Technical Document TNA 134

Telecom ISDN User-Network Interface: Layer 3:

PART C

Generic Procedures for the Control of ISDN Supplementary Services


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TELECOM ISDN USER-NETWORK INTERFACE LAYER 3 PART C GENERIC PROCEDURES FOR THE CONTROL OF ISDN SUPPLEMENTARY SERVICES

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TELECOM ISDN USER-NETWORK INTERFACE LAYER 3 PART C GENERIC PROCEDURES FOR THE CONTROL OF ISDN SUPPLEMENTARY SERVICES

1 General

This part defines the generic procedures applicable for the control of supplementary services at the user-network interface. These procedures may be used for the invocation and operation of supplementary services in association with existing calls or independent of any existing call.

This Part is based on ITU-T Recommendation Q.932.

2 Overview of the generic protocols and of their scope

Three generic protocols are defined for the control of supplementary services at ISDN user-network interfaces. These protocols operate at layer 3 of the control plane at the S/T reference points, and assume that the use of layers 1 and 2 conforms to Recommendations I.430 [1], I.431 [2] and Q.921 [3]. In addition, the three generic protocols assume the existence of an established data link and use the acknowledged information transfer service available at the layer 2 to layer 3 interface.

2.1 Three generic protocols

Three generic protocols are defined for the control of supplementary services, two of which are stimulus, the third being functional; these protocols are:

- the Keypad protocol;
- the Feature key management protocol; – the Functional protocol.

2.1.1 Stimulus protocols

2.1.1.1 Keypad protocol

The Keypad protocol is based on the use of the Keypad facility and Display information elements. The Keypad facility information element may be included in the SETUP and INFORMATION messages. The Display information element or the Called party number information element may be included in any message sent by the network to the user according to Recommendation Q.931 [4].

This protocol applies to supplementary service invocation in the user-to-network direction, and the keypad facility codes used for the invocation of individual supplementary services are network dependent.

The protocol is stimulus in the sense that it does not require any knowledge about the invoked supplementary service by the user equipment. It may be used in any state of a call and in association with a call for supplementary service invocation and is applicable to both the basic and primary rate access structures. Clause 4 contains a detailed specification of this generic protocol.

2.1.1.2 Feature key management protocol

The Feature key management protocol is based on the use of two information elements that are specified in clauses 4.7.3/B: the Feature activation and Feature indication information elements. The Feature activation information element may be included in the SETUP and in the INFORMATION messages in the user-to-network direction. The Feature indication information element may be included in basic call control messages in the network-to-user direction. The Feature indication information element is not currently used on public and Centrex ISDN lines.

This protocol typically applies to supplementary service operation during calls but also allows for non-call related supplementary service control. Non-call related supplementary service control is accomplished by sending an INFORMATION message with the dummy call reference value and which contains a Feature activation information element. The user may send a Feature activation request at any time, and the network may send a Feature indication information element at any time. The supplementary service associated with the Feature identifier is service provider dependent and must be coordinated between the user and the service provider at subscription time. As a service provider option, more than one service profile may be allocated to an interface, but in this case the terminal identification procedures as defined in Annex A must be used in order to relate an appropriate service profile to a particular user. Terminal identifcation procedures are not currently used on public and Centrex ISDN lines.

NOTE – The term "service profile" refers to the information that the network maintains for a given user to characterize the service offered by the network to that user. A portion of this may contain the association of feature identifiers to specific supplementary services. A service profile is normally allocated to an interface but may optionally be allocated to a particular user's terminal equipment or to a group of user's terminal equipment using the procedures as defined in Annex A.

This protocol is stimulus in the sense that it does not require knowledge of the invoked supplementary service by the user's terminal equipment. Knowledge of the service profile contained in the network and of the association of Feature keys to specific supplementary service invocations is required to unambiguously define the requested supplementary service. This protocol is typically applicable to the basic rate access structure. A detailed description of this protocol is contained in clause 5.

2.1.1.3 Information Request procedures

For networks which support access to services using the Keypad protocol and/or the Feature key management protocol, the Information Request (IRQ) procedures may be utilized to prompt for additional information when the network determines that additional information is required.

The support of the procedures in this subclause and the recognition of the Information Request information element is a network and a user option, and is supported on the basis of a bilateral agreement between the user and the network. This procedure is used for the operation of some supplementary services such as Call Waiting and Three Way Calling.

The information request message sequence is initiated when the network sends the user and INFORMATION message (in any call state using an active Call Reference Value or the dummy call reference value) or a SETUP ACKNOWLEDGE message (as first response to a SETUP message in case of overlap sending) that contains the Information Request information element. The information request may be included in the SETUP ACKNOWLEDGE message when the network is responding to a feature request contained in a SETUP message that contains no called party address information. The Information Request information element shall be coded with the information request indicator set to "prompt for additional information" and type of information set to the appropriate value. After sending the information request prompt, the network will start timer T302 on receipt of every INFORMATION message if the request information is not complete.

No Recommendation Q.931 call state changes should occur when the INFORMATION message is sent or received.

The user may always send the requested information in Keypad facility information elements contained in one or more INFORMATION messages. In addition, if the information requested was a called party number, then the user may also send the requested information in the Called party number information element in the INFORMATION messages.

In both the call associated and non-call associated cases, when the network has determined that sufficient information has been received to proceed, it may send an INFORMATION message to the user, containing the "information request completed" to signal the end of information sending.

If the additional information was requested during overlap sending, and if the network has determined that sufficient information has been received for the call to proceed, then the network shall send a CALL PROCEEDING message to the user with the Information Request information element coded to indicate that the request for information has been completed unless this complete indication has been returned in an INFORMATION message earlier. If no call is to be established based on the information received by the network in the overlap sending state but a non-dummy call reference has been used for the information exchange, the network should initiate clearing of the call reference by sending a DISCONNECT message. The DISCONNECT message in this case may contain the Information Request information

element, coded to indicate that the request for information has been completed and the Cause information element coded to cause value #16 “normal clearing”.

If the user initiates call clearing with a clearing message that allows a response from the network (DISCONNECT or RELEASE), the network should follow normal call clearing procedures and may include the Information Request information element in the appropriate call clearing message (RELEASE or RELEASE COMPLETE), coded to indicate that the request for information is complete.

2.1.2 Functional protocol

The Functional protocol is based on the use of the Facility information element and the FACILITY message, as well as of other specific functional messages specified in clause 7 of ITU-T Recommendation Q.932. This protocol is symmetrical and is applicable to both the basic and primary rate access structures.

This protocol is functional in the sense that it requires the knowledge of the related supplementary service by the user equipment supporting it. This facilitates user equipment operation without human intervention by defining semantics for the protocol elements which user equipment can process on its own.

Functional procedures may follow a Keypad or a Feature key management supplementary service invocation.

3 Co-existence of protocols supported by a network

Networks may support more than one of these generic protocols for the control of supplementary services. The support of multiple generic protocols is a network option. Users shall be informed by the service provider at subscription time of the supplementary services available, and of the generic protocols supported on their access.

As a general rule, the Functional protocol shall be used unless the network specifies the use of a stimulus protocol for the invocation of certain supplementary services, or the users have subscribed to a feature key management facility and service profile.

In general, the Keypad protocol and Feature key management protocol have only local significance while the Functional protocol may have other than local significance.

For a given call instance, the protocol applied at a local interface may be different from the one applied at a remote user’s interface.

Some networks may support only one of the generic protocols per user access for the invocation of supplementary services. Other networks may choose to support a single generic protocol for the control of supplementary services, depending on the user access interface type (e.g. Feature key or Keypad on the basic access, functional on the primary access). This has to be arranged at subscription time.

Network supporting multiple generic protocols per access in the user to network direction (i.e. for the supplementary service invocation) will implicitly recognize the protocol option chosen by the user on the basis of the received message type or information element type.

Networks supporting more than one generic protocol per access in the network to user direction (i.e. at the remote user interface) may choose to apply a particular protocol depending on the supplementary service characteristics involved. In a case where, for a given supplementary service, more than one protocol can be supported, then the use of the terminal identification procedure as described in Annex A may have to be used in order to determine the protocol supported by that user’s terminal equipment, as registered at subscription time.

User service profile procedures as described in Annex A provide a means of characterising the services offered to different groups of one or more terminals on the same user access interface. A network may, therefore, use a parameter within a user service profile to determine the appropriate procedures for network initiated supplementary services towards the associated group of one or more terminals.

4 Keypad protocol

The Keypad protocol is based on the use of the Keypad facility and Display information elements. While the generic procedures associated with Keypad invocation are specified in this clause, the allocation of the access codes used to request/indicate a supplementary service are not to be standardized within the CCITT.

An example of the use of the Keypad protocol is given in Appendix I.

4.1 General

This generic procedure is based on the use of:

– the Keypad facility information element by the user to invoke a supplementary service from the network by providing access codes using either en-bloc or overlap sending; and

– the Display information element by the local network to give an indication to the local user (or by the remote network to the remote user) regarding a supplementary service being invoked. This procedure may be complemented in the case of calls where the Bearer capability information element in the SETUP message is coded indicating “speech” or “3.1 kHz audio”, or “UDI with tones/announcements”, by the provision of in-band tones/announcements to the user.

NOTE– As a network option, the Keypad facility information element may be used by the network to give an indication to the user when the network expects an automatic reaction to the received information to acknowledge an invoked supplementary service. As the semantics of the Keypad facility information element are not standardized, the use of the Keypad facility information element in the network-to-user direction may inhibit terminal portability since for a terminal to operate successfully on more than one network it must be capable of interpreting various different semantics as assigned by the network to the Keypad facility information. In any case, user equipment not supporting this option shall follow the error recovery procedures defined in 5.8/Q.931 of receipt of the Keypad facility information element.

The Keypad protocol may be used in conjunction with the Feature key management (see clause 5) or Functional protocol (see clause 6) during the invocation of a supplementary service.

The Keypad protocol is based on the use of the Keypad facility information element within the INFORMATION or SETUP messages during the establishment, active and clearing phases of a call.

4.2 Messages used in the Keypad protocol

As specified in Recommendation Q.931, the Keypad facility information element may be included in both the SETUP and INFORMATION messages and may be sent in the user-to-network direction.

4.3 Coding of the Keypad facility information element

The contents of the Keypad facility information element are a string of IA5 characters. The syntax of the IA5 character string and the allocation of values for given supplementary services are not subject to CCITT standardization.

4.4 Elements of procedure

4.4.1 General

The Keypad protocol includes the following aspects:

1) the Keypad protocol may be used during the call establishment, active, and clearing phases of a call to invoke supplementary services. Supplementary service information is conveyed in Keypad facility information elements sent in either SETUP or INFORMATION messages;

2) supplementary service information can be sent from the user to the network either en-bloc or using overlap sending;

3) the network may prompt the user to send the required information using the Display information element and/or in-band tones or announcements. Whether this action shall occur or not is supplementary service and network specific. In any case, in-band tones or announcements shall only be used when the Bearer capability information element indicates “speech” or “3.1 kHz audio”or "UDI with tones/announcements”;

4) there may be different combinations of user provided information followed by network prompts. Examples of such possible combinations are shown in Table 4-1, where the term "stage" is used to refer to information sent by the user between network prompts (if any).

TABLE 4-1/Q.932

Example of stages for sending of information

Number of stages	Sending information		
1	All information sent en-bloc		
1	All information sent overlap		
2	Overlap	Prompt	Overlap
2	En bloc	Prompt	En-bloc
2	Overlap	Prompt	En-bloc
2	En bloc	Prompt	Overlap
3	Overlap	Prompt	Overlap
	... Prompt	Overlap, etc.	
NOTE – The number of possible stages is network dependent and may also be dependent on the specific supplementary service being invoked.			

4.5 Procedures at the invocation interface

4.5.1 User procedures

The procedures below define how information (using either en-bloc or overlap sending) may be sent in a single stage from the user to the network. The procedures are applicable for each stage of user-to-network information sending.

4.5.1.1 En-bloc sending of access codes

En-bloc sending of supplementary service information is accomplished by sending the "complete" supplementary service information in:

– the SETUP message, if the supplementary service is being invoked during the call establishment; or

– the INFORMATION message, if the supplementary service is being invoked from the active phase of the call or during the clearing phase of a call.

The term "complete" supplementary service information means that sufficient supplementary service information is sent to the network to specify a service without any additional network prompting being required. The network determines that the supplementary service information is "complete" by either:

– analysis of the information contents of the Keypad facility information element; or – the presence of a "sending complete" indication (see 5.1.3/Q.931).

If the network determines that the information contents of the Keypad facility information element are invalid, the network shall use the error procedures specified in 4.5.2.3.

If the network determines that the information contents are valid and that the user is allowed to invoke the requested service, the network shall respond using the procedures as specified in 4.5.2.1.

4.5.1.2 Overlap sending of access codes

Overlap sending of supplementary service information is the sending of the "complete" supplementary service information (see 4.5.1.1 for the definition of complete) segmented such that a number of Recommendation Q.931 messages are used to convey the "complete" supplementary service information. The possible combination of messages:

a) for supplementary services invoked during call establishment, consists of using the SETUP message plus one or more INFORMATION messages which will be sent in the overlap sending state; or

b) for supplementary services invoked in the active or clearing phases of the call, consists of using two or more INFORMATION messages.

For case a), normal overlap sending procedures, as specified in 5.1.3/Q.931, shall be used.

For case b), the transmission or receipt of INFORMATION messages shall not cause any change to the Recommendation Q.931 call state.

The network shall respond to valid supplementary service information with one of the network responses as described in 4.5.2.1. If the supplementary service information is invalid, then the error procedures as described in 4.5.2.3 shall apply.

4.5.2 Network procedures

4.5.2.1 Network responses to user requests

After receiving information from the user, the network may take one of the following actions. Items 1) to 4) are applicable in the cases of both en-bloc and overlap sending; item 5) is applicable only in the case of information sent using overlap sending.

1) Clear the call reference via the normal call clearing procedures (see 5.3/Q.931) including the appropriate Cause and optional Display information element(s).

2) Send a CALL PROCEEDING message to the user.

   NOTE – This network response is only applicable in a case where the supplementary service is being invoked during call establishment and not in the cases of the supplementary service being invoked from the active or clearing phases of the call.

3) Send an INFORMATION or clearing message to the user that includes a Display information element containing an appropriate response to the request for a supplementary service. The receipt of an INFORMATION message by the user shall not cause any change to the Recommendation Q.931 call state.

4) Prompt the user for more information using the procedures as specified in 4.5.2.2. This further information could be additional, or new information input by the user or another attempt by the user to re-input the original information correctly. Such procedures are network dependent and may be supplementary service specific.

5) Wait for more overlap information. The allowed waiting period is governed by timer T302 in the case of information sent in the overlap sending state and call control timers for overlap information sent during other phases of the call.

The precise action to be taken is dependent on the specific supplementary service being invoked.

4.5.2.2 Network prompting and in-band tone/announcement control

The network may prompt the user for more information or may provide in-band tones or announcements regardless of whether or not the Keypad facility information element was included in the initial SETUP message. The network shall determine whether prompting and/or in-band tone or announcement control should occur. Possible factors governing the provision of prompting and in-band information are:

– the nature of the supplementary service;

– the value of the inter-digit timer;

– the type of interface; and

– the current status or progress of the supplementary service request.

Simultaneously with the application of in-band tones or announcements, the network may send a PROGRESS message containing a Progress indicator information element with the progress descriptor No. 8, *In-band information or appropriate pattern now available.*

The network may, in addition to an audible prompt (i.e. tone or announcement), request information from the user by sending an INFORMATION message which contains the Display and/or Signal information elements (but shall not contain the Called party number information element).

The sending of the INFORMATION message by the network does not result in a change to the Recommendation Q.931 call state. However, when this message is sent in the network overlap sending state, timer T302 shall be re-initialized.

The network may prompt the user more than once (i.e. multiple stages may occur), but the network should not prompt the user again prior to the user's response or, when in the overlap sending state, prior to the expiry of timer T302. This is to avoid situations where a user's response could be related to two unacknowledged network prompts.

NOTE – As a network option, the Information Request procedures described in 2.1.1.3 may be used to prompt the user for additional information related to a given service request.

4.5.2.3 Error conditions and treatment

An error condition exists in the following circumstances:

a) timer T302 expires and complete information has not been received;

b) information containing a "sending complete" indication indicating en-bloc sending, but the user information sent is not complete;

c) information received by the network (complete or incomplete) is invalid. Invalid information is information sent with incorrect format or containing invalid facility identifier or parameter codes;

d) the user attempts to invoke a supplementary service to which the user has not subscribed or to which the user is not allowed access.

The action to be taken by the network in these situations is as follows:

NOTE – The text below identifies possible actions that may be taken in an error situation. The specific action to be taken is network and supplementary service dependent.

4.5.2.3.1 Supplementary service being invoked during call establishment

The network shall take one of the following actions:

i) In-band tones or announcements are applied. If a SETUP ACKNOWLEDGE message has not already been sent, the network shall send a CALL PROCEEDING message to the user, indicating the B-channel to be used and including the Progress indicator information element with progress descriptor No. 8, *In-band information or appropriate pattern is now available*.

If a SETUP ACKNOWLEDGE message has already been sent, the network shall send a PROGRESS message to the user, including the Progress indicator information element with the progress descriptor No. 8, *In-band information or appropriate pattern is now available*.

The network may prompt the user using the procedures as specified in 4.5.2.2 to re-input the required information. Otherwise, after the in-band tone or announcement has been applied, the call reference shall be cleared by either the user initiating call clearing or the network initiating call clearing at the expiry of a tone or announcement timer. Both the network and the user shall use the clearing procedures as specified in 5.3/Q.931.

ii) No in-band tones or announcements are to be applied. The call reference shall be cleared by the network initiating call clearing procedures as specified in 5.3/Q.931.

4.5.2.3.2 Supplementary service being invoked from the active state or during the call clearing phase

The network shall take one of the following actions:

i) In-band tones or announcements are applied. The network may prompt the user using the procedures as specified in 4.5.2.2 to re-input the request. Otherwise, depending on the specific supplementary service being invoked, the call shall either be cleared or remain in the same call state. In the case where the call is cleared, clearing shall occur after the in-band tone or announcement has been applied. Clearing shall occur either by the user initiating call clearing or by the network initiating call clearing at the expiry of a tone or announcement timer. Both the network and the user shall use the clearing procedures as specified in 5.3/Q.931.

ii) No in-band tones or announcements are to be applied. Depending on the specific supplementary service being invoked, the call shall either be cleared or remain in the same call state. In the case where the call is to be cleared, the call reference shall be cleared by the network initiating call clearing using the procedures as specified in 5.3/Q.931. If the call remains in the same call state, the user may be informed that the

supplementary service request was unsuccessful by the network sending an INFORMATION message in accordance with 4.5.2.1, item 3).

4.6 Procedures at the remote interface

The Display and/or Signal information elements can be used for the purpose of providing notification to the remote user from the network. In this case, however, this information is used simply for the purpose of informing the human user, and no automatic reaction to the received information is to be performed by the user's equipment itself.

5 Feature key management protocol

The Feature key management protocol is a mechanism allowing users to invoke network supplementary services. As these are stimulus procedures, the protocol elements do not, by themselves, identify the service invoked. To determine the service invoked requires knowledge of the user's service profile maintained in the network. No call state changes directly occur by these procedures.

The Feature key management protocol is based on two information elements: Feature activation and Feature indication. The Feature activation information element is the means by which a user requests a supplementary service. The Feature activation information element contains a feature identifier number which the network then maps to the corresponding service as indicated by that user's service profile. The user's equipment need not have any knowledge of what service is being indicated by the feature identifier number and the user may send a feature request at any time.

Feature indication is the means by which a response to a Feature activation is indicated by the network. The feature identifier number correlates the network's response with a user's request and/or an indicator associated with a user's equipment. The Feature indication information element also contains a status indicator. The status indicator indicates the status of the requested service and may be used by the user's equipment as appropriate with its man-machine interface.

5.1 Messages

The Feature activation and Feature indication information elements may be present in several of the messages defined in Recommendation Q.931. The Feature activation information element may appear in the following messages in the user-tonetwork direction:

1) SETUP
2) INFORMATION

The Feature indication information element may be sent in the network-to-user direction in the following messages:

a) SETUP
b) SETUP ACKNOWLEDGE
c) CONNECT
d) CALL PROCEEDING
e) ALERTING
f) INFORMATION
g) DISCONNECT
h) RELEASE
i) RELEASE COMPLETE

5.2 Procedures

5.2.1 Assumptions and restrictions

a) These procedures assume that only one Feature activation request will appear in a message.
b) The phrase "call associated services" used herein is defined as services which act upon or relate to an existing call (as defined by the existence of a call reference).

c) These procedures are used for the invocation of supplementary services which relate to predefined specific bearer capabilities and/or are context dependent. Hence the capability to include protocol elements to indicate the bearer capability that the supplementary service is to act upon is not provided.

5.2.2 Invocation of supplementary services

The user may request a feature by including a Feature activation information element in the messages defined in 5.1. If the INFORMATION message is used, it may be sent at any time. The user will indicate the desired feature by specifying the appropriate value in a feature identifier number.

5.2.2.1 Determination of call reference in the INFORMATION message

When the Feature activation information element is sent in the INFORMATION message, then the following rules apply:

a) if no call references exist, then the dummy call reference must be used (for this non-call associated service type);

b) if a call reference(s) has been established, then that value may be used regardless of whether the service type is call associated or non-call associated;

c) if a call reference(s) has been established, the dummy call reference may be used only if the service type is non-call associated. If the service type is call associated, then the appropriate call reference must be used. An exception to this rule is when only one call is established. In this instance it is permissible for the user to use the dummy call reference for either service type.

This is summarized in Figure 5-1.

It is always correct for the user's equipment to use the dummy call reference when no calls exist, or to use an established call reference if one exists, independent of the service type.

Service type	No calls exist	Call(s) exist
Non-call associated	Use dummy call reference	Use dummy or active call reference
Call associated	Error; not allowed	Use an active call reference (Note)

NOTE – The dummy call reference value may be used if only one call is established.

FIGURE 5-1/Q.932

Use of the call reference in an INFORMATION message

5.2.3 Network responses

The network may respond to a Feature activation request in several ways. This action will be supplementary service and network specific.

5.2.3.1 Normal responses

5.2.3.1.1 Return of a Feature indication

The network may return a Feature indication information element in an INFORMATION message or any other appropriate call control message as defined in 5.1. The feature indication may or may not have the same feature identifier number as was present in the original feature activation request. The status indicator will be provided as appropriate to the specific supplementary service requested.

5.2.3.1.2 Prompting for further information

The network may prompt the user for more information. When in the overlap sending state, it may do so using the Information Request procedures (described in 2.1.1.3).

The user's response shall follow normal overlap sending procedures as defined in Recommendation Q.931. As a network option, the Information Request procedures described in 2.1.1.3 may be used to prompt the user for additional information related to a given service request.

5.2.3.1.3 Implicit response

The network, under certain situations, may not return any explicit indication to the user after a feature activation request. In this case the response is implicit, such as the acknowledgement inherent in providing the service.

5.2.3.1.4 Return of Signal, Cause, or Display information elements

The network may return any combination of Signal, Cause, or Display information elements in conjunction with the responses as described in 5.2.3.1. The use of these information elements is supplementary service and network specific. Coding and the appropriate messages that may contain these information elements are as defined in Recommendation Q.931.

5.2.3.2 Responses during error conditions

When an error condition exists (as defined in 5.2.5), the network may:

a) Respond with one or more of the following options:
   1) return a Feature indication information element;
   2) prompt for further information (see 2.1.1.3);
   3) provide an implicit response; or
   4) return Signal, Cause, or Display information elements.

b) Ignore the Feature activation request and not respond at all.

c) Clear appropriate existing calls in conjunction with the above actions.

5.2.4 General aspects

5.2.4.1 Use of Feature indication information elements independent of a feature request

The network may choose to send Feature indication information at any time independent of the status of any call(s). Multiple Feature indication information elements may be returned in an INFORMATION message or in an appropriate call control message if more than one indicator is to be updated.

5.2.4.2 Deactivation procedures

When explicitly deactivating a supplementary service, two methods may be used:

a) sending of a feature activation request with the same feature identifier may deactivate the supplementary service. Some supplementary services may be "toggled" on and off;

b) sending of a feature activation request with a different feature identifier which is explicitly defined (between the user and network) as the deactivator for that particular supplementary service.

5.2.4.3 Clearing of a call

If a Feature activation information element is sent using the call reference of an active call, and that call is cleared for some reason, then there does not exist a call reference with which to correlate the feature indication. If a Feature indication information element is to be returned, then one of the following options may be used:

a) the network may send a Feature indication information element in one of the call clearing messages (i.e. DISCONNECT, RELEASE, or RELEASE COMPLETE);

b) the network may send a Feature indication information element in an INFORMATION message after clearing has occurred using the dummy call reference.

5.2.5 Error conditions

5.2.5.1 Invalid feature activation request

If a user requests a feature using an invalid feature identifier number, the network may take actions specified in 5.2.3.2 as appropriate. An invalid feature identifier number is one in which the user has not subscribed to a corresponding service, or the value is not understood by the service provider (e.g. out of range).

5.2.5.2 Invalid call reference

If a user violates the use of the call reference as stated in 5.2.2.1, the network should not provide the service and should respond as indicated in 5.2.3.2.

5.2.5.3 Sending of multiple feature activation requests

If a sequence of feature activation requests is received in separate messages so rapidly that the network cannot respond to the first feature activation request prior to receiving a subsequent feature activation request, the network may take one of the following actions:

a) act upon all feature activation requests by returning multiple Feature indication information elements (or other responses as detailed in 5.2.3.1). These may be sent in a single message or in multiple messages;

b) act upon the first feature activation request by returning a single response. This response should correspond to the first feature activation request. Feature activation requests after the first request are discarded and ignored by the network.

The determination of which action to take is network and supplementary service specific.

6 Functional protocol

6.1 General

6.1.1 Introduction

This subclause specifies the functional signalling procedures for the control of supplementary services at the user-network interface. This generic protocol utilizes functions and services provided by Recommendations Q.930 [5] and Q.931 [4] basic call control procedures and the functions of the data link layer as defined in Recommendations Q.920 [6] and Q.921 [3].

Support of some supplementary services in the Q.95x-Series requires the support of procedures provided in this section and the associated protocol. The support of these procedures otherwise is a network and user option based on a bilateral agreement.

6.1.2 Scope of the procedures

The procedures defined in clause 6 specify the basic methodology for the control (e.g. invocation, notification, cancellation, etc.) of supplementary services. The procedures are independent of whether the user-network interface is a basic or primary rate interface.

6.1.3 Categories of procedures

Two categories of procedures are defined for the functional signalling for supplementary services. The first category, called the separate message approach, utilizes separate message types to indicate a desired function. The HOLD and RETRIEVE set of messages are identified for this category.

The second category, called the common information element procedure, utilizes the Facility information element.

Both categories are specified in a symmetrical manner and can be signalled both in the network-to-user and the user-to-network directions.

6.1.4 Supplementary service functions

The control of supplementary services by either the network or the user includes the following cases:

a) the invocation of supplementary services during the establishment of a call;

b) the invocation of supplementary services during the clearing of a call;

c) the invocation of call related supplementary services during the active state of a call;

d) the activation, deactivation, interrogation or registration of supplementary services independent from an active call;

e) the invocation of multiple, different supplementary services within a single message;

f) the invocation of supplementary services related to different calls;

g) cancellation of invoked supplementary services and notification to the initiator of the supplementary service.

The correlation of a call related supplementary service and the call which it modifies is provided by use of the call reference [cases a), b), c), e), f) and g) listed above].

The correlation of call independent supplementary service invocations and their responses is provided by the combination of the call reference of the message containing the Facility information element and the invoke identifier present within the Facility information element itself [refer to cases d), e) and g)].

The identification of different supplementary service invocations within one single message is provided by the invoke identifier of the corresponding Facility information element [refer to cases e) and g)]. The identification of supplementary service invocations related to different calls (e.g. HOLD) is provided by different messages with the corresponding call reference of the appropriate call [refer to case f)], i.e. different call reference values are used to identify each call individually.

6.2 Separate messages category

The messages defined in this section are specified as separate functional messages for invoking specific functions which require changes of the resources and the auxiliary state and also require synchronization of the peer-to-peer state machines. Therefore, these functions cannot be performed in conjunction with the call establishment and clearing procedures but may be used in conjunction with various supplementary services. The functions of these messages are not to be duplicated or overlapped by those of the Facility information element.

The following individual messages are defined:

HOLD

HOLD ACKNOWLEDGE

HOLD REJECT

RETRIEVE

RETRIEVE ACKNOWLEDGE

RETRIEVE REJECT

These messages are currently not supported on public and Centrex ISDN lines. Therefore, the rest of this clause is not reproduced.

6.3 Common information element category

A REGISTER, a FACILITY or an existing Recommendation Q.931 call control message is used to carry the Facility information element which requests the desired supplementary service.

The Facility information element is not currently supported. Therefore, this clause is not reproduced.

6.4 Network side channel reservation function

Channel reservation does not currently apply on public and Centrex ISDN lines. Therefore, the rest of this clause is not reproduced.

7 Message functional definition and content

The messages defined in clause 7 of ITU-T Recommendation Q.932 are not used on Telecom's public ISDN lines. Therefore, this clause is not reproduced.

8 General message format and information element coding

The information elements defined in clause 8 of ITU-T Recommendation Q.932 have been reproduced in clause 4 of Part B.

9 Generic Notification Procedures

9.1 General

9.1.1 Introduction

This subclause specifies the functional signalling procedures that support the delivery of notifications at the usernetwork interface. Notifications can be characterized by the following properties:

- they do not cause a change of state on either side of the user-network interface;
- they represent a one-way flow of information that requires no response; and
- they provide additional information that can be discarded without the need for significant error recovery if they are unrecognized by a user.

As a consequence of these properties it is possible to provide a generic set of procedures optimized to support the delivery of notifications at the user-network interface.

This subclause builds in a compatible manner on the basic call control procedures and in particular on the following:

- Subclause 5.9/Q.931, User notification procedures.

These notification procedures may be applied for any call type. Terminals must accept notification in any state of the call.

9.1.2 Scope of the Procedures

The procedures in Clause 9 define the basic methodology for the delivery of notifications at the user-network interface. The procedures are independent of whether or not the user-network is a point to point or point to multi-point configuration. The application of the full range of these procedures in the direction user to network is for further study.

9.1.3 Categories of Procedures

The generic procedures for the delivery of notification can be primarily categorized by the context of the delivery and secondarily categorized by the type of information contained in the notification. The procedures specified in Clause 9 consider the delivery of notifications in the following two contexts:

- Subclause 9.2 defines the procedures for the delivery of call related notifications on an active call reference; and

– Subclause 9.3 defines the procedures for the delivery of call independent notifications when no active call reference appropriate to the notification exists. Not currently implemented.

Procedures for both contexts are defined for the delivery of three types of notification information as follows:

1) The delivery of simple notification "indicators" based on the Notification indicator information element, as well as additional codepoints in the Notification indicator information element defined for Q.95x – Series supplementary services;

2) The delivery of notification "parameters" that are specified as information elements using the Q.931 encoding scheme defined in 4.5/Q.931 (Note including Q.931 encoded information elements defined for Q.95x – Series supplementary services;

3) When no response is required (e.g. REJECT), the delivery of notification "components" using an extension codepoint in octet 3 of the Notification indicator information element and ASN.1 encoded information in subsequent octets. Not curretly implemented.

When no "parameters" are present option 1 (delivery of notification indicator will be used. When parameters are present, individual supplementary services will determine which options are applicable.

NOTE – With regard to the delivery of notification "parameters", the use of the Notification indicator information element and Q.931 information elements together in a message other than NOTIFY requires further study.

9.2 Call Related Notifications

9.2.1 Introduction

The generic procedures for call related notifications are a compatible extension of the user notification procedures specified in 5.9/Q.931. the procedures specified in 9.2.2 enable the network to notify a user of supplementary service related events on an appropriate active call reference. A call reference is considered active in this context from the initiation of call establishment (including the SETUP message) to the completion of call clearing (including the RELEASE COMPLETE message). These procedures encompass the delivery of notifications using the active call reference of the call the notification is associated with. The application of these procedures in the direction user to network, in addition to those already defined in Recommendation Q.931, remains for further study.

9.2.2 Procedures

9.2.2.1 Delivery of Call Related Notifications

The delivery of call related notifications make use of an active call reference and its underlying data link layer connection.

If the delivery of the notification coincides with call establishment or clearing procedures, the notification information can be carried in the associated call control messages. Otherwise, the notification information is delivered in a NOTIFY message. The three types of notification information defined in 9.1.3 are supported in these messages.

9.2.2.2 Error handling

If a terminal does not recognize an information element in a NOTIFY message, or a new codepoint or extension contents of the Notification indicator information element, it shall handle it according to the procedures in 5.8/Q.931.

9.3 Call Independent Notifications

Not currently implemented.

9.3.1 Introduction

The generic procedures for call independent notifications are a compatible addition to the use notification procedures specified in 5.9/Q.931. The procedures specified in 9.3.2 enable the network to notify a user of supplementary service related events when no appropriate call reference is active.

The application of these procedures in the direction user to network remains for further study.

9.3.2 Procedures

9.3.2.1 Underlying Data Link Layer Services

The delivery of call independent notifications requires the underlying services of the data link layer.

The procedures described in 9.3.2.2 and 9.3.2.3 make use of the acknowledged data link layer service supported on point to point data link layer connections. The network can use the data link broadcast capability to transfer notifications.

Terminals requiring the delivery of call independent notifications should retain an active data link layer connection, unless sufficient subscription information is available in the network to cause a data link layer connection to the required terminal to be established. If no subscription information is available, mechanisms for the data link layer connection to be established are for further study.

9.3.2.2 Delivery of Call Independent Notifications

Call independent notifications are delivered using the NOTIFY message on the dummy call reference. The three types of notification information defined in 9.1.3 are supported in this message.

The dummy call reference is specified in 4.3/Q.931. The NOTIFY message is specified in 3.1.7/Q.931.

9.3.2.3 Error handling

If a terminal does not recognize an additional new information element in the NOTIFY message, or a new codepoint or extension contents of the Notification indicator information element, it shall handle it according to the procedures in 5.8/Q.931.

9.4 Extension of the Notification indicator information element

See 4.5.22, Part B.

Annex A

User service profiles and terminal identification

(This annex forms an integral part of this Recommendation)

A.1 Introduction

These optional procedures allow an ISDN to support identification and selection of specific terminals on a multi-point user-network interface to support multiple user service profiles in those cases in which Recommendation Q.931 information elements are not sufficient for such purposes.

A terminal or network which desires to support such multiple profiles for terminals which could not otherwise be distinguished, must support this additional identification procedure. Otherwise, it is completely optional.

TABLE A.1/Q.932

Terminology

Service profile	Service profile refers to the information that the network maintains for a given user to characterize the service offered by the network to that user. As an example, this may contain the association of feature identifiers to specific supplementary services. A service profile may be allocated to an access interface or to a particular user equipment or a group of user equipments.

SPID	The service profile identifier is a parameter carried in a service profile identification information element that is sent from the user to network to allow network assignment of a USID and TID. A user's SPID should uniquely identifiy a specific profile of service characteristics stored within the network. The SPID will allow the network to distinguish between different terminals that would otherwise be indistinguishable (e.g. same ISDN number). The SPID value is provided to the user at subscription time.
USID	User service identifier. A USID uniquely identifies a service profile on an access interface.
TID	Terminal identifier. A TID value is unique within a given USID. If two terminals on an interface subscribe to the same service profile, then the two terminals will be assigned the same service USID. However, two different TIDs are required to uniquely identify each of the two terminals.
EID	Endpoint identifier. The endpoint identifier information element is used for terminal identification. The endpoint identifier parameters contain a USID and TID and additional information used to interpret them.

Figure A.1 shows examples of the relationships of terminals, SPIDs, USIDs, and TIDs and their dynamic relationship to TEIs. In this example, terminals 1, 3, 4 and 5 support the automatic endpoint identifier parameter assignment procedure and terminal 2 does not, but has the endpoint identifier parameters locally entered. Terminal 6 does not support terminal identification, therefore it utilizes the specified default service profile.

NOTE – Items in parentheses indicate values or relationships which are dynamically established by initialization procedures (see A.4). Others are established via administrative actions and stored as a result of manual entry.

A user or network that does not recognize the information elements used by this annex shall, if these elements are received, apply the error procedures defined in 5.8/Q.931.

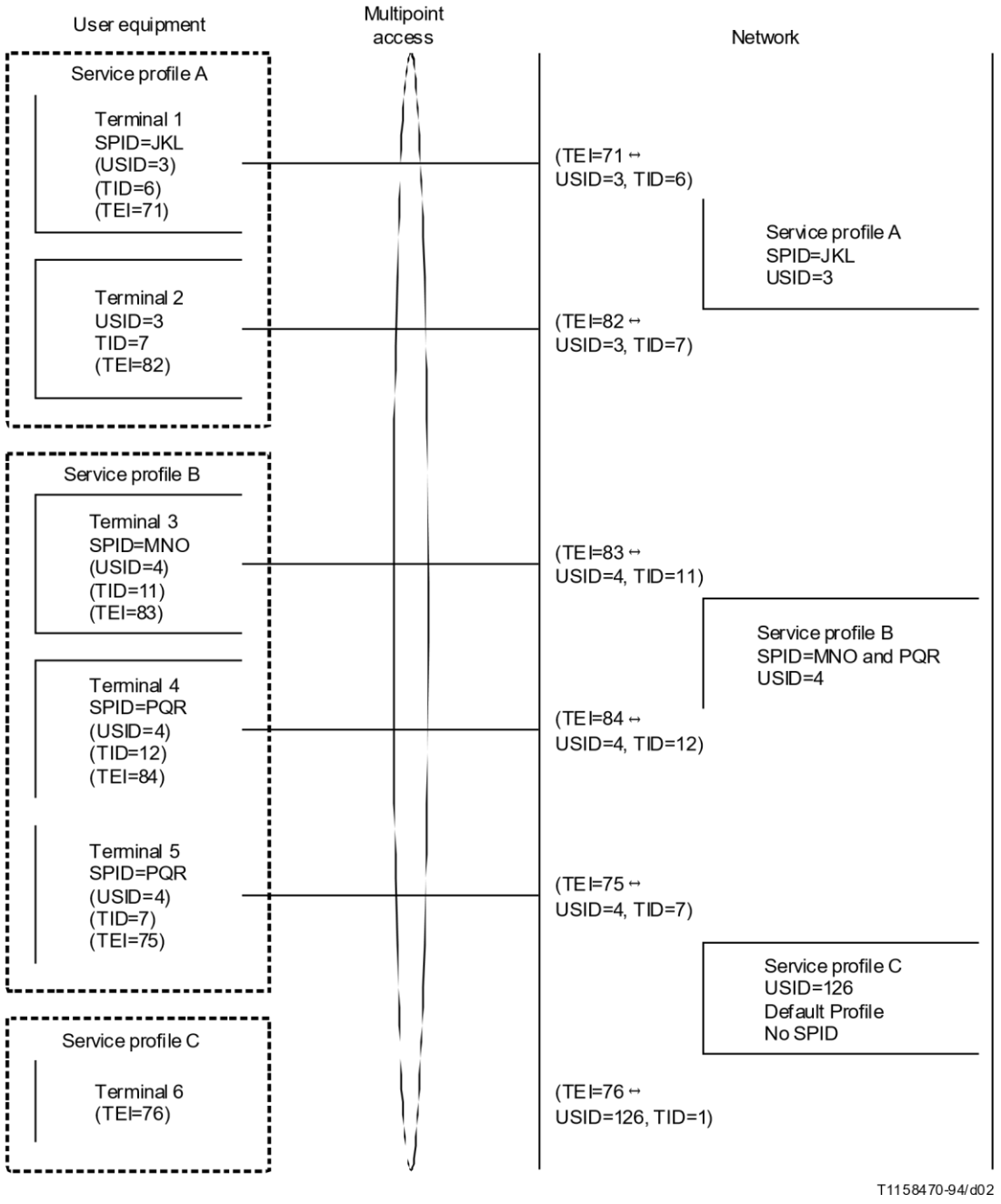


FIGURE A.1/Q.932

Relationship of service profile, SPID, USID, TID and TEI

A.2 User service profiles

The support of user service profiles requires that the service requests from a terminal are associated by the network with a specific profile. A USID is used to identify the profile on an access. The service profile is assigned to a data link connection so that the network can associate all of the service requests from the corresponding Connection Endpoint Suffix (CES) with the required profile (see Note). The assignment of a service profile to a data link connection minimizes the per-service request overhead of profile identification.

The procedures for assigning service profile to a data link connection are incorporated into the initialization procedures described in A.4.

NOTE – CES along with SAPI constitute the CEI (Connection Endpoint Identifier) that is used to identify message units passed between the data link layer (as represented by the TEI) and Layer 3.

A.3 Terminal identification

The support of terminal identification requires that a call sent by the network can be addressed to:

- all of the terminals of a user service profile;
- one terminal of a user service profile; or
- all but one terminal of a user service profile.

A USID is used to identify the user service profile with a (set of) terminals on an access interface and a TID is used toidentify individual terminals within a user service profile on an access.

The USID and TID may be entered into the terminal by the user as arranged at subscription time, or dynamically downloaded to the terminal from the network with an automatic assignment procedure.

The USID and TID parameters are used by the terminal to check the compatibility of a call offered by the network. The inclusion of a USID and TID with only access uniqueness minimizes the per-call overhead of supporting terminal addressing.

The procedures for downloading the USID and TID to a terminal are incorporated into the automatic endpoint identifier allocation and initialization procedures described in A.4. The procedures for using a USID and TID for terminal identification in an offered call sent by the network are described in A.5.

A.4 Initialization

The initialization procedure provides for the association by the network of the service requests from a terminal on a particular data link connection (as represented by the TEI) with a user service profile. A user requested automatic assignment procedure is described to also support automatic assignment of USID and TID parameters and their downloading by the network to a terminal.

Since initialization provides the basis for subsequent association of a service profile with a data link connection, normally, user equipment that supports initialization is expected to request the initialization procedure (e.g. on the first Layer 3 message after dynamic assignment of a TEI). However, a request for initialization is allowed at any time. The data link connection is always associated with the most recently identified service profile. Under some circumstances, the network may solicit terminal initialization.

A.4.1 Terminal requested initialization

a) Terminals may initialize by sending an Endpoint identifier information element (containing a USID and TID) in an INFORMATION message at any time to the network. Subsequent to this, the network may associate the service profile with the data link over which the message was sent.

b) For terminals which support automatic assignment of USID and TID parameters, initialization (that is, association of a service profile with a data link connection) is provided as part of the automatic assignment procedure described here.

   A user may initiate automatic assignment of the endpoint identifier by sending a Service profile identification information element in an INFORMATION message with the dummy call reference. The Service profile identification information element should contain the SPID parameter allocated at the time of subscription. The initialization is acknowledged with an INFORMATION message with the Endpoint identifier information element containing a USID and TID, the values of which are determined by the network. It results in an association of the data link over which it was received with the identified service profile.

   When a terminal determines that the initialization procedure has failed, it assumes that the network cannot support the procedure and does not repeatedly attempt initialization.

A.4.2 Network solicited initialization

The network may solicit a request for initialization on a data link connection by sending an Information request information element with codepoint “terminal identification” in an INFORMATION message with the dummy call reference. Upon receiving the request, the terminal may respond as described in the previous A.4.1 a) or b).

When a network determines that the initialization procedure has failed, it assumes that the terminal cannot support the procedures and does not repeatedly request initialization.

A.4.3 Collision

When terminal initialization and network solicitation procedures collide, the terminal ignores the solicitation from the network and the network proceeds as normal upon receipt of the initialization request from the terminal.

A.5 Identification procedures

When the network offers a call using terminal addressing, the Endpoint identifier information element is included in the SETUP message.

When a terminal receives a SETUP message containing the Endpoint identifier information element, it shall:

- if it is not supported, handle the Endpoint identifier information element in accordance with 5.8.7/Q.931 and complete normal compatibility checking procedures; or,
- test for an address compatibility with the Endpoint identifier information element if it is supported in addition to completing the normal compatibility checking procedures.

APPENDIX I

Examples of the use of the generic protocols

I.1 Introduction

This appendix is provided as an illustration of the application of the protocol types defined in this Specification.

The signalling sequences shown are not exhaustive and are only intended to illustrate possible supplementary service control sequences.

This appendix has been extensivley revised. Revision marks are therefore not included.

I.2 Example Use Of The Keypad Protocol

This example shown in Figure I.1/C illustrates the application of the stimulus protocol using the Keypad facility and Display information elements to register a period for which all incoming calls will be diverted to an announcement advising that the called user does not wish to be disturbed at this time (Do Not Disturb service). This protocol does not impose a need for the terminal to be aware of any states other than those required for basic call control.

In this example the network associates the contents of the Keypad facility information element with the appropriate feature. The user is shown to subsequently enter supplementary service parameters using the Keypad facility information element in INFORMATION messages. Feature status information may be provided by the network in the Display information element, the Signal information element or in-band tones. The network completes feature processing and the user is shown to clear the call reference. Alternatively, depending on the specific feature request, a CALL PROCEEDING message might be returned by the network and normal call processing procedures would continue.

The user may also include all digit information in the SETUP message using en-bloc procedures.

The example shown in Figure I.2/C illustrates the same service where tones are generated by the terminal in response to the Signal information element from the network.

Some of the services and functions the Keypad protocol is used for are:

Registration of Call diversion services
Activation of Call diversion services
Activation of Do not disturb service Activation
of wake up service

Key to Figures I.1/C-I.4/C:

CALL PROC	CALL PROCEEDING message
DISC	DISCONNECT message
DND	Do Not Disturb service
DT	dial tone
feact	Feature activation information element
flash	Switchhook flash
INFO	INFORMATION message
infreq	Information request information element
progind	Progress indicator information element
REL	RELEASE message
REL COM	RELEASE COMPLETE message
RBT	Ring Back Tone
SCT	Switching Complete Tone
signal	Signal information element

TE NETWORK

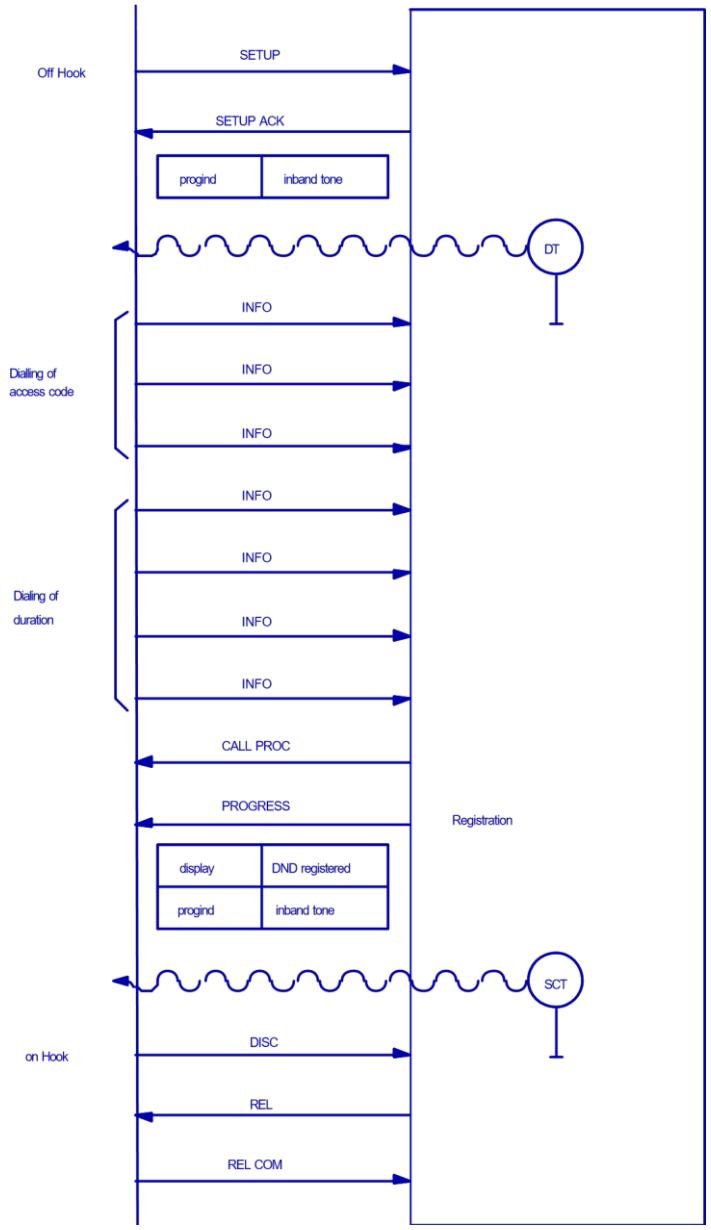


FIGURE I.1/C

Do Not Disturb Service - Network Provided Tones

TE NETWORK

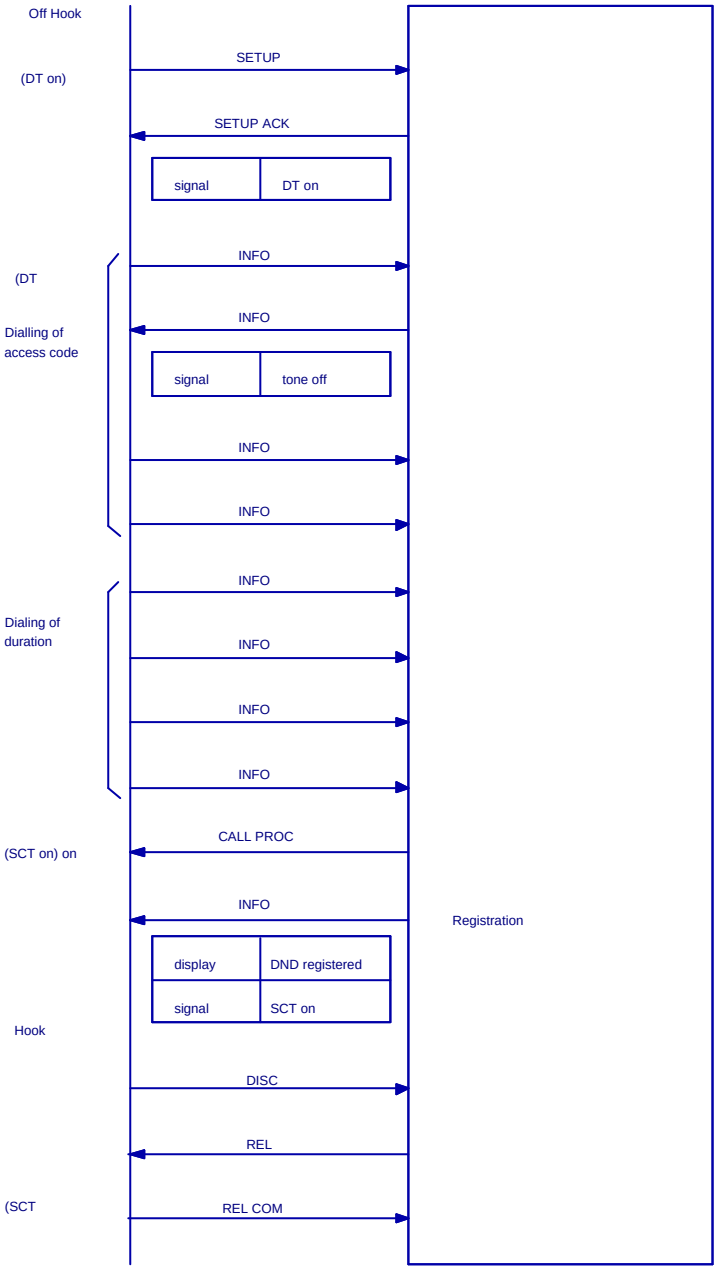


FIGURE I.2/C

Do Not Disturb Service - Terminal Provided Tones

I.3 Example Use Of The Feature Key Management Protocol

The example shown in Figure I.3/C illustrates a user initiating the Three way calling feature using the Feature activation information element. The network prompts for address digits using the information request procedures of § 4.5.1.4 and §

4.5.2.2.1. The user is shown to subsequently enter address information using the either the Keypad facility or Called party number information element in an INFORMATION message. Feature status information may be provided by the network by inband tones. Control of communications with the two parties Y and Z are controlled by the Feature activation information element.

The user may also include all digit information in the SETUP message using en-bloc procedures.

The example shown in Figure I.4/C illustrates the same service where tones are generated by the terminal in response to the signal information element from the network. Note that Ring back tone is always provided from the network.

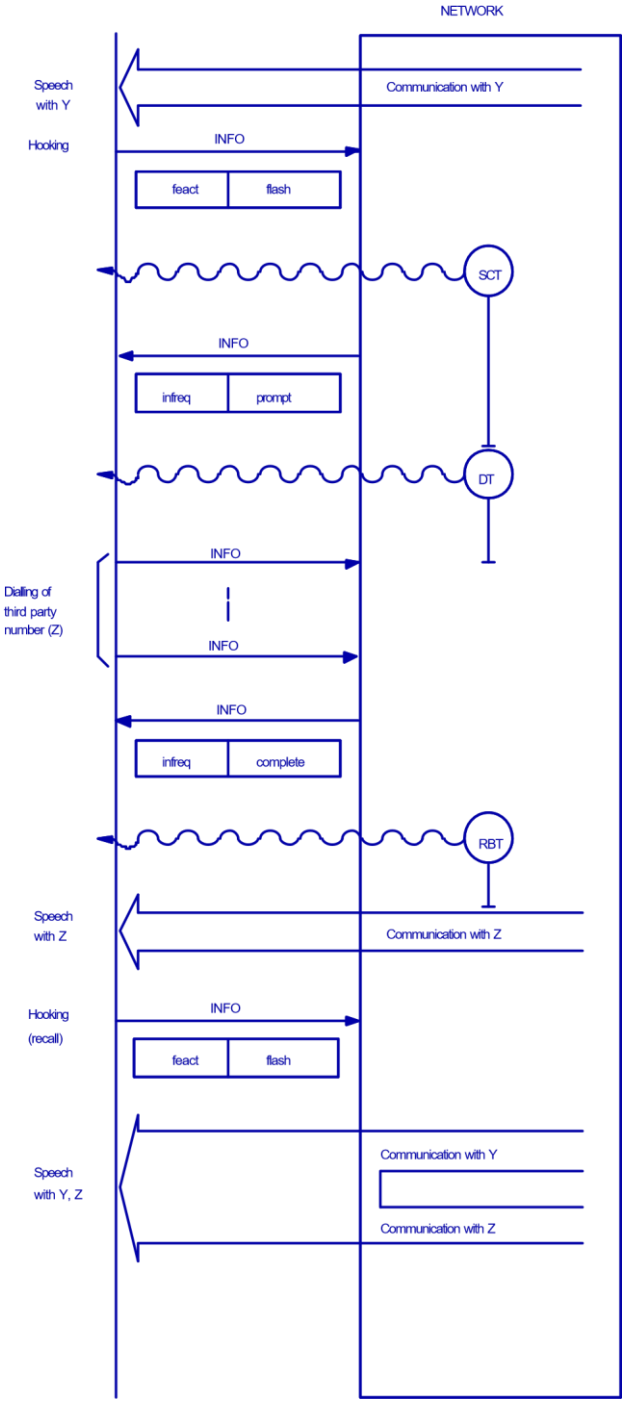
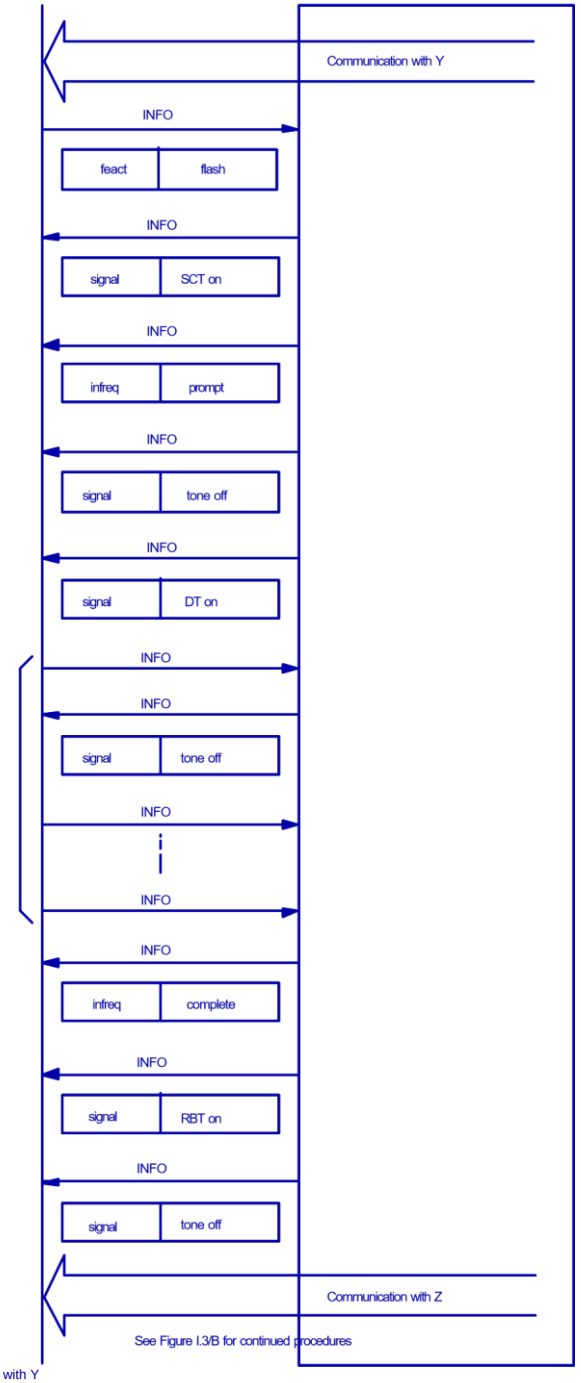


FIGURE I.3/C **Three Way Calling -**

Network Provided Tones

TE NETWORK



Speech with Y

Hooking
(recall)

(SCT on)

(SCT off)

(DT on)

FIGURE I.4/C

Three Way Calling - Terminal Provided Tones