledge to the MS.

7.2.4.8 All features reset

The system shall provide a facility to the MS to reset all his SFs to the initial default state, as defined by the network operator. This SF may only be accessed directly via the PNC, which is the PNC-H of the MS (i.e. PNC-I = PNC-H).

Call processing of a MS "All Feature Reset" request shall be as described below:

a) The MS shall access his PNC-H using an access method on which SFs are supported;

b) The MS inputs his AdC and AC;

c) The PNC-H authenticates the MS by comparing the AdC and AC against the contents of the MS's database;

d) The MS requests an all Feature Reset;

e) The PNC-H shall reset all SFs related to the MS [Roaming, Temporary barring, DD and Call diversion] to their initial default state, defined by the network operator;

f) The PNC shall send an appropriate SF acknowledgement to the MS.

7.3 Call processing transaction time limits

ETS 300 133-2 [2] defines Quality of Service (QOS) limits. When the call processing affecting a QOS limit is contained within a single PNC then the PNC shall meet the applicable limit.

In order to guarantee these QOS limits when two or more PNCs are involved in the processing of a call (i.e. when an I4 operation is involved - see Clause 10), the following time limits shall be met when initiating or processing the applicable I4 transaction. The time limit specified shall be met for greater than 90% of calls processed:

I4 Operation	Time delay limit (seconds)	
	PNC-I	PNC-H
Pager information	3	3
Choice of destination	3	3
Page request	5	5
Roaming validation	3	3
Roaming reset	3	3
Roaming information	3	3
Change roaming	3	3
Confirm change of roaming	3	3

The PNC-I time includes three elements:

- the processing time from when the user terminates the input until the applicable I4 operation is placed into the PNC I4 output queue;
- the time the transaction is queued before being transmitted to the PNC-H;
- the processing time from receiving the I4 response from the PNC-H until a response is given to the user.

NOTE: For the page request operation the response (acknowledgement) is given to the calling party before the I4 response is received from the PNC-H except, optionally, for group calls.

The PNC-H time includes two elements:

- the processing time from the receipt of the I4 operation until the applicable I4 response is placed into the PNC I4 output queue;
- the time the transaction is queued before being transmitted to the PNC-I.

The response time experienced by the user shall include the above processing times and also the transmission delay within the PSPDN. The limits for PSPDN transmission delay are detailed in CCITT Recommendation X.135 [36].

For the transmit I4 operation the following processing time limits shall be met for greater than 90% of calls processed:

I4 Operation	Time delay limit (seconds)	
	PNC-H	PNC-T
Transmit	5	5

The PNC-H time includes two elements:

- the processing time from when the user terminates the input (or from the receipt of an I4 page request) until the transmit I4 operation is placed into the PNC I4 output queue;

- the time the transaction is queued before being transmitted to the PNC-T.

The PNC-T time includes two elements:

- the processing time from the receipt of the I4 operation until the applicable I4 response is placed into the PNC I4 output queue;

- the time the transaction is queued before being transmitted to the PNC-H.

For the call diversion (DIV) I4 operations the following processing time limits shall be met for greater than 90% of calls processed:

I4 Operation	Time delay limit (seconds)	
	PNC-H	PNC-H(DIV)
Call diversion start	5	5
Call diversion end	5	5

The PNC-H time includes two or three elements:

- the processing time from when the call diversion is initiated or ended until the applicable I4 operation is placed into the PNC I4 output queue;

- the time the transaction is queued before being transmitted to the PNC-H(DIV);

- If the call diversion start or stop results from a MS request for immediate action - the processing time from receiving the I4 response from the PNC-H until a response is given to the MS.

The PNC-H(DIV) time includes two elements:

- the processing time from the receipt of the I4 operation until the applicable I4 response is placed into the PNC I4 output queue;

- the time the transaction is queued before being transmitted to the PNC-H.

8 Access methods

8.1 General

Facilities shall be offered to the user to gain access to the requested service and/or the SS. The access method shall depend on:

- access network;
- access type;
- access mode;
- access terminal.

A combination of these four parameters shall identify an access method. A list of some possible access methods is given in Annex C (informative). Other options may also be offered.

Access methods fall into two categories:

- telephonic (access methods 1, 2 and 3 in Annex C), making use of a telephone set;
- non-telephonic, using any other type of terminal.

Procedures (dialogues) for each access method shall conform to the relevant subclause of Clause 8. These procedures shall be harmonised as much as possible. An access service is defined as a set of such access methods.

When using an interactive mode, the experienced user should be able to bypass some parts of the dialogue (i.e. not to receive all the guidance from the system).

Bureau access methods shall offer access only to features already subscribed.

Access by the calling party to some SSs is only permitted by legitimisation (e.g. see Annex D, figure D.3.8). The access by mobile or FSs is only permitted by authentication (see Annex D, figure D.5).

Subclause 8.2 defines the essential and optional access methods for each service and SS. In addition the following general principles shall apply, unless stated otherwise in subclauses 8.3 to 8.9 (concerning the dedicated access methods):

- two-stage selection type shall normally be used with non telephonic access methods;
- provision of multi-language access is not essential and shall be according to network operator's policy;
- it is not essential that all offered SSs are accessible with each access method;
- the special characters defined in subclause 8.1.5 shall be used for access methods 2 and 3 and are recommended for other access methods;
- when using one-stage selection type, only one paging call shall be allowed within the session.

To harmonise the dialogues among the different access methods, generic protocols are described in subclauses 8.1.1 to 8.1.3.

8.1.1 Generic protocol for non-interactive access mode

The access procedure is a non-interactive operation used by either automatic emitting devices or subscriber terminals, where prompt signals from the PNC are not required.

The operation for each call may be divided in the following phases:

a) Preparation;

- preparation of the call in local mode.

b) Transmission (automatic);

- call establishment (calling party-PNC-I);
- information transfer;
- ACK/NACK and call clearing.

The call may consist of one or more messages according to the network operator's policy.

The network dependent control procedures should be those which are defined for the access network on which the ERMES service is provided.

8.1.2 Generic protocol for interactive access mode - two-stage selection

The calling party may access the system via one of the two service numbers.

Service number 1 (SN1)

- primarily intended for call input and access to call-input related SSs.

Service number 2 (SN2)

- primarily intended for access to control the SFs.

SN1 and SN2 shall be provided for certain access types e.g. telephonic access. However, it is a matter of network operator's policy whether or not to permit users to input calls and access SFs from a single SN for all other types of access.

The protocol has been divided to show the principal dialogue accessible via each of the two service numbers. The optional links between them are also shown.

8.1.2.1 Functional description of the protocol

8.1.2.1.1 Common elements (for both service numbers)

After every input prompt the system starts a timer and then waits for input from the calling party. The wait time T1 is defined by the network operator. The system shall validate each character as it is input and may give an error indication if the character is invalid. The sequence is as shown in Annex D, figure D.1. The system responds according to the input received as follows:

a) Complete input.

The information plus terminator is received and the complete input may then be validated. For certain types of access the network operator may choose to have the system repeat the input made by the calling party and request confirmation that it is as required. This confirmation is optional and should occur where indicated in Annex D, figure D.1.

b) Incomplete or Interrupted input.

No terminator is received by the system and when t = T1 an interrupt sequence is initiated as shown in Annex D, figure D.1 (see subclause 8.1.2.4.2).

c) No input.

When t = T1, a time-out sequence is initiated as shown in Annex D, figure D.1 (see subclause 8.1.2.4.3).

d) Quit command.

Depending on the access method, the Quit command may be either a single character (see Annex D, figure D.1) or a combination of characters (see Annex D, figure D.2). In either case the system normally presents the closing message and the call is terminated.

e) Escape command.

Depending on the access method, the Escape command may be either a single character (see Annex D, figure D.1) or a combination of characters (see Annex D, figure D.2). In either case the system shall delete an incomplete input or move to a previous system input prompt (see subclause 8.1.2.3.1).

f) Help command.

Depending on the access method, the Help command may be either a single character (see Annex D, figure D.1) or a combination of characters (see Annex D, figure D.2). In either case the system initiates a help sequence. See subclause 8.1.2.4.1.

8.1.2.1.2 Protocol via service number 1 (SN1)

The calling party accesses the system using SN1. A dialogue then proceeds between the calling party and the system as described in Annex D, figure D.2. The optional links to the SN2 protocol are also shown.

In order to make a paging call, the calling party is required to input the AdC and message (if relevant). According to network operator's policy, a decision is then made by the calling party whether or not to make a follow-on call. When the call is completed, the system presents the closing message and the call is terminated.

The network operator may choose whether or not to support the subscriber directory and specific call input related SSs via this SN.

Call-input related SSs.

The calling party may enter either:

1) the AdC with block separator followed by the call input related SS identification code with its associated parameters with terminator; or

2) the AdC with terminator followed by the call input related SS identification code with its associated parameters with terminator, prior to entering the message part with terminator as shown in the two examples below:

a)

System		Calling party
Enter AdC	AdC#	
Enter message		*72#
Enter message		ABCDEFG#
Page accepted		

b)

System		Calling party
Enter AdC	AdC*72#	
Enter message		ABCDEFG#

Page accepted

The dialogue for each SS is shown in Annex D, figures D3.1 to D3.8.

When the relevant details have been provided the calling party is returned to the main protocol and may then choose further SSs or may input the message as required.

Examples of typical calls via SN1 are shown in Annex G, figures G1.1 to G1.3.

8.1.2.1.3 Protocol via Service Number 2 (SN2)

The calling party accesses the system using SN2. A dialogue then proceeds between the calling party and the system as described in Annex D, figure D.5. The optional links to the SN1 protocol are also shown.

Following input of the AdC (to which the SFs are to apply) together with an AC, the calling party chooses a specific SF. The calling party may, at this point, ask for the status of a particular SF. The system selects the appropriate dialogue to direct the calling party to input the required information. Further authentication may be required for some SFs and this would be requested in the dialogue. The calling party may input an identification code to cause all SFs details to be reset (see ETS 300 133-2 [2], subclause 5.3.1.1.2).

For every SF with start and stop date and time, the calling party should be able to choose the activation moment as the starting date and time. The ending date and time may be omitted. The duration is predetermined by each operator.

The dialogue for roaming is shown in Annex D, figure D.6 as this is the only mandatory SF. The calling party may change or check the status of the SFs for the required AdC.

Optionally, the network operator may permit the calling party to access more than one SF during the same call. When the caller decides to end the call the system presents the closing message and the call is terminated.

8.1.2.2 System responses and acknowledgement

This subclause specifies the general system response and acknowledgement types together with a brief description where appropriate. The specification of the format and wording for all responses and acknowledgements in every provided language is to be defined by the network operator, as is the extent of the help and guidance facilities (see also subclause 8.1.2.4).

All system responses and acknowledgements are presented by the system within a time specified by the QOS limits for the ERMES service which are contained in ETS 300 133-2 [2], subclause 7.2.

The system should be capable of recognising input from the calling party made during a system response. Any input made should suppress the rest of the system response.

8.1.2.2.1 General system messages

Table 4 describes the general system messages. The network operator may choose the wording of these messages.

Table 4: General system messages

Message Type	Description
Greeting message	A greeting to the calling party on initial access to the system.
Closing message	A goodbye message to the calling party before the line is disconnected. This message is normally presented in response to a calling party's decision that the call is completed.

If the system closes the call, a closing message shall be presented. It is optional for a closing message to be presented following the page accepted acknowledgement.

8.1.2.2.2 Input prompts

Tables 5 and 6 describe the input prompts generated by the system and the response normally expected from the calling party. The network operator may choose the wording of the prompts.

Table 5: Input prompts

Prompt by system	Input expected	Additional notes
Address code request	Address code	
Message request	Message	The message request input prompt may vary according to the facilities of the pager and address code selected
Authentication request	Authentic-ation code	
Legitimisation request	Legitimis-ation code	
Follow-on call	Decision	The network operator may also permit the calling party to input the transfer to subscriber features command
Subscriber feature request	Identificat-ion of the Subs.Feature	
Subscriber feature parameter request	Feature parameter	Depends on the subscriber feature selected
More transactions request	Decision	The network operator defines the options available to the calling party
Confirm correct	Decision	Optionally used in validati-on sequence where the system repeats the input received
More help request	Decision	
Change to subscrib-er features request	Decision	

Table 6: Roaming input prompts

Prompt by system	Input expected	Additional notes
Geographical areas request	Geographical areas	
Start date and time request	Start date and time	Implicit acknowledgement of acceptance of areas
Stop date and time request	Stop date and time	
More roaming request	Decision	

8.1.2.2.3 Input acknowledgements

A positive response of call accepted or SS acknowledgement may be replaced by continuing with the protocol. The system therefore presents the next input prompt or system message. These imply an acknowledgement of the previous input as indicated in subclause 8.1.2.2.2.

A conditional acceptance may be given by the system if the network status is between the upper and lower call acceptance thresholds. On receipt of a conditional acceptance the calling party is required to confirm that he wishes to continue the input of the call. Where the calling party's input receives a negative acknowledgement, i.e. call not accepted or page not accepted, the network operator may supply additional information to the calling party describing the reasons for this response.

There are specific input acknowledgement types as shown in table 7 below:

Table 7: Input acknowledgement types.

Acknowledgement	Explanation
Call accepted (call not accepted)	The called address is (is not) valid and the system is (is not) ready to accept the call
Call conditionally accepted	The network status is low
Page accepted (page not accepted)	The additional information and/ or the optional features are (are not) valid and the call shall (shall not) be transmitted
Supplementary service acknowledgement	Supplementary service is (is not) valid
Supplementary service status acknowledgement	Supplementary service is (is not) active - response to status check
Subscriber feature acknowledgement	The feature has (has not) been successfully completed
Authentication invalid	The authentication code input is invalid
Legitimisation invalid	The legitimisation code input is invalid
Incomplete/no input acknowledgement	This message is presented when the wait time has elapsed and either no input or an incomplete input has been received
NOTE: The network operator may choose the acknowledgement wording.	

8.1.2.2.4 Help and guidance messages

The full extent of the help and guidance facilities are for the network operator to define. The message types shown in table 8 should be provided:

Table 8: Help and guidance message types

Message type	Description
General help message	Details of how to access the help facilities
Input specific guidance messages	Range subject to network operator's policy
Final input opportunity	This message is appended to guidance information on the final opportunity to input information when help, interrupt, time-out sequences have been invoked or invalid information for a validation or legitimisation sequences has been input

8.1.2.3 Input editing and typing error correction

8.1.2.3.1 The escape command

If at the system prompt the escape command only is input, the system shall step back through the protocol to the previous input prompt. New information may then be input. The calling party may use the escape command to step back through the protocol as far as the previous AdC request prompt.

If the escape command is input following an incomplete input (i.e. prior to the terminator), the incomplete input shall be deleted and the calling party may then input new information.

8.1.2.3.2 Other editing commands - terminals other than DTMF telephones

Individual characters and the format of inputs are validated as they are input. The calling party may edit the input using the facilities provided on the PNC prior to the (input) terminator being input. (After the terminator is input the system assumes that the input is complete). If the system finds the input is invalid, the calling party shall be prompted to make a new input or to edit the previous input, (the latter is an option for the network operator).

As a minimum, the following editing facilities shall be provided:

a) delete previous character;

b) delete line (all characters until the previous carriage return);

c) print line (re-display the contents of the field).

8.1.2.4 Guidance to the calling party

All system input prompts should be unambiguous and clearly describe what input the system expects from the calling party. The system presents a general help message following the greeting banner which describes how to access additional help information.

Appropriate guidance messages are presented according to the input by the calling party.

8.1.2.4.1 Help command

A help message specific to the particular input prompt is given. The full extent of the help facilities available to the calling party is a matter of network operator's policy.

8.1.2.4.2 Incomplete or interrupted input

A guidance message specific to the particular input prompts is given. The network operator may also present guidance relating to the incomplete input made by the calling party. The calling party is then reprompted to make an input. The incomplete input made by the calling party prior to the guidance

message is not affected. The network operator defines the number of times this guidance is given. A final guidance message is also presented to the calling party prior to the last input opportunity.

8.1.2.4.3 No input - time-out

A guidance message specific to the particular input prompt is given. The calling party is then re-prompted to make an input. The network operator defines the number of times this guidance is given. A final guidance message is also presented to the calling party prior to the last input opportunity.

8.1.2.4.4 Invalid input

A guidance message relating to the reasons for rejection of the input is given. The calling party is then re-prompted to make an input. The network operator defines the number of times this guidance is given. A final guidance message is presented to the calling party prior to the last input opportunity.

8.1.3 Generic protocol for interactive access mode - one-stage selection

In one-stage selection the calling party accesses the system directly using the AdC of the MS.

8.1.3.1 Functional description of the protocol

The protocol enables calling parties to make a one-stage selection call to the system in order to initiate paging calls. Call-input related SSs may also be accessed. SFs are not supported by this protocol.

The protocol is shown in Annex D, figure D.4.

8.1.3.1.1 Common elements

After every input prompt the system starts a timer and then waits for input from the calling party. The wait time T1 is defined by the network operator. The system shall validate each character as it is input and may give an error indication if the character is invalid. The sequence is as shown in Annex D, figure D.1. The system responds according to the input received as follows:

a) Complete input.
The information plus terminator is received and the complete input may then be validated. For certain access methods the network operator may choose to have the system repeat the input made by the calling party and request confirmation that it is as required. This confirmation is optional and should occur where indicated in Annex D, figure D.1.

b) Incomplete or Interrupted input

No terminator is received by the system and when t = T1 an interrupt sequence is initiated as shown in Annex D, figure D.1. See subclause 8.1.2.4.2.

c) No input.

When t = T1, a time-out sequence is initiated as shown in Annex D, figure D.1. See subclause 8.1.2.4.3.

d) Quit command.

Depending on the access method, the Quit command may be either a single character (see Annex D, figure D.1) or a combination of characters (see Annex D, figure D.2). In either case the system normally presents the closing message and the call is terminated.

e) Escape command.

Depending on the access method, the Escape command may be either a single character (see Annex D, figure D.1) or a combination of characters (see Annex D, figure D.2). In either case the system shall delete an incomplete input or move to a previous system input prompt. See subclause 8.1.2.3.1.

f) Help command.

Depending on the access method, the Help command may be either a single character (see Annex D, figure D.1) or a combination of characters (see Annex D, figure D.2). In either case the system initiates a help sequence (see subclause 8.1.2.4.1).

8.1.3.1.2 The protocol

The protocol is as shown in Annex D, figure D.4 and typical call examples are shown in Annex G figures G2.1 to G2.3.

8.1.3.2 System responses and acknowledgements

This subclause specifies the general system response and acknowledgement types together with a brief description where appropriate. The specification of the format and wording for all responses and acknowledgements, for each language provided, is to be defined by the network operator, as is the extent of the help and guidance facilities (see also subclause 8.1.3.4).

All system responses and acknowledgements shall be presented by the system within the times specified by the QOS limits for the ERMES service. These are defined in ETS 300 133-2 [2], subclause 7.2.

The system should be capable of recognising input from the calling party made during a system response. Any input made should suppress the rest of the system response.

8.1.3.2.1 General system message

Table 9 describes the general system messages. The network operator may choose the wording of these messages.

Table 9: General system messages

Message Type	Description
Greeting message	A greeting to the calling party on initial access to the system
Closing message	A goodbye message to the calling party before the line is disconnected. This message is normally presented in response to a calling party's decision that the call is completed

If the system closes the call, a closing message shall be presented. It is optional for a closing message to be presented following the page accepted acknowledgement.

8.1.3.2.2 Input prompts

Table 10 describes the input prompts generated by the system and the response normally expected from the calling party. The network operator may choose the wording of these prompts.

Table 10: Input prompts and expected responses

Prompt from the System	Input expected by the system	Additional notes
Message request	Message	The message request input prompt may vary according to the facilities of the pager and address code selected.
Legitimisation request	Legitimisation code	
More transactions request	Decision	The network operator defines the options available to the calling party. This is only applicable to supplementary services and not calls
Optional Prompts		
Confirm correct	Decision	Used in validation sequence where the system repeats the input received
More help request	Decision	

8.1.3.2.3 Input acknowledgments

A positive response of call accepted or SS acknowledgement may be replaced by continuing with the protocol. The system therefore presents the next input prompt or system message. These imply an acknowledgement of the previous input.

A conditional acceptance may be given by the system if the network status is between the upper and lower call acceptance thresholds. On receipt of a conditional acceptance the calling party is required to confirm that he wishes to continue the input of the call.

When a negative acknowledgement is given to an input made by the calling party i.e. legitimisation invalid, the network operator may supply additional information to the calling party describing the reasons for the response.

There are specific input acknowledgment types as shown in table 11 (the network operator may choose the wording of the acknowledgements):

Table 11: Input acknowledgements

Acknowledgement	Explanation
Call accepted (call not accepted)	The called address code is (is not) valid and the system is (is not) ready to accept the call
Call conditionally accepted	The network status is low
Page accepted (page not accepted)	The additional information and/or the optional supplementary services are (are not) valid and the call shall (shall not) be transmitted
Legitimisation invalid	The legitimisation code input is invalid
Incomplete/no input acknowledgement	This message is presented when the wait time has elapsed and either no input or an incomplete input (i.e. no terminator) has been received
Supplementary service acknowledgement	Supplementary service is (is not) valid

8.1.3.2.4 Help and guidance messages

The full extent of the help and guidance facilities are for the network operator to define. Message types as described in subclause 8.1.2.2.4 should be provided.

8.1.3.3 Input editing and typing error correction

8.1.3.3.1 The escape command

If at the system prompt the escape command only is input, the system shall step back through the protocol to the previous input prompt. New information may then be input. The calling party may use the escape command to step back through the protocol as far as the initial system input prompt.

If the escape command is input following an incomplete input (i.e. prior to the terminator), the incomplete input is deleted and the calling party may then input new information.

8.1.3.3.2 Other editing commands - terminals other than DTMF telephones

Individual characters and the format of inputs are validated as they are input. The calling party may edit the input using the facilities provided on the PNC prior to the (input) terminator being input. After the terminator is input the system assumes that the input is complete. If the system finds the input is invalid, the calling party shall be prompted to make a new input or to edit the previous input, (the latter is an option for the network operator).

As a minimum the following editing facilities shall be provided:

a) delete previous character;

b) delete line (all characters until the last carriage return);

c) print line (re-display the contents of the field).

8.1.3.4 Guidance to the calling party

All system input prompts should be unambiguous and clearly describe what input the system expects from the calling party. The system presents a general help message following the greeting banner which describes how to access additional help information.

Appropriate guidance messages are presented according to the input by the calling party.

8.1.3.4.1 Help command

A help message specific to the particular input prompt is given. The full extent of the help facilities available to the calling party is a matter of network operator's policy.

8.1.3.4.2 Incomplete or interrupted input

A guidance message specific to the particular input prompts is given. The network operator may also present guidance relating to the incomplete input made by the calling party. The calling party is then re-prompted to make an input. The incomplete input made by the calling party prior to the guidance message is not affected. The network operator defines the number of times this guidance is given. A final guidance message is also presented to the calling party prior to the last input opportunity.

8.1.3.4.3 No input - time-out

A guidance message specific to the particular input prompt is given. The calling party is then re-prompted to make an input. The network operator defines the number of times this guidance is given. A final guidance message is also presented to the calling party prior to the last input opportunity.

8.1.3.4.4 Invalid input

A guidance message relating to the reasons for rejection of the input is given. The calling party is then re-prompted to make an input. The network operator defines the number of times this guidance is given. A final guidance message is presented to the calling party prior to the last input opportunity.

8.1.4 Character conversion

Character conversion is applicable for numeric and alphanumeric services and applies only to the message part.

NOTE: The access method may limit access to the complete ERMES character set.

Each PNC shall have a character conversion table for each access method supported by the PNC. The character conversion tables shall be defined by the operator according to national requirements.

Only the PNC-I shall perform character conversion. Where a page or transmit request is received via the I4 interface from another PNC no conversion shall be performed.

If a calling party inputs a character which is not mapped by the operator to the ERMES character set then that character shall be rejected and the calling party shall be notified.

8.1.5 Use of special characters

In order to harmonise the user access to the ERMES system, figure 11 presents a set of special characters and their implementation in different access methods. The characters shall be used in the DTMF access. Their use is recommended for other access methods.

Access Type / Function	DTMF telephone	Alpha numeric terminal	Telex	Videotex	MHS	ISDN UUS1	ISDN UUS3	NOTES
Prefix	* and #	/	/	/	/	/	/	NOTE 1
Block Separator	*	/	/	/	/	/or *	/or*	
Parameter Separator	*	,	,	,	,	,	,	
Terminator	#	CR or #	CR LF	CR or #	CR LF	CR or #	CR or #	
End of Message Indicator	#	^Z	CR LF NNNN	^Z		^Z	^Z	^Z = Control+Z
Help			/HELP					
Escape	* #	ESC						
Quit			++++					
Delete Character		DEL or BS	Rub Out					BS = Control+H
Delete Line		^X	XXXXX ANUL					
NOTE 1: Prefix shall be at the beginning of the field. Paging messages may not start with the prefix character.								

Figure 11: Use of special characters in ERMES

More detailed descriptions of the usage of these special characters are in subclauses 8.1.2 and 8.1.3, and in the subclauses describing the associated access dialogues.

In the non-interactive access methods, the special characters used for text editing depend on the system used and are not within the scope of this standard.

8.2 Access methods applicable to each service

The access method numbers referred to in the following subclauses are defined in Annex C.

8.2.1 Basic services

Tone-only paging: access methods 1 and 2 are essential.

Numeric paging: access method 3 is essential.

Alphanumeric paging: it is essential to provide at least one access method having an interactive mode and an alphanumeric terminal.

Transparent data paging: this service has many similarities with alphanumeric paging and several of the access methods defined are able to support transparent data paging. However, bureau access method is not permitted.

8.2.2 Supplementary services

8.2.2.1 Page input related supplementary services

For every page input related SS the access method shall be the same as the associated basic service. For telephonic access methods, support for DTMF shall be provided. The following shall also apply:

Valid input acknowledgement: the full extent and the wording of the message shall be defined by the network operator and may vary according to the access method and the allowed presentation facilities. The meaning of the message shall comply with subclause 8.1.2. With non-interactive access methods this acknowledgement need not be provided.

Choice of destination: with telephonic access methods a limitation may be imposed on the number of Geographical Areas (GAs) the calling party may request in order to utilise a simple dialogue.

Multi-address: with telephonic access methods a limitation may be imposed on the number of addresses the calling party may request in order to utilise a simple dialogue.

Reverse charging: is not allowed with telephonic access methods unless implicitly included in the SN used to access the PNC.

8.2.2.2 Subscriber features

Two-stage selection shall be provided for access to SFs. One-stage selection shall not be allowed.

SF acknowledgement: the full extent and the wording of the message are to be defined by the network operator and may vary according to the access method and the allowed presentation facilities. The meaning of the message shall comply with subclause 8.1.2.

8.2.2.2.1 Subscriber directory

If an electronic directory is provided by the network operator, an interactive mode is recommended. The same access service as for alphanumeric paging service should be offered. Depending on the network operator's choice, it may be accessed via SN1 (see subclause 8.1.2.1.2).

8.2.2.2.2 Fixed subscribers

Only access to the PNC where the FS is registered is permitted. For this reason there is no requirement to harmonise dialogues. However, taking into account the types of information to be managed, the appropriate access methods, normally with interactive mode, are recommended.

8.2.2.2.3 Mobile subscribers

Roaming: access method 3 and one non-telephonic access method with interactive mode and alphanumeric terminal are essential.

For telephonic access some limitations on the number of GAs and/or the number of periods of time may be imposed in order to simplify the dialogue. (Normally one GA associated with one period of time may be activated or deactivated). A status check should provide information on whether or not roaming is activated.

Temporary barring: the provision of appropriate access method(s) shall be determined by each operator.

Deferred delivery: the provision of appropriate access method(s) shall be determined by each operator.

Diversion: the provision of appropriate access method(s) shall be determined by each operator.

Message retrieval: the provision of appropriate access method(s) shall be determined by each operator. When using telephonic access method only retransmission is permitted. Deactivation is not applicable for this service. A status check shall allow the MS to receive the total number of stored messages with the message number of the latest stored message.

Password management: access method 3 is essential if services are provided which require the management of passwords.

Legitimisation code management: access method 3 is essential if services are provided which require the management of legitimisation codes.

All features: the provision of appropriate access method(s) shall be determined by each operator; only deactivation and status check are allowed.

8.3 Telephonic access methods

8.3.1 General

Two access types are applicable for telephonic access: one-stage selection and two-stage selection. In one-stage selection the AdC corresponds to the telephone number used when the ERMES system is accessed. In two-stage selection the ERMES system is first accessed by using a SN. The AdC is entered when the connection to the PNC is established.

The use of Dual Tone Multi-Frequency (DTMF) is assumed except in one-stage selection for tone-only service.

8.3.1.1 Input editing and typing error correction

In the telephonic access the escape command may be used to correct typing errors. The operation of the escape command is described in subclause 8.1.2.3.1. The character sequence *# is used as an escape command and the 'end of message' indication is #.

8.3.1.2 Invoking the characters in the numeric service

The numeric message character set is defined in ETS 300 133-2 [2]. Figure 12 shows the keyboard lay-out that shall be used when inputting these characters using the DTMF telephone access method. Numbers shall be entered by a single press of the corresponding keyboard button. Non-numeric characters shall be selected by pressing and releasing the asterisk (*) as a shift character and then pressing the number corresponding to the non-numeric character. For example a numeric message 358-1234/111 is typed: **358 *4 1234 *1 111**

/ 1	SP 2	U 3
– 4	. 5	% 6
7	8	9
*	0	#

Figure 12: Coding of ERMES numeric characters with a DTMF keypad (where SP = Space).

8.3.1.3 Invoking the characters in the alphanumeric service

An alphanumeric message may contain all the numeric characters and the capital letters from A to Z.

Figures 13 and 14 present two alternatives how to code letters and non-alphanumeric characters with a DTMF telephone keyboard. Other alternatives may be defined by the network operator.

/ 1 SP	SP 2 A B C	U 3 D E F
- 4 G H I	. 5 J K L	% 6 M N
7 P R S	8 T U V	9 W X Y
* Esc AI num	0 O Q Z	#

Figure 13: CEPT T/SF Guide-line proposal

/ 1 A B C	SP 2 D E F	U 3 G H I
- 4 J K L	. 5 M N O	% 6 P Q R
7 S T U	8 V W X	9 Y Z
* Esc AI Num	0 SP ?	#

Figure 14: CEPT T/CS 34-15

The system has two operational modes, numeric mode and alphanumeric (alpha) mode. The default mode is numeric and the alphanumeric mode is started by the character sequence **d# where "d" is a digit indicating the type of keyboard used (d = 1 for the keyboard of figure 13 and d = 2 for the keyboard of figure 14). The "d" digit is not required if the calling party uses the default keyboard recommended by the operator. The character sequence ***# ends the alpha mode and the system returns to the numeric mode.

In the numeric mode the numbers are entered by pressing directly the keyboard buttons and non-numeric characters are selected by using the asterisk (*) as a shift character followed by the corresponding number.

In the alpha mode the number of times the button is pressed indicates the selected character. The leftmost character is selected when the button is pressed once, two pressings selects the middle character and

three selects the rightmost one. The selection is confirmed by pressing the character #. When the coding presented in figure 13 is used, the sentence WELCOME AT 10.30 is typed as follows:

**# 9# 33# 555# 222# 0# 6# 33# 1#

Alpha W E L C O M E Sp

2# 8# 1# ***# 10 *5 30

A T Sp Numeric 10 . 30

The message is deleted in the alpha mode with a character sequence *#

8.3.1.4 Guidance to the calling party

The use of recorded announcements is preferred because of the possibility of presenting more detailed information.

The system shall have a time-out function that releases the telephone line, if the calling party does not continue the typing within a defined time. A special announcement or tone shall be used as a time-out warning to inform the calling party of the element that should be entered next. The timing, the number of and the structure of the warnings is according to the operator's policy.

If the typing is not continued after the last warning, the telephone line shall be disconnected by the PNC.

8.3.2 One-stage selection method

8.3.2.1 Tone-only message input

8.3.2.1.1 Functional description of the protocol

The calling party dials the MS's tone-only AdC. The tone-only message shall be sent to the MS if the AdC is valid. The calling party shall receive the 'page accepted/call not accepted' acknowledgement, and should then terminate the call.

Only one tone-only message may be sent within one phone call. If the AdC is not valid, the calling party shall be given an error indication, and should hang up the receiver before making further calls.

The PNC shall have a time-out function that disconnects the telephone line, if the calling party does not hang up the telephone within a defined time after the acknowledgement.

If one-stage selection is used, the accessed PNC is always the PNC-H of the MS.

8.3.2.2 Numeric message input

8.3.2.2.1 Functional description of the protocol

The access protocol has two phases. The calling party first dials the AdC. This first phase does not necessarily require the use of DTMF signalling.

If the AdC is not valid, the calling party shall be given an error indication, and should hang up the receiver before making further calls.

If the call is accepted, the calling party is able to access the PNC. The message and End Of Message (EOM) is entered using of DTMF signalling. The PNC shall check the length of the message and that the message contains only those characters specified in the numeric character set given in ETS 300 133-2 [2]. The 'page accepted/page not accepted' acknowledgement shall then be sent to the calling party. If the page is not accepted, the PNC shall indicate that it is ready for another message. The operator may limit the number of trials.

8.3.2.2.2 System responses and acknowledgements

The PNC shall support the responses and acknowledgements defined in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure;
- time-out warning.

8.3.2.3 Alphanumeric service

8.3.2.3.1 Functional description of the protocol

The access protocol has two phases. The calling party first dials the AdC. This first phase does not necessarily require the use of DTMF signalling.

If the AdC is not valid, the calling party shall be given an error indication, and should hang up the receiver before making further calls.

If the call is accepted, the calling party is able to access the PNC. The message and EOM is entered using DTMF signalling. The PNC shall check the length of the message and that the message does not contain characters unacceptable to the receiver. The 'page accepted/page not accepted' acknowledgement shall be sent to the calling party. If the page is not accepted, the PNC shall indicate that it is ready for another message. The operator may limit the number of trials.

8.3.2.3.2 System responses and acknowledgements

The PNC shall support the responses and acknowledgements presented in the subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure;
- time-out warning.

8.3.2.4 Message input with supplementary services

8.3.2.4.1 Functional description of the protocol

In one-stage selection the provision of SSs is restricted to numeric access and alphanumeric access only. The SSs are selected by entering the activation prefix * and the SS identification code after the AdC. Call input related SS identification codes are as follows:

-71 Choice of destination
-72 Repetition
-73 Prioritisation
-74 Multi address call
-75 Urgent message
-76 Deferred delivery
-77 Standard text selected from the list located in the MS's PNC-H
-78 Standard text selected from the list located in the calling party's PNC-I

The additional parameters needed to activate a service are entered after the service identification code. The character * is used as the block separator and the parameter list is terminated by the character #. If the calling party keys the terminator while some of the parameters are still missing, the PNC should guide the calling party to enter the missing parameters.

It is possible to activate several SSs within one call input by entering the new activation prefix, service identification code and the list of parameters after the previous SS terminator. The operator may limit the number and the combination of services within a call.

8.3.2.4.2 System responses and acknowledgements

The PNC shall provide at least the following acknowledgements:

- supplementary service accepted;

- supplementary service not accepted.

8.3.2.4.3 Supplementary service sequences

Terms in brackets are optional and the usage of the terms depends on the provision of the service.

Choice of destination:

*71*GA1(*GA2*…*GAn)#'Message'#

where GA is the geographical area identification.

Repetition:

*72#'Message'#

Prioritisation:

*73*PR(*ID)#'Message'#

where PR is the priority number 1 or 3. ID is the legitimisation or AC depending on the provision of the service.

Multi-address call:

*74*AdC2(*AdC3*…*AdCn)#'Message'#

Urgent message:

*75(*ID)#'Message'#

where ID is the legitimisation or authentication code.

Deferred delivery:

*76*DDMMYY*HHMM#'Message'#

where DDMMYY means day, month, year and HHMM is hour and minute.

Standard text:

*77*TNO#

where TNO is the number of the selected text. The accessed standard text list is that provided by the operator of the PNC-H of the MS.

Standard text:

*78(*LID*ID)*TNO#

where LID is the text list identification, ID is the legitimisation code and TNO is the number of the selected text. The accessed standard text list is located in the PNC-I of the calling party .

8.3.3 Two-stage selection method

8.3.3.1 Tone-only message input

8.3.3.1.1 Functional description of the protocol

The access protocol has two phases. First the SN is dialled, and the calling party gets access to the PNC. In this first phase the calling party may use a DTMF telephone or a loop disconnect telephone depending on the telephone network used.

The AdC is keyed after the 'AdC request' prompt using DTMF signalling. The terminator # shall be used at the end of the number. The PNC shall validate the AdC and send the 'call accepted/call not accepted' acknowledgement to the calling party. The calling party shall then be requested to confirm the page with the EOM character #. If confirmed the page shall be sent and the calling party shall receive a 'page accepted' acknowledgement.

If the page is accepted, further calls may be input, if permitted by the operator. If the AdC is not valid, the calling party may be offered the opportunity of retrying with a new AdC. The operator may limit the number of trials.

Typing errors may be corrected before the EOM indication by deleting the AdC and rekeying it. The tone-only message shall not be sent if the calling party hangs up the telephone without keying the EOM character.

8.3.3.1.2 System responses and acknowledgements

The PNC shall support the responses and acknowledgements specified in subclause 8.1.2.2. The system shall provide at least the following acknowledgements:

- call accepted;

- page accepted;

- call not accepted,

and should provide the following acknowledgements:

- transmission in all areas not guarantied;

- unable to send message because of system failure;

- time-out warning.

8.3.3.2 Numeric message input

8.3.3.2.1 Functional description of the protocol

The access protocol normally has three phases. First the SN is dialled, and the calling party gets access to the PNC. In this first phase, the calling party may use a DTMF telephone or a loop disconnect telephone depending on the telephone network used.

The AdC is keyed after the 'AdC request' prompt using DTMF signalling. The terminator # shall be used at the end of the number. The PNC shall validate the AdC and send the 'call accepted/not accepted' acknowledgement to the calling party. If the AdC is not valid, the calling party may be offered the opportunity of retrying with a new AdC. The operator may limit the number of trials.

If the call is accepted, the message may be entered. The PNC shall check the length of the message and that the message contains only those characters specified in the numeric character set given in ETS 300 133-2 [2]. The 'page accepted/page not accepted' acknowledgement shall then be sent to the calling party. If the page is accepted, further calls may be input if permitted by the operator. If the page is not accepted, the PNC indicates that it is ready for another message. The operator may limit the number of trials.

The user is not required to wait for the 'call accepted' acknowledgement and may continue entering the message. The PNC shall respond with the 'page accepted/not accepted' acknowledgement.

8.3.3.2.2 System responses and acknowledgements

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- transmission in all areas not guaranteed;
- unable to send message because of system failure;
- time-out warning.

8.3.3.3 Alphanumeric message input

8.3.3.3.1 Functional description of the protocol

The access protocol has normally three phases. First the SN is dialled, and the calling party gets access to the PNC. In this first phase, the calling party may use a DTMF telephone or a loop-disconnect telephone depending on the telephone network used.

The AdC is keyed after the 'AdC request' prompt using DTMF signalling. The terminator # shall be used at the end of the number. The PNC shall validate the AdC and send the 'call accepted/not accepted'

acknowledgement to the calling party. If the AdC is not valid, the calling party may be offered the opportunity of retrying with a new AdC. The operator may limit the number of trials.

If the call is accepted, the message may be entered. The PNC shall check the length of the message and that the message contains only those characters specified in the numeric character set given in ETS 300 133-2 [2]. The 'page accepted/page not accepted' acknowledgement shall then be sent to the calling party. If the page is accepted, further calls may be input if permitted by the operator. If the page is not accepted, the PNC indicates that it is ready for another message. The operator may limit the number of trials.

The user is not required to wait for the 'call accepted' acknowledgement and may continue entering the message. The PNC shall respond with the 'page accepted/not accepted' acknowledgement.

8.3.3.3.2 System responses and acknowledgements

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- transmission in all areas not guaranteed;
- unable to send message because of system failure;
- time-out warning.

8.3.3.4 Call input with supplementary services

8.3.3.4.1 Functional description of the protocol

The SSs are selected by entering the activation prefix * and the SS identification code after the AdC. The calling party shall terminate the AdC before entering the SS activation prefix. Call input related SS identification codes are as follows:

-71 Choice of destination
-72 Repetition
-73 Prioritisation
-74 Multi address call
-75 Urgent message
-76 Deferred delivery
-77 Standard text selected from the list located in the MS's PNC-H
-78 Standard text selected from the list located in the calling party's PNC-I

The additional parameters needed to activate a service are entered after the service identification code. The character * is used as the block separator and the parameter list is terminated by the character #. If the calling party keys the terminator while some of the parameters are still missing, the PNC should guide the calling party to enter the missing parameters.

It is possible to activate several SSs within one call input by entering a new activation prefix, service identification code and a list of parameters after the previous SS terminator. The operator may limit the number and the combination of services within a call.

8.3.3.4.2 System responses and acknowledgements

The PNC shall provide at least the following acknowledgements:

- supplementary service accepted;
- supplementary service not accepted.

8.3.3.4.3 Supplementary service sequences

Terms in brackets are optional and the usage of the terms depends on the provision of the service.

Choice of destination:

AdC#*71*GA1(*GA2*…*GAn)#'Message'#

where GA is the geographical area identification.

Repetition:

AdC#*72#'Message'#

Prioritisation:

AdC#*73*PR(*ID)#'Message'#

where PR is the priority number 1 or 3. ID is the legitimisation or authentication code depending on the provision of the service.

Multi-address call:

There are two alternatives to enter two or more AdCs. The first one is to enter all the relevant addresses continuously separated by * and terminated by #.

AdC1*AdC2(*…*AdCn)#'Message'#

Another alternative is to enter first one AdC and append the remainder after the multi-address call service identification code.

AdC1#*74*AdC2(*AdC3*…*AdCn)#'Message'#

Urgent message:

AdC#*75(*ID)#'Message'#

where ID is the legitimisation or authentication code.

Deferred delivery:

AdC#*76*DDMMYY*HHMM#'Message'#

where DDMMYY means day, month, year and HHMM is hour and minute.

Standard text:

AdC#*77*TNO#

where TNO is the number of the selected text. The accessed standard text list is that provided by the operator of the PNC-H of the MS.

Standard text:

AdC#*78(*LID*ID)*TNO#

where LID is the text list identification, ID is the legitimisation code and TNO is the number of the selected text. The accessed standard text list is located in the PNC-I of the calling party.

8.3.3.5 Subscriber features for fixed subscribers

8.3.3.5.1 Functional description of the protocol

The provision of a dedicated telephonic access for FSs is according to the operator's policy. The implementation of the access and the protocol is not specified within this standard. The following service identification codes are reserved for FS access:

-82 Address list management
-83 Access to the accumulated call charges
-84 Password management
-85 Legitimatisation code management
-87 Standard text management

For call input the SS identification codes defined in subclause 8.3.3.4.1 shall be used.

8.3.3.6 Subscriber features for mobile subscribers

8.3.3.6.1 Functional description of the protocol

The SFs are accessed by first entering the AdC and the AC. After the validation of the AdC and the AC the service identification code with the service code prefix is entered. The prefix indicates the type of the process to be applied to the service. The following prefixes are used:

- * Service activation;
- # Service deactivation;
- *# Service status check.

The service identification codes are as follows:

-90 Roaming;
-91 Temporary barring;
-92 Diversion;
-93 Message retransmission;
-94 Password management;
-95 Legitimisation code management;
-96 Deferred delivery;
-99 All features.

The additional parameters needed to control a service are entered after the service identification code. The character * is used as a block separator and the parameter list is terminated by the character #. If the calling party keys the terminator while some of the parameters are still missing, the PNC should guide the calling party to enter the missing parameters.

It is possible to control several SSs within one call by entering the new SS code prefix, service identification code and the list of parameters. The operator may limit the number and the combination of services within a call.

8.3.3.6.2 System responses and acknowledgements

The PNC shall provide at least the following acknowledgements:

- subscriber feature accepted;

- subscriber feature not accepted.

8.3.3.6.3 Subscriber feature control sequences

This is only a simplified description of the control sequences. The usage of the terms in brackets depends on the provision of the service.

For every SF with start and stop date and time, the calling party should be able to choose the activation moment as the starting date and time. The ending date and time may be omitted. The duration is predetermined by each operator. For instance, a roaming demand with default values shall be dialled as:

90##GA1(..... *GA_n)#

Roaming:

Activation: *90*DDMMYY*HHMM#ddmmyy*hhmm#GA1(*...*GAn)#

where DDMMYY is the starting date (day, month, year), HHMM is the starting time (hour, minute), ddmmyy is the ending date, hhmm is the ending time and GA is the geographic area.

Deactivation: #90#

Cancels all activated roamings. The system shall prompt the user to confirm the command. The command shall be confirmed by keying #, or aborted by keying *# (escape).

Deactivation: #90*DDMMYY*HHMM#ddmmyy*hhmm#GA#

A command to deactivate only a selected part of the preliminary activated roamings.

Status check: *#90#

Temporary barring:

Activation: *91*DDMMYY*HHMM#ddmmyy*hhmm(#MID)#

where DDMMYY is the starting date (day, month, year), HHMM is the starting time (hour, minute), ddmmyy is the ending date, hhmm is the ending time and MID is the message identification.

Deactivation: #91#

Status check: *#91#

Diversion:

Activation: *92*DDMMYY*HHMM#ddmmyy*hhmm#DAdC#

where DDMMYY is the starting date (day, month, year), HHMM is the starting time (hour, minute), ddmmyy is the ending date, hhmm is the ending time and DAdC is the divert AdC.

Deactivation: #92#

Status check: *#92#

Message retransmission:

Activation: *93*LN*HN#

where LN is the lowest and HN is the highest number of the messages to be sent.

Deactivation: Not valid

Status check: *#93#

The MS receives the last message number and the total number of stored messages.

Password management:

Activation: *94*NPW*NPW#

where NPW is the new password.

Deactivation: Not valid

Status check: Not valid

Legitimatisation code management:

Activation: *95*SIC*OLC*NLC*NLC#

where SIC is the service identification code of the associated service, OLC is the old code and NLC is the new code.

Deactivation: Not valid.

Status check: Not valid.

Deferred delivery:

Activation: *96*DDMMYY*HHMM#

where DDMMYY is day, month and year and HHMM is hour and minute.

Deactivation: #96#

Status check: *#96#

All features:

Activation: Not valid.

Deactivation: #99#

Command resets all currently activated SSs to their default values. The system shall prompt the user to confirm the command. The command shall be confirmed by keying #, or aborted by keying *# (escape).

Status check: *#99#

The MS receives a list of all activated features.

8.4 Alphanumeric terminal access methods

In these access methods, the use of an alphanumeric terminal is assumed. Depending on the access network, a modem may be required. When connected to the ISDN, the telecommunication interface of the terminal shall be in accordance with the I.4xx series of CCITT Recommendations.

Alphanumeric terminal access methods shall, as a minimum requirement, comply with the essential sections of subclauses 8.1 and 8.2.

8.5 Telex access

8.5.1 One-stage selection

8.5.1.1 General

In one-stage selection telex access to the ERMES system, the individual telex number assigned to the MS shall be within the national telex numbering plan.

The individual telex number shall consist of digits which identify the PNC and the AdC. The composition and assignment of the individual telex number is for each operator to determine. However, the structure of the AdC shall follow subclause 6.1.

Procedures for call establishment should appear to the calling party to be the same as for any telex call.

When one-stage selection is used, the accessed PNC is always the PNC-H of the MS.

8.5.1.2 Interactive mode

8.5.1.2.1 Functional description of the protocol

The incoming call shall be answered, provided that the telex number is valid.

The protocol shall follow the generic protocol for interactive access mode presented in subclause 8.1.3.

8.5.1.3 Non-interactive mode

8.5.1.3.1 Functional description of the protocol

The incoming call shall be answered, provided that the telex number has been correctly selected.

The protocol shall follow the generic protocol for non-interactive access mode presented in subclause 8.1.1.

8.5.2 Two-stage selection - interactive

8.5.2.1 General

There are two modes of interactive telex access: an interactive mode and a fast interactive mode. The interactive mode has detailed prompting and is intended for use by callers who are unfamiliar with the input of messages via telex. The fast interactive mode is intended for use by callers who wish to prepare messages off-line and who are familiar with message input via telex and do not need the level of user-prompting provided by the interactive method of message input.

8.5.2.1.1 System responses and acknowledgements

These shall be as described in subclause 8.1.2.2.

8.5.2.1.2 Input editing and typing error correction

These shall be as described in subclause 8.1.2.3. The "rub-out" key shall be used as a delete character command. The sequence "XXXXX ANUL" shall be used as a delete line command. The terminator for each input is "carriage return, line feed". The EOM is "NNNN" on a new line.

8.5.2.1.3 Guidance to the calling party

Guidance shall be as described in subclause 8.1.2.4.

8.5.2.2 The protocol via SN1

Telex access for the input of calls is normally provided via SN1. The calling party dials SN1 (belonging to the national telex numbering plan) for the required PNC (prefixed by the international access code if required; this access code is in CCITT Recommendation F.69 [11]). See also subclause 8.1.2.1.2.

8.5.2.2.1 Interactive mode

After exchanging answerbacks in accordance with normal telex procedures, the system shall prompt the calling party for input, following the generic protocol defined in subclause 8.1.2.1.2.

8.5.2.2.2 Fast interactive mode

After dialling the telex Service Number SN1 and exchanging answerbacks in accordance with normal telex procedures, the caller shall input the call information in the following format:

C: ZCZC
<AdC> See NOTE 1
<message> See NOTE 5
NNNN

The system shall respond as follows:

S: ZCZC
<AdC>
<Acknowledgement or guidance message>
NNNN

NOTE 1: S and C stand respectively for System and Caller.

NOTE 2: < > indicates the content of the field and are not required.

NOTE 3: Carriage return and line feed characters are used between each line.

NOTE 4: The AdC shall conform to the ERMES numbering plan.

NOTE 5: For numeric and alphanumeric call only. The content of the messages is restricted to the appropriate character set, for numeric see ETS 300 133-2 [2] and for alphanumeric see the CCITT telex alphanumeric character set recommendations. (CCITT Recommendation S.1 [15], CCITT Recommendation S.2 [16]).

NOTE 6: Several calls may be input by repeating the sequence within one session, if this facility is supported by the operator.

NOTE 7: The message is terminated by "NNNN" on a new line.

NOTE 8: The calling party inputs "++++" on a new line when he ends the transaction.

8.5.2.2.3 Call input related supplementary services

8.5.2.2.3.1 Interactive mode

After exchanging answerbacks in accordance with normal telex procedures, the system shall prompt the calling party for input, following the generic protocol as specified in 8.1.2.1.2.

"/" is to be used as a block separator and "," as a parameter separator.

8.5.2.2.3.2 Fast interactive mode

After dialling the telex service number SN1 and exchanging answerbacks according to the telex procedure, the caller shall input the call information as shown in the following example:

C: ZCZC
<AdC>/<SIC1>,<P1>,<P2>/<SIC2>
<message>
NNNN

This would initiate a call with supplementary services SIC1 and SIC2.

The system shall respond as follows:

S: ZCZC
<AdC>
<Acknowledgement or guidance message>
NNNN

Multiple SSs may be accessed by separating each service identification code by "/". Additional information relating to a SS (where applicable) follows the service identification code and each parameter is preceded by ",".

8.5.2.3 The protocol via SN2

Telex access for SFs is normally provided via SN2. The protocol followed shall be as described in 8.1.2.1.3.

As roaming is the only essential SF which may be accessed from a visited PNC, examples of the protocol are given for both interactive and fast interactive modes.

8.5.2.3.1 Roaming interactive mode

After exchanging answerbacks in accordance with normal telex procedures, the dialogue then proceeds as described in Annex D, figure D.6.

8.5.2.3.2 Roaming fast interactive mode

After exchanging answerbacks in accordance with normal telex procedures, the caller shall input a roaming service request as shown below:

C: ZCZC
<AdC>
<AC>
<90> See NOTE 1
<Activation> See NOTE 2
<Start date and time>
<Stop date and time>
<Geographical areas>
NNNN

NOTE 1: <90> corresponds to the SIC for roaming.

NOTE 2: <Activation> corresponds to the function type request.

The ordering of information provided shall follow the generic protocol described in 8.1.2.1.3.

The system shall respond as follows:

S: ZCZC
<AdC>
<90>
<Start date and time>
<Stop date and time>
<Geographical areas>
<Confirm request>
NNNN

8.5.3 Two-stage selection - non-interactive

8.5.3.1 General

This access method is intended for message switches, telex machine which cannot support conversational dialogue or for use by calling parties who wish to pre-format their calls off-line.

The calling party should indicate non-interactive mode with the non-interactive service request. See subclause 8.1.1.

8.5.3.2 The protocol via SN1

8.5.3.2.1 Call input

The page information format shall be as described for the fast interactive mode as presented in subclause 8.5.2.2.3.2. Automatic advice of delivery/non-delivery shall be given by the PNC-I.

8.5.3.2.2 Call input related supplementary services

Multiple supplementary services may be accessed by separating each service identification code by "/".

Additional information related to a SS (where applicable) follows the service identification code and each additional parameter is preceded by ",".

NOTE: using the non-interactive input, it is not possible to access some SSs which require information to be passed back to the calling party.

EXAMPLE:

C: ZCZC
<AdC>/<SIC1>,<P1>,<P2>/<SIC2>/<SIC3>
<message>
NNNN

This would initiate a call with supplementary services SIC1,SIC2 and SIC3.

8.5.3.3 The protocol via SN2

This shall be as described in 8.1.2.1.3 and shall conform the format of information as shown in 8.5.2.3.2 for the fast interactive mode.

8.6 Message handling system access

8.6.1 General

This subclause describes the general, operational and service procedure for the provision of intercommunication between the Interpersonal Messaging (IPM) service and the ERMES service.

The communication is based on store and forward principles and allows users of the IPM service to send electronic messages to ERMES MSs. The Interpersonal Messaging Service is specified in CCITT Recommendation X.400 [17]. The User Agents (As) used in the IPM service (IPM-UAs) comprise a special class of co-operating UAs.

It should be noted that the delivery times of Message Handling System (MHS) specified in CCITT Recommendation F.410 [12] exceed those specified for the ERMES system.

In CCITT Recommendation X.400 [17], for MHS, a user is either a person or a computer process. The user prepares messages with the assistance of a UA. The UA is a computer application process which may include functions for local editing, temporary storage and archiving.

The interaction between the user and UA is not within the scope of the CCITT Recommendation X.400 series. Similarly the functions provided to the user by the UA (the MHS equivalent to the I6 interface) are not within the scope of this ETS.

8.6.2 ERMES access unit

The IPM service is a messaging service which may be provided on a variety of networks and allows several forms of addresses, whereas the ERMES service provides transmission of messages to MSs identified by a numeric AdC. To match the dissimilar characteristics of the two services it is necessary to provide communication via an ERMES Access Unit (AU). This is illustrated in figure 15.

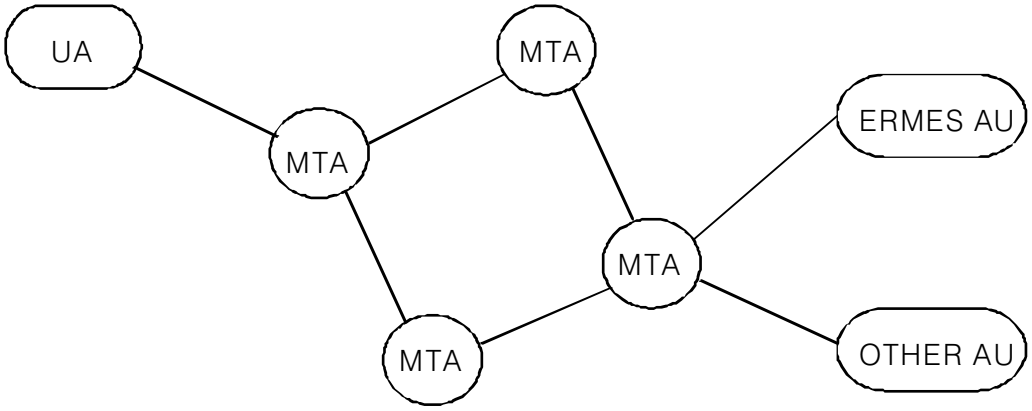


Figure 15: Functional Model of MHS - ERMES interworking

The ERMES AU may be located in the PNC.

All functions needed for reliable transport of interpersonal messages (IP-messages) from the originator to the ERMES AU and vice versa are already specified in the X.400 series of CCITT Recommendation X.400 [17].

8.6.3 Structure of IP-message

The IPM class of UAs create messages containing a content specific to the IPM.

The IP-message contains information (e.g. to, cc, subject) provided by the user which is transformed by the IPM UA into the heading of the IP-message. The main information that the user wishes to communicate is contained within the body of the IP-message.

8.6.4 One-stage selection

The one-stage selection method is recommended because it enables the calling party to take advantage of all the advanced features of the X.400 series of CCITT Recommendations. The standardised addressing integrates the ERMES service with all major office automation systems.

8.6.4.1 Operational procedures

Messages from an IPM service user to an ERMES MS are sent as normal IP-messages with appropriate IPM elements of service (CCITT Recommendation F.420 [13]). A MHS address shall be allocated to each ERMES MS.

When a message is received by the ERMES AU, the recipient (mobile subscriber) shall be validated against the ERMES subscription database. The message shall also be validated to ensure that the content size, content type, and/or enclosed information types are acceptable.

For numeric or alphanumeric messages the message content, if valid, shall be converted into the appropriate character set defined in ETS 300 133-2 [2]. The converted message shall be distributed to the ERMES system for transmission to the MS.

A delivery notification shall be sent back to the originating IPM service user if requested. In the event that the message cannot be delivered to the MS a non-delivery notification shall be sent back to the IPM service user, unless the IPM user has requested prevention of non-delivery notification.

Subclauses 8.6.4.1.1 and 8.6.4.1.2 specify the IPM elements of service applicable to the ERMES AU, and define the processing required.

8.6.4.1.1 Basic IPM service

Ref. F.400 Annex B	Element of service	Action to be taken	Examples
B12	Content type Indication	May indicate transparent data	
B15	Converted indication	Ignore	
B22	Delivery time stamp indication.	Ignore	
B29	Expire date indication	Display in message heading	MESSAGE INVALID AFTER: <value>
B37	IP-message identification	Display in message heading	MESSAGE REFERENCE: <value>
B41	Message identification	Ignore	
B47	Non-delivery notification	The ERMES AU shall generate a delivery report	
B54	Original encoded information types indication	Ignore	
B89	Submission time	Display in message	SUBMITTED: <value>
B90	Typed body	Ignore	

8.6.4.1.2 IPM optional user facilities selectable on a per-message basis

Ref. F.400 Annex B	Element of service	Action to be taken	Examples
B5	Authorising user indication	Display in message heading	AUTHORITY: <value>
B6	Auto-forwarded indication	Ignore	
B8	Blind copy recipient info.	Display in message heading	BCC: <value>
B9	Body part encrypted indication	Message shall be treated as transparent data	
B13	Conversion prohibited	Message shall be treated as transparent data	
B18	Cross-reference indication	Display in message heading	REFERENCE: <value>
B21	Delivery notification	The ERMES AU shall send a delivery report	
Ref. F.400 Annex B	**Element of service**	**Action to be taken**	**Examples**
B25	Disclosure of other recipients	Disclose all recipients	
B26	Distribution List (DL) expansion history indication	Ignore	
B31	Forwarded IP-message indication	The ERMES AU shall build a message heading for each message contained in the body part	
B32	Grade of delivery selection	The ERMES AU shall convert the grade of delivery to priority 1 - 3	
B35	Importance indication	Urgent message indication shall be sent to the receiver	
B36	Incomplete copy indication	Display in message heading	INCOMPLETE COPY:
B38	Language indication	Ignore	
B39	Latest delivery designation	Ignore	

B42	Message origin authentication	Authentication of calling party for restricted operations and for charging	
B45	Multi-destination delivery	Deliver for message to all recipients	
B46	Multi-part body	Ignore	
B48	Non-receipt notification request indication	Ignore	
B52	Obsoleting indication	Display in message	OBSOLETES: <value>
B55	Originator indication	Ignore	
B62	Primary & copy recipients indication	Display in message heading	TO: <value> CC: <value>
B63	Probe	NS	
Ref. F.400 Annex B	**Element of service**	**Action to be taken**	**Examples**
B64	Probe origin authentification	NS	
B67	Receipt notification request indication	Ignore	
B68	Redirection disallowed by originator	Prohibits ERMES call diversion	
B72	Reply request indication	Display in message heading	REPLY REQUESTED BY SENDER:
B73	Replying IP-message indication	Display in message heading	REPLY TO MESSAGE: <value>
B80	Sensitivity indication	Ignore	
B88	Subject indication	Display in message heading	SUBJECT: <value>

NS = Not specified

8.6.4.2 Call input

The calling party has the two following alternate ways of addressing, when the paging messages are sent to the MS:

- TO: - addressing;
- CC: - addressing.

When TO: - addressing is used, the ERMES AU shall transfer the body part of the IP-message to the ERMES system for transmission to the MS.

In the CC: - addressing, the IP-message heading is to be sent to the MS. The elements of service related to the IP-message heading shall be converted into printable text. The language of this text is a national

matter. The CC: - addressing could be used when the calling party wishes to confirm to the MS that a message has been sent to an electronic mailbox.

8.6.4.3 Call input with supplementary services

In the one-stage selection method, the calling party may use available IPM elements of service when accessing the ERMES AU. The UA used by the calling party may not be able to provide access to all ERMES SSs. The following list presents an example of the ERMES services and the relevant IPM services.

ERMES service	E/O	Related IPM Element of Service	
Authentication with password	E	B42	Message origin authentication
Authentication	O	B42	
Priority 1	O	B32	Grade of delivery selection
Priority 3	O	B32	
Multi-addressing	O	Supported by the IPM	
Called group indication	O	B62	Primary and copy recipient indication
Urgent message indication	O	B35	Importance indication
Deferred delivery	O	B19	Deferred delivery

E: Essential
O: Optional

8.6.5 Two-stage selection

The two-stage selection method, if provided, is mainly intended to be used for activating the SFs for MSs, e.g. roaming.

8.6.5.1 Operational procedures

Messages from an IPM service user to an ERMES service are sent as normal IP-message with appropriate IPM elements of service (CCITT Recommendation F.420 [13]). A MHS address shall be allocated to each ERMES two-stage selection SN. The AdC of the MS shall be included in the body part of the IP-message.

When a message is received by the ERMES AU, the recipient (mobile subscriber) shall be validated against the ERMES subscription database. The message shall also be validated to ensure that the content size, content type, and/or enclosed information types are acceptable.

For numeric or alphanumeric messages the message content, if valid, shall be converted into the appropriate character set defined in ETS 300 133-2 [2]. The converted message shall be distributed to the ERMES system for transmission to the MS.

A delivery notification shall be sent back to the originating IPM service user if requested. In the event that the message cannot be delivered to the MS a non-delivery notification shall be sent back to the IPM service user, unless the IPM user has requested prevention of non-delivery notification.

Subclause 8.6.4.1 specifies the IPM elements of service applicable to the ERMES AU, and defines the processing required.

8.6.5.2 Call input

The calling party shall access the ERMES AU SN1 by using the TO: - addressing. The AdC of the MS and the paging message are both included in the body part of the IP-message. The following call input format is recommended:

AdC
Message
EOM

The recommended special characters are defined in subclause 8.1.5.

8.6.5.3 Call input with supplementary services

The calling party shall access the ERMES AU SN1 by using the TO: - addressing. The selected ERMES SS identification codes with associated parameters shall be included into the body part of the IP-message between the AdC and the paging message as follows:

AdC
/SIC1, P1/SIC2, P1, P2
Paging Message

NOTE: SIC = Service Identification Code
P = Parameters

The recommended special characters are presented in subclause 8.1.5. The calling party may use available IPM elements of service when accessing the ERMES AU.

8.6.5.4 Access to subscriber features

The calling party shall access the ERMES AU SN2 by using the TO: - addressing. It is recommended that the order of the parameters and the usage of the special characters are in accordance with subclause 8.1. The following example shows the activation of roaming:

AdC
AC
90
Activation
Start date and time
Stop date and time
Geographical areas

NOTE: 90 = Service identification code for roaming.

8.7 Bureau access

The provision of a bureau service access method to enable access to ERMES services via an operator is optional. This access method is not harmonised.

8.8 Videotex access method

8.8.1 General

The use of a videotex terminal is assumed. As specified in CCITT Recommendation F.300 [14], Videotex service offers interactive mode only. It is also assumed that this access method only allows two-stage selection.

The ERMES operator may benefit from all the facilities provided within the videotex network. These facilities are described in CCITT Recommendation F.300 [14] paragraph 3.

This access method should follow the generic protocol for two-stage selection type, interactive mode, as specified in subclause 8.1.2.

8.8.2 Message page input

In order to render the dialogue as simple and easy to handle as possible, the number of screens should be limited to what is strictly necessary. As far as the page input is concerned the number of pages depend on the type of message. For tone-only and numeric, there should be only one page. For alphanumeric messages, there should normally be two pages: the first one should allow the input of the AdC and the possible SSs; the second one, the input of the message itself. The general forms are for each operator to determine.

In addition to these basic forms, there should be additional pages which may be called for the guidance of the calling party when entering or editing his message. These pages should be specified by each operator according to the level of detail they want to provide to their customers (the minimum requirements are defined in subclause 8.1.2).

8.9 ISDN Access

8.9.1 General

Many of the possible ERMES access methods may be interfaced to the PNC via an ISDN I5 interface. Some of the possible access methods are illustrated in figure 16. The non-ISDN I6 access dialogues for these methods are defined for each access method in the relevant subclauses listed at the bottom of figure 16.

This subclause describes the I6 access dialogues for ISDN terminals, using (except in subclause 8.9.2.1) the ISDN Supplementary Services "User-To-User Signalling", services 1 and 3 as specified in CEPT Recommendation T/SF 31-7 [8].

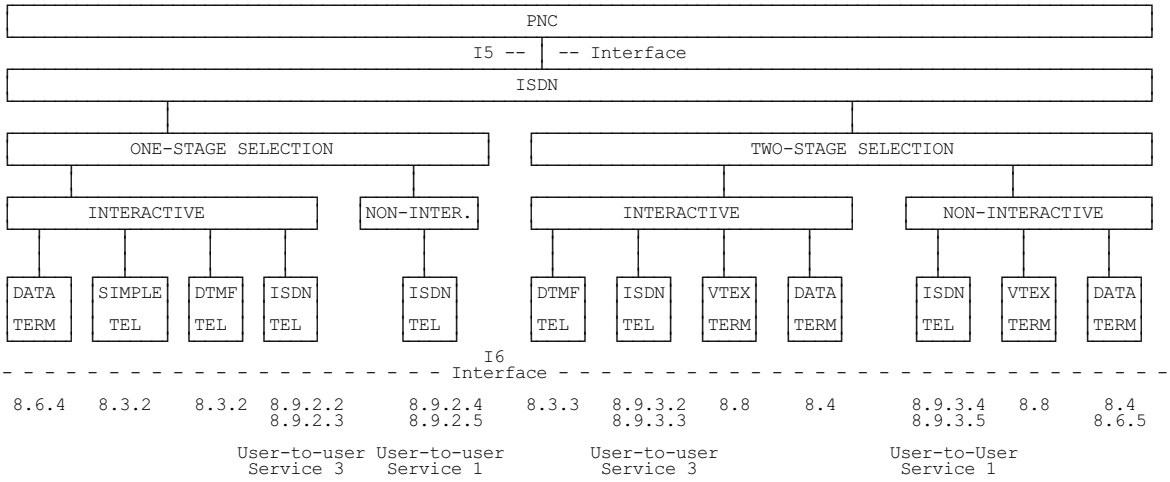


Figure 16: Access methods supported by ISDN

8.9.2 One-stage selection

8.9.2.1 One-stage selection for tone-only service via ISDN

This subclause describes the protocol used when tone-only messages are sent from an ISDN telephone not using the User-to-User signalling facility.

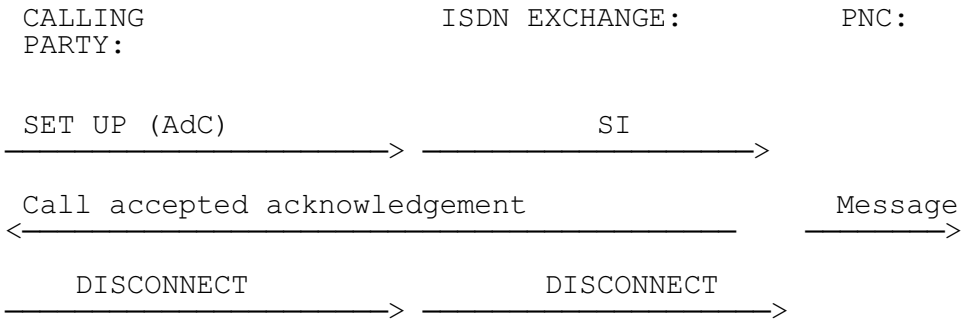
The calling party dials the MS's tone-only AdC. The PNC shall validate the Subscriber Identification (SI) and send the tone-only message to the MS, if the AdC is valid. The calling party shall be sent a "call accepted acknowledgement" via the B channel, and the ISDN connection may be released.

Only one tone-only message may be sent within one phone call. If the call is not accepted, the calling party should hang up the phone and try again with another AdC.

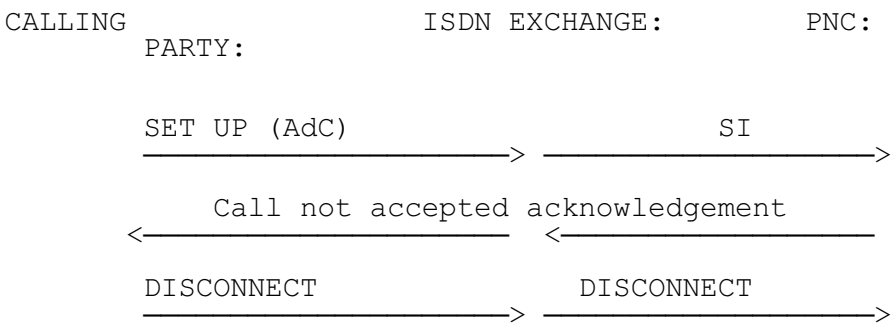
The PNC shall have a time-out function that disconnects the ISDN connection, if the telephone is not hung up within a defined time after the acknowledgement.

Examples of the one-stage selection protocol for tone-only service are given below:

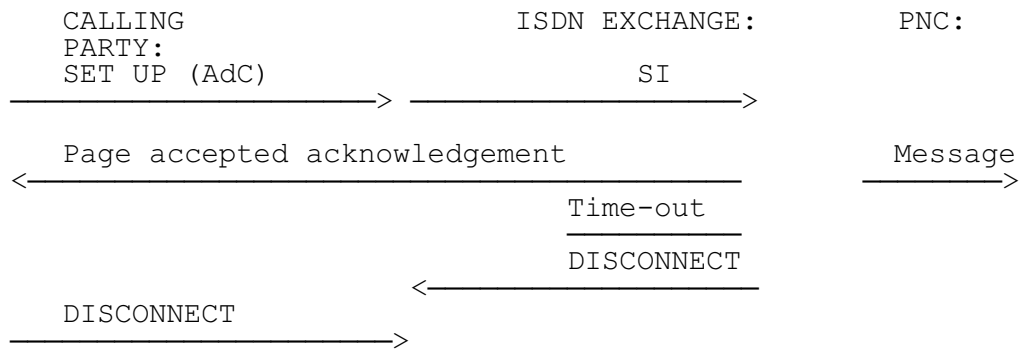
1**)** Normal call



2**)** Call with a wrong AdC



3) Call with a time-out



8.9.2.2 One-stage selection for numeric service via ISDN (UUS3)

This subclause describes the protocol used when numeric messages are sent using an ISDN-telephone with the UUS3 facility. The protocol takes account of:

- home area access;
- internetwork access;
- message editing.

This procedure uses the possibility to send a limited amount of information over the D channel in the ISDN networks. The possibility of sending DTMF coded information over the B channel is not described in this protocol.

Sending of messages

The following information is used when a message is sent:

- message with end of the message indication (EOM)

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure;
- time-out warning.

The PNC shall have a time-out function that releases the ISDN connection if the calling party does not continue sending User to User Information (UUI) within a defined time. A special announcement (via B or D channel (UUI 3)) or tone shall be used as a time-out warning to inform the calling party of the element that should be typed in next. The timing, the number and the structure of the warnings are according to the operator's policy. The use of recorded announcements is preferred because of the possibility of presenting more detailed information. If the sending of UUI is not continued after the last warning, the ISDN connection is disconnected by the PNC.

Typing errors may be corrected before the "end of the message" indication by deleting the message and retyping it. The message is not sent if the ISDN connection is released and the EOM character is missing.

The protocol

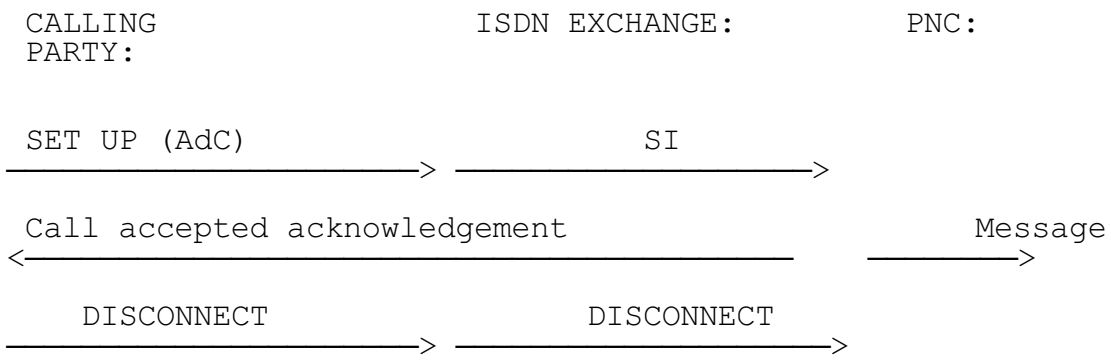
The access protocol normally has two phases. First the AdC is dialled, and then the calling party is connected to the PNC.

The PNC shall validate the AdC and if valid send the "call accepted" acknowledgement to the calling party. If the AdC is not valid a "call not accepted" acknowledgement shall be sent to the calling party and the ISDN connection is released.

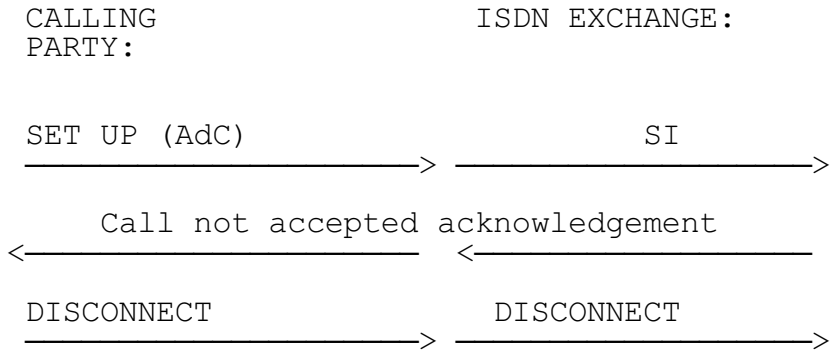
If the call is accepted, the message may be sent. The PNC shall check the length of the message and that the message contains only those characters specified in the numeric character set in ETS 300 133-2 [2]. The "page accepted/page not accepted" acknowledgement shall then be sent to the calling party. If the page is not accepted, the PNC shall indicate that it is ready for another message. The operator may limit the number of trials.

Examples of one-stage selection protocol for numeric service via ISDN are given below:

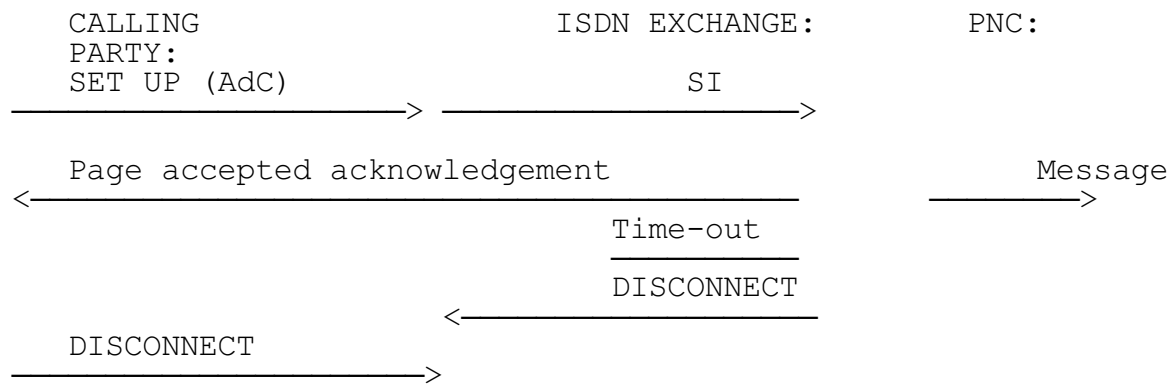
1**)** Normal call



2**)** Call with a wrong AdC



3) Call with a time-out



8.9.2.2 One-stage selection for numeric service via ISDN (UUS3)

This subclause describes the protocol used when numeric messages are sent using an ISDN-telephone with the UUS3 facility. The protocol takes account of:

- home area access;
- internetwork access;
- message editing.

This procedure uses the possibility to send a limited amount of information over the D channel in the ISDN networks. The possibility of sending DTMF coded information over the B channel is not described in this protocol.

Sending of messages

The following information is used when a message is sent:

- message with end of the message indication (EOM)

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure;
- time-out warning.

The PNC shall have a time-out function that releases the ISDN connection if the calling party does not continue sending User to User Information (UUI) within a defined time. A special announcement (via B or D channel (UUI 3)) or tone shall be used as a time-out warning to inform the calling party of the element that should be typed in next. The timing, the number and the structure of the warnings are according to the operator's policy. The use of recorded announcements is preferred because of the possibility of presenting more detailed information. If the sending of UUI is not continued after the last warning, the ISDN connection is disconnected by the PNC.

Typing errors may be corrected before the "end of the message" indication by deleting the message and retyping it. The message is not sent if the ISDN connection is released and the EOM character is missing.

The protocol

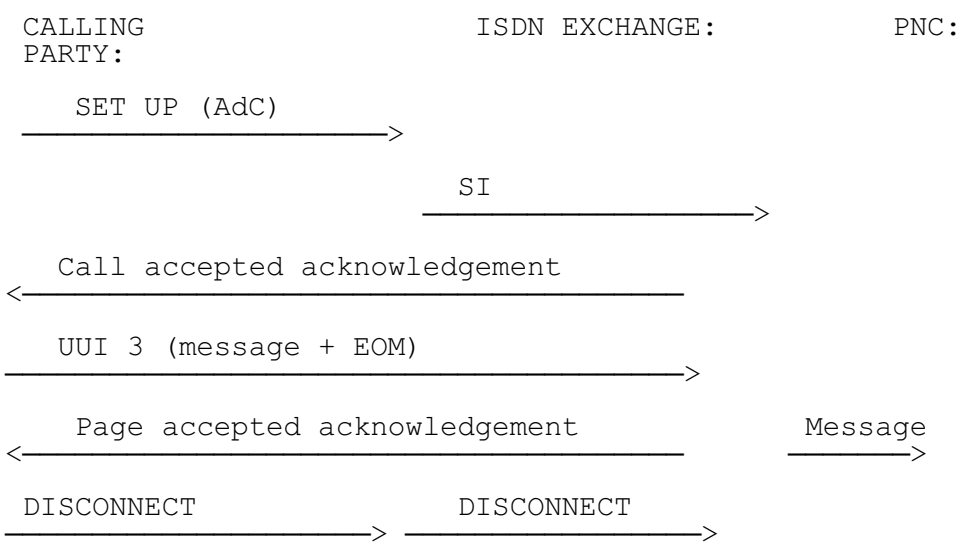
The access protocol normally has two phases. First the AdC is dialled, and then the calling party is connected to the PNC.

The PNC shall validate the AdC and if valid send the "call accepted" acknowledgement to the calling party. If the AdC is not valid a "call not accepted" acknowledgement shall be sent to the calling party and the ISDN connection is released.

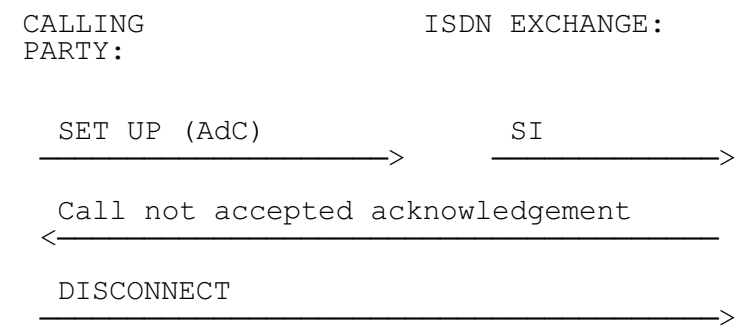
If the call is accepted, the message may be sent. The PNC shall check the length of the message and that the message contains only those characters specified in the numeric character set in ETS 300 133-2 [2]. The "page accepted/page not accepted" acknowledgement shall then be sent to the calling party. If the page is not accepted, the PNC shall indicate that it is ready for another message. The operator may limit the number of trials.

Examples of one-stage selection protocol for numeric service via ISDN are given below:

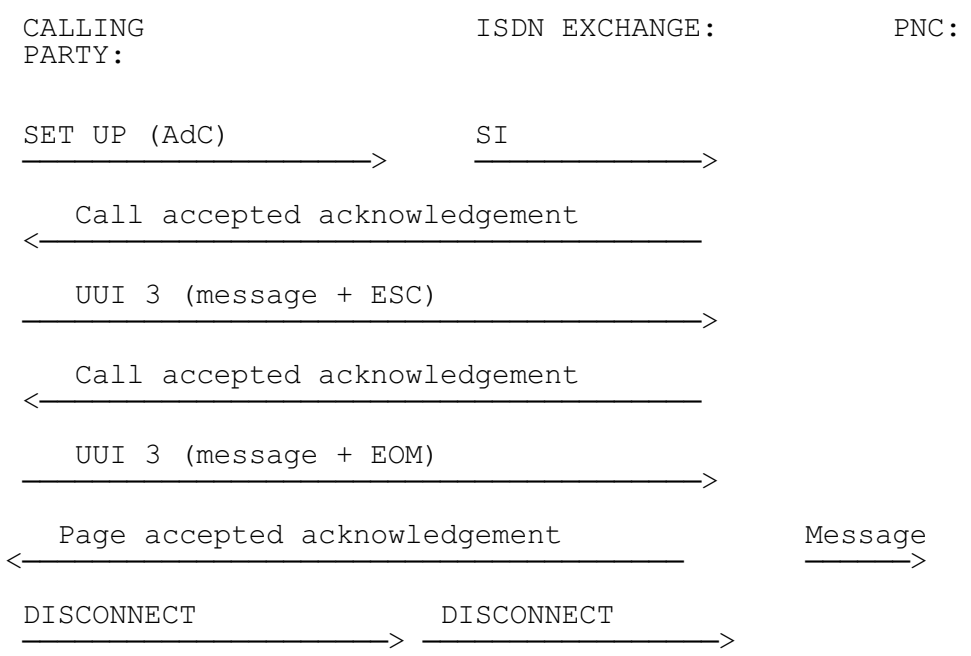
1) Normal call



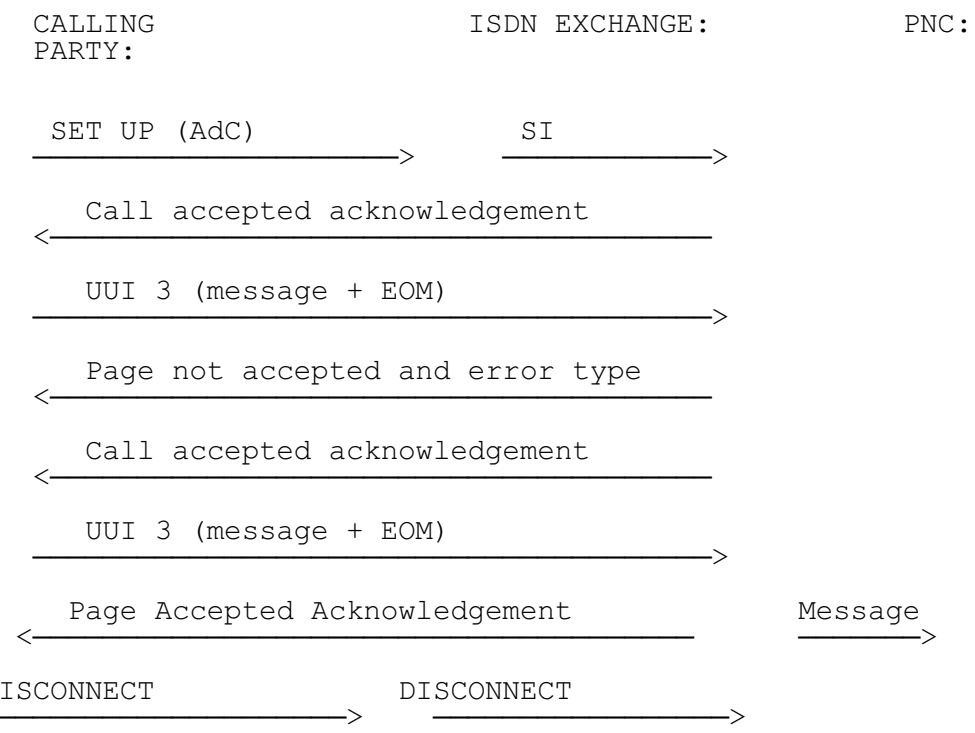
2) Call with a wrong AdC



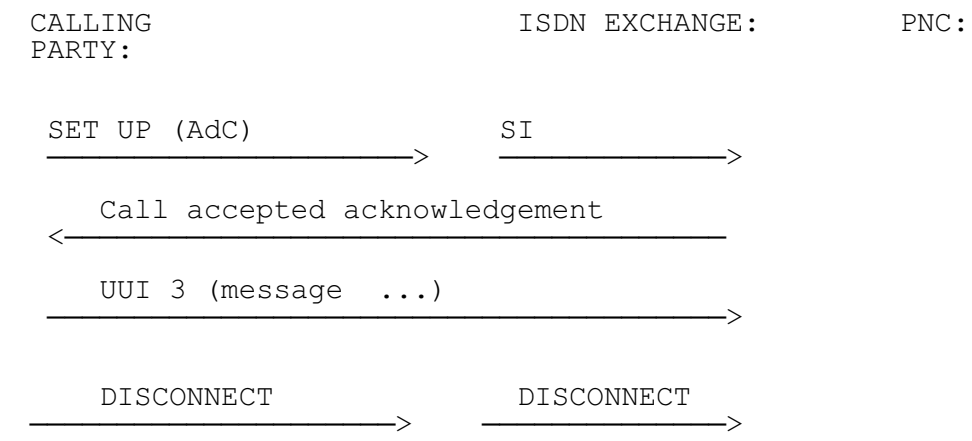
3) Call with message editing



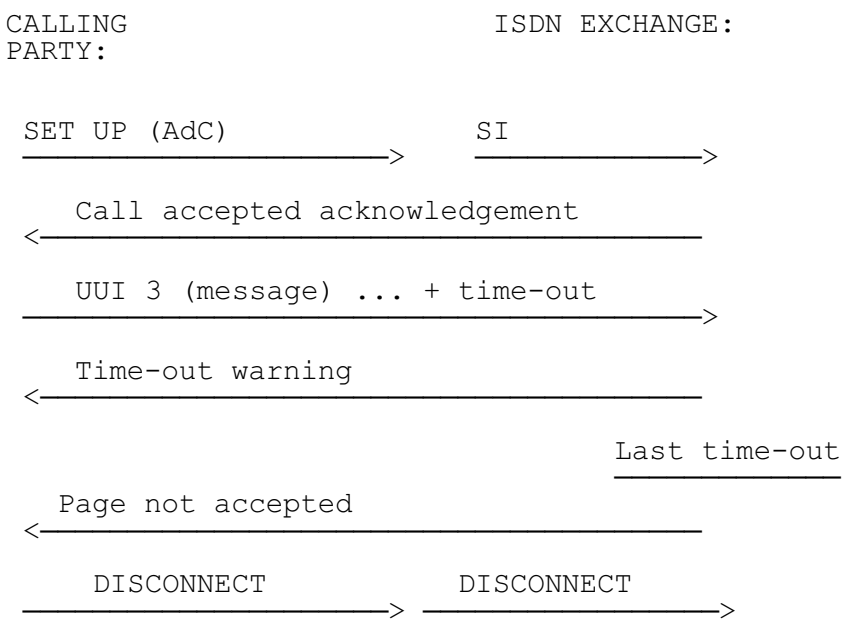
4) Call with a non-acceptable message



5) Interrupted call



6) Call with a time-out



8.9.2.3 One-stage selection for alphanumeric service via ISDN (UUS3)

The access method for alphanumeric service is similar to the procedure for the numeric service (see subclause 8.9.2.2).

8.9.2.4 One-stage selection for numeric service via ISDN (UUS1)

This subclause describes the protocol used when numeric messages are sent by using an ISDN telephone with the UUS1 facility.

This procedure uses the possibility to send a limited amount of information over the D channel in the ISDN network. The information is sent in the call set-up message and is therefore a non-interactive procedure. The possibility of sending DTMF coded information over the B channel is not described in this protocol.

Sending of messages

The following information is used when a message is sent:

- subscriber identification (SI);
- message with end of the message indication (EOM).

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure.

The responses may be sent either via the B channel or via the D channel as a UUI 1 message (see examples below).

The protocol

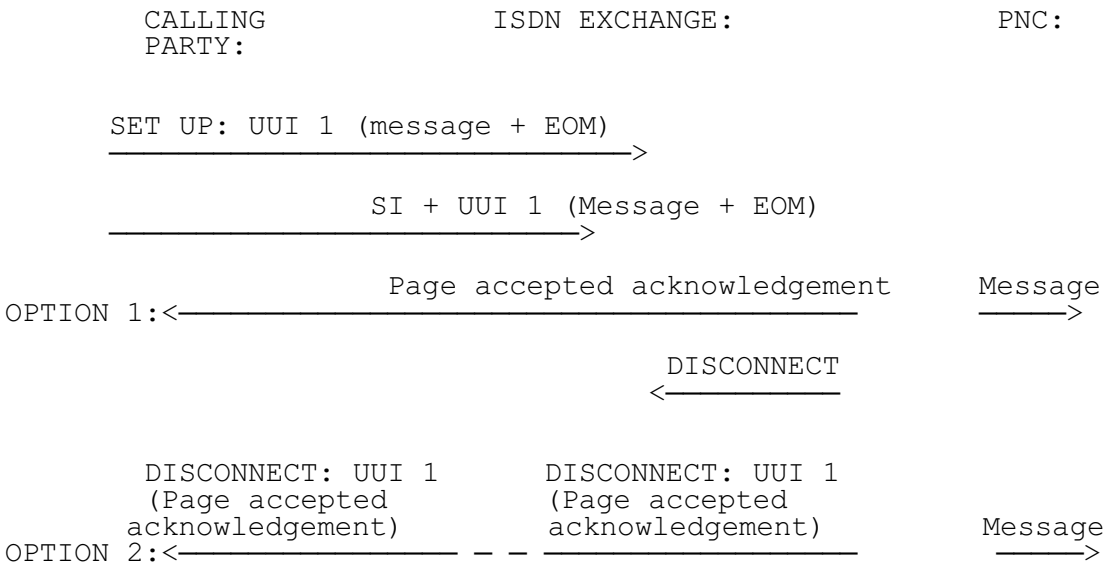
The access method is a non-interactive mode operation, where the SI is included in the address field of the call set-up message. The message is included in the UUI. The message is terminated by an EOM (#).

The PNC shall validate the SI and the message. If the validation is successful the message shall be transmitted to the MS and a "page accepted" acknowledgement shall be sent to the calling party. If the SI or message is not valid, a "call not accepted" or a "page not accepted" acknowledgement shall be sent to the calling party.

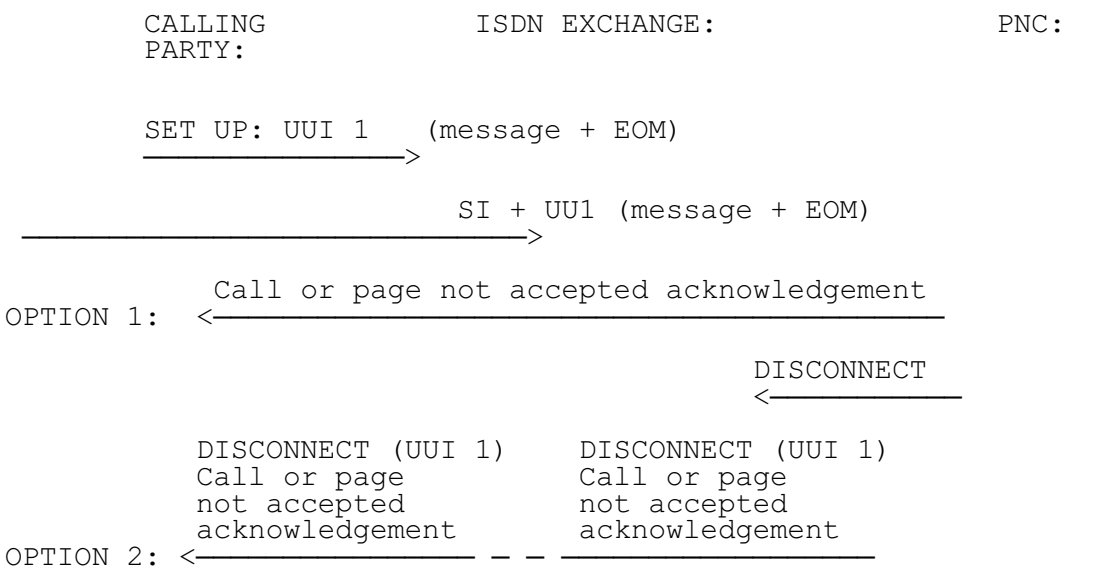
The calling party does not have the possibility of sending more information. Therefore the PNC shall disconnect the connection after sending the response.

Examples of one-stage selection protocol for an ISDN telephone with user-to-user signalling facility are given below.

1**)** Normal call



2) Call with non-acceptable AdC or message



8.9.2.5 One-stage selection for alphanumeric service via ISDN (UUS1)

The access method for alphanumeric service is similar to the procedure for the numeric service (see subclause 8.9.2.4).

8.9.3 Two-stage selection access type

8.9.3.1 Two-stage selection for tone-only service via ISDN (UUS3)

This subclause describes the protocol used when tone-only messages are sent by using an ISDN-telephone with the user-to-user signalling service 3 facility.

The protocol takes account of:

- home area access
- internetwork access
- message editing

This procedure uses the possibility to send a limited amount of information over the signalling channel in the ISDN network. The possibility of sending DTMF coded information over the B channel is not described in this protocol.

Sending of messages

The following information is used when an AdC is sent:

- address Code (AdC);
- end of the AdC indication (EOM).

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- AdC request;
- page accepted;
- call not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure
- time-out warning.

The PNC shall have a time-out function that releases the ISDN connection if the calling party does not continue the sending of UUI within a defined time. A special announcement (via B or D channel (UUI 3)) or tone shall be used as a time-out warning to inform the calling party of the element that should be typed in next. The timing, the number of and the structure of the warnings is according to the operator's policy. The use of recorded announcements is preferred, because of the possibility of presenting more detailed information. If the sending of UUI is not continued after the last warning, the ISDN connection is disconnected by the PNC.

Typing errors may be corrected before the EOM indication by deleting the AdC and retyping it.

The protocol

The access protocol has two phases. First the SN is dialled and the calling party is connected to the PNC.

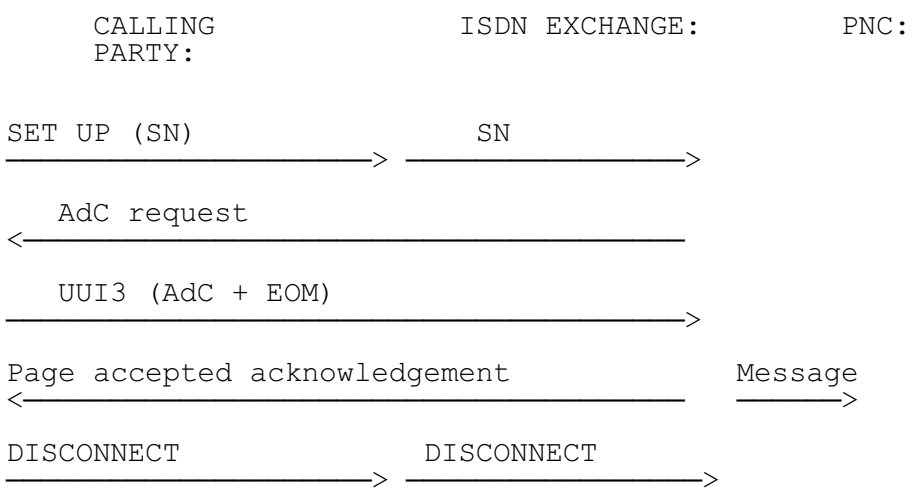
The AdC is sent after the "AdC request" prompt by using UUS3. The AdC may be sent in one or more UUI 3 messages. The EOM is used at the end of the number. The PNC shall validate the AdC and if valid shall send the "page accepted" acknowledgement to the calling party. If the page is accepted, further calls may

be input if permitted by the operator. If the AdC is not valid, the calling party has the possibility to retry with a new AdC. The operator may limit the number of trials.

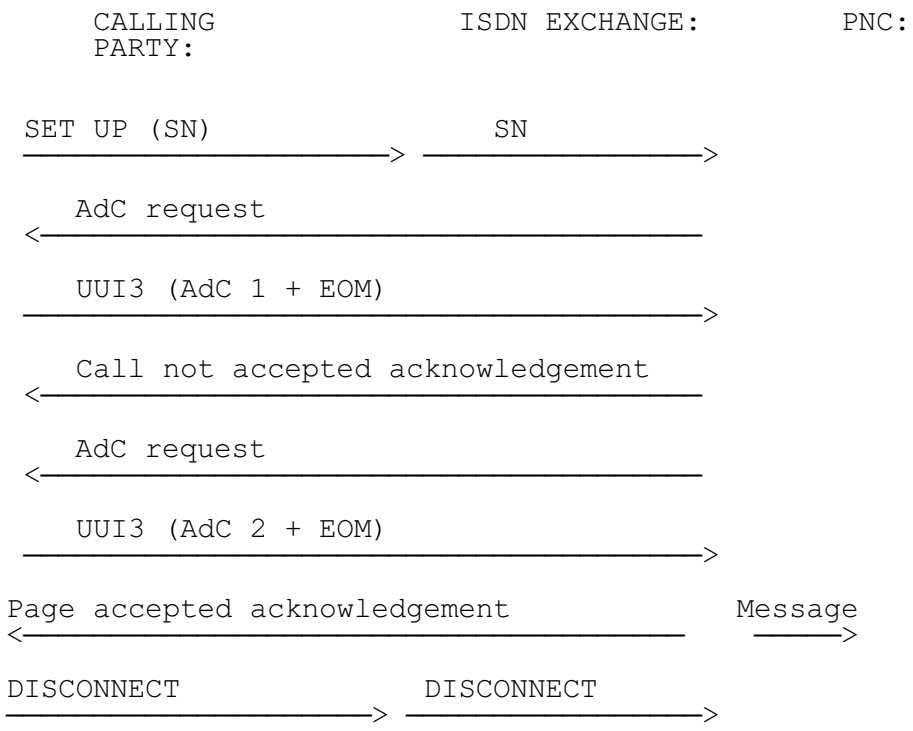
The tone-only message is not sent if the ISDN connection is released and the EOM character is missing.

Examples of two-stage selection protocol for tone-only service via ISDN are given below:

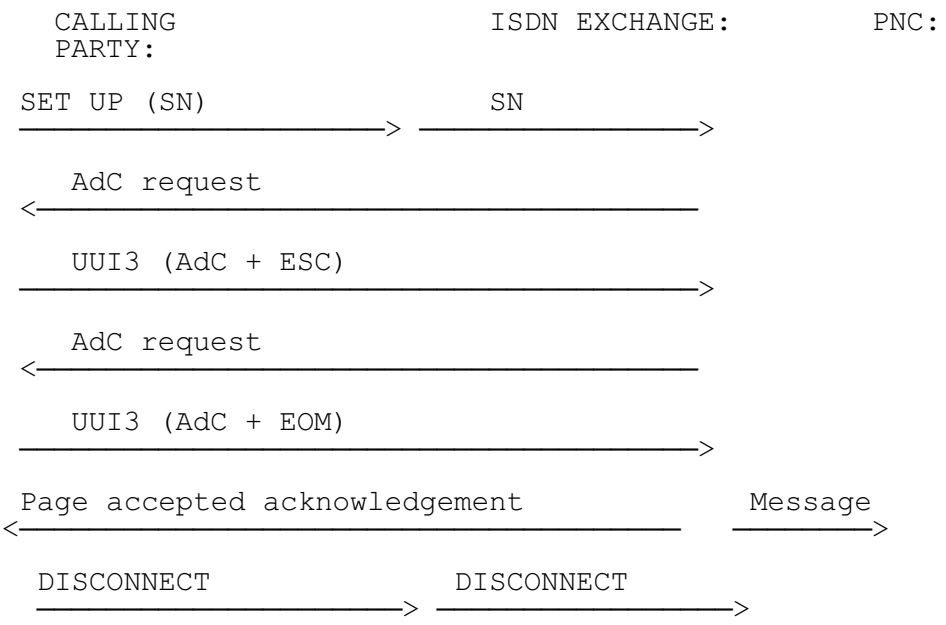
1) Normal call



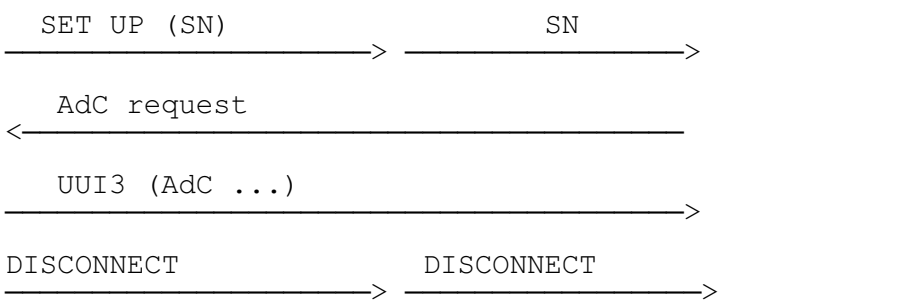
2) Call with a wrong AdC



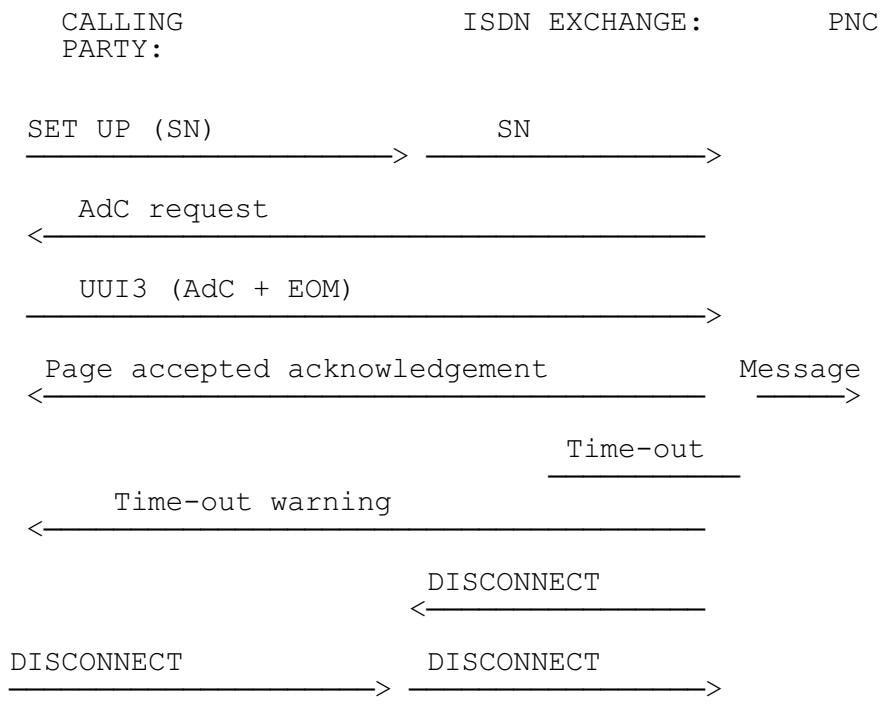
3) Call with AdC editing



4) Interrupted call



5) Call with a time-out



8.9.3.2 Two-stage selection for numeric service via ISDN (UUS3)

This subclause describes the protocol used when numeric messages are sent by using an ISDN telephone with the UUS3 facility. The protocol takes account of:

- home area access;
- internetwork access;
- message editing.

This procedure uses the possibility to send a limited amount of information over the signalling channel in the ISDN network. The possibility of sending DTMF coded information over the B channel is not described in this protocol.

Sending of messages

The following information is used when a message is sent:

- address Code (AdC);
- end of the address code (EOM);
- message with end of the message indication (EOM).

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- AdC request;
- call accepted;
- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure;
- time-out warning.

The system has a time-out function that releases the ISDN connection if the calling party does not continue the sending of UUI within a defined time. A special announcement (via B or D channel (UUI 3)) or tone shall be used as a time-out warning to inform the calling party of the element that should be typed in next. The timing, the number of and the structure of the warnings is according to the operator's policy. The use of recorded announcements is preferred because of the possibility of presenting more detailed information. If the sending of UUI is not continued after the last warning, the ISDN connection is disconnected by the PNC.

Typing errors may be corrected before the "end of the message" indication by deleting the message and retyping it. The message is not sent if the ISDN connection is released and the EOM character is missing.

The protocol

The access protocol has three phases. First the SN is dialled, and the calling party is connected to the PNC.

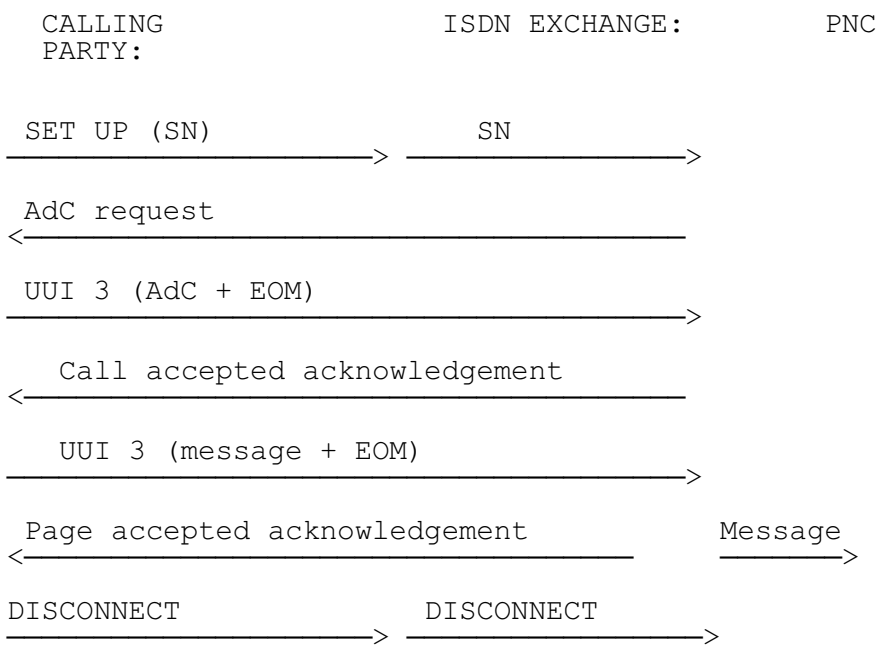
The AdC is sent after the "AdC request" prompt by using UUS3. The AdC may be sent in one or more UUI 3 messages. The EOM is used at the end of the AdC. The PNC shall validate the AdC and if valid shall send the "call accepted" acknowledgement to the calling party. If the AdC is not valid, the calling party has the possibility to retry with a new AdC. The operator may limit the number of trials.

If the call is accepted, the message may be sent. The PNC shall check the length of the message and that the message contains only those characters specified in the numeric character set in ETS 300 133-2 [2]. The "page accepted/page not accepted" acknowledgement shall then be sent to the calling party. If the page is accepted, further calls may be input if permitted by the operator. If the page is not accepted, the PNC shall indicate that it is ready for another message. The operator may limit the number of trials.

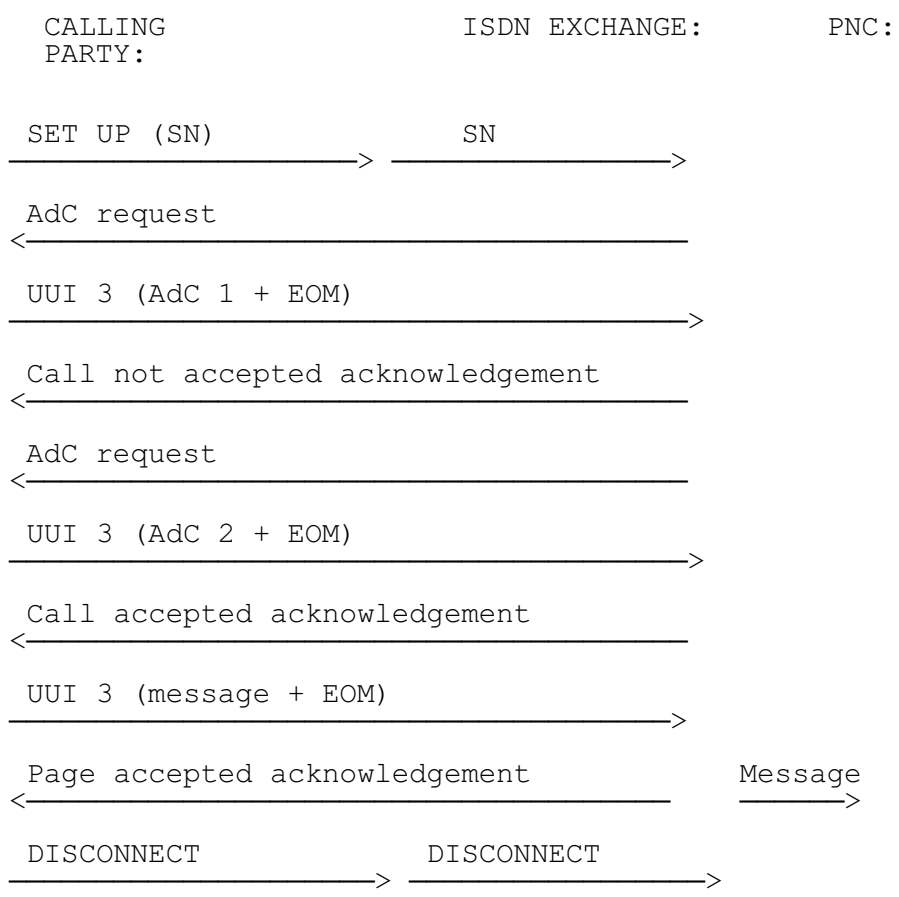
The user is not required to wait for the "call accepted" acknowledgement and may continue entering the message. The PNC responds with the "page accepted" acknowledgement.

Examples of two-stage selection protocol for numeric service via ISDN are given below:

1) Normal call

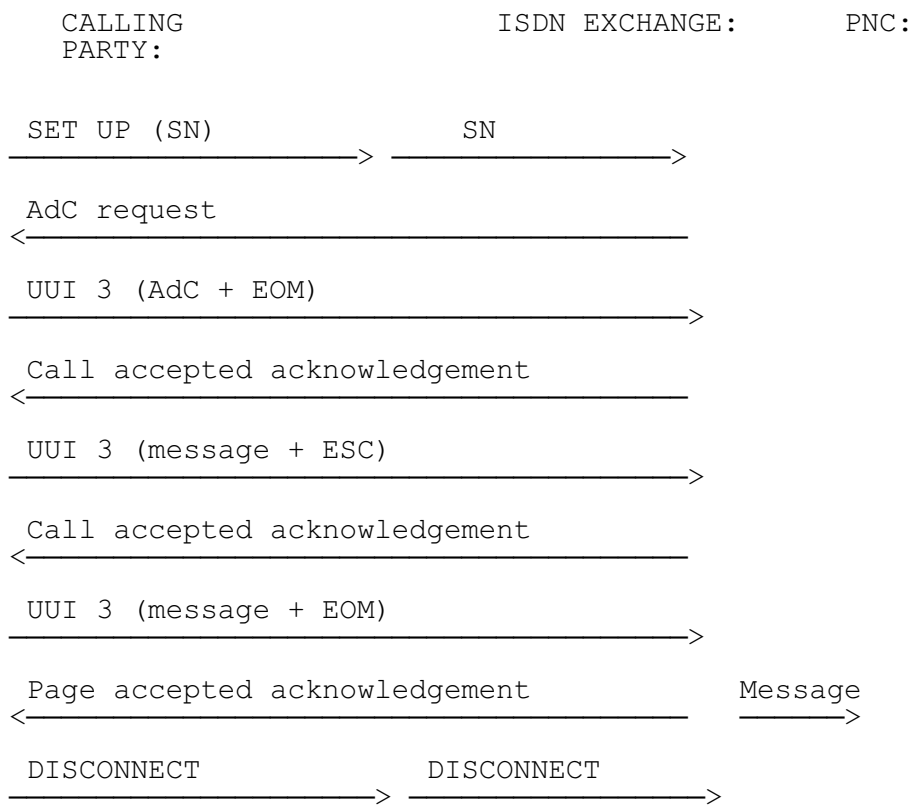


2) Call with a wrong AdC

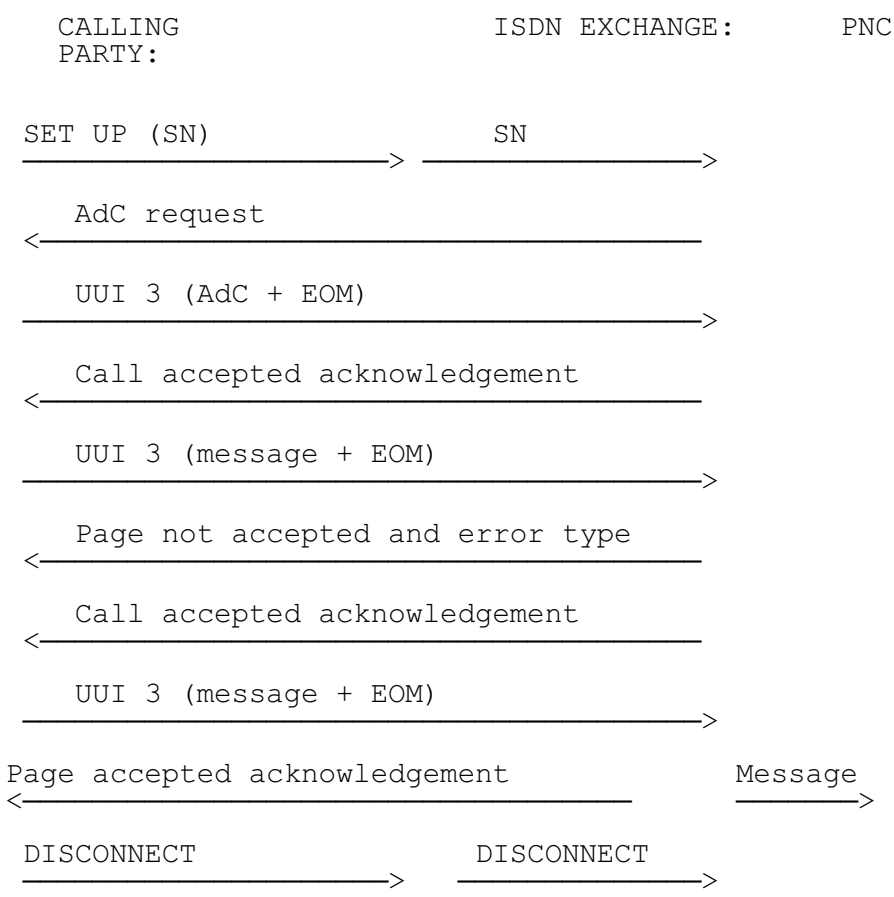


‘

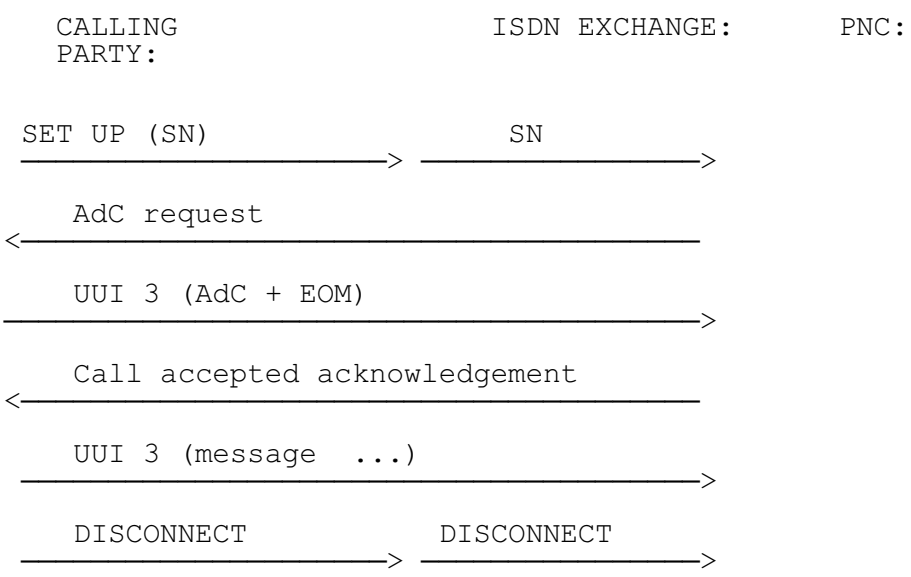
3) Call with message editing



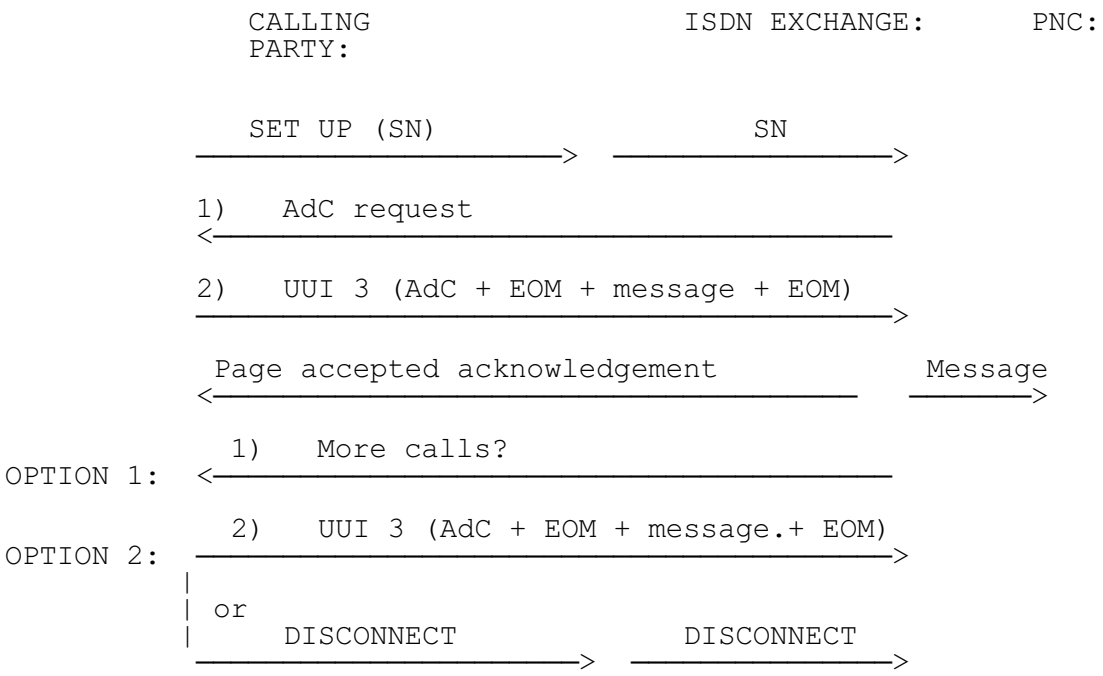
4) Call with a non-acceptance message



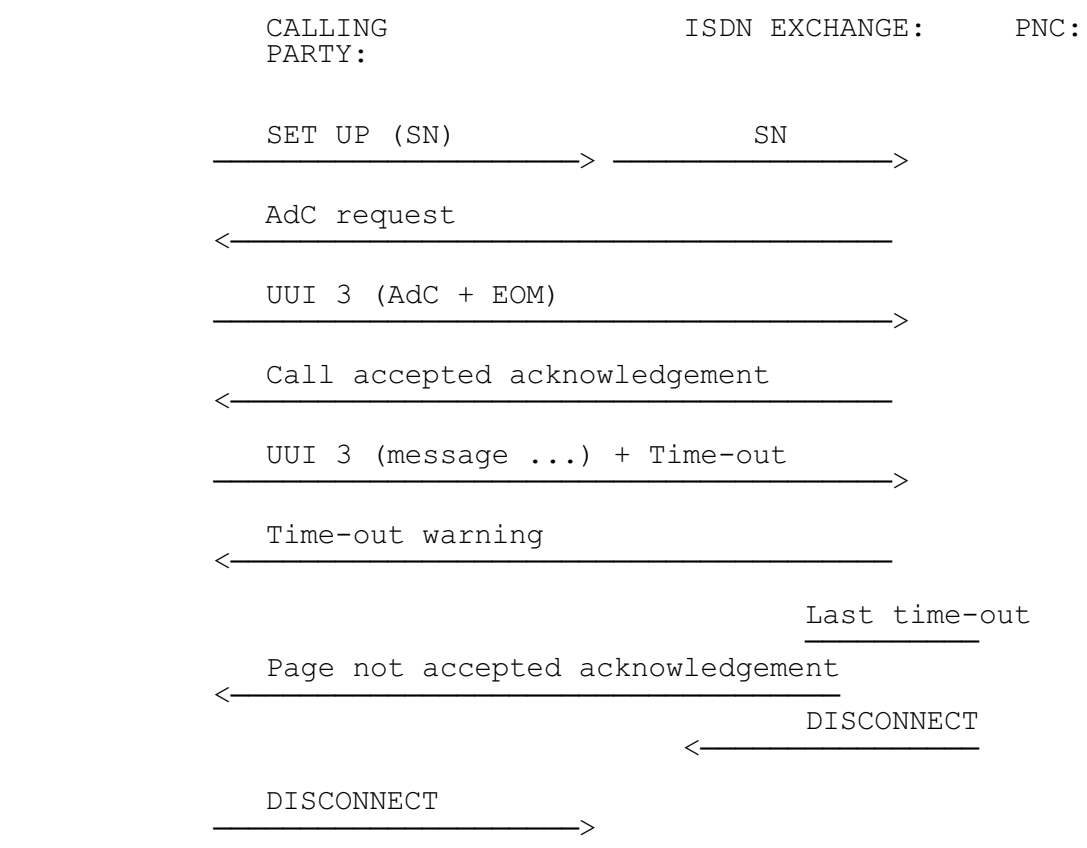
5) Interrupted call



6**)** Continuous input



7) Call with a time-out



8.9.3.3 Two-stage selection for alphanumeric service via ISDN (UUS3)

The access method for alphanumeric service is similar to the procedure for the numeric service (see subclause 8.9.3.2).

8.9.3.4 Two-stage selection for numeric service via ISDN (UUS1)

This subclause describes the protocol used when numeric messages are sent by using an ISDN telephone with the UUS1 facility.

This procedure uses the possibility to send a limited amount of information over the D channel in the ISDN network. The information is sent in the call set-up message and is therefore a non-interactive procedure.

Sending of messages

The following information is used when a message is sent:

- SN;
- Address code (AdC) with end of AdC indication (EOM);
- Message with end of the message indication (EOM).

The PNC shall support the responses and acknowledgements specified in subclause 8.1.3.2. The system shall provide at least the following acknowledgements:

- page accepted;
- call not accepted;
- page not accepted,

and should provide the following acknowledgements:

- call conditionally accepted (transmission/delay in all areas not guaranteed);
- unable to send message because of system failure.

The responses may be sent either via the B channel or via the D channel as a UUI 1 message (see examples below).

The protocol

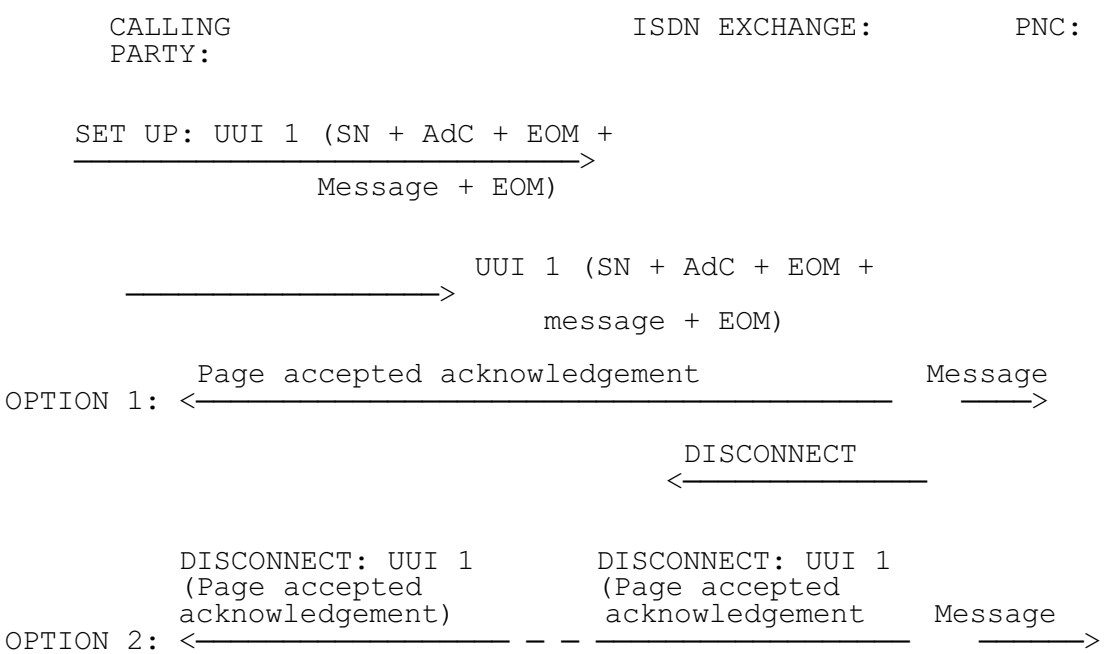
The access method is a non-interactive mode operation, where the AdC and the message are sent in the UUI field of the call set-up message. The AdC is separated from the message by an EOM (#). The message is terminated by an EOM (#).

The PNC shall validate the AdC and the message. If the validation is successful the message shall be transmitted to the MS and a "page accepted" acknowledgement shall be sent to the calling party. If the AdC or message is not valid a "call not accepted" or "page not accepted" acknowledgement shall be sent to the calling party.

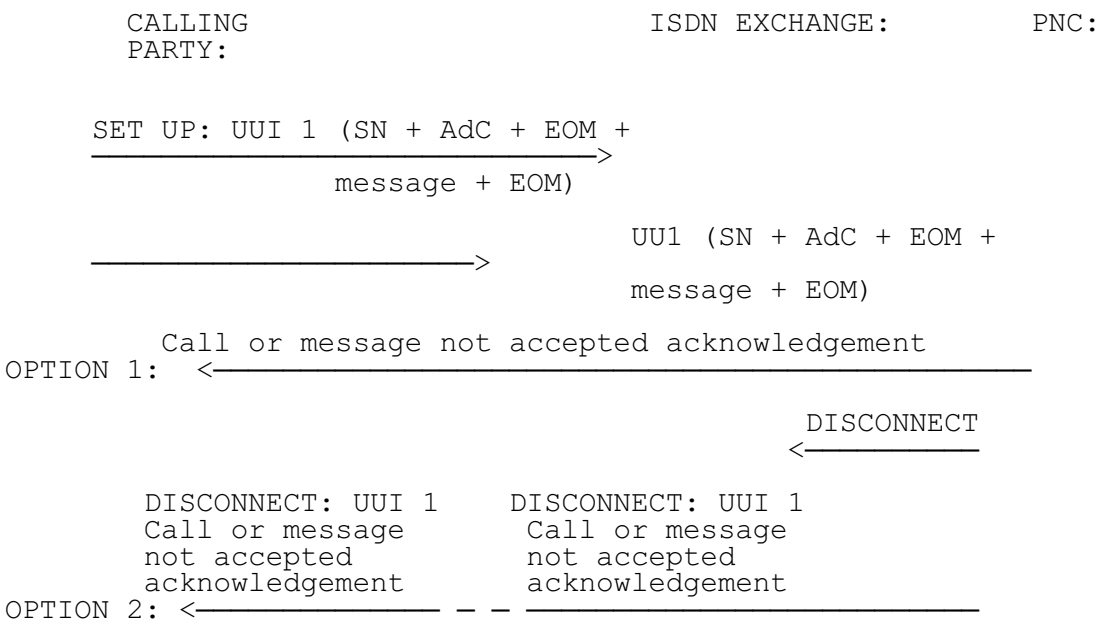
The calling party does not have the possibility of sending more information. Therefore the PNC shall disconnect the connection after sending the response.

Examples of two-stage selection access protocol for an ISDN telephone with user-to-user signalling facility are given below.

1) Normal call



2) Call with non-acceptance AdC and/or message



8.9.3.5 Two-stage selection for alphanumeric service via ISDN (UUS1)

The access method for alphanumeric service is similar to the procedure for the numeric service (see subclause 8.9.3.4).

9 I5 Interface

9.1 General

The I5 interface is the interface between the access telecommunication network and the PNC as shown in figure 2. The access telecommunication networks to the I5 interface normally comply with the relevant CCITT Recommendations. However, the I5 interface may vary according to national variations in implementation of the networks. Access may be provided via the following networks.

- Public Switched Telephone Network;
- Packet Switched Public Data Network;
- Circuit Switched Public Data Network;
- Integrated Services Digital Network;
- Telex Network.

A computer interface to facilitate automation of access to ERMES services or for the provision of a gateway for other services (i.e. value-added services) is described in subclause 9.2.

9.2 Universal computer protocol

9.2.1 Introduction

This optional protocol is included in the ERMES standard to allow network operators to offer a simple standardised protocol to other systems for access to the paging service. The protocol covers the application level of the data communication between the PNC and external computer applications. In addition to the application level a simple packet structure with a communication error detection function is included. The protocol is therefore suitable to use over various public data networks e.g. as packet switched (CCITT Recommendation X.25 [19]), circuit switched (CCITT Recommendation X.21 [18]) and over modem connections in the public telephone network. The network related procedures are not covered by this ETS.

In addition to public access, network operators may use this protocol to provide a "gateway" to a PNC from systems which may include:

- Alarm monitoring systems;
- Operator bureau message input systems;
- Data broadcast/narrowcast systems;
- Road traffic information systems;
- Existing paging networks.

Depending on the application for which the universal computer protocol is used, not all parts of the protocol may be required.

9.2.2 Operation and result

The communication on the application level is based on transactions consisting of one operation and one corresponding result. To separate different transactions from each other and to avoid duplicate operations when communication errors occur, each operation shall include a transaction reference number. The same transaction reference number shall be included in the corresponding result.

9.2.3 Data transaction sequence

The data transaction sequence starts with the originating application transmitting an operation and then waiting for the corresponding result. The recipient application shall validate a received message by investigating the checksum and the syntax of the message. After the validation the recipient application responds with the appropriate result.

The result for a valid operation may vary depending on the type of operation. If the operation is rejected by the recipient application, the reason shall be reported in the result to the originating application.

The received result shall also be validated regarding the checksum and syntax. If the operation and the result is valid the sequence is complete. For all of the cases when a transaction fails due to communication problems, checksum error in operation or result, or time-out, the originating application shall retransmit the operation with the same transaction number as used in the previous attempt. The recipient application shall in the case of receiving multiple copies of the same operation, with the same transaction reference number, respond with multiple results indicating the reception of the multiple operations. The operation shall for this case only be executed once regardless of the number of copies received.

9.2.4 Description of message format

9.2.4.1 General

Each message, operation or result, shall consist of a main body whose format shall be as follows:

START HEADER DATA CHECKSUM STOP

The start character shall be "STX" (02hex)
The stop character shall be "ETX" (03hex)

The header and the data field consists of parameters terminated with the character '/' (2Fhex). A parameter may contain a list of items. The items shall then be separated by a character ',' (2Chex).

No parameter terminator shall be sent between the STX and the header, or between the checksum and the ETX.

The separators '/' (2Fhex) and ',' (2Chex) are not allowed in the content of every parameter. In every parameter the type of characters refers to IA5. Numeric characters are between 0 (30hex) and 9 (39hex).

As far as the ERMES message part parameters (NMsg, AMsg or TMsg) the following encoding shall be used by the calling machine:

For NMsg, every ERMES numeric character given in ETS 300 133-2 [2], table B.1 shall be encoded into one IA5 character according to table 12 below:

Table 12: IA5 character codes

B4	B3	B2	B1	IA5 character
0	0	0	0	0 (30hex)
0	0	0	1	1 (31hex)
....				...
1	0	0	1	9 (39hex)
1	0	1	0	A (41hex)
....				...
1	1	1	1	F (46hex)

For AMsg, every ERMES character given in ETS 300 133-2 [2], table B.2 shall be encoded into two IA5 characters. The 4 Least Significant Bits (LSBs) shall be encoded according table 12 above and the 3 Most Significant Bits (MSBs) shall be encoded according to table 13 below:

Table 13: MSB encoding

B7	B6	B5	IA5 character
0	0	0	0 (30hex)
....			...
1	1	1	7 (37hex)

The character containing the 3 MSB shall be transmitted first.

For TMsg, the data bit stream, which is left justified, shall be divided into 4 bits strings. Each of them are encoded according to table 12. Up to 3 trailing bits with value "0" are added if necessary.

These encoding methods shall apply also to the message part of the standard text as required in the appropriate operations or results.

9.2.4.2 Header

The header shall comprise four parameters with fixed length. The parameters shall be terminated with the character '/' (2Fhex). All parameters listed below are essential (E) and shall always have a value.

Parameter	Type	Presence	Description
TRN	2 num. char.	E	Transaction reference number, right justified with leading zero.
LEN	5 num. char.	E	Total number of IA5 characters contained between STX and ETX, right justified with leading zeros
O/R	Char. 'O' or	E	'O' indicates operation, and char. 'R' 'R' indicates result
OT	2 num. char.	E	Operation type as defined in subclause 9.2.5

9.2.4.3 Data field

The data field varies in format and length depending on the operation or result specified in the header part. The data field consists of a number of parameters separated by the character '/' (2Fhex). A parameter may contain a list of items. The items shall then be separated by the character ',' (2Chex). In the case that the operation or result terminates with empty parameters the parameters may be omitted.

Essential parameters (E) shall always have a value.

Optional (O) parameters may or may not have a value. Optional parameters with no value shall be empty parameters, this mean that two adjacent separators are present in the data field.

9.2.4.4 Checksum

The checksum shall be derived by the addition of all bytes of the header, data field separators and data fields. The 8 LSBs of the result is then represented as two printable characters. The character containing the 4 MSB shall be transmitted first. For example, if the checksum is 3Ahex the representation shall be the characters '3' (33hex) and 'A' (41hex).

9.2.5 Operations provided by the Universal Computer Interface

The following operations are defined:

00	Enquiry operation
01	Call input operation
02	Multiple address call input operation
03	Call input with SSs operation
04	Address list information operation
05	Change address list operation
06	Advice of accumulated charges operation
07	Password management operation
08	Legitimisation code management operation
09	Standard text information operation
10	Change standard text operation
11	Request roaming information operation
12	Change roaming information operation
13	Roaming reset operation
14	Message retrieval operation
15	Request call barring operation
16	Cancel call barring operation
17	Request call diversion operation
18	Cancel call diversion operation
19	Request deferred delivery operation
20	Cancel deferred delivery operation
21	All features reset operation

9.2.5.1 Enquiry operation

The operation is used by a calling party to obtain the status of and features related to a MS's AdC. The network operator may restrict the use of this operation.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	Address code, mobile subscriber
OAdC	String of num. char.	O	Address code, originator
AC	String of char.	O	Authentication code, originator

9.2.5.1.1 Enquiry operation (positive result)

The following list shows the parameters used in the positive result data field.

Parameter	Type	Presence	Description
ACK	Char. 'A'	E	Positive acknowledgement
BAS	Char. '1' or '0'	O	Barring status
LAC	Char. '1' or '0'	O	Leg. code for all calls requested
L1P	Char. '1' or '0'	O	Leg. code for priority 1 requested
L3P	Char. '1' or '0'	O	Leg. code for priority 3 requested
LRC	Char. '1' or '0'	O	Leg. code for rev. charging requested
LUM	Char. '1' or '0'	O	Leg. code for urgent message requested
RT	1 num. char.	E	Receiver type: TO=1, Num.=2, Alpha.=3, Transp. data=4
NoN	2 num. char.	O	Maximum number of num. char. accepted
NoA	4 num. char.	O	Maximum number of alpha char. accepted
NoB	5 num. char.	O	Maximum number of data bits accepted

9.2.5.1.2 Enquiry operation (negative result)

The following list shows the parameters used in the negative result data field.

Parameter	Type	Presence	Description
NAC	Char 'N'	E	Negative acknowledgement
EC	2 num. char	E	Error code
SM	String of char.	O	System message

Error codes which may be returned in the operations negative result are listed in 9.2.7.

9.2.5.2 Call input operation

The operation is used for call input when no SSs are requested by the calling party. The following list shows the parameters used in the operation data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	Address code, recipient
OAdC	String of num. char.	O	Address code, originator
AC	String of char.	O	Authentication code, originator.
MT	1 numeric char. (1-4)	E	Message type. Associated parameters depend on the value of the message type.
alternative 1.			Tone-only: No additional parameters used.
alternative 2.			
NMsg	String of char.	O	Numeric message.

alternative 3.

AMsg	String of char.	O	Alphanumeric message.

alternative 4.

NB	String of num. char	E	No. of bits in Transparent Data (TD) message.
TMsg	String of char.	O(1)	TD message encoded into IA5 characters.

9.2.5.2.1 Call input operation (positive result)

The following list shows the parameters used in the positive result data field.

Parameter	Type	Presence	Description
ACK	Char. 'A'	E	Positive acknowledgement
SM	String of char.	O	System message

9.2.5.2.2 Call input operation (negative result)

Negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.3 Multiple address call input operation

The operation is used for multiple address call input. This operation only allows standard text SS. The following list shows the parameters used in the operation data field.

Parameter	Type	Presence	Description
NPL	String of num. char.	M	Number of parameters in the following RAd:s list.
RAd:s	1 string of num. char. or 2 strings of num. char. separated with ','	M	List of parameters: Each parameter consists of AdC combined with optional legitimisation code for all calls.
OAdC	String of num. char.	O	Address code, originator.
AC	String of char.	O	Authentication code, originator.
MT	1 numeric char. (1-5)	M	Message type. Associated parameters depend on the value of the message type.
alternative 1.			Tone-only: No additional parameters used.

alternative 2.

NMsg	String of char.	O	Numeric message.

alternative 3.

AMsg	String of char.	O	Alphanumeric message.

alternative 4.

NB	String of num. char	O	Number of bits in the transparent data
TMsg	String of char.	O(2)	TD message encoded into IA5 characters

---

(1) This parameter shall be present if NB not equal to 0.
(2) This parameter shall be present if NB not equal to 0.

alternative 5.

PNC	Char. 'H' or char. 'I'	O	Definition of the PNC from which the standard text shall be chosen. Char 'H' represents PNC-H; char. 'I' represents PNC-I.
LNo	String of num. char.	O	Standard text list number requested by the calling party.
LST	String of num. char.	O	Legitimisation code for standard text
TNo	String of num. char.	O	Standard text number requested by the calling party

The parameters for alternative 5 are essential if the Message Type (MT) defined is standard text.

9.2.5.3.1 Multiple address call input operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.
If any AdC listed as recipient in the operation are invalid then they may be indicated in an error report within the system message.

9.2.5.3.2 Multiple address call input operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.4 Call input with supplementary services operation

This operation is used for call input when SSs are requested by the calling party. The operation does not support multi-address calls because of incompatibility with other SSs. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
RAd	1 String of num. char. or 2 strings of num. char. separated with ','	E	Address code, recipient, combined with optional legitimisation code for all calls.
OAdC	String of num. char.	O	Address code, originator.
AC	String of char.	O	Authentication code, originator.
NPL	String of num. char.	E	Number of parameters in the following GA:s list[(3)].
GA:s	String of char.	O	List of additional GA:s requested by the calling party.
RP	Char '1'	O	Repetition requested.
PR	Char '1' or '3'	O	Priority request 1 or 3.
LPR	String of num. char.	O	Legitimisation code for priority requested.
UR	Char '1'	O	Urgent message indicator request.
LUR	String of num. char.	O	Legitimisation code for urgent message.
RC	Char '1'	O	Reverse charging request.
LRC	String of num. char.	O	Legitimisation code for reverse charging.
DD	Char '1'	O	Deferred delivery request.
DDT	10 num. char.	O[(4)]	Deferred delivery time DDMMYYHHmm
MT	1 num. char. (1-5)	E	Message type. Associated parameters depend on the value of the message type.
alternative 1.			Tone-only shall use no additional parameters.
alternative 2.			
NMsg	String of char.	O	Numeric message.

---

(3) If there is no GA, then NPL = 0.
(4) Essential if DD is '1'.

alternative 3.

AMsg	String of char.	O	Alphanumeric message.

alternative 4.

NB	String of num. char	O	Number of bits in the TD.
TMsg	String of char.	O	TD message encoded into IA5 characters.

alternative 5.

PNC	Char. 'H' or char. 'I'	O	Definition of the PNC from which the standard text shall be chosen. Char 'H' represents PNC-H char 'I' represents PNC-I.
LNo	String of num. char.	O	Standard text list number requested by the calling party.
LST	String of num. char.	O	Legitimisation code for standard text.
TNo	String of num. char.	O	Standard text number requested by the calling party.

The parameter NB for alternative 4 is essential if MT is TD.
The parameters for alternative 5 are essential if the MT defined is standard text.

9.2.5.4.1 Call input with supplementary service operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1

9.2.5.4.2 Call input with supplementary information (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.5 Address list information operation

This is the operation request address list information. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
GAdC	String of num. char.	E	Group address code with which the address list are registered.
OAdC	String of num. char.	E	Address code, originator.
AC	String of char.	E	Authentication code.

9.2.5.5.1 Address list information operation (positive result)

The following list shows the parameters used in the positive result data field.

Parameter	Type	Presence	Description
ACK	String of char.	E	Positive acknowledgement.
NPL	String of num. char.	E	Number of parameters in the following RAd:s list.
RAd:s	1 string of num. char. or 2 strings of num. char. separated with ','	E	List of parameters. Each parameter consists of AdC combined with optional legitimisation code for all calls.
GAdC	AdC combined with optional legitimisation code for acceptance of all calls.	E	Group AdC.
SM	String of char.	O	System message.

9.2.5.5.2 Address list information operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.6 Change address list operation

The operation is used to change address list information. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
GAdC	String of num. char.	E	Group AdC with which the address list are registered.
OAdC	String of num. char.	E	Address code, originator.
AC	String of char.	E	Authentication code.
NPL	String of num. char.	E	Number of parameters in the following RAd:s list.
RAd:s	1 string of num. char. or 2 strings of num. char. separated with ','.	E	List of parameters. Each parameter consists of AdC combined with optional legitimisation code for all calls.
A/D	Char 'A' (41hex) or char. 'D' (44hex)	E	Add to/delete from fixed subscriber address list record.

9.2.5.6.1 Change address list operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.6.2 Change address list operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.7 Advice of accumulated charges operation

This is the operation request accumulated charges information for a subscription. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which information of accumulated charges are requested.
AC	String of char.	E	Authentication code.

9.2.5.7.1 Advice of accumulated charges operation (positive result)

The following list shows the parameters used in the positive result.

Parameter	Type	Presence	Description
ACK	String of char.	E	Positive acknowledgement.
CT	10 num. char.	E	The date and time from which the charges are accumulated DDMMYYhhmm.
AAC	String of num. char	E	Accumulated charges.
SM	String of char.	O	System message.

9.2.5.7.2 Advice of accumulated charges operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.8 Password management operation

The operation is used by subscribers to change the AC. The parameter AC is the same as the password. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which the password or AC are to be changed.
AC	String of char.	E	Authentication code.
NAC	String of char.	E	New AC.

9.2.5.8.1 Password management operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1

9.2.5.8.2 Password management operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.9 Legitimisation code management operation

The operation is used to change legitimisation codes for restricted operations. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC to which restricted operations may be requested.
AC	String of char.	E	Authentication code.
LAC	String of char.	O	New legitimisation code for all calls.
L1P	String of char.	O	New legitimisation. code for level 1 priority.
L3P	String of char.	O	New legitimisation. code for level 3 priority.
LRC	String of char.	O	New legitimisation code for reverse charging acceptance.
LUM	String of char.	O	New legitimisation code for urgent message acceptance.
LST	String of char.	O	New legitimisation code for use of standard text.

9.2.5.9.1 Legitimisation code management operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.9.2 Legitimisation code management operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.10 Standard text information operation

This is the operation request standard texts. If the operation is restricted the calling party shall prove his authorisation by sending the legitimisation code. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
LNo	String of num. char.	E	Standard text list number.
LC	String of char.	O	Legitimisation code.

9.2.5.10.1 Standard text information operation (positive result)

The following list shows the parameters used in the positive result data field.

Parameter	Type	Presence	Description
ACK	String of char.	E	Positive acknowledgement.
NPL	String of num. char.	E	Number of parameters in the following ST:s list.
ST:s	1 string of num. char. and 1 string of char. separated with ','.	E	List of parameters. Each parameter consists of standard text number followed by the standard text itself.
SM	String of char.	O	System message.

9.2.5.10.2 Standard text information operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.11 Change standard text operation

The operation is used by a FS to change the content of standard texts associated with their subscription. The following list shows the parameters used in the operation data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC to which the standard text are registered.
AC	String of char.	E	Authentication code.
LNo	String of num. char.	E	Standard text list number.
TNo	String or num. char.	E	Standard text number.
STx	String of char.	E	The Standard text.

9.2.5.11.1 Change standard text operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.11.2 Change standard text operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.12 Request roaming information operation

The operation is used by a MS to request roaming information. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String or num. char.	E	AdC for which roaming information are requested.
AC	String of char.	E	Authentication code.

9.2.5.12.1 Request roaming information operation (positive result)

The following list shows the parameters used in the positive result data field.

Parameter	Type	Presence	Description
ACK	String of char.	E	Positive acknowledgement.
NPL	String of num. char.	E	Number of parameters in the following GAR:s list.
GAR:s	1 string of char. followed by 2 strings of 10 num. char. separated with ','	E	List of parameters. Each parameter consists of the name of the GA, the start time for roaming in this GA DDMMYYhhmm and the stop time (DDMMYYhhmm').
SM	String of char.	O	System message.

9.2.5.12.2 Request roaming information operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.13 Change roaming operation

The operation is used by a MS to change roaming information registered. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which change of roaming information are requested.
AC	String of char.	E	Authentication code
NPL	String of num. char.	E	Number of parameters in the following CR:s list.
CR:s	See below:	E	List of parameters. Each parameter consists of 4 items separated with ',' which are described below:
GA	String of char.	E	GA to add to or delete from the subscribers roaming record.
ST	10 num. char.	O[5]	Start time for GA (DDMMYYhhmm).
SP	10 num. char.	E	Stop time for GA (DDMMYYhhmm).
A/D	Char 'A' (41hex) or char 'D' (44hex)	E	Add to/Delete from subscriber roaming record.

If several periods of time are requested for the same GA, the subscriber shall have to send several parameters (one per GA and period of time).

9.2.5.13.1 Change roaming operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.13.2 Change roaming operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

---

(5) If not present , action to be undertaken as soon as the operation is registered.

9.2.5.14 Roaming reset operation

This operation is used by a MS to reset roaming information. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char	E	AdC to which roaming reset are requested
AC	String of char.	E	Authentication code.

9.2.5.14.1 Roaming reset operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.14.2 Roaming reset operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.15 Message retrieval operation

The operation is used by a MS to request retransmission or retrieval on stored messages. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String or num. char.	E	AdC for the mobile subscription to which messages are stored.
AC	String of char.	E	Authentication code.
MNo	1 String of num. char. 2 string of num. char. separated with ','	E	Message number to be transmitted or the first and last message numbers to be retrieved.
R/T	Char 'R' (52hex) or char 'T' (54hex)	E	Retrieval with positive result or retransmit on radio channel.

9.2.5.15.1 Message retrieval operation (positive result)

The following list shows the parameters used in the positive result data field.

Parameter	Type	Presence	Description
ACK	Char 'A'	E	Positive acknowledge
NPL	String of num. char.	E	Number of parameters in the following Msg:s list.
Msg:s	See below:	O	List of parameters. Each parameter consists of 4 items separated with ',' which are described below:
MN	String of numeric char		Message number of the retrieved message.
MT	One num. char. (1-4)		Message type.
SDT	10 num. char.		Stored date and time (DDMMYYhhmm).
MP	String of char.		Message part encoded according to the type of message.
SM	String of char.	O	System message

9.2.5.15.2 Message retrieval operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.16 Request call barring operation

This operation is used by a MS to request call barring. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which call barring is requested.
AC	String of char.	E	Authentication code.
ST	10 num. char	O[6]	Start time (DDMMYYhhmm).
SP	10 num. char.	E	Stop time (DDMMYYhhmm).

9.2.5.16.1 Request call barring operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.16.2 Request call barring operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.17 Cancel call barring operation

This operation is used by a MS to cancel call barring. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which call barring is cancelled.
AC	String of char.	E	Authentication code.

9.2.5.17.1 Cancel call barring operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1

9.2.5.17.2 Cancel call barring operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.18 Request call diversion operation

This operation is used by a MS to request call diversion. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC from which calls are diverted.
AC	String of char.	E	Authentication code.
DAdC	String of char.	E	AdC to which calls are diverted.
ST	10 num. char.	O[7]	Start time DDMMYYhhmm.
SP	10 num. char.	E	Stop time DDMMYYhhmm.

9.2.5.18.1 Request call diversion operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

---

(6) If not present , action to be undertaken as soon as the operation is registered.
(7) If not present , action to be undertaken as soon as the operation is registered.

9.2.5.18.2 Request call diversion operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.19 Cancel call diversion operation

The operation is used by a MS to cancel call diversion. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC to which calls where diverted.
AC	String of char.	E	Authentication code.

9.2.5.19.1 Cancel call diversion operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.19.2 Cancel call diversion operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.20 Request deferred delivery

The operation is used by a MS to request DD. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which deferred delivery is requested.
AC	String of char.	E	Authentication Code.
ST	10 num. char	O[(8)]	Start time (DDMMYYhhmm).
SP	10 num. char.	E	Stop time (DDMMYYhhmm).

9.2.5.20.1 Request deferred delivery (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.20.2 Request deferred delivery (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.21 Cancel deferred delivery

The operation is used by a MS to cancel DD. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which deferred delivery is requested.
AC	String of char.	E	Authentication code.

---

(8) If not present , action to be undertaken as soon as the operation is registered.

9.2.5.21.1 Cancel deferred delivery (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.21.2 Cancel deferred delivery (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.5.22 All features reset operation

The operation is used by a MS to reset all his SFs to the initial default value, as defined by the network operator. The following list shows the parameters used in the operations data field.

Parameter	Type	Presence	Description
AdC	String of num. char.	E	AdC for which all features reset is requested.
AC	String of char.	E	Authentication code.

9.2.5.22.1 All features reset operation (positive result)

For positive result parameters, see subclause 9.2.5.2.1.

9.2.5.22.2 All features reset operation (negative result)

For negative result parameters, see subclause 9.2.5.1.2. Error codes which may be returned in the operations negative result are listed in subclause 9.2.7.

9.2.6 Error codes

01	Checksum error
02	Syntax error
03	Operation not supported by system
04	Operation not allowed
05	Call barring active
06	AdC invalid
07	Authentication failure
08	Legitimisation code for all calls, failure
09	GA not valid
10	Repetition not allowed
11	Legitimisation code for repetition, failure
12	Priority call not allowed
13	Legitimisation code for priority call, failure
14	Urgent message not allowed
15	Legitimisation code for urgent message, failure
16	Reverse charging not allowed
17	Legitimisation code for rev. charging, failure
18	Deferred delivery not allowed
19	New AC not valid
20	New legitimisation code not valid
21	Standard text not valid
22	Time period not valid
23	Message type not supported by system
24	Message too long
25	Requested standard text not valid
26	Message type not valid for the pager type

9.2.7 Error codes applicable to each operation

Error code	Operation code																						
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
01	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
02	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
03	Y			Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	
04	Y			Y	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	
05		Y	Y	Y																		
06	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
07	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
08		Y	Y	Y																		
09													Y									
10				Y																		
11				Y																		
12				Y																		
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16				Y																		
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18				Y																		
19								Y														
20									Y													
21				Y						Y	Y											
22													Y			Y		Y		Y		
23			Y	Y																		
24		Y	Y	Y																		
25				Y							Y											
26		Y	Y	Y																		

10 Network interworking (I4 interface)

10.1 General

The I4 Interface is the interface over which PNCs communicate with each other, to:

a) process calls for paging, and

b) request information on and update MS roaming records.

This specification of the I4 Interface is the minimum required. This profile is called the "basic kernel" and shall be implemented as specified (see especially subclause 10.4 - Use of ACSE).

This Clause covers:

- the description of the protocol stack required for the I4 Interface;

- the description of the messages exchanged at application level.

The use of these messages by the applications are described in Clause 7 (Call processing).

10.2 Protocol stack for the I4 interface

This part gives the definition of all the layers required to build up the I4 Interface. The minimum of functionality is given for all the layers when this minimum is available from CCITT. This minimum functionality does not imply that other functionalities cannot be realised in some PNCs. These extra functionalities shall never be invoked for the I4 Interface.

10.2.1 Physical, link and network layers

These three layers allow the PSPDN access. They are described in CCITT Recommendation X.25 [19].

There is no restriction on the use of virtual circuits. Each entity (PNC-I, PNC-H and PNC-T) must be able to handle outgoing and incoming calls.

Interworking with the transport layer shall be provided in accordance with the rules described in CCITT Recommendation X.223 [27].

10.2.2 Transport layer

The transport layer is defined in CCITT Recommendation X.214 [23] for the service and in CCITT Recommendation X.224 [28] for the protocol.

A class 2 protocol shall be utilised over the I4 Interface. The use of expedited data is not foreseen.

10.2.3 Session layer

The session layer is defined in CCITT Recommendation X.215 [24] for the service and in CCITT Recommendation X.225 [29] for the protocol.

The basic kernel shall be utilised over the I4 Interface. This implies the following functional units:

- establishment of a session connection;

- normal data transfer;

- release of the session connection (without negotiation).

No other functional unit is required over the I4 Interface.

10.2.4 Presentation layer

The presentation layer is defined in CCITT Recommendation X.216 [34] for the service and in CCITT Recommendation X.226 [30] for the protocol.

Only the kernel functional unit is required over the I4 Interface. The functional units dealing with the context management are not foreseen.

10.2.5 Application layer

This application layer is shared by two sub-layers and the specific part of the PNCs. These two sub-layers are Association Control Service Element (ACSE) and Remote Operation Service Element (ROSE). The specific part of the application layer is described in subclause 10.3.

10.2.5.1 ACSE

The ACSE is defined in CCITT Recommendation X.217 [25] (for the service part) and in CCITT Recommendation X.227 [31] (for the protocol part). The differences between X.217 and ISO 8649, described in CCITT Recommendation X.217 [25], do not impact on the use of ACSE over the I4 interface.

10.2.5.2 ROSE

The ROSE is defined in CCITT Recommendation CCITT Recommendation X.219: "Remote operations: model, notation and service definition" [26] (for the service part) and in CCITT Recommendation X.229: "Remote operations: Protocol specification" [35] (for the protocol part).

There is no sub-set defined for ROSE in the recommendations. However the following requirements may imply a reduced version for ROSE and ACSE:

- the classes 1 and 5 for the operations are not foreseen;
- the operations defined in this specification are class 2 (result and error always expected);
- only the association class 1 is taken into account
- no linked operation.

Subclause 10.5 gives more information on the use of operations for communication between peer entities at application level.

Registration of ROSE and abstract syntax contexts (see Annex F) shall be agreed among network operators in accordance with the guide-lines included in CCITT Recommendation X.208 [20], CCITT Recommendation X.209 [21] and CCITT Recommendation X.219 [26].

10.2.5.3 Other application entities

There is no need, especially at application level, for other entities such as Remote Transfer Service Element (RTSE). The protocol stack as defined in previous subclauses is sufficient to ensure communication between PNC entities.

10.3 PNC operations

10.3.1 Introduction

This subclause describes the operations used by applications within PNCs in order to co-operate. Annex E contains a more detailed specification of these operations (in terms of parameters) and Annex F gives the Abstract Syntax Notation one (ASN.1) form. This description is the reference for the implementation.

Each I4 operation is an independent event and there is no requirement for the responding PNC to relate together the operations processed.

10.3.2 Description of operations

10.3.2.1 General

The following subclauses give generalities on the use of each operation. The name of the operation is the name of the subclause. The parameters and the expected results (positive or negative) are given in Annex E. For more details for the handling of these operations by the application, refer to Clause 7 (Call processing).

10.3.2.2 Pager information

This operation is invoked by the PNC-I to request information concerning a MS. This request is addressed to the PNC-H of the MS.

10.3.2.3 Page request

This operation is used by a PNC-I to send a message to the PNC-H. The final destination shall be a MS.

10.3.2.4 Transmit

This operation is used by the PNC-H to request the PNC-T to transmit a message to a specific mobile.

10.3.2.5 Choice of destination

This operation is invoked by the PNC-I to check on the status of the service area for the MS in combination with the GAs defined by the calling party using the choice of destination SS.

10.3.2.6 Roaming validation

This operation is invoked by the PNC-I to validate the AdC and AC input by a MS requesting a roaming SF transaction.

10.3.2.7 Roaming reset

This operation is invoked by the PNC-I to pass on to the PNC-H a roaming reset request input by a MS.

10.3.2.8 Roaming information

This operation is invoked by the PNC-I to pass on to the PNC-H a roaming information request input by a MS.

10.3.2.9 Change roaming

This operation is invoked by the PNC-I to request the result of roaming changes input by a MS. The roaming database held by the PNC-H is not affected by this operation.

10.3.2.10 Confirm change of roaming

This operation is invoked by the PNC-I to pass on a confirmed request for changes in roaming input by a MS. The roaming database held by the PNC-H is affected by this operation.

10.3.2.11 Call diversion start

This operation is invoked by the PNC-H of the AdC from which calls are to be diverted to inform the PNC-H of the divert AdC that call diversion has commenced.

10.3.2.12 Call diversion stop

This operation is invoked by the PNC-H of the AdC from which calls are being diverted to inform the PNC-H of the divert AdC that call diversion has ceased.

10.3.3 Use of operations

Figures 17 and 18 illustrate the exchange of operations between PNCs. These diagrams do not show the association establishment and release (see subclause 10.4).

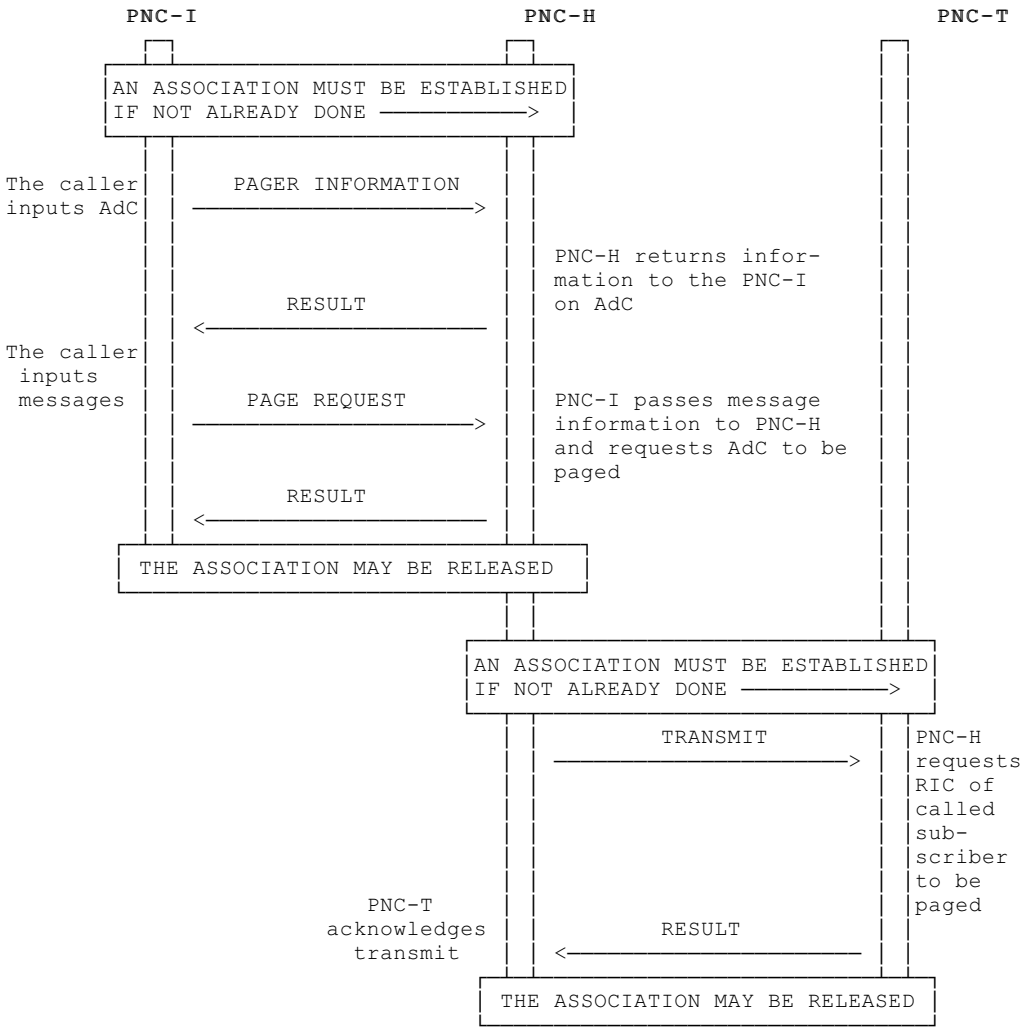


Figure 17: Flow diagram showing call processing for paging.

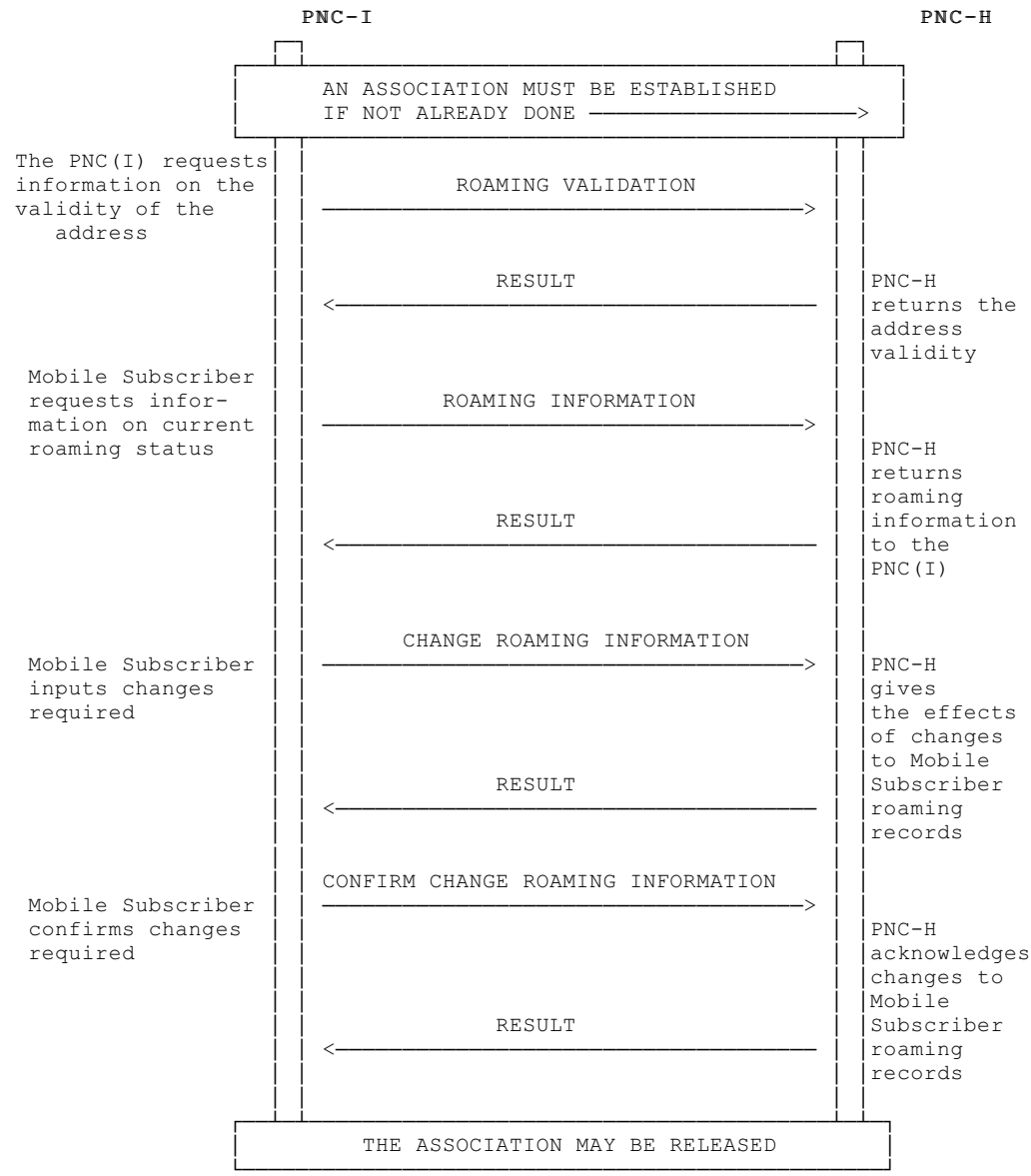


Figure 18: Flow diagram showing call processing for roaming

10.4 Use of ACSE

ACSE is used to establish an association between peer entities. This association shall be established before an operation may be invoked (association class 1). Only the entity which establishes the association may invoke operations. An association may be released only by the entity which has established the association. The peer entity may only invoke abort of the association but in this case it is possible to lose data. The abort of an association is considered as an abnormal situation.

The association may also be abnormally released by the lower layers. In this case ACSE shall report an "abort by the provider" to the upper entity.

It is not the purpose of this I4 Interface specification to indicate when an association must be released. The applications within PNCs have the liberty to decide when an association has to be established and/or released. This allows an established association to be maintained during peak periods in order to save the time required to establish association.

Information dealing with the profile is exchanged during the association establishment phase.

10.5 Use of ROSE

The ROSE entity is defined, at a service level, by CCITT Recommendation X.219 [26]. The service provided by the ROSE entity to the application entity is described below.

During the ROSE bind operation PNCs exchange authorisation information in order to ensure that no malicious calls may be handled either by authorised or non-authorised PNCs.

This information is a password stored in each PNC according to the network address of the PNC. The management of this password is described in the PNC specification and the O&M specification.

When a PNC wants to establish an association with a peer entity, it sends as a parameter the password of the PNC to be accessed. The receiving entity checks this password with the one stored in its database. If the password is correct, the called PNC confirms the association establishment and gives back its password to the calling PNC in order that the calling PNC may be sure of the identification of the called PNC. Receiving the password, the first PNC checks the password (according to the address provided by the lower layers) and the association may then be used for message delivery.

If the password is incorrect, the called PNC shall refuse the association establishment. It may also provide information to the OMC that a malicious entity has tried to enter the ERMES system. When the password checking fails at the calling entity after receiving the association confirmation, the association shall be released by an abort request and the OMC advised.

The service description below is given only as a guide. There is no constraint on the way to realise the ROSE and application entities.

RO-Invoke
The RO-Invoke service is used by the invoker (one application entity within a PNC) to cause the invocation of an operation to be performed by the performer (the peer entity within the called PNC). Two primitives are used:

RO-Invoke-Request from an application to the ROSE entity;

RO-Invoke-Indication from the ROSE entity to an application.

The operation exchanged by these primitives is contained in the parameter "argument" of the primitive. An "Invoke ID" parameter issued by the caller allows the link with the results (positive or negative).

RO-Result
The RO-Result service is used by a ROSE user (an application of PNC) to reply to a previous RO-INVOKE-INDICATION in the case of a successfully performed operation. Two primitives are used:

RO-Result-Request from an application to the ROSE entity;

RO-Result-Indication from the ROSE entity to an application.

The "result" parameter is used to report of the success of the operation by the set of information required by the operation. The RO-Result uses the same Invoke-ID as the RO-Invoke primitive.

RO-Error
The RO-Error service is used by a ROSE user (an application of PNC) to reply to a previous RO-INVOKE-INDICATION in the case of an unsuccessfully performed operation. Two primitives are used:

RO-Error-Request from an application to the ROSE entity;

RO-Error-Indication from the ROSE entity to an application.

RO-Reject-U
The RO-Reject-U service is used by an application to reject a request (within a RO-Invoke-Indication) if it has detected a problem. This service may also be used by an application to reject a response (positive or negative). For the I4 Interface only the first case is possible. Two primitives are used:

RO-Reject-U-Request from an application to the ROSE entity;

RO-Reject-U-Indication from the ROSE entity to an application.

RO-Reject-P
The RO-Reject-P service is used to advise an application of a problem detected by the ROSE provider. There is only one primitive associated to this service:

RO-Reject-P-Indication from the ROSE entity to an application.

RO-Bind
The RO-bind Service is used to allow the service of ACSE to establish an association. The RO-Bind primitive is used to exchange passwords between PNCs.

RO-Unbind
The RO-Unbind Service is used to allow the service of ACSE to release an association.

Figures 19 and 20 show some combinations of these primitives.

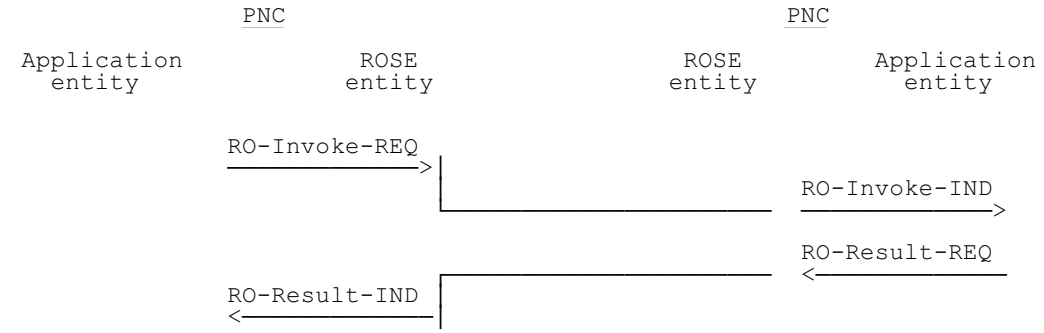


Figure 19: Operation invocation and positive report

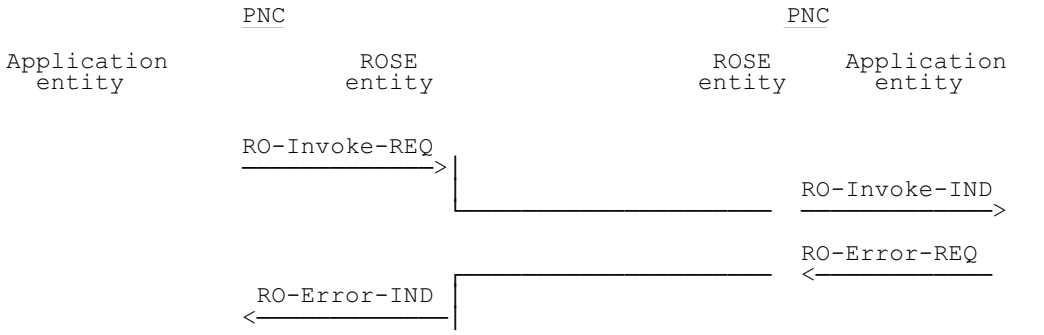


Figure 20: Operation invocation and negative report

10.6 PNC addressing

10.6.1 PNC network address

The address formats for the I4 network layer are described in Annex A of CCITT Recommendation X.213 [22].

10.6.2 PNC layer 4,5,6 and application addresses

The final form of addressing for I4 layers above the network layer shall be determined by agreement among network operators.

11 I3 interface

11.1 General description

The I3 interface is the interface over which the PNC-T communicates to the PAC.

The interface shall facilitate transport of all paging services provided for paging calls. It shall also transport control and status messages for the purpose of ensuring that the PNC knows the status of its PAC and associated BSs.

Since a standardised I3 interface is not essential this description only gives a functional specification of the data which has to be exchanged in order to fulfil the fundamental functions of the system.

11.2 Functional description

11.2.1 List of functional messages

11.2.1.1 Paging data transfer, individual call

The following list includes all the data items which may be transferred to the PAC within an individual paging call. Calls to paging groups using a common RIC are included within this functional message.

Radio Identity Code (RIC)
Paging category
Paging message (including called group indicator if present)
Urgent message indicator
Message split indicator
Message number
ERMES Code Number
Alert function
Valid sub-sequence numbers (SSN) (if restricted)
Additional information type (part of)
Called group indication
Sub-sequence mask (SM) if restricted
Active cycle indication (NL) if restricted
Frequency subset number (FSN)
Priority
External traffic indicator
Parameters for remote programming of pager
Possibility for additional information to be defined in the future (RSVD)

11.2.1.2 Paging data transfer, group call

The following list includes all the data items which may be transferred to the PAC within a group paging call.

Radio Identity Code (RIC)
Paging category
Paging message (including called group indicator if present)
Urgent message indicator
Message split indicator
Message number
ERMES Code Number
Alert function
Valid sub-sequence number (SSN) (if restricted)
Additional information type (part of)
Called group indication
Sub-sequence mask (SM) if restricted
Active cycle indication (NL) if restricted
Frequency subset number (FSN)
Priority
Roaming traffic indicator
Parameters for remote programming of pager
Possibility for additional information to be defined in the future (RSVD)

11.2.1.3 Operation and maintenance messages

	Direction of transfer of messages			
	PNC --> PAC		PAC--> PNC	
	(OMC)	(OS)	(OS)	(OMC)
Control commands		X		
Configuration modification		X		
Status request		X		
Software loading		X		
Traffic information				X
Autonomous alarm				X

Additional information on the contents and use of the above O&M messages is given in ETS 300 133-7 [6].

12 PAC to BS interface (I2 interface)

12.1 General aspects and principles

The I2 interface is a bidirectional interface between the PAC and the BS. Each PAC is linked with all the BSs covering its own PA.

The standardised I2 interface that may be used to connect the BSs to the PAC by dedicated point-to-point links is specified in this subclause.

The I2 interface carries the services provided to the system users as specified in ETS 300 133-4 [3], as well as the operation and maintenance functions related to the network management procedures as specified in ETS 300 133-7 [6]. The main (and most time critical) data flow is from the PAC to BS, due to the paging call transmissions.

Transmissions over the PAC-BS data link shall be under the complete control of the PAC with the PAC as master and the BS as slave. This means that the BS shall not invoke any transmission without a PAC request.

The MSB of every octet shall be transmitted first.

In this Clause only layers 1, 2, 4 and 7 are described. Layer 1 and 2 are according to existing CCITT/ISO standards. Layer 4 and 7 are described according to the OSI-model.

12.2 Layer 1

The DTE/DCE physical interface elements shall be X.21bis according to the CCITT Recommendation X.25 [19], Fascicle VIII.2. The setting of bit-rate shall be adjustable.

12.3 Layer 2

The single link layer procedures across the I2 interface shall be according to "Information processing systems - Data communication - High-level data link control procedures - Description of the X.25 LAPB compatible DTE data link procedures", in ISO standard 7776 [35].

The link layer shall transfer an error signal to higher layers when no response to the procedure for link set-up, link resetting or link disconnection, as described in subclauses 5.3.1, 5.3.3 and 5.6.1 of ISO standard 7776 [35], is received correctly.

12.4 Layer 3

Layer 3 is not used. This protocol layer is empty.

12.5 Layer 4 (fragmentation)

12.5.1 General

The layer 4 fragmentation makes it possible to divide an application packet into several small packets. The size of a packet is mainly based on the quality of the lines and the buffer sizes of the involved equipment. Layer 4 is a dedicated I2 layer.

12.5.2 Fragmentation header

Each information field in the High Level Data Link Control (HDLC) frame according to link layer procedures between signalling terminals shall contain a fragmentation header preceding the application data. The fragmentation header shall take the following form:

	FRN	NOP	PN	FLP	Fragmented application data
No of octets	1	1	1	2	n

FRN - Fragmentation Reference Number.
Binary number used by layer 4 to keep a complete message together.

NOP - Number Of Packets.
Binary number indicating how many packets a complete message consists of.

PN - Packet Number.
Binary number identifying each packet.

FPL - Fragmented Packet Length.
Binary number of octets (n) in the fragmented application data field.

The fragmentation reference number together with number of packets and packet number enable fragmentation of application data which is contained in the application data fields.

12.5.3 Description

Fragmentation to lower layers shall only be performed when a complete frame structure, as described in subclause 12.6.4, is delivered from the application layer.

The application layer shall not receive the application packet from layer 4 until a complete frame is delivered from the lower layers. The fragmentation depends upon system parameter N1 at the link layer, "maximum number of bits in an I frame", described in ISO standard 7776 [35], subclause 5.7.3.

When packets are delivered from lower layers and a missing packet in a sequence of packets is discovered, the application packet shall be regarded as lost.

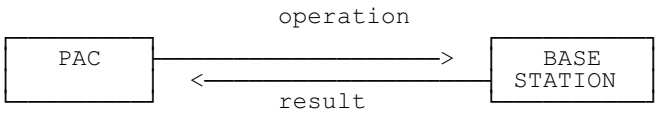
If a layer 4 message is not completed within the time T, or if an error signal, as described in subclause 12.3, is received from the lower layer then the fragmentation process shall be reset and the application packet regarded as lost. The length of timer T shall be greater than the time-outs at the link layer.

12.6 Layer 7 (Application)

12.6.1 General

The I2 interface supports a real time application. On this level the PAC manages call processing for the paging data and also BS control and supervision (for the system and O&M data).

Each transaction between the PAC and BS comprises one operation and its corresponding result, as indicated below.



Although the I2 interface is nominally for point-to-point dedicated link operation the application layer described in this subclause has some addressing features so that the protocol may be adapted for other network configurations.

12.6.2 Data processing

There are two main functions utilising the I2 protocol:

- Paging traffic processing;
- Processing of Operation & Maintenance data.

O&M data comply with the operation, maintenance and performance management categories as specified in ETS 300 133-7 [6].

A division into several transactions is shown below.

PAC————> BS	BS————> PAC
TRAFFIC OPERATION	TRAFFIC RESULT
* Page request operation	* Page request result
O&M OPERATION	O&M RESULT
* BS time reference operation * Control command operation * Status request operation * Poll request operation * Report request operation	* BS time reference result * Control command result * Status request result * Poll request result * Report request result

12.6.3 Application header

All I2 transactions shall start with the Application Header (AH) shown below.

	ORI	PAA	BSA	TRN	TPL
No of octets	1	1	2	1	2

ORI - Operation or Result Identification.
Operation and results have different numbers where the MSB is used for indication ("0" for Operation, "1" for Result) described below:

00000001 Operation 1 = Page request
00000010 Operation 2 = BS time reference
00000011 Operation 3 = Status request
00000100 Operation 4 = Control command
00000101 Operation 5 = Poll request
00000110 Operation 6 = Report request

Numbers within 0000111 - 00111111 shall be reserved for future standardised Results.

10000001 Result 1 = Page request
10000010 Result 2 = BS time reference
10000011 Result 3 = Status request
10000100 Result 4 = Control command
10000101 Result 5 = Poll request
10000110 Result 6 = Report request

The BS shall use the result 10000000 if it receives an undefined or not implemented operation.

Numbers within 10000111 - 10111111 shall be reserved for future standardised operations.

Numbers not reserved are free for manufacturers' specific purposes.

PAA - PAC address.
Binary number which identifies the PAC. This address shall be unique in a paging network. The address indicates the originator for an Operation and the terminator for a Result. When PAA is not used the field shall be set to zero.

BSA - BS Address.
Binary number which identifies a single BS or a group of BSs. A BS may have several addresses and at least one address shall be unique to the paging network. The address indicates the terminator for an Operation and the originator for a Result. The BS shall only respond to a valid address. When BSA is not used the field shall be set to zero.

TRN - Transaction reference number.

Binary number generated by the PAC to identify the transaction.
The BS shall use the same number in its response.

TPL - Transaction Packet Length.
Binary number of octets (n) in the transaction data field.

12.6.4 Transaction data

12.6.4.1 General

Every transaction consist of one operation and its corresponding result. Each operation comprises a request from the PAC and produces a logical response from the BS.

Every result shall contain an acknowledge field. A positive result indicates that the BS has received the operation correctly and expects to perform the order. A negative acknowledge indicates that performance of the operation is not possible either because the BS received an operation that included an undefined or invalid field from the PAC, or that the BS was not able to perform due to a failure.

When further details about a BS failure are required a status request transaction may be used to inform the PAC about the type of error.

An undefined or invalid field from the PAC corresponds to an error during the exchange of information between the PAC and BS.

12.6.4.2 Page request transaction

The page request operation is used by the PAC to transmit one or several batches containing addresses and/or messages and to update the system information / Supplementary System Information (SSI) in the batch headers of the I1 interface.

The page request result acknowledges whether the operation was performed.

If there are no addresses or messages to be sent an empty page request may be sent to update the fixed part of the SI/SSI in the batch header.

12.6.4.2.1 Page request operation

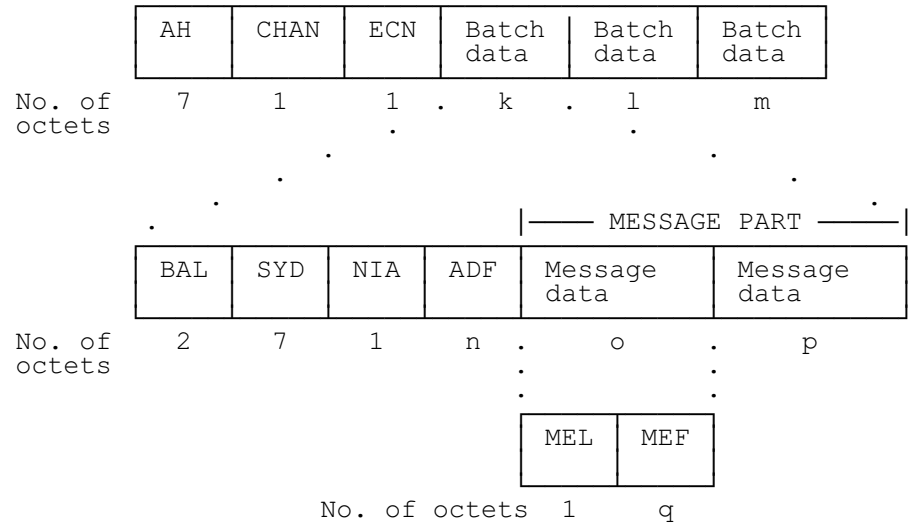
The page request operation contains all relevant data for one or several complete batches.

Only the information part (first 18 bits) of each code-word of system information, supplementary system information, initial addresses and messages shall be sent via the I2 interface. The remaining 12 bits of error correction coding (as described in ETS 300 133-4 [3], Clause 7) shall be added in the BS.

NOTE: All other invariable information on the I1 interface such as preamble, synchronisation word, address partition terminator(s) and message delimiters shall be added by the BS. The interleaving of message code-words shall also be performed by the BS.

Unless otherwise stated these 18 bit words mentioned above shall be concatenated and placed in consecutive octets. Any remaining bits in the last octet in the fields shall be set to 0.

The page request frame structure shall take the following form:



AH - Application Header.
The header is specified in subclause 12.6.3.

CHAN - CHAnnel Number.
The Channel Number is binary coded and indicates the frequency on which the batch shall be transmitted. Channel Number is defined in ETS 300 133-4 [3], subclause 9.2.

ECN - ERMES Code Number.
This field contains a binary value information to discriminate between variant or upgrades of basic ERMES coding structure at the I1 interface.

BAL - BAtch Length.
This field contains the binary number of octets for the complete batch (i.e. SYD, NIA, ADF, MELs, MEFs). The field shall be repeated for each batch in the page request.

SYD - SYstem Data.
This field contains the SI and SSI as described in ETS 300 133-4 [3], subclause 6.3. The field shall be repeated for each batch in the page request.

NIA - No of Initial Addresses.
This field contains the binary number of initial addresses in the address field. As stated in ETS 300 133-4 [3], subclause 5.4, the maximum number of initial addresses in one batch is limited to 139. The field shall be repeated for each batch in the page request.

ADF - ADdress Field.
This field contains the initial addresses which shall be transmitted in the address partition of the requested batch. The initial addresses shall be assembled in order of transmission. The field shall be repeated for each batch in the page request.

MEL - MEssage Length.
This field contains the binary number of code-words in the following message field. Only the message (or part message) length within the same batch shall be given. MEL=0 shall be used as an integral message indicator (IMI) as described below.

MEF - MEssage Field.
This field contains message code-words for transmission in the message partition of the requested batch. Message code-words shall include both message header and message data as described in ETS 300 133-4 [3], subclause 6.5.

Messages shall be assembled in the order of transmission. The message part of each batch data frame containing only complete messages (i.e. with I1 message headers) shall start and finish with an IMI. In the case of a message continued in a further batch (of the same or further sub-sequence) as described in ETS 300 133-4 [3], subclauses 11.4.1 and 11.4.2 the terminating IMI shall be omitted in the message part with the message to be continued and the commencing IMI omitted in the message part where the message does continue.

12.6.4.2.2 Page request result

Page request positive result indicates that the BS has received correctly the page request operation and expects to transmit. Page request negative result indicate to the PAC that the BS has received but may not perform the page request operation.

The page request result frame structure shall take the following form:

	AH	PRA	OMI
No. of octets	7	1	2

AH - Application Header.
The header is specified in subclause 12.6.3.

PRA - Page Request Acknowledge.
This field is bit oriented. The MSB acknowledges and, when needed, reports if there is a failure in the BS that makes the performance of the operation impossible.

MSB

0	BS may perform the operation
1	BS may not perform the operation

Bit numbers 7 to LSB indicate if there is a PAC related error that inhibits performance of the operation. If there is more than one PAC related error only the first shall be reported.

Bit 7 - LSB;

0000000	No format error
0000001	mismatching TPL
0000010	not valid CHAN
0000011	not valid ECN
0000100	not valid Batch data
0000101	page request operation received too late

Numbers up to 0001111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

OMI - Operation & Maintenance Information.
This field shall, if used, include more detailed O&M information about the BS. The contents of the OMI field shall be made known and agreed upon by both the PAC and the BS. If not used, the OMI field shall be set to zero.

12.6.4.3 BS time reference transaction

The BS time reference operation may be used to initiate the synchronisation process of BSs transmission time in accordance with ETS 300 133-4 [3], subclause 13.3.

12.6.4.3.1 BS time reference operation

The BS time reference operation frame structure shall take the following form:

	AH	TRD
No. of octets	7	n

AH - Application Header.
The header is specified in subclause 12.6.3.

TRD - Time Reference Data.
This field shall include the necessary data to perform the operation of the synchronisation process. The contents of the TRD field shall be made known and agreed upon by both the PAC and BS.

12.6.4.3.2 BS time reference result

Base station time reference positive result indicates that the BS has received correctly the BS time reference operation and expects to perform as specified.

BS time reference negative result indicates to the PAC that the BS has received but may not perform the BS time reference operation.

	AH	TRA
No. of octets	7	1

AH - Application Header.
The header is specified in subclause 12.6.3.

TRA - Time Reference Acknowledge.
This field is bit oriented. The MSB acknowledges, and when needed, report if there is a failure in the BS that makes performance of the operation impossible.

MSB;

0	BS may perform the operation.
1	BS may not perform the operation.

Bits 7 to LSB indicate if there is a PAC related error that inhibits performance of the operation. If there is more than one PAC related error, only the first shall be reported.

Bits 7 to LSB;

0000000	no format error.
0000001	mismatching TPL.
0000010	not valid TRD.

Numbers up to 0000111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

12.6.4.4 Status request transaction

The status request may be used to obtain detailed information on the status at the BS.

The status request operation shall give the PAC the opportunity to choose whether the BS reports logged or current failures.

The status request result shall enable the BS to report a table of indicated failures including;

- whether it is a logged or current failure,
- type of error,
- from which subunit at the BS the failure indication originates,
- the time when the failure occurred.

12.6.4.4.1 Status request operation

The PAC invokes the status request operation in order to get a complete status report from the BS. The status request operation frame structure shall take the following form:

	AH	SRT
No. of octets	7	1

AH - Application Header.
The header is specified in subclause 12.6.3.

SRT - Status Request Type.
Indicates the type of status information required by the PAC:

00000001	Current failure report.
00000010	Logged failure report.
00000011	Current and logged failure report.

Numbers up to 00000111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

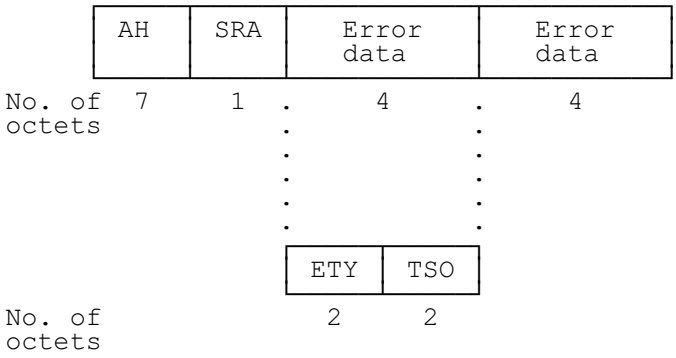
12.6.4.4.2 Status request result

The BS reports its indicated status only when specifically requested by the PAC.
When the status request type is, current and/or logged failure, the status request result shall contain tables of either:

- current failures;
- logged failures;
- current and logged failures.

When no failure exists the table shall be empty and only the Status Request Acknowledge (SRA) included in the result.

The status request result frame structure shall be as shown below. The result may consist of one or several error data fields.



AH - Application Header.
The header is specified in subclause 12.6.3.

SRA - Status Request Acknowledge.
This field is bit oriented. The MSB acknowledges, and when needed, reports if there is a failure in the BS that makes performance of the operation impossible.

MSB;

0	BS may perform the operation.
1	BS may not perform the operation.

Bits 7 to LSB indicate if there is a PAC related error that inhibits performance of the operation. If there is more than one PAC related error, only the first shall be reported.

Bits 7 to LSB;

0000000	No format error.
0000010	Mismatching TPL.
0000001	not valid SRT.

Numbers up to 0000111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

If a PAC related error is reported in SRA no error data shall follow.

ETY - Error TYpe.
This field indicates the BS error code. These codes shall be made known and agreed upon by both the PAC and BS.

TSO - Time Stamp Occurrence.
This field contains the time when the failure occurred. The size of the field is two octets. These octets form an integer word, and various bits of the word denote certain aspects of the time; bits 12 through MSB (16) give the hour, bits 6 through 11 give the minute and bits LSB (1) through 5 give the second (unit = 2 seconds).

12.6.4.5 Control command transaction

The control command modifies or changes the internal configuration of the BS and its subunits. The control command operation shall contain the action to be taken and necessary complementary information. The control command result shall indicate whether the required operation was successfully performed.

12.6.4.5.1 Control command operation

The PAC invokes the control command operation in order to control functions and parameters in the BS. The control command operation frame structure shall take the following form:

	AH	COC	COI
No. of octets	7	1	n

AH - Application Header.
The header is specified in subclause 12.6.3.

COC - Control Order Command.
This field selects what is to be controlled.

00000001	switch on/off - operational/standby
00000010	adjust frequency offset
00000011	change channel
00000100	change output power
00000101	adjust alarm thresholds
00000110	adjust time
00000111	run diagnostic
00001000	turn on/off alarms
00001001	change BS address
00001010	change effective sub-sequence length
00001011	set time of day

Numbers up to 01111111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

COI - Control Order Information.
This field shall, when necessary, contain information to realise the control order command.

When COC is:	COI shall include:
switch on/off (operational/standby)	Field 1. (One octet) Contains the identity of the subunit at the BS to be switched. These subunit identity codes shall be made known and agreed upon by both the PAC and BS. Field 2. (One octet) MSB; 0 off 1 on Bit 7; 0 standby 1 operational Bits 6 to LSB shall not be used.
adjust frequency offset	Field 1. (One octet) Contain the identity of the transmitter to be adjusted. These subunit (transmitter) identity codes shall be made known and agreed upon by both the PAC and BS. Field 2. (n octets) The nominal offset value. This value shall be made known and agreed upon by both the PAC and BS.
change channel	Field 1. (One octet) Contain the identity of the transmitter, to be adjusted. These subunit (transmitter) identity codes shall be made known and agreed upon by both the PAC and BS. Field 2. (One octet) Contain the change to be done and if the indicated transmitter shall be active or standby MSB; 0 Standby 1 Active Bits 7 to LSB identify the RF channel number. 0000000 No change 0000001 RF channel 1, up to 0010000 RF channel 16.
change output power	Field 1. (One octet) Contain the identity of the transmitter to be adjusted. These subunit (transmitter) identity codes shall be made known and agreed upon by both the PAC and BS. Field 2. (One octet) Power value that shall be made known and agreed upon by both the PAC and BS.
adjust alarm thresholds	Field 1. (Two octets) The identity of the alarm to be adjusted. These alarm identity codes shall be made known and agreed upon by both the PAC and BS. Field 2. (n octets) The threshold value. These threshold values shall be made known and agreed upon by both the PAC and BS.

adjust time

Field 1. (n octets)
The contents of these octets shall be made known and agreed upon by both the PAC and BS in accordance with subclause 12.6.4.3.1.

run diagnostic

Field 1. (One octet)
Contains the identity of the diagnostic to run. These diagnostic identity codes shall be made known and agreed upon by both the PAC and BS.

turn on/off alarms

Field 1. (Two octets)
Identifies the alarm to be turned on/off. These alarm identity codes shall be made known and agreed upon by both the PAC and BS.
When the octets are set to zero all alarms on the BS shall be cleared.

Field 2. (One octet)
MSB;
0 off
1 on
Bits 7 to LSB shall not be used.

change BS address

Field 1. (Three octets)
BS old address as defined in subclause 12.6.3

Field 2. (Three octets)
BS new address as defined in subclause 12.6.3. This command may be used to add or delete an address by including address 0 either as the new or old address.

sub-sequence length

Field 1. (One octet)
Channel No.(CHAN) as defined for the page request operation.

Field 2. (One octet)
Cycle No.(CYN) as defined for the page request operation.

Field 3. (One octet)
Sub-sequence No.(SSN) as defined for the page request operation.

Field 4. (Two octets)
Effective sub-sequence length in code-words.
A binary coded value between 0-2500.

set time of day

Field 1. (Two octets)
Hours, minutes and seconds as defined in the TSO for the status request.

12.6.4.5.2 Control command result

The BS frame structure shall respond to the PAC on a control command operation. The control command result frame structure shall take the following form:

	AH	COA
No. of octets	7	1

AH - Application Header.
The header is specified in subclause 12.6.3.

COA - Control Acknowledge.
This field is bit oriented. The MSB acknowledges, and when needed, report if there is a failure in the BS that makes performance of the operation impossible.

MSB;
0 BS may perform the operation
1 BS may not perform the operation

Bits 7 to LSB indicate if there is a PAC related error that inhibits performance of the operation. If there are more than one PAC related error, only the first shall be reported.

Bits 7 to LSB;
0000000 no format error
0000001 mismatching TPL
0000010 not valid COC
0000011 not valid COI

Numbers up to 0000111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

12.6.4.6 Poll request transaction

The PAC invokes the poll request operation to find if the BS is in a normal or failure state. The poll request result reports whether the BS is or has been in a failure state since the last status request result was transmitted.

12.6.4.6.1 Poll request operation

The poll request operation frame structure shall take the following form:

	AH
No. of octets	7

AH - Application Header.
The header is specified in subclause 12.6.3.

12.6.4.6.2 Poll request result

The poll request result frame structure shall take the following form:

	AH	POA	BSS
No. of octets	7	1	1

AH - Application Header.
The header is specified in subclause 12.6.3.

POA - POll request Acknowledge.
This field is bit oriented. The MSB acknowledges, and when needed, report if there is a failure in the BS that makes performance of the operation impossible.

MSB;
0 BS may perform the operation
1 BS may not perform the operation

Bits 7 to LSB indicate if there is a PAC related error that inhibits performance of he operation. If there are more than one PAC related error, only the first shall be reported.

Bits 7 to LSB;
0000000 No format error
0000001 a mismatching TPL

Numbers up to 0000111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.
If an error is reported in POA, no BSS shall follow.

BSS - Base Station Status
This octet reports whether the BS is, or has been, into a logged or current failure state since the last status request operation.

00000000 No failure at BS
00000001 Logged failure
00000010 Current failure
00000011 Logged and current failure

Numbers up to 00000111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

12.6.4.7 Report request transaction

The report request is used to measure the state or the result of BS parameters.

The report request operation shall contain the parameter to be checked and, when needed, contain the necessary complementary information.

If the operation is successful, the Report request result shall contain the value of the requested parameter.

12.6.4.7.1 Report request operation

The report request operation frame structure shall take the following form:

	AH	RRP	RRI
No. of octets	7	1	n

AH - Application Header.
The header is specified in subclause 12.6.3.

RRP - Report Request Parameter.
This field defines which parameters in the BS shall be checked:

00000001 On/off - operational/standby status
00000010 programmed frequency offset
00000011 channel number
00000100 output power
00000101 alarm thresholds
00000110 monitored time
00000111 report diagnostic result
00001000 alarm on/off status
00001001 BS address
00001010 check effective sub-sequence length
00001011 time of day check
00001100 report temperature

Numbers up to 01111111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.

RRI - Report Request Information.
This field contains information about the parameter to be measured:

When RRP is:	RRI shall include:
on/off (operational/ standby status)	Field 1. (One octet) The subunit at the BS to be checked for status. These subunit identity codes shall be made known and agreed upon by both the PAC and BS.
programmed frequency offset	Field 1. (One octet) The identity of the transmitter that shall report its programmed frequency offset. These subunit (transmitter) identity codes shall be made known and agreed upon by both the PAC and BS.
channel No.	Field 1. (One octet) The identity of the transmitter that shall report its channel number(s). These subunit (transmitter) identity codes shall be made known and agreed upon by both the PAC and BS.
output power	Field 1. (One octet) The identity of the transmitter that shall report its output power. These subunit (transmitter) identity codes shall be made known and agreed upon by both the PAC and BS.
alarm thresholds	Field 1. (Two octets) Identifies the alarm that shall report its alarm threshold. These alarm identity codes shall be made known and agreed upon by both the PAC and BS.
monitored time	RRI field not included
report diagnostic results	Field 1. (One octet) The identity of the diagnostic to run. Diagnostic identity codes shall be made known and agreed upon by both the PAC and BS.
alarm on/off status	Field 1. (Two octet) The identity of the alarm, that shall report its alarm on/off status. These alarm identity codes shall be made known and agreed upon by both the PAC and BS.
BS address	RRI field not included
effective sub-sequence length	Field 1. (One octet) Channel no(CHAN) as defined for the page request operation. Field 2. (One octet) Cycle no(CYN) as defined for the page request operation. Field 3. (One octet) Sub-sequence no (SSN) as defined for the page request operation.

report temperature — Field 1. (One octet)
The subunit at the BS that shall report its temperature. These subunit identity codes shall be made known and agreed upon by both the PAC and BS.

time of day check — RRI field not included.

12.6.4.7.2 Report request result

The report request result frame structure shall take the following form:

	AH	RRA	RPI
No. of octets	7	1	n

RRI - Report Request Information.
AH - Application Header.
The header is specified in subclause 12.6.3.

RRA - Report Request Acknowledge.
This field is bit oriented. The MSB acknowledges, and when needed, report if there is a failure in the BS that makes performance of the operation impossible.

MSB;
0 BS may perform the operation
1 BS may not perform the operation

Bits 7 to LSB indicate if there is a PAC related error that inhibits performance of the operation. If there is more than one PAC related error, only the first shall be reported.

Bits 7 to LSB;
0000000 No format error
0000001 mismatching TPL
0000010 not valid RRP
0000011 not valid RRI

Numbers up to 0001111 shall be reserved for future use.
Numbers not reserved are free for manufacturers' specific purposes.
If an error is reported in RRA, no RPI shall follow.

RPI - Reported Parameter Information
This field shall contain information about the measured parameter.

When RRP is:	RPI shall include:
on/off-operational/standby status	Field 1. (One octet) MSB; 0 off 1 on Bit 7; 0 standby 1 operational Bits 6 to LSB shall not be used.
programmed frequency offset	Field 1. (One octet) The nominal offset value. These offset value shall be made known and agreed upon by both the PAC and BS.

channel No. — Field 1. (n octets)
This field contains a table of elements. Each element, of size one octet, is a binary number representation of the channels that the addressed transmitter serves.
The MSB indicates whether it is a standby or an active transmitter. MSB;
0 Standby
1 Active
Bits to 7 to LSB;
Channel Number at the addressed transmitter, where
RF channel 1 = 0000001
RF channel 16 = 0010000

output power — Field 1. (One octet)
Power value. Shall be made known and agreed upon by both the PAC and BS.

alarm thresholds — Field 1. (n octets)
The threshold value. These threshold values shall be made known and agreed upon by both the PAC and BS.

monitored time — Field 1. (n octets)
The contents of this field shall be made known and agreed upon by both the PAC and BS, in accordance with subclause 12.6.4.3.1.

report diagnostic results — Field 1. (n octets)
These diagnostic results shall be made known and agreed upon by both the PAC and BS.

alarm on/off status — Field 1. (One octet)
MSB;
0 off
1 on
Bits 7 to LSB shall not be used

BS address — Field 1. (Three octets)

BS address as specified in subclause 12.6.3

When RRP is: — RPI shall include:

effective sub-sequence length — Field 1. (Two octets)
The effective sub-sequence length in code-words.
A binary coded value between 0-2500.

report temperature — Field 1. (One octet)
Temperature value. This value shall be made known and agreed upon by both the PAC and BS.

time of day check — Field 1. (Two octets)
Include hours, minutes and seconds as defined in the TSO for the status request (subclause 12.6.4.4.2)

13 Paging network controller specification

13.1 PNC functional description

In the system architecture, each operator's network is associated with a functional entity called the PNC. This functional entity is linked with the other operator's networks through the I4 interface, is linked with the access networks through the I5 and I6 interfaces, and distributes paging messages within its own network through the I3, I2 and I1 interfaces.

For call processing each PNC may fulfil three roles; that of PNC-H, PNC-I and PNC-T. These three roles are performed by the same PNC in the case of a local call.

The main functional processes performed by the PNC are consequently:

- management of the interfaces I3, I4, I5;
- management of its databases;
- calculation for the call acceptance; and
- management of the PNC-OMC interworking.

The PNC also carries out other functional processes as described in the following paragraphs.

13.2 Database specifications

For each parameter there are two indications. The first one indicates if the parameter depends on an essential (E) or optional (O) service or facility; the second one if it is a flag (F) and if it contains more information.

13.2.1 Mobile subscriber AdC-records database

E AdC

O F AdC valid/out of service

E RIC

O F Common group RIC

O F Called group indication
- group number/name

E Alert function

E FSN

O F External traffic group

O F Valid sub-sequences and cycles
- relevant sub-sequences and cycle numbers

E Service area

E Type of receiver

E Class of subscribed basic service
- subscribed message length

E F Authentication procedure
- password
- conditional number for reverse calling
- conditional certificate identification

E F Legitimisation
- depending on the services which need legitimisation, there may be a list of legitimisation codes.

E F Roaming
- list of roaming requests which contains
* table of geographical areas
* start date, time
* stop date, time

E Message numbering
- reference to the mobile subscriber RIC-message database

E F Priority

O Priorities, which may be activated by calling party

O F Subscription of temporary barring service

O F Temporary barring
- start date, time
- stop date, time
- MS pre-programmed text message

O F Subscription of diversion

O F Diversion of traffic
- new mobile subscriber AdC
- start date, time
- stop date, time

O F Diversion recipient
- list of original AdCs

O F Reverse charging acceptance
- conditional or affecting all calls

O F Repetition of the message

O F Message storing and retrieval

O F Automatic retransmission of last message number
- location of information needed (e.g. timer, number of retransmission, etc.)

O F Encryption
- encryption key

O F Urgent message indication

O F Subscription of deferred delivery service

O F Deferred delivery
- start date, time
- stop date, time
- indication, if calling party should be informed
- MS pre-programmed text message

O Number of deferred messages

O F CUG
- list of CUG numbers/names

O Location of RIC-message database

O Location of traffic database

13.2.2 Mobile subscriber RIC-message database

E RIC

E Message numbering counter

O List of messages which contains
- AdC
- message number
- message
- date and time of transmission from PNC-H to PNC-T

13.2.3 Fixed subscriber records database

E AdC

O F AdC valid/out of service

E Authentication procedure
- password
- conditional reverse calling number
- conditional certificate identification

E F Legitimisation
- depending on the services which need legitimisation, there may be a list of legitimisation codes

O Priorities

O F CUG
- list of CUG numbers/names

O F Standard text
- name of message bank

O F Group definition
- list of GAdCs

O Location of traffic database

O Accumulated charges information

13.2.4 Group database for group calls

O GAdC

O F GAdC valid/out of service
AdCs list (list of members)

O F Use of GAdC only by fixed subscribers

representative (AdC), who controls the group

O F Called group indication
- group number/name

E Class of subscribed basic service
- subscribed message length

E F Authentication procedure
- password
- conditional number for reverse calling
- conditional certificate identification

E F Legitimisation
- depending on the services which need legitimisation, there may be a list of legitimisation codes

E F Priority

O Priorities, which may be activated by calling party

O F Subscription of temporary barring service

O F Temporary barring
- start date, time
- stop date, time
- MS pre-programmed text message

O F Subscription of diversion

O F Diversion of traffic
- new MS AdC
- start date, time
- stop date, time

O F Diversion recipient
- list of original AdCs

O F Reverse charging acceptance
- conditional or affecting all calls

O F Repetition of the message

O F Urgent message indication

O F Subscription of deferred delivery service

O F Deferred delivery
- start date, time
- stop date, time
- indication, if calling party should be informed
- MS pre-programmed text message

O Number of deferred messages

O F CUG
- list of CUG numbers/names

O Location of message database

O Location of traffic database

Remark: If the service group call is offered, it remains optional for the network operator to decide about combinations with other services.

13.2.5 Closed user group database

- CUG number/name.
- Representative (AdC) who controls the CUG.
- AdCs list (list of members).

13.2.6 System addressing database

The system addressing database contains addresses and passwords for other external and internal elements within the ERMES network.

13.2.6.1 PNC/PNC addressing

The addressing PNC/PNC over the I4 interface shall use the addressing capabilities of public CCITT Recommendation X.25 [19] data networks. The PNC system addressing database therefore contains for each system/operator the addresses/number, the Data Network Identification Code (DNIC) and network address(es). (See CCITT Recommendation X.121 [32]).

Direct private circuit links between PNCs are permitted by mutual agreement between operators.

Furthermore there is included a list of the valid passwords to the different operators/systems. The password list shall be made so it accepts/contains passwords according to subclause 13.4.1.

Passwords shall only be used during the set-up of a link.

The PNC shall be advised by the OMC, which address(es) and passwords are valid. Addresses and passwords may be changed at any time.

13.2.6.2 PNC/OMC addressing

The addressing PNC/OMC is up to the operators/manufactures, since the PNC/OMC interface is an internal network interface and shall depend on the chosen transmission method (CCITT Recommendation X.25 [19], hired lines, ISDN, etc.).

13.2.6.3 PNC/PAC addressing

The addressing PNC/PAC is up to the operators/manufacturers, since the I3 interface is an internal network interface, and shall depend on the chosen transmission method (CCITT Recommendation X.25 [19], hired lines, ISDN, etc.).

13.2.7 System configuration database

The PNC requires a database of all the connected interfaces, e.g., I5, I4 and all other internal input and output interfaces, together with the configuration data associated with each interface (in service or out of service). However since this information is only used internally within each PNC there is no requirement to harmonise this database. This information may be retrieved and possibly modified by the OMC according to the operator's needs.

13.2.8 System status database

The following data items shall be held in the PNC system status database.

For each PA and GA within the network controlled by the PNC:

- Availability
- Delay
  - Priority 1 (if this service is provided)
  - Priority 2
  - Priority 3 (if this service is provided)

For other PNCs within the ERMES system:

- Status (available/not available)

- For each GA of coverage controlled by those PNCs

  - Availability

  - Delay
- Priority 2
- Priority 3 (if this service is provided)

  (See subclause 13.6 for details of the calculation of availability and delay).

This system status information may be retrieved and possibly modified by the OMC, according to the operator's needs.

13.2.9 Geographical area database

For each GA of coverage provided to home MSs on an operator's PNC a database record shall be kept relating the GAs of coverage to the operator's PAs.

For each GA of coverage provided to external MSs a GA database record shall be kept in its PNC-H holding the GA reference and the PNC controlling the GA.

For each GA of coverage which one operator provides for another operator, a database record shall be kept holding the GA identity used by the other operator and the PAs comprising the GA. The identity of a GA shall be assigned by the operator for whom the service is provided, not by the PNC holding the GA database. The identity of the PA is defined within the PNC controlling the PA.

This GA data may be retrieved and possibly modified by the OMC, according to the operator's needs.

13.3 Management of the I5 interface

The management of the I5 interface is a part of the PNC functional entity. As the PNC may be linked to several access networks, there may be one or more I5 interfaces on a PNC. The I5 management functions are:

a) configuration;
b) processing of fault situations;
c) processing of O&M information.

13.3.1 Configuration

The I5 interface is configured in accordance with the network access type parameters.

13.3.2 Processing of fault situations

There may be the following error situations in the management of the I5 interface:

Fault: no response from I5.
Action: alarm message is passed to OMC.
Fault: I5 error is active.
Action: alarm message is passed to the OMC.

13.3.3 Processing of O&M data

The PNC receives O&M data from the OMC for management of the I5 interface. Such data includes:

a) configuration information (type of I5...);
b) operation informations (link open/not open...).

The PNC may also hold O&M information on the I5 interface, which is passed on request to the OMC. This data could include:

a) traffic data;
b) I5 status.

13.4 Management of the I4 interface

Fault conditions on the I4 interface shall be notified to the appropriate PNC-I, H or T application process by the ROSE application service. These fault conditions shall be relayed by the PNC-OS to the associated OMC entity which shall initiate the appropriate action.

13.4.1 Control of I4 passwords

The passwords to be used by the I4 ROSE application service to authenticate inter-PNC communications shall be passed to the ROSE process by the associated OMC on initialisation of the PNC. Each password shall be associated with the appropriate PNC network address within the ROSE application service.

The I4 password may only be changed via the associated OMC. When a change of password is required the associated OMC shall inform the PNC of the new password. The PNC shall accept any communications referencing the new password immediately, but shall continue to accept the previous password for a period of 1 hour.

The OMC shall then inform all other OMCs within the ERMES O&M network of the new passwords. Each OMC shall then inform its associated PNC. The PNC shall use the new password when establishing all further connections with the referenced PNC.

The PNC shall notify its associated OMC of any unauthorised access attempts (i.e connection attempts using an incorrect password).

13.5 Management of the I3 interface

The management of the I3 interface is a part of the PNC functional entity. As there may be several PAs and respective PACs under the control of the PNC there are one or more I3 interfaces in one PNC.

13.6 Call acceptance principles and calculation

13.6.1 General principles

When an AdC is input by the calling party, the PNC-H shall calculate the associated availability and delay within the service area currently defined for the AdC (i.e. the area in which a call would be transmitted, including any current roaming PAs or GAs), before allowing the input of further call data. The formulae for these calculations are defined in subclauses 13.6.2 to 13.6.4.

Each operator shall determine an upper and a lower acceptance threshold for both availability and delay.

If the availability status and the delay status of the AdCs service area are both above the upper threshold then the call shall be treated as unconditionally accepted and shall proceed in the normal way.

If the availability status or the delay status is between the upper threshold and the lower threshold then the PNC-I shall be informed that the status (availability/delay) of the service area is degraded. Optionally, according to the choice of the operator, the PNC-I may inform the calling party of this (using a conditional acceptance message, see subclause 8.1.2.2.3), and offer the calling party the option to abandon the call.

If the availability status and/or the delay status is below the lower threshold then the PNC-I shall be informed that the call cannot be accepted, and the calling party shall be advised accordingly.

If an operator does not wish to use the conditional acceptance procedure, the two call acceptance thresholds shall be set to the same value.

In order for the PNC-H to calculate the availability and delay of the current service area for each AdC, each PNC shall maintain a database of the availability and delay for each PA within its own network, using information provided by its associated OMC.

Each PNC shall also maintain a similar availability and delay database for each roaming GA within the ERMES system provided to its own MSs, using status information from other OMCs within the system, relayed via its associated OMC. The information on availability and delay for each GA shall be exchanged among OMCs in a quantized form as detailed in tables 14 and 15.

Table 14: Determination of availability status

Percentage Availability $\delta_{n,k}$	<15	>15 <25	>25 <35	>35 <45	>45 <55	>55 <65	>65 <75	>75 <85	>85 <95	≥95
Network Availability Status $AS_{n,k}$	0	1	2	3	4	5	6	7	8	9

Table 15: Determination of delay status

Percentage Delay $\mu_{n,k}$	>300	<300 >275	<275 >250	<250 >225	<225 >200	<200 >175	<175 >150	<150 >125	<125 >100	≤100
Network Delay Status $DS_{n,k}$	0	1	2	3	4	5	6	7	8	9

The network delay in the table 15 is expressed as a percentage of the message delivery time QOS limit defined in ETS 300 133-2 [2], e.g. a network delay of 200 % would mean that 10 % of calls were exceeding twice the message delivery time specified.

13.6.2 Definition of terms

This subclause defines and allocates the functions needed for call acceptance within the ERMES system.

Since the information required for the calculation of call acceptance involves the O&M network, a part of the functionality here defined is also referenced in ETS 300 133-7 [6].

In the following, the "local call" case (i.e. the call generated and transmitted entirely within a single operator's network) is considered separately from the case of a call involving at least two operators. In addition, a distinction is made between the quantities (or parameters) to be calculated or considered at telecommunication level and those referred to the O&M environment.

Subclause 13.6.3 defines the states and parameters which are detected by any single entity on the basis of its internal situation. Subclause 13.6.4 defines the method to be used in evaluating the availability and delay.

The availability and delay scheme is illustrated diagrammatically in figure 21. The figure represents the ERMES system entities and also the sub-group of entities involved in a generic call "c".

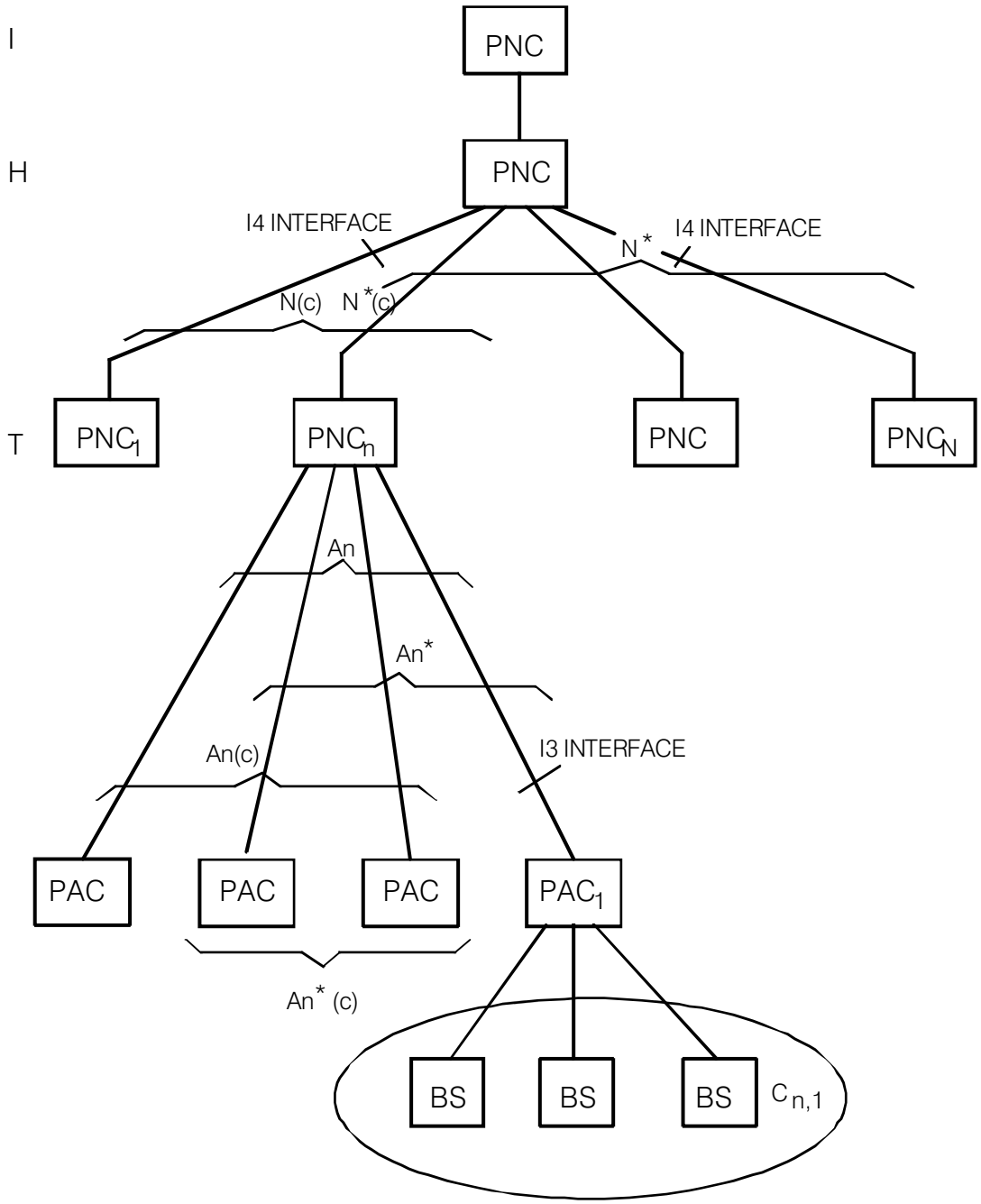


Figure 21: Availability and delay model

Let:

N the set of PNCs belonging to the ERMES system

A_n the set of PACs associated to the PNCn

$C_{n,l}$ the area covered by the transmitters of PACl, which is, by turn, associated with PNCn

$D_{n,l}$ the equivalent density of receivers inside the nominal PACn,l.

NOTE: $D_{n,l}$ is a relative figure derived from the population density within $C_{n,l}$, and is estimated from demographic information. The operator may also apply other weighting factors.

If an asterisk (*) is appended to the above letters, the attribute "available" shall apply; for instance A_n* stands for "the set of available PACs associated to the PNC_n", $C_{n,l}$* for "the area covered by the available transmitters of PAC_l".

Hence: $N^* \equiv \{N: SI4C_n . SPNC\text{-}T_n \equiv 1\}$

$A_n^* \equiv \{l: SI3C_{n,l} . SPAC_{n,l} \equiv 1\}$

where:

$SI4C_n$ is a logical variable assuming the value 0 if the interface I4 between PNC-H and PNC-T is in failure condition, 1 otherwise.

$SPNC\text{-}T_n$; $SI3C_{n,l}$; $SPAC_{n,l}$ are logical variables defined in a similar way and related respectively to $PNC\text{-}T_n$; I3 interface between $PNC\text{-}T_n$ and its l-th PAC; PAC_l associated to $PNC\text{-}T_n$.

If a "c" between brackets (c) is added to the two sets, then they refer to a single call c, i.e. they define the set of PNCs or PACs involved in the call as destination entities. Hence, N(c) means "the set of transmitting PNCs addressed by the call c"; $A_n(c)$ means "the set of PACs associated to the PNC_n and addressed by the call c".

Attributes * and (c) may apply together so $A_n^*(c)$ means "the set of available PACs associated to PNC_n and addressed by the call c".

It is easy to verify that:

$N^*(c) \equiv N^* \cap N(c)$

$A_n^*(c) \equiv A_n^* \cap A_n(c)$

Notation defined below refers to the delay mechanism affecting the delivery of a message.

$F_{n,l}$: The 90 % delay time (i.e. the time within which 90 % of calls are transmitted from receipt by the PAC) estimated for a message within PAC_l, associated to PNC_n.

Network availability and delay are estimated as a function of the above parameters.

13.6.3 State detection and parameter calculation

A list is given below of the data and parameters known or measured in the OMC, PNC-OS and PAC-OS, which are used in the calculation of availability and delay. (The list includes elements also referenced in ETS 300 133-7 [6]).

a) Each PAC continuously monitors the operation state (operation, working and access situation) of its broadcasting and distribution network (base stations and relevant communication lines). This state is controlled by the O&M function "Status Control", see ETS 300 133-7 [6]. The PAC-OS updates this state when required (for reasons of failure, restoration to service, or exclusion for maintenance).

b) Each PAC-OS (described in the formula below as the l-th PAC, belonging to the n-th PNC), evaluates the 90% delay time for transmission $F_{n,l}$. The evaluation is done periodically (for example every 15 minutes) and it is characterised per priority class of the message.

c) Each OMC (described as the OMC associated to the n-th PNC), knows the operation state of its associated PACs and that of the relevant communication links. It therefore knows the set A_n^* of PACs which may be accessed for paging message transmission. In addition it knows the operation state (i), above, of every associated PAC; hence it may calculate the equivalent number of users present in the available area $C_{n,l}^*$ of any (l-th) PAC;

$$C_{n,l}^* . D_{n,l}^*$$

as well as the probability of reaching the user, given that he is in that PA (PA user visibility):

$$\delta_{n,l} = \frac{C_{n,l}^* . D_{n,l}^*}{C_{n,l} . D_{n,l}}$$

The computation is possible since the above parameters are permanently registered in the OMC; they are only modified according to events like: insertion of a new transmitter; modification of some emission power; updating of the reference densities.

Summarising, the following data are available to any (n-th) operator:

l-th PAC-OS:	-	operation state of its area;
	-	90% delay time for transmission $F_{n,l}$ per priority class;
n-th OMC:	-	available area and density $C_{n,l}^*$; $D_{n,l}^*$ per PA;
	-	user visibility $\delta_{n,l}$ per PA.

13.6.4 Availability and delay evaluation

Network availability and delay may be considered independently for the purposes of call acceptance calculation. They are however linked, as explained in more detail below, in that if the delay within a PA exceeds the lower delay threshold it is considered as unavailable.

13.6.4.1 Availability evaluation involving only paging areas

For the particular case of a call which is only to be transmitted in PAs controlled by the PNC-H, the availability S(c) may be evaluated by the PNC-H by using the relative density concepts:

$$S(c) = \sum_{l \in A_n^*(c)} C_{n,l}^* . D_{n,i}^* \frac{1}{\sum_{i \in A_n(c)} C_{n,i} . D_{n,i}} \qquad \text{.... (1)}$$

It should be noted that this formula attributes a weighting factor for each PA according to the service area and the relative population density.

13.6.4.2 Availability evaluation involving only geographical areas

The GA availability status, $AS_{n,k}$, of the k-th GA within the n-th PNC is evaluated by the OMCn and exchanged with the other OMCs as described in ETS 300 133-7 [6].

The destination attributes of the call c are taken into account by the PNC-H which, by knowing $AS_{n,k}$ for each GA of the ERMES system may evaluate the network availability for that call:

$$S(c) = \frac{1}{\sum_{n \in N(c)} \left| G_n(c) \right|} \cdot \sum_{n \in N^*(c)} \sum_{k \in G_n(c)} AS_{n,k} \qquad \text{.... (2)}$$

where $\left| G_n(c) \right|$ represents the number of GAs defined inside the n-th network which are involved in call c.

It should be noted that the probability of a user being within a particular GA is not dependent on relative population density, i.e the same probability is assumed for all the GAs involved in the call. Relative population density is only taken into account for evaluating the user visibility within a PA or GA.

13.6.4.3 Availability evaluation involving paging and geographical areas

A formula similar to (2) above could be used by the PNC-H to evaluate the availability for a call c involving both PAs and GAs, if the status of each PA is defined using its visibility in a similar way to the status for a GA. Other formulae similar to (1) may be defined by the operator if it is required to apply different weights to PAs and GAs.

13.6.4.4 Delay evaluation involving only paging areas

Probability criteria are also used for the evaluation of network delay .

For the particular case of a call which is only to be transmitted in PAs controlled by the PNC-H, D(c), the associated delay, is calculated by making reference to the delay within each PAC and invoking directly the destination attributes of c. Accordingly, D(c) is calculated as:

$$D(c) = \frac{1}{\left|A_n{}^*(c)\right|} \quad \sum_{l \in A_n{}^*(c)} F_{n,l} \qquad \text{....(3)}$$

and then related to the thresholds to determine the call acceptance.

13.6.4.5 Delay evaluation involving only geographical areas

The GA delay status $DS_{n,k}$ of the k-th GA within the n-th PNC is evaluated by the OMC_n and exchanged with the other OMCs as described in ETS 300 133-7 [6].

The PNC-H, when dealing with a call involving only GA(s) calculates the associated delay status by making reference to the delay status of the GAs involved:

$$D(c) = \frac{1}{\sum_{n \in N^*(c)} \left|G_n(c)\right|} \cdot \sum_{n \in N^*(c)} \quad \sum_{k \in G_n(c)} DS_{n,k} \qquad \text{.... (4)}$$

Equation (4) is formally identical to (2). It represents the mean 90% delay status for the relevant GAs involved in call c. D(c) is then related to the two thresholds to determine the call acceptance.

The two thresholds may depend on the priority class.

The above formula has a "smoothing" effect on the influence of any heavily delaying directions. If only one GA out of those involved in the call is seriously congested then call transmission is still possible.

13.6.4.6 Delay evaluation involving both paging and geographical areas

A formula similar to (4) above could be used by the PNC-H to evaluate the associated delay for a call c involving both PAs and GAs, if the status of each PA is defined using its delay in a similar way to the status for a GA. Other formulae may be defined by the operator if it is required to apply different weights to PAs and GAs.

13.7 Universal time reference

A number of SSs e.g. roaming, diversion of traffic, temporary barring, and DD require access to time information for activation/de-activation.

The universal time shall be used as a reference. The absolute time accuracy of a PNC shall be maintained at better than ± 1 second. This is to ensure that the difference in time between any centre and the user shall not be so great that a loss of paging message may occur.

This could happen if a subscriber were to ask for "deferred delivery" until a specified time. If the time accuracy were not sufficient, the receiver could be switched on some moments after the stored paging messages had been sent. The opposite may also happen if the subscriber switches off his receiver after requesting "deferred delivery" and there are still paging messages buffered in the transmission network.

When entering a command for service some time must be allowed to elapse before the execution of that service. A change should therefore never be accepted for a time earlier than the message delivery time in the network. (see subclause 7.2.6 of ETS 300 133-2 [2]).

13.8 Translation of national character sets to the ERMES character set

When a subscriber is generating messages to be sent over a paging network different methods are accepted e.g. DTMF signalling from ordinary telephone sets, CCITT AI5 code from a data terminal.

One method may appear to be the same in different countries but very often the interpretation of the characters might be different depending on the national character sets used in each case.

When a message is entered into the network a translation of the generated characters shall be made in the PNC-I. The translation is from the national (local) character set used to the universal character set specified in ETS 300 133-2 [2], Annex B.2.

When this translation has been made no further translations shall be performed, since alphanumeric receivers used in any ERMES network shall be capable of presenting the characters according to the above mentioned table.

Problems may occur when a particular national character is missing in the ERMES table. In this case the network operator shall decide how and if the character shall be translated. If no character in the ERMES table is acceptable a special character might be replaced by a number of ERMES characters or it might be decided that no conversion will be performed. In this case the calling party shall be notified that the character has been rejected.

Different national character sets could be accepted in the same operator network. In each case the PNC-I has to be notified of the type of input terminal and alphabet which is being used. Based on this information a selection of the proper translation table may be made. A number of different translation tables may therefore exist for each network.

The types of acceptable terminals and alphanumeric characters shall be decided by the network operator.

13.9 Encryption

If the optional message encryption service is provided then encryption shall be carried out within the PNC-H of the MS. The encrypted message shall be passed to PNC-Ts as a binary message within the I4 transmit operation (if applicable).

13.10 Transparent data calls

For transparent data calls the function of character conversion shall not be performed by the PNC-I. The message shall be passed to the PNC-H as a binary message within the I4 page request operation (if applicable). The message shall then be passed to PNC-Ts as a binary message within the I4 transmit operation (if applicable).

13.11 Call queuing

Calls shall be passed by the PNC-I to the PNC-H with minimum delay. Grouping of calls for transmission over the I4 interface is permitted, provided the overall QOS time delay limits are met (see subclause 7.2 of ETS 300 133-2 [2]).

Calls shall be passed by the PNC-H to the PNC-T with minimum delay. Grouping of calls for transmission over the I4 interface is permitted, provided the overall QOS time delay limits are met (see subclause 7.2 of ETS 300 133-2 [2]).

Calls shall be passed by the PNC-T to the appropriate PAC(s) with minimum delay. Grouping of calls for transmission over the I3 interface is permitted, provided the overall QOS time delay limits are met. During periods of heavy traffic it may be necessary for the PNC-H and PNC-T to give priority to the processing of priority 1 calls over priority 2 calls, and similarly priority 2 calls over priority 3 calls, in order to meet the required QOS limits.

If calls cannot be transferred to the next functional entity then those calls shall be queued within the current PNC entity.

14 Paging area controller

14.1 General description

The PAC controls one PA of an operator network. Each PA may contain several base stations.

PAC deals with the traffic control process. It receives page messages from the PNC in any order, performs the necessary batching, queueing and priority management before sending page request operations to the BSs under its control. PAC functions may be subdivided into three logical parts:

- Input (I3 interface);
- Output (I2 interface);
- Control.

The input and output sections are compliant with Clauses 11 and 12 respectively. The Control section implements the basic functions assigned to PAC.

PAC-OS is the basic operations system associated with the PAC (see ETS 300 133-7 [6]). It deals with the O&M functions assigned to the PAC. Figure 22 shows the relationship between the PAC, PAC-OS, I2 and I3 interfaces.

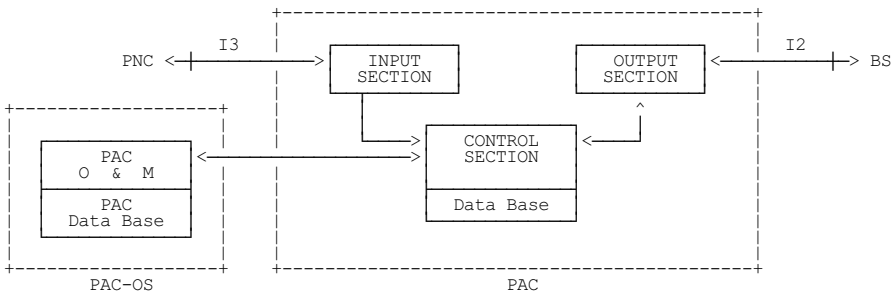


Figure 22: PAC architecture

14.2 PAC architecture

The functional entity PAC shown in figure 22 is defined by:

- the set of BSs it may address with page request operations to be transmitted;
- the set of sub-sequences and frequency channels utilised by these BSs.

The OMC may modify the PAC configuration by creating or deleting PAC entities. The only constraints on these modifications are that:

- the set of BSs identifying the new PA may be addressed by the new PAC;
- the new sub-sequence and channel assignments shall be compatible with the time and frequency plan adopted for the other PAs.

Both constraints are known by the OMC which takes the decision to define a new PA according to traffic needs. This approach also allows definition of the so-called "network time slot" as a particular case of the process.

In the network time slot the entire set of BSs in a network may be considered, at least for a single time slot on a given channel, as creating a network wide PA. The association of different groups of BSs under a single PA, even if performed within only one sub-sequence, requires complete synchronisation of the transmitters involved.

The network time slot mechanism described above may be implemented either as a network PAC (as described) or as an additional PNC functionality (which implies some optional parameters to be exchanged through I3 interface). These aspects are further clarified in subclause 14.2.1.

14.2.1 Management of the paging area in a time division environment

An example of sub-sequence (time slot) allocation in a cluster of PAs is shown figure 23(i). The assignment is performed on the same frequency channel by allocating to each PA (hexagon identified by a capital letter) a number of sub-sequences (time slots) tied to the relevant traffic needs. Similar concepts are also applicable when more than one frequency is assigned to the cluster. The sub-sequences (integer numbers identify the sub-sequence number within a cycle) are arranged in such a way that repetitions in contiguous areas are avoided. In this scheme each elementary area is associated with a PAC which controls the BSs providing the coverage.

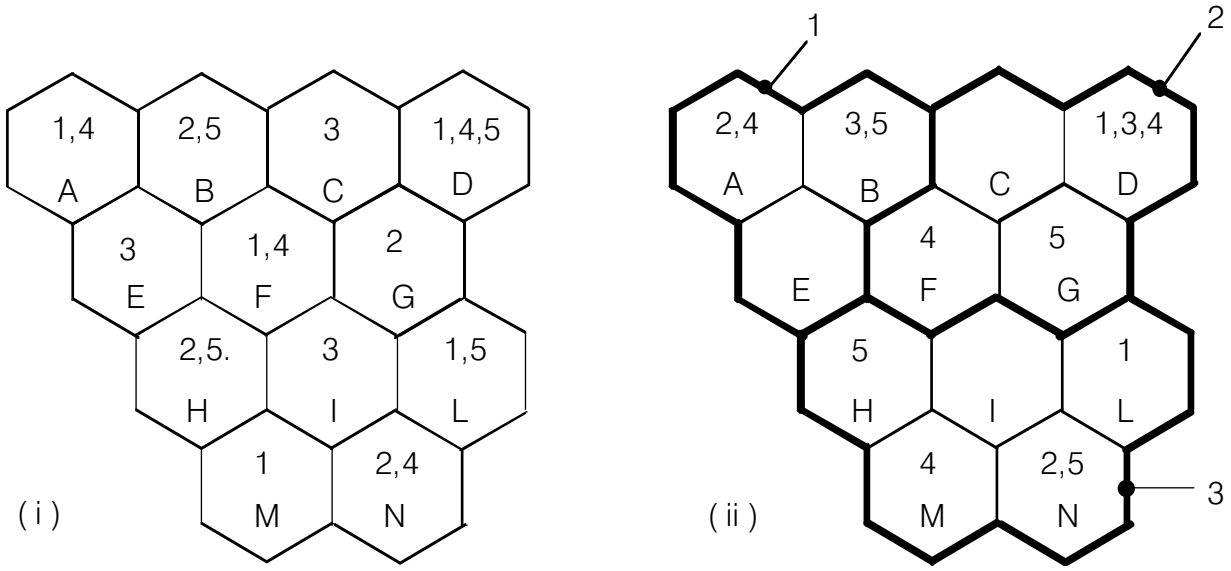


Figure 23: Allocation of sub-sequences in a time divided network

According to traffic needs and particularly to the prevailing message destination or paging subscriptions, the PA configuration may be modified to that of figure 23 (ii). In this case several elementary areas are grouped together to form areas which are assigned one (or more) slots. The network time slot is a particular case. Hence areas A, B and E are in this case assigned sub-sequences (2 and 4 to A; 3 and 5 to B) while the area A+B+E is assigned sub-sequence 1.

Control of the above regionalisation may be performed in two ways:

- by defining a new PAC dealing with sub-sequence 1 in all the (synchronous) BSs belonging to A, B and E;

- by assigning the same sub-sequence 1 to the PACs A, B, E (previously working independently) under the PNC control.

If a network does not support the changeable PA feature and the network time slot concept, then a network wide message may be transmitted by sending it separately in each PA.

14.3 Input section (I3 interface)

The application functions of the I3 interface described in Clause 11 consist of:

- checking the validity of the received page message;

- sending this message to the control section if there are no message errors;

- sending response to PNC (logical ACK/NACK) according to the message validity.

NOTE: the message validity concept refers to the message syntax, semantics and to the feasibility of the message transfer to the control section.

Operation at the input section shall be as shown in figure 24.

14.4 Output section (I2 interface)

The application functions of the I2 interface defined in Clause 12 consist of:

- forming the page request operation;

- sending the page request operation to the set of active BSs controlled by the PAC;

- receiving the result message from the BSs involved;

- reporting to the control section the negative or positive page request result from BSs or time-out expired cases.

The decision about the actions to be started regarding the message not properly received by the BSs or not transmitted by the output section is left to the control section.

Operation at the output section shall be as shown in figure 25.

14.5 Control section

The control section plays the central role assigned to the PAC. It converts the page message flow from the PNC to the page request operation flow directed to the BSs. Accordingly it shall implement the following basic functions:

- input control;

- output control;

- allocation, queueing of the messages and accomplishment of the priority criteria;

- traffic control;

- communication with O&M.

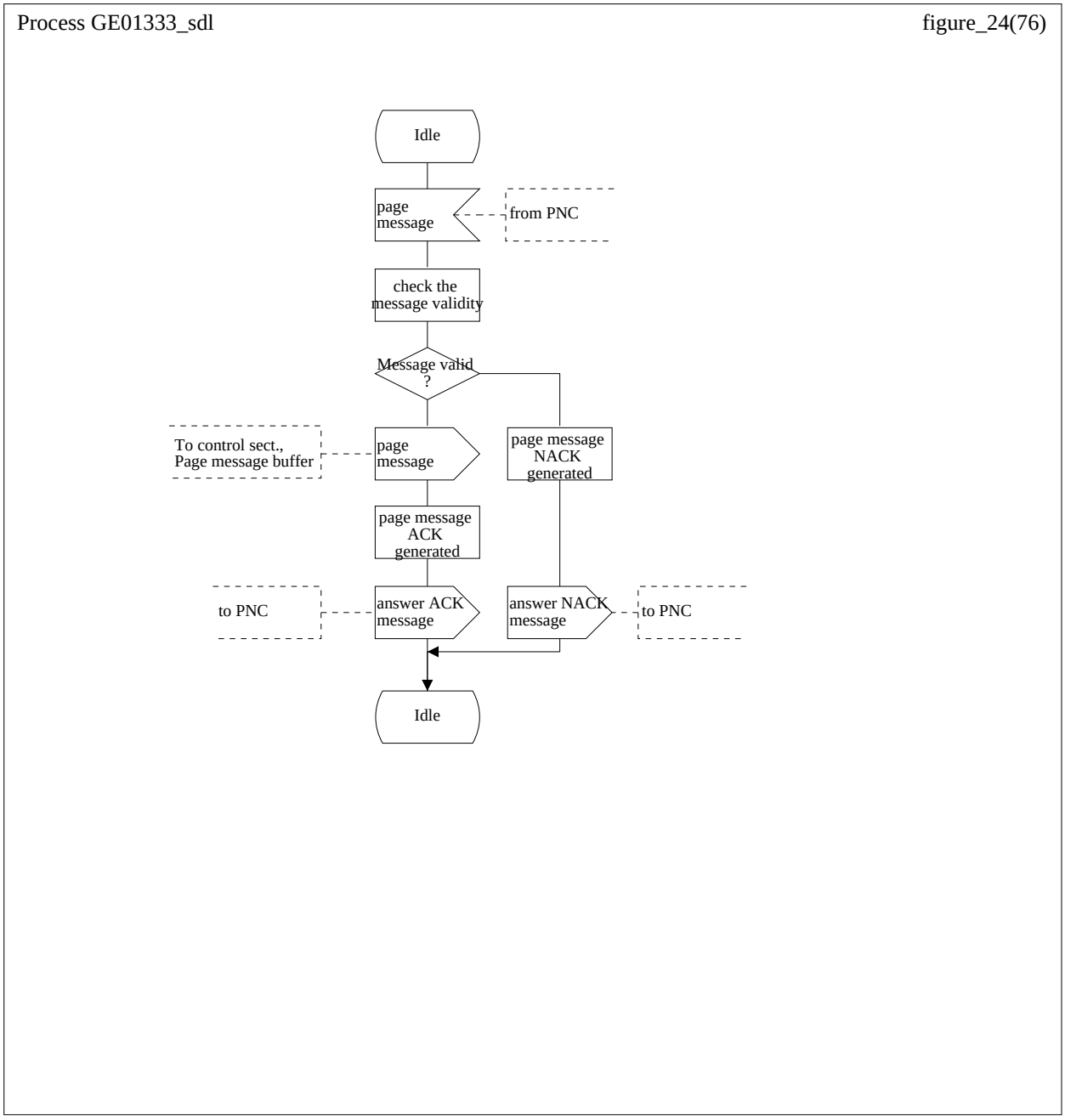


Figure 24: SDL diagram for input section - application functions

NOTE: SDL = Specification and Description Language, defined in the Z.100 series of CCITT Recommendation Z.100 [37].

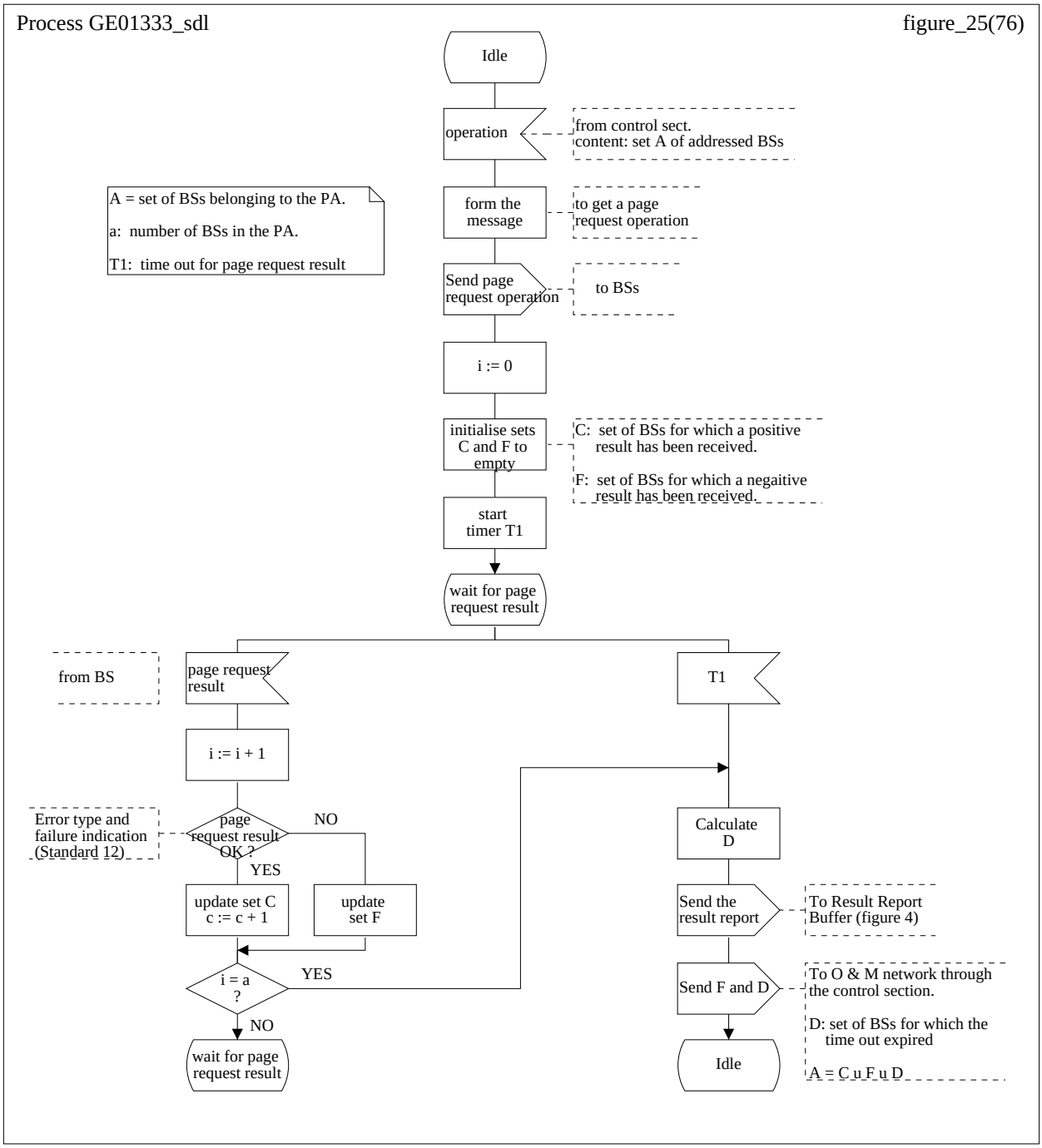


Figure 25: SDL diagram for output section - application functions

14.5.1 Functional implementation

The general functionality of the control section may be depicted as in figure 26 and is given as an example. Input events to the control section are shown on the upper side of the figure whilst the lower side reports the actions and results. It should be noted that the page messages, the result reports and the s_i events are served in increasing order of priority. s_i represents a sequence of instants synchronous with the batch boundaries (0,75 second). In s_i the control section must terminate its message allocation in the i-th batch and send it to the output section. Messages and results are inserted in the queues (page message buffer and report result buffer) by the input and output sections respectively.

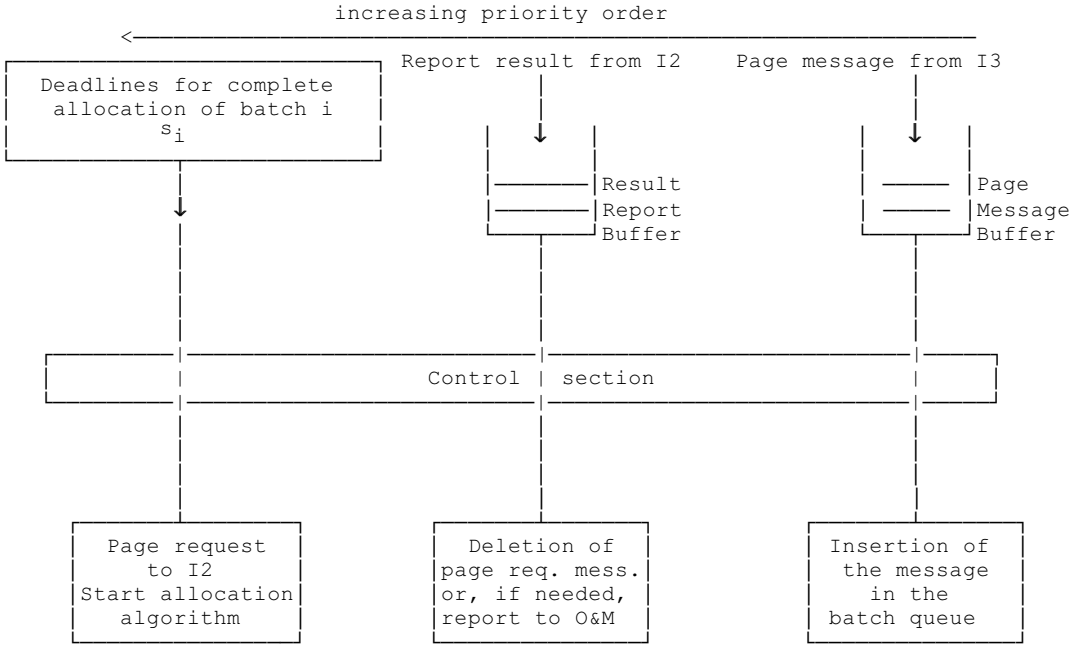


Figure 26: Functionality of the control section

Attention is drawn to the following points in figure 26:

- the input control with the page message buffer, loaded with messages from the input section. The relevant service consists in the insertion of the message in the internal queues for allocation;

- the output control, working according to the s_i deadlines for sending the page request operation to the output section and also dealing with the report result messages which cause either a deletion or a re-presentation of the page request operation in the queues;

- the allocation process control, also working according to the s_i deadline, where the allocation algorithm is started on the new (i+1)-th batch (or on a new set of batches, depending on the allocation criterion).

14.5.2 Input control

The following tasks shall be performed by the input control:

- receive the page message coming from the input section;
- derive from Frequency Subset Number (FSN), the Frequency Subset Indicator (FSI) to be associated with the message;
- enter the message and the initial addresses in suitable queues according to priority.

In the case of a group call whose members are associated with different FSIs the message should be allocated and repeated for each FSI involved.

14.5.3 Output control

The following tasks shall be performed by the output control:

a) Format the data according to the page request operation format (see figure 27):
- add the Channel Reference Number (CHAN);
- add system information
- calculate and insert the initial address;
- insert all the addresses in a decreasing order;
- for each message:
  * calculate and insert the message length,
  * update message header with the needed parameters, (see ETS 300 133-4 [3] subclause 6.5.1),
  * insert message header and the message content.

b) Send the page request operation to the output section.

c) Receive results from the output section:
- if ACK, delete the message from the relevant buffers;
- if NACK or time-out, delete the message from the relevant buffers and report to 0&M.

NOTE: ACKs, NACKs and time-outs refer to the entire set of BSs involved in the message delivery (see also Page request result, subclause 12.6.4.2.2).

14.5.4 Allocation process

The Allocation Process is responsible for:

a) Taking the addresses and the messages to be allocated from the internal buffers.

b) Allocating them within a pre-assigned set of batches according to the following criteria:

- priority of the messages;
- channel efficiency;
- time between the initial address and the message transmission starting instant;
- constraints related to the kind of the message to be transmitted (group call, long message, individual message);
- constraints related to the pager behaviour (e.g. limitations in the access to the cycles);
- busy pagers (i.e. those for which a receiving transaction is in progress).

The second and third criteria concern two requirements in conflict with each other. To maximize the channel efficiency and minimize the receiver battery consumption. A trade-off has to be reached in dimensioning the control parameters.

c) Defining the long messages and take the necessary actions.

d) Dealing with the set of information connecting a decision interval for allocation to the subsequent one.

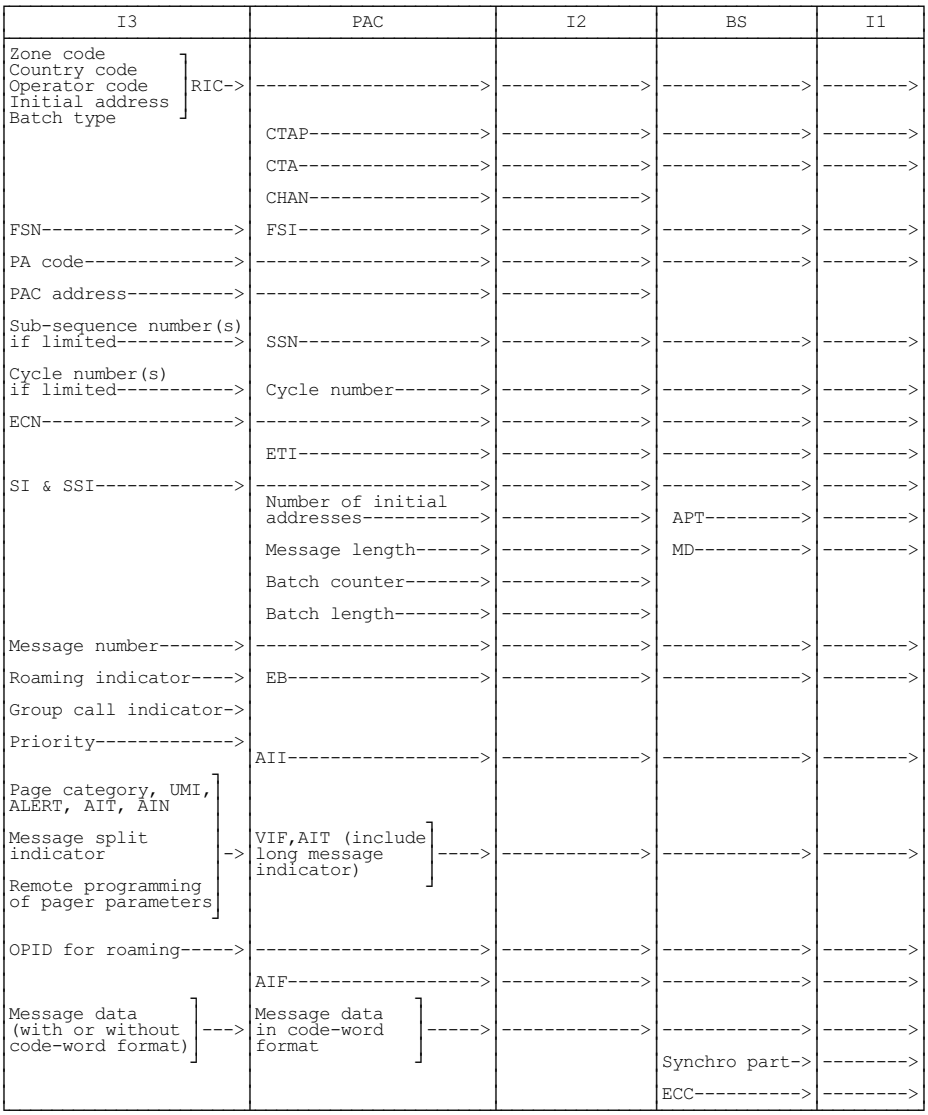


Figure 27: Traffic data flow in the control section

14.5.5 Example of call processing

An example of call processing is given in this subclause based on a possible choice of processing control parameters and queueing procedure.

14.5.5.1 Control parameters

The following parameters shall be defined:

Decision interval n_d: is the number of batches which are considered together to decide the message allocation in the batches. The parameter is utilised by the message allocation algorithm : n_d may range from 1 to 16. If a balanced load situation arises among the batches, then n_d may be set to 1 (no overload between one "heavy loaded" batch and a "low loaded" batch. $n_d > 1$ should work well when an unbalanced situation is present. In general some information has to be transferred from a decision interval i to a decision interval i+1, for example in the case of a group call and for long messages.

Minimum anticipation interval T_A: is the minimum interval between the transmission of the page request operation to the Output section and the air transmission time of the batch contained in the operation itself. T_A represents the minimum time interval for sending the page operation to the output section in order to satisfy the correct transmission instant to the air. It is assumed that the batches sent from the control to the output section are carried one at a time as soon as the relevant message allocation is completed. In

the example it is also assumed that the operation message carried by the I2 interface is formed by exactly one batch (batch counter = 1). T_A is affected by the time taken to process the batch and transmit it to the required BSs. It depends also on the grouping of batches in the output section.

Once the value of the control parameters has been chosen, a sequence of s_i is deduced. s_i corresponds to an interrupt point for the control section process and is a deadline for having completed the allocation for the batch i, having transmitted the batch i to the output section and having shifted the decision interval n_d by one batch.

Figure 28 illustrates a case in which T_A is assigned the value of 3 batch intervals and n_d is set to 4. During the time interval s_{i-1}-s_i, the control section allocates the messages taking into account the space available in batches A, B, C, D. In s_i, batch A is considered in final status and hence transmitted to the output section. In the same instant the n_d interval is moved to the right and batches B, C, D, E considered for message allocation.

NOTE: The mechanism described applies equally well to a frequency divided network in which a single channel (all sub-sequences) is continuously available to the BSs. In a time divided network it is better to apply the allocation process to the entire sub-sequence.

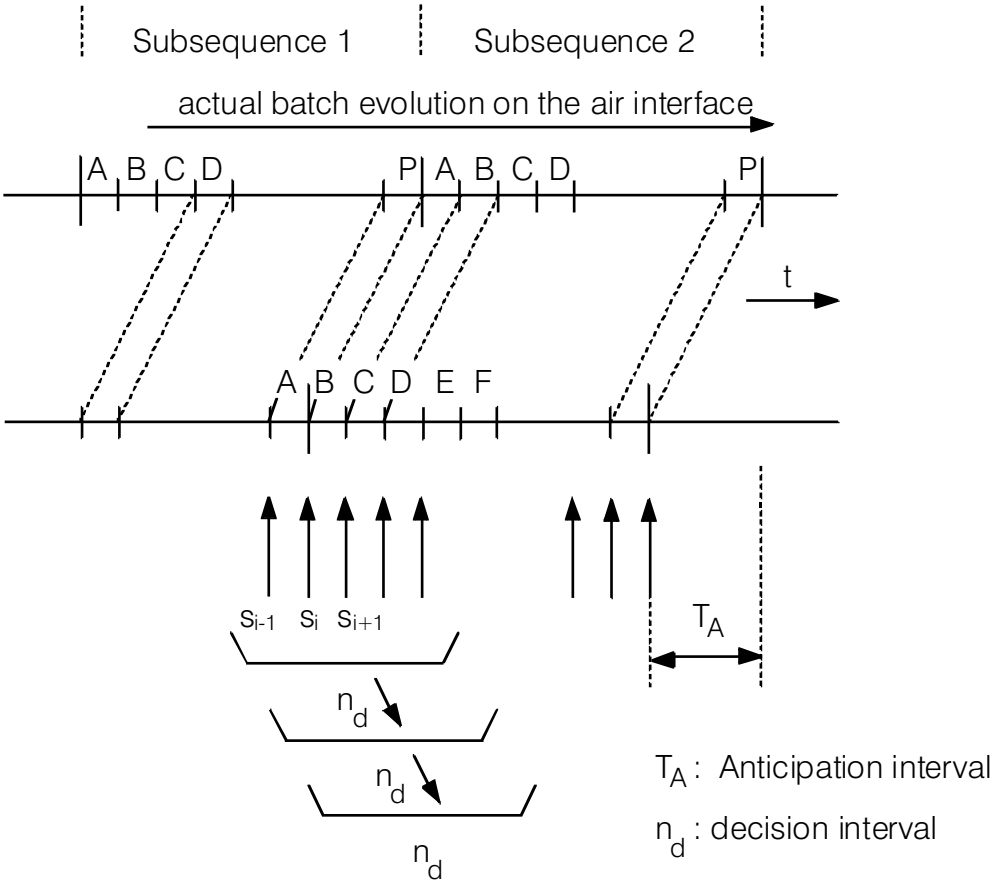


Figure 28: Time anticipation for message transmission and allocation

14.5.5.2 Queueing procedure

Figure 29 illustrates a procedure for queueing the messages and for deleting them when the result report message is received. It refers to a particular FSI (channel): a corresponding scheme has to be created by the PAC every time FSI are added. The FSI knowledge identifies the relevant sub-sequences (see the definition of a PA). The figure also identifies a number of buffers whose description implicitly explains the procedure.

- Initial Address Buffer (IAB), each is associated with a batch. It queues the initial addresses according to the three defined priority classes. The addresses are inserted and served in sequence according to the head of the line criterion. An Initial Address Service Pointer (IASP) designates the firstly arrived initial address to be served (by insertion in the relevant batch); the designated address belongs to the highest priority class among those represented in IAB in that instant. An Initial Address Confirmation Pointer (IACP) designates the first initial address to be confirmed as received by the BSs. Figure 29 shows only IABs relevant to batches A, B, C, D.

- Every initial address stored in IAB unequivocally identifies (by means of a pointer) the message it is associated with stored in the message buffer.

- The message buffer stores all together and without following any ordering, the messages waiting for insertion in the batches. There need only be one message buffer per activated FSI within the PAC. Every message is identified by the initial address in the IAB.

- The message buffer as well as IABs are loaded with the page messages (from the input section) and unloaded by the control section according to the ACK flow coming back from the output section. The erasing mechanism makes use of the linking buffer described below.

- The Q buffer stores the initial addresses already sent to the pagers but whose following message (inserted in a given batch by the allocation algorithm) did not reach the BSs, due to a line error or an over-delay. The lost events are detected by a specific result report message. Every initial address stored in the Q buffer unequivocally identifies (by addressing it) the associated message which is stored in the message buffer.

- The linking buffer registers some information about the batches whose reception has not been acknowledged yet by the BSs. It is lengthening on its "head side" (left in the figure) by 1 batch element every time the batch is considered definitely formed by the allocation algorithm (instants si). The linking buffer on the other hand is shortening every time a page request message is acknowledged by a positive result report. Every batch element, say the i-th, contains two fields, these are:

  * The forward chain which is a list of the initial addresses inserted in the i-th batch for transmission. Each initial address is associated with the allocation of the relevant message (batch, sub-sequence, cycle);

  * The backward chain which is a list of the initial addresses whose associated messages has been inserted in the i-th batch. (In principle, the forward chain contains also the backward chain information, but the latter has been introduced to avoid complex scanning processes in the control section).

Handling of long messages is the responsibility of the allocation algorithm. The algorithm for message allocation along the batches shall be decided by the network operator.

The SDL diagram describing message queueing and control is shown in figure 30.

14.6 Database

For normal operation, the PAC makes use of two kinds of database (see figure 22). One is contained in its control section and the other one, mainly storing configuration data, states and parameters, belongs to the PAC-OS.

14.6.1 PAC traffic database in the control section

- I3 message queues.
- I2 batch queues.
- Internal traffic queues.
- BSs addresses belonging to the PAC.
- Country code.
- Operator code.
- PA code.
- Border area indicator.
- Supplementary system information.

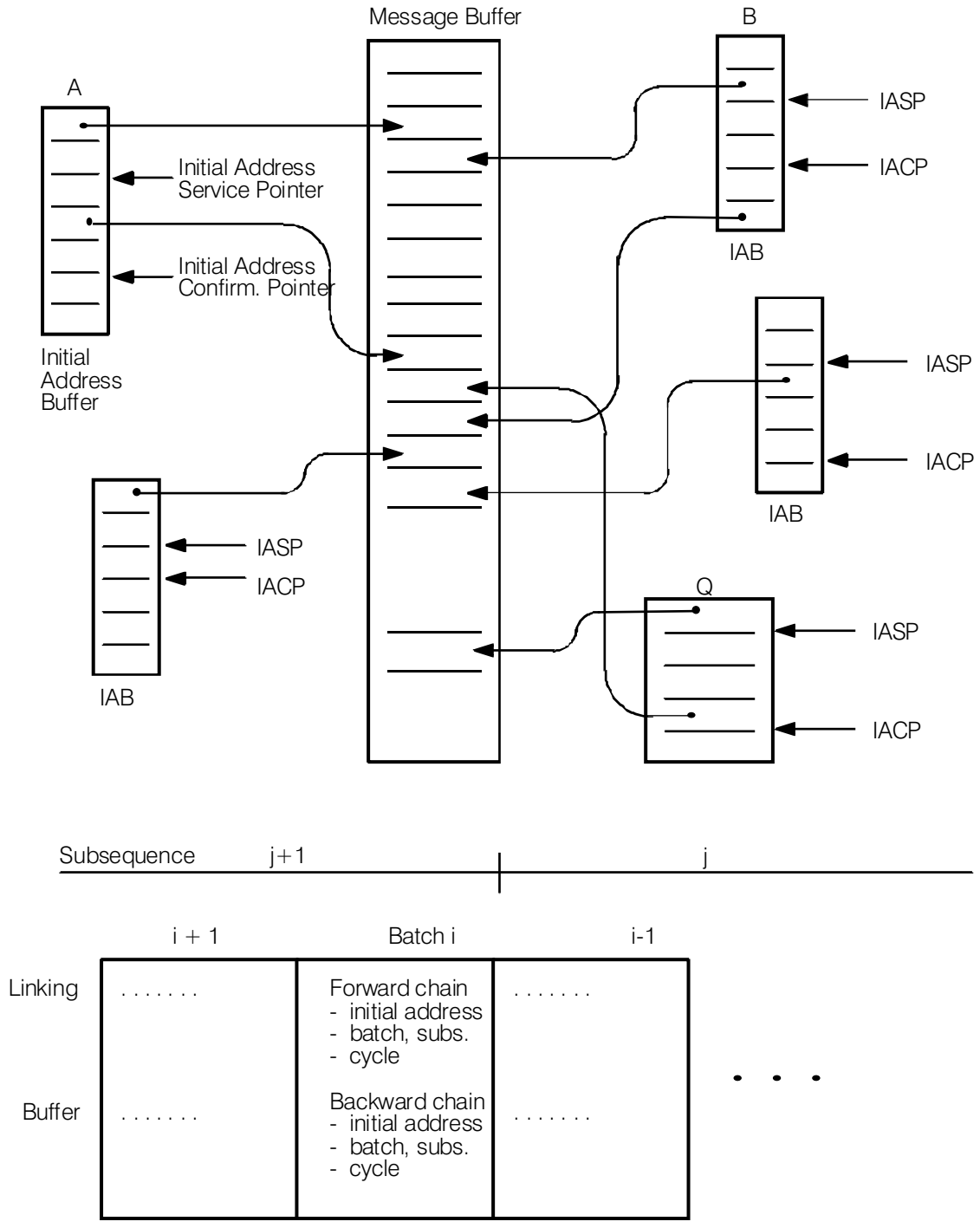


Figure 29: Message queueing and control - conceptual representation

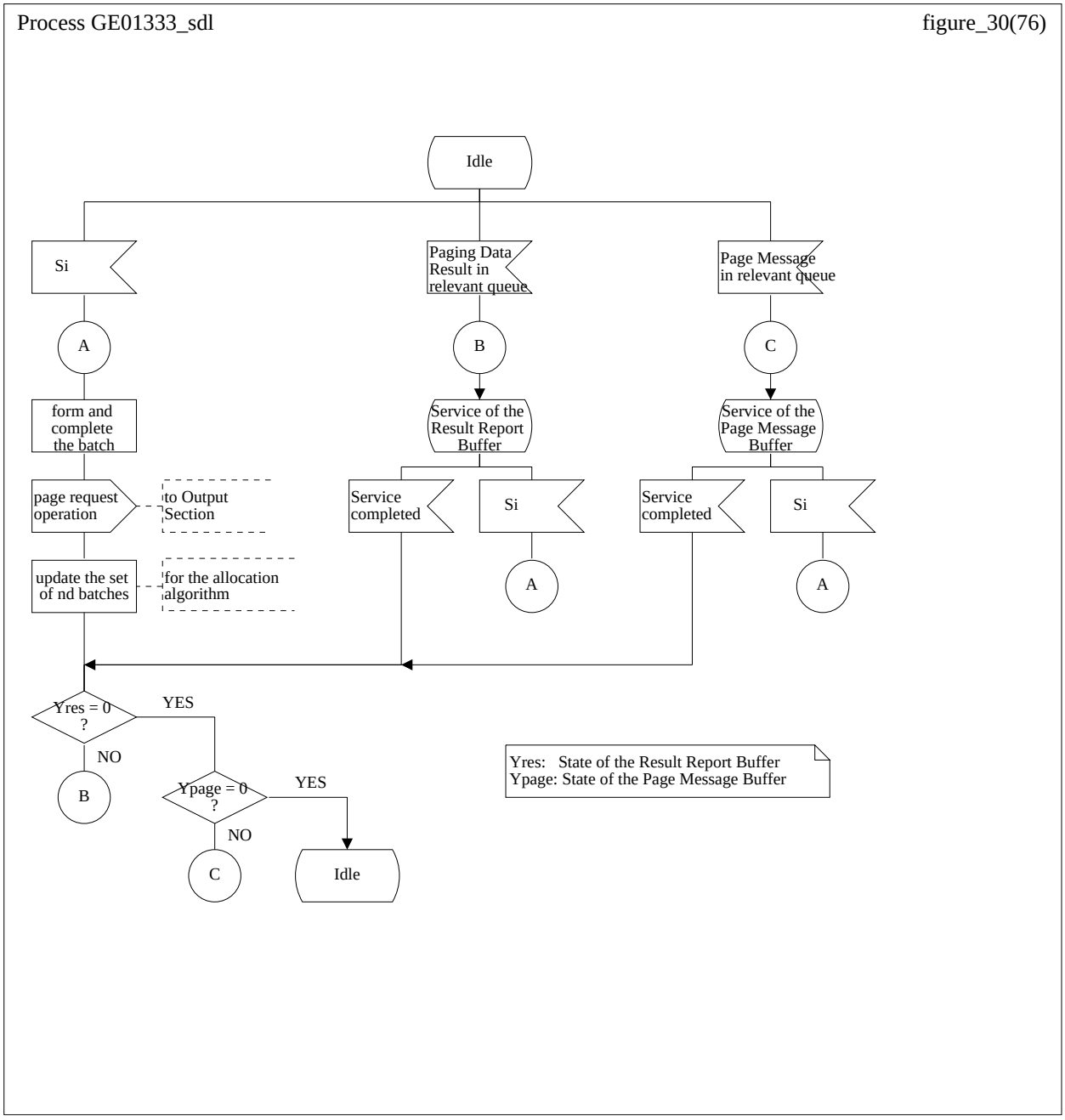


Figure 30: Message queueing and control - SDL diagram

Annex A (normative): Incompatible combinations of supplementary services

Table A.1 answers the question: If the MS has already activated a SF, which SF(s) cannot subsequently be activated by the MS and which SS(s) cannot be activated by the calling party, whilst the SF is activated.

Table A.1

Incompatible Supplementary Service or Subscriber Feature	Requested by	Subscriber Feature already activated by the mobile subscriber
Roaming	Mobile Subscriber	Diversion of traffic Temporary barring
Diversion of traffic	Mobile Subscriber	All SSs shall, if already activated, be suspended Closed user group (if the divert recipient does not belong to the CUG) Temporary barring
Choice of destination	Calling party	Diversion of traffic Priority 1 and priority 3 (if they are not offered in the requested geographical areas) Temporary barring
Repetition	Mobile Subscriber	Diversion of traffic Temporary barring
Repetition	Calling party	Diversion of traffic (if repetition is not offered by the divert recipient's PNC) Repetition activated by the mobile subscriber Temporary barring
Message storing and retrieval	Mobile Subscriber	Diversion of traffic Temporary barring

continued

Table A.1 (continued)

Incompatible Supplementary Service or Subscriber Feature	Requested by	Subscriber Feature already activated by the mobile subscriber
Automatic retransmission of last message number	Mobile Subscriber	Diversion of traffic Temporary barring
Priority 1	Mobile Subscriber	Roaming (outside home network) Diversion of traffic Priority 3 (see NOTE 1) Temporary barring Deferred Delivery
Priority 1	Calling party	Roaming (outside home network) Diversion of traffic (if priority 1 is not offered by the divert recipient's PNC) Priority 1 (see NOTE 1) Priority 3 (see NOTE 2) Temporary barring Deferred delivery
Priority 3	Mobile Subscriber	Roaming (if priority 3 is not offered by the visited network) Diversion of traffic Priority 1 (see NOTE 2) Temporary barring
Priority 3	Calling party	Roaming (if priority 3 is not offered by the visited network) Diversion of traffic (if priority 3 is not offered by the divert recipient's PNC) Priority 1 (see NOTE 1) Temporary barring

continued

Table A.1 (concluded)

Incompatible Supplementary Service or Subscriber Feature	Requested by	Subscriber Feature already activated by the mobile subscriber
Reverse charging	Mobile Subscriber	Diversion of traffic Temporary barring
Reverse charging	Calling party	Temporary barring
Urgent message indication	Mobile Subscriber	Roaming (except if urgent message service is offered by the visited network) Diversion of traffic Temporary barring
Urgent message indication	Calling party	Roaming (except if urgent message service is offered by the visited network) Diversion of traffic (except if the pager of the divert recipient has this feature) Temporary barring
Deferred delivery	Mobile Subscriber	Diversion of traffic Automatic retransmission of last message number and priority 1 shall, if already activated, be suspended Temporary barring
Deferred delivery	Calling party	Diversion of traffic (if deferred delivery is not offered by divert recipient's PNC) Temporary barring
NOTE 1: Except if priority 1 is provided on a subscription basis and activated on a per call basis. NOTE 2: Except if priority 3 is provided on a subscription basis and activated on a per call basis.		

Annex B (normative): SDL diagrams for call processing and I4 operations.

This Annex is normative for call processing where communication over the I4 interface is involved and informative for other aspects of call processing.

B.1 General

This Annex describes, using the SDL graphical representation, the call processing for paging calls, for MS control of roaming and for call diversion (see Clause 7). The figures also show the use of the appropriate I4 operation where communications over the I4 interface are involved during the processing of a call.

B.2 Call processing for page input

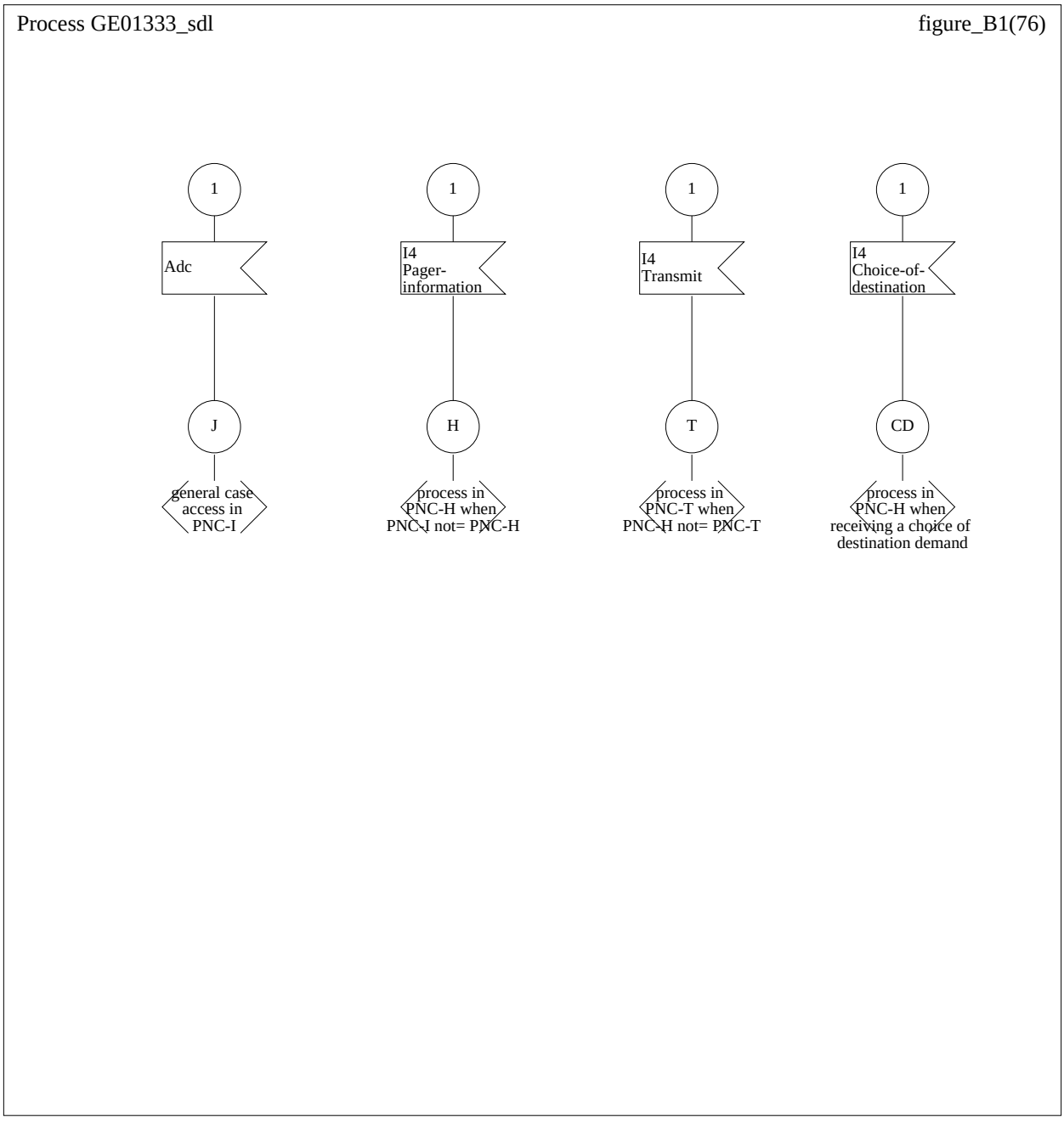


Figure B.1: Call processing for page input

Process of supplemenary services in case of local call

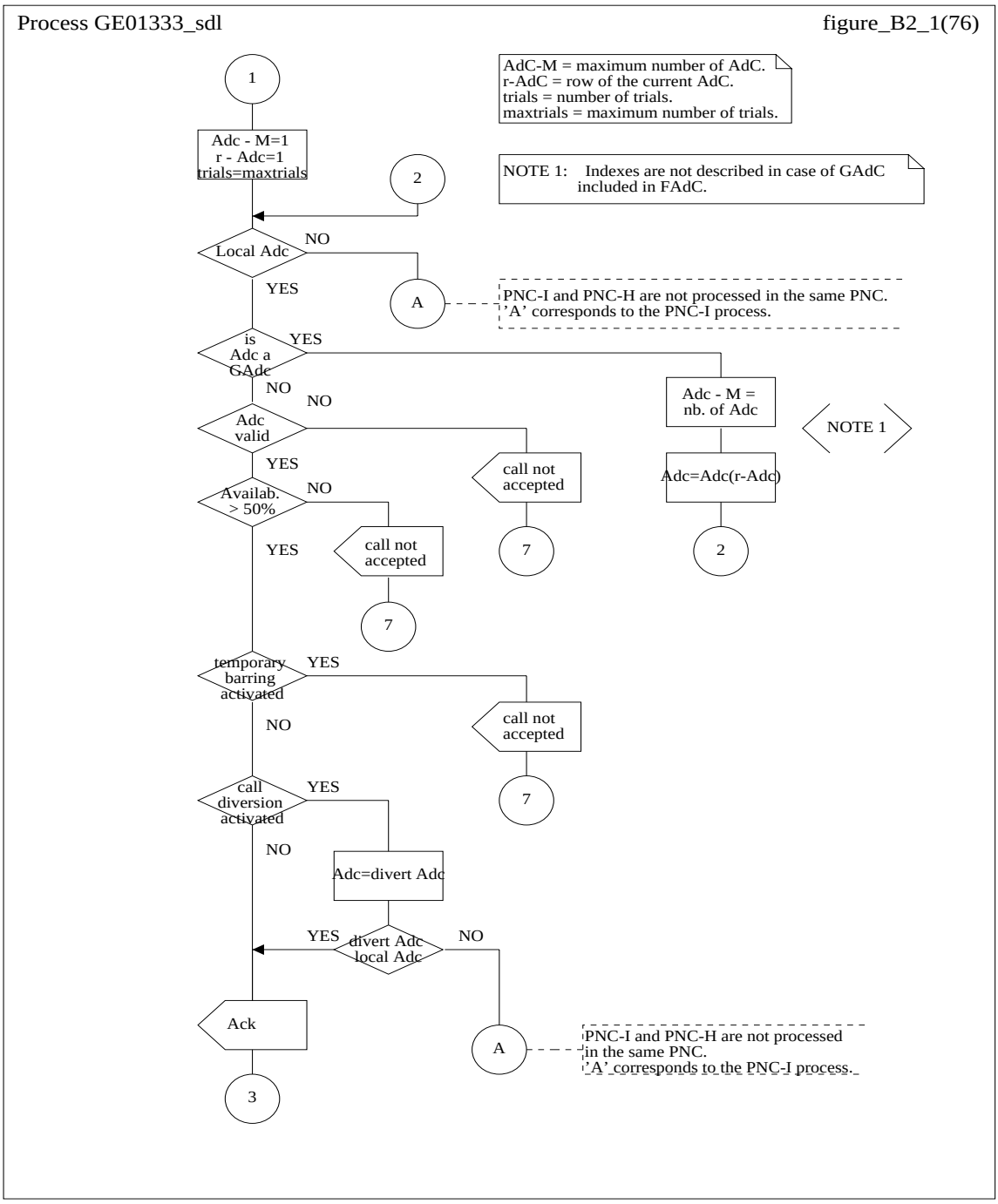


Figure B.2 (sheet 1 of 5): Call processing for page input - local call

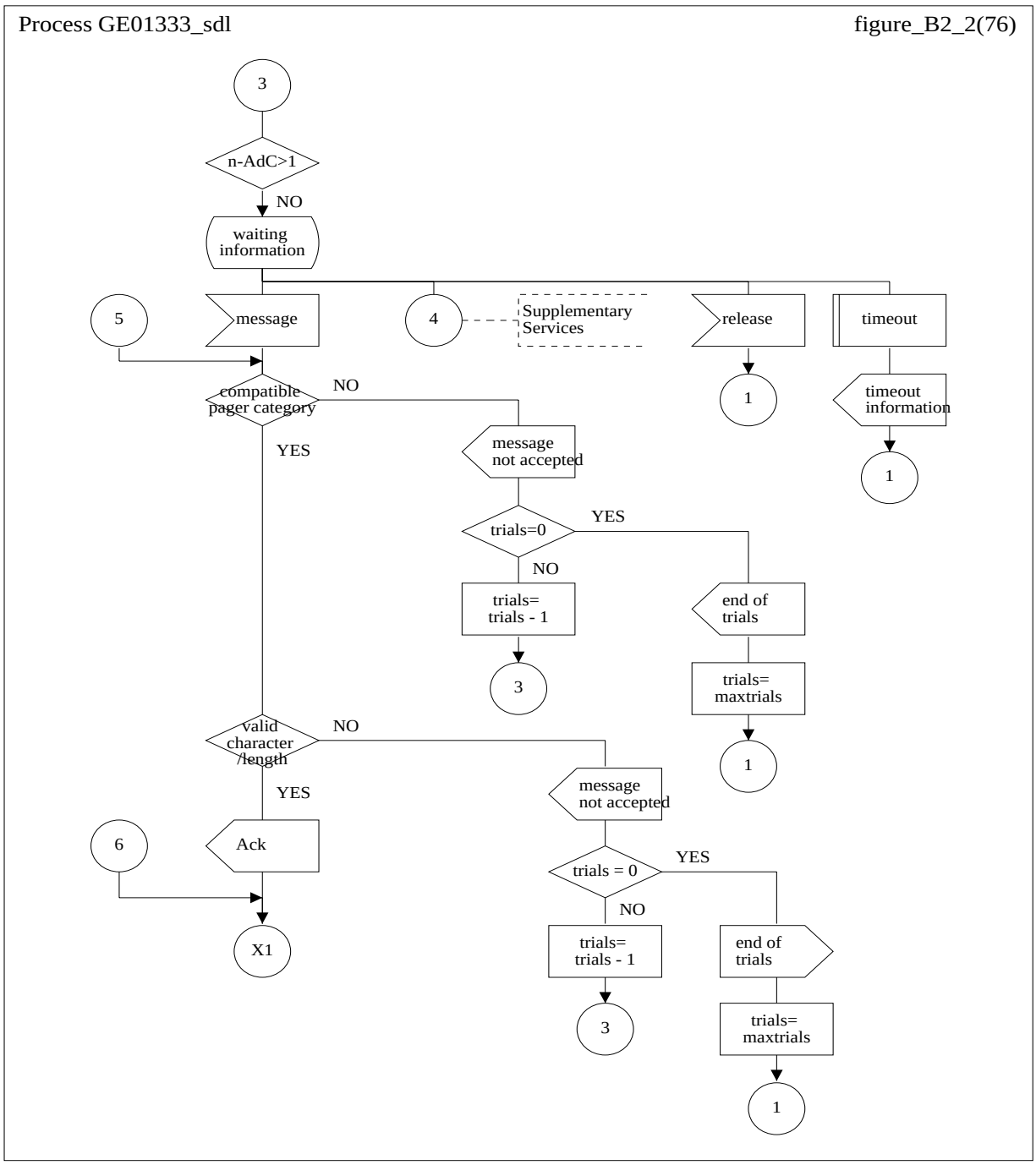


Figure B.2 (sheet 2 of 5): Call processing for page input - local call

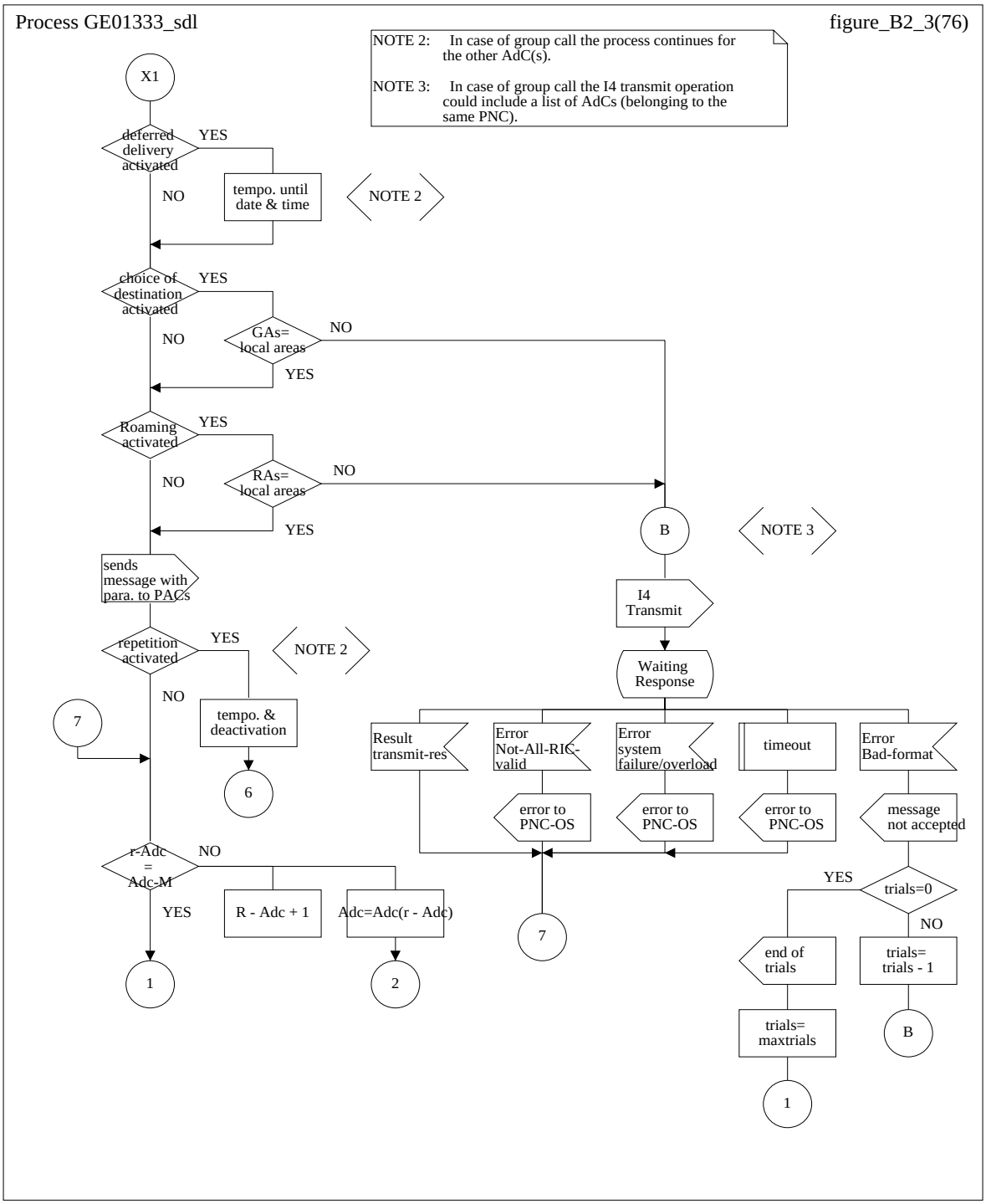


Figure B.2 (sheet 3 of 5): Call processing for page input - local call

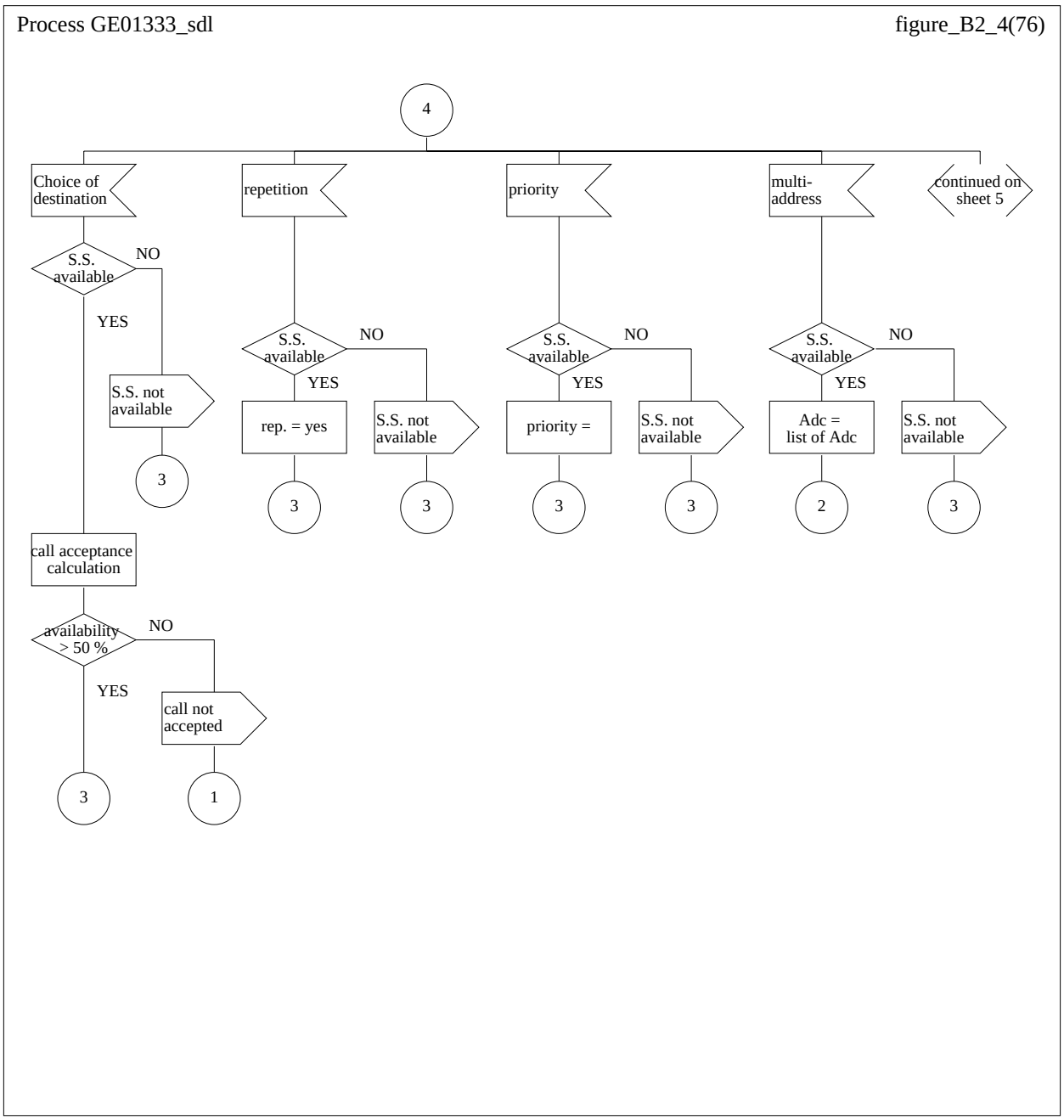


Figure B.2 (sheet 4 of 5): Call processing for page input - local call

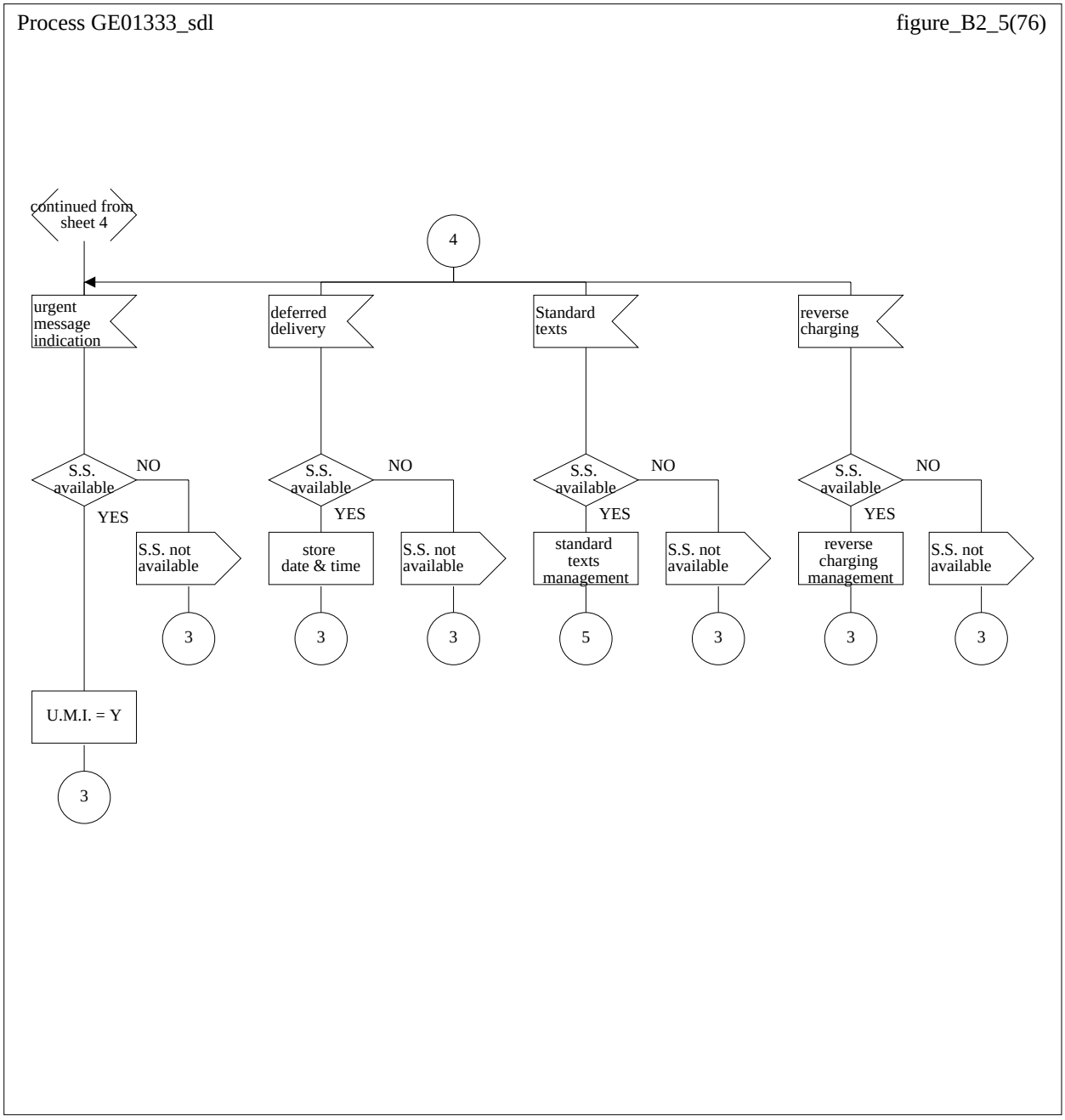


Figure B.2 (sheet 5 of 5): Call processing for page input - local call

Process in PNC-I.

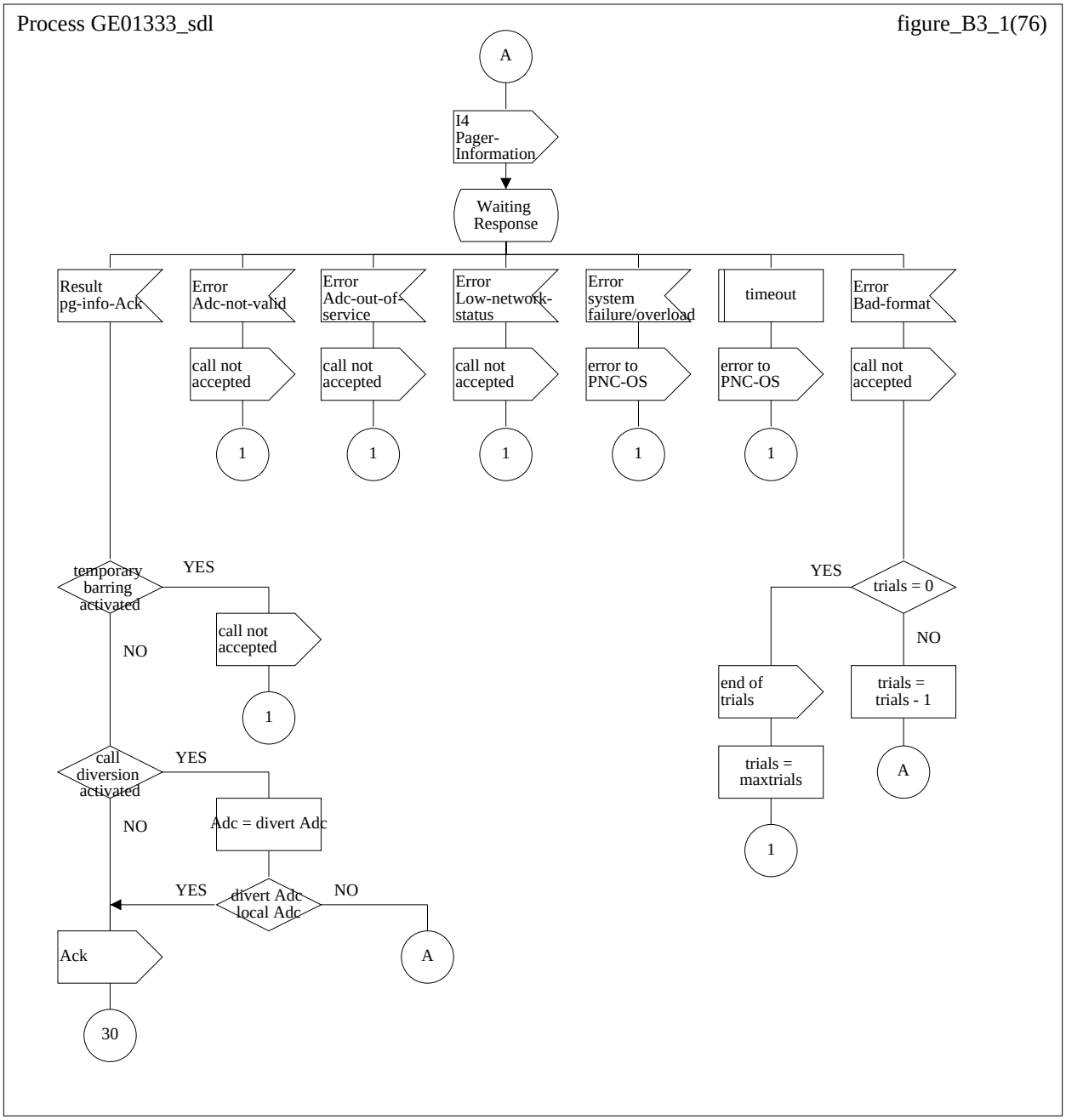


Figure B.3 (sheet 1 of 6): Call processing for page input - distant call, PNC-I

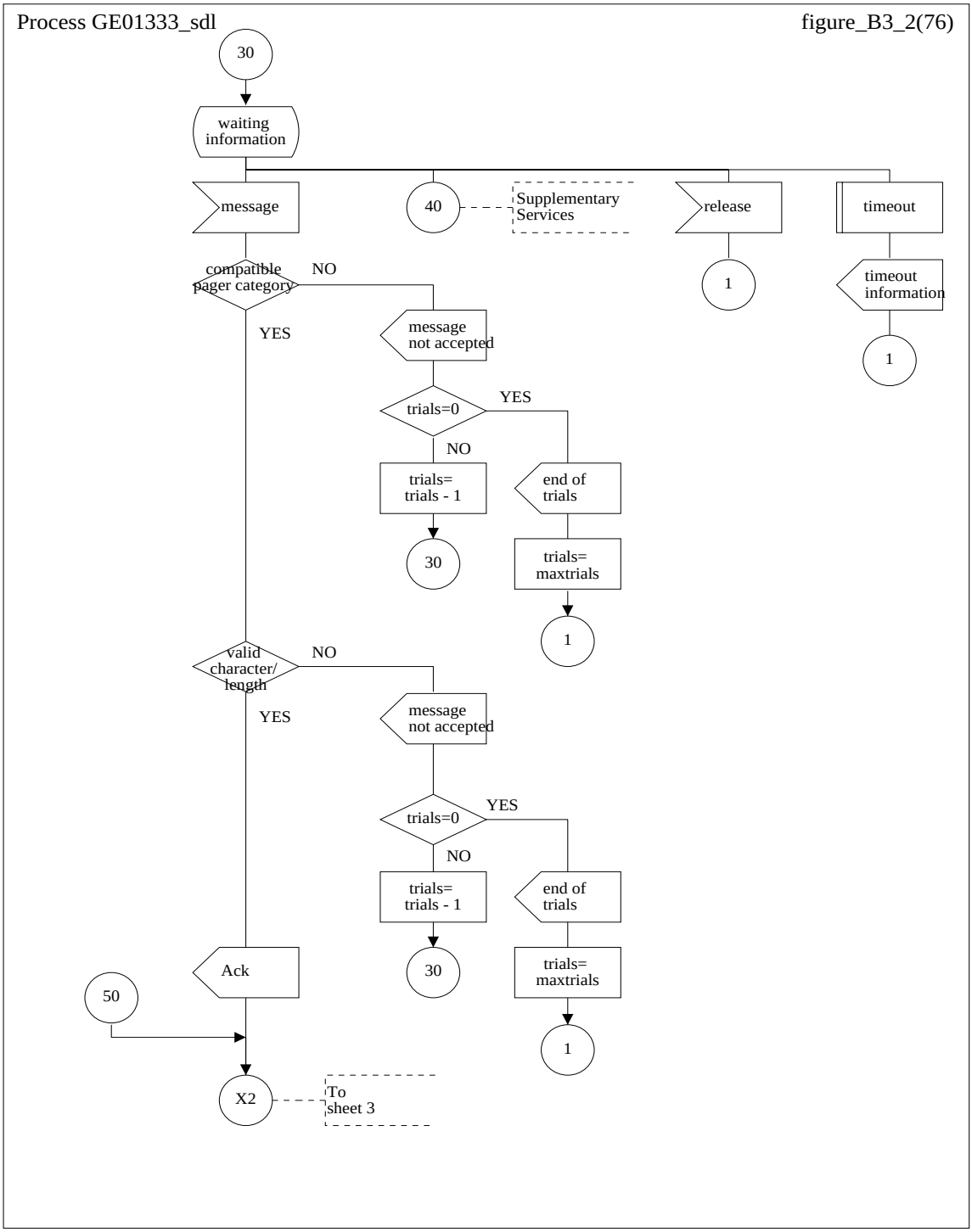


Figure B.3 (sheet 2 of 6): Call processing for page input - distant call, PNC-I

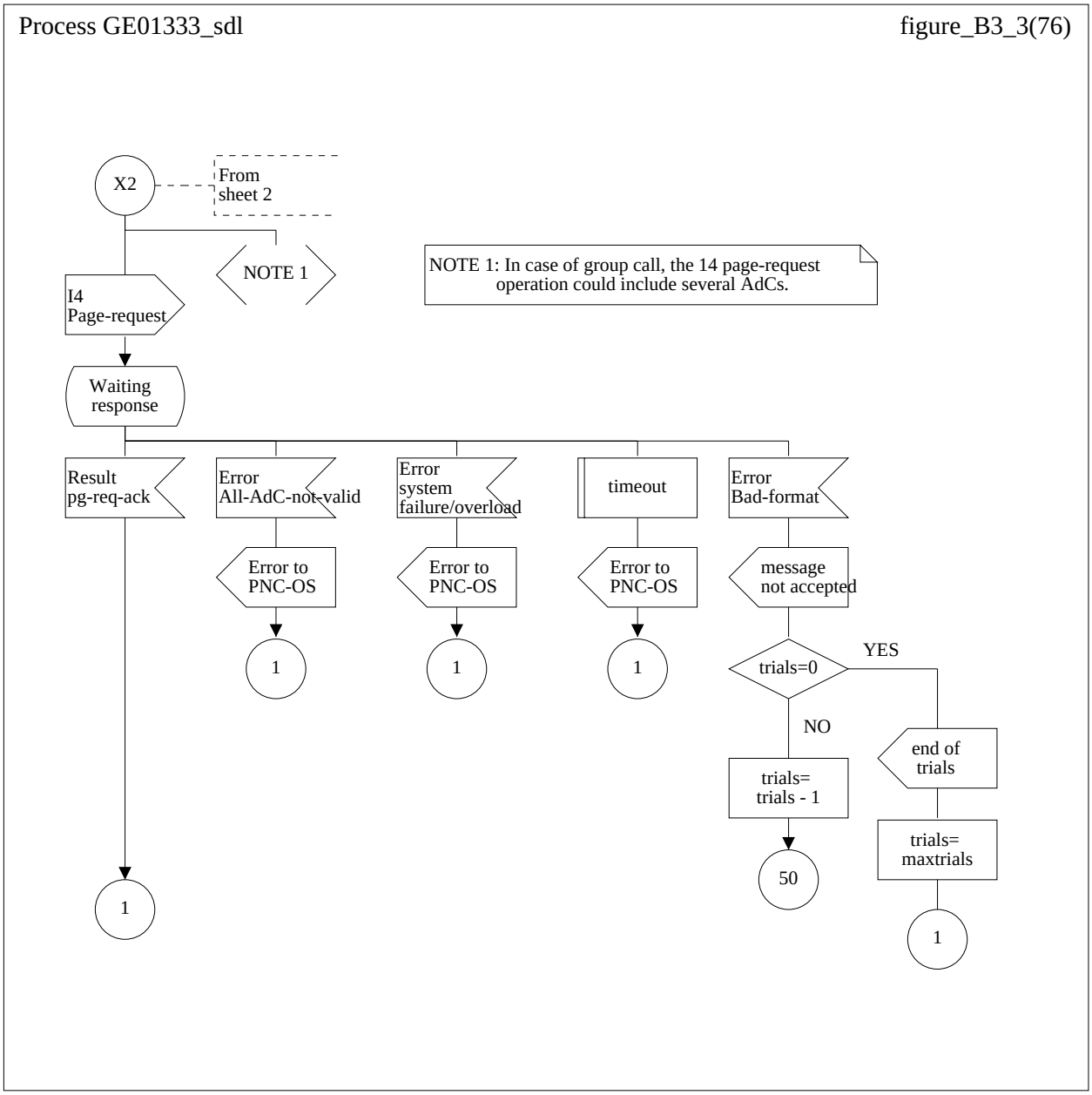


Figure B.3 (sheet 3 of 6): Call processing for page input - distant call, PNC-I

Process of supplementary services in PNC-I.

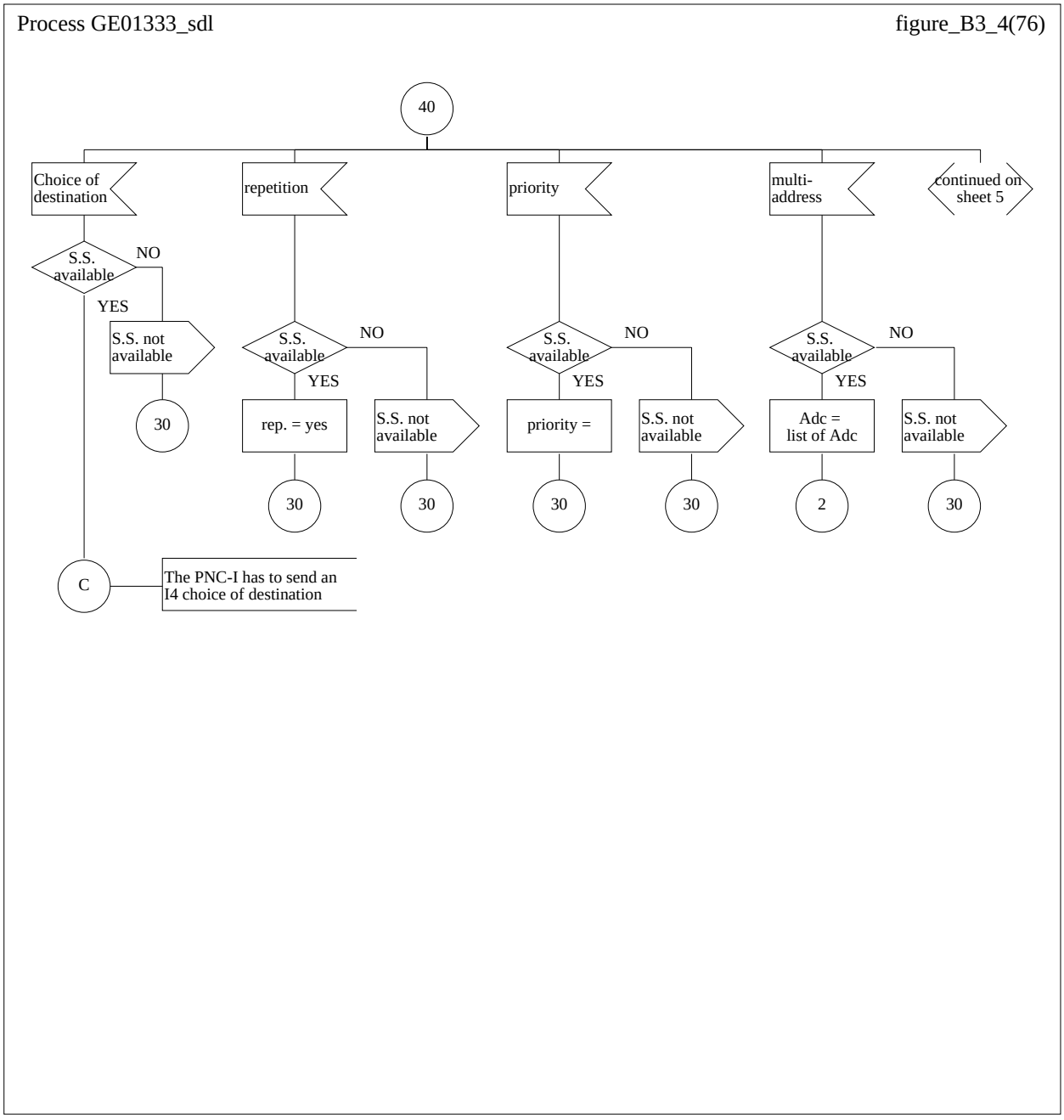


Figure B.3 (sheet 4 of 6): Call processing for page input - distant call, PNC-I

Process of supplementary services in PNC-I.

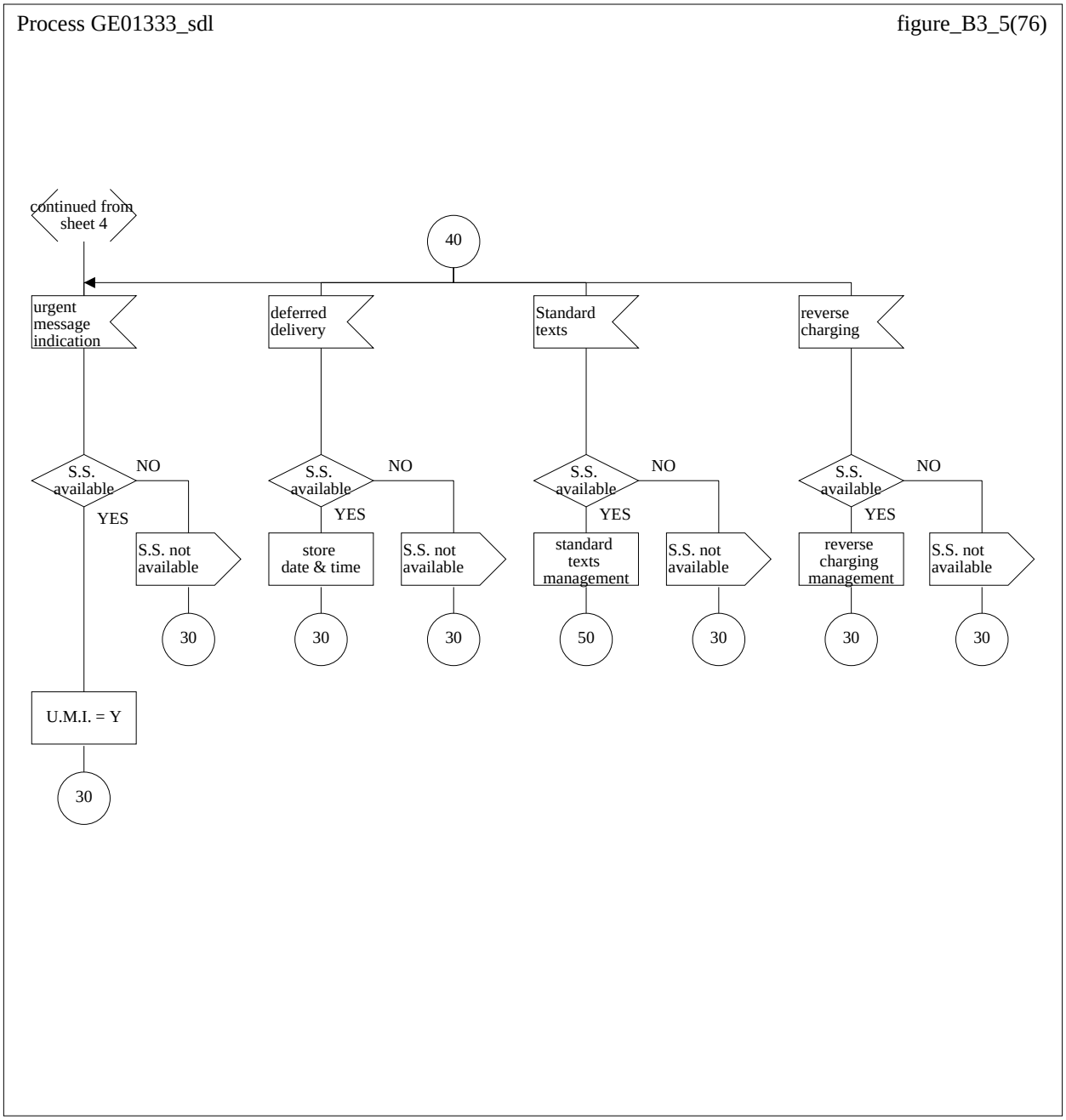


Figure B.3 (sheet 5 of 6): Call processing for page input - distant call, PNC-I

Process of supplementary services in PNC-I.

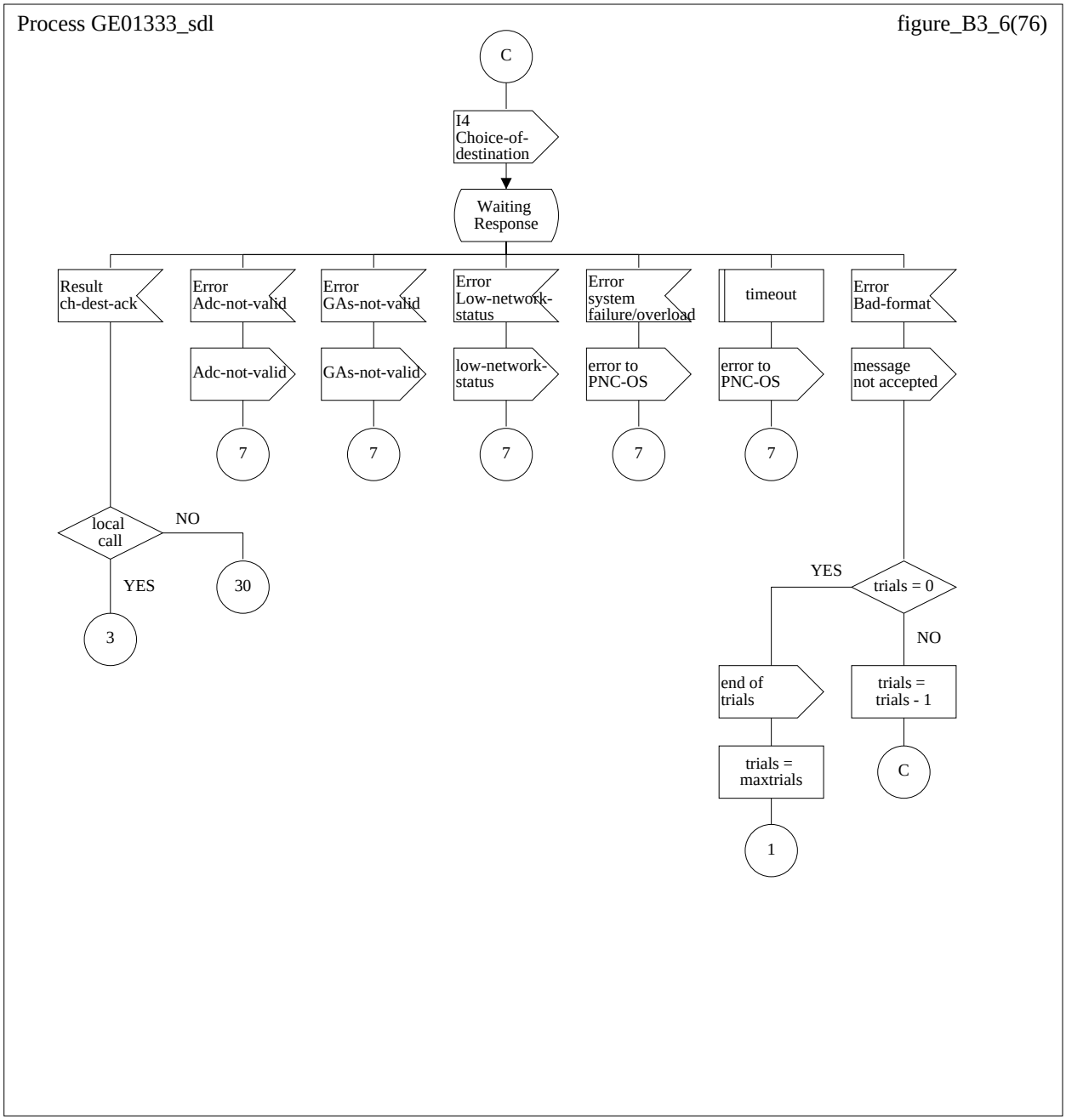


Figure B.3 (sheet 6 of 6): Call processing for page input - distant call, PNC-I

Process of PNC-H when PNC-I and PNC-H are not processed in the same PNC.

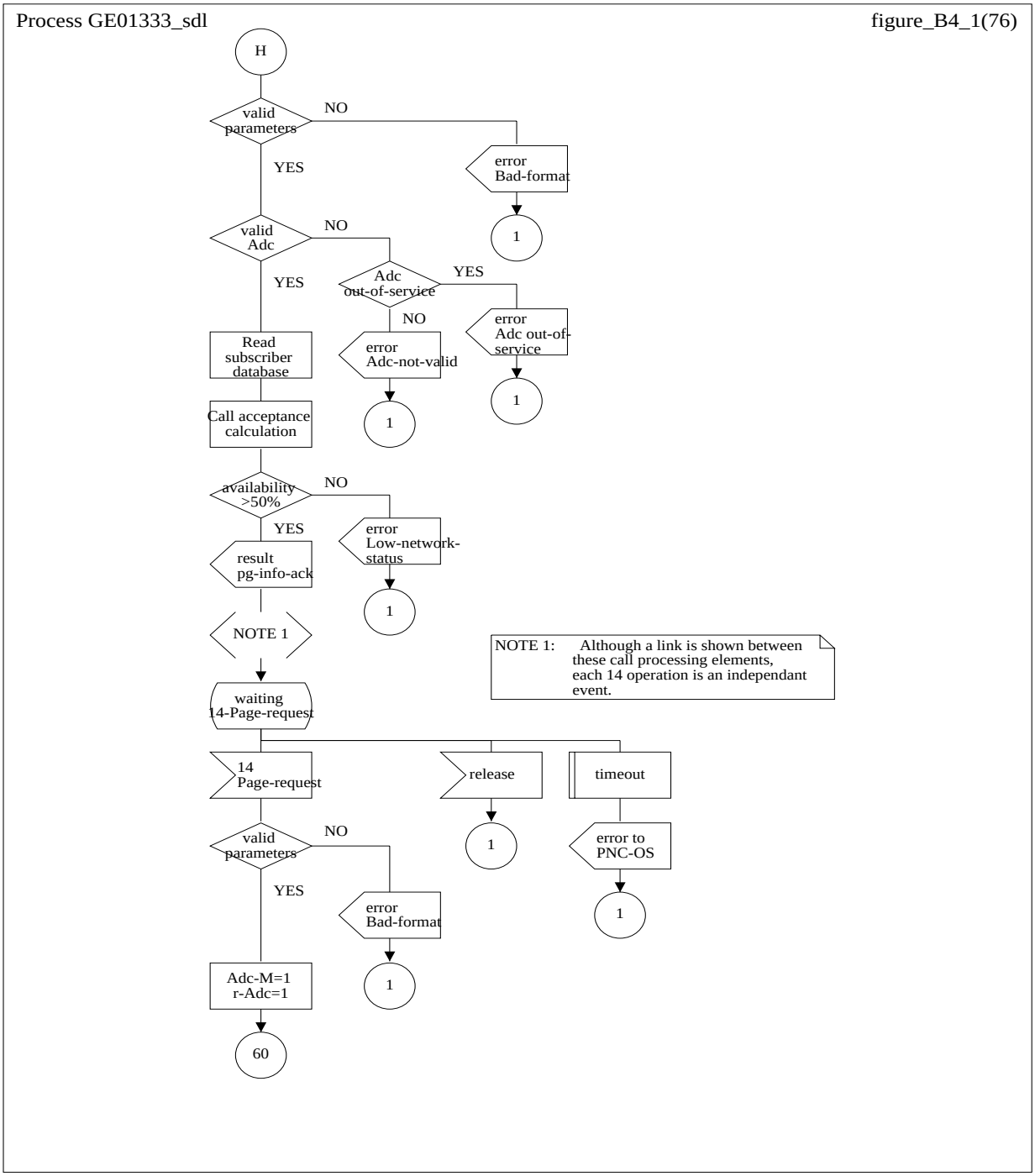


Figure B.4 (sheet 1 of 6): Call processing for page input - distant call, PNC-H

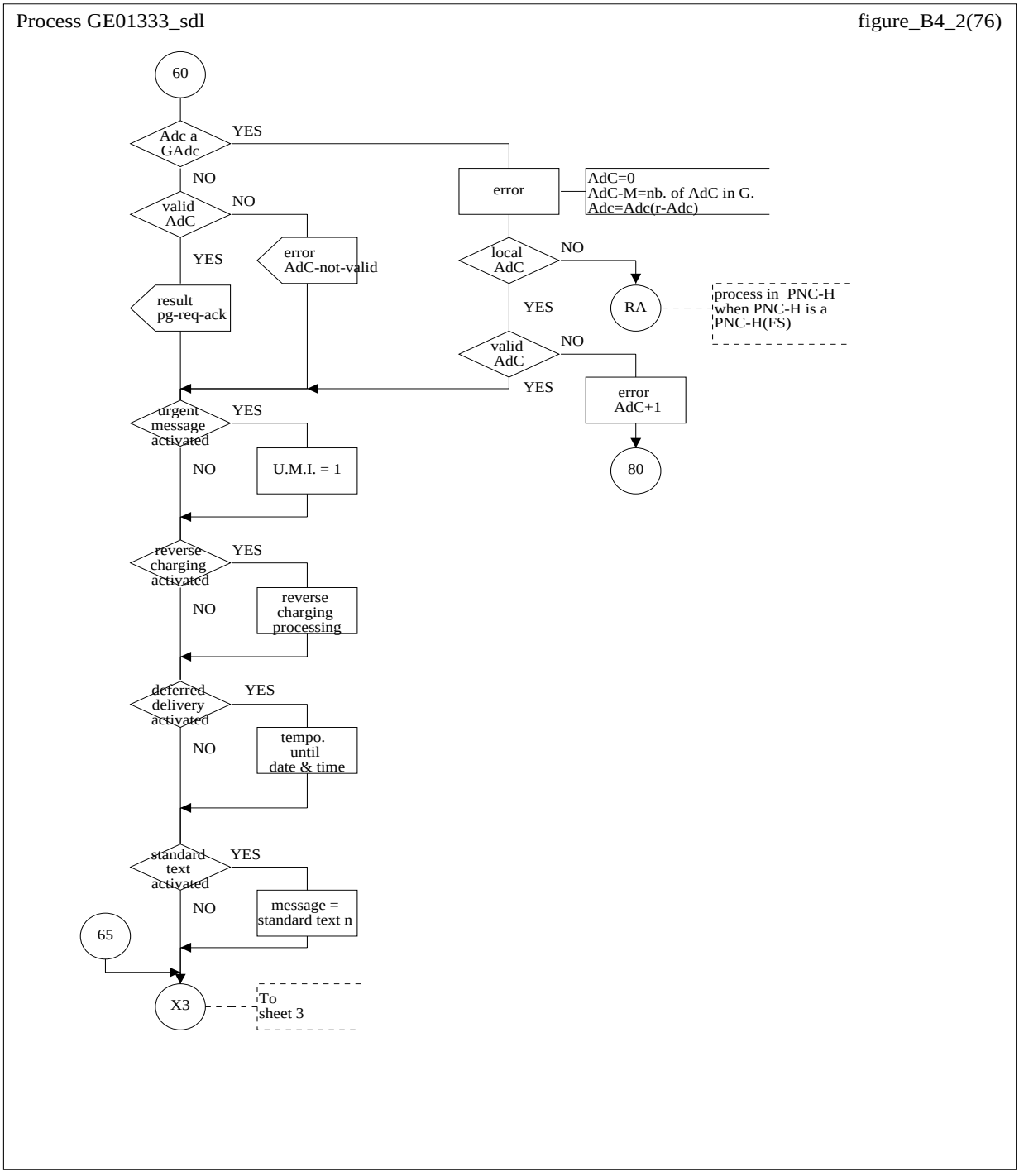


Figure B.4 (sheet 2 of 6): Call processing for page input - distant call, PNC-H

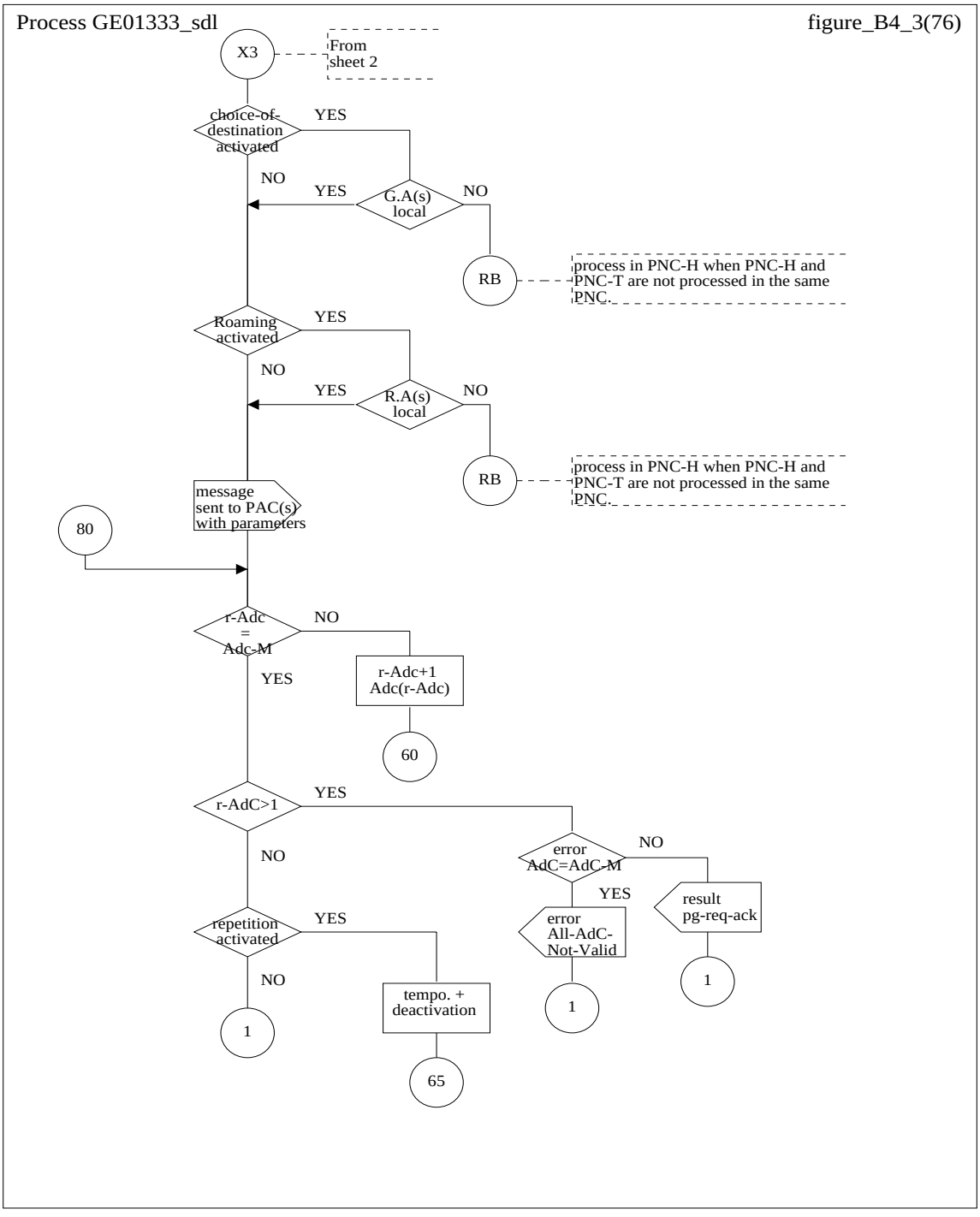


Figure B.4 (sheet 3 of 6): Call processing for page input - distant call, PNC-H

Process in PNC-H when PNC-H and PNC-T are not processed in the same PNC.

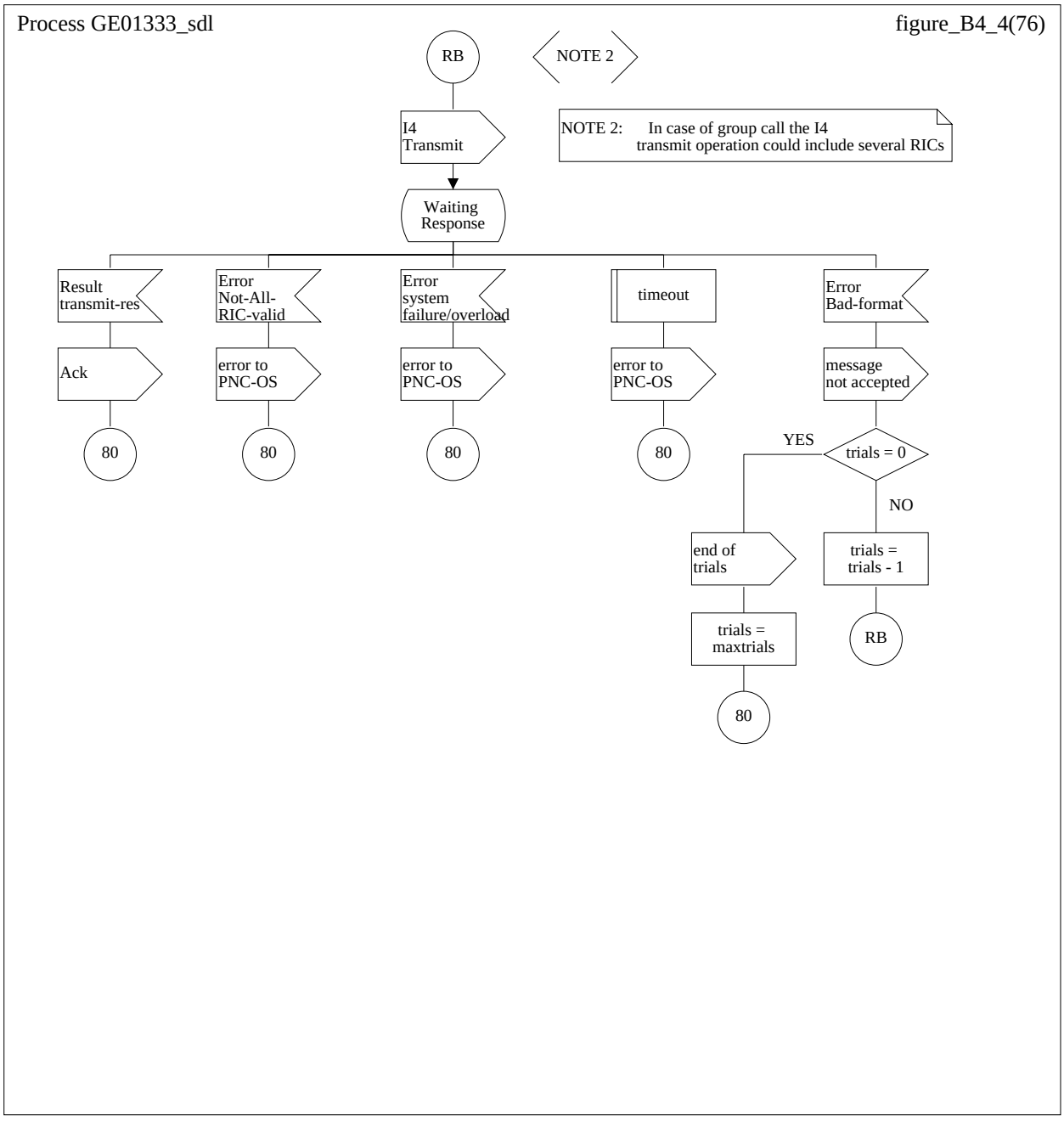


Figure B.4 (sheet 4 of 6): Call processing for page input - distant call, PNC-H

Process in PNC-H when PNC-H is a PNC-H(FS).

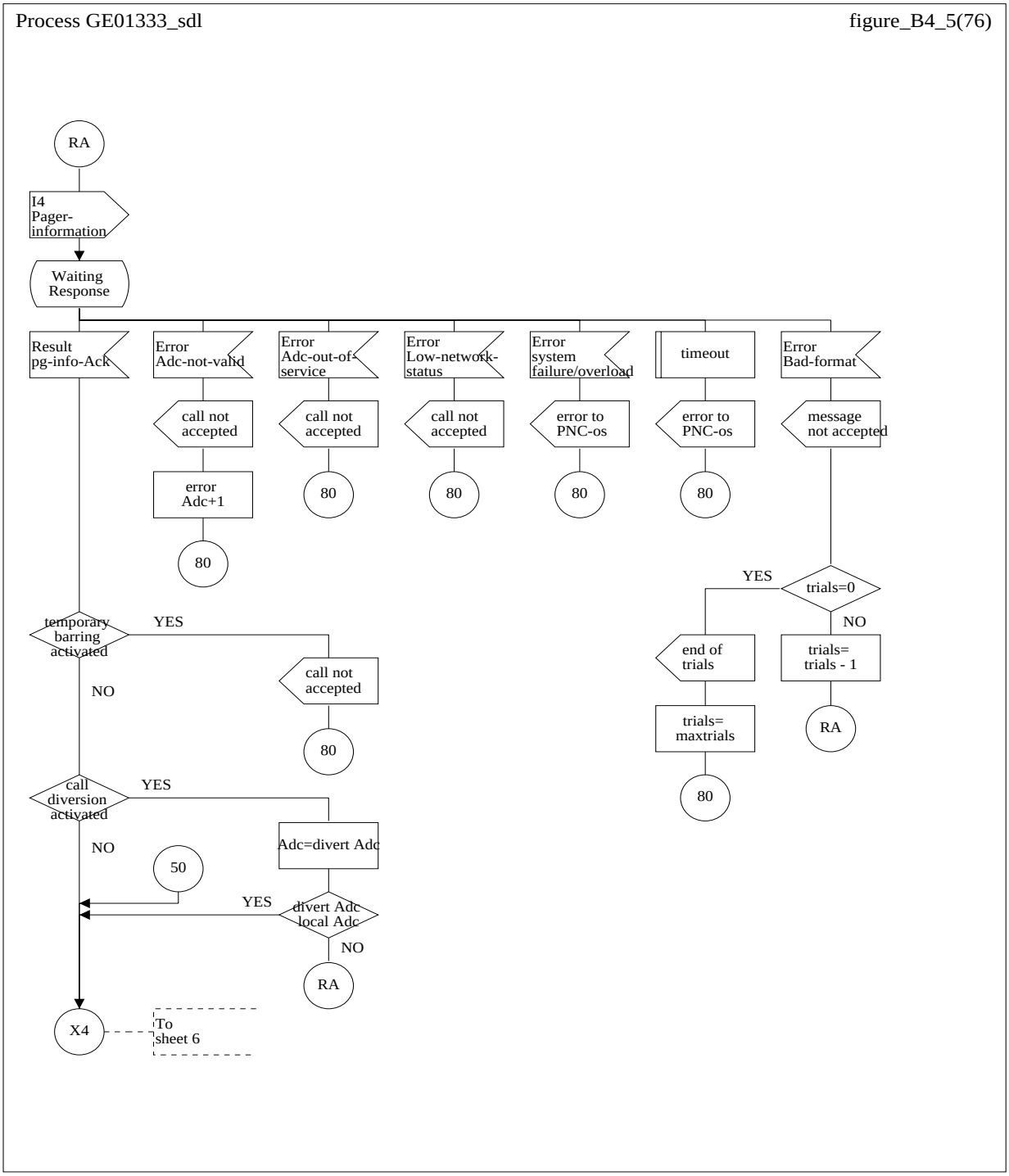


Figure B.4 (sheet 5 of 6): Call processing for page input - distant call, PNC-H

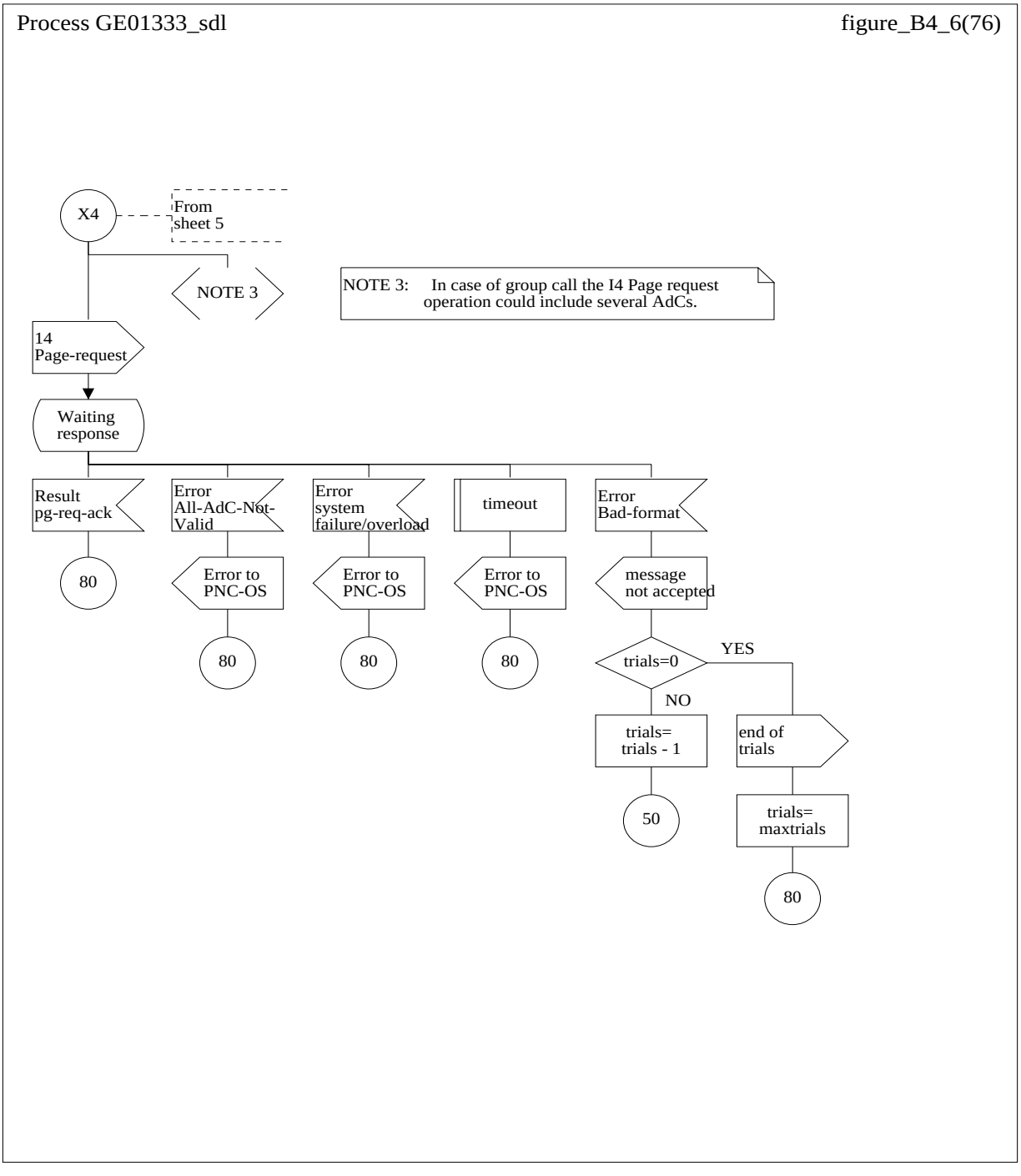


Figure B.4 (sheet 6 of 6): Call processing for page input - distant call, PNC-H

Process in PNC-T when PNC-H and PNC-T are not processed in the same PNC.

Process GE01333_sdl figure_B5_1(76)

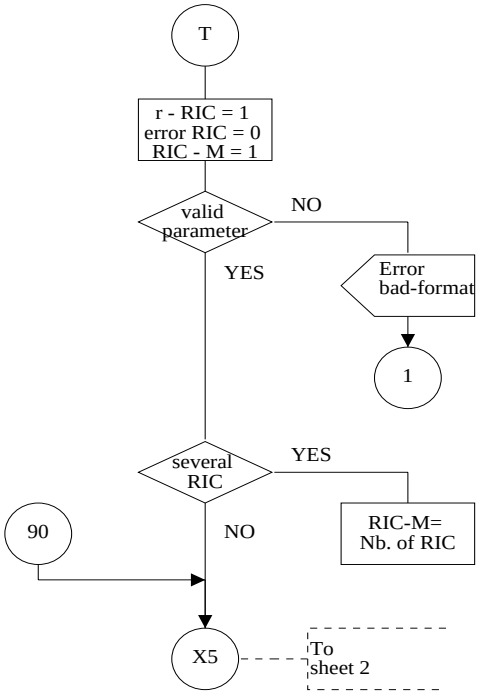


Figure B.5 (sheet 1 of 2): Call processing for page input - external call, PNC-T

Process GE01333_sdl figure_B5_2(76)

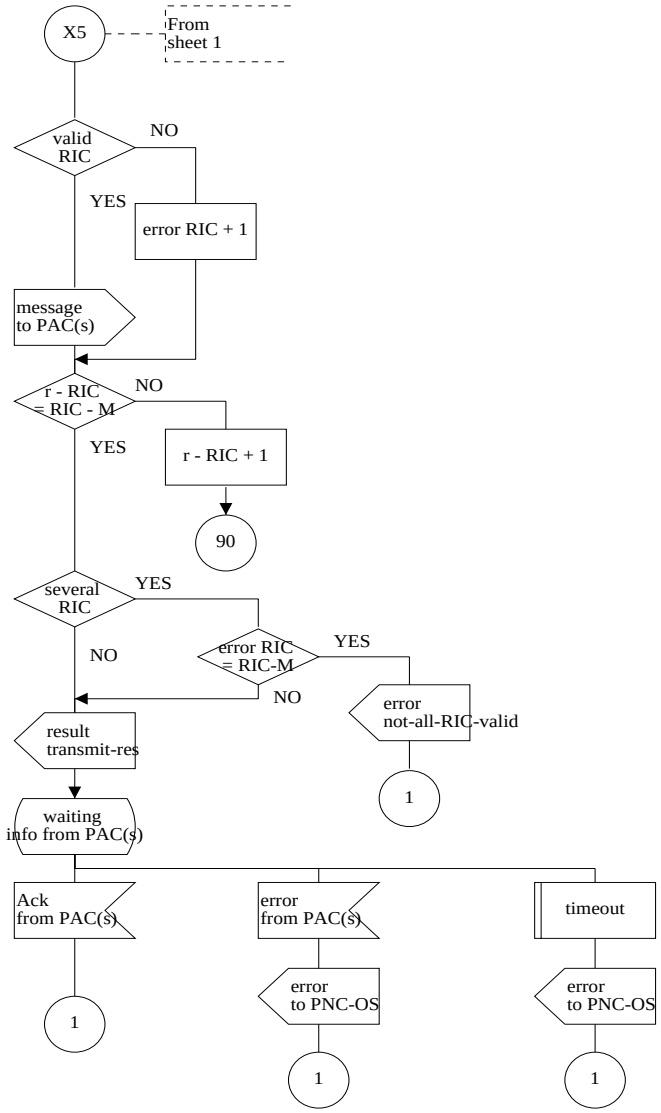


Figure B.5 (sheet 2 of 2): Call processing for page input - external call, PNC-T

Process when an I4 choice of destination is received in one PNC-H when PNC-I not= PNC-H.

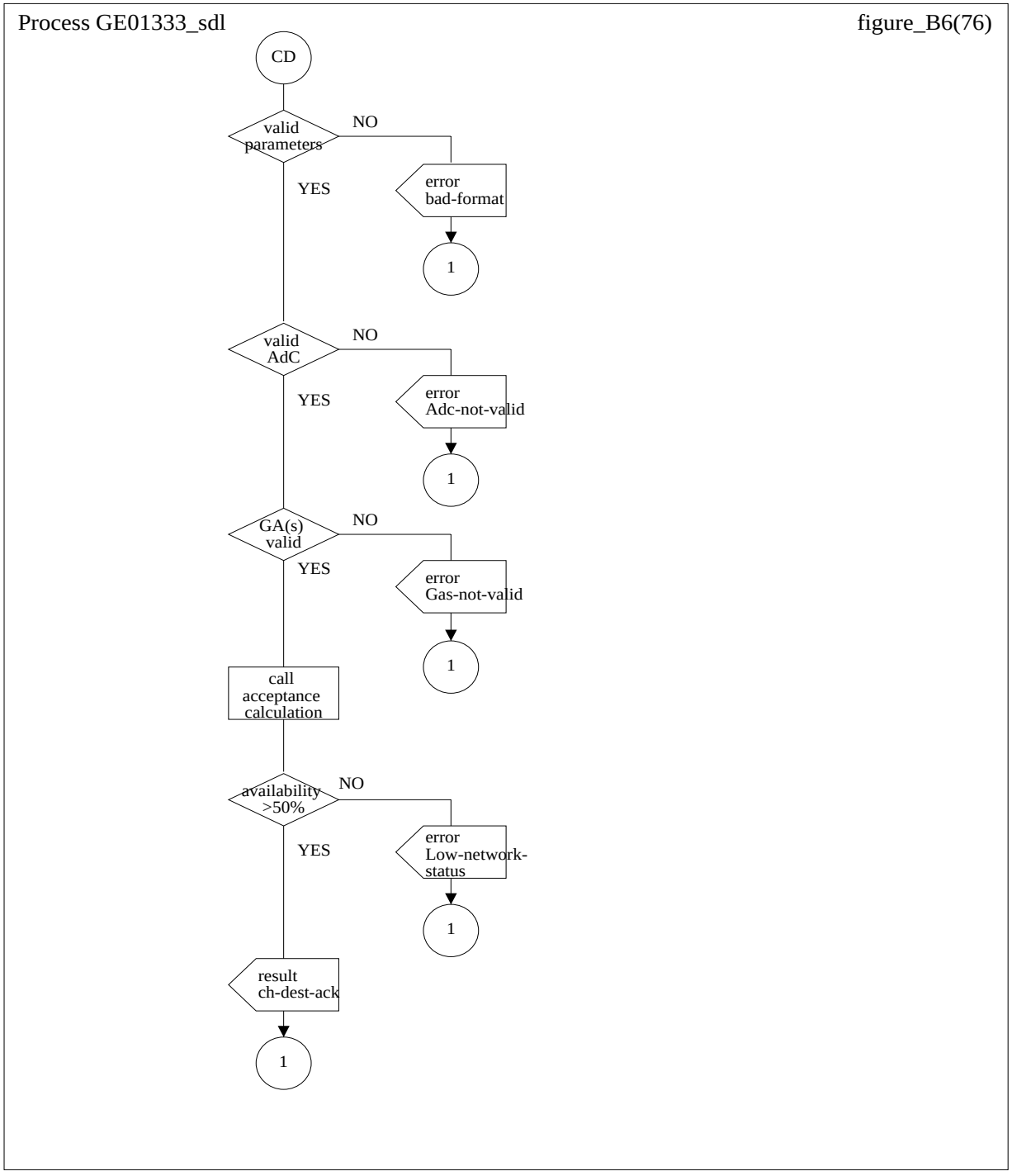


Figure B.6: Call processing for page input - distant call, choice of destination, PNC-H

B.3 Call processing for roaming

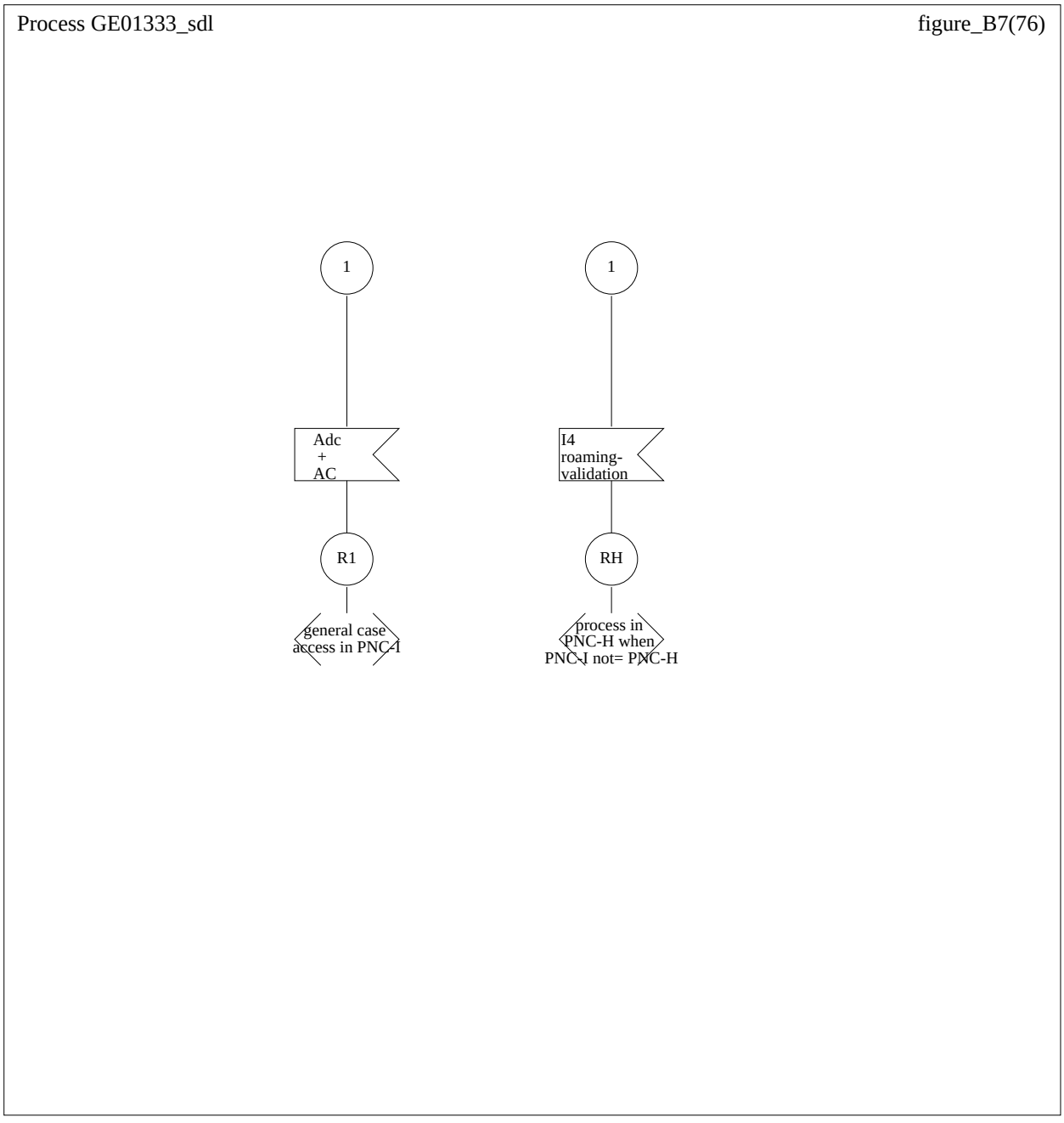


Figure B.7: Call processing for roaming

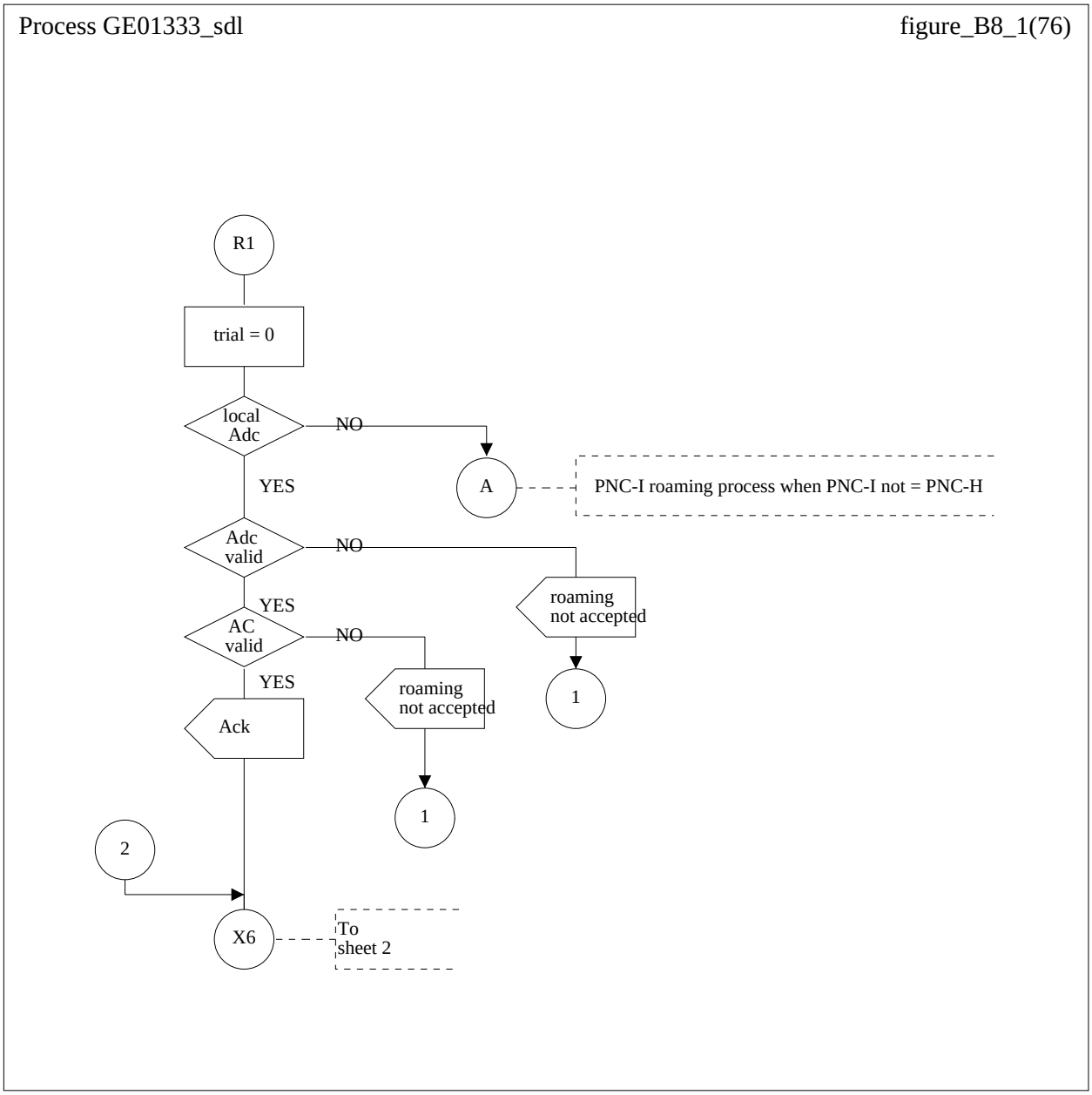


Figure B.8 (sheet 1 of 2): Call processing for roaming - local call

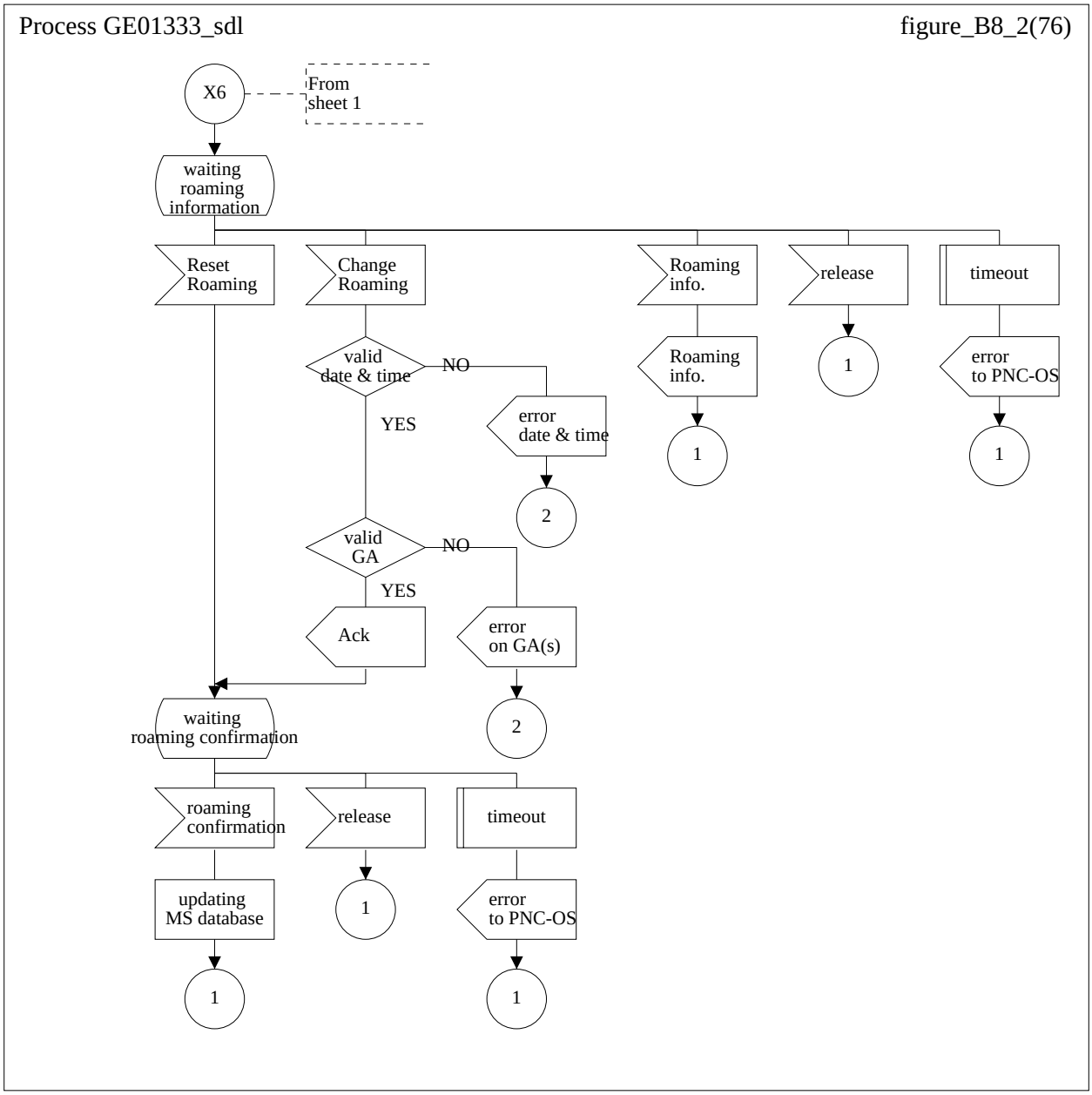


Figure B.8 (sheet 2 of 2): Call processing for roaming - local call

PNC-I roaming process when PNC-I not= PNC-H.

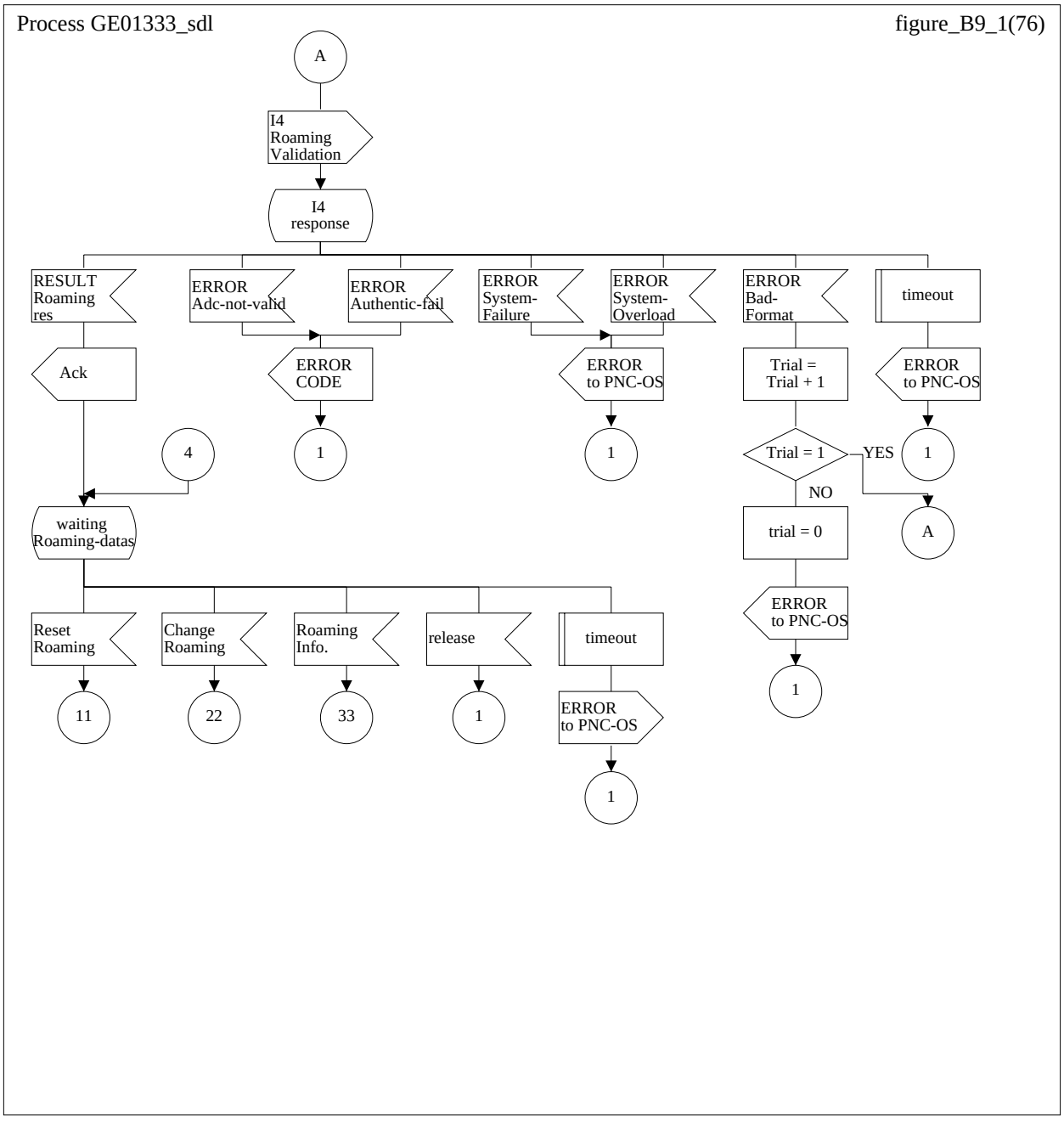


Figure B.9 (sheet 1 of 6): Call processing for roaming - distant call, PNC-I

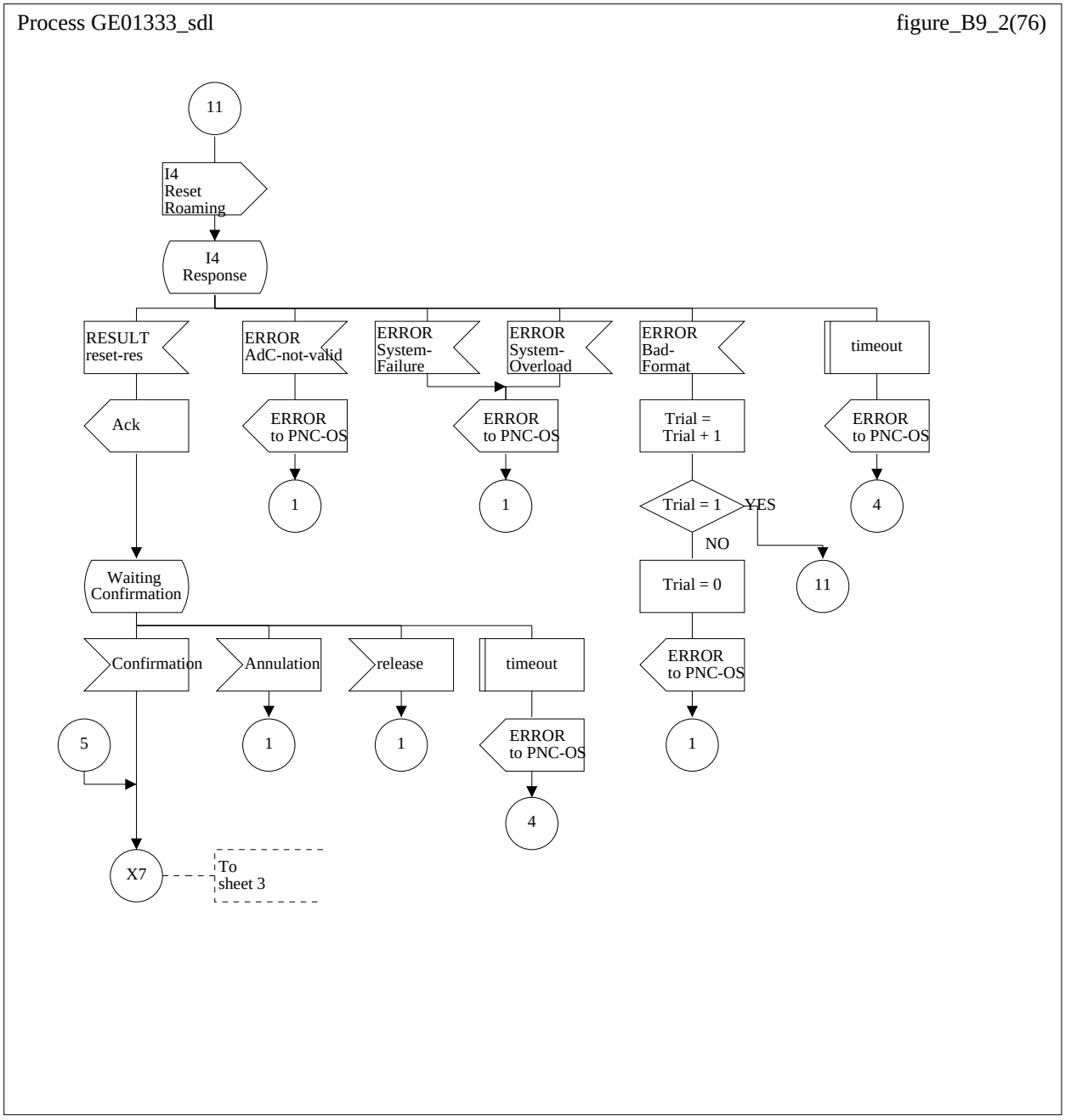


Figure B.9 (sheet 2 of 6): Call processing for roaming - distant call, PNC-I

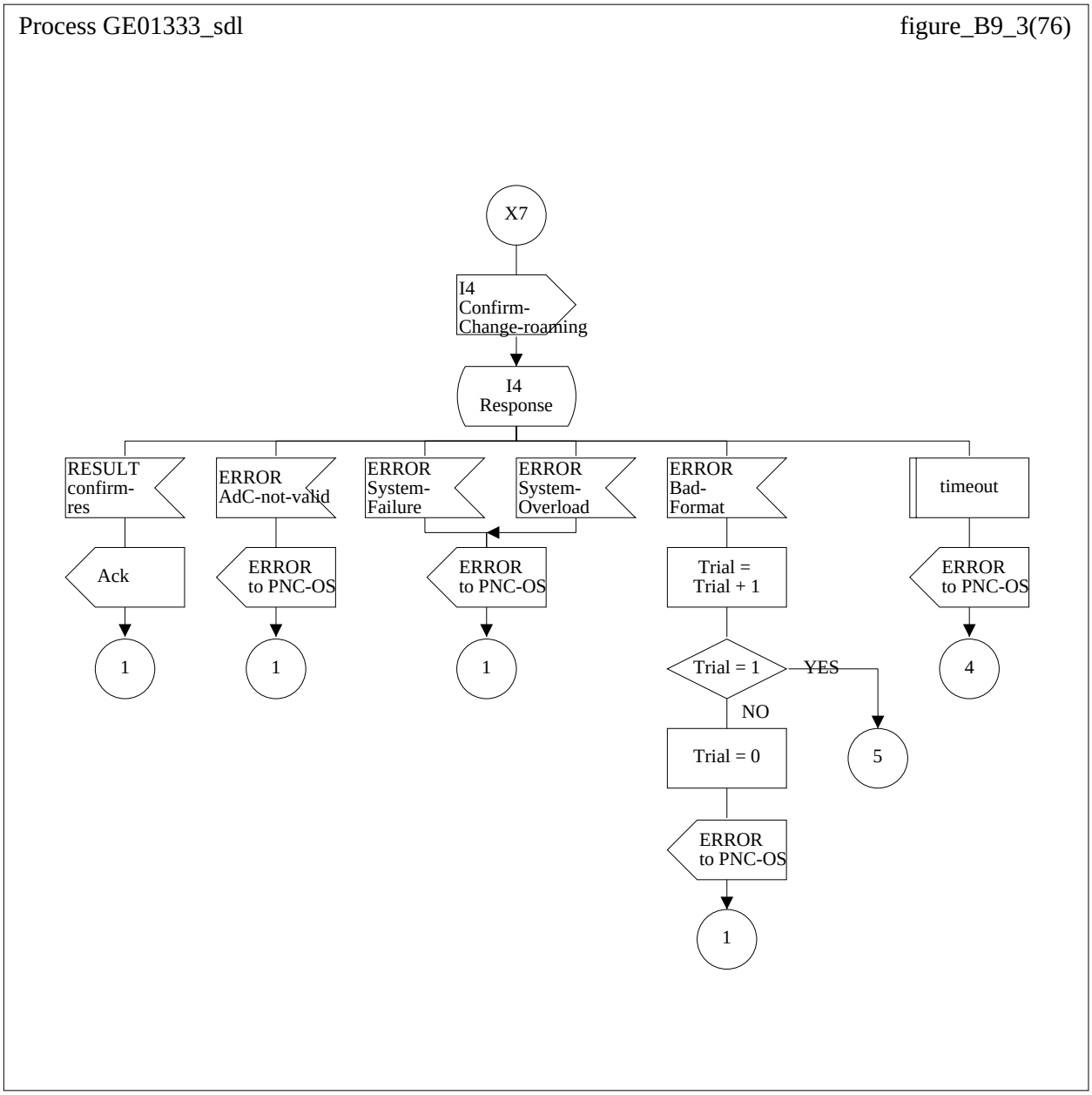


Figure B.9 (sheet 3 of 6): Call processing for roaming - distant call, PNC-I

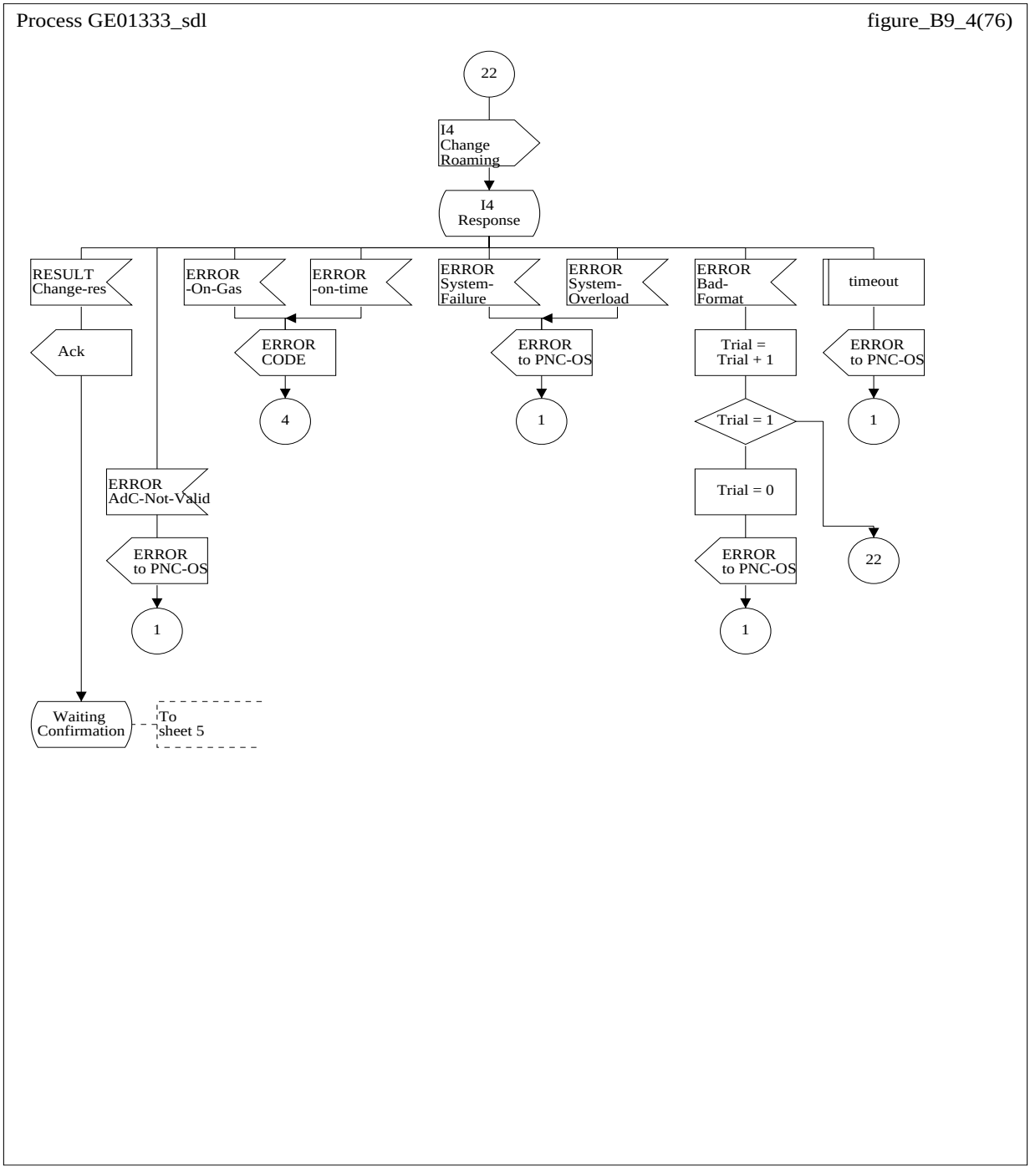


Figure B.9 (sheet 4 of 6): Call processing for roaming - distant call, PNC-I

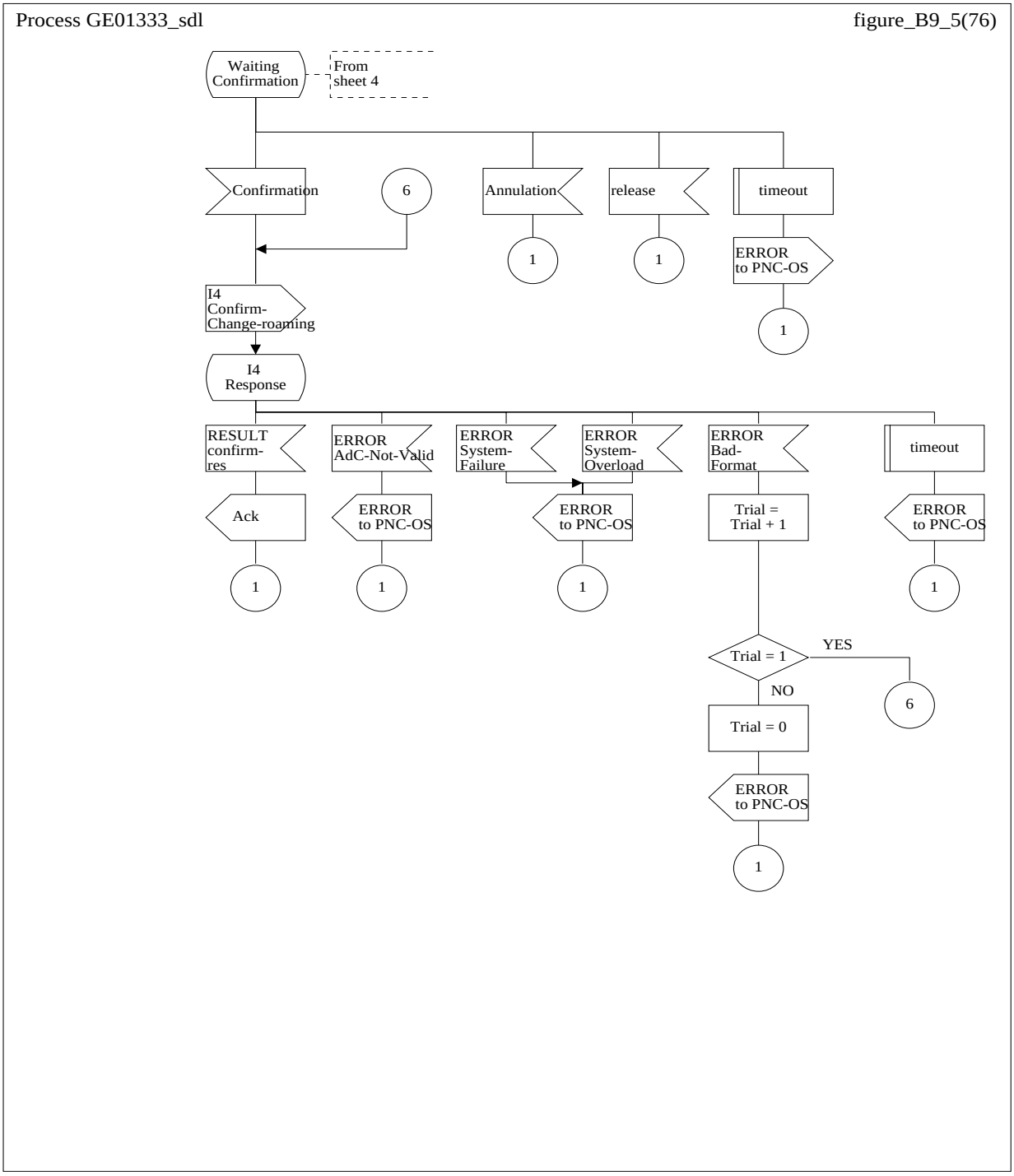


Figure B.9 (sheet 5 of 6): Call processing for roaming - distant call, PNC-I

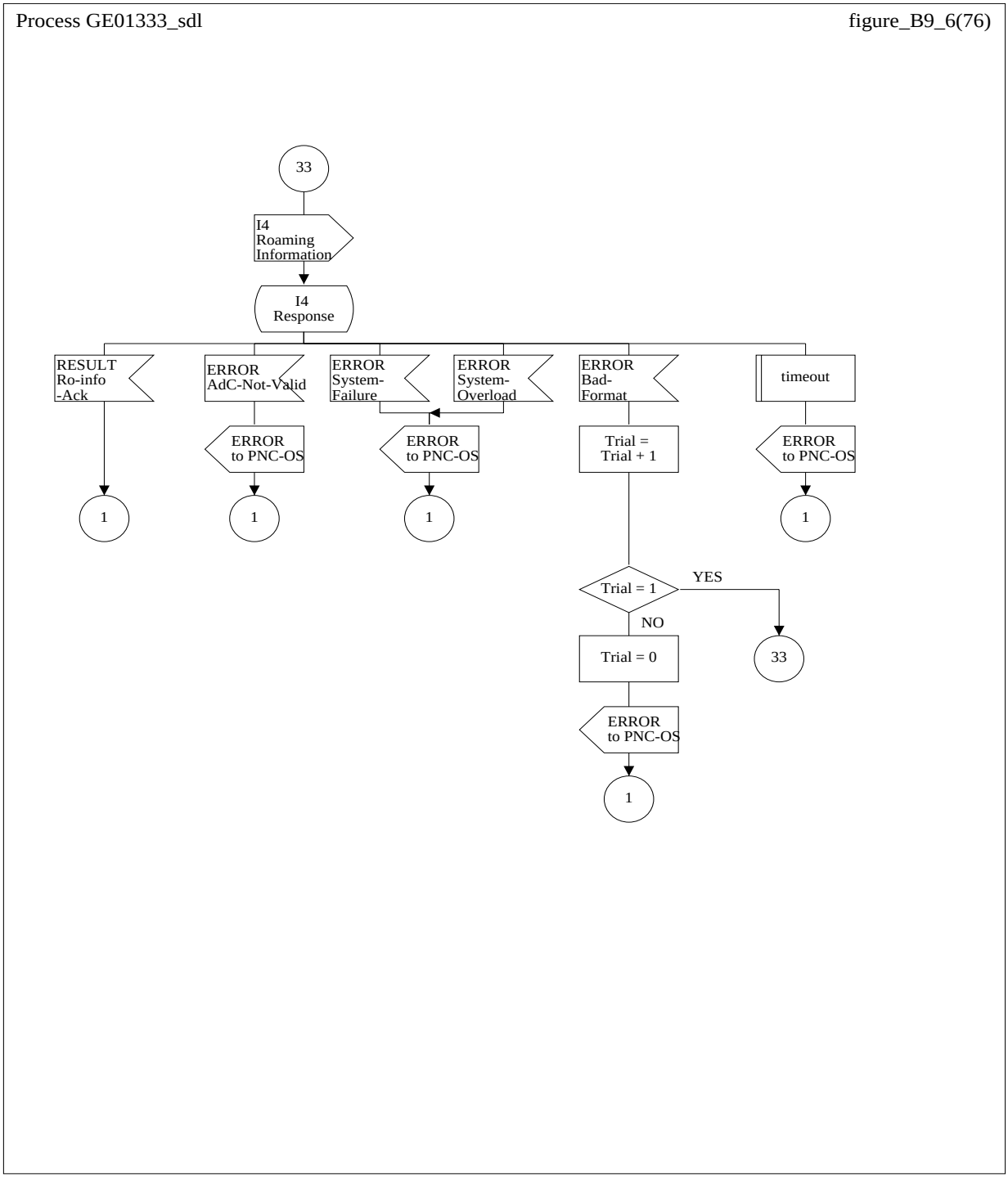


Figure B.9 (sheet 6 of 6): Call processing for roaming - distant call, PNC-I

PNC-H roaming process.

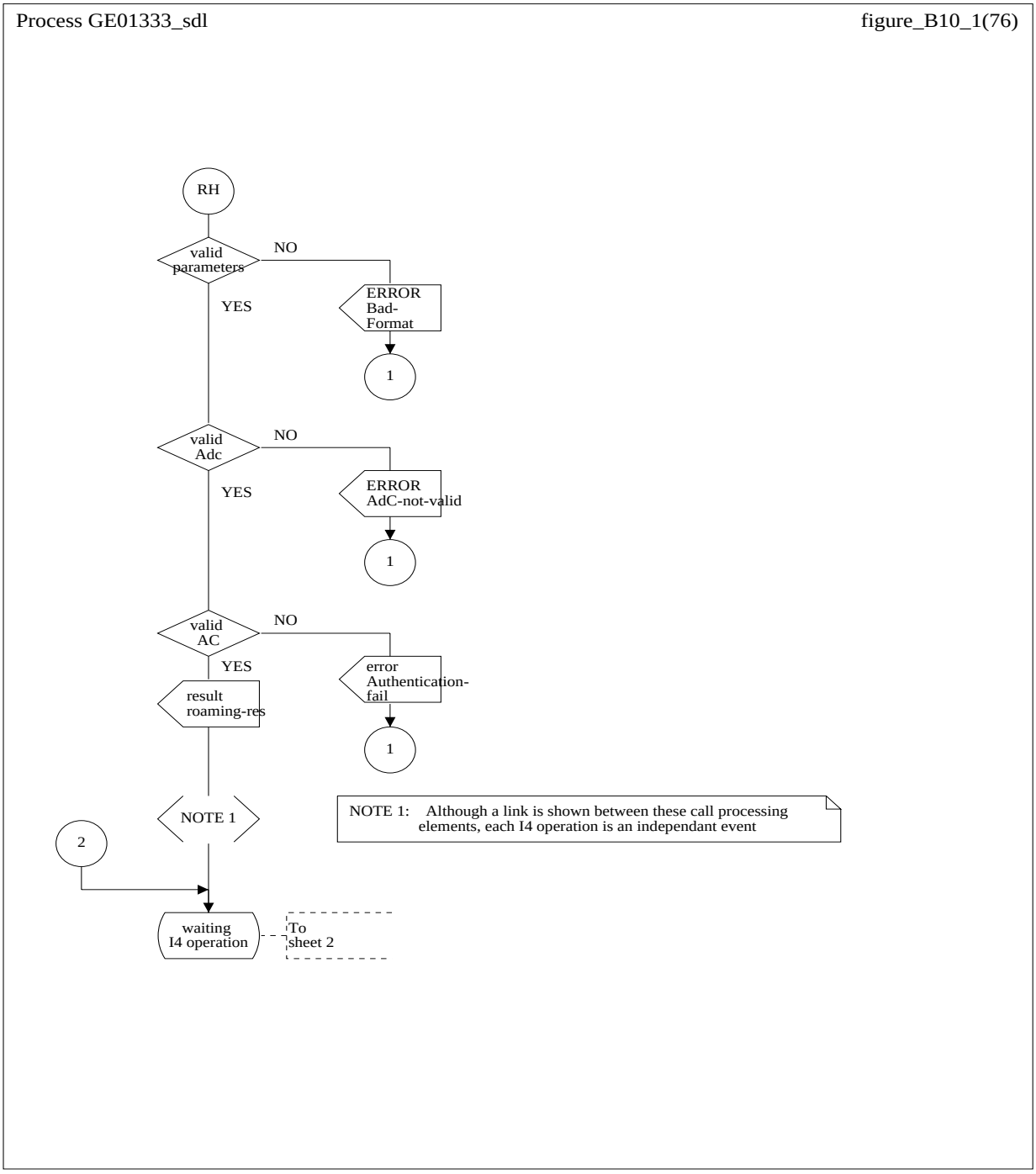


Figure B.10 (sheet 1 of 2): Call processing for roaming - distant call, PNC-H

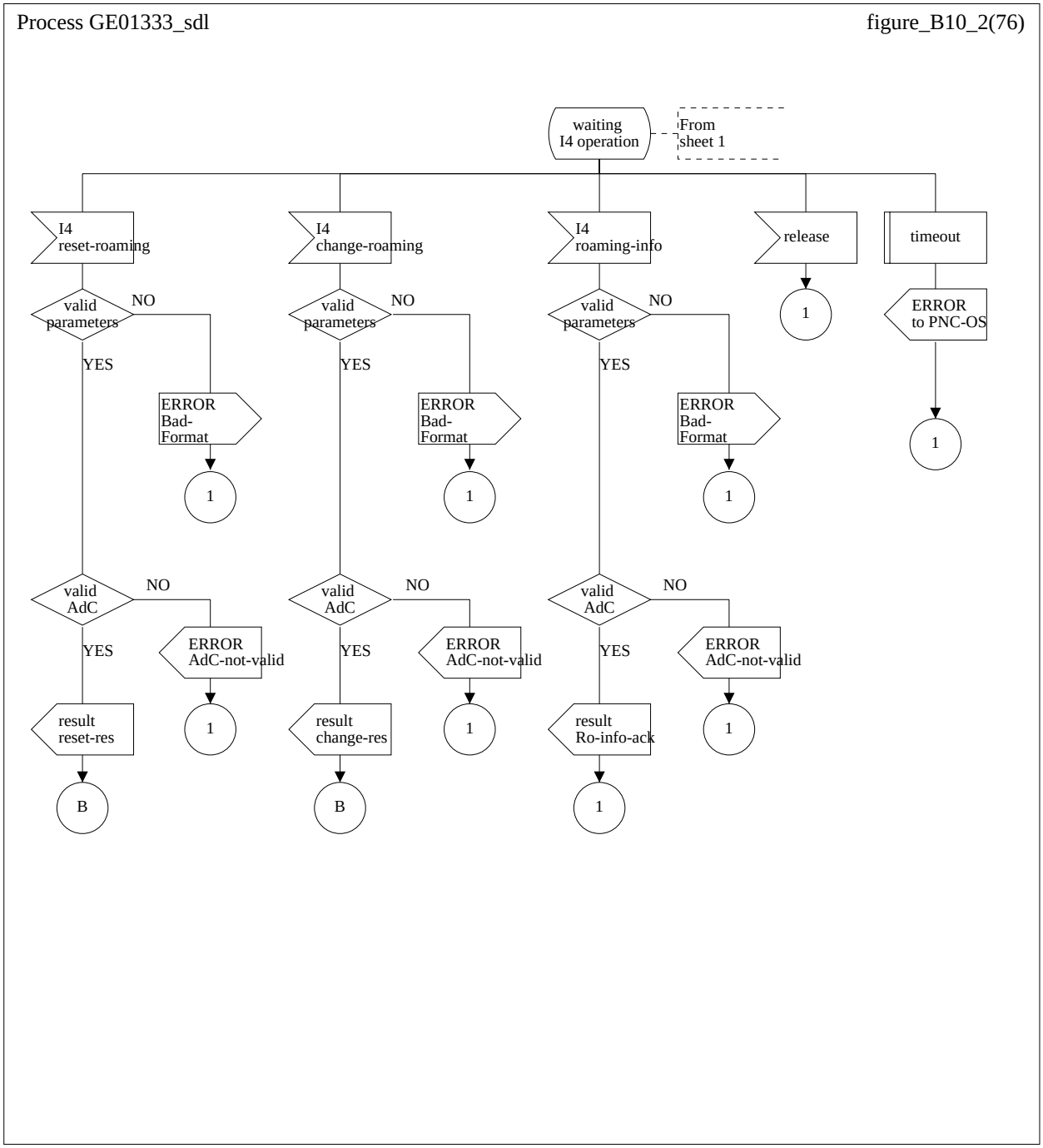


Figure B.10 (sheet 2 of 2): Call processing for roaming - distant call, PNC-H

B.4 Call processing for call diversion

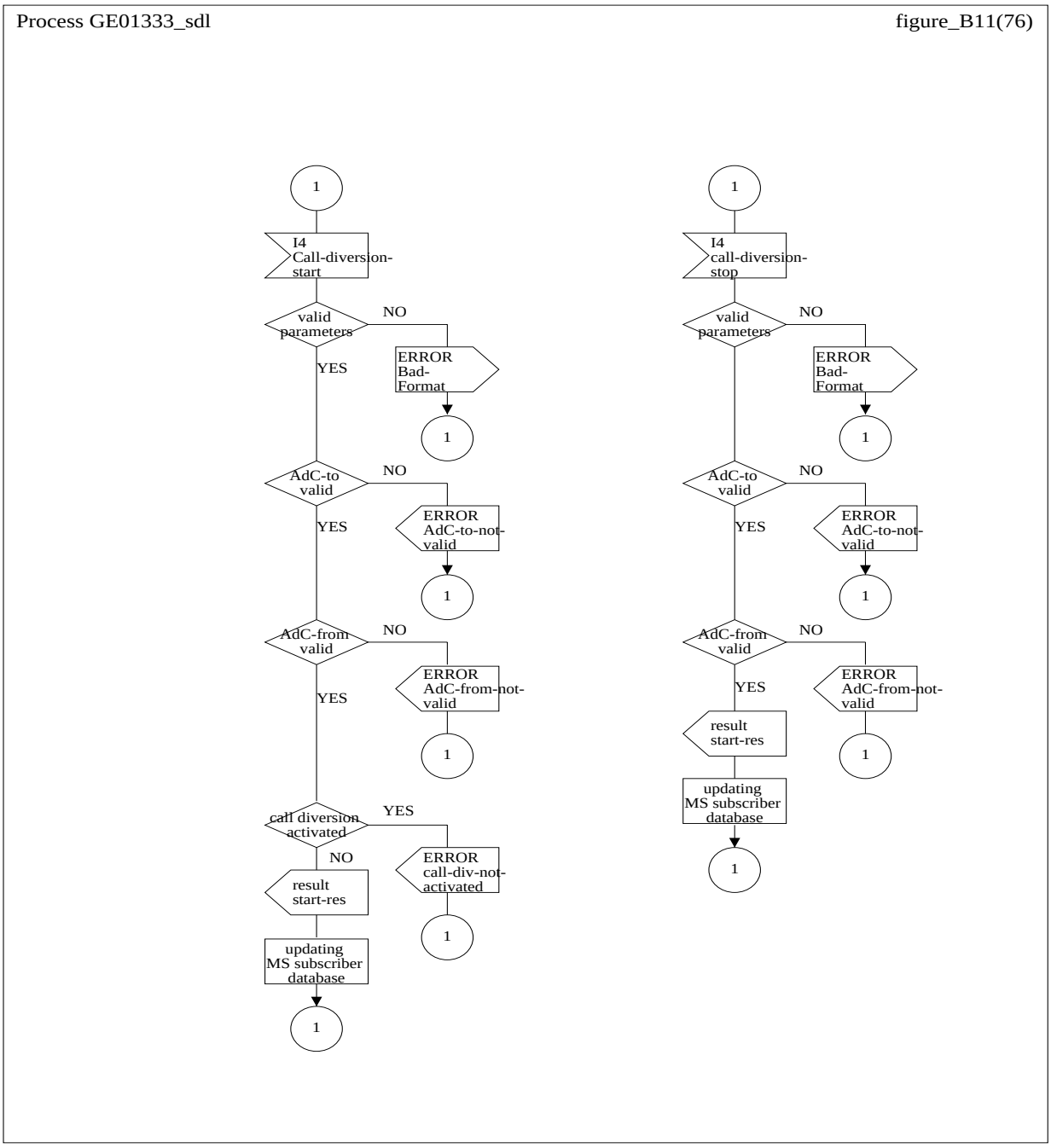


Figure B.11: Call processing for call diversion

Annex C (informative): List of access methods

This Annex gives a description of some possible access methods. It shows the combination of the four parameters (network, type, mode and terminal - see Clause 8) of each described access method. The access method numbers are used for reference purposes within Clause 8.

Table C.1

Access Method	Access Network	Access Type	Access Mode	Access Terminal
1.	PSTN	one-stage	inter-active	decadic telephone
2.	PSTN	one-stage	inter-active	DTMF telephone
3.	PSTN	two-stage	inter-active	DTMF telephone
4.	PSTN	two-stage	inter-active	alpha-numeric terminal
5.	PSTN	two-stage	non int-eractive	alpha-numeric terminal
6.	TELEX	one-stage	inter-active	telex terminal
7.	TELEX	one-stage	non int-eractive	telex terminal
8.	TELEX	two-stage	inter-active	telex terminal
9.	TELEX	two-stage	non int-eractive	telex terminal
10.	PSPDN	two-stage	inter-active	videotex terminal
11.	PSPDN	two-stage	inter-active	X.25 terminal
12.	PSPDN	two-stage	non int-eractive	X.25 terminal
13.	Bureau	two-stage	inter-active	telephone

continued

Table C.1 (concluded)

Access Method	Access Network	Access Type	Access Mode	Access Terminal
14.	CSPDN	two-stage	inter-active	CSPDN terminal
15.	CSPDN	two-stage	non int-eractive	CSPDN terminal
16.	ISDN	one-stage	inter-active	ISDN terminal
17.	ISDN	one-stage	non int-eractive	ISDN terminal
18.	ISDN	two-stage	inter-active	ISDN terminal
19.	ISDN	two-stage	non int-eractive	ISDN terminal
20.	PSPDN (X.400)	two-stage	non int-eractive	X.400 terminal
21.	PSPDN (X.400)	one-stage	non int-eractive	X.400 terminal

NOTE: CSPDN = Circuit Switched Packet Data Network.

Annex D (normative): SDL diagrams for interactive access mode

This Annex is normative for access methods 1 and 2 for tone-only paging and for access method 3 for numeric paging. It is informative for all other access methods.

D.1 General

This Annex describes, using the SDL graphical representation, the generic protocols for accessing the ERMES system for page input and SFs. The figures represent the dialogues between the user and the ERMES system through the I6 interface (see Clause 8).

D.2 For page input

Figure D.2 deals with the generic protocol for access methods using two-stage selection and an interactive access mode. Figure D.8 deals with the generic protocol for access methods using one-stage selection and an interactive access mode. Macros for character input common to both protocols are described in figure D.1.

SS dialogues are described in figures D3.1 to D3.8 for both one-stage and two-stage protocols.

D.3 For subscriber features

The dialogue for SFs is described in figure D.5. The dedicated part of the SFs is described only for roaming and is in figure D.6.

Process GE01333_sdl figure_D1_1(76)

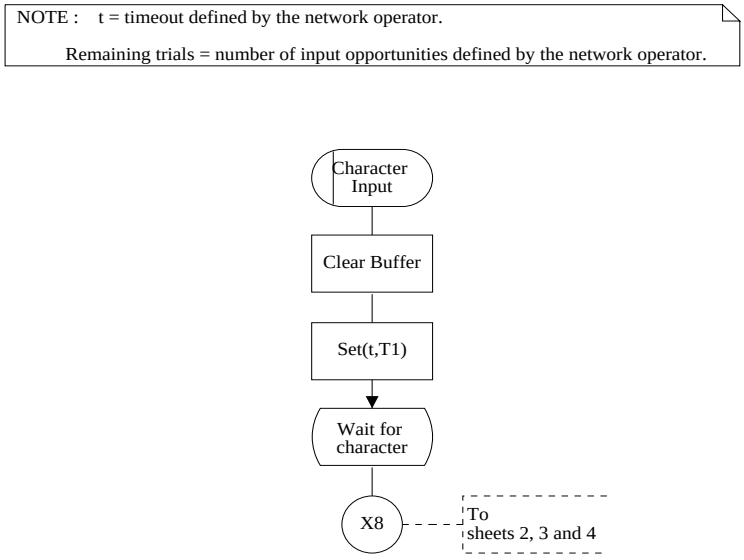


Figure D.1 (sheet 1 of 3): Calling party input macro

Process GE01333_sdl figure_D1_2(76)

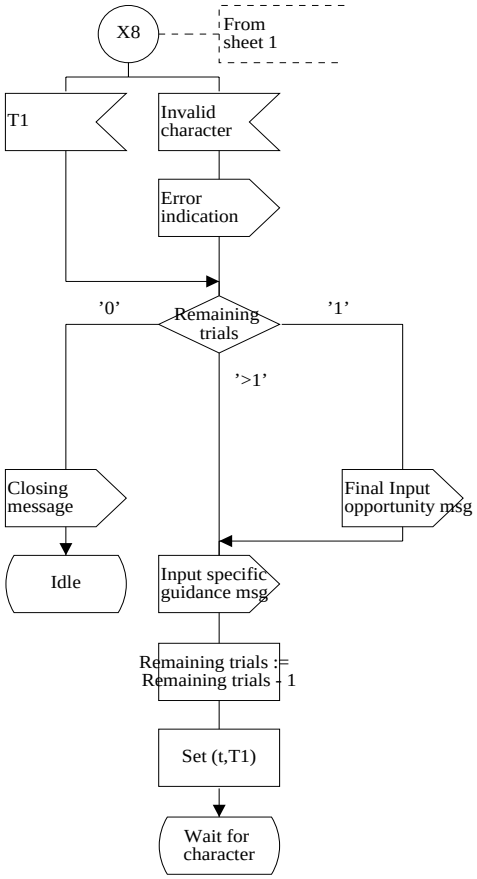


Figure D.1 (sheet 2 of 3): Calling party input macro

Process GE01333_sdl figure_D1_3(76)

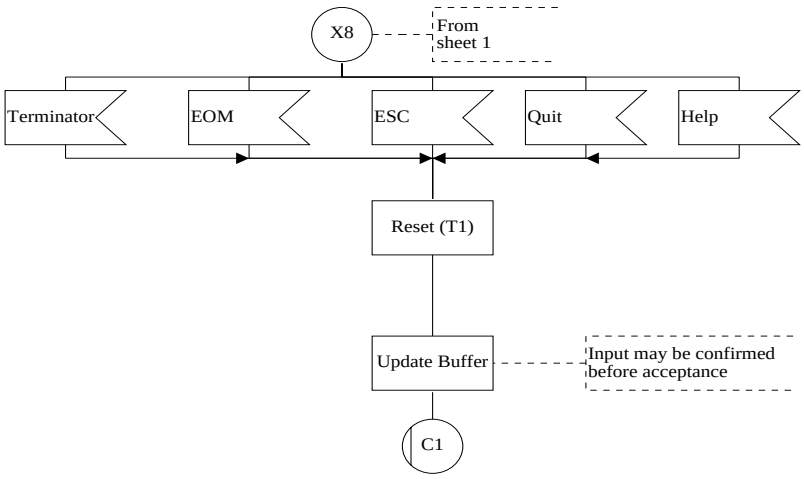


Figure D.1 (sheet 3 of 3): Calling party input macro

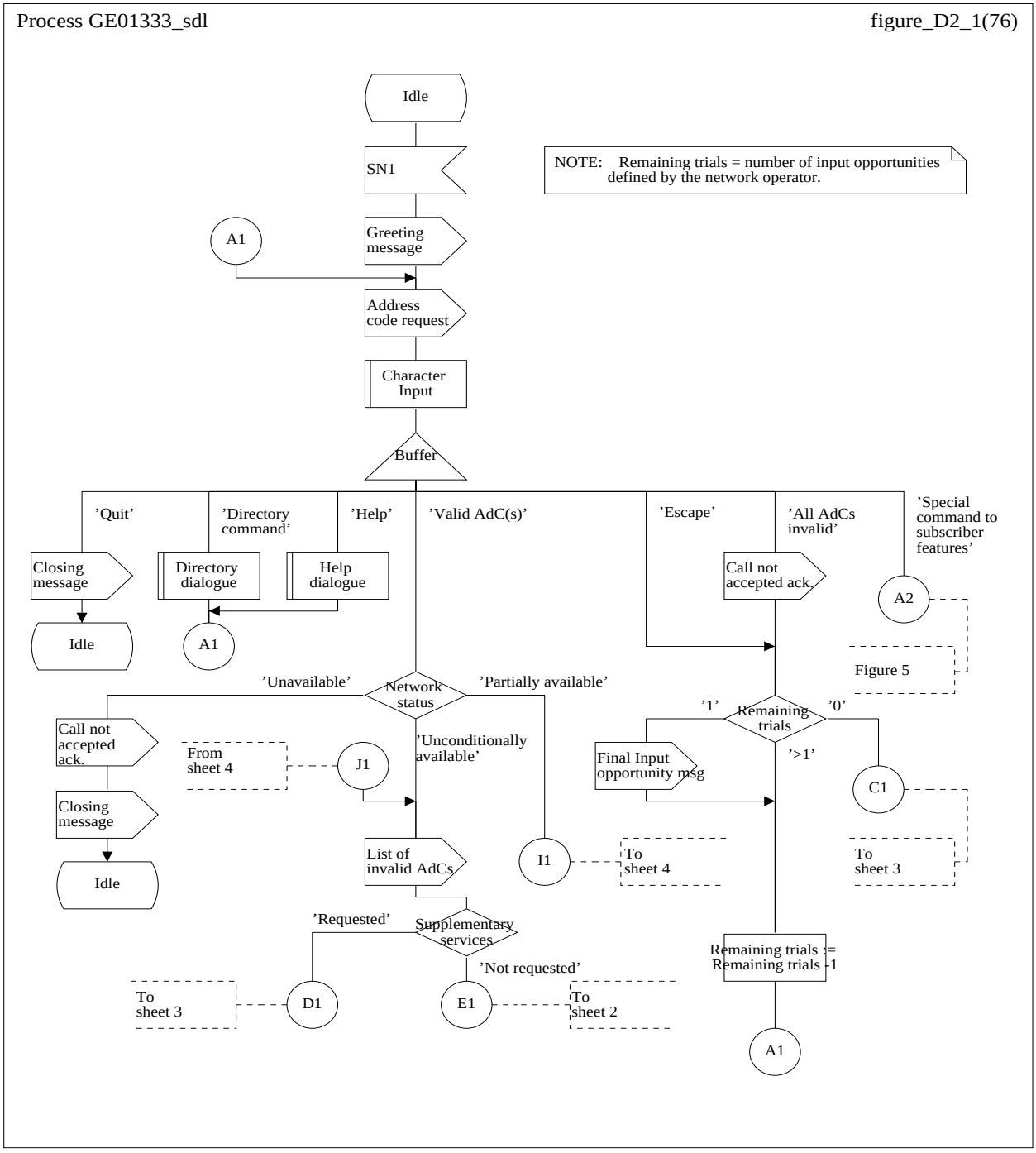


Figure D.2 (sheet 1 of 4): Two-stage selection protocol via service number 1

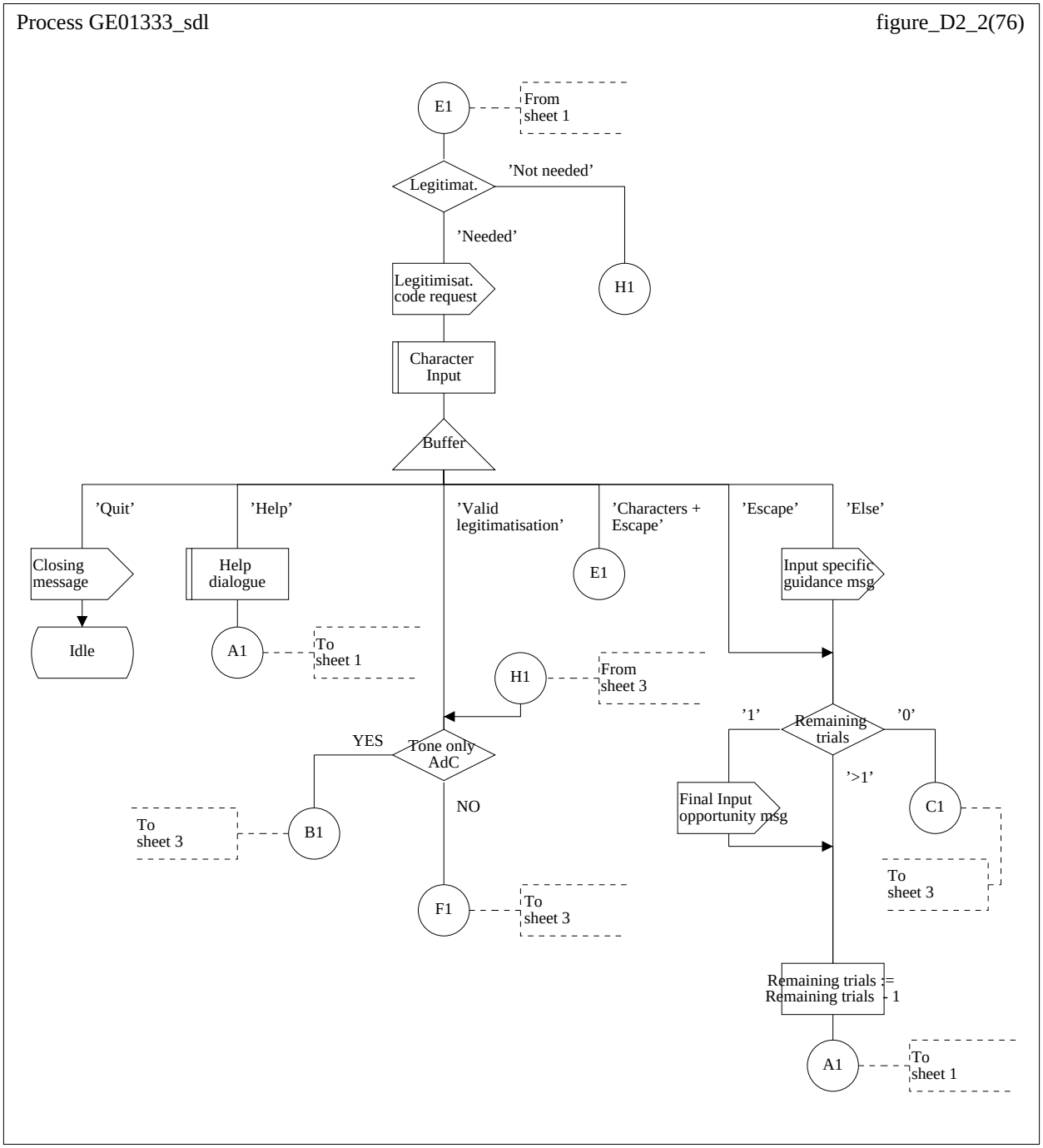


Figure D.2 (sheet 2 of 4): Two-stage selection protocol via service number 1

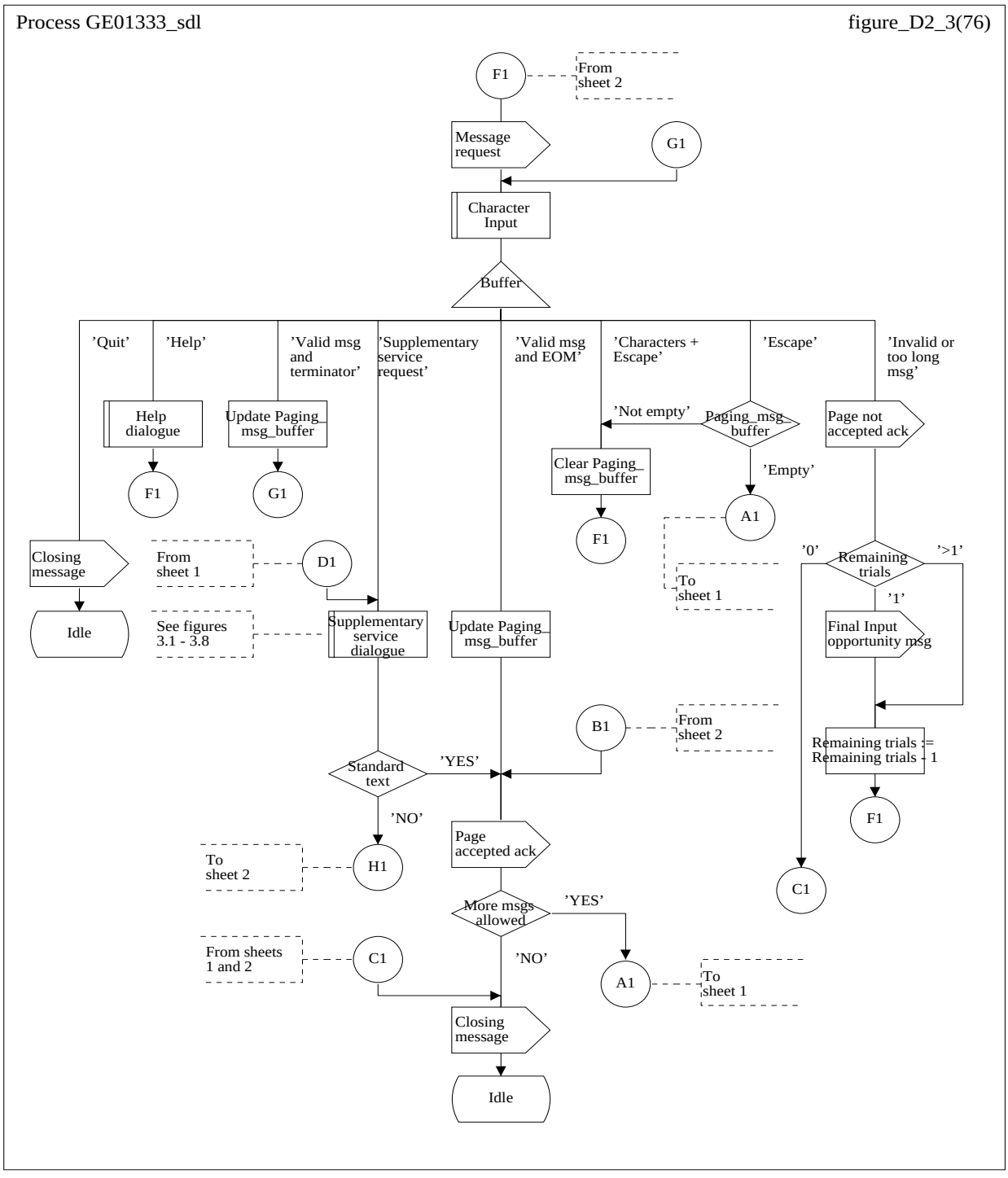


Figure D.2 (sheet 3 of 4): Two-stage selection protocol via service number 1

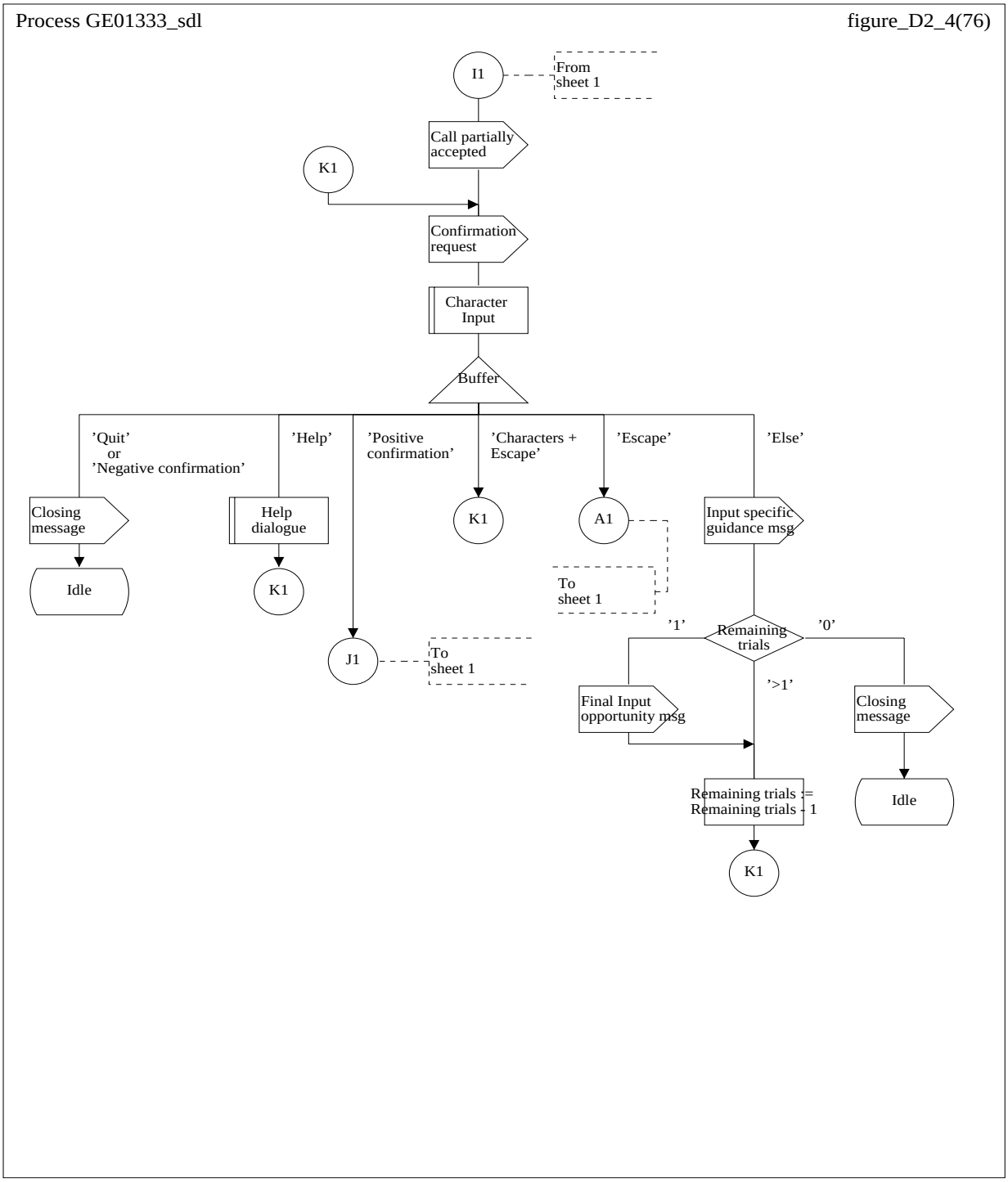


Figure D.2 (sheet 4 of 4): Two-stage selection protocol via service number 1

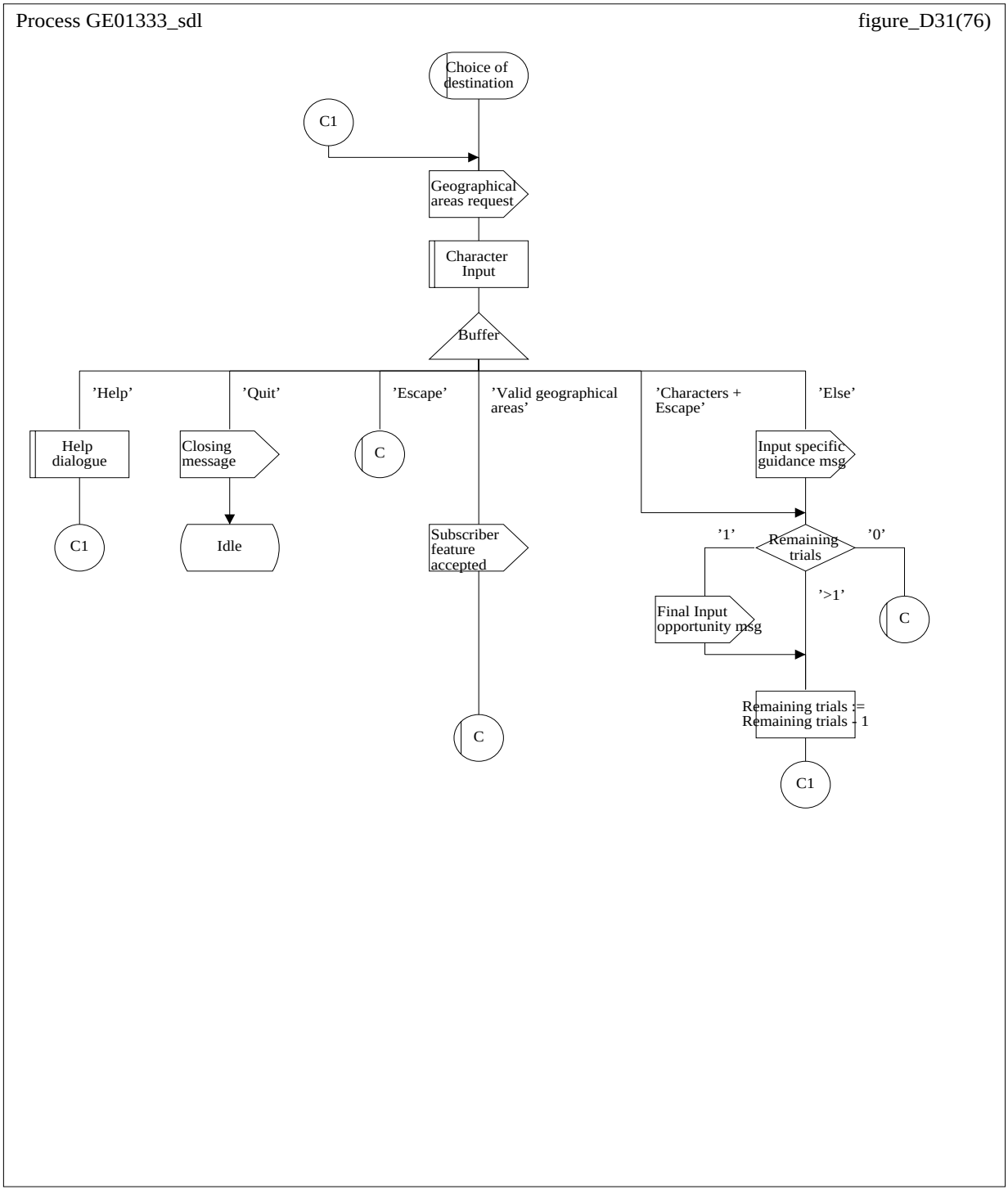


Figure D.3.1: Choice of destination

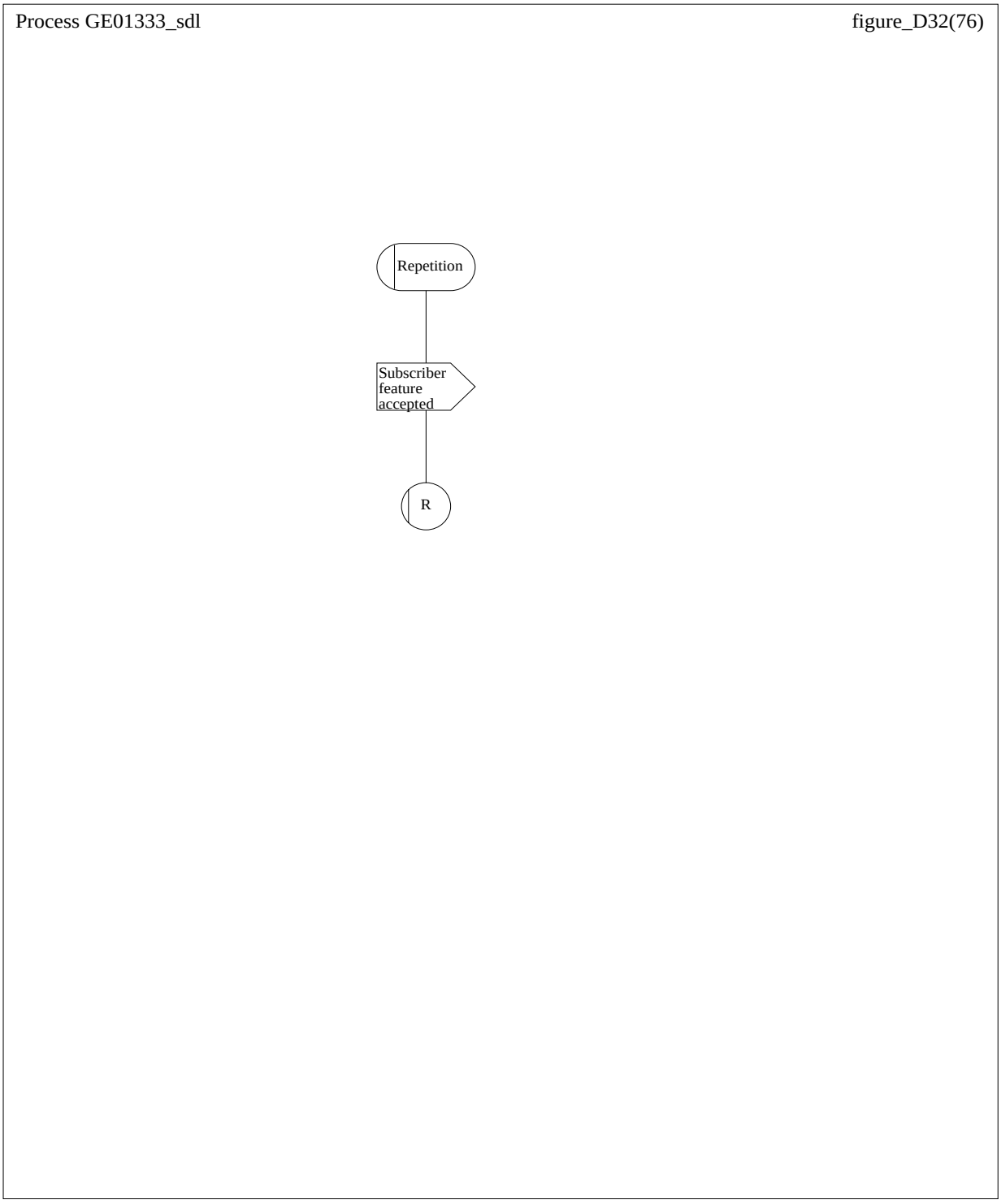


Figure D.3.2: Call repetition

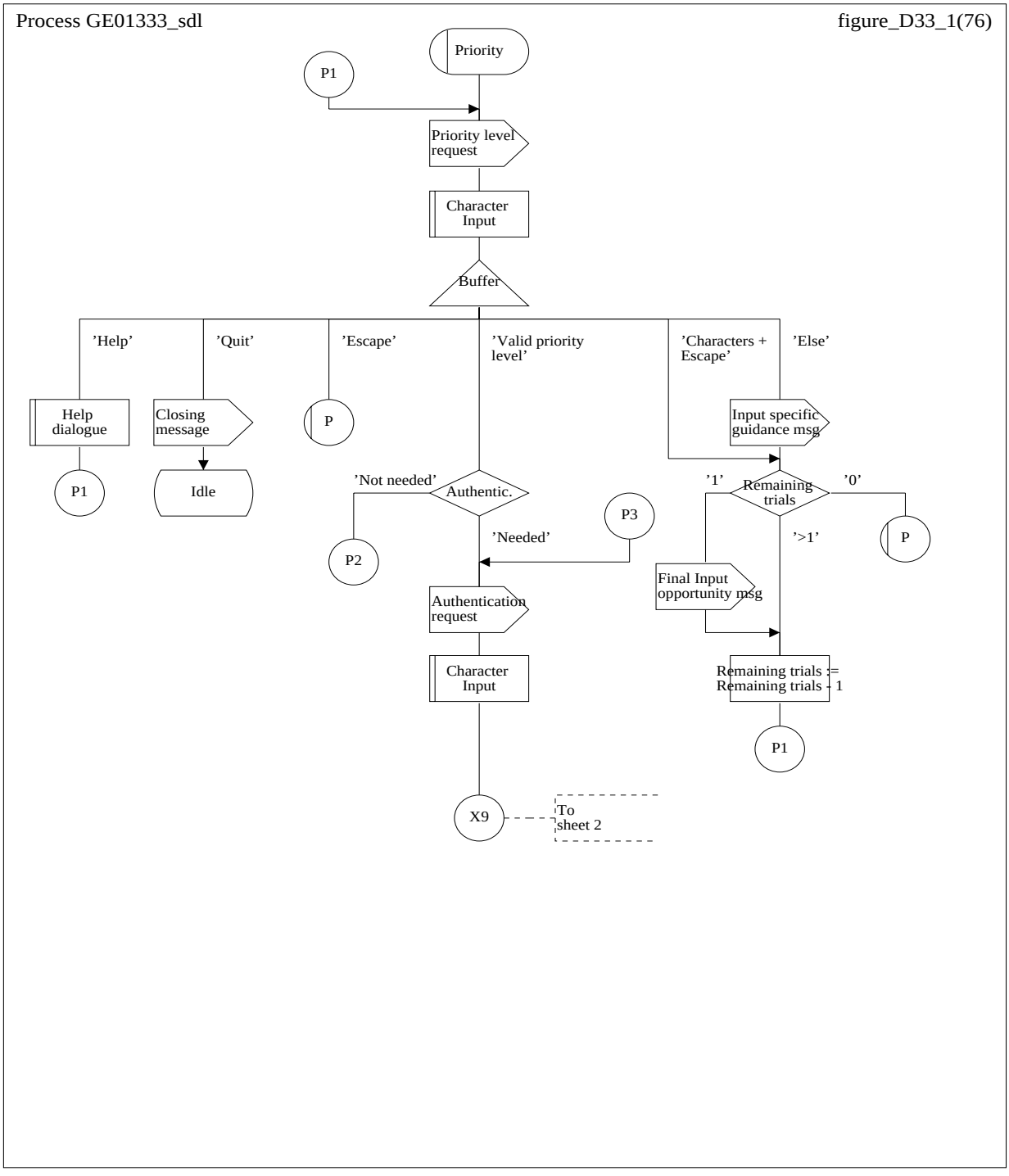


Figure D.3.3 (sheet 1 of 2): Priority

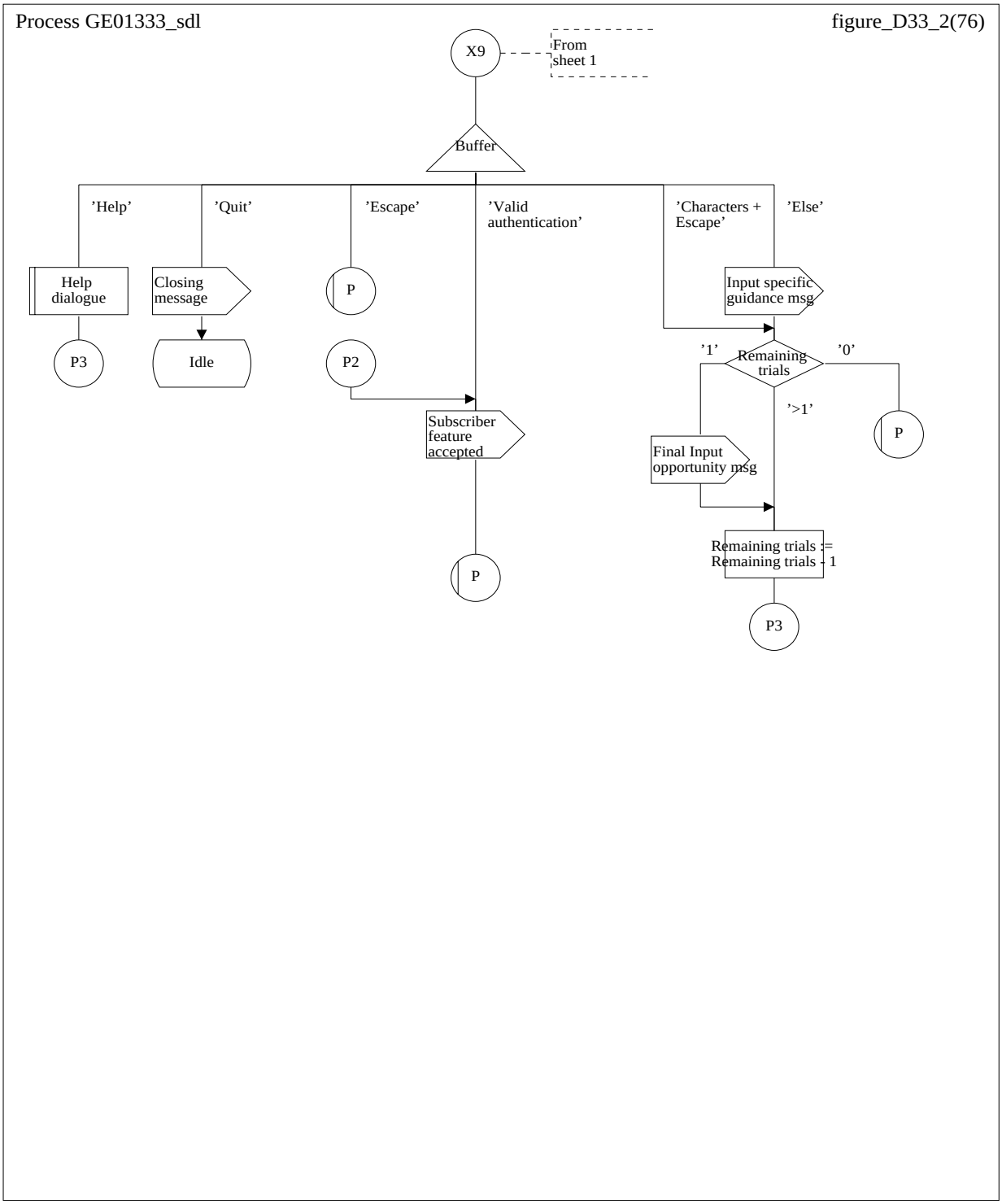


Figure D.3.3 (sheet 2 of 2): Priority

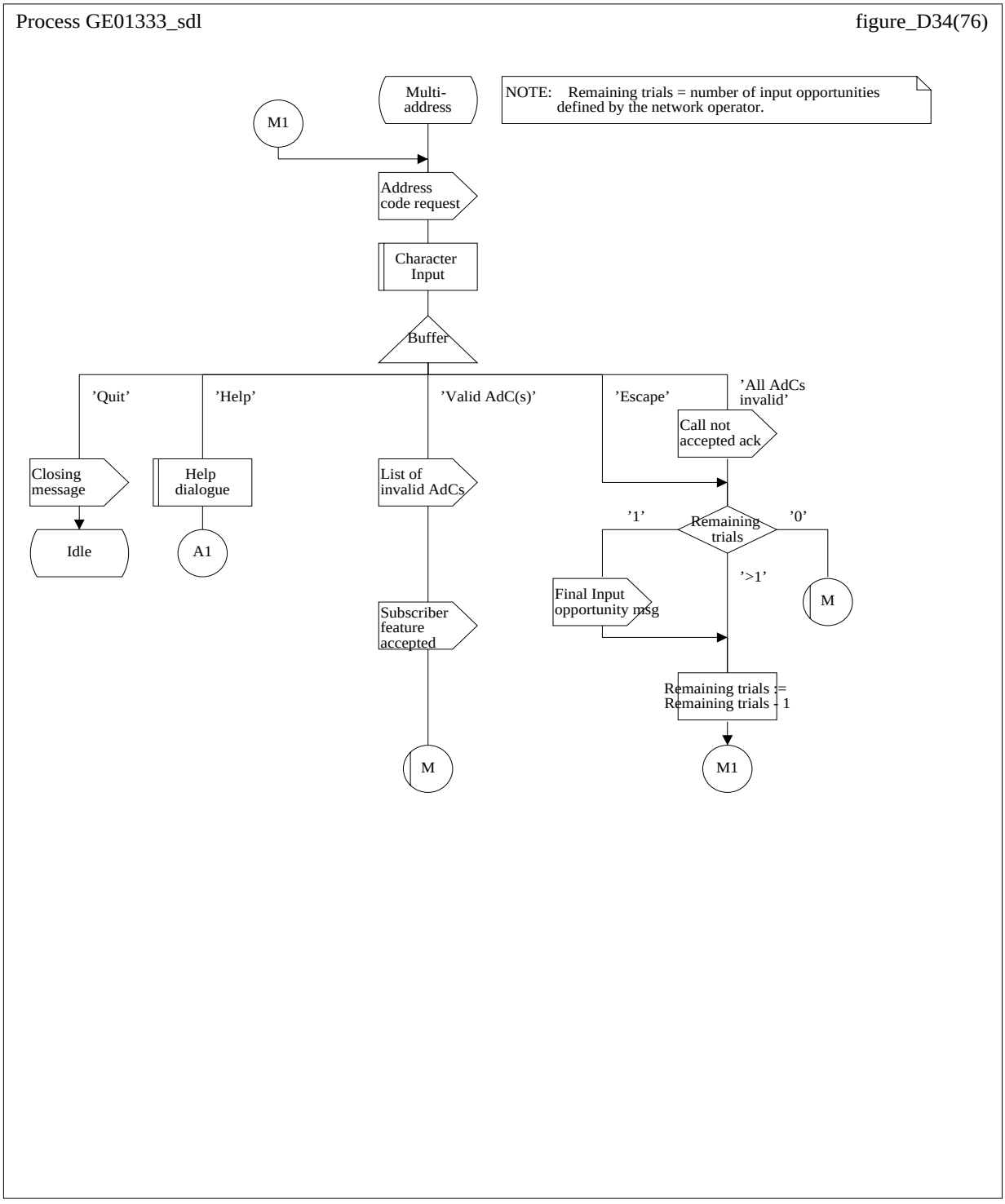


Figure D.3.4: Multi-address calls

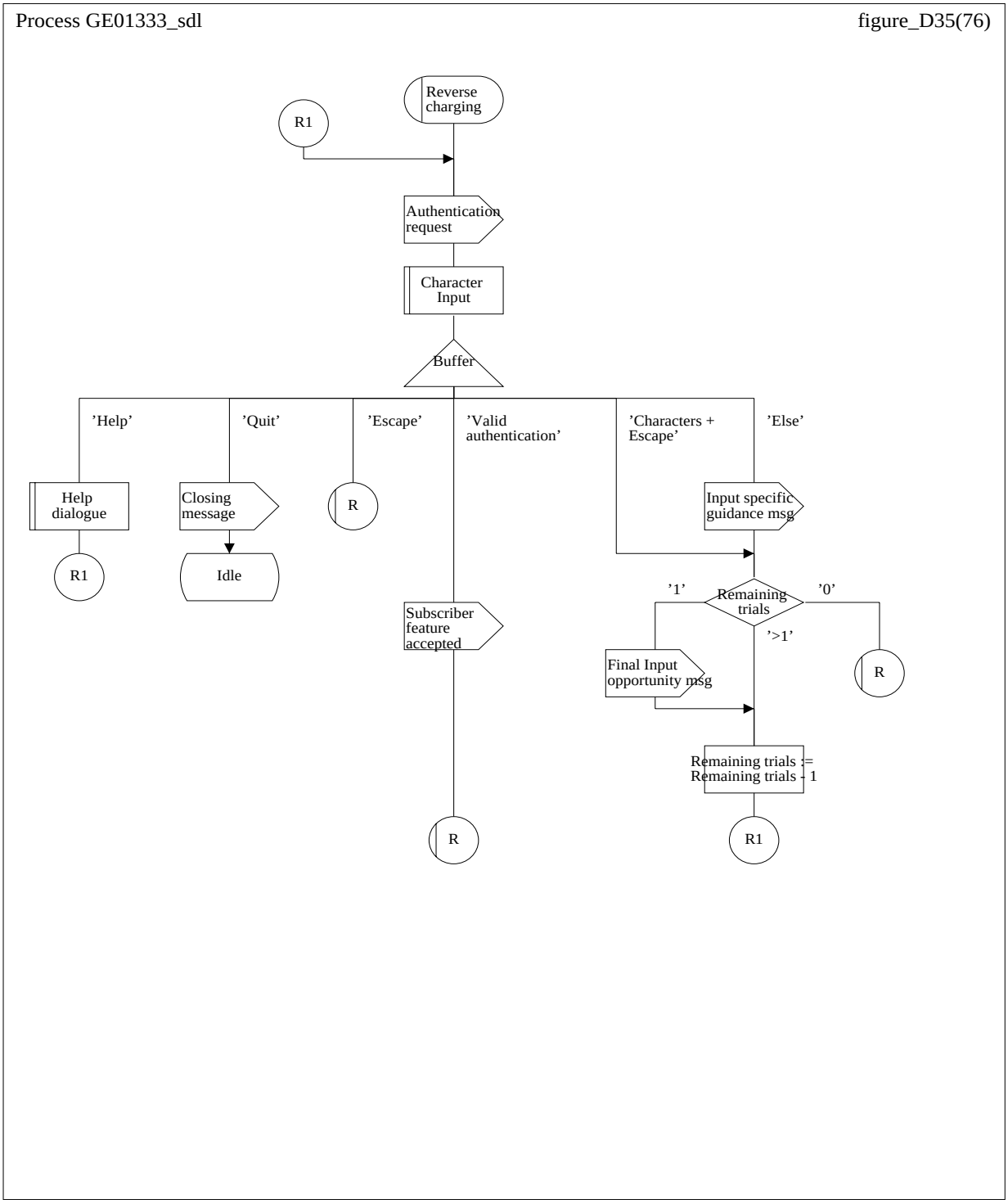


Figure D.3.5: Reverse charging request

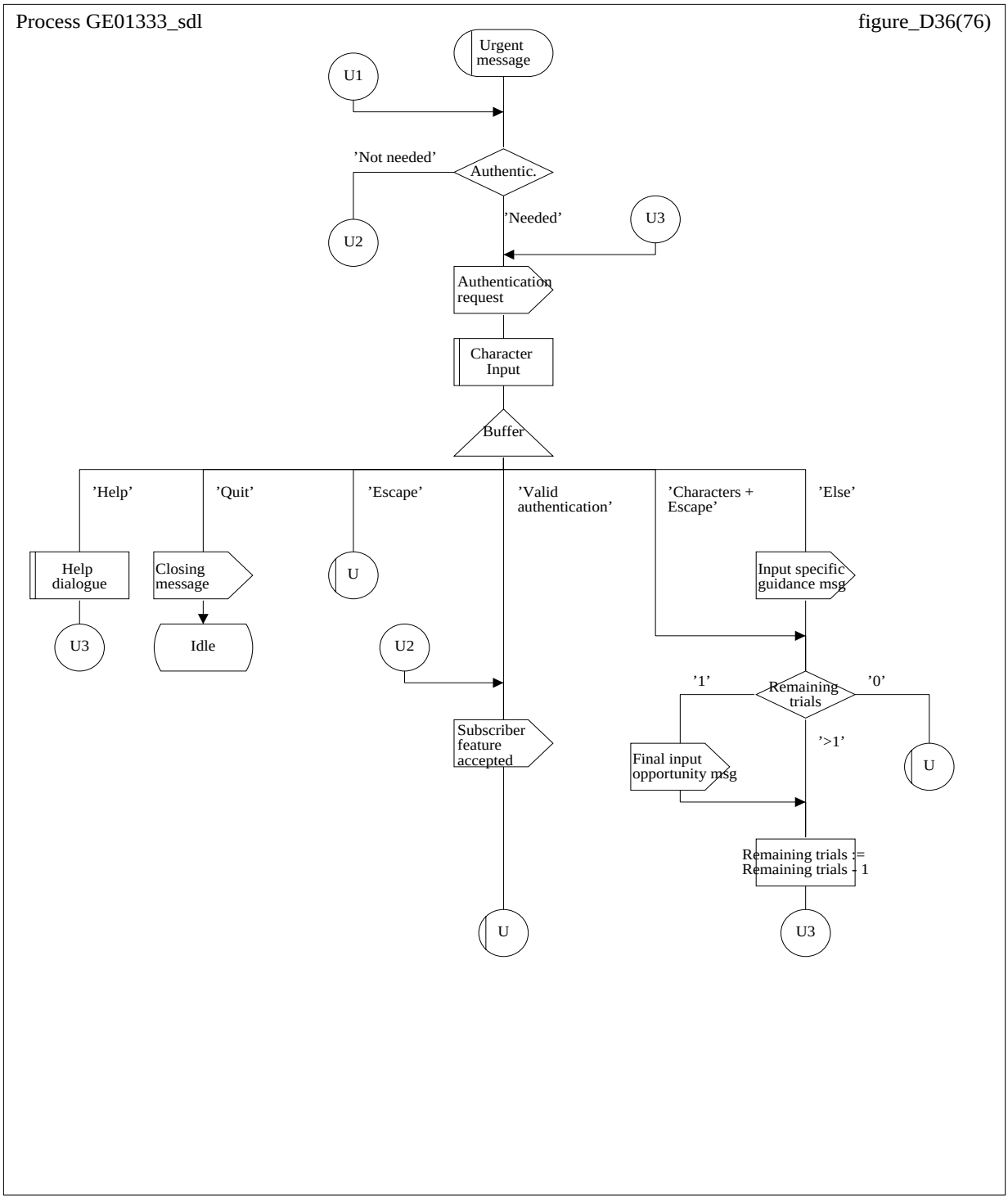


Figure D.3.6: Urgent message

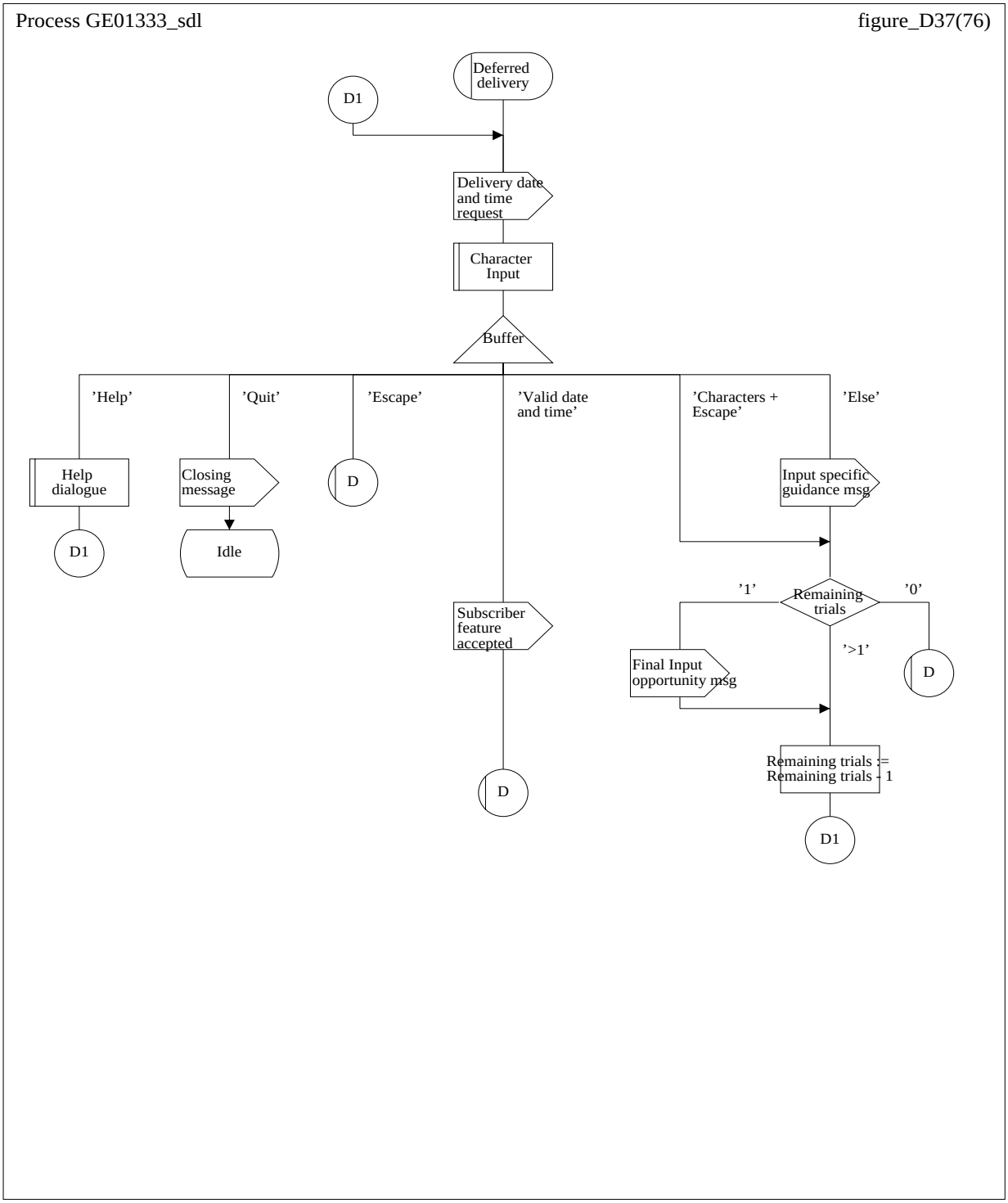


Figure D.3.7: Deferred delivery

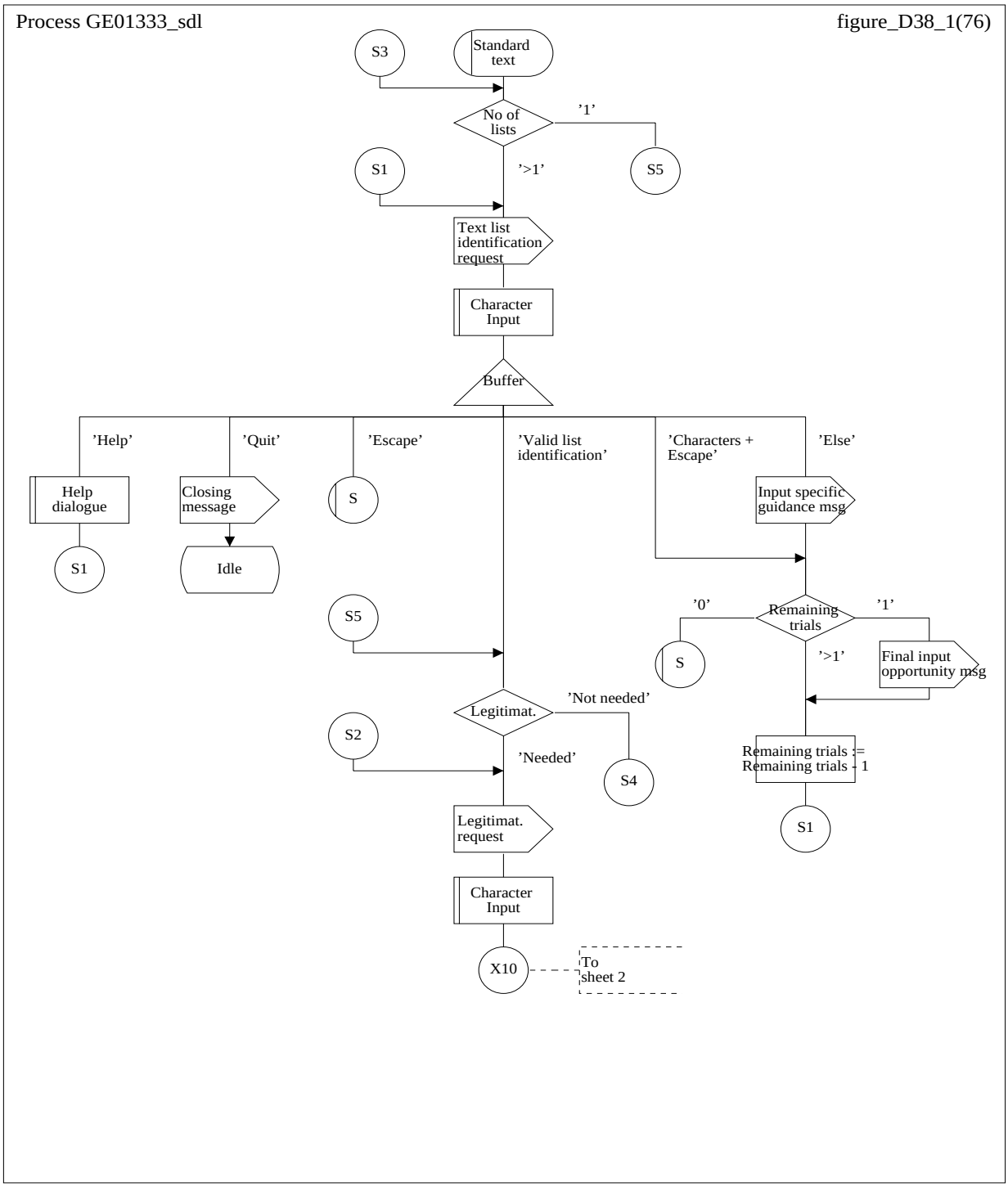


Figure D.3.8 (sheet 1 of 2): Standard text dialogue

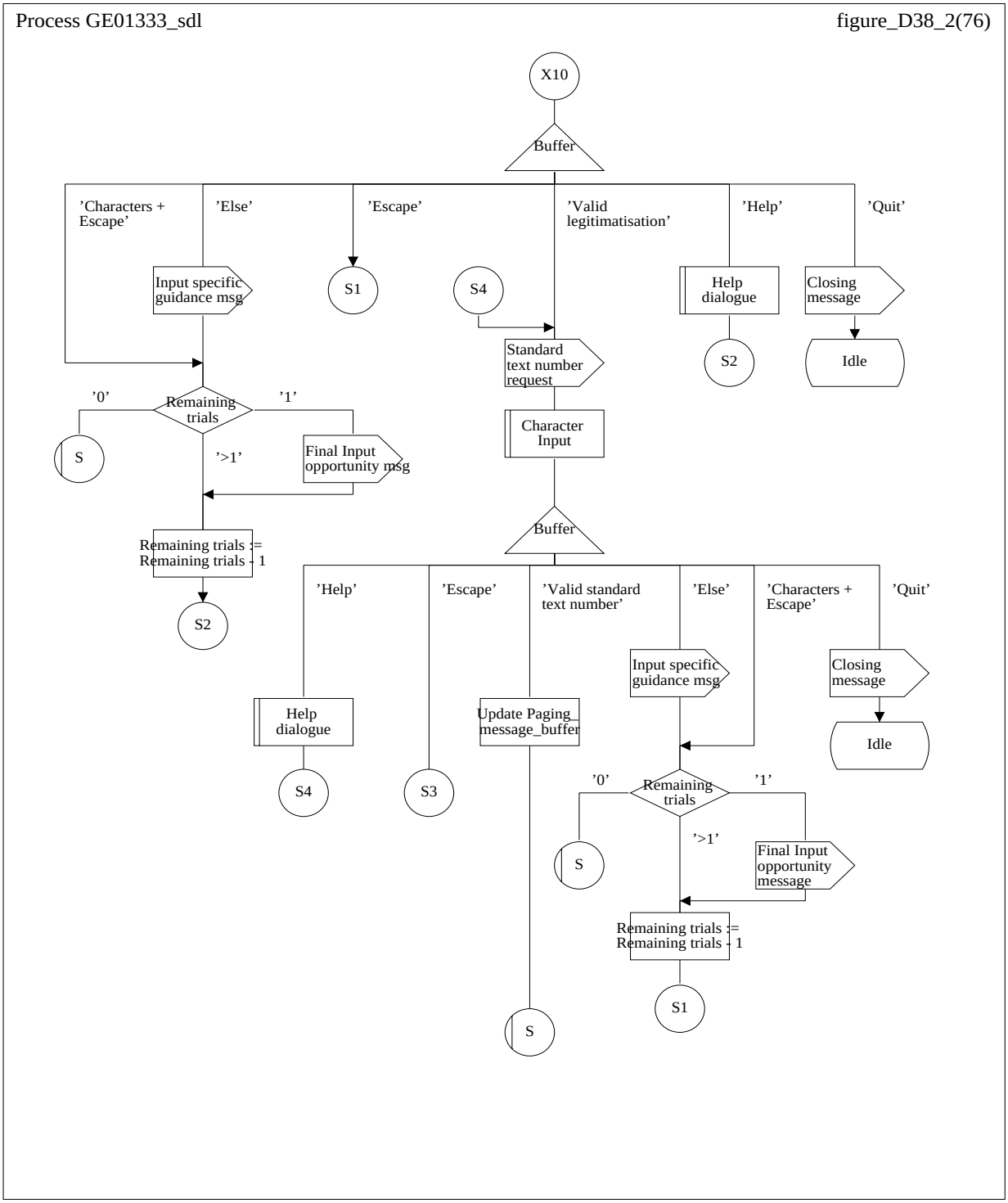


Figure D.3.8 (sheet 2 of 2): Standard text dialogue

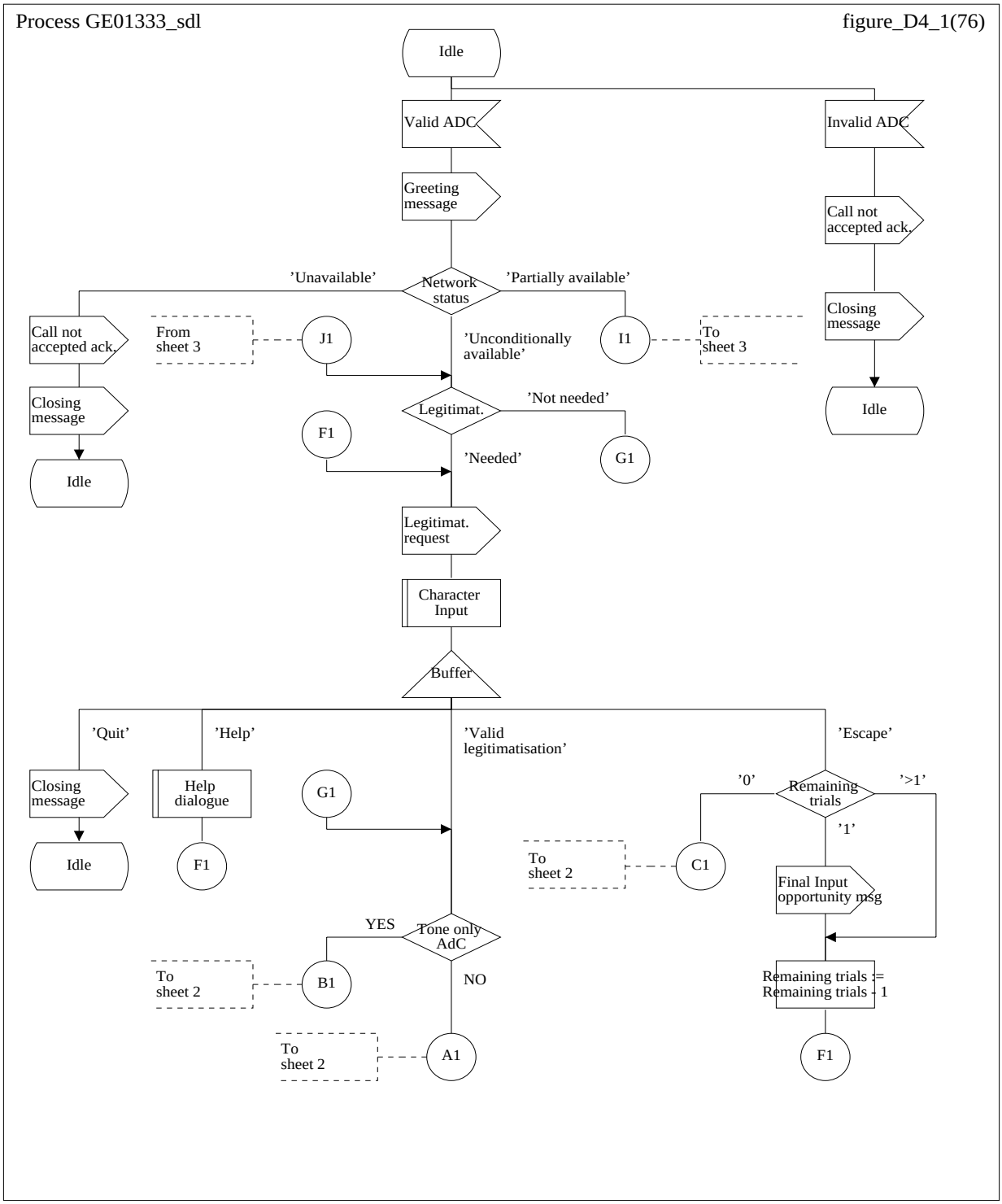


Figure D.4 (sheet 1 of 3): one-stage selection protocol for page input - interactive mode

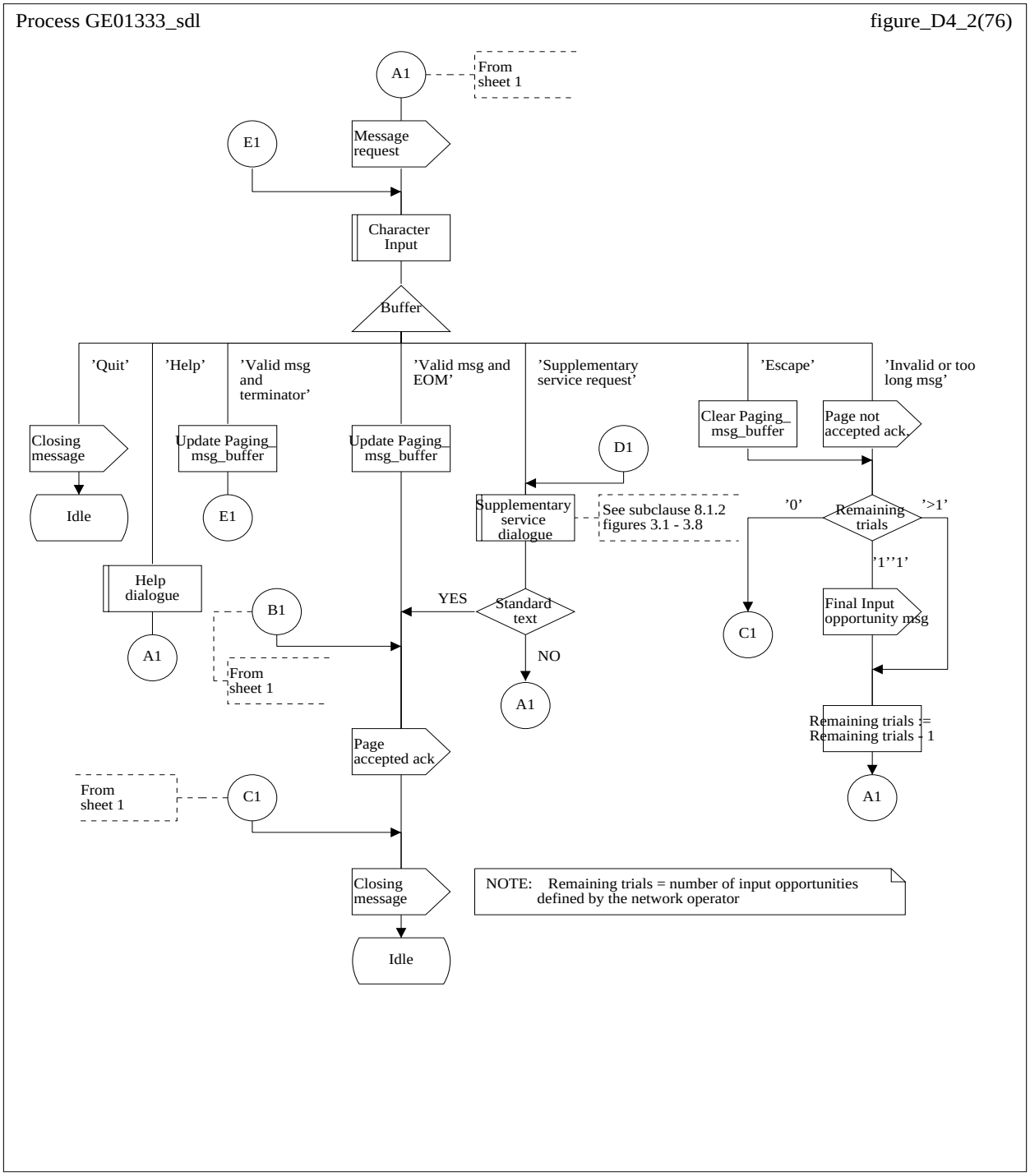


Figure D.4 (sheet 2 of 3): one-stage selection protocol for page input - interactive mode

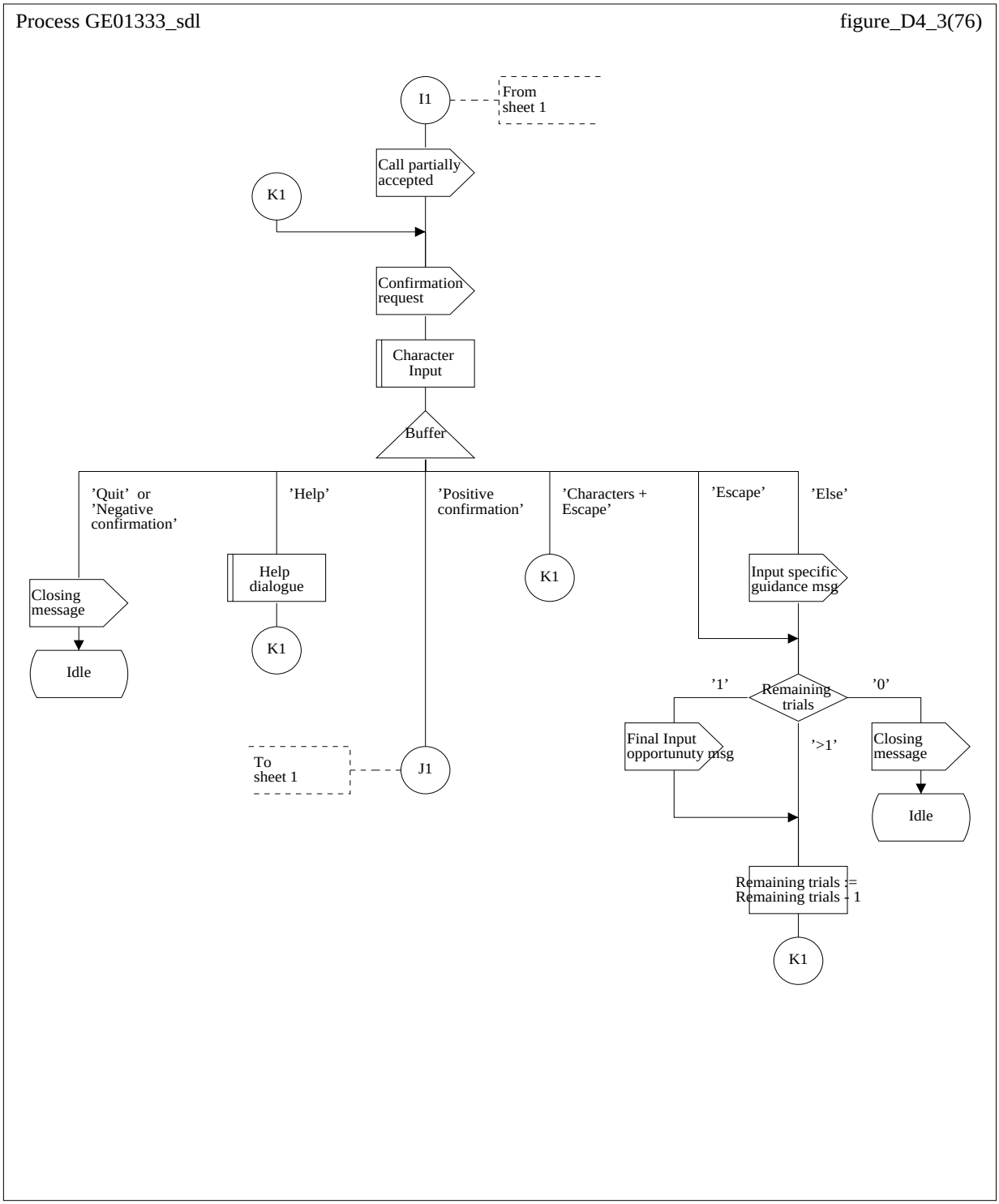


Figure D.4 (sheet 3 of 3): one-stage selection protocol for page input - interactive mode

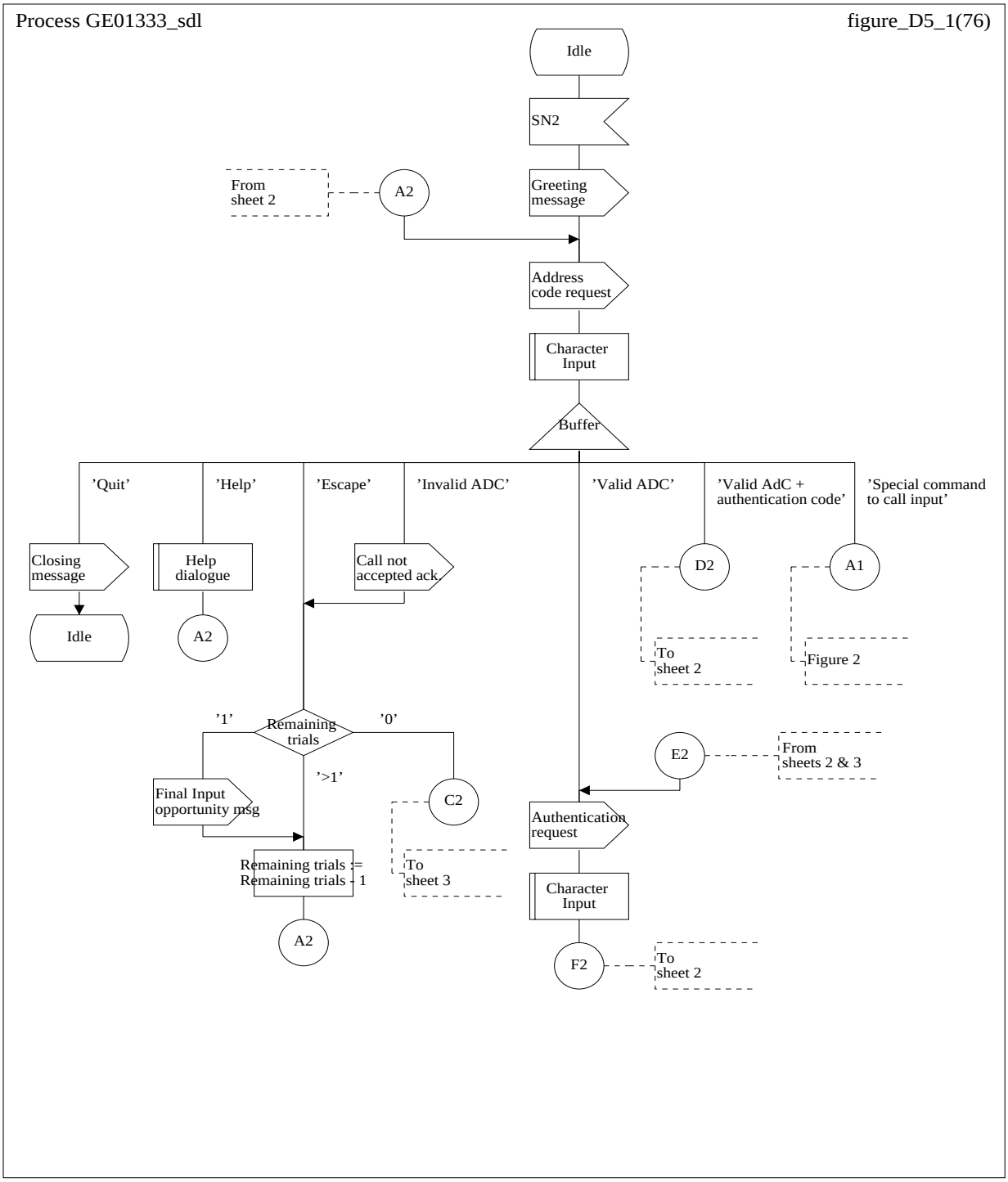


Figure D.5 (sheet 1 of 2): Two-stage selection protocol via service number 2

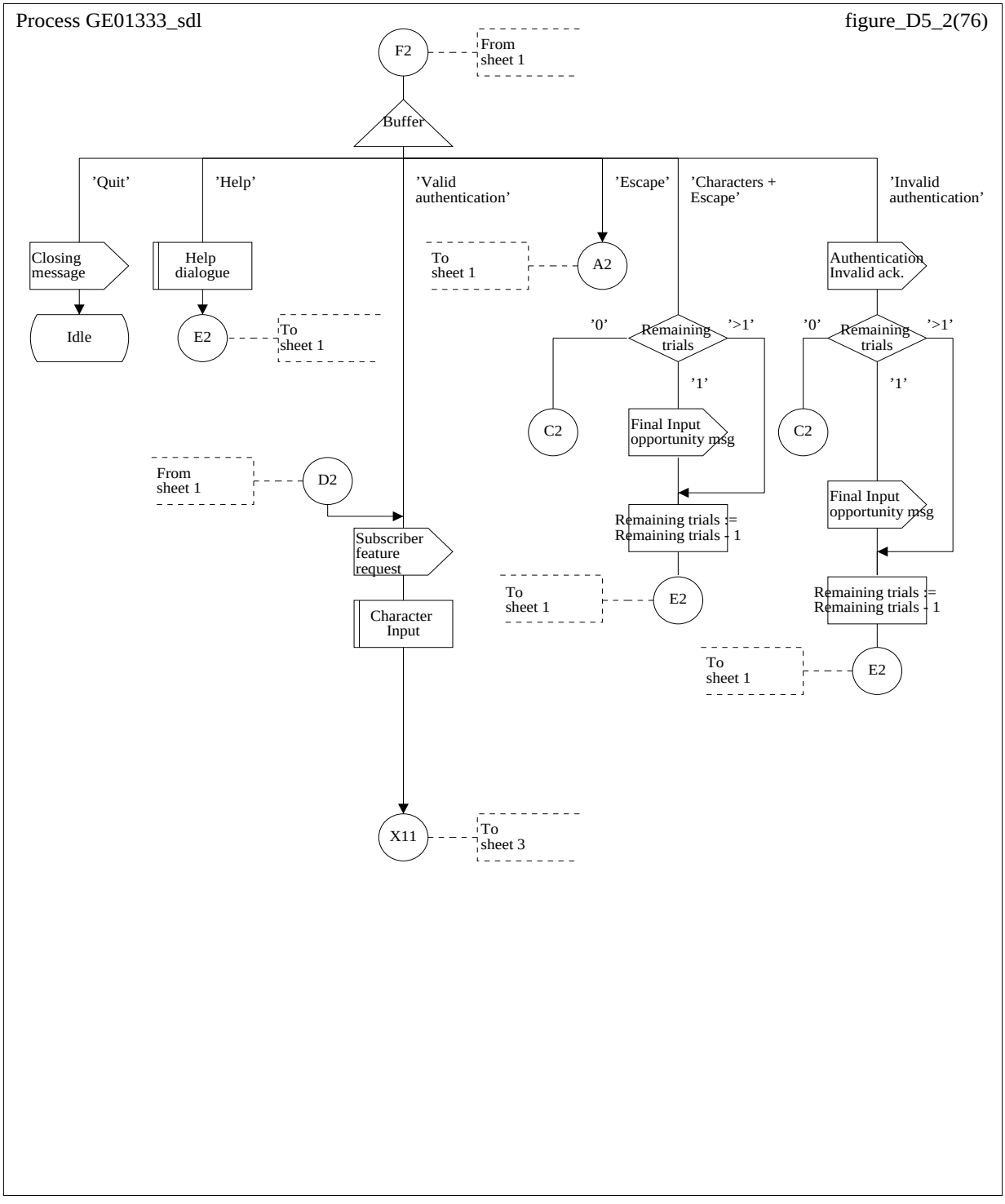


Figure D.5 (sheet 2 of 2): Two-stage selection protocol via service number 2

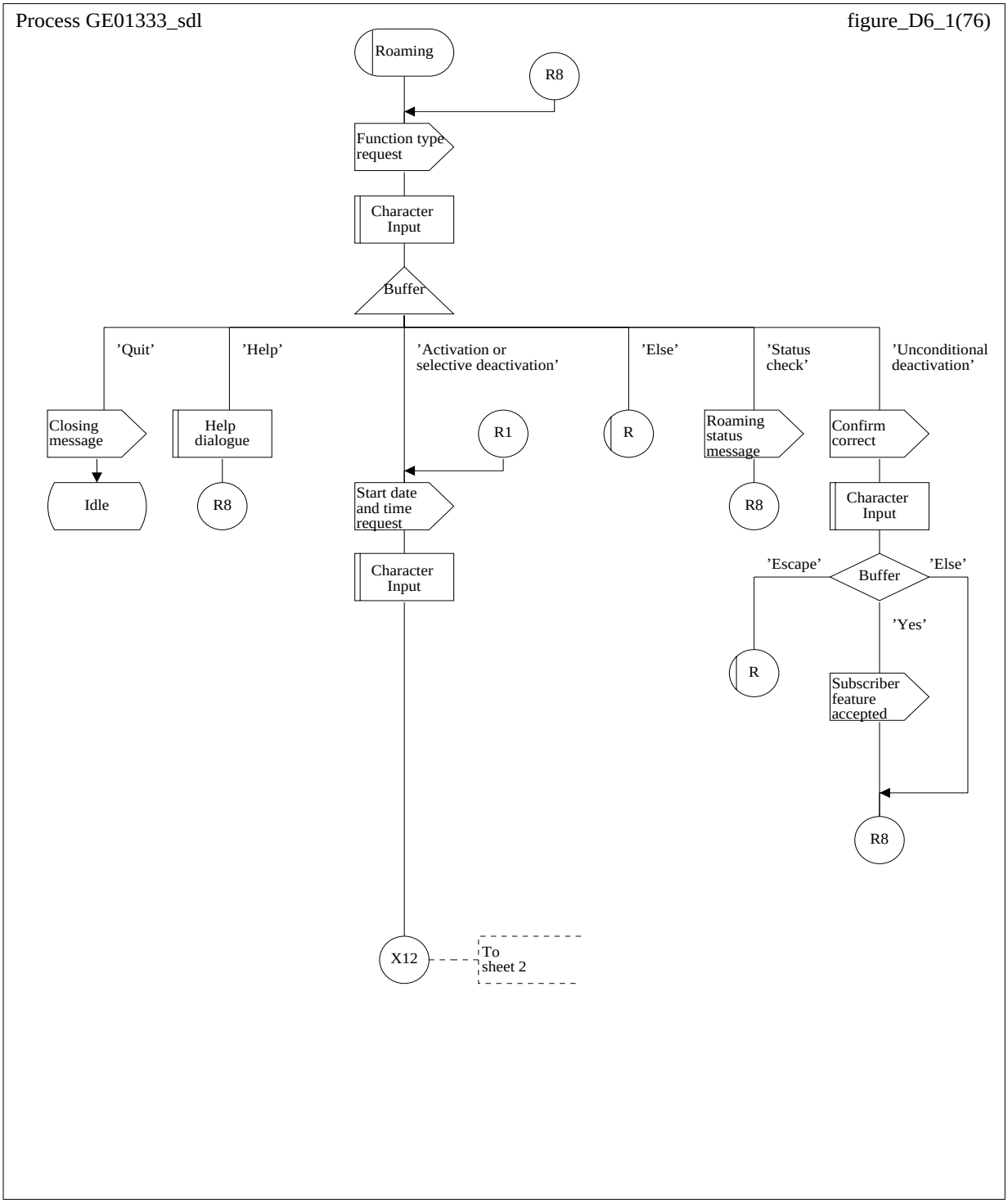


Figure D.6 (sheet 1 of 4): Roaming dialogue

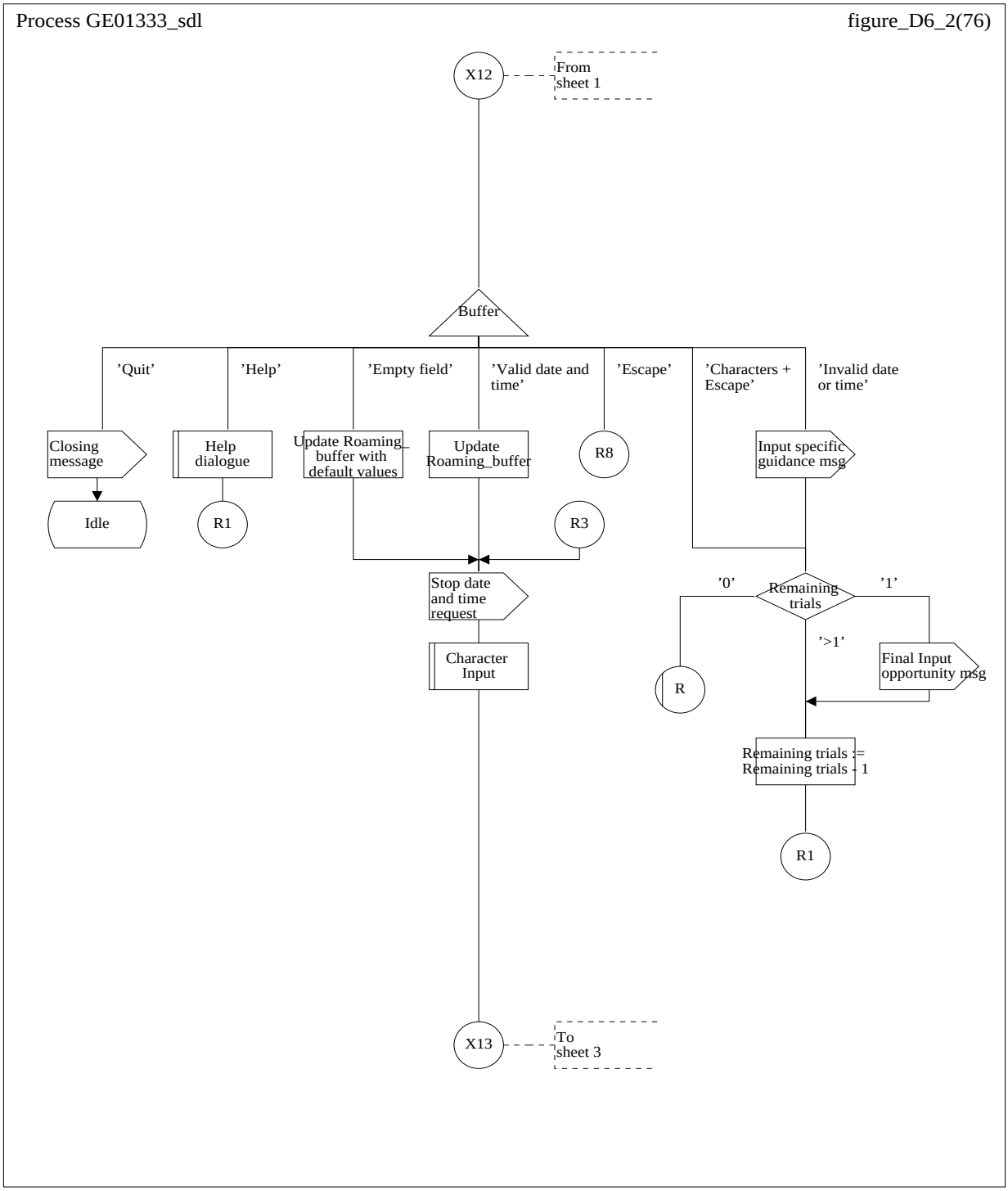


Figure D.6 (sheet 2 of 4): Roaming dialogue

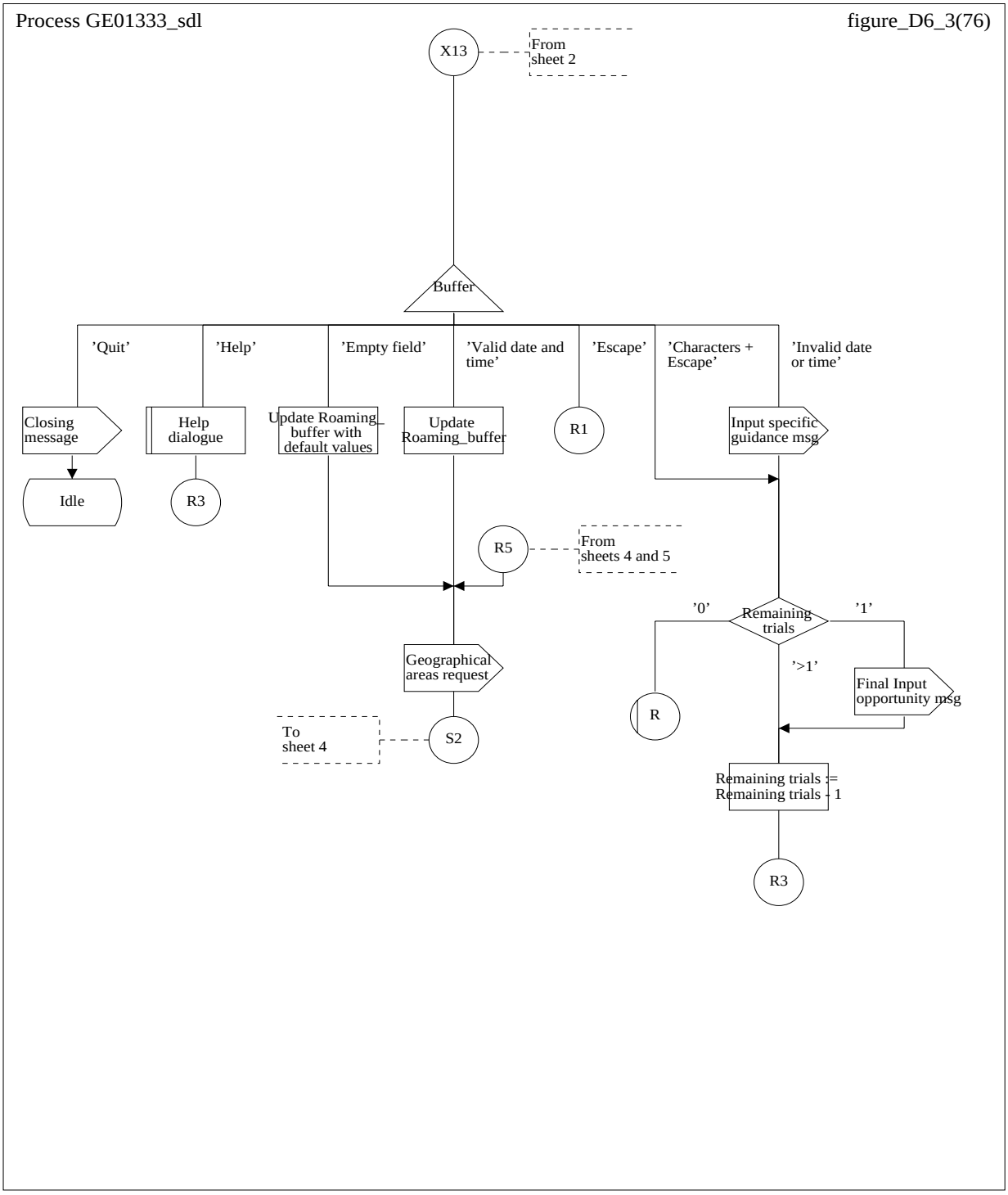


Figure D.6 (sheet 3 of 6): Roaming dialogue

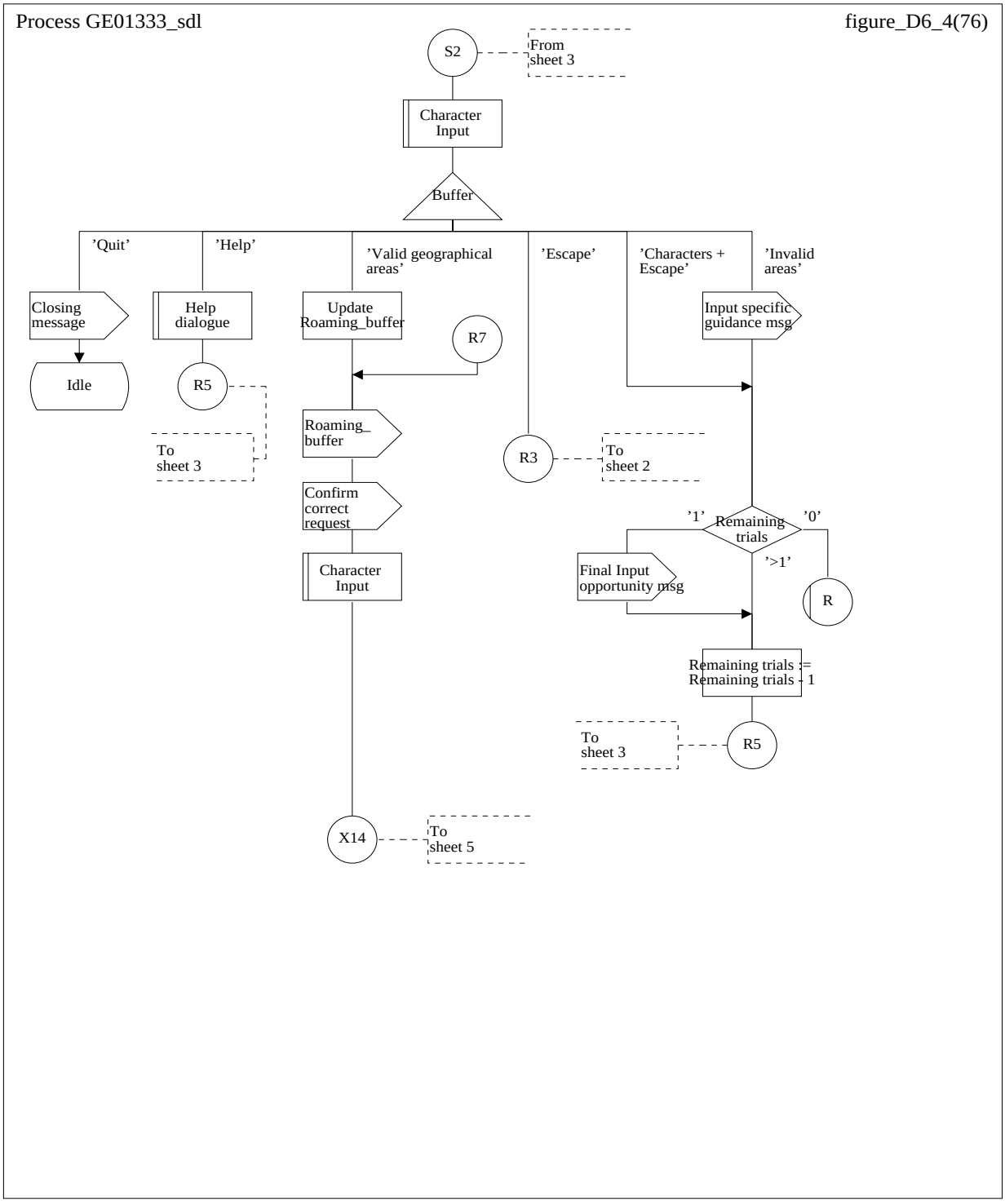


Figure D.6 (sheet 4 of 6): Roaming dialogue

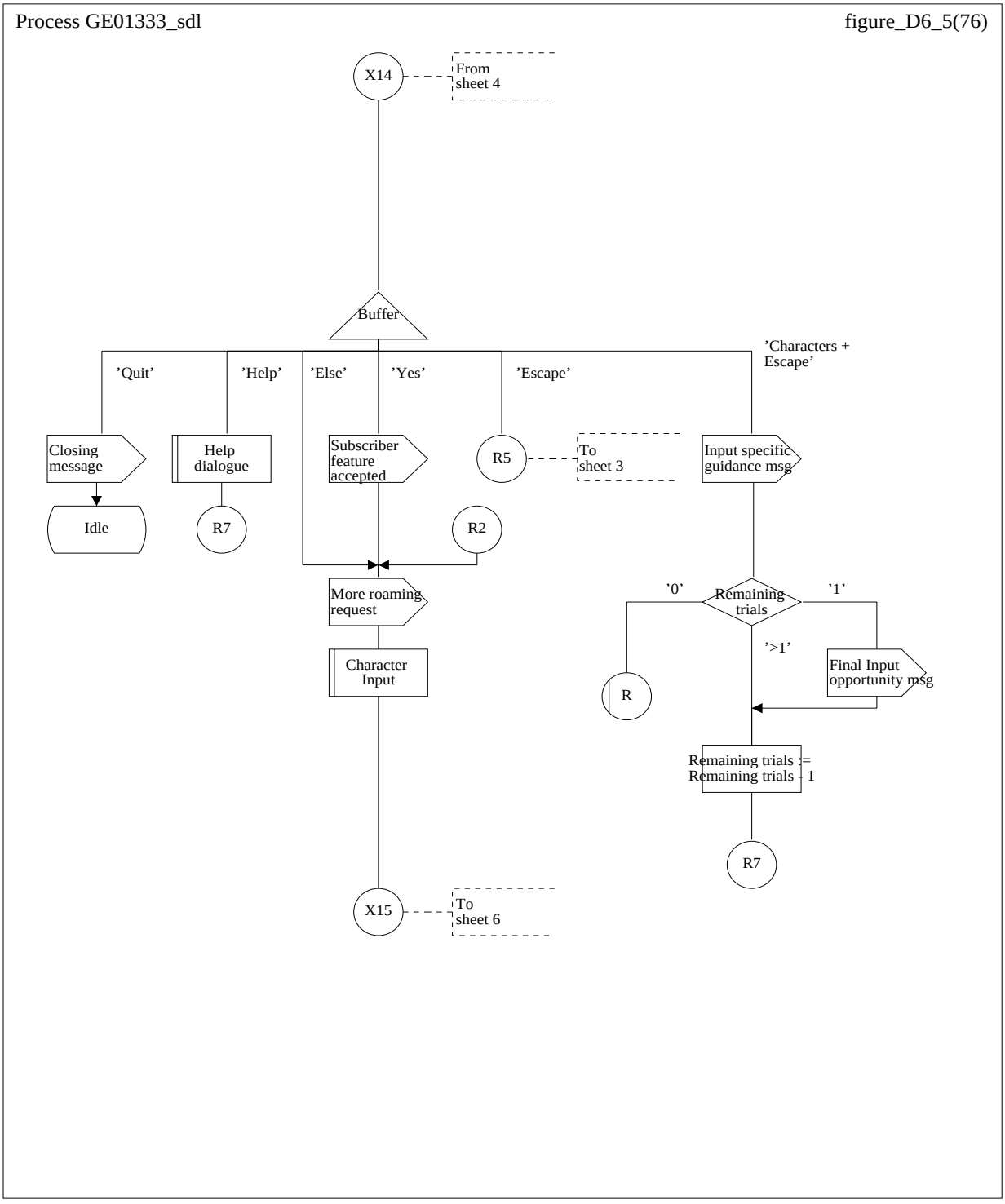


Figure D.6 (sheet 5 of 6): Roaming dialogue

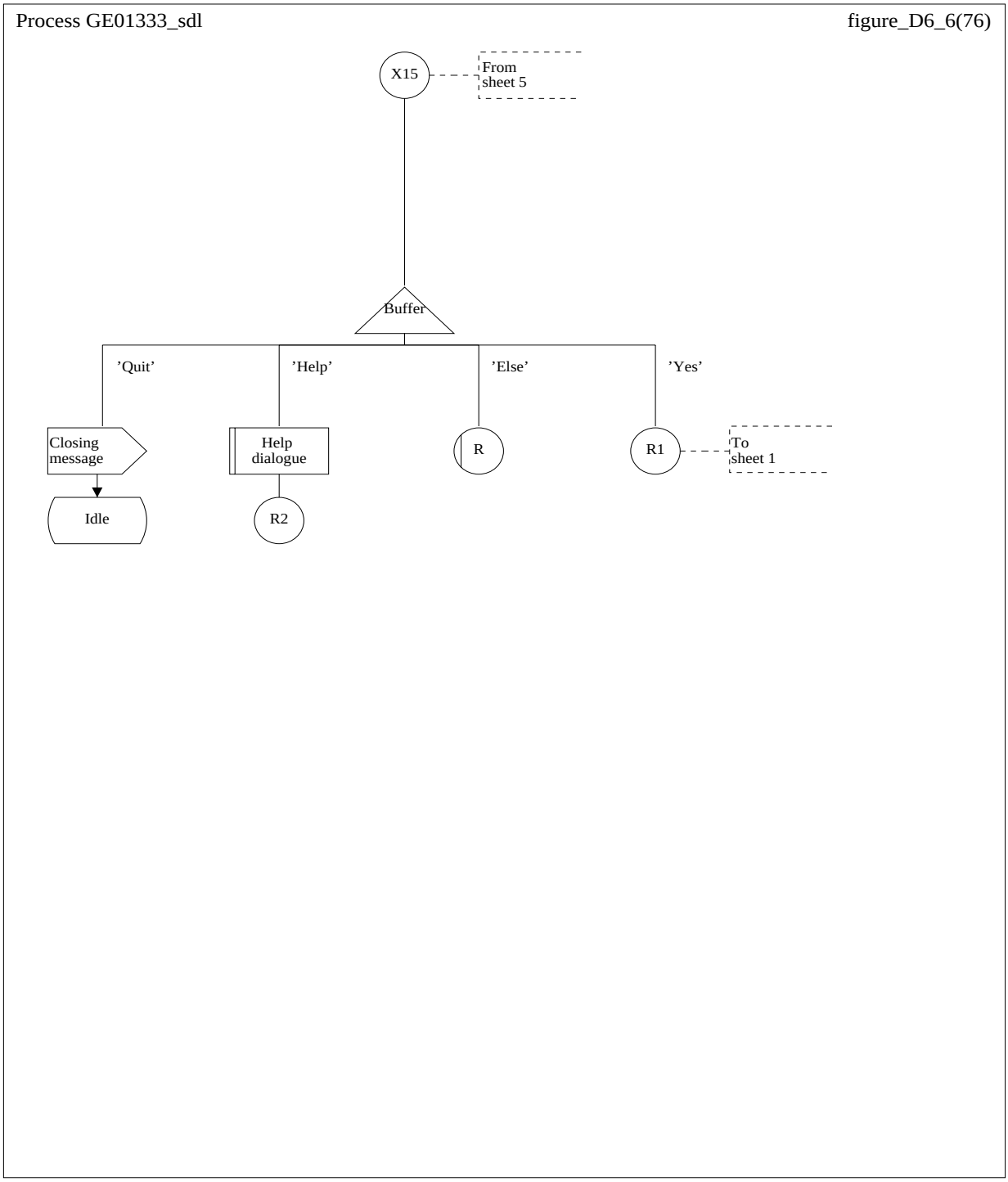


Figure D.6 (sheet 6 of 6): Roaming dialogue

Annex E (normative): PNC I4 ROSE operations

E.1 General

The following PNC I4 ROSE operations are defined:

Table E.1: ROSE operations

I4 ROSE OPERATION	OPERATION PARAMETER	OPERATION ACK
Pager Information	PG-info-Par	PG-info-Ack
Choice of Destination	CH-dest-Par	CH-dest-Ack
Page Request	PG-req-Par	PG-Req-Ack
Transmit	Transmit-Par	Transmit-Ack
Roaming Validation	Ro-Valid-Par	Ro-Valid-Ack
Roaming Reset	Ro-Reset-Par	Ro-Reset-Res
Roaming Information	Ro-Infor-Par	Ro-Info-Ack
Change Roaming	Ro-Change-Par	Ro-Change-Ack
Confirm Change of Roaming	Ro-Confirm-Par	Ro-Confirm-Res
Call Diversion Start	Divert-start-Par	Divert-start-Res
Call Diversion Stop	Divert-Stop-Par	Divert-Stop-Res

The operations and associated parameters are defined in the following tables. The data formats are specified in Annex F.

E.1.1 Pager information operation

Table E.2 details the parameter within a Pager Information Operation

Table E.2: Operation parameters

Parameter	Parameter Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC for which information is required

+ see Annex F.

E.1.1.1 Pager information operation - positive result

Table E.3 lists the parameters which may be included within a positive result to a pager information operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present depending on the SFs for the pager.

Table E.3: Positive result parameters

Choice Element	Param-eter	Param. Type+	Subsid. info. *	Presence in SDU	Description
MTB			Y TBT	MC (NOTE 1)	Mobile invoked Temporary barring
DAdC	DAdC	Octet string	N	MC (NOTE 1)	AdC to which calls are to be diverted
PAGER				MC (NOTE 1)	Pager Information (Params. as below)
	PT	Intg.	N	M	Pager Type (Tone, Num.,Alpha.,Trans.)
	MC	Intg.	N	O (NOTE 2)	Maximum message length for pager
	STS	Bool.	N	M	Status of mobile sub's service area
	CL	Bool.	Y LCL	O	Legitimisation req-uired for all calls
	CD	Bool.	N	O	Choice of destinat-ion of calls(NOTE3)
	PR1	Bool.	Y PR1L	O	Priority 1 calls (NOTE 4)
	PR3	Bool.	N	O	Priority 3 calls (NOTE 5)
	UR	Bool.	Y URL	O	Urgent message ind-icator

continued

Yes, N = No, M = Mandatory, O = Optional.
+ see Annex F.
* See table E.4 of subsidiary information.

Table E.3 (concluded): Positive result parameters

Choice Element	Param-eter	Param. Type+	Subsid. info. *	Presence in SDU	Description
	DD	Bool.	Y DDT	O	Deferred delivery (NOTES 5,6)
	MDD	Bool.	Y DDM	O	Mobile invoked Deferred delivery
	ST	Bool.	Y MST	O	Standard Text mess-ages (NOTES 5,6)
	RP	Bool.	Y RPL	O	Repetition (NOTE 5)
	RC	Bool.	Y RCL	O	Reverse charging
	GAdC	Bool.	N	O	Flag denoting AdC is a Group AdC

Y = Yes, N = No, M = Mandatory, O = Optional
+ see Annex F
* See table E.4 of subsidiary information

NOTE 1: A MTB, DAdC or a PAGER choice element shall be present (with their respective associated data parameters, if applicable)

NOTE 2: This parameter shall be present if the pager type is not tone-only.

NOTE 3: Choice of destination is not possible if the call has been initiated as the result of a call being diverted from another pager.

NOTE 4: Priority 1 messages cannot be accepted if the mobile has invoked DD.

NOTE 5: This feature could vary between MSs for a given PNC-H or could be available as a standard feature for all MSs for a given PNC-H. If it is a standard feature then there is no need to transfer this parameter for each pager. The availability of such standard features could be in a parameter file (held at each PNC) of the standard facilities available for all other PNCs within the ERMES network.

NOTE 6: Information on the maximum acceptable (deferral time /text list number) may also be included with this data element, but this information may alternatively be agreed between operators as a global limit(s) held in a local parameter file to be applied to all calls using this feature input to the PNC-I for the applicable PNC-H.

General Note:

The pager may have other SFs, some only available within the Home Network, others which are permanently or temporarily subscribed to by the mobile subscriber , but which are always invoked and therefore there is no need to advise the PNC-I of the details of such features.

Table E.4 lists the parameters which may be included within a positive result to a pager information operation, but may only be present if the relevant associated parameter is present within the result data. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present depending on the SFs for the pager.

Table E.4: Subsidiary information associated with positive result parameters

Parameter	Ass. Param. (NOTE 1)	Presence in SDU	Description
LCL	CL	O	Legitimisation Code (for all calls)
PR1L	PR1	O	Legitimisation Code (for Priority 1)
URL	UR	O	Legitimisation Code (for Urg.mess.ind.)
DDT	DD	O	Maximum deferral time for MS message
DDM	MDD	O	Deferred delivery MS message
TBT	MTB	O (NOTE 2)	End of Temporary barring time
TBM	MTB	O (NOTE 2)	Temporary barring MS message
MST	ST	O	Maximum allowable text list number
RPL	RP	O	Legitimisation code (for Repetition)
RCL	RC	O	Legitimisation code (for Rev. charging)

O = Optional

NOTE 1: See the table E.3 of positive result parameters.

NOTE 2: Either a TBT or a TBM parameter shall be present (or neither).

E.1.1.2 Pager information operation - negative result parameters

The following error parameters may be returned within a negative result to a pager information operation:

AdC not valid - An indication that the AdC within the operation request is not valid;

AdC out of service - An indication that the AdC is temporarily out of service;

Low network status - An indication that the availability or transmission delay within the service area for the AdC is below the call acceptance threshold.

E.1.2 Choice of destination operation

Table E.5 lists the parameters which may be included within a choice of destination operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present depending on the pager features invoked by the calling party.

Table E.5: Operation parameters

Param.	Param. Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC to be paged
GAs	Octet string	Mandatory	List of additional GAs requested by the calling party

+ see Annex F

E.1.2.1 Choice of destination operation (positive result)

Table E.6 lists the parameters which may be included within a Choice of Destination Operation Positive Result. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present depending on the pager features invoked by the calling party.

Table E.6: Positive result parameters

Param-eter	Param. Type+	Presence in SDU	Description
ST	Bool.	Mandatory	Combined status of the MS's service area and the GAs requested within the choice of destination oper.

+ see Annex F

E.1.2.2 Choice of destination operation (negative result)

The following error parameters may be returned within a negative result to a choice of destination operation:

AdC not valid - An indication that the AdC within the operation request is not valid;

AdC out of service - An indication that the AdC is temporarily out of service;

GAs not valid - An indication that one (or more) of the GAs within the operation request is not valid;

Low network status - An indication that the availability or transmission delay within the service area for the AdC is below the call acceptance threshold.

E.1.3 Page request operation

Table E.7 lists the parameters which may be included within a page request operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present depending on the pager features invoked by the calling party.

Table E.7: Operation parameters

Param-eter	Choice element	Param. Type+	Presence in SDU	Description
AdC1		Octet string	M	First Adc to be paged
AdCn		Octet string	O (NOTE 1)	List of AdCs within grp.call Pg.Req.
PT		Intg.	M	Pager Type (Tone, Num.,Alpha.,Trans.)
	TO	Bool.	MC (NOTE 2)	Flag to indicate tone-only pager
	ST	Intg.	MC (NOTE2,3)	Standard text message req.(+text no.)
	PM	Octet string	MC (NOTE 2)	Message
GAs		Octet string	O	GAs requested in in Choice dest. SS.
PR		Intg.	O	Priority 1 or 3 call request
UR		Bool.	O	Urgent message indicator requested
DD		I4Time	O	Deferred delivery req. (+ del. time)
RP		Bool.	O	Repetition requested
RC		Bool.	O (NOTE 3)	Reverse charging requested

M = Mandatory, MC = Mandatory Choice, O = Optional
+ see Annex F

NOTE 1: AdCn parameter(s) shall only be present if the page request operation is for a group call.

NOTE 2: A PM, or an ST, or a TO parameter shall be present (ASN.1 choice elements - see Annex F).

NOTE 3: Standard text messages and Reverse charging are not possible for a page request operation for a group call.

E.1.3.1 Page request operation (positive result)

An acknowledgement parameter is included within a positive result to a page request operation.

If any AdCs within the page request (for a group call operation) are invalid then they shall be indicated in an error report within the positive result.

E.1.3.2 Page request operation (negative result)

The following error parameters may be returned within a negative result to a page request operation.

All AdCs not valid - An indication that all AdCs (or one if only one AdC was included) within the operation are invalid.

E.1.4 Transmit operation

Table E.8 lists the parameters which may be included within a transmit operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present depending on the pager features invoked by the calling party.

Table E.8: Operation parameters

Choice element	Param-eter	Param. Type+	Presence in SDU	Description
	RIC1	Octet string	M	First RIC to be paged
	NL	Intg.	O (NOTE 1)	Transmit Cycles for RIC1 (NL value)
	SM1	Octet string	O (NOTE 2)	Transmit Subsequ. for RIC1 (SM mask)
	FSN1	Intg.	M	Frequency Sub-set Number for RIC1
	AF1	Intg.	M	Alert function for RIC1
	MN1	Intg.	M	Message number for RIC1
	GAs1	Octet string	M	List of GAs in which to page RIC1
	MSI1	Bool.	O	Message split indicator for RIC1
	PR1	Intg.	O	Priority 1 or 3 call requested
	UMI1	Bool.	O	Urgent message ind-icator requested

continued

M = Mandatory, O = Optional
+ see Annex F

NOTE 1: This parameter shall only be included if the transmission cycles in which the call may be transmitted differ from the default value of NL=2.

NOTE 2: This parameter shall only be included if there is a restriction on the transmission sub-sequences in which the call may be transmitted. (For most pagers there is no restriction).

Table E.8 (concluded): Operation parameters

Choice element	Param-eter	Param. Type+	Presence in SDU	Description
	RICn	Octet string	O (NOTE 3)	list of RICs for grp call Operation
	TCn	Intg.	O (NOTE 1)	Transmit Cycles for RICn (NLn value)
	TSn	Octet string	O (NOTE 2)	Transmit Subsequ for RICn (SMn mask)
	FSNn	Intg.	O (NOTE 4)	Frequency Sub-set Number for RICn
	AFn	Intg.	O (NOTE 4)	Alert function for RICn
	MNn	Intg.	O (NOTE 4)	Message number for RICn
	GAsn	Octet string	O (NOTE 4)	List of GAs in which to page RICn
	MSIn	Bool.	O	Message split indicator for RICn
	PRn	Intg.	O	Priority 1 or 3 call requested
	UMIn	Bool.	O	Urgent message ind-icator requested
	ECN	Intg.	M	ERMES Code Number for pager(s)
	PT	Intg.	M	Pager Type (Tone, Num.,Alpha.,Trans.)
TO		Bool.	MC (NOTE 5)	Flag to indicate tone-only pager
AT		Bool.	MC (NOTE5,6)	Automatic transm. of last mess. No.)
PM		Octet string	MC (NOTE 5)	Message

M = Mandatory, MC = Mandatory Choice, O = Optional
\+ see Annex F

NOTE 1: This parameter shall only be included if there is a restriction on the transmission cycles in which the call may be transmitted differ from the default value of NL=2.

NOTE 2: This parameter shall only be included if there is a restriction on the transmission sub-sequences in which the call may be transmitted. (For most pagers there is no restriction).

NOTE 3: RICn parameter(s) and associated parameters shall only be present if the transmit operation is for a group call.

NOTE 4: These parameters shall be present if an RICn parameter is present.

NOTE 5: A PM, or an AT, or a TO parameter shall be present (ASN.1 choice elements - see Annex F)

NOTE 6: Automatic transmission of the last message number is not applicable to group call transmit operations.

E.1.4.1 Transmit operation (positive result)

An acknowledgement parameter is included within a positive result to a transmit operation.

If any RICs within the transmit operation (for a group call operation) are invalid then they shall be indicated in an error report within the positive result.

E.1.4.2 Transmit operation (negative result)

The following error parameter be returned within a negative result to a transmit operation.

All RICs not valid - An indication that all RICs (or one if only one RIC was included) within the operation are invalid.

GAs not valid - An indication that one (or more) of the GAs within the operation request is not valid.

E.1.5 Roaming validation operation

Table E.90 lists the parameters which may be included within a roaming validation operation. The parameters listed as mandatory shall always be present.

Table E.9: Operation parameters

Parameter	Parameter Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC for which transactn. is requested
AC	Octet string	Mandatory	Authentication Code

+ see Annex F

E.1.5.1 Roaming validation operation (positive result)

An acknowledgement parameter is included within a positive result to a roaming validation operation.

E.1.5.2 Roaming validation operation (negative result)

The following error parameters may be returned within a negative result to a roaming validation operation.

AdC not valid - An indication that the AdC within the operation request is not valid.

AdC out of service - An indication that the AdC is temporarily out of service.

Authentication fail - An indication that the Authorisation Code included within the operation is not valid.

E.1.6 Roaming reset operation

Table E.10 lists the parameters which may be included within a roaming reset operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present.

Table E.10: Operation parameters

Para-meter	Parameter Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC for which transactn. is requested

+ see Annex F

E.1.6.1 Roaming reset operation (positive result)

An acknowledgement parameter is included within a positive result to a roaming reset operation.

E.1.6.2 Roaming reset operation (negative result)

The following error parameter may be returned within a negative result to a roaming reset operation.

AdC not valid - An indication that the AdC within the operation request is not valid.

E.1.7 Roaming information operation

Table E.11 lists the parameters which shall be included within a roaming information operation.

Table E.11: Operation parameters

Param-eter	Parameter Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC for which informatn. is requested

+ see Annex F

E.1.7.1 Roaming information operation (positive result)

Table E.12 lists the parameters which may be included within a roaming information request operation positive result.

Table E.12: Positive result parameters

Param-eter	Param. Type+	Presence in SDU	Description
GA1	Octet string	O	1st GA for which a roaming record exists
ST1	I4Time	O (NOTE 1)	Start time for roaming in GA1
SP1	I4Time	O (NOTE 1)	Stop time for roaming in GA1
A list with the same parameters as for GA1 follows, for all GAs for which a roaming record exists for the AdC referenced			

M = Mandatory, O = Optional
+ see Annex F.

NOTE 1: These parameters shall be present if a GA1 parameter is included in the operation result.

E.1.7.2 Roaming information operation (negative result)

The following error parameter may be returned within a negative result to a roaming information operation.

AdC not valid - An indication that the AdC within the operation request is not valid.

E.1.8 Change roaming operation

The change roaming operation does not result in the change of the MS's roaming records, but only allows him to see what the result of the changes requested in his roaming records would be. The MS roaming records are only changed as the result of a confirm change of roaming operation.

Table E.13 lists the parameters which may be included within a change roaming operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present.

Table E.13: Operation parameters

Param-eter	Param. Type+	Presence in SDU	Description
AdC	Octet string	M	AdC for which ch.of roaming is requestd
GA1	Octet string	M	1st GA to add to/ del. from mob.subs. roaming records
ST1	I4Time	M	Start time for change in GA1
SP1	I4Time	M	Stop time for change in GA1
A/D	Bool.	M	Add to/delete from mobile subs roaming
A list with the same parameters as for GA1 follows, for all GAs for which the mobile subscriber has requested changes			

M = Mandatory, O = Optional
+ see Annex F

E.1.8.1 Change roaming operation (positive result)

The positive result of a change roaming operation details the dates and times during which roaming shall be provided for those GAs affected by the information input by the MS. Other roaming records may exist, but are not detailed in the result.

Table E.14 lists the parameters which may be included within a change roaming request operation positive result. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present.

Table E.14: Positive result parameters

Param-eter	Param. Type+	Presence in SDU	Description
GA1	Octet String	O	1st GA affected by changes requested
ST1	I4Time	O (NOTE 1)	Start time for roaming in GA1
SP1	I4Time	O (NOTE 1)	Stop time for roaming in GA1
A list with the same parameters as for GA1 follows, for all GAs affected by the change roaming operation			

M = Mandatory, O = Optional
+ see Annex F

NOTE 1: These parameters shall be present if a GA1 parameter is included in the operation result. (No roaming GA records would exist if the MS has deleted all roaming as a result of the change roaming operation).

E.1.8.2 Change roaming operation (negative result)

The following error parameters may be returned within a negative result to a change roaming operation.

AdC not valid - An indication that the AdC within the operation request is not valid.

Error on GAs added - An indication that the roaming GA(s) included within the operation to be added to the MSs roaming record is (are) invalid.

Error on GAs deleted - An indication that the roaming GA(s) included within the operation to be deleted from the MSs roaming record is (are) invalid.

Error on start time - An indication that the start time(s) included within the operation is (are) invalid.

Error on stop time - An indication that the stop time(s) included within the operation is (are) invalid.

E.1.9 Confirm change of roaming operation

The confirm change of roaming operation results in the amendment of the MS roaming records held on the PNC-H of the MS.

Table E.15 lists the parameters which may be included within a confirm change of roaming operation. The parameters listed as mandatory shall always be present, the parameters listed as optional may or may not be present.

Table E.15: Operation parameters

Para-meter	Param. Type+	Presence in SDU	Description
AdC	Octet string	M	AdC for which ch.of roaming is confirmd
GA1	Octet string	M	1st GA to add to/ del. from mob.subs. roaming records
ST1	I4Time	M	Start time for change in GA1
SP1	I4Time	M	Stop time for change in GA1
A/D	Bool.	M	Add to/delete from mobile subs roaming
A list with the same parameters as for GA1 follows, for all GAs for which the mobile subscriber has confirmed changes			

+ see Annex F, M = Mandatory, O = Optional

E.1.9.1 Confirm change of roaming operation (positive result)

An acknowledgement parameter is included within a positive result to a confirm change of roaming operation.

E.1.9.2 Confirm change of roaming operation (Negative result)

The following error parameters may be returned within a negative result to a confirm change of roaming operation.

AdC not valid - An indication that the AdC within the operation request is not valid.

Error on GAs added - An indication that the roaming GA(s) included within the operation to be added to the MSs roaming record is (are) invalid.

Error on GAs deleted - An indication that the roaming GA(s) included within the operation to be deleted from the MSs roaming record is (are) invalid.

Error on start time - An indication that the start time(s) included within the operation is (are) invalid.

Error on stop time - An indication that the stop time(s) included within the operation is (are) invalid.

E.1.10 Call diversion start operation

The call diversion start operation is invoked by the PNC-H at the start of the period of call diversion requested by the MS, when the AdC of the pager to which calls are being diverted is not homed on the same PNC as the AdC from which calls are being diverted. It is used to inform the PNC-H of the AdC to which calls are to be diverted that call diversion has been initiated.

Table E.16 lists the parameters which may be included within a call diversion start operation.

Table E.16: Operation parameters

Parameter	Parameter Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC to which calls are being diverted
AdCD	Octet string	Mandatory	AdC from which calls are being divtd.

+ see Annex F

E.1.10.1 Call diversion start operation (positive result)

An acknowledgement parameter is included within a positive result to a Call Diversion Start operation.

E.1.10.2 Call diversion start operation (negative result)

The following error parameters may be returned within a negative result to a call diversion start operation.

AdC to not valid - An indication that the AdC to which calls are to be diverted is not valid.

AdC from not valid - An indication that the AdC from which calls are to be diverted is not valid.

E.1.11 Call Diversion stop operation

The call diversion stop operation is invoked by the PNC-H at the end of the period of call diversion requested by the MS, when the AdC of the pager to which calls are being diverted is not homed on the same PNC as the AdC from which calls are being diverted. It is used to inform the PNC-H of the AdC to which calls are being diverted that call diversion has ceased.

Table E.17 lists the parameters which may be included within a call diversion stop operation.

Table E.17: Operation parameters

Parameter	Parameter Type+	Presence in SDU	Description
AdC	Octet string	Mandatory	AdC to which calls were being diverted
AdCD	Octet string	Mandatory	AdC from which calls were being divtd.

+ see Annex F

E.1.11.1 Call diversion stop operation (positive result)

An acknowledgement parameter is included within a positive result to a Call Diversion Stop operation.

E.1.11.2 Call diversion stop operation (negative result)

The following error parameters may be returned within a negative result to a call diversion stop operation.

AdC to not valid - An indication that the AdC to which calls are to be diverted is not valid.

AdC from not valid - An indication that the AdC from which calls are to be diverted is not valid.

E.2 Negative result parameters common to all operations

The three error parameters listed below are common to all operations and may therefore be included within the negative result of any operation. The error results which are applicable for individual operation are listed within the description of the operation.

System failure - The requested operation cannot be performed by the PNC due to a system failure.

System overload - The requested operation cannot be performed by the PNC due to a processing overload condition.

Bad format - The requested operation cannot be performed by the PNC due to missing mandatory parameters within the operation request, an incorrect parameter value, or for other format-related reasons.

Annex F (normative): PNC I4 ROSE ASN.1 transcription

F.1 General

This Annex specifies the abstract syntax for the I4 Interface protocol using the Abstract Syntax Notation one (ASN.1), defined in CCITT Recommendation X.208 [20].

The encoding rules which are applicable to the defined abstract syntax are the Basic Encoding Rules for Abstract Syntax Notation one, defined in CCITT Recommendation X.209 [21].

For each I4 parameter which has to be transferred by a I4 Protocol Data Unit (PDU) (I4 message), there is a PDU field (an ASN.1 Named Type) whose ASN.1 identifier has the same name as the corresponding parameter, except for the differences required by the ASN.1 notation (blanks between words are replaced by a hyphen "-", the first letter of the first word is lower-case and the first letter of the following words are capitalised (e.g., "choice of destination" is mapped to choice-Of-Destination"). In addition some words may be abbreviated as follows:

info = information.
id = identity.
ms = mobile subscriber.

When a mandatory element is missing in any component or inner data structure, a reject component is returned (if the association still exists). The problem cause to be used is "Mis-typed parameter". When an optional element is missing in an invoke component or in an inner data structure when it is required by the context, an error component is returned; the associated type error is DataMissing.

F.2 Operation types ASN.1 specification

The ASN.1 specification of the operation types required for the I4 Interface is provided in the single ASN.1 module "I4-ROSE operations" which follows.

I4 ROSE OPERATIONS

```
ROSE DEFINITIONS ::=

BEGIN



OPERATION ::= INTEGER
      {
         pager-Information              (1),
         choice-Of-Destination          (2),
         page-Request                   (3),
         roaming-Validation             (4),
         roaming-Reset                  (5),
         roaming-Information            (6),
         change-Roaming                 (7),
         confirm-Change-Roaming         (8),
         call-Diversion-Start           (9),
         call-Diversion-Stop            (10),
         transmit                       (11)
      }



ERROR ::= INTEGER
      {
         adc-Not-Valid                  (1),
         adc-Out-Of-Service             (2),
         paging-Msg-Error               (3),
         system-Failure                 (4),
         system-Overload                (5),
         bad-Format                     (6),
         all-Adc-Not-Valid              (7),
         all-Ric-Not-Valid              (8),
         gas-Not-Valid                  (9),
         authentic-Fail                 (10),
         low-Network-Status             (11),
         adc-From-Not-Valid             (12),
         adc-To-Not-Valid               (13),
         error-On-Gas-Add               (14),
         error-On-Gas-Del               (15),
         error-On-Start-Time            (16),
         error-On-Stop-Time             (17)
      }
```

```
PG-Info-Par ::= PG-Address

PG-Info-Ack ::= CHOICE
        {
           temporary-barring        [0] MTB,
           divert-adc           [1] Address-Code,
           pager                [2] Pager
        }

CH-Dest-Par         ::= SEQUENCE
        {
           adc                  [0] Address-Code,
           gas                  [1] Geo-Areas
        }


CH-Dest-Ack         ::= SEQUENCE
        {
           availability-gas     [0] BOOLEAN
        }

PG-Req-Par ::= SEQUENCE
        {
           adc-1                        [0] Address-Code,
           adc-n                [1] IMPLICIT SEQUENCE OF Address-Code OPTIONAL,
           pager-type           [2] Pager-Type,
           message              [3] Pager-Message,
           gas                  [4] Geo-Areas OPTIONAL,
           priority             [5] INTEGER
                                        {
                                        prio1           (1),
                                        not-used        (2),
                                        prio3           (3)
                                        } OPTIONAL,
           urgent-indic                 [6] BOOLEAN OPTIONAL,
           def-delivery                 [7] I4-Time OPTIONAL,
           repeat               [8] BOOLEAN OPTIONAL,
           rev-charging                 [9] BOOLEAN OPTIONAL
        }



PG-Req-Ack::= SEQUENCE
        {
           general-result       [0] BOOLEAN,
           result-per-ms        [1] IMPLICIT SEQUENCE OF MS-Result OPTIONAL
        }

RO-Valid-Par        ::= SEQUENCE
        {
           adc                  [0] Address-Code,
           ac                   [1] Authentic-Code
        }

RO-Valid-Res        ::= INTEGER (0)

RO-Reset-Par        ::= PG-Address

RO-Reset-Res        ::= INTEGER (0)
```

```
RO-Info-Par          ::= PG-Address

RO-Info-Ack          ::= RO-Info-Type

RO-Change-Par        ::= RO-Change-Type

RO-Change-Ack        ::= RO-Info-Type

RO-Confirm-Par       ::= RO-Change-Type

RO-Confirm-Res       ::= INTEGER (0)

Divert-Start-Par     ::= Divert-Type

Divert-Start-Res     ::= INTEGER (0)

Divert-Stop-Par              ::= Divert-Type

Divert-Stop-Res      ::= INTEGER (0)

Transmit-Par         ::= SEQUENCE
        {
           ric-1                [0] Ric-Record,
           ric-n                [1] IMPLICIT SEQUENCE OF Ric-Record OPTIONAL,
           ecn                  [2] INTEGER,
           pt                   [3] Pager-Type
           pm                   [4] Transmit-Message
        }

Transmit-Ack         ::= SEQUENCE
        {
           general-result       [0] BOOLEAN,
           result-per-ric               [1] IMPLICIT SEQUENCE OF Ric-Result OPTIONAL
        }


PG-Address ::= SEQUENCE
        {
           adc                  [0] Address-Code
        }

Pager          ::= SEQUENCE
        {
           pager-type           [0] Pager-Type,
           max-length           [1] INTEGER OPTIONAL,
           status               [2] BOOLEAN,
           legitim-req          [3] Legim-Value OPTIONAL,
           choice-destination           [4] BOOLEAN OPTIONAL,
           priority-1           [5] Priority-1 OPTIONAL,
           priority-3           [6] BOOLEAN OPTIONAL,
           urgent-indic                 [7] Urgent OPTIONAL,
           deferred-delivery    [8] Def-Del OPTIONAL,
           ms-invoke-def-del            [9] Ms-Def-Delivery OPTIONAL,
           standard-text        [10] Standard Text OPTIONAL,
           repetition           [11] Repetition OPTIONAL,
           reverse-charging     [12] Rev-Charge OPTIONAL,
           group-flag           [13] BOOLEAN OPTIONAL
        }
```

```
Pager-Type          ::= INTEGER
        {
           tone          (1),
           numeric       (2),
           alpha                 (3),
           transparent           (4)
        }

Legim-Value         ::= SEQUENCE
        {
           legim-indic [0] BOOLEAN,
           legim-code  [1] I4-Legim-Code OPTIONAL
        }

Priority-1          ::= SEQUENCE
        {
           pr-1-indic  [0] BOOLEAN,
           legim-code  [1] I4-Legim-Code OPTIONAL
        }

Urgent                      ::= SEQUENCE
        {
           urgent-indic        [0] BOOLEAN,
           legim-code  [1] I4-Legim-Code OPTIONAL
        }

Def-del                     ::= SEQUENCE
        {
           def-del-indic       [0] BOOLEAN,
           def-del-time        [1] I4 time       OPTIONAL
           def-allow   [2] Def-Allow     OPTIONAL
         }
Standard Text               ::= SEQUENCE
        {
           st-indic    [0] BOOLEAN
           max-text-no         [1] INTEGER_
        }
Ms-Def-Delivery     ::= SEQUENCE
        {
           ms-def-indic        [0] BOOLEAN,
           ms-def-msg          [1] I4-Msg OPTIONAL
        }
Repetition          ::= SEQUENCE
        {
           rept-indic  [0] BOOLEAN,
           legim-code  [1] I4-Legim-Code OPTIONAL
        }
Rev-Charge          ::= SEQUENCE
        {
           rev-ch-indic        [0] BOOLEAN,
           legim-code  [1] I4-Legim-Code OPTIONAL
        }

Pager-Message       ::= CHOICE
        {
           tone-only   [1] BOOLEAN,
           standard-txt        [2] INTEGER,
           message     [3] I4-Msg
        }
```

```
Transmit-Message ::= CHOICE
        {
           tone-only   [1] BOOLEAN,
           auto-tx-l-mn        [2] BOOLEAN,
           message     [3] I4-Msg
        }

RO-Info-Type                ::= SEQUENCE
        {
           ro-info     [0] IMPLICIT SEQUENCE OF Def-Ro-Info
        }

RO-Change-Type  ::= SEQUENCE
        {
           adc         [0] Address-Code,
           ro-change   [1] IMPLICIT SEQUENCE OF Def-Ro-Change
        }

Divert-Type         ::= SEQUENCE
        {
           adc-to      [0] Address-Code,
           adc-from    [1] Address-Code
        }

Geo-Areas           ::= [0] IMPLICIT SEQUENCE OF Geo-Area


Ric-Record          ::= SEQUENCE
        {
           ric         [0] Radio-Id-Code,
           nl          [1] INTEGER OPTIONAL,
           sm          [2] OCTET STRING OPTIONAL,
           fsn         [3] INTEGER,
           af          [4] INTEGER,
           mn          [5] INTEGER,
           gas         [6] Geo-Areas,
           ms          [7] BOOLEAN OPTIONAL,
           priority-val [8] INTEGER
                               {
                               prio1           (1),
                               not-used        (2),
                               prio3           (3)
                               } OPTIONAL,
           ric-urgent  [9] BOOLEAN OPTIONAL
        }

Ric-Result          ::= SEQUENCE
        {
           ric         [0] Radio-Id-Code,
           unit-error  [1] INTEGER
        }

MTB                 ::= SEQUENCE
        {
           tbt         [0] I4-Time OPTIONAL,
           tbm         [1] I4-Msg OPTIONAL
        }
```

```
-- Def-Ro-Change is the roaming modification instruction

Def-Ro-Change     ::= SEQUENCE
      {
         ga          [0] Geo-Area,
         st          [1] I4-Time,
         sp          [2] I4-Time,
         add         [3] BOOLEAN
      }

-- Def-Ro-Info is the roaming status description

Def-Ro-Info       ::= SEQUENCE
      {
         ga          [0] Geo-Area OPTIONAL,
         st          [1] I4-Time OPTIONAL,
         sp          [2] I4-Time OPTIONAL
      }

MS-Result         ::= SEQUENCE
      {
         adc         [0] Address-Code,
         unit-error  [1] INTEGER
      }




Def-Allow         ::= SEQUENCE
      {
         def-deliv           [0] BOOLEAN OPTIONAL,
         max-allow-defer-time    [1] INTEGER,
      }

I4-Time                   ::= SEQUENCE
      {
         i4-day                  [0] INTEGER,
         i4-month            [1] INTEGER,
         i4-year             [2] INTEGER,
         i4-hour             [3] INTEGER,
         i4-min              [4] INTEGER,
         i4-sec                  [5] INTEGER
      }

Address-Code          ::= OCTET STRING (SIZE(1..20))

Geo-Area          ::= OCTET STRING (SIZE(1..20))

I4-Msg                    ::= OCTET STRING (SIZE(1..16900))

Radio-Id-Code         ::= OCTET STRING (SIZE(1..20))

Authentic-Code    ::= OCTET STRING (SIZE(1..20))

I4-Legim-Code         ::= OCTET STRING (SIZE(1..20))

END
```

ROSE ASSOCIATION

The following module describes the parameters associated with the Bind and Unbind PDUs.

```
I4-ASSOCIATION DEFINITIONS ::=

BEGIN

*ExtconPDU              ::=  CHOICE
      {
         bindArg          [1]     IMPLICIT I4-Bind-Param,
         bindRes          [2]     IMPLICIT I4-Bind-Conf,
         bindErr          [3]     IMPLICIT I4-Bind-Failure,
         unbindArg        [4]     IMPLICIT I4-Unbind-Param,
         unbindRes        [5]     IMPLICIT I4-Unbind-Confirm,
         unbindErr        [6]     IMPLICIT I4-Unbind-Failure
      }

I4-Bind-Param           ::= SEQUENCE
      {
         initiator-Id     [0]     Name,
         password         [1]     Password,
         operation        [2]     List-Of-Operations
      }

I4-Bind-Conf        ::= SEQUENCE
      {
         respid           [0]     Name,
         password         [1]     Password,
         operations       [2]     List-Of-Operations,
         connect-Time             [3]     Time-When-Connected
      }

I4-Bind-Failure         ::= SEQUENCE
      {
         failure-Reason   [0]     I4-Fail-Reason
      }

I4-Unbind-Param    ::= SEQUENCE
      {
         connect-Time             [3]     Time-When-Connected
      }

I4-Unbind-Confirm  ::= SEQUENCE
      {
         connect-Time             [3]     Time-When-Disconnected
      }

I4-Unbind-Failure  ::= SEQUENCE
      {
         failure-Reason   [0]     I4-Fail-Reason
      }

Name                    ::= SEQUENCE
      {
         operator         [0]     Operator OPTIONAL,
         bilateralAgreem  [1]     BilateralAgreem OPTIONAL,
         dataNetworkAddress       [2]     X121Address OPTIONAL
      }
```

```
Time-When-Connected             ::= UTCTime

Time-When-Disconnected ::= UTCTime

List-Of-Operations          ::= BIT STRING
      {
         pager-Information                (1),
         choice-Of-Destination    (2),
         page-Request             (3),
         roaming-Validation               (4),
         roaming-Reset            (5),
         roaming-Information              (6),
         change-Roaming           (7),
         confirm-Change-Roaming           (8),
         call-Diversion-Start             (9),
         call-Diversion-Stop              (10),
         transmit                 (11)
      }

-------------------------------------------------------------------------------------------------------------
-- I4-Fail-reason contains one of the error indications given in the following table.
-------------------------------------------------------------------------------------------------------------
--          Error Indication                -              Reason
-------------------------------------------------------------------------------------------------------------
--                                          -
--          not-entitled                    -    The responder is not entitled to accept a
--                                          -    request for an association between itself
--                                          -    and the initiator.
--                                          -
--          temporary-overload              -    The responder is not able to establish
--                                          -    an association due to temporary overload.
--                                          -
--          temporary-failure               -    The responder is not able to establish
--                                          -    an association due to a temporary failure
--                                          -    (having an impact on an upper layer).
--                                          -
--          incorrect-ID-or-Password        -    The responder shall not accept the request
--                                          -    to establish an association between
--                                          -    itself and the initiator due to incorrect
--                                          -    identity or password
--                                          -
--          not-supported                   -    The responder does not recognise the
--                                          -    telecommunication subsystem type of the
--                                          -    initiator or cannot support any of the
--                                          -    operations suggested on the association.
--                                          -
--          not-connected                   -    Used within an unbind failure response.
--                                          -
-------------------------------------------------------------------------------------------------------------

I4-Fail-Reason                  ::= INTEGER
      {
         not-Entitled                     (0),
         temporary-Overload               (1),
         temporary-Failure                (2),
         incorrect-ID-Or-Password         (3),
         not-Supported            (4),
         not-Connected            (5)
      }
```

```
Operator                ::= PrintableString (SIZE(0..20))

BilateralAgreem         ::= PrintableString (SIZE(0..20))

X121Address                     ::= NumericString   (SIZE(0..15))

Password                ::= PrintableString (SIZE(0..20))

END
```

Annex G (informative): Typical I6 dialogues for the input of calls

This Annex shows typical examples of dialogue through the I6 interface (some of which include SS dialogues). Figures G.1.1 to G.1.3 deal with access for call input with two-stage selection and interactive mode. Figures G.2.1 to G.2.3 deal with access for call input with one-stage selection and interactive mode.

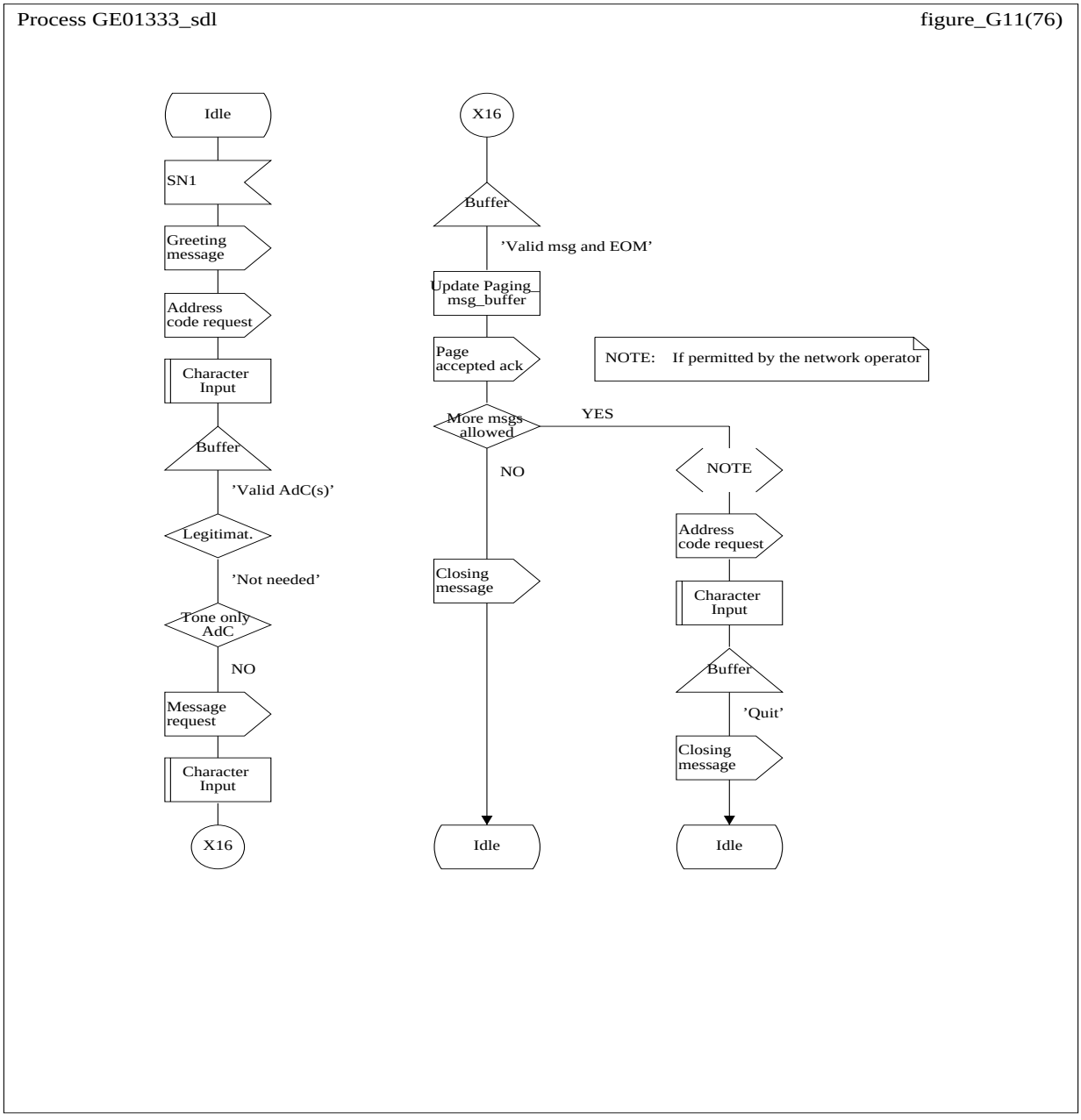


Figure G1.1: A typical two-stage selection call with no supplementary services

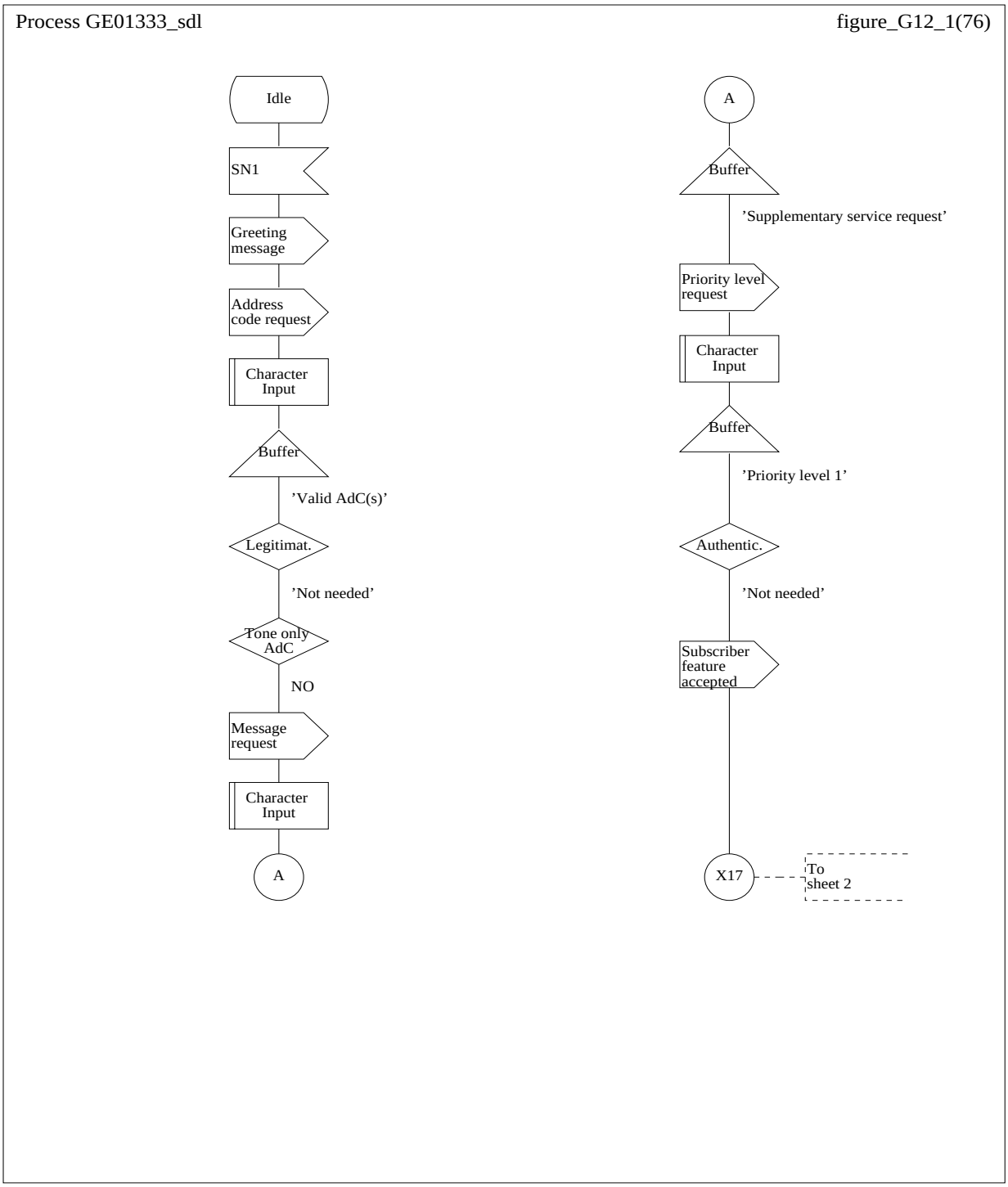


Figure G1.2 (sheet 1 of 2): A typical two-stage selection call with level 1 priority and standard text

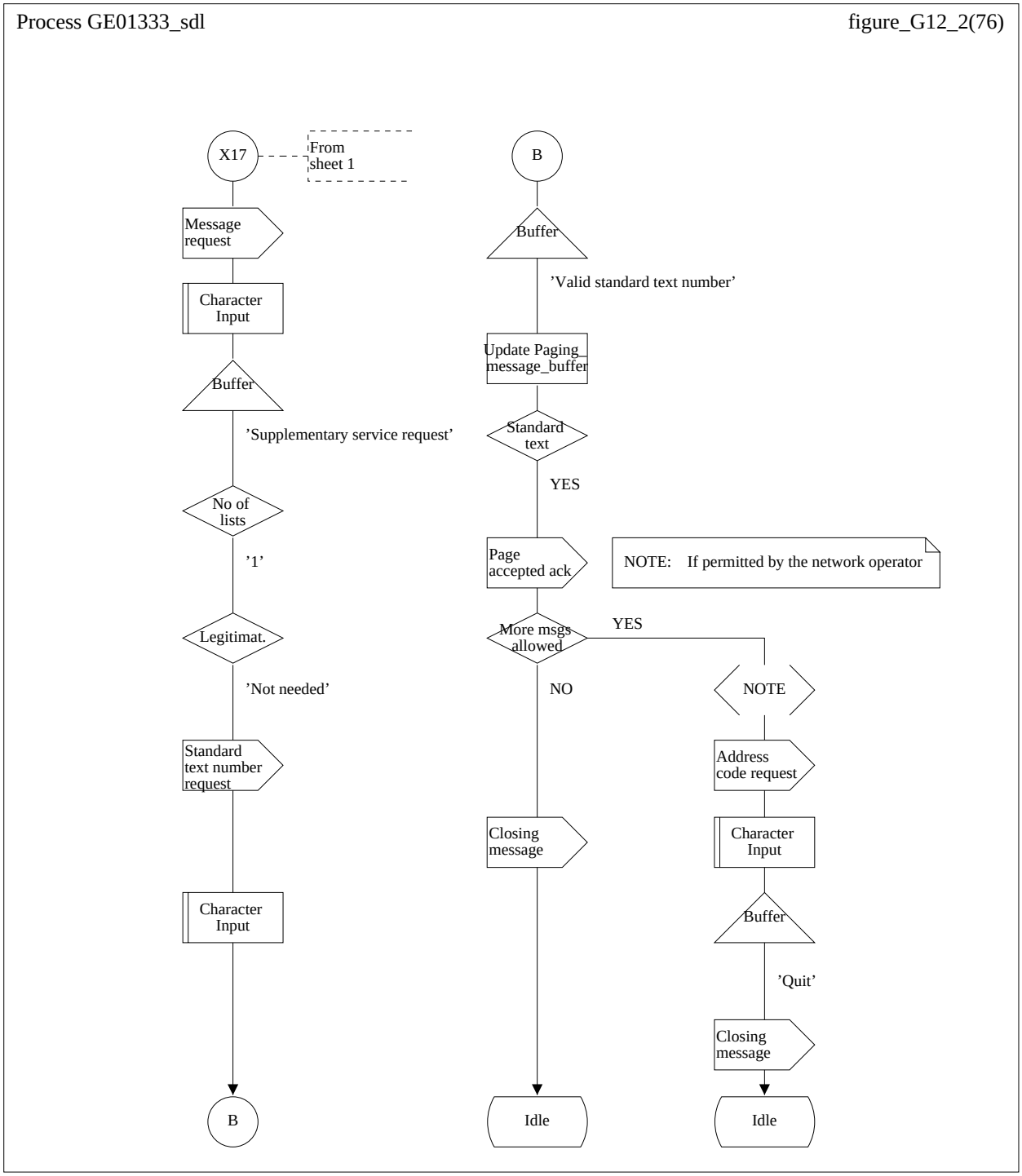


Figure G1.2 (sheet 2 of 2): A typical two-stage selection call with level 1 priority and standard text

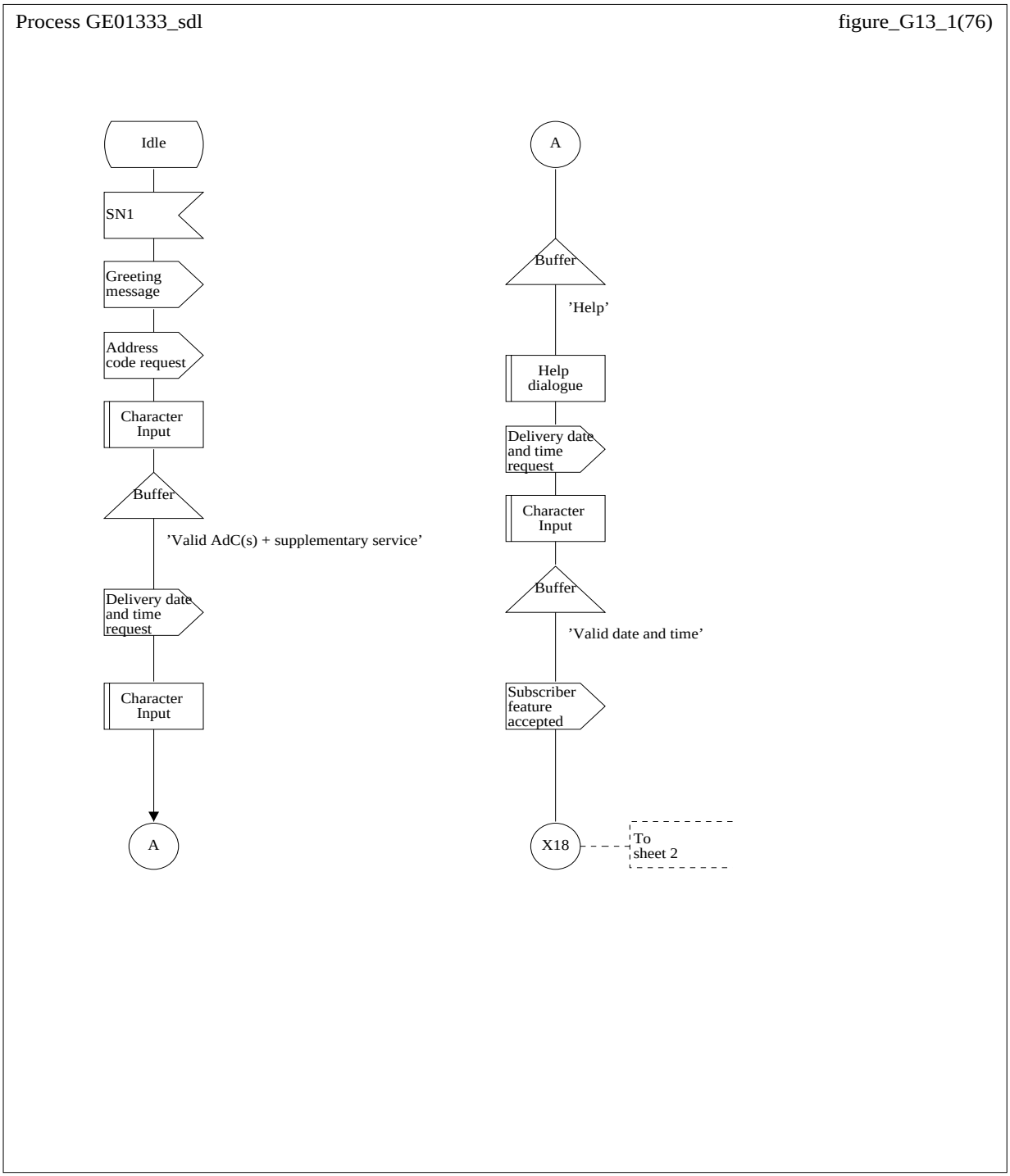


Figure G1.3 (sheet 1 of 2): A typical two-stage selection deferred dilivery tone only call with help facility

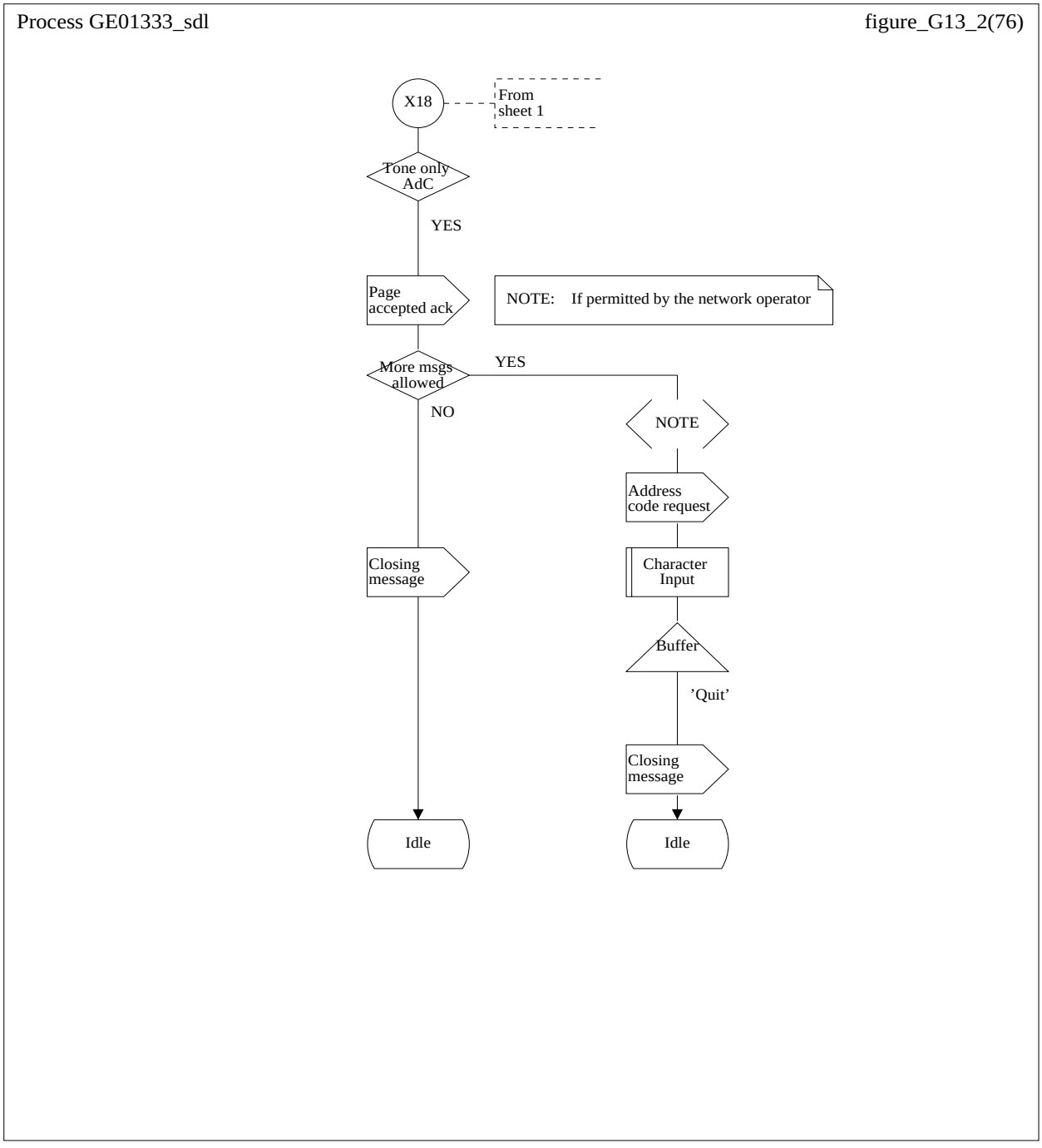


Figure G1.3 (sheet 2 of 2): A typical two-stage selection deferred dilivery tone only call with help facility

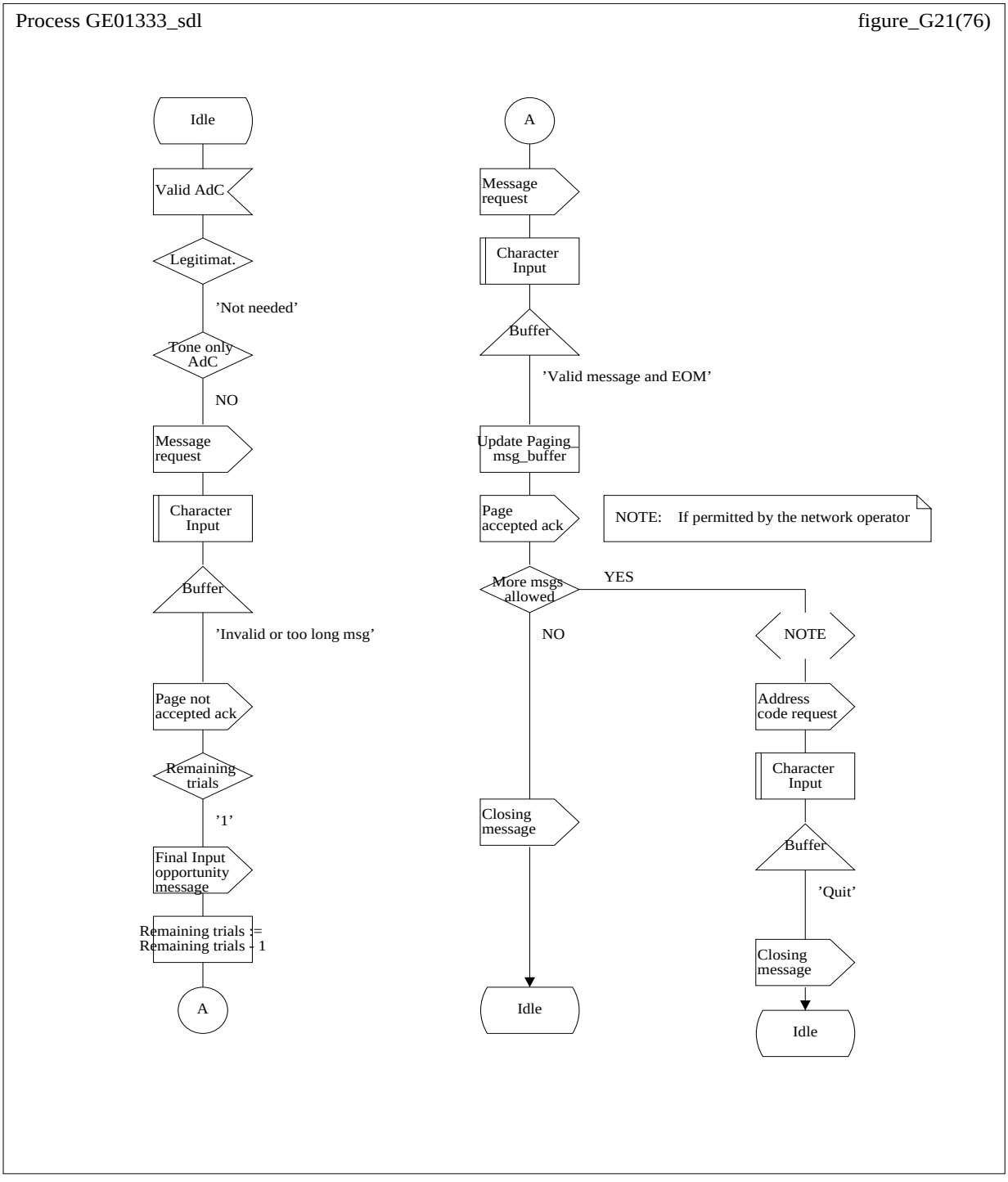


Figure G2.1: A typical one-stage selection protocol with a correction to the message

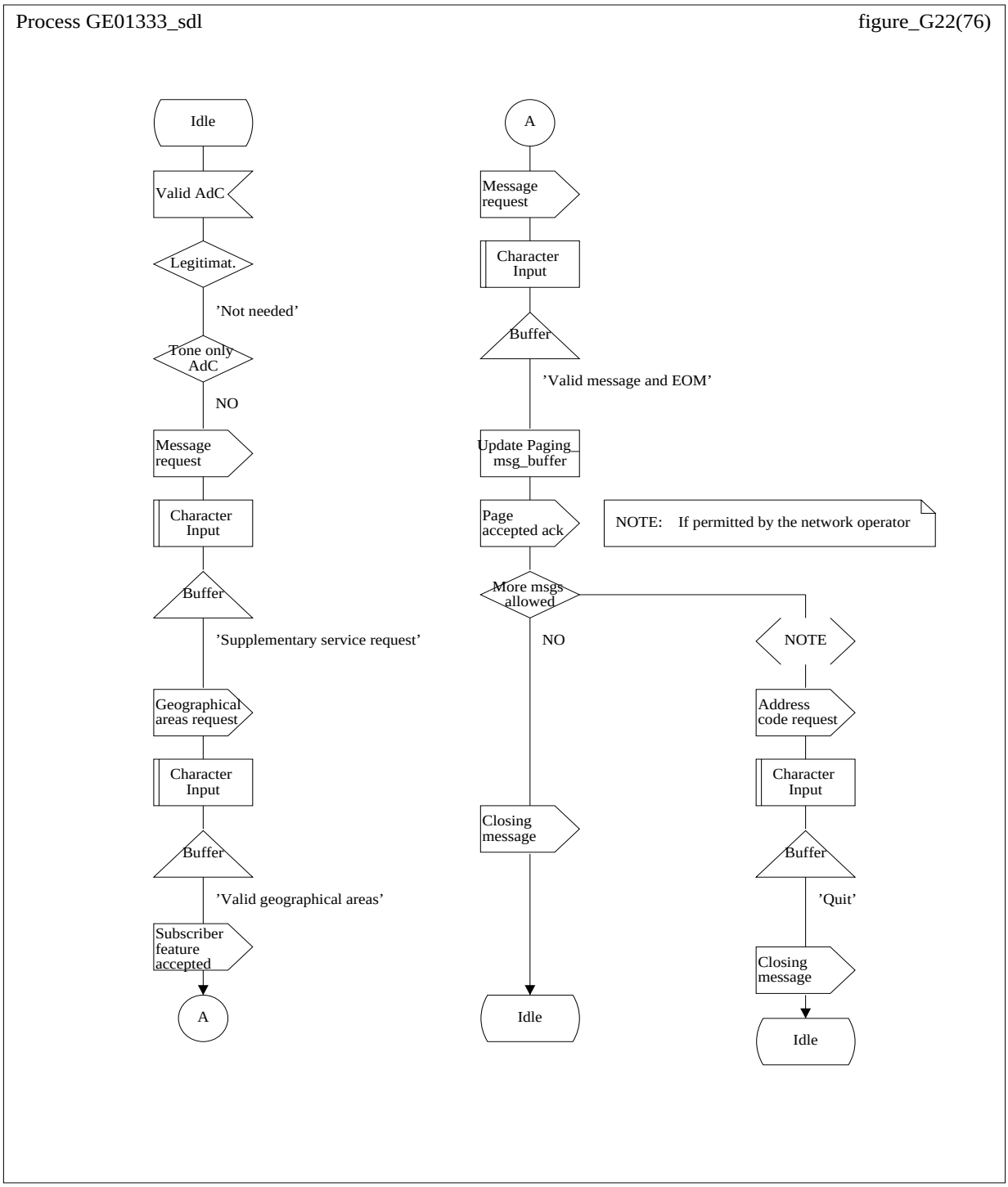


Figure G2.2: A one-stage selection call with choice of destination

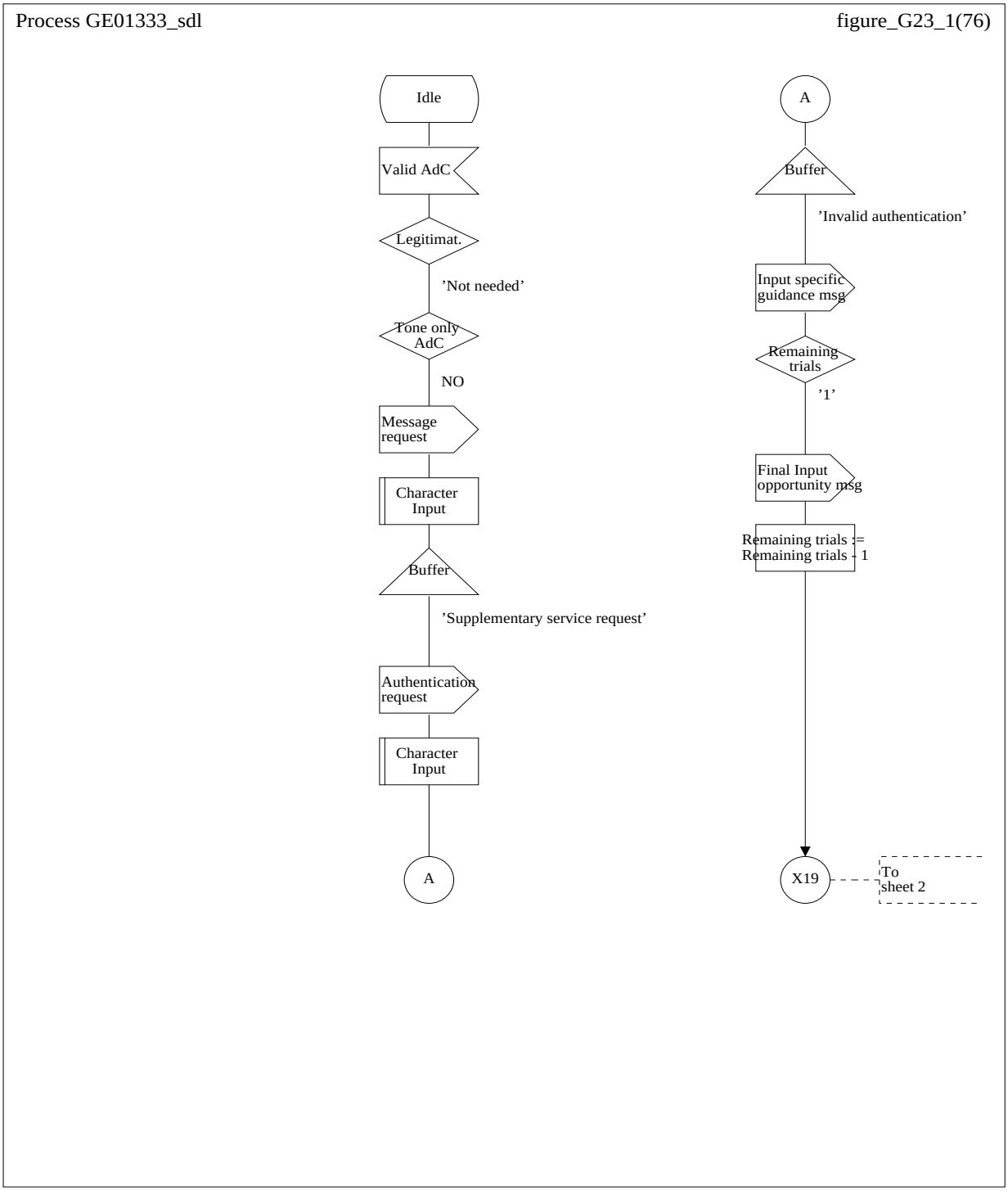


Figure G2.3 (sheet 1 of 2): A successful one-stage selection call with unsuccessful reverse charging request

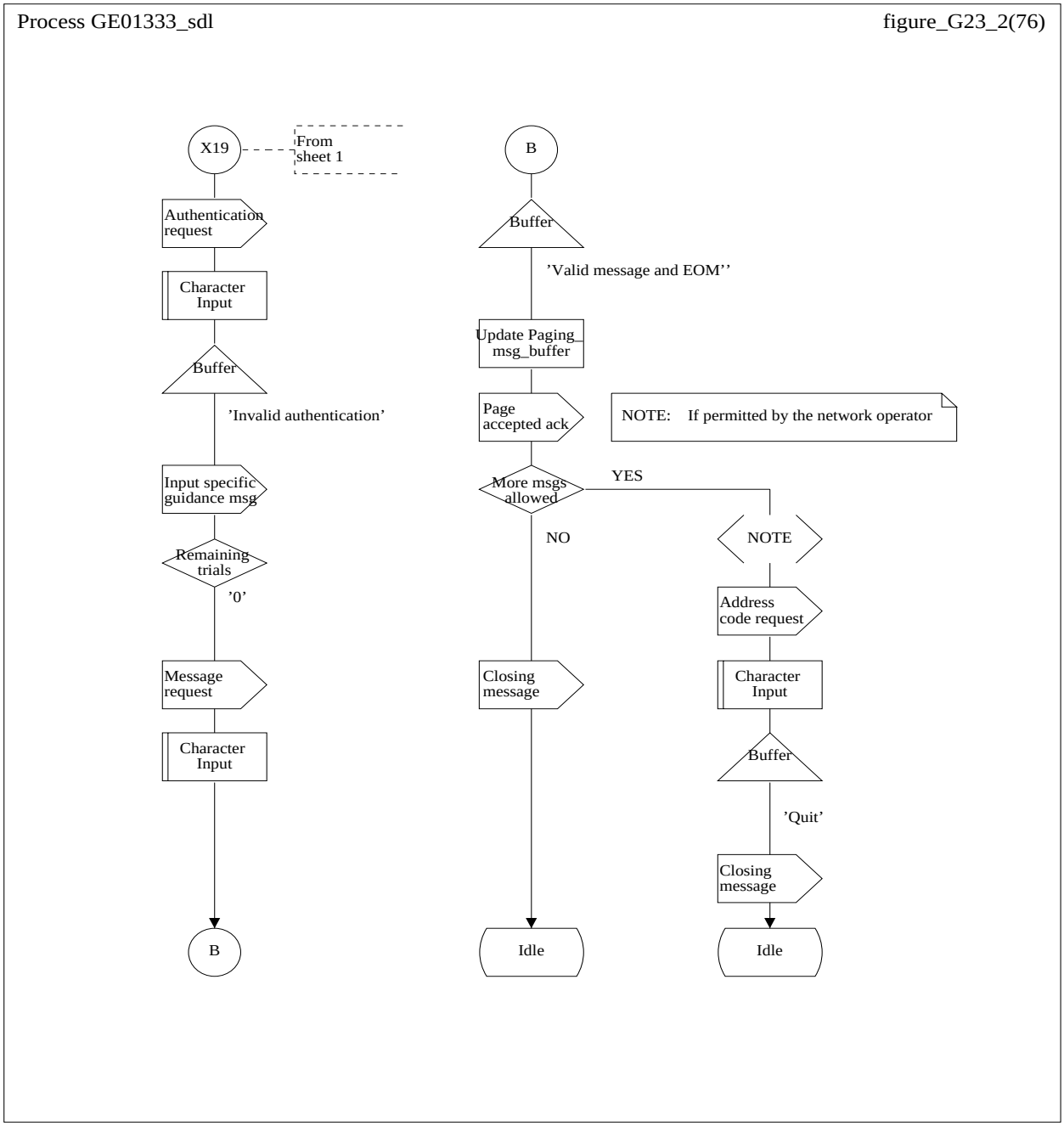


Figure G2.3 (sheet 2 of 2): A successful one-stage selection call with unsuccessful reverse charging request

History

Document history	
July 1992	First Edition
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