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SPECIFICATIONS OF SIGNALLING SYSTEM No. 7

STAGE 3 DESCRIPTION FOR COMMUNITY OF INTEREST SUPPLEMENTARY SERVICES USING SS No. 7
Clause 1 – Closed User Group (CUG)
Clause 3 – Multilevel precedence and preemption

ITU-T Recommendation Q.735

(Previously "CCITT Recommendation")

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation Q.735, clauses 1 and 3, was prepared by the ITU-T Study Group XI (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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CONTENTS

			Page
1	Closed User Group (CUG)		1
	1.1	Definition	1
	1.2	Description	1
	1.3	Operational requirements	2
	1.4	Coding requirements	2
	1.5	Signalling requirements	10
	1.6	Interactions with other supplementary services	13
	1.7	Interaction with other networks	15
	1.8	Signalling flows	15
	1.9	Parameter value (timers)	19
	1.10	Dynamic description (SDLs)	19
3	Multilevel precedence and preemption (MLPP)		24
	3.1	Definition	24
	3.2	Description of MLPP service	24
	3.3	Operational requirements	25
	3.4	Coding requirements	25
	3.5	Signalling Requirements	31
	3.6	Interactions with other supplementary services	41
	3.7	Interactions with other networks	43
	3.8	Signalling Flows	43
	3.9	Parameter Values-Timers	49
	3.10	Dynamic Description (SDLs)	49
Appendix I			66

Recommendation Q.735

STAGE 3 DESCRIPTION FOR COMMUNITY OF INTEREST SUPPLEMENTARY SERVICES USING SS No. 7

(Helsinki, 1993)

1 Closed User Group (CUG)

1.1 Definition

The supplementary service Closed User Group (CUG) enables users to form groups, to and from which access is restricted. A specific user may be a member of one or more CUGs. Members of a specific CUG can communicate among themselves but not with users outside the group. Specific CUG members can have additional capabilities that allow them to originate calls outside the group, and/or to receive calls from outside the group. Specific CUG members can have additional restrictions that prevent them from originating calls to other members of the CUG, or from receiving calls from other members of the CUG.

1.2 Description

1.2.1 General description

A CUG is a group of users who may be members of one or several public networks; each ISDN member of a CUG is identified by an ISDN number.

The Closed User Group (CUG) supplementary service enables a group of users to intercommunicate only among themselves or, as required, one or more users may be provided with incoming/outgoing access to users outside the group.

The stage 1 definition of the CUG service is given in Recommendation I.255. The stage 2 description including network functions are given in Recommendation Q.85.1, and the stage 3 DSS 1 description is given in Recommendation Q.955.1. This stage 3 description of the CUG uses the ISDN User Part protocol as defined in Recommendations Q.761-Q.764 and Q.730.

The realization of the CUG facilities is done by the provision of interlock codes and is based on various validation checks as defined in Recommendation Q.85 at call set-up, determining whether or not a requested call to or from a user having a CUG facility is allowed. In particular, a validation check is performed by verifying that both the calling and called parties belong to the CUG indicated by the interlock code.

The data for each CUG that a user belongs to can either be stored at the local exchange to which the user is connected (decentralized administration of CUG data), or at dedicated point(s) in the network (centralized administration of CUG data).

In 1.5.2.1.1 i) the call set-up procedure based on decentralized administration of CUG data is specified making use of the ISDN User Part as defined in Recommendations Q.761-764 and Q.766.

In 1.5.2.1.1 ii) the call set-up procedure based on centralized administration of CUG data is specified making use of the ISDN User Part as defined in Recommendations Q.761-764, Q.766 and Q.767 and the Transaction Capabilities (TC) as defined in Recommendations Q.771-775.

In 1.5.2.1.1 ii) the application service element (ASE) on top of Transaction Capabilities for CUG validation check with centralized administration of CUG data is specified.

1.2.2 Specific terminology

CUG: Closed User Group.

Calling Party Number is the network (e.g. E.164) number of the calling party.

Called Party Number is the network (e.g. E.164) number of the called party.

CUG Interlock Code is the code to uniquely identify a CUG inside the network.

Called User Index is the local index at the called user to identify a particular CUG he belongs to.

CMC: CUG Management Centre

1.2.3 Qualification on the applicability to telecommunication services

Not applicable.

1.2.4 State definitions

No specific state definitions are required.

1.3 Operational requirements

1.3.1 Provision/withdrawal

See Recommendation I.255.1.

1.3.2 Requirements on the originating network side

Not applicable.

1.3.3 Requirements in the network

No specific network requirement identified.

1.3.4 Requirements on the terminating network side

Not applicable.

1.4 Coding requirements

Clause 3/Q.763 gives the coding for the Closed User Group interlock code and the Optional forward call indicator parameters which are required to support this service.

See Tables 1-1 through 1-10.

TABLE 1-1/Q.735

Action at the gateway with a network without CUG capability

CUG call indicator in IAM	Action at the gateway exchange
CUG without outgoing access	Release the call with cause #29
CUG with outgoing access	Treat the call as an ordinary call[a)]
Non-CUG	Treat the call as an ordinary call

a) Discard the interlock code parameter and change the CUG call indicator of the optional forward call indicator to non-CUG call or discard the whole parameter if appropriate.

TABLE 1-2/Q.735

Handling of a CUG call at the destination exchange

<table>
<tr><td rowspan="3">CUG call indicator in IAM</td><td rowspan="3">CUG match check</td><td colspan="5">Class of called user</td></tr>
<tr><td colspan="2">CUG</td><td colspan="2">CUG+IA</td><td rowspan="2">No CUG</td></tr>
<tr><td>No ICB</td><td>ICB</td><td>No ICB</td><td>ICB</td></tr>
<tr><td rowspan="2">CUG with OA not allowed</td><td>Match</td><td>CUG call</td><td>Release cause #55</td><td>CUG call</td><td>Release cause #55</td><td rowspan="2">Release the call with cause #87</td></tr>
<tr><td>No match</td><td colspan="2">Release the call with cause #87</td><td colspan="2">Release the call with cause #87</td></tr>
<tr><td rowspan="2">CUG with OA allowed</td><td>Match</td><td>CUG call</td><td>Release cause #55</td><td>CUG+OA call</td><td>Non-CUG call</td><td rowspan="2">Non-CUG call</td></tr>
<tr><td>No match</td><td colspan="2">Release the call with cause #87</td><td colspan="2">Non-CUG call</td></tr>
<tr><td>Non-CUG</td><td>–</td><td colspan="2">Release the call with cause #87</td><td colspan="2">Non-CUG call</td><td>Non-CUG call</td></tr>
</table>

IA Incoming access

OA Outgoing access

ICB Incoming calls barred

Match called The interlock code in the received IAM matches one of the CUGs to which the user belongs.

No match The interlock code does not match any of the CUGs to which the called user belongs.

NOTE – As OA attribute of the called user is of no concern at the destination exchange, CUG+OA class is equivalent to CUG, and CUG+IA class is equivalent to CUG+IA in this table. Subscription of preferential CUG by the called user is also of no concern in this table.

TABLE 1-3/Q.735

Validation check of CUG call concerning the calling user

Calling user class	Indication from calling user				
	CUG call with index	CUG+OA call with index	CUG call without index	CUG+OA call without index	Non-CUG call
CUG without pref.	CUG call (*1) (*3) IC: spec. CUG	CUG call (*1) (*3) IC: spec. CUG	Return Error cause #62	Return Error cause #62	Return Error cause #62
CUG+OAE without pref.	CUG call (*1) (*3) IC: spec. CUG	CUG+OA (*2) (*3) IC: spec. CUG	Return Error cause #62	Non-CUG call	Return Error cause #62
CUG+OAI without pref.	CUG+OA (*2) (*3) IC: spec. CUG	CUG+OA (*2) (*3) IC: spec. CUG	Non-CUG call	Non-CUG call	Non-CUG call
CUG with pref.	CUG call (*1) (*3) IC: spec. CUG	CUG call (*1) (*3) IC: spec. CUG	CUG (*4) call IC: pref. CUG	Return Error cause #62	CUG call IC: pref. CUG (*4)
CUG+OAE with pref.	CUG call (*1) (*3) IC: spec. CUG	CUG+OA (*2) (*3) IC: spec. CUG	CUG (*4) IC: pref. CUG	Non-CUG call	CUG call (*4) pref. CUG
CUG+OAI with pref.	CUG+OA (*1) (*2) (*3) IC: spec. CUG	CUG+OA (*2) (*3) (*1) IC: spec. CUG	(*4) (*5)	CUG+OA (*1) (*4) IC: pref. CUG	(*4) (*5)
No CUG	Return Error cause #50	Return Error #50	Return Error #50	Return Error #50	Non-CUG call

OAE Outgoing access, explicit request required.

OAI Outgoing access, implicit outgoing access for all calls.

IC Interlock code of the CUG selected.

NOTE – As IA (incoming access) attribute of the calling user is of no concern for this validation check, CUG+OA/IA is equivalent to CUG+OA in this table.

(*1) In case of OCB (outgoing calls barred) within the Error with cause #53.

(*2) In case of OCB within the CUG, the call is interpreted as a non-CUG call.

(*3) In case the specified index does not match any of the registered indices, Return Error with cause #90.

(*4) In the case of OCB within the CUG, this combination is not allowed.

(*5) Both “Preferential CUG” and “implicit” outgoing access options imply that no subscriber procedures are needed to invoke either options when placing a call. When a user subscribes to both options, the network does not know which option the user is invoking, if no additional procedures are used when placing the call. Then one of the following operations are recommended:

a) if no information is given, the preferential CUG will be assumed;

b) the network will route the call with preferential CUG with outgoing access. The call will therefore be connected if the called access is:

– a member of preferential CUG; or

– a member of another CUG with incoming access; or

– a non-CUG user.

TABLE 1-4/Q.735

Validation check of CUG call concerning the called user

<table>
<tr><td rowspan="3">CUG call ind. in IAM</td><td rowspan="3">CUG match check</td><td colspan="5">Class of called user</td></tr>
<tr><td colspan="2">CUG</td><td colspan="2">CUG+IA</td><td rowspan="2"></td></tr>
<tr><td>No ICB</td><td>ICB</td><td>No ICB</td><td>ICB</td></tr>
<tr><td rowspan="2">CUG with OA not allowed</td><td>Match</td><td>CUG call</td><td>Return Error cause #55</td><td>CUG call</td><td>Return Error cause #55</td><td>Return Error with cause #87</td></tr>
<tr><td>No match</td><td colspan="2">Return Error with cause #87</td><td colspan="2">Return Error with cause #87</td><td></td></tr>
<tr><td rowspan="2">CUG with OA allowed</td><td>Match</td><td>CUG call</td><td>Return Error cause #55</td><td>CUG+OA call</td><td>Non-CUG call</td><td rowspan="2">Non-CUG call</td></tr>
<tr><td>No match</td><td colspan="2">Return Error with cause #87</td><td colspan="2">Non-CUG call</td></tr>
<tr><td>Non-CUG</td><td>–</td><td colspan="2">Return Error with cause #87</td><td colspan="2">Non-CUG call</td><td>Non-CUG</td></tr>
</table>

Match The interlock code in the receive IAM matches one of the CUGs the called user belongs to.

No match The interlock code does not match any of the CUGs the called user belongs to.

NOTES

1 As OA (outgoing access) attribute of the called user is of no concern at the destination exchange, CUG+OA class is equivalent to CUG and CUG+OA/IA class is equivalent to CUG+IA in this table.

Subscription of preferential CUG by the called user is also of no concern in this table.

2 The ASN.1 information for the centralized CUG service is contained in Appendix I.

TABLE 1-5/Q.735

Parameters of operations and outcomes

CUG Check 1

CUG Check 1	Timer = 5-10 sec	Class = 1	Code = 00000001
Parameters with Invoke		Opt/Man	Reference
CallingUserIndex		O	10.1
CUGCallIndicator		M	10.2
CallingPartyNumber		M	10.3
BearerCapability		M	10.9
HighLayerCompatibility		O	10.10
Parameters with Return Result			
CUGInterlockCode		O	10.5
CUGCallIndicator		M	10.2
Linked Operations			
Not applicable			
Errors			
UnsuccessfulCheck			10.7

NOTES

1 The CallingPartyNumber (10.3) is the network (e.g. E.164) number of the calling party. It is expressed in the same manner as the ISUP Calling party number in 3.8/Q.763. The code of this parameter is "10000011".

2 The CUGInterlockCode (10.5) is the code to uniquely identify a CUG inside the network. It is expressed in the same manner as the ISUP CUG interlock code in 3.13/Q.763. The code of this parameter is "10000101".

3 The BearerCapability (10.9) is expressed in the same manner as the Bearer capability information element (octets 3 & 4) from 4.5.1/Q.931 to 4.5.29/Q.931. The code for this parameter is "10001000".

```
CUGCheck1                    OPERATION

PARAMETER      SEQUENCE      { BearerCapability,
                             CUGCallIndicator,
                             CallingPartyNumber,
                             CallingUserIndex  OPTIONAL,
                             HighLayerCompatibility  OPTIONAL }

RESULT         SEQUENCE      { CUGCallIndicator,
                             CUGInterlockCode  OPTIONAL }

ERRORS                       { UnsuccessfulCheck }
::= 1
```

TABLE 1-6/Q.735

Parameters of operations and outcomes

CUG Check 2

CUG Check 2	Timer = 5-10 sec	Class = 1	Code = 00000010
Parameters with Invoke		Opt/Man	Reference
CUGInterlockCode		O	10.5
CUGCallIndicator		M	10.2
CalledPartyNumber		M	10.4
BearerCapability		M	10.9
HighLayerCompatibility		O	10.10
Parameters with Return Result			
CalledUserIndex		O	10.6
CUGCallIndicator		M	10.2
Linked Operations			
Not applicable			
Errors			
Unsuccessful Check			10.7

NOTES

1 The CalledPartyNumber (10.4) is the network (e.g. E.164) number of the called party. It is expressed in the same manner as the ISUP Called party number in 3.7/Q.763. The code of this parameter is "10000100".

2 The CalledUserIndex (10.6) is the local index at the called user to identify a particular CUG the called user belongs to. The code of this parameter is "10000110".

3 The HighLayerCompatibility (10.10) is expressed in the same manner as the High layer compatibility information element (octet 3) from 4.5.1/Q.931 to 4.5.29/Q.931. The code of this parameter is "10001001".

```
CUGCheck2                    OPERATION

PARAMETER     SEQUENCE       { BearerCapability,
                               CUGCallIndicator,
                               Called PartyNumber,
                               CUGInterlockCode  OPTIONAL,
                               HighLayerCompatibility  OPTIONAL }

RESULT        SEQUENCE       { CUGCallIndicator,
                               CalledUserIndex  OPTIONAL }

ERRORS        { UnsuccessfulCheck }
::= 2
```

TABLE 1-7/Q.735

Parameter coding

CallingUserIndex	Code = 10000001
Contents	Meaning
Integer	Binary representation of the CUG index

NOTE – The CallingUserIndex (10.1) is the local index at the calling user to identify a particular CUG the calling user belongs to.

```
CallingUserIndex    ::= [1] IMPLICIT LocalIndex
LocalIndex          ::= INTEGER (0 .. 32767)
-- Some networks may specify a maximum value of the CUG Index from 0 to 9999.
```

TABLE 1-8/Q.735

CUGCallIndicator

CUGCallIndicator	Code=10000010
Contents	Meaning
00000000	Non-CUG call
00000001	Non-CUG call
00000010	CUG call with outgoing access
00000011	CUG call without outgoing access

NOTE – The CUGCallIndicator (10.2) indicates whether the call is requested or designated as a CUG call and whether outgoing access is requested or allowed.

```
CUGCallIndicator    :: [2] IMPLICIT CallIndicator

CallIndicator       :: INTEGER  { NonCUGCall  (0),
                                  NonCUGCall  (1),
                                  outgoingAccessAllowedCUGCall (2),
                                  outgoingAccessNotAllowedCUGCall (3) }
```

TABLE 1-9/Q.735

Errors

UnsuccessfulCheck	Code = 00000001
Parameters	
Cause	10.8
UnsuccessfulCheck Error **PARAMETERS { Cause }** **::= 1**	

TABLE 1-10/Q.735

Cause

Cause		Code = 10000111
Contents binary (decimal)	Meaning	
00110010 (50) 00110101 (53) 00110111 (55) 00111110 (62) 01011010 (90) 01010111 (87) 01011000 (88) 01101111 (111)	Requested facility not subscribed Outgoing calls barred within CUG Incoming calls barred within CUG InconsistencyInDesignatedOutgoing AccessInformationAndSubscriber Class Non-existent CUG User not member of CUG Incompatible destination Protocol error, unspecified	

NOTE – The Cause indicates the reason why the CUG check is unsuccessful.

```
Cause       ::= [7] IMPLICIT CauseCode
CauseCode   ::= INTEGER   { RequestedFacilityNotSubscriber (50),
                            outgoingCallsBarredWithinCUG (53),
                            incomingCallsBarredWithinCUG (55),
                            inconsistencyInDesignatedOutgoing-
                            AccessInformationAndSubscriberClass (62),
                            UserNotMemberOfCUG (87),
                            IncompatibleDestination (88),
                            ProtocolErrorUnspecified (111) }
```

1.5 Signalling requirements

1.5.1 Activation/deactivation/registration

Not applicable.

1.5.2 Invocation and operation

1.5.2.1 Actions at the originating local exchange

1.5.2.1.1 Normal operation

Upon receipt of a request for CUG service the network shall check its validity in conjunction with the access capabilities contained in the user profile. If a non-valid request is received or the checks cannot be performed, then the network shall reject the call and return an appropriate indication to the calling user.

The realization of the CUG facilities is accomplished by the provision of interlock codes and is based on various validation checks as defined in Recommendation Q.85 at call set-up, determining whether or not a requested call to or from a user having a CUG facility is allowed. In particular, a validation check is performed by verifying that both the calling and called parties belong to the CUG indicated by the interlock code.

The data for each CUG that a user belongs to, can either be stored at the originating local exchange to which the user is connected (decentralized administration of CUG data), or at dedicated point(s) in the network (centralized administration of CUG data).

i) **Normal operation with decentralized administration of CUG data**

The actions at the originating exchange at call set-up from a user belonging to a CUG, depends on the result of the validation checks performed, based on whether the user belongs to one or more CUGs and on the combination of CUG facilities that applies.

a) *CUG without outgoing access*

If the result of the validation check indicates that the call should be dealt with as a CUG call, the interlock code of the selected CUG is obtained. The initial address message forwarded to the next exchange then includes the interlock code together with an indication that the call is a CUG call without outgoing access. The ISUP preference indicator of the forward call indicators parameter in the IAM is set to "ISUP required all the way".

b) *CUG call with outgoing access*

If the result of the validation check indicates that the call should be dealt with as a CUG call with outgoing access, the interlock code of the selected CUG together with an outgoing access indication is obtained. The initial address message forwarded to the next exchange then includes the interlock code together with an indication that the call is a CUG call for which outgoing access is allowed. The ISUP preference indicator of the forward call indicators parameter in the IAM is set to "ISUP preferred all the way", unless another service requires a more stringent setting.

c) *Non-CUG*

If the result of the validation check indicates that the call should be dealt with as a non-CUG call, the initial address message forwarded to the next exchange then does not include an interlock code nor a CUG call indication.

d) *Call rejected*

If the result of the validation check indicates that the call is to be rejected, the call set-up is not initiated.

See Table 1-3.

ii) **Normal operation with centralized administration of CUG data**

NOTE – This procedure is not compatible with the *Blue Book* version of centralized CUG. However, the possibility exists to map binary characters to IA5 characters.

In the local exchange an indication is stored, showing only whether the user has either none or one of the Closed User Group facilities.

The originating exchange requests the CUG validation check to the dedicated point by invocation of the "CUG check 1" operation through TC. This operation and associated parameters are described in Figure 1-3. The following actions at the originating exchange depend on the result of this validation check.

a) *CUG call indication*

If the result of the validation check for the calling user at the originating exchange indicates that the check for the calling user has been successful, the interlock code of the selected CUG possibly together with an outgoing access indication is obtained. The initial address message forwarded to the next exchange then includes the interlock code together with an indication that the call is a CUG call without outgoing access or a CUG call with outgoing access.

b) *Non-CUG call indication*

If the result of the validation check indicates that the call should be dealt with as a non-CUG call, the initial address message forwarded to the next exchange then does not include an interlock code or a CUG call indication.

c) *Call rejected*

If the result of the validation check indicates that the call is to be rejected, the call set-up is not initiated.

ASE for CUG service with centralized administration of CUG data

The application service element (ASE) for CUG service with centralized administration of CUG data provides the procedures between the exchanges and the CUG management centres (CMC) for CUG validation check.

Two similar but different procedures are defined for CUG validation check. One is the procedure between the originating exchange of a CUG call and a CMC to check the qualification of the calling user to establish the present CUG call. The other is the procedure between the terminating exchange of a CUG call and a CMC to check the qualification of the called user to accept the present CUG call. One TC operation is defined for each of these procedures.

Procedure

CUG Check 1

This operation is used between the originating exchange of a call and dedicated point for CUG validation check of the calling user.

To check the qualification of the calling user the originating exchange initiates the transaction to the CMC by invocation of the CUG Check 1 operation with appropriate parameters. The CMC, in response to this invocation, terminates the transaction with the check result. The check result contains the interlock code and other parameters in case of successful check or an error cause in case of unsuccessful check. Figure 1-3 shows the primitive flows between the ASE and the TC at the exchange and between the ASE and the TC at the CMC for this case. Table 1-3 shows the result of the validation check which is performed by the CMC, according to various parameters, concerning the calling use.

1.5.2.1.2 Exceptional procedures

No exceptional procedures are identified.

1.5.2.2 Actions at the transit exchange

1.5.2.2.1 Normal operation

Each transit exchange sets up a CUG call as an ordinary call. The information related to the CUG facilities received from the preceding exchange, i.e. an interlock code, a CUG call indication possibly with an indication that outgoing access is allowed, is forwarded to the succeeding exchange.

1.5.2.2.2 Exceptional procedures

No exceptional procedures are identified.

1.5.2.3 Actions at the outgoing international gateway exchange

1.5.2.3.1 Normal operation

In the case of an international CUG call, no special functions are required at the gateway exchange provided that the international interlock code assigned to the international CUG concerned is used in the national network at the gateway exchange. However, in the case where a national interlock code other than the applicable international interlock code is used within a national network, interlock code conversion is required at the gateway exchange.

1.5.2.3.2 Exceptional procedures

No exceptional procedures are identified.

1.5.2.4 Actions at the incoming international gateway exchange

1.5.2.4.1 Normal operation

In the case of an international CUG call, no special functions are required at the gateway exchange provided that the international interlock code assigned to the international CUG concerned is used in the national network at the gateway exchange. However, in the case where a national interlock code other than the applicable international interlock code is used within a national network, interlock code conversion is required at the gateway exchange.

1.5.2.4.2 Exceptional procedures

In case of interworking with a network which does not support the CUG facility, the incoming gateway exchange may release the call depending on the contents of the CUG call indicator in the received IAM. The action at the gateway exchange, in this case, is indicated in Table 1-1. In cases where a call is rejected as the result of the interworking, a release message including the cause parameter indicating #29 Facility rejected + diagnostics indicating CUG without access is sent towards the originating exchange.

1.5.2.5 Actions at the destination local exchange

1.5.2.5.1 Normal operation

i) **Decentralized CUG**

At the destination exchange a validation check of the acceptability of a call is made according to the rule specified in Recommendation Q.85 where either the calling party (as indicated by a CUG call indication or the CUG interlock code in the initial address message received) or the called party belongs to a CUG. The call set-up is continued only in cases where the information received checks with the information stored at the destination exchange. Table 1-2 indicates the action to be taken by the destination exchange as the result of the validation check.

In cases where a call is rejected as the result of the validation check because of incompatible CUG information, a release message including the cause parameter indicating one of the following values is sent towards the originating exchange:

#29 Facility rejected + diagnostics indicating CUG without OA

#55 Incoming calls barred within CUG

#87 User not member of CUG

#111 Protocol error, unspecified.

Figure 1-1 illustrates example message flows for CUG calls with decentralized administration of CUG data.

ii) **Centralized CUG**

In the case of an incoming CUG call for which the validation check for the calling user has successfully been performed, by the validation of the CUG call indication or the CUG interlock code. The received initial address message includes the interlock code and CUG call indication possibly with an indication that outgoing access is allowed. The destination exchange then forwards the information received in the initial address message to the dedicated point for CUG validation check. In this case, the destination exchange invokes the “CUG Check 2” operation through TC. This operation and associated parameters are defined below.

a) *Check successful indication*

If the result of the validation check indicates that the check has been successful, the index of the CUG selected for the called user and possibly an outgoing access indication are obtained. The CUG call set-up request is forwarded to the called user with these indications.

b) *Non-CUG call indication*

If the result of the validation check indicates that the call should be dealt with as a non-CUG call, the set-up request of a non-CUG call is forwarded to the called user.

c) *Call rejected*

If the result of the validation check indicates that the call is rejected, the reason why the call has been rejected is obtained. A release message including the cause parameter indicating one of the values, as listed in 1.5.2.5.1, is sent towards the originating exchange.

ASE for CUG service with centralized administration of CUG data

The application service element (ASE) for CUG service with centralized administration of CUG data provides the procedures between the exchanges and the CUG management centres (CMC) for CUG validation check.

The TC operation for the procedure between the terminating exchange of a CUG call and a CMC to check the qualification of the called user to accept the present CUG call is defined.

Procedure

CUG Check 2

This operation is used between the terminating exchange of a call and dedicated point for CUG validation check of the called user.

To check the qualification of the called user, the terminating exchange initiates the transaction to the CMC by invocation of the CUG Check 2 operation with appropriate parameters. The CMC, in response to this invocation, terminates the transaction with the check result. The check result contains the index number for the called user and other parameters in case of successful check or an error cause in case of unsuccessful check. Figure 1-4 shows the primitive flows between the ASE and the TC at the exchange and between the ASE and the TC at the CMC for this case. Table 1-4 shows the result of the validation check which is performed by the CMC, according to various parameters, concerning the called user.

At the dedicated point, the CUG validation check is performed according to the rules defined in Recommendation Q.85. The procedures between the dedicated point and the exchange follow those as defined in the ASE part of this Recommendation.

1.5.2.5.2 Exceptional procedures

If a non-CUG call is received with a CUG interlock code, or a CUG call is received without interlock code, then the call shall be released with cause #111 “protocol error, unspecified”.

1.6 Interactions with other supplementary services

1.6.1 Call waiting (CW)

No impact on ISUP.

1.6.2 Call transfer services

No applicable interaction at this time.

1.6.3 Connected line identification presentation (COLP)

No impact on ISUP.

1.6.4 Connected line identification restriction (COLR)

No impact on ISUP.

1.6.5 Calling line identification presentation (CLIP)

No impact on ISUP.

1.6.6 Calling line identification restriction (CLIR)

No impact on ISUP.

It is an option to allow invocation of CLIR in connection with a CUG call.

1.6.7 Closed User Group (CUG)

Not applicable.

1.6.8 Conference calling (CONF)

No impact on ISUP.

All conferees shall belong to the same Closed User Group. When adding a new conferee, the Closed User Group restrictions shall be checked before the new conferee is allowed to enter the conference.

This check is under the responsibility of the conference controller.

1.6.9 Direct dialling-in (DDI)

No impact on ISUP.

When the direct dialling-in supplementary service applies, the CUG supplementary membership shall not be available for each direct dialling-in number, but instead shall be on the basis of the entire range of direct dialling-in numbers applicable at an access or group of accesses.

1.6.10 Call diversion services

1.6.10.1 Call forwarding busy (CFB)

No impact on ISUP.

CUG restrictions must be met between the calling user and every intermediate forwarding user. The parameters of the CUG requested by the calling user will be used for the forwarding call and by this means CUG restrictions must be met between the calling user and the forwarded to user.

Served user B outgoing barring attributes will not be used to determine if forwarding can be done.

1.6.10.2 Call forwarding no reply (CFNR)

No impact on ISUP.

1.6.10.3 Call forwarding unconditional (CFU)

No impact on ISUP.

1.6.10.4 Call deflection (CD)

No impact on ISUP.

1.6.11 Line hunting (LH)

No impact on ISUP.

1.6.12 Three-party service (3PTY)

No impact on ISUP.

NOTE – For the successful invocation of the three-party supplementary service, any CUG restrictions normally applied to individual CUG calls between user A-B or A-C shall still apply when the three-party service is invoked, i.e. the CUG check procedure is only performed on each individual leg of the call.

1.6.13 User-to-user signalling (UUS)

1.6.13.1 User-to-user signalling, service 1 (UUS1)

No impact on ISUP.

1.6.13.2 User-to-user signalling, service 2 (UUS2)

No impact on ISUP.

1.6.13.3 User-to-user signalling, service 3 (UUS3)

No impact on ISUP.

1.6.14 Multiple subscriber number (MSN)

No impact on ISUP.

1.6.15 Call hold (HOLD)

No impact on ISUP.

1.6.16 Advice of charge (AOC)

No impact on ISUP.

1.6.17 Sub-addressing (SUB)

No impact on ISUP.

1.6.18 Terminal portability (TP)

No impact on ISUP.

1.6.19 Completion of calls to busy subscriber (CCBS)

No applicable interaction at this time.

1.6.20 Malicious call identification (MCID)

No impact on ISUP.

1.6.21 Reverse charging (REV)

No impact on ISUP.

1.6.22 Multilevel precedence and preemption (MLPP)

No impact on ISUP.

1.6.23 Private numbering plan (PNP)

No applicable interaction at this time.

1.6.24 Charge card

No applicable interaction at this time.

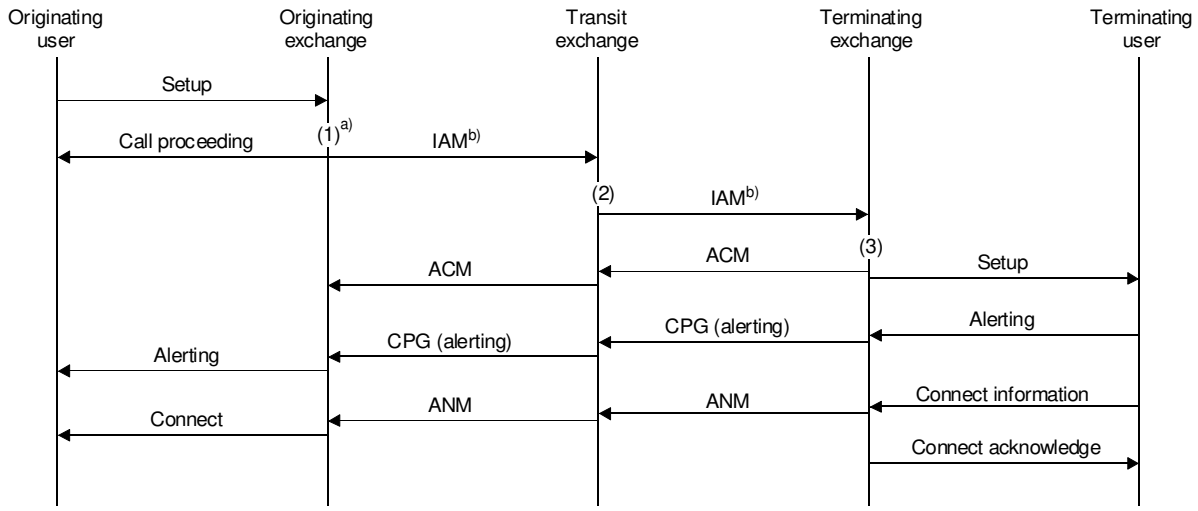
1.7 Interaction with other networks

A CUG may span over several networks. In this case the responsibility for the management of this CUG is in one of these networks; in addition, there is a need for a CUG identification mechanism that would be accepted by all of the encompassed networks. One such mechanism presently exists for CUGs spanning over data networks having X.121 as the numbering plan (see Recommendation X.180, Administrative Arrangements for International Closed User Groups). An equivalent mechanism should be defined for CUGs on networks using the E.164 numbering plan, or on networks which do not use the same numbering plan.

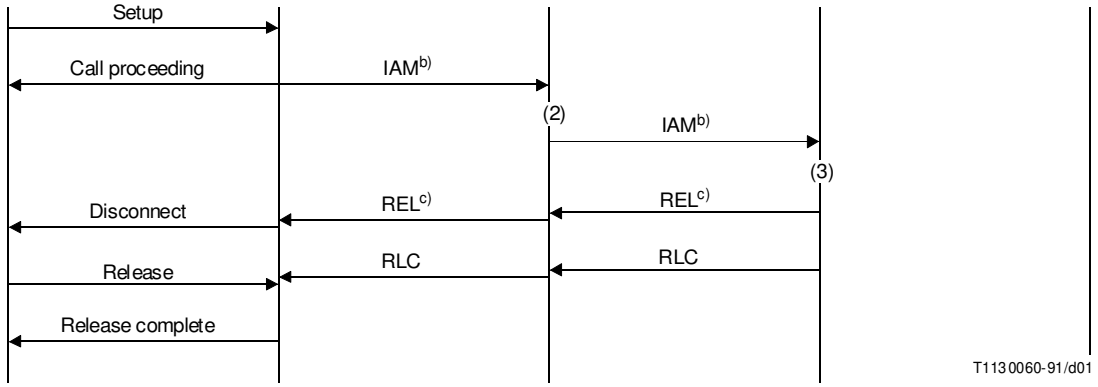
1.8 Signalling flows

Figure 1-1 for the decentralized CUG service.

FIgures 1-2 to 1-4 for the centralized CUG service.



a) Successful establishment of a CUG call



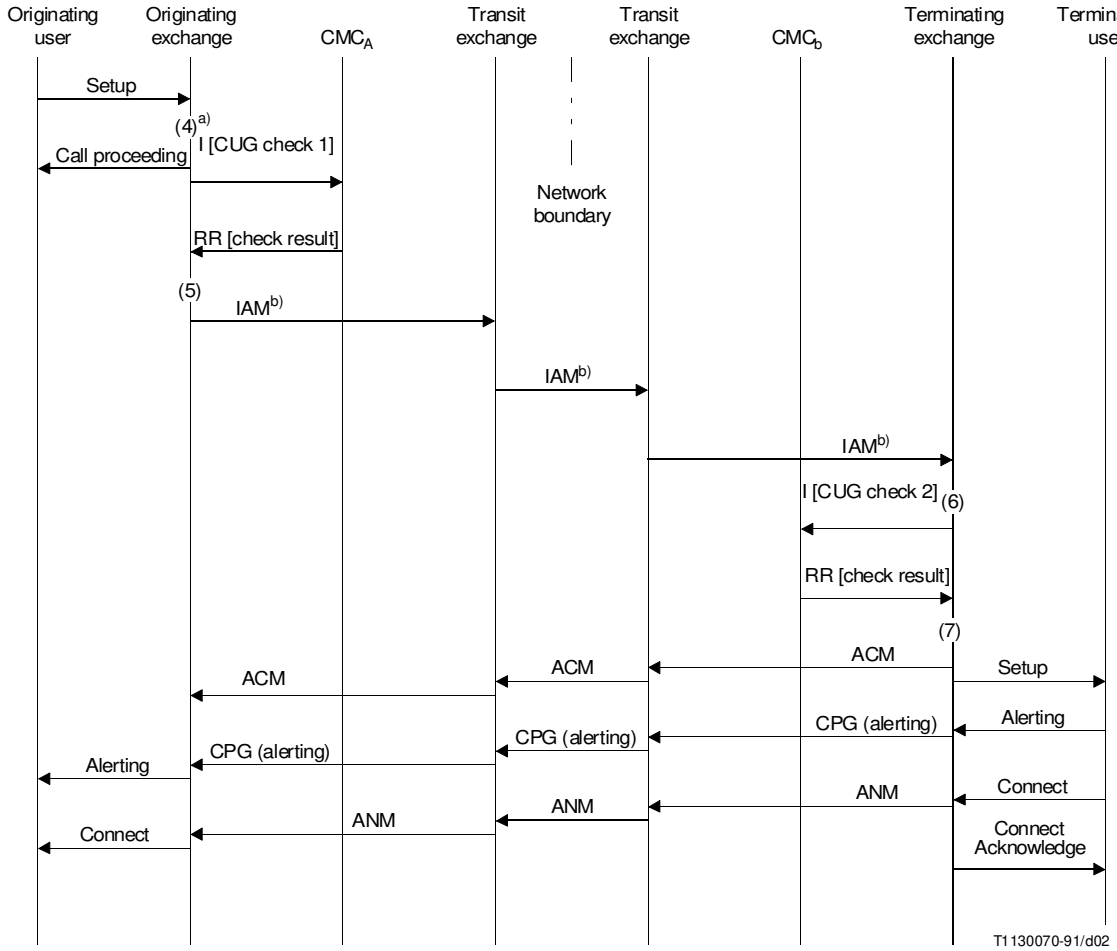
b) Unsuccessful establishment of a CUG call

OE Originating exchange
TE Transit exchange
DE Destination exchange
IAM Initial address message
CPG Call progress
ANM Answer message
ACM Address complete message

a) ( ) Indicates exchange functions. These are described below Figure 1-2.
b) IAM contains the interlock code and CUG call indication, possibly with outgoing access.
c) REL contains the cause parameter to indicate why the call is being released.

FIGURE 1-1/Q.735

Decentralized operation of CUG



CMC CUG management center
I Invoke
RR Return result

a) ( ) Indicates exchange functions. These are described below.

b) IAM contains the interlock code, CUG call indication possibly with outgoing access.

(1) Validation check on whether the requested call is allowed to the calling user. based on the data stored at the originating exchange.

(2) In the case of an international gateway exchange, interlock code conversion if the national network is not using international interlock codes.

(3) Validation check on whether the requested call is allowed to the called user, based on the data stored at the destination exchange.

(4) Check if the calling user subscribes to the CUG service.

(5) Check of the result of the validation check performed in a CMC.

(6) Check if the called user subscribes to the CUG service.

(7) Check of the result of the validation check performed in a CMC.

NOTE – Example message flow for a CUG call with centralized administration of CUG data.

FIGURE 1-2/Q.735

Centralized operation of CUG

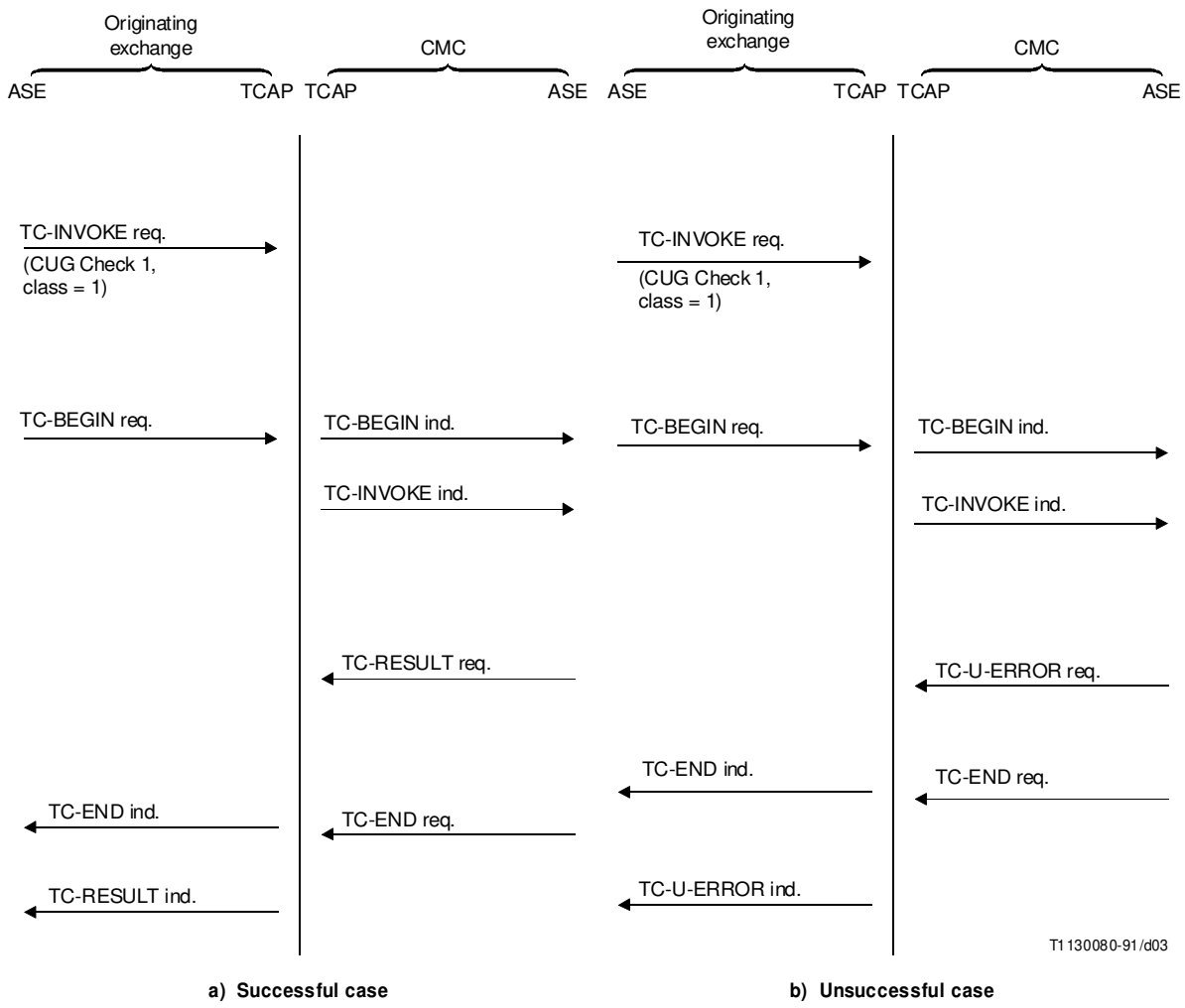


FIGURE 1-3/Q.735

Primitive flows between ASE and TCAP for CUG Check 1

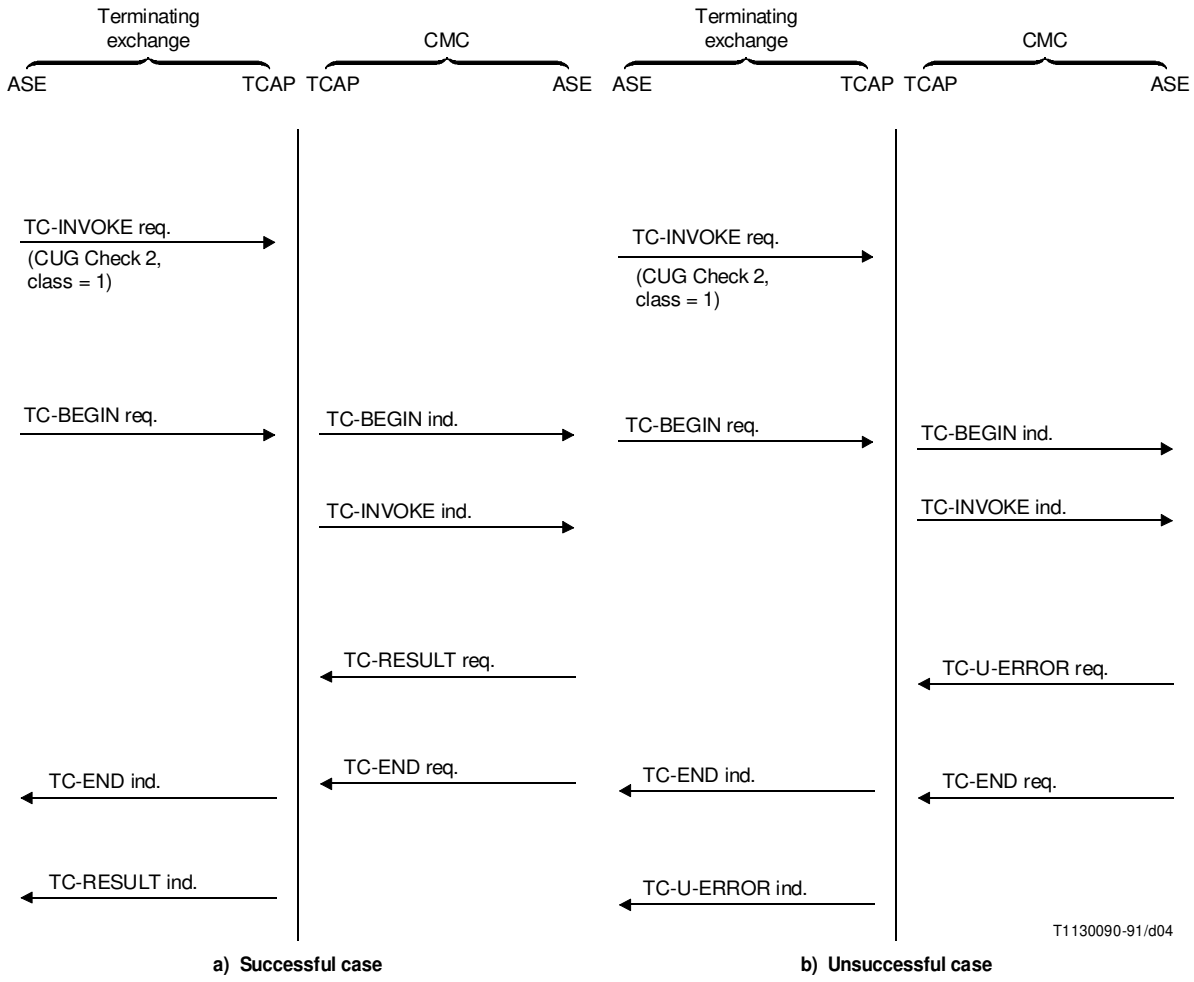


FIGURE 1-4/Q.735

Primitive flows between ASE and TCAP for CUG Check 2

1.9 Parameter value (timers)

No specific timers are required.

1.10 Dynamic description (SDLs)

See Figures 1-5 through 1-8.

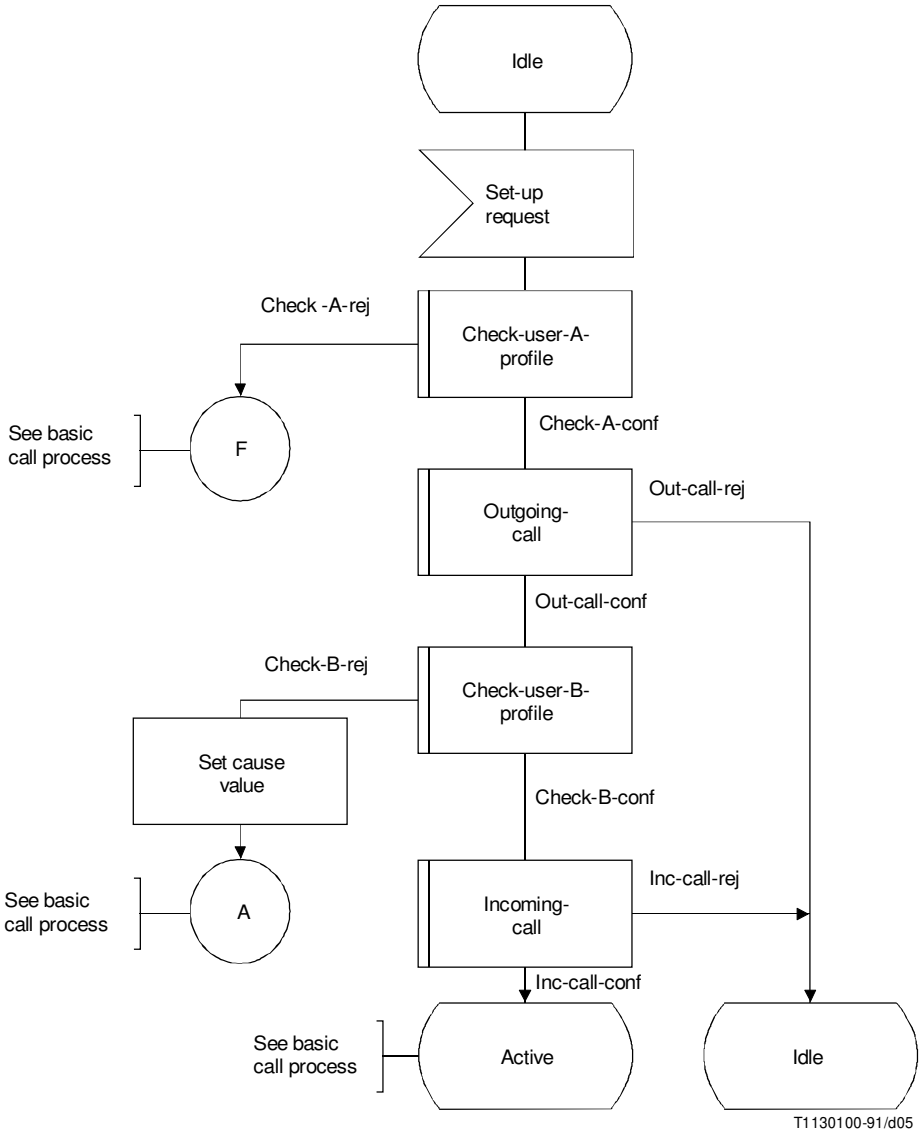


FIGURE 1-5/Q.735

Closed user group

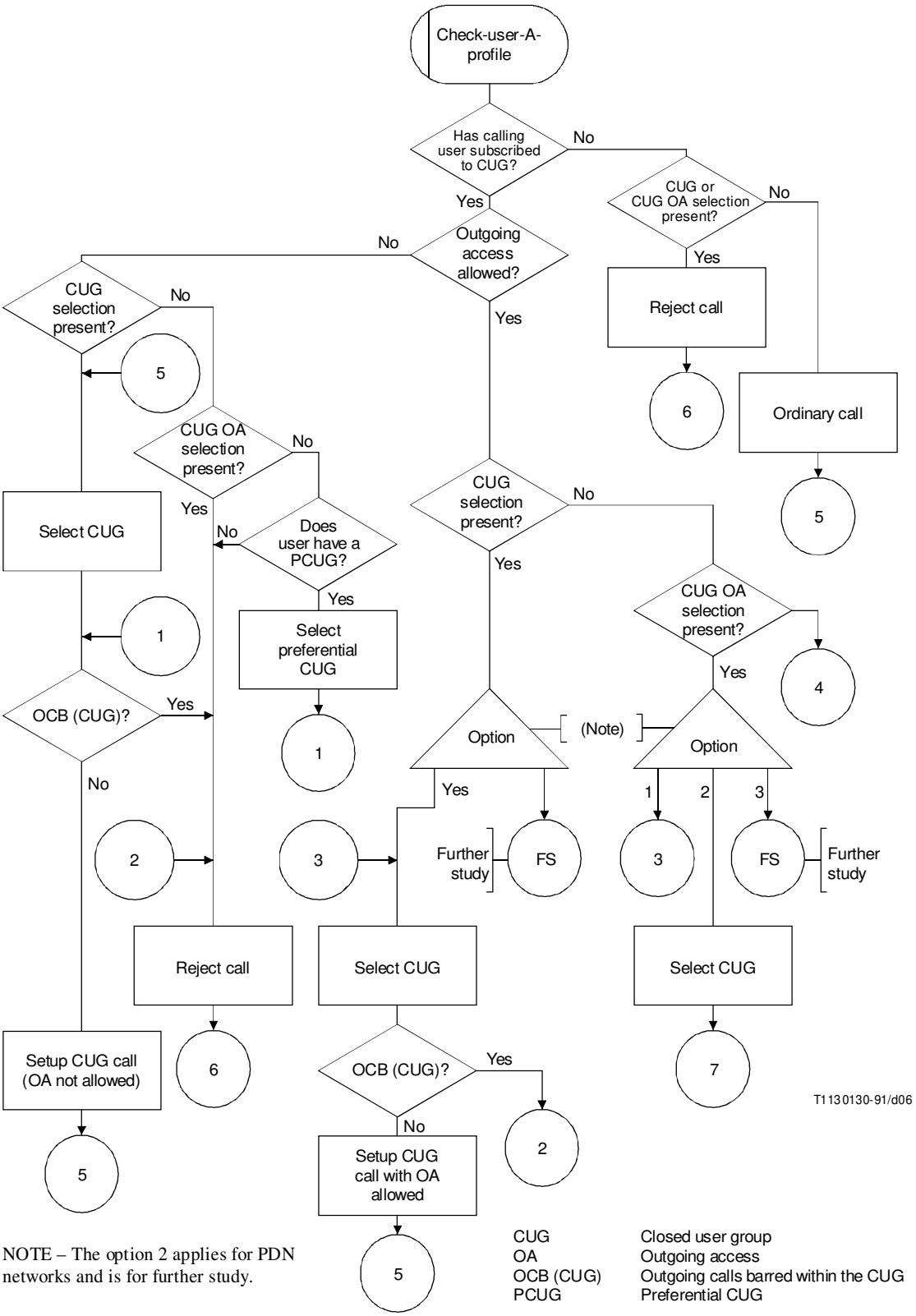
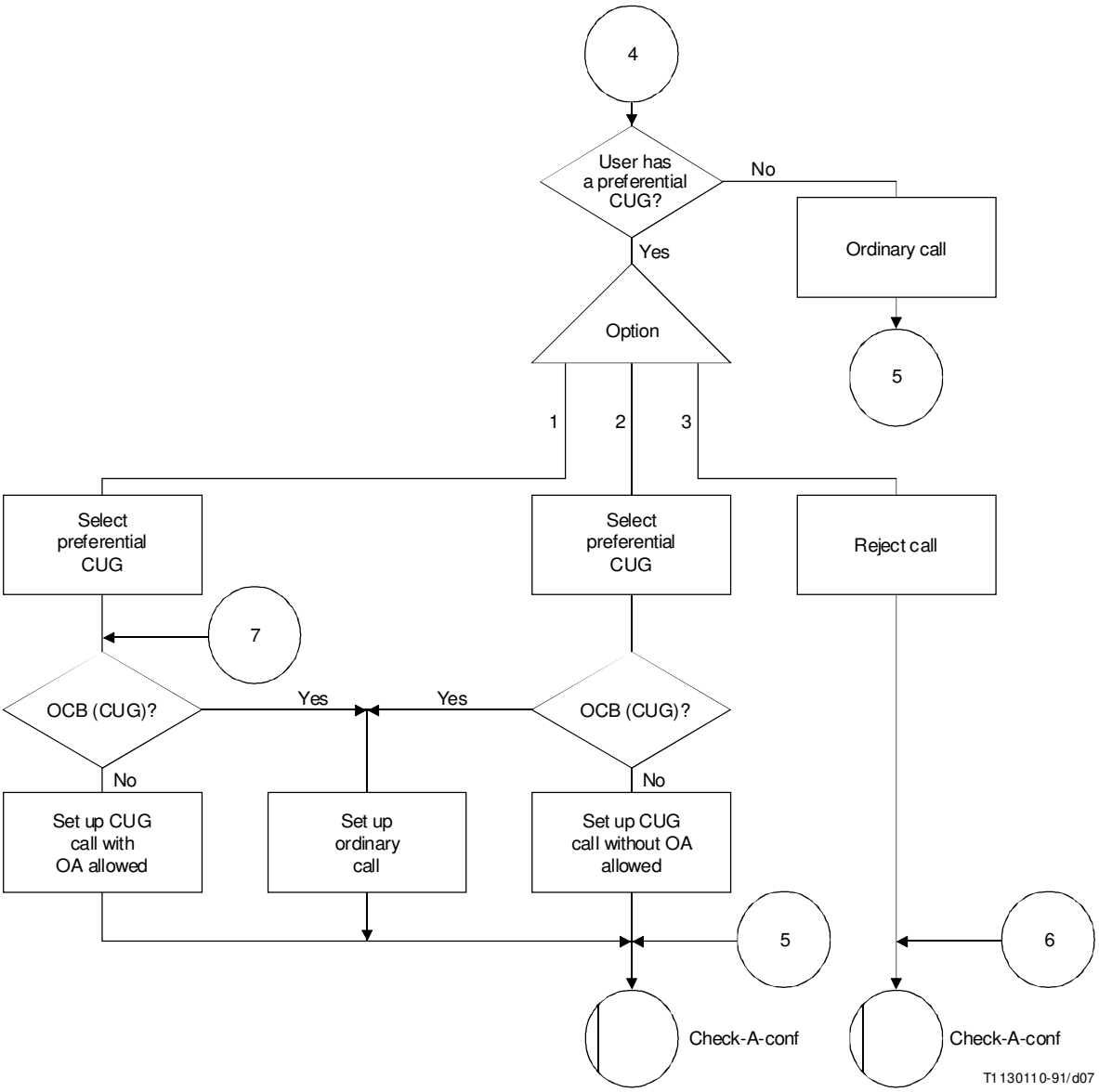


FIGURE 1-6/Q.735

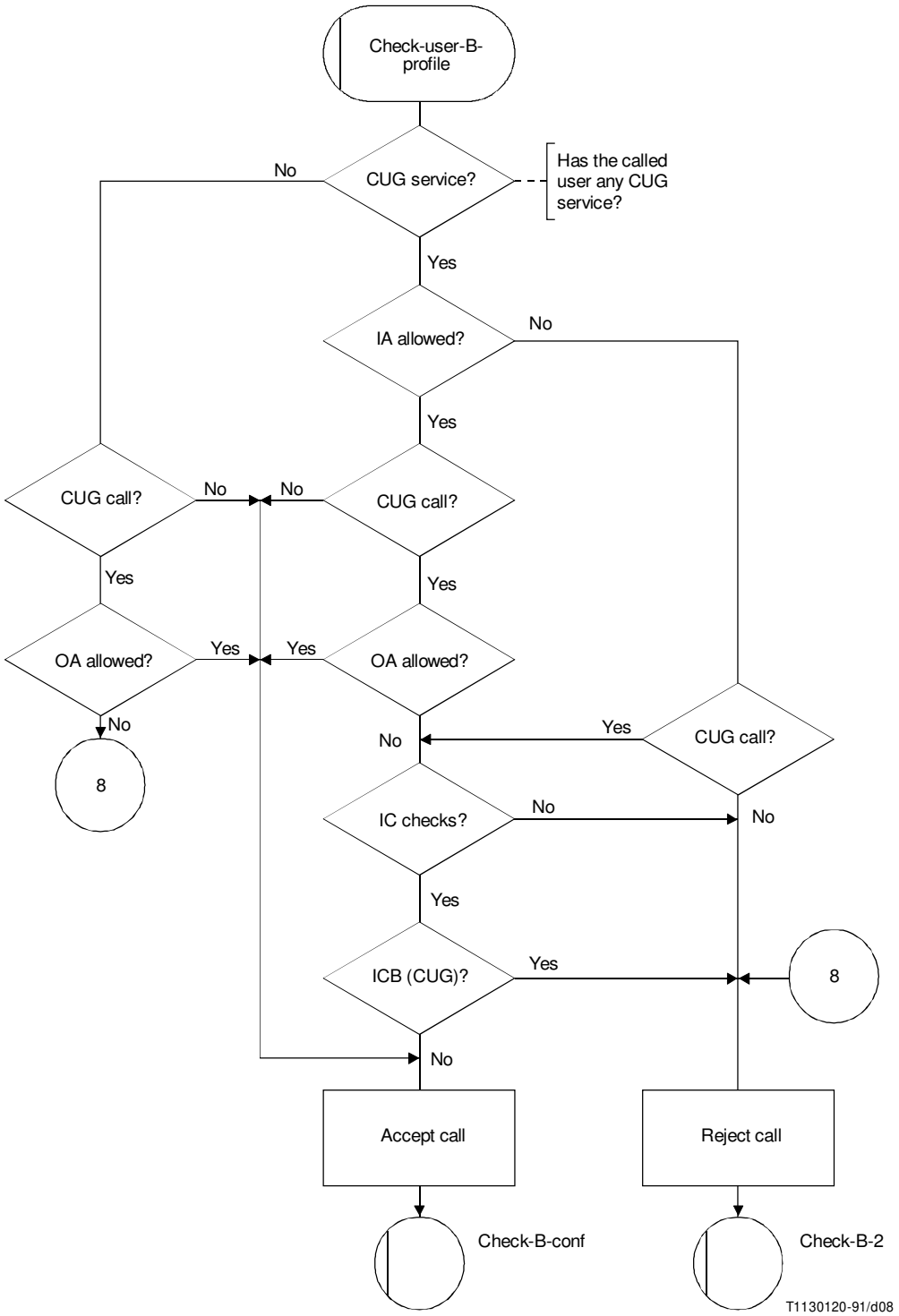
Closed user group



OA Outgoing access
OCB (CUG) Outgoing calls barred within the CUG

FIGURE 1-7/Q.735

Closed user group



IA Incoming access
OA Outgoing access
IC Interlock code
ICB (CUG) Incoming calls barred within the CUG

FIGURE 1-8/Q.735

Closed user group

3 Multilevel precedence and preemption (MLPP)

3.1 Definition

The Multilevel Precedence and Preemption (MLPP) supplementary service provides prioritized call handling service. This service has two parts – precedence and preemption. Precedence involves assigning a priority level to a call. Preemption involves the seizing of resources, which are in use by a call of a lower precedence, by a higher level precedence call in the absence of idle resources. Users in networks that do not support this service will not be affected by this service.

3.2 Description of MLPP service

3.2.1 General description

The MLPP service is provided as a network provider's option to a domain of a network. The domain can be the whole network or a subset of the network. The MLPP service applies to all network resources in the domain that is in common use. The maximum precedence level of a subscriber is set at the subscription time by the service provider based on the subscriber's need. The subscriber may select a precedence level up to and including the maximum subscribed to precedence level on a per call basis.

Precedence calls (MLPP calls that have a higher precedence than the lowest level of precedence) that are not responded to by the called party (e.g. call unanswered and/or unacknowledged, called party busy with call of equal or higher precedence, or called party busy and non-preemptable) are diverted to a predetermined alternate party. This alternate party may be another subscriber or a network operating position.

Preemption may take one of two forms. First, the called party may be busy with a lower precedence call which must be preempted in favour of completing the higher precedence call from the calling party. Second, the network resources may be busy with calls some of which are of lower precedence than the call requested by the calling party. One or more of these lower precedence calls must be preempted to complete the higher precedence call. There are three characteristics of preemption:

- Any party whose connection was terminated (whether that resource is reused or not) must receive a distinctive preemption notification.
- Any called party of an active call that is being preempted by a higher precedence call should be required to acknowledge the preemption before being connected to the new calling party.
- When there are no idle resources, preemption of the lowest lower level of precedence resources shall occur.

A call can be preempted any time after the precedence level of the call has been established and before call clearing has begun.

The MLPP service is not intended to provide preemption of users that do not subscribe to the MLPP service. The service provides for preemption of calls within the MLPP domain, which consists of the resources belonging to the users that subscribe to the MLPP service. In other words, calls that are originated by or made to non-MLPP users will not be preempted. Calls that are originated by MLPP subscribers may be preempted by calls of higher precedence only in networks that support this service.

The stage 1 definitions for the MLPP service are given in Recommendation I.255.3 and the stage 2 service description is given in Recommendation Q.85.3. This stage 3 description for MLPP uses the ISDN User Part defined in Recommendations Q.761-Q.764 and Q.730, and Transaction Capability (TC) defined in Recommendations Q.771-Q.774. The stage 3 DSS 1 description is given in Recommendation Q.955.3.

3.2.2 Specific terminology

The following terminology is used in this Recommendation:

A preempting call is a call with precedence level higher than the lowest (Routine) level of precedence, for which a call set-up request has been received at the exchange.

A preemption initiating exchange is the exchange that is congested and has received a preempting call set-up request.

Congestion has been encountered when it is determined that all circuits capable of routing the call are busy.

An MLPP call is a call for which a precedence level has been established and the exchange has sent an Initial Address Message (IAM) but has not sent or received a Release (REL) message.

A preemptable circuit is a circuit within the same domain as the preempting call for which a precedence level has been established and is active with or reserved for an MLPP call with a precedence level lower than that of the preempting call. A busy or reserved circuit for which a precedence level is not specified is not a preemptable circuit.

End Exchanges are the exchanges that serve as originating, gateway, and destination exchanges for the MLPP call.

Look-ahead for busy is a set of TC operations which may be performed as a network option to look through the network for available circuits and reserve these circuits before attempting call set-up.

3.2.3 Qualifications on the applicability to telecommunication services

See Recommendation I.255.3.

3.2.4 State definitions

No specific state definitions are required.

3.3 Operational requirements

3.3.1 Provision/withdrawal

See Recommendation I.255.3.

3.3.2 Requirements on the originating network side

Not applicable.

3.3.3 Requirements in the network

Notification to the calling and preempted users (as a result of preemption in the network or access) shall be conveyed using Cause # 8, 9 and 46, as described in this Recommendation.

3.3.4 Requirements on the terminating network side

Not applicable.

3.4 Coding requirements

3.4.1 ISDN-User Part Formats and Parameter Codings

3.4.1.1 Messages

3.4.1.1.1 Initial Address Message (IAM)

The format of the Initial Address Message (IAM) message is shown in Recommendation Q.763.

3.4.1.1.2 Release Message (REL)

The format of the Release Message (REL) message is shown in Recommendation Q.763.

3.4.1.1.3 Address Complete Message (ACM)

The format of the Address Complete Message is shown in Recommendation Q.763.

3.4.1.1.4 Call Progress Message (CPG)

The format of the Call Progress Message is shown in Recommendation Q.763.

3.4.1.2 Parameters

3.4.1.2.1 Precedence Parameter - Format and Coding

The format of the Precedence parameter is shown below. The subfields in the Precedence parameter identify the precedence level, the MLPP network and domain, and whether a path has been reserved or path reservation is allowed.

	8	7	6	5	4	3	2	1
Octet 1	Spare	LFB		Spare	Precedence level			
2	1st NI digit				2nd NI digit			
3	3rd NI digit				4th digit			
4	Most significant bit							
	MLPP service domain							
6	Least significant bit							

The following codes are used in the Precedence parameter subfields:

Octet 1

1) LFB

0 0 LFB Allowed

1 0 LFB Not Allowed

0 1 Path reserved

1 1 Spare

2) Precedence level

0 0 0 0 FLASH OVERRIDE (0)

0 0 0 1 FLASH (1)

0 0 1 0 IMMEDIATE (2)

0 0 1 1 PRIORITY (3)

0 1 0 0 ROUTINE (4)

0 1 0 1

to Spare

1 1 1 1

Octets 2 and 3

3) Network identity (NI)

Each digit is coded in binary coded decimal representation from 0 to 9.

The first digit of this field is coded 0. The TCC (Telephony Country Code) follows in the second to fourth NI digits (the most significant TCC digit is in the 2nd NI digit). If the TCC is one or two digits long, the excess digit(s) is (are) inserted with the code for ROA or network identification, if necessary. If octet 2 is not required, it is coded all zeros.

Octets 4 - 6

4) MLPP service domain

A code expressing in pure binary representation the number allocated to an MLPP service domain administered by a particular ISDN. Bit 8 of octet 4 is the most significant and bit 1 of octet 6 is the least significant, respectively.

3.4.1.2.2 Cause Indicator Parameter – Format and Coding

The format of the cause indicator parameter field is shown in Recommendation Q.763.

The following coding will be used for cause values 8, 9 and 46:

Cause value

0 0 0 1 0 0 0 (8) preemption

0 0 0 1 0 0 1 (9) preemption-circuit reserved for reuse

0 1 0 1 1 1 0 (46) precedence call blocked

3.4.1.2.3 Generic Notification Indicator Parameter – Format and Coding

The format of the notification indicator parameter field is shown in Recommendation Q.763.

The following code will be used to indicate Call Completion Delay:

Notification Ind

0 0 0 0 1 0 0 Call Completion Delay

3.4.1.2.4 Optional Backward Call Indicators Parameter

The format of the optional backward call indicators parameter field is shown in Recommendation Q.763.

The following code will be used to indicate the status of a MLPP user.

Bit D: Non-MLPP user indicator

0 no indication

1 MLPP user

3.4.2 Transactions Capabilities (TC) Format and Parameter Codings

3.4.2.1 Application Service Element (ASE) for TC Look-ahead For Busy (LFB)

3.4.2.1.1 Parameter - Provide Value (for Look-ahead For Busy Begin)

```
parameter-ProvideValue          OPERATION
PARAMETER                       ProvideValueRequest
RESULT                          ProvideValueResult
ERRORS                          { dataUnavailable,
                                  taskRefused,
                                  unexpectedDataValue }

::=

ProvideValueRequest ::= SEQUENCE {
    lookAheadForBusyEnd LookAheadForBusyEnd,
    bearerCapabilitySupported BearerCapabilitySupported,
    serviceKey ServiceKey }

ProvideValueResult ::= SEQUENCE {
    lookAheadForBusyEnd LookAheadForBusyEnd,
    bearerCapabilitySupported BearerCapabilitySupported }

BearerCapabilitySupported ::= ENUMERATED {
    notSupported (1),
    supported (2),
    notAuthorized (3),
    notPresentlyAvail (4),
    notImplemented (5) }

LookAheadForBusyEnd ::= SEQUENCE {
    location Location,
    acknowledgementType AcknowledgeType }

Location ::= ENUMERATED {
    user (0),
    privateNetworkServingLocalUser (1)
```

```
        publicNetworkServingLocalUser (2),
        transitNetwork (3),
        privateNetworkServingRemoteUser (4),
        publicNetworkServingRemoteUser (5),
        localInterface (6),
        InternationalNetwork (7),
        beyondInterworkingPoint (8) }

AcknowledgmentType ::= ENUMERATED {
        pathReservationDenied (0),
        negative (1),
        positive (2) }

ServiceKey ::= SEQUENCE {
        destNum Digits,
        circuit CircuitIdCode,
        bearerCapReq BearerCapReq,
        precedence Precedence,
        callRef CallRef,
        callingNum Digits }

CircuitIdCode ::= OCTET STRING (SIZE (2))
BearerCapabilityRequested ::= OCTET STRING (SIZE (3..6))
-- see Q.931
Precedence ::= OCTET STRING (SIZE (2..?))

CallRef ::= SEQUENCE {
        callIdentity        OCTET STRING (SIZE (3)),
        pointCode           OCTET STRING (SIZE (2)) }

Digits ::= IA5String(from("0"|"1"|"2"|"3"|"4"|"5"|
        "6"|"7"|"8"|"9"|"*"|"#")) (SIZE (1..maxNumberOfDigits))

maxNumberOfDigits ::= 16
```

3.4.2.2 Parameters

3.4.2.2.1 Look-ahead For Busy End

The Look-ahead For Busy End Parameter is used to indicate whether preemptable resources were found. It is 1 octet long and is of type OCTET STRING. The contents are coded as follows:

Location

Bits DCBA indicate the location which initiated the response and are defined as follows:

Location	D	C	B	A
User	0	0	0	0
Private Network serving the local user	0	0	0	1
Public Network serving the local user	0	0	1	0
Transit Network	0	0	1	1
Public Network serving the remote user	0	1	0	0
Private Network serving the remote user	0	1	0	1
Local interface	0	1	1	0
International Network	0	1	1	1
Network beyond interworking point	1	0	0	0
NOTE – All other values are reserved				

Bits FE are spare

Acknowledgment Type

Bits HG indicate the acknowledgment type. This indicates whether the request for search and reservation of circuits was accepted. Bits HG are defined as follows:

AcknowledgmentType	H	G
Path reservation denied	0	0
Negative acknowledgment	0	1
Positive acknowledgment	1	0
Spare	1	1

3.4.2.2.2 Bearer Capability Requested

The format and coding of the Bearer Capability Requested parameter is shown in Recommendation Q.931.

3.4.2.2.3 Bearer Capability Supported

The Bearer Capability Supported parameter is used to indicate the reason a bearer capability requested was not available. The parameter is 1 octet in length and is of type OCTET STRING. The contents are coded as follows:

Bearer Capability Supported	H	G	F	E	D	C	B	A
Not supported	0	0	0	0	0	0	0	1
Supported	0	0	0	0	0	0	1	0
Not authorized	0	0	0	0	0	0	1	1
Not presently available	0	0	0	0	0	1	0	0
Not implemented	0	0	0	0	0	1	0	1

3.4.2.2.4 Digits

The format and coding of the Digits parameter is shown in Recommendation Q.773.

3.4.2.2.5 Circuit Identification Code

The Circuit Identification Code parameter is used to identify the physical path between two exchanges. The parameter is coded contextual. The parameter is 2 octets in length and is of type OCTET STRING. The contents are coded as follows:

Circuit identification code	H	G	F	E	D	C	B	A
Octet 1	Circuit Identification Code (least significant bits)							
Octet 2	Spare				Circuit ID Code (most significant bits)			

3.4.2.2.6 Precedence

The Precedence parameter is used to identify the MLPP call in terms of priority treatment, network identity and MLPP service domain. The format and contents of the Precedence parameter are as follows:

Octet	H	G	F	E	D	C	B	A
1	Spare				Precedence level			
2	1st NI digit				2nd NI digit			
3	3rd NI digit				4th NI digit			
4	Most significant bit							
	MLPP service domain							
6	Least significant bit							

Octet 1

(1) Bits HGFE are spare

(2) Bits DCBA indicate the precedence level and are coded as follows:

PRECEDENCE	D	C	B	A
FLASH OVERRIDE (0)	0	0	0	0
FLASH (1)	0	0	0	1
IMMEDIATE (2)	0	0	1	0
PRIORITY (3)	0	0	1	1
ROUTINE (4)	0	1	0	0

Octets 2 and 3

(3) Extension Indicator (ext)

0 Octet continues through the next octet

1 Last octet

(3) Network identity (NI)

Each digit is coded in binary coded decimal representation from 0 to 9.

The first digit of this field is coded 0. The TCC (Telephony Country Code) follows in the second to fourth NI digits (the most significant TCC digit is in the 2nd NI digit). If the TCC is one or two digits long, the excess digit(s) is (are) inserted with the code for ROA or network identification, if necessary. If octet 2 is not required, it is coded all zeros.

Octets 4 - 6

(4) MLPP service domain

A code expressing in pure binary representation the number allocated to an MLPP service domain administered by a particular ISDN. Bit 8 of octet 4 is the most significant and bit 1 of octet 6 is the least significant, respectively.

3.4.2.2.7 Call Reference

The Call Reference parameter is used to identify a particular MLPP call independent of the physical circuit. The parameter is 5 octets in length and is of type OCTET STRING. The format and contents are coded as follows:

Call Reference	H	G	F	E	D	C	B	A
Octet 1 Octet 2 Octet 3	Call Identity							
Octet 4	Point Code							
Octet 5	Spare							

Call Identity

Octets 3-1 indicate the identification number allocated to the call, in pure binary representation.

Point Code

Octets 5-4 indicate the code of the signalling point in which the call identity is relevant.

3.5 Signalling Requirements

3.5.1 Activation/Deactivation/Registration

Not applicable.

3.5.2 Invocation and Operation

3.5.2.1 Invocation

The MLPP service is invoked by the Precedence parameter in the Initial Address Message.

3.5.2.2 Normal Operation for Networks Supporting Multilevel Precedence and Preemption

This subclause details the ISDN-User Part and (optional) TC procedures associated with MLPP service in networks that support the MLPP calls. In a network that supports Multilevel Precedence and Preemption (MLPP) service, if an exchange receives an MLPP call request, the exchange establishes the Precedence Level and MLPP Service Domain associated with the call. If there are idle circuits to complete the requested call, the procedure in 3.5.2.2.1 is followed. If there are no idle circuits to complete the requested call, the procedure in 3.5.2.2.2 is followed.

3.5.2.2.1 Procedures When No Circuit Congestion Is Encountered

If an exchange receives an MLPP call request, it establishes and maintains for the duration of the call the Precedence Level and MLPP Service Domain associated with the call, and if the selection of a suitable, idle circuit is successful, the circuit is marked busy at the selected Precedence Level and MLPP Service Domain and an Initial Address Message (IAM) is sent to the succeeding exchange.

The IAM sent should contain, in addition to parameters specified in Recommendation Q.763, the Precedence parameter indicating the Precedence Level associated with the call. The LFB indicator of the Precedence parameter may be coded "LFB allowed" or "LFB not allowed" based on the MLPP call request. The MLPP Service Domain indicator field is set to identify the specific MLPP Service Domain subscribed to by the MLPP call originator. This value is used to identify within networks, where multiple MLPP services may exist, the MLPP calls of the same domain.

Subsequent call set-up action follows the procedures for a basic call specified in Recommendation Q.764 except for the return of address complete message (ACM) from the destination exchange. The ACM shall indicate if the called party is a MLPP user. If the called party is a non-MLPP user, each exchange will remove all MLPP precedence and MLPP service domain markings from the circuits associated with the call. The optional backward call indicators parameter field shall be coded as specified in 3.4.1.2.4. The purpose of this procedure is to eliminate any chance that an MLPP call to a non-MLPP user will be preempted after the call is in service.

3.5.2.2.2 Procedures When Circuit Congestion Is Encountered

If an exchange receives an MLPP call request, it establishes the Precedence Level and MLPP Service Domain associated with the call as specified in 3.5.2.2.1, and if the selection of a suitable, idle circuit is not successful, the action taken is determined by the Precedence Level associated with the call.

If the Precedence Level is 4 (ROUTINE), the lowest level of precedence, the procedure for unsuccessful call set-up, specified in Recommendation Q.764 is followed.

If the Precedence Level is 3 (PRIORITY) or higher, the exchange searches for preemptable circuits to complete the call as follows:

1) A search proceeds for a preemptable circuit that is busy at a lower Precedence Level than the preempting call. A successful internal search locates the lowest precedence circuit suitable for preemption that is in the same MLPP Service Domain. Individual networks may provide their own algorithm to specify the search method.

2) If such a circuit is found, it is marked "reserved for reuse" by the preempting call and the call set-up continues in accordance with ISDN-UP procedures specified in 3.5.2.2.3. As a network option, the TC Look-ahead For Busy (LFB) procedure (see 3.5.2.2.4) may be provided to perform an external search for preemptable circuits further in the call connection prior to the ISDN-UP procedures being used for preemption of the existing call, if the MLPP call request indicates that LFB procedures are allowed for the preempting call.

3) If a suitable circuit is not found, the preempting call is released as specified in 3.5.2.2.5.2 when the search for preemptable circuits is unsuccessful.

3.5.2.2.3 ISDN-UP Procedures

When circuit congestion is encountered at an exchange, the ISDN-User Part procedures are initiated upon successful search of preemptable circuits. The search is conducted by the exchange encountering circuit congestion (called the preemption initiating exchange). When the search for a preemptable circuit is successful, the identified circuit is marked "reserved for reuse." The reserved circuit is then preempted (see 3.5.2.2.3.1) and the preempting MLPP call set-up continues (see 3.5.2.2.5.1) using the ISDN-User Part protocol.

3.5.2.2.3.1 Network Release of Preempted Calls

Release of an MLPP call because of preemption is initiated after a search successfully locates and marks reserved a preemptable inter-exchange circuit to service the preempting call.

Circuit release sequences shall be generated at the preemption initiating exchange for those circuits terminating the switched connection serving the MLPP call being preempted. Where both terminations of this switched connection are interexchange circuits, two different release sequences will be required. The two release sequences are: 1) Release of Circuit Reserved for Reuse, and 2) Release of Circuit Not Reserved for Reuse.

Release sequence (1) is used to release the circuit selected to complete the preempting call. Release sequence (2) is used to release circuits of the MLPP call that will not be reused by the preempting call.

A released circuit of an MLPP call that shall be reserved for reuse is utilized to resume the routing of the preempting call. To prevent a circuit intended for the preempting call from being seized by another call, it shall be marked "circuit reserved for reuse" when it is released.

1) *Actions at the Preemption Initiating Exchange*

a) *Release of Circuit Reserved for Reuse* – The preemption initiating exchange immediately starts the release of the switched path and, at the same time, sends a Release Message to the succeeding exchange. The Cause Indicators parameter of the Release Messages is coded to indicate "preemption-circuit reserved for reuse" by coding the cause value subfield with cause 9 – "preemption-circuit reserved for reuse."

The circuit that has been selected for the preempting call was marked "circuit reserved for reuse". This prevents another call from selecting the circuit between the time the circuit is released and the time the preempting call resumes the set-up sequence. A timer is started to ensure that a Release Complete Message is received from the succeeding exchange at the expiry of timer T_1. (Expiration of this timer is covered in 2.9.6/Q.764).

Expiration of timer T_1 or receipt of Reset Circuit Signal concerning the circuit "reserved for reuse" results in the preemption initiating exchange abandoning the selection of the reserved circuit to extend the preempting call. The reserved circuit is treated according to the T_1 expiration procedures in 2.10.6/Q.764 or the Reset Circuit procedures, whichever is appropriate. Selection of a new circuit to service the preempting call shall be reattempted. The reattempt shall search first for an idle circuit before entering the preemptable circuit search. Any call set-up failure after initiating the reattempt results in abandoning the preempting call as specified in 3.5.2.2.5.2 for an unsuccessful call.

Receipt of a Release Complete (RLC) message on the circuit reserved for reuse resumes the set-up sequence for the preempting call as specified in 3.5.2.2.5.1 and cancels timer T_1.

b) *Release of Circuit Not Reserved for Reuse* – The preemption initiating exchange immediately starts the release of the switched path, and at the same time, sends a Release Message to the succeeding exchange. The Cause Indicators parameter of the Release Message is coded to indicate "preemption – circuit not reserved for reuse" by coding the cause value subfield with cause 8 – "preemption"

The location value is determined by the types of networks involved (e.g. private, local, transit or international) and whether the preemption initiating and succeeding exchanges are located within the same or separate networks. A circuit not reserved for reuse is indicated by any location subfield code other than "local interface controlled by this signalling link." A timer is started to ensure that a Release Complete Message is received from the succeeding exchange at the expiry of timer T_1. (Expiration of this timer is covered in 2.9.6/Q.764)

2) *Actions at an Intermediate Exchange*

a) *Receipt of Release Message Concerning a Circuit Reserved for Reuse* – A preempted circuit that will be reserved for reuse shall be indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with a cause value of 9 – "preemption-circuit reserved for reuse".

On receipt of this Release Message from the preceding exchange, an intermediate exchange shall:

i) Immediately start the release of the switched path. The circuit from the preceding exchange is marked "circuit reserved for reuse". This prevents another call from selecting the reserved circuit between the time the circuit is released and the time the preempting call resumes the set-up sequence. A timer T_{RR} is started to ensure that circuits reserved for reuse are released to the pool of available circuits at an exchange at the expiry of timer T_{RR}. When the path has been fully disconnected a Release Complete Message is returned to the preceding exchange.

ii) At the same time, release any interconnected circuit. If the circuit is controlled by ISDN-UP then send a Release message to the succeeding exchange as specified in 2.2.2/Q.764. The procedures for release of a circuit not reserved for reuse shall be employed. The Cause Indicators parameter of the Release Message is coded to indicate "preemption – circuit not reserved for reuse" by coding the cause value subfield with cause 8 – "preemption".

b) *Receipt of Release Message Concerning a Circuit Not Reserved for Reuse* – A preempted circuit that is not reserved for reuse shall be indicated by the receipt a Release Message in which the Cause Indicators parameter is coded with cause value of 8 – "preemption".

On receipt of this Release Message from the preceding exchange, an intermediate exchange shall:

i) Immediately start the release of the switched path. When the path has been fully disconnected, a Release Complete Message is returned to the preceding exchange.

ii) At the same time, release any interconnected circuit. If the circuit is controlled by ISDN-UP then send a Release Message to the succeeding exchange as specified in 2.2.2/Q.764. The procedures for release of a circuit not reserved for reuse shall be employed. The Cause Indicators parameter of the Release Message is coded to indicate "preemption – circuit not reserved for reuse" by coding the cause value subfield with Cause 8 – "preemption".

3) *Actions at an End Exchange*

a) Receipt of Release Message Concerning a Circuit Reserved for Reuse – A preempted circuit that shall be reserved for reuse shall be indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with cause value of 9 – "preemption-circuit reserved for reuse".

On receipt of this Release Message from the preceding exchange, an end exchange shall:

i) Notify the party or parties of the call by tones or other indication that the call terminated at this exchange is being preempted.

ii) Immediately start the release of the switched path. The circuit from the preceding exchange is marked "circuit reserved for reuse". This prevents another call from selecting the reserved circuit between the time the circuit is released and the time the preempting call resumes the set-up sequence. A timer T_{RR} is started to ensure that circuits reserved for reuse are released to the pool of available circuits at an exchange at the expiry of timer T_{RR}. When the path has been fully disconnected, a Release Complete Message is returned to the preceding exchange.

b) *Receipt of Release Message Concerning a Circuit Not Reserved for Reuse* – A preempted circuit that is not reserved for reuse shall be indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with cause value of 8 – "preemption".

On receipt of this Release Message from the preceding exchange, an end exchange shall:

i) Notify the party or parties of the call by tones or other indication that the call terminated at this exchange is being preempted.

ii) Immediately start the release of the switched path. When the path has been fully disconnected, a Release Complete Message is returned to the preceding exchange.

3.5.2.2.4 TC Look-ahead For Busy (LFB) Procedures

Look-ahead For Busy is a set of TC operations which may be performed as a network option to look through the network for available circuits and reserve these circuits before attempting call set-up. It checks the status of circuits ahead (i.e. whether they are idle, preemptable or non-preemptable), and reserves a path for the preempting call whose Precedence Level is higher than the lowest level of precedence. The LFB procedure is intended to eliminate preemption of other calls by a preempting call that may not be completed.

The Look-ahead For Busy procedures are initiated, by the exchange that has encountered circuit congestion and has successfully located and reserved (internal to the exchange) a busy and preemptable outgoing circuit, if the MLPP call request indicates that path reservation is allowed for the preempting call (i.e. the LFB Indicator field in the Precedence parameter received in the IAM is set to "LFB allowed"). If the internal search for a busy and preemptable circuit was successful but the MLPP call request indicates that no path reservation is allowed for the call (i.e. the LFB indicator field is set to "LFB not allowed") then the ISDN-User Part procedures specified in 3.5.2.2.3 and 3.5.2.2.5 are followed as if the LFB option is not supported in the network.

The following subclauses describe the LFB Begin message and how each exchange shall respond depending on the availability of its circuits or the response received from a succeeding exchange. The response received by an exchange will indicate either:

a) "Positive acknowledgment" – which indicates that a path at least as far as the next succeeding switch is reserved for the preempting call;

b) "Negative acknowledgment" – which indicates that the path to the called party is blocked by 1) equal or higher precedence calls or 2) Bearer Capability not being supported; or

c) "Reservation denied" – which indicates that the far end of the outgoing circuit could not be reserved. This could be caused by either dual seizure or preemption by a higher precedence level call.

When a succeeding exchange has a problem processing an LFB Begin message, a Reject or Error Component is returned. If the reason is because of a protocol error, the Reject Component is returned. If the reason is an error in data or lack of resources, for example, an Error Component is sent with an error code "unexpected data value" or "unavailable resources," respectively. Receipt of either the Reject or Error Components will be processed the same as described for expiry of Timer T_L.

3.5.2.2.4.1 Actions at the Preemption Initiating Exchange

A search external to the exchange for preemptable circuits in the network is initiated when an internal search successfully locates and reserves a preemptable circuit for the preempting call. The exchange initiating the external search, the LFB procedures, is referred to as the preemption initiating exchange.

1) *Sending a TC LFB Begin Message*

Upon identifying a preemptable circuit, the preemption initiating exchange labels the circuit "reserved" with the Precedence Level, MLPP Service Domain and a Call Reference associated with the preempting call. The Precedence Level and MLPP Service Domain are determined by the MLPP call request received at the preemption initiating exchange; the Call Reference is assigned at the exchange to uniquely identify the preempting call reserving the circuit. The preemption initiating exchange then performs the Look-ahead For Busy (LFB) procedure by sending a TC LFB Begin message to the exchange at the far end of the outgoing circuit.

This message has a Begin message type and contains a single component. This single component has an Invoke component, a Parameter Provide Value operation code, and a parameter set indicating that parameter values are to be provided by the far-end exchange for the Bearer Capability Supported and Look-ahead For Busy End parameter. The Service Key in the parameter set contains the Calling Party Number[1)], Destination Number, Bearer Capability Requested, Circuit Identification Code, Call Reference, and Precedence parameter to indicate the call for which path search and reservation is requested. The format and coding for these parameters are provided in 3.4.2. This TC LFB Begin message is sent using point code routing, with the Destination Point Code (DPC) of the far-end exchange.

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1) Calling Party Number is required by DSS 1.

At the same time the LFB Begin message is sent, an ACM is sent toward the originating exchange to indicate call progress and cancel any call set-up control timers. The Generic Notification Indicator parameter shall be included and coded as specified in 3.4.1.2.3 to indicate "call completion delay."

Upon sending the LFB Begin message the preemption initiating exchange starts timer T_L.

2) *Awaiting a TC LFB End*

After reserving a preemptable circuit and sending a TC LFB Begin message to the succeeding exchange, the preemption initiating exchange waits for a TC LFB End. The Bearer Capability Supported (BCS) and LFB End parameters shall be returned in each response. However, only the Bearer Capability values received when the LFB End value is set to Negative Acknowledgment are used. The BCS parameter returned with any other response shall be ignored. Subsequent action is determined by the events below.

a) *TC LFB End with Negative Acknowledgment is Received*

If a TC LFB End with Acknowledgment Type subfield in the Look-ahead For Busy End parameter coded "negative acknowledgment" is received, the preempting call is cleared using the procedure specified in 3.5.2.2.5.2 and timer T_L is cancelled.

b) *TC LFB End with Positive Acknowledgment is Received*

If a TC LFB End with Acknowledgment Type subfield in the Look-ahead For Busy End parameter coded "positive acknowledgment" is received at the preemption initiating exchange, the LFB procedure is successfully completed. The preemption initiating exchange cancels timer T_L and then proceeds to perform the ISDN-User Part procedures in 3.5.2.2.3 and 3.5.2.2.5 to preempt MLPP calls and set up the preempting call.

c) *TC LFB End with Reservation Denial Indication is Received*

If a TC LFB End with Acknowledgment Type subfield in the Look-ahead For Busy End parameter coded "path reservation denied" is received, then the preemption initiating exchange cancels timer T_L and attempts to complete the preempting call per ISDN-User Part procedures without the LFB procedures. See 3.5.2.2.3 and 3.5.2.2.5.

d) *Timer T_L Expires*

If timer T_L expires, the preemption initiating exchange attempts to complete the preempting call utilizing preemption without the LFB procedures using ISDN-User Part procedures specified in 3.5.2.2.3 and 3.5.2.2.5.

3.5.2.2.4.2 Actions at the Intermediate Exchange

1) *Receiving a TC LFB Begin Message*

The following procedures describe actions taken when an intermediate exchange receives a TC LFB Begin message. This Begin message contains information requesting a search for available network circuits to complete the preempting call and reservation of available paths.

a) The intermediate exchange will mark the incoming circuit, indicated by the Circuit Identification Code provided, "reserved" with the Precedence and Call Reference parameters received in the incoming Begin message.

b) The intermediate exchange searches for a suitable outgoing circuit based on relevant routing data and the Destination Number, Bearer Capability Requested, and Precedence parameters contained in the Service Key parameter of the incoming Begin message. If a suitable idle circuit is found the idle circuit is marked "reserved" with the Precedence and Call Reference values. If a suitable, idle circuit is not found, but a preemptable circuit is found, the preemptable circuit is marked "reserved" with the Precedence and Call Reference values. The Precedence parameter is used to identify the precedence level and the MLPP Service domain of the preempting call. The Call Reference received in the incoming Begin message is used to uniquely identify the preempting call reserving the circuit.

c) A timer T_{LR} is started after a suitable outgoing circuit is identified to ensure that both the incoming and outgoing circuits marked "reserved" are released to the pool of available circuits at the expiry of timer T_{LR}.

d) Upon completion of the circuit selection and reservation, the intermediate exchange sends a LFB Begin message to the succeeding exchange at the far-end of the outgoing circuit. The parameter of the operation in the invoke component of the LFB Begin message are coded exactly as described in 3.5.2.2.4.1, item 1 (para 2) except that the Circuit Identification Code is the one assigned to the outgoing circuit reserved for the preempting call.

e) Upon sending the LFB Begin message the intermediate exchange starts Timer T_L.

2) *Sending a TC LFB End*

A TC LFB End is sent from an intermediate exchange if a) reservation of incoming circuit fails, b) the search for a suitable outgoing circuit [3.5.2.2.4.2 1)] fails, c) a TC LFB End has been received from the succeeding exchange, or if d) timer T_L expires, whichever occurs first.

a) *Marking Incoming Circuit Reserved Fails*

If the incoming circuit is already marked "reserved" with a Precedence Level equal to or higher than the preempting call or for another domain, then return a LFB End parameter coded "path reservation denied."

b) *Search for a Suitable Outgoing Circuit Fails*

If the search for a suitable outgoing circuit fails after a TC LFB Begin message is received at an intermediate exchange, the exchange will reply with a TC message of the End message type and a Return Result component type. The incoming circuit is unreserved. The Look-ahead For Busy End parameter indicates if LFB procedures were successfully performed end-to-end. The Acknowledgment Type subfield should be coded "negative acknowledgment." The Location subfield should be coded with the appropriate location code. If the bearer capability requested is not available, the Bearer Capability Supported parameter is coded with the appropriate reason for the non-availability. Code values for "not supported" and "not implemented" shall be interpreted the same. If the bearer capability requested is available it shall be coded "Supported." The TC End is sent using point code routing, with the Destination Point Code (DPC) of the preceding exchange.

c) *TC LFB End is Received from the Succeeding Exchange*

If TC LFB End is received from the succeeding exchange while timer T_L is still running, then a TC LFB End is sent to the preceding exchange using point code routing, with the Destination Point Code (DPC) of the preceding exchange and timer T_L is cancelled. The Look-ahead For Busy End parameter indicates if LFB procedures were successfully performed end-to-end. The Acknowledgment Type and Location subfields of the Look-ahead For Busy End parameter for the TC message sent are set to the values received except when the Acknowledgment Type subfield is set to "path reservation denied." In this case the subfield value is changed to "positive acknowledgment." The Bearer Capability Supported parameter fields are set to the values received.

If the Acknowledgment Type subfield value in the Look-ahead For Busy End parameter received is "positive acknowledgment," the incoming and outgoing circuit reservations identified respectively, by the Circuit Identification Code (CIC) parameter contained in the Service Key parameter set of the TC LFB Queries previously received and sent, and also the associated Call Reference (CR) value, will be maintained until the associated IAM is received or expiry of timer T_{LR}.

If the Acknowledgment Type subfield value in the Look-ahead For Busy End parameter received is "path reservation denied," the outgoing circuit reservation identified by the CIC and CR value will be "unreserved" and the incoming circuit reservation will be maintained until the associated IAM is received or expiry of timer T_{LR}.

If the Acknowledgment Type subfield value in the Look-ahead For Busy End parameter received is "negative acknowledgment," then the exchange will immediately "unreserve" the incoming and outgoing circuits identified by the CIC and CR values, and cancel timer T_{LR}.

d) *Timer T_L Expires*

If timer T_L expires before a TC LFB End is received from the succeeding exchange, the exchange will "unreserve" the outgoing circuit reservation identified by the CIC and CR values and send a TC message which is a End message type containing a Return Result component to the preceding exchange. The Acknowledgment Type subfield of the Look-ahead For Busy parameter is coded "positive acknowledgment." The Location subfield is coded with the appropriate location code. The Bearer Capability Supported parameter shall be coded "Supported." The TC LFB End is sent using point code routing, with the DPC of the preceding exchange.

If a TC LFB End is received from a succeeding exchange after timer T_L is expired, no action should be taken.

3.5.2.2.4.3 Actions at the End Exchange

1) *Receiving a TC LFB Begin Message*

When an end exchange receives a TC LFB Begin message containing information requesting a search for available circuits to complete the preempting call and reservation of available paths, the exchange reserves the incoming circuit indicated by the Circuit Identification Code parameter provided with the Call Reference and Precedence parameters. Failure of this reservation is handled as indicated in 3.5.2.2.4.2, 2a) except the location subfield is coded with the appropriate location code. A timer T_{LR} is started to ensure that circuits marked "reserved" are released to the pool of available circuits at an exchange at the expiry of timer T_{LR}. The end exchange may be the destination exchange for the call, or the gateway exchange within a network if the call is to be routed to another network. Subsequent action at the end exchange depends on whether the exchange is the destination exchange for the preempting call, or the exchange is the gateway exchange within a network.

2) *Sending a TC LFB End*

a) *Procedure at the Destination Exchange*

Upon labelling the incoming circuit as "reserved" the destination exchange determines if the preempting call can be successfully completed, i.e. if the bearer capability requested is supported and if the called party interface is idle, preemptable or non-preemptable, consistent with access protocol procedures.

i) If the access interface supports the Bearer Capability requested, and is idle or busy and preemptable, the interface is "reserved" consistent with access protocol procedures. The destination exchange will reply with a TC message which is an End message type containing a Return Result component. The Look-ahead For Busy End parameter indicates if the LFB procedures were performed end-to-end. The Acknowledgment Type subfield of the LFB End parameter is coded "positive acknowledgment." The Bearer Capability Supported parameter shall be coded "Supported." The Location subfield of the parameter is coded with the appropriate location code. The TC LFB End is sent using point code routing, with the DPC of the preceding exchange.

ii) If the access interface is busy and not preemptable, or if the Bearer Capability requested is not supported by the access interface, the destination exchange shall immediately "unreserve" the incoming circuit, cancel timer T_{LR} and reply with a TC message which is an End message type containing a Return Result component. The Look-ahead For Busy End parameter indicates if the LFB procedures were performed end-to-end. The Acknowledgment Type subfield of the parameter is coded "negative acknowledgment." The Location subfield is coded with the appropriate location code. If the bearer capability requested is not available, the Bearer Capability Supported parameter is coded with the appropriate reason for the non-availability. Code values for "not supported" and "not implemented" shall be interpreted the same. If the bearer capability requested is available it shall be coded "Supported." The TC LFB End is sent using point code routing, with the DPC of the preceding exchange.

iii) If the access interface is busy and not preemptable, the destination exchange will immediately "unreserve" the incoming circuit, cancel timer T_{LR} and reply with a TC message which is a Response package type containing a Return Result component. The Look-ahead For Busy Response parameter indicates if the LFB procedures were performed end-to-end. The Acknowledgment Type subfield of the parameter is coded "negative acknowledgement." The Location subfield is coded with the appropriate location code. The Bearer Capability Supported parameter shall be coded "Supported." The TC LFB Response is sent using point code routing, with the DPC of the preceding exchange.

b) *Procedures at the Gateway Exchange Within a Network*

Upon labelling the incoming circuit as "reserved" the gateway exchange within a network supporting MLPP will take action based on the characteristics of the succeeding network.

i) If the succeeding network does not support MLPP service, then the gateway exchange within the network that supports MLPP will reply with a TC message which is an End message type containing a Return Result component. The Acknowledgment Type subfield of the Look-ahead For Busy End parameter is coded "positive acknowledgment." The Bearer Capability Supported parameter shall be coded "Supported." The Location subfield of the parameter is coded "beyond an interworking point." The TC LFB End is sent using point code routing, with the DPC of the preceding exchange.

ii) If the succeeding network supports the MLPP service without the LFB option, then the gateway exchange within the network that supports MLPP with the LFB option will reply with a TC message which is an End message type containing a Return Result component. The Acknowledgment Type subfield of the Look-ahead For Busy End parameter is coded "positive acknowledgment." The Bearer Capability Supported parameter shall be coded "Supported." The Location subfield of the parameter is coded "beyond an interworking point." The TC LFB End is sent using point code routing, with the DPC of the preceding exchange.

iii) If the succeeding network supports MLPP service with the LFB option, then the gateway exchange will follow the procedures as specified for intermediate exchanges in 3.5.2.2.4.2.

3.5.2.2.5 MLPP Call Set-up

3.5.2.2.5.1 Successful MLPP Call Set-up

1) *Call Set-up Action at the Preemption Initiating Exchange*

Upon successful release of the "circuit reserved for reuse" [see 3.5.2.2.3.1 1)] the preempting call is set up on that circuit. The circuit is marked busy at the Precedence Level and MLPP Service Domain associated with the preempting call and an Initial Address Message (IAM) is sent to the succeeding exchange.

The IAM sent contains, in addition to parameters specified in Recommendation Q.763, the Precedence parameter, and if the TC LFB procedures were performed, the Call Reference parameter. The Precedence Level subfield of the Precedence parameter is set according to the Precedence Level associated with the call. The LFB indicator subfield is coded as follows unless the subfield is set to "LFB not allowed" by the preempting call set-up. In this case the LFB indicator will not be changed.

a) The LFB indicator subfield of the Precedence parameter is coded "LFB allowed" if the TC LFB procedures were not performed for the preempting call.

b) The LFB indicator subfield of the Precedence parameter is coded "Path reserved" if the TC LFB procedures were performed for the preempting call and the Acknowledgment Type subfield of the Look-ahead For Busy End parameter received in the TC LFB End message indicated "positive acknowledgment".

c) The LFB indicator subfield of the Precedence parameter is coded "LFB not allowed" if the preempting call set-up request indicated "LFB not allowed," or when either 1) the IAM is sent upon expiration of timer T_L at the initiating exchange or 2) the TC LFB End message indicated "path reservation denied."

The Call Reference parameter contains the Call Reference value assigned by the exchange when the circuit was "reserved" [see 3.5.2.2.4.1 1)].

Subsequent call set-up is performed according to the procedures for normal call set-up specified in Recommendation Q.764.

2) *Call Set-up Action at the Intermediate/End Exchange*

When an exchange receives an IAM containing the Precedence parameter, the exchange establishes the Precedence Level associated with the call, and examines the LFB and MLPP Service Domain indicator subfields of the Precedence parameter.

a) If incoming circuit is marked "reserved for reuse" timer T_{RR} is cancelled.

b) If the LFB indicator subfield is not set to "Path reserved" then the intermediate/end exchange searches for an idle circuit to complete the requested call. If the search for an idle circuit is successful, procedure in 3.5.2.2.1 is followed. If there are no idle circuits to complete the requested call, procedure in 3.5.2.2.2 is followed.

c) If the LFB indicator subfield is set to "Path reserved" and if the optional Look-ahead For Busy (LFB) procedure (see 3.5.2.2.4) is supported in the network, then the exchange looks for the Call Reference value (CR) and searches for the outgoing circuit marked" reserved" with the same CR. The circuit "reserved" is the outgoing circuit whose Call Reference value is associated with the Call Reference value received in the Call Reference parameter in the IAM for the incoming circuit.

When the circuit marked "reserved" is found, timer T_{LR} is cancelled. If the circuit is busy, the MLPP call on the circuit is preempted using the release sequence "Release of Circuit Reserved for Reuse" specified in 3.5.2.2.3.1 1).

d) If the IAM is received after expiry of timer T_{LR} or there is no outgoing circuit reservation marked for this preempting call when the LFB indicator subfield is set to "Path reserved", the exchange will update the LFB subfield to indicate "LFB not allowed" and search for a new circuit to service the preempting call. The reattempt shall search first for an idle circuit before entering the preemptable circuit search. If the search succeeds, the IAM will be sent to the succeeding exchange. Any call set-up failure after initiating the reattempt results in abandoning the preempting call.

3) Timer T_{LR} Expiry

If timer T_{LR} expires before the IAM is received, the exchange will verify that the CR associated with the circuit reservation(s) is the same CR associated with timer T_{LR} that has expired before clearing reservations and returning the circuits to the pool of available circuits.

3.5.2.2.5.2 Unsuccessful Search of Preemptable Circuits

If an exchange receives an MLPP call request, establishes the Precedence Level and Bearer Capability associated with the call, but the search for a suitable circuit is not successful, the call request is denied. The exchange will return a Release (REL) Message to the preceding exchange with the cause value in the Cause Indicator parameter coded with CCITT standard Cause 46 – "precedence call blocked" unless the call is blocked due to lack of the bearer capability requested, in which case, the appropriate cause value is used. Subsequent action follows procedures specified in Recommendation Q.764 for unsuccessful call set-up treatment.

3.5.2.3 Actions at the outgoing international gateway exchange

3.5.2.3.1 Normal operation

None identified.

3.5.2.3.2 Exceptional procedures

None identified.

3.5.2.4 Actions at the incoming international gateway exchange

3.5.2.4.1 Normal operation

None identified.

3.5.2.4.2 Exceptional procedures

None identified.

3.5.2.5 Actions at the destination exchange

3.5.2.5.1 Normal operation

None identified.

3.5.2.5.2 Exceptional procedures

None identified.

3.6 Interactions with other supplementary services

3.6.1 Call Waiting (CW)

No impact on ISUP.

3.6.2 Call Transfer Services

No applicable interaction at this time.

3.6.3 Connected line identification presentation (COLP)

No impact on ISUP.

3.6.4 Connected line identification restriction (COLR)

No impact on ISUP.

3.6.5 Calling line identification presentation (CLIP)

No impact on ISUP.

3.6.6 Calling line identification restriction (CLIR)

No impact on ISUP.

3.6.7 Closed user group (CUG)

No impact on ISUP.

3.6.8 Conference calling (CONF)

No impact on ISUP.

3.6.9 Direct dialling-in (DDI)

No impact on ISUP.

3.6.10 Call diversion services

No impact on ISUP.

NOTE – When an MLPP call that has been diverted to a non-MLPP user is preempted, the non-MLPP user may not receive the appropriate release cause value (cause 8).

3.6.10.1 Call forwarding busy (CFB)

No impact on ISUP.

3.6.10.2 Call forwarding no reply (CFNR)

No impact on ISUP.

3.6.10.3 Call forwarding unconditional (CFU)

No impact on ISUP.

3.6.10.4 Call deflection (CD)

No impact on ISUP.

3.6.11 Line hunting (LH)

No impact on ISUP.

3.6.12 Three-party service (3PTY)

No impact on ISUP.

3.6.13 User to user signalling (UUS)

3.6.13.1 User to user signalling, service 1 (UUS1)

No impact on ISUP.

3.6.13.2 User to user signalling, service 2 (UUS2)

No impact on ISUP.

3.6.13.3 User to user signalling, service 3 (UUS3)

No impact on ISUP.

3.6.14 Multiple subscriber number (MSN)

No impact on ISUP.

3.6.15 Call hold (HOLD)

No impact on ISUP.

3.6.16 Advice of charge (AOC)

No impact on ISUP.

3.6.17 Sub-addressing (SUB)

No impact on ISUP.

3.6.18 Terminal portability (TP)

No impact on ISUP.

3.6.19 Completion of calls to busy subscriber (CCBS)

No applicable interaction at this time.

3.6.20 Malicious call identification (MCID)

No impact on ISUP.

3.6.21 Reverse charging (REV)

No applicable interaction at this time.

3.6.22 Multilevel precedence and preemption (MLPP)

Not applicable.

3.6.23 Private numbering plan (PNP)

No applicable interaction at this time.

3.6.24 International Telecommunication Charge Card

No applicable interaction at this time.

3.7 Interactions with other networks

3.7.1 Networks Without Multilevel Precedence and Preemption

The treatment in networks that do not implement Multilevel Precedence and Preemption procedures shall be as stated in the following subclauses.

3.7.1.1 Networks That Terminate MLPP Calls

The precedence parameter shall be removed at the network interface without notification and the call will continue as a normal call. The release of a preempted call shall be treated as a normal release.

3.7.1.2 Networks That Transport MLPP Calls to Other MLPP Networks

Such a network should convey intact the ISDN-UP parameters and values associated with MLPP depending on bilateral agreement. These parameters are the Precedence parameter and Release Causes for preemption (Cause 8) and precedence call blocked (Cause 46).

In case of signalling congestion, the IAM retains the priority originally assigned if the IAM source/domain is recognized.

The network may change the location code associated with the preemption cause value as appropriate.

The network shall treat an MLPP call, whose IAM contains a Precedence parameter the same as if it were an ordinary call.

The network shall treat the release of a preempted call the same as a normal release.

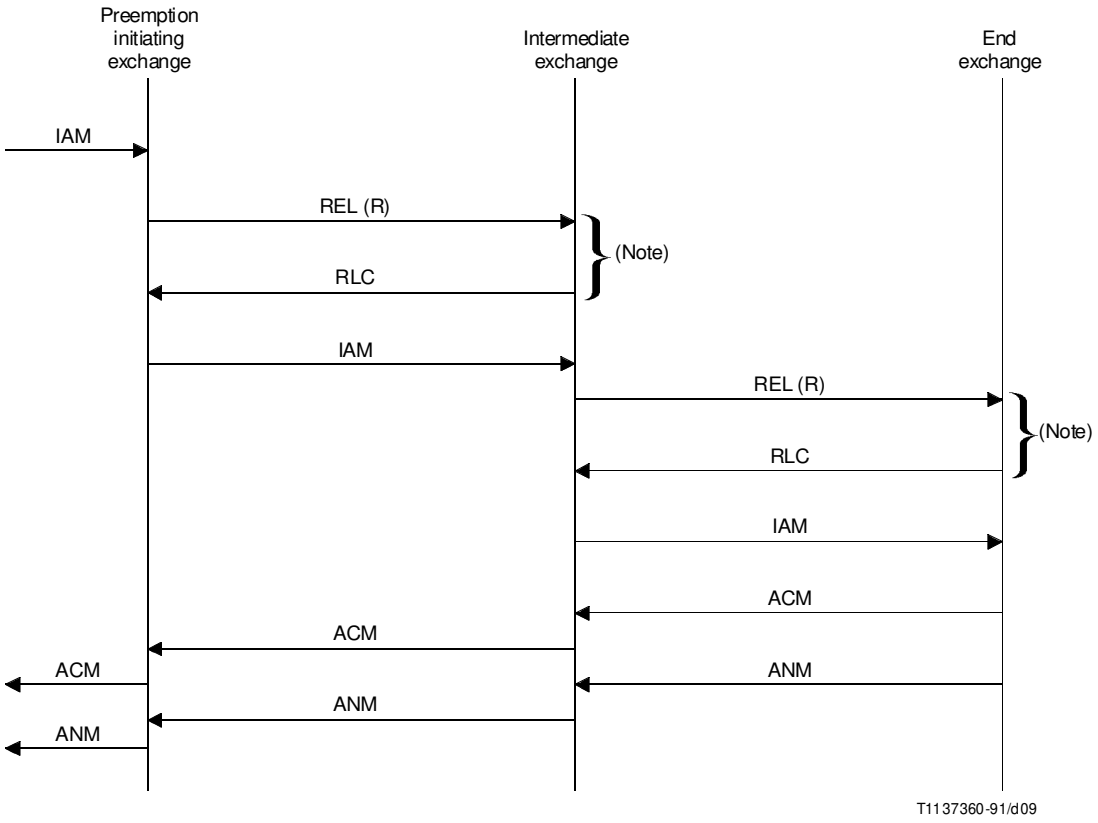
3.7.2 Networks with MF Signalling

In the event of SS7-MF interworking that may occur between the calling and called parties, the interworking exchange will follow the procedures specified for a gateway exchange in 3.5.2.2.4.3 2b) for networks that do not support LFB. If the MF network supports non-ISDN MLPP Service, the call will be established utilizing MLPP procedures that are applicable within the MF network. If the connected MF network does not support MLPP, the call will be established as a normal call within the MF portion of the network and the SS7 MLPP Service parameters are not required to be conveyed.

3.8 Signalling Flows

In Figures 3-1 to 3-6, the ISDN-User Part messages are denoted by solid lines between exchanges and TC messages are indicated by dashed lines. Specific notations used in the figures are detailed below.

Notation	*Meaning*
IAM (A)	ISDN-UP IAM with LFB indicator in the Precedence parameter set to “LFB allowed”
IAM (R)	ISDN-UP IAM with LFB indicator in the Precedence parameter set to “Path reserved”
REL (R)	ISDN-UP REL with cause value “preemption-circuit reserved for reuse (8)” NOTE – The release sequence denoted by “*” is performed only if a busy and preemptable circuit had been reserved by the preceding LFB Begin message.
LFB Begin	TC Begin message type message sent to perform the Look-ahead For Busy operation. Its parameter set is shown in Figure 3-2.
LFB End (ACK)	Response to the LFB Begin message with the Acknowledgment Type subfield of the Look ahead For Busy End parameter set to “positive acknowledgment”
R	Circuit reserved
ACM(D)	ISDN-UP ACM with notification indicator set to “Call completion delay”



NOTE – Performed only if circuit was busy and preemptable.

FIGURE 3-1/Q.735

MLPP Successful call set-up without LFB option

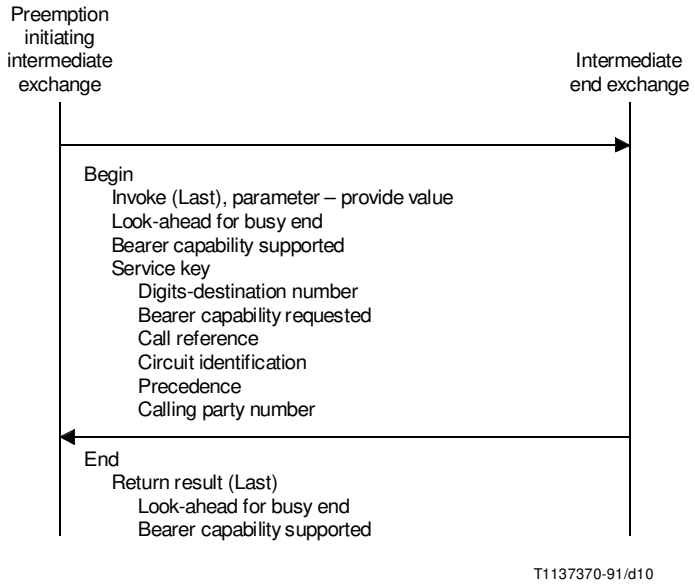
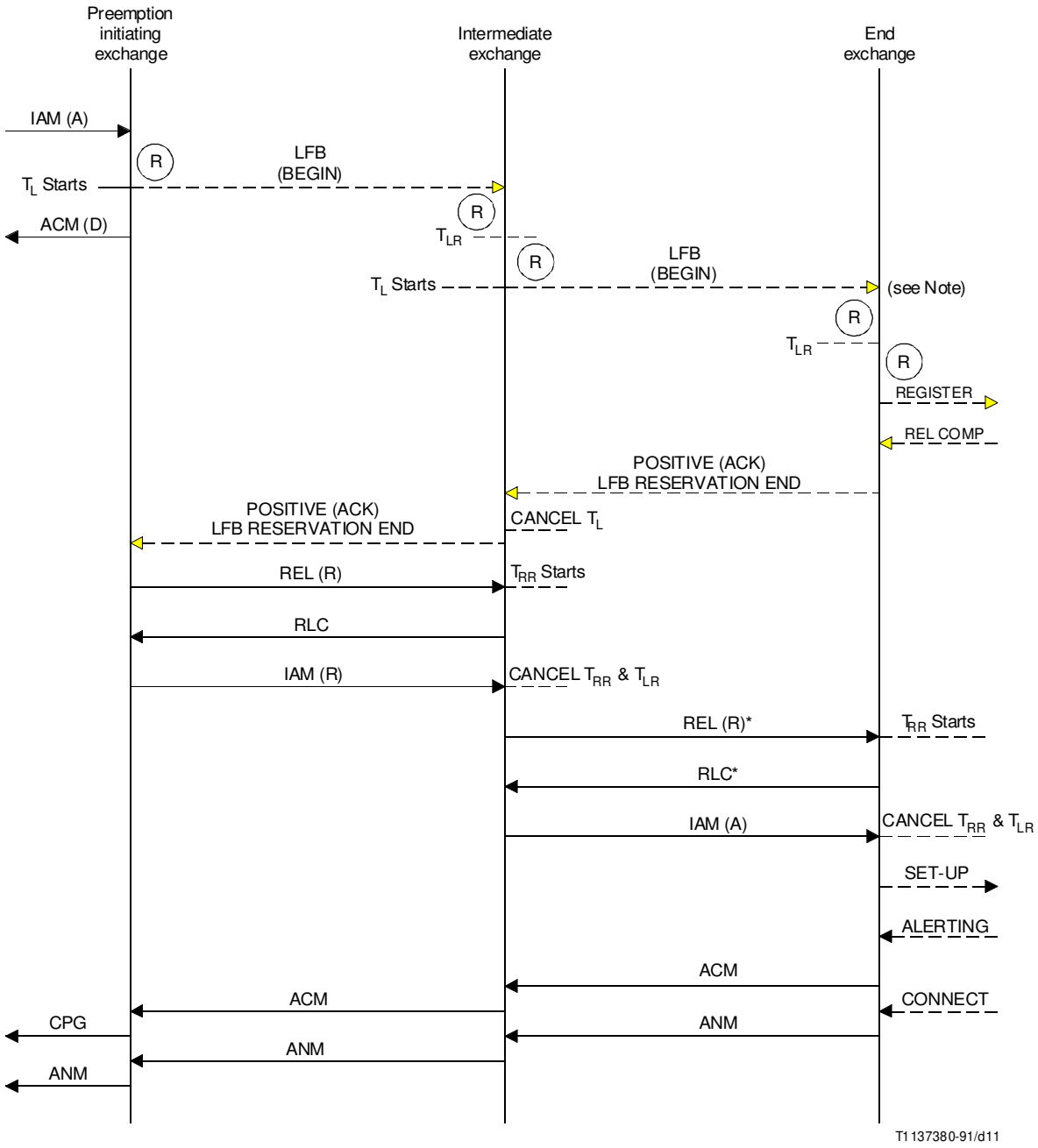


FIGURE 3-2/Q.735

Parameter – Provide value for LFB begin message



NOTE – Access procedures are illustrative only.

FIGURE 3-3/Q.735

MLPP successful call set-up with LFB option

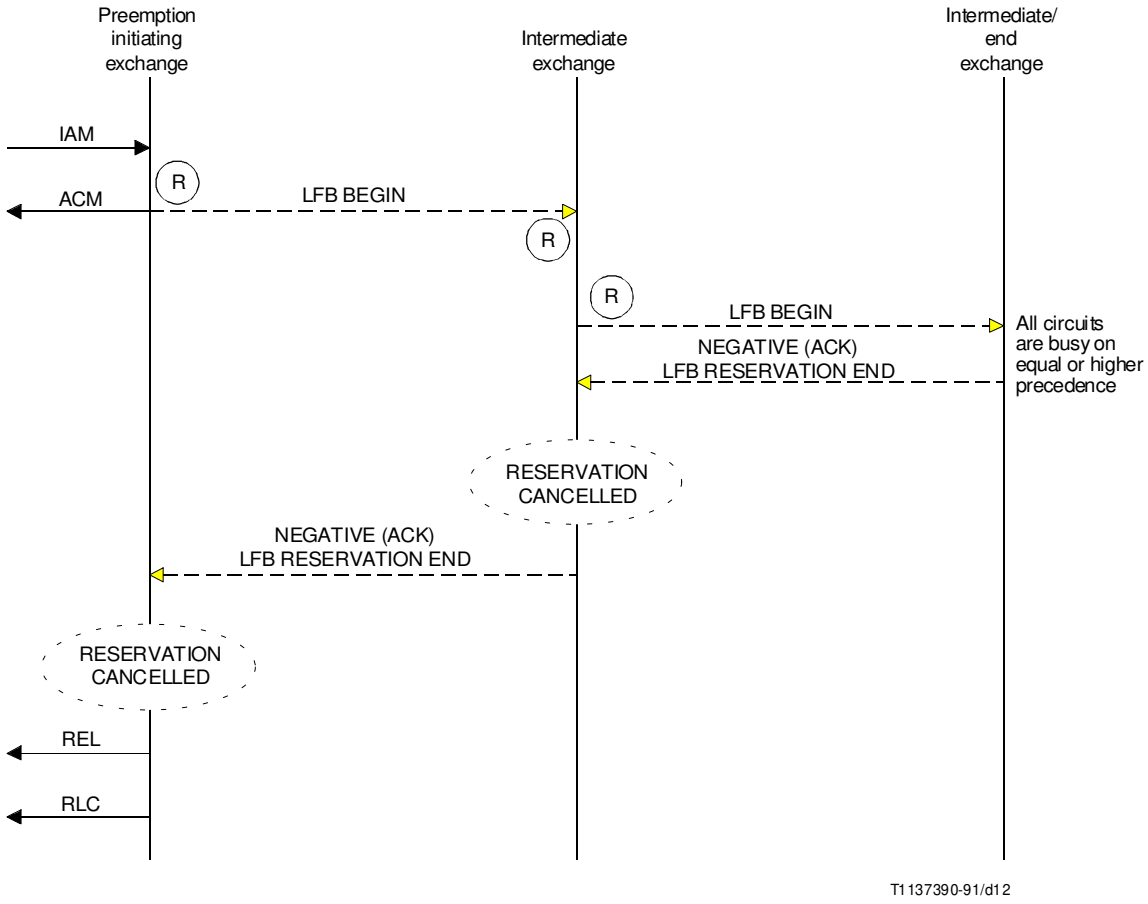


FIGURE 3-4/Q.735

MLPP Unsuccessful call set-up with LFB option

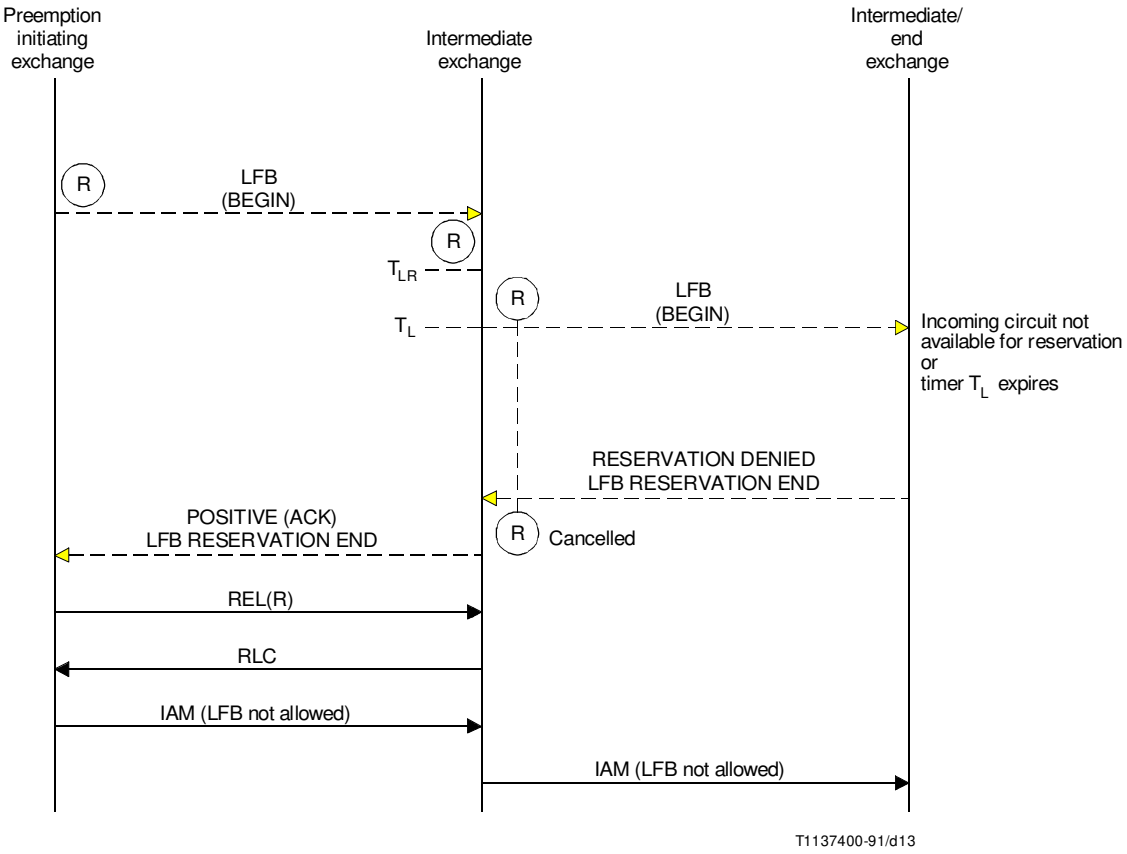
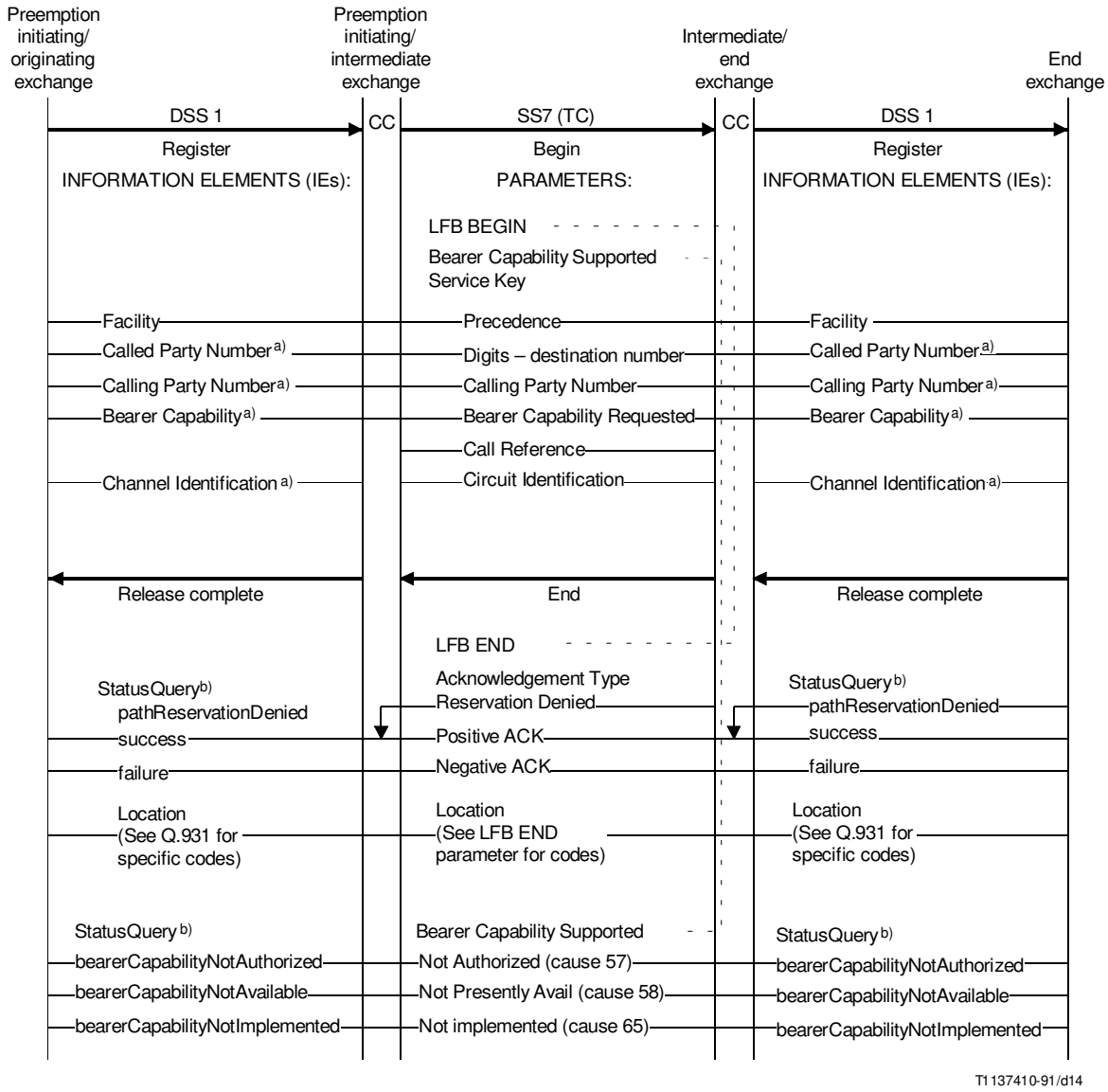


FIGURE 3-5/Q.735

Reservation response indicates path reservation denied; also sent on expiration of timer T_L



a) These IEs are encapsulated within the Facility IE.

b) StatusQuery and Location are contained in Facility IE.

NOTE – If the LFB Query originates in the SS7 Network, the Negative Ack result will be returned to DSS 1 in a REL message with appropriate Cause code [to indicate either the lack of Bearer Capability (cause 57, 58 or 65) or preemptable resources (ANSI standard cause 46)], and Location code.

FIGURE 3-6/Q.735

LFB Transaction messages (SS7/DSS 1)

3.9 Parameter Values-Timers

Four timers are employed with the MLPP operation; timer T_1, T_L, T_{LR}, and T_{RR}. Timer T_1 value is specified in Recommendation Q.764. The value of the remaining timers are as follows:

a) Timer T_L is started when a TC LFB Begin is sent from an exchange. The duration is approximately 15 seconds.

b) Timer T_{LR} is started when the TC LFB Begin successfully locates and marks as reserved a preemptable circuit. This timer has an approximate value of 30 seconds.

c) Timer T_{RR} is started when a call is preempted and the circuit is reserved for reuse. This timer has an approximate value of 15 seconds.

3.10 Dynamic Description (SDLs)

This subclause contains the SDL diagrams for both ISDN-UP and TC (LFB) processing of MLPP calls. The SDLs are divided into three figures: Figure 3-7 covers the Preemption Initiating Exchange; Figure 3-8 the Intermediate Exchange; and Figure 3-9 the End Exchange.

The SDLs show only the exchanges and messages involved in the set-up of one preempting call from the time the call encounters circuit congestion until it leaves the network going to either another SS7 network through a gateway or to a DSS 1 access network. Other exchanges and messages that may be involved in the complete release of a preempted call are not shown in order to reduce the complexity of the SDLs. However, the initiation of these release messages to the other exchanges is shown.

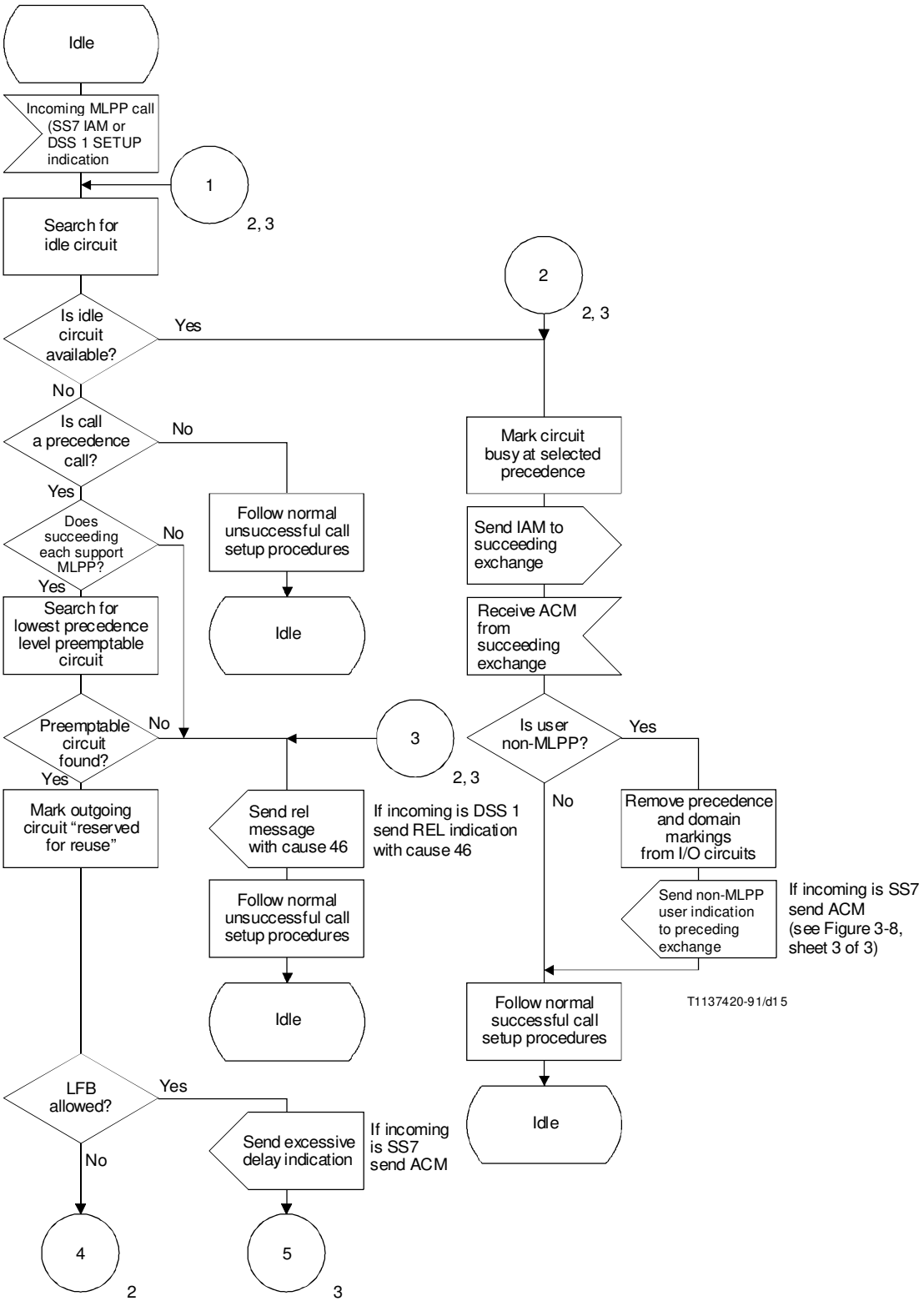


FIGURE 3-7/Q.735 (sheet 1 of 3)

Preemption initiating exchange – Procedures for incoming MLPP call

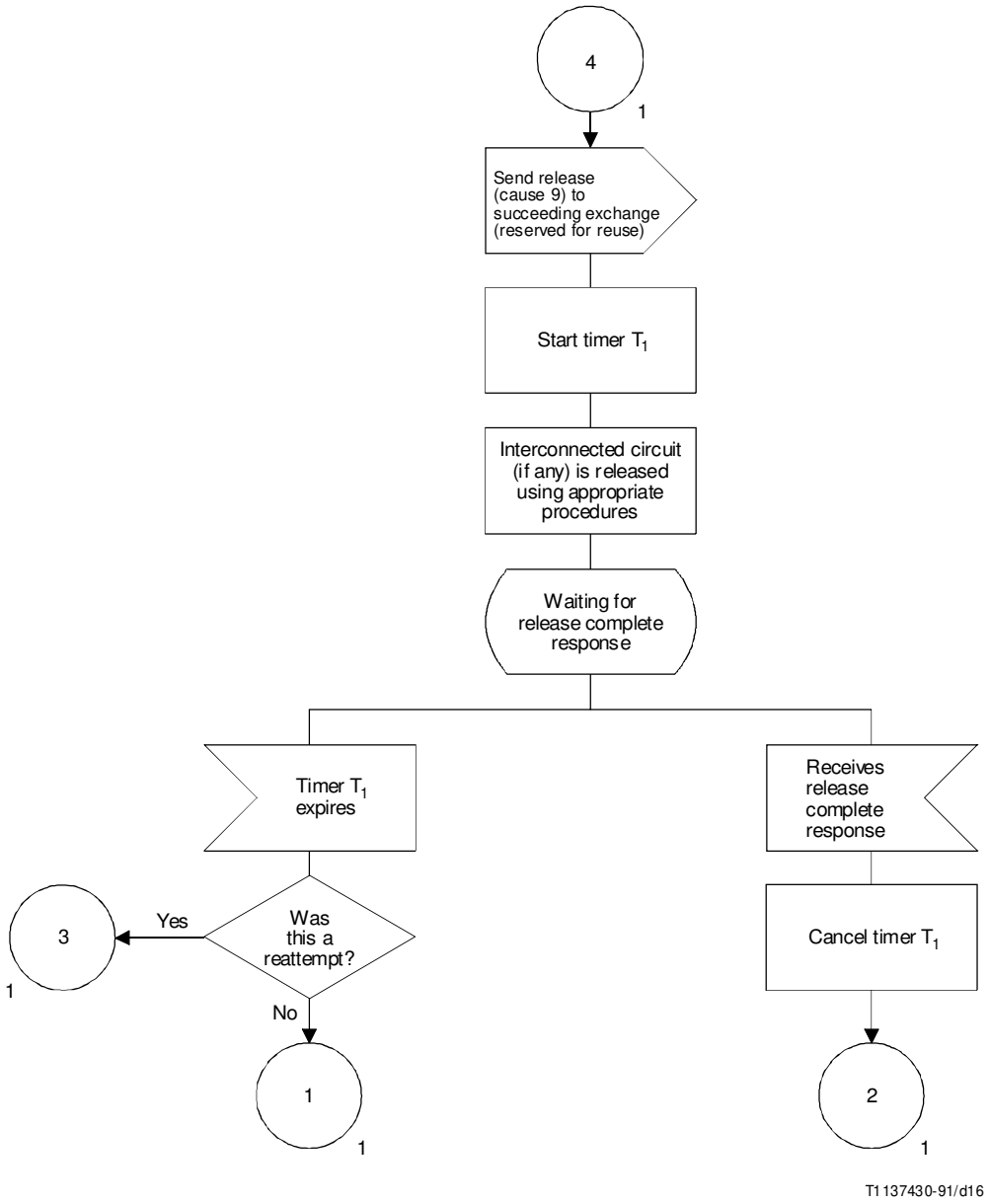


FIGURE 3-7/Q.735 (sheet 2 of 3)

Preemption initiating exchange – Release of resources

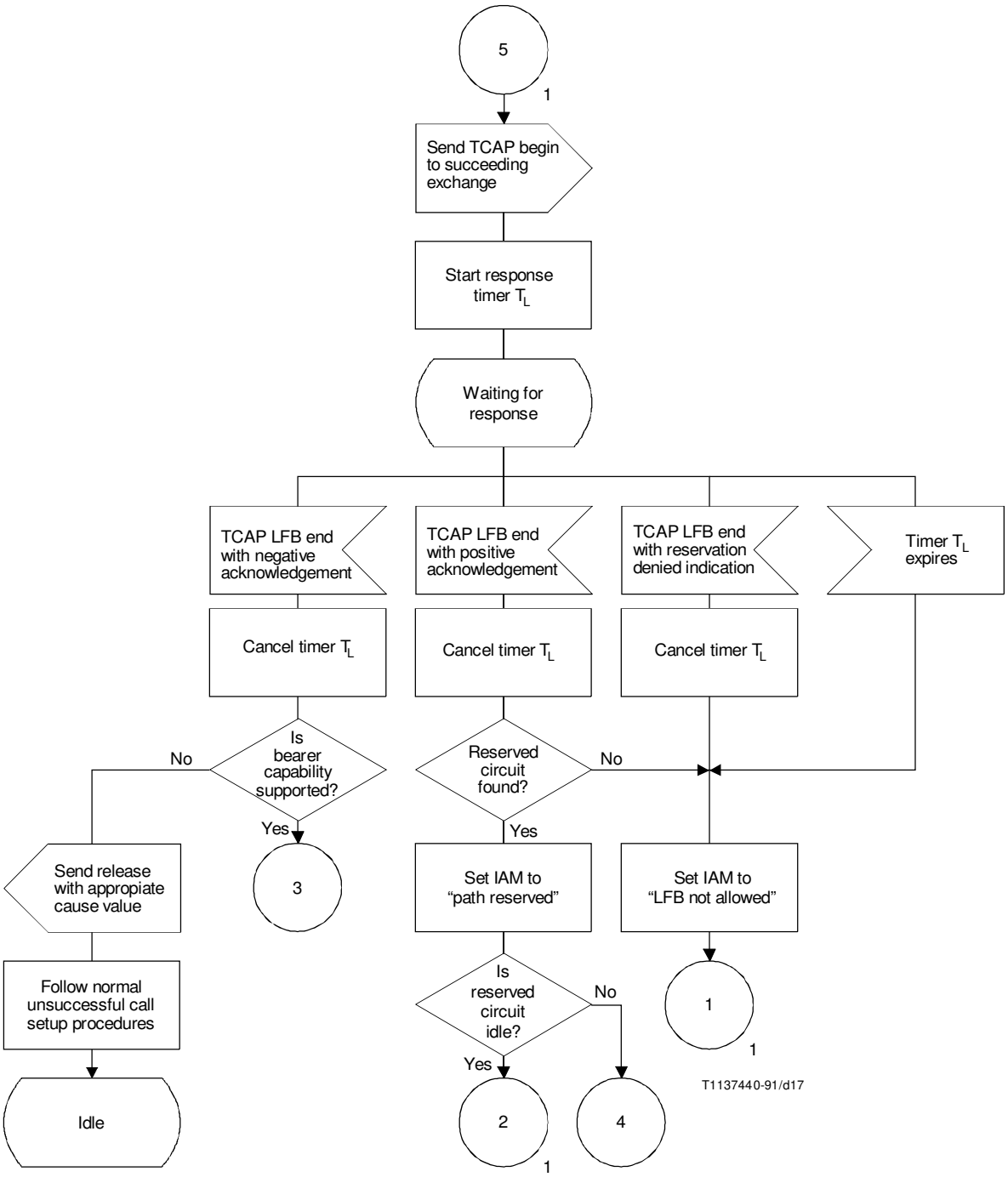


FIGURE 3-7/Q.735 (sheet 3 of 3)

Preemption initiating exchange – LFB procedures

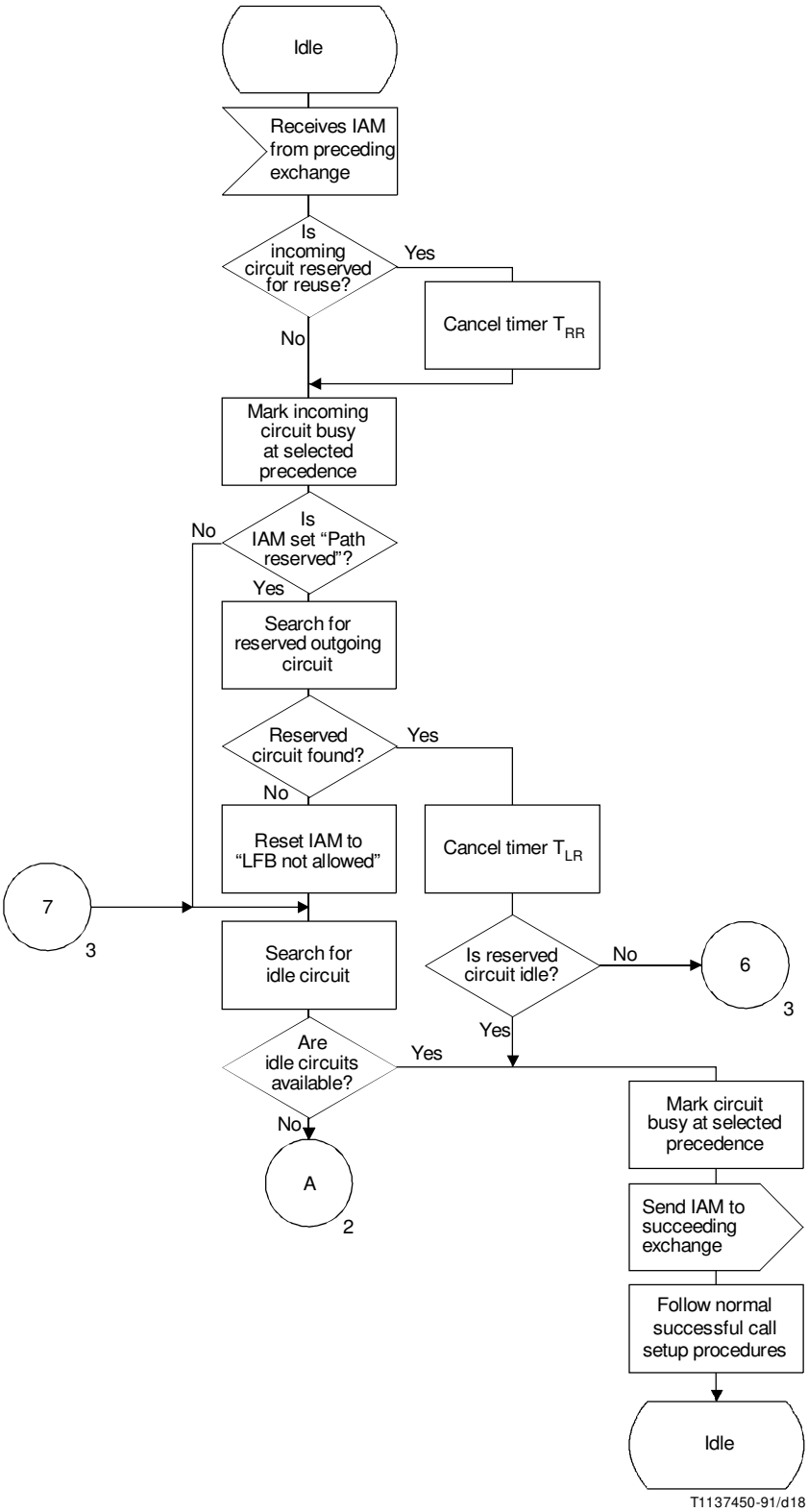


FIGURE 3-8/Q.735 (sheet 1 of 6)

Intermediate exchange – Receipt of IAM from preceding exchange

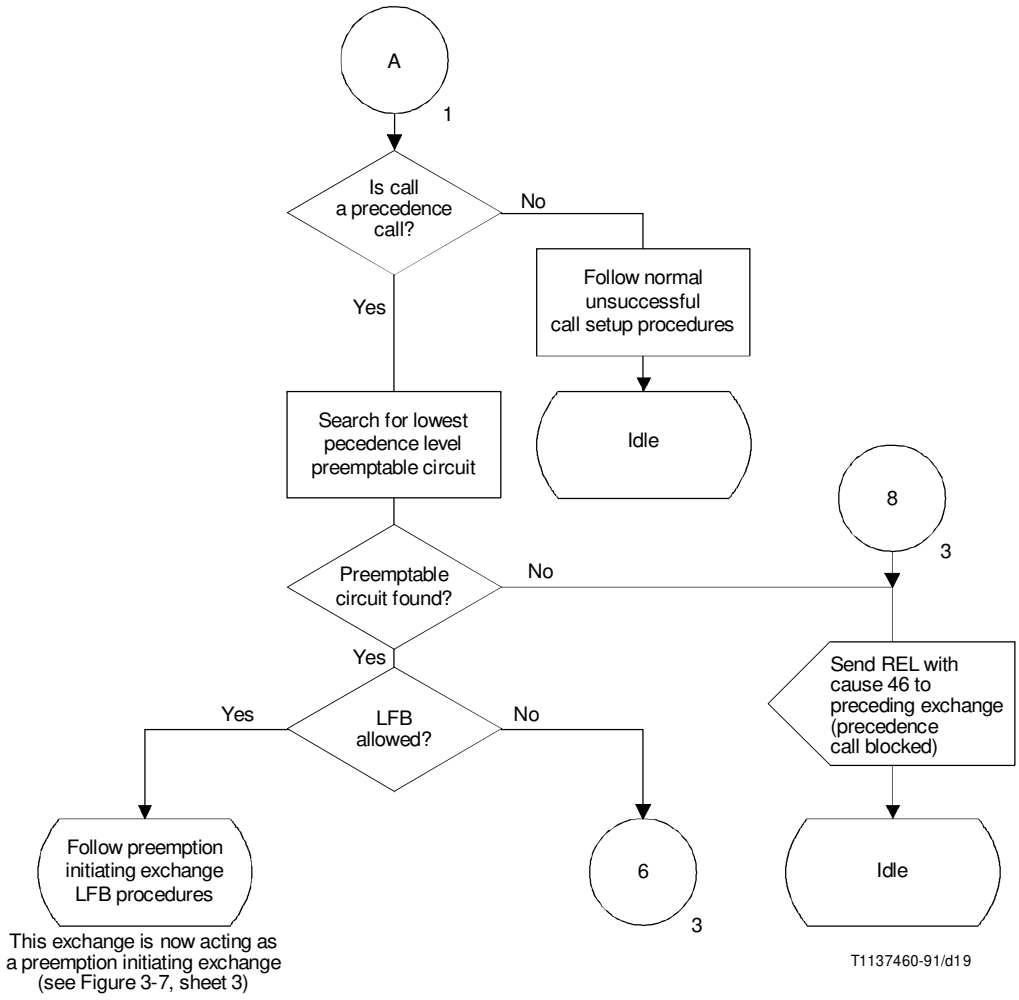


FIGURE 3-8/Q.735 (sheet 2 of 6)

Intermediate exchange – Receipt of IAM from preceding exchange

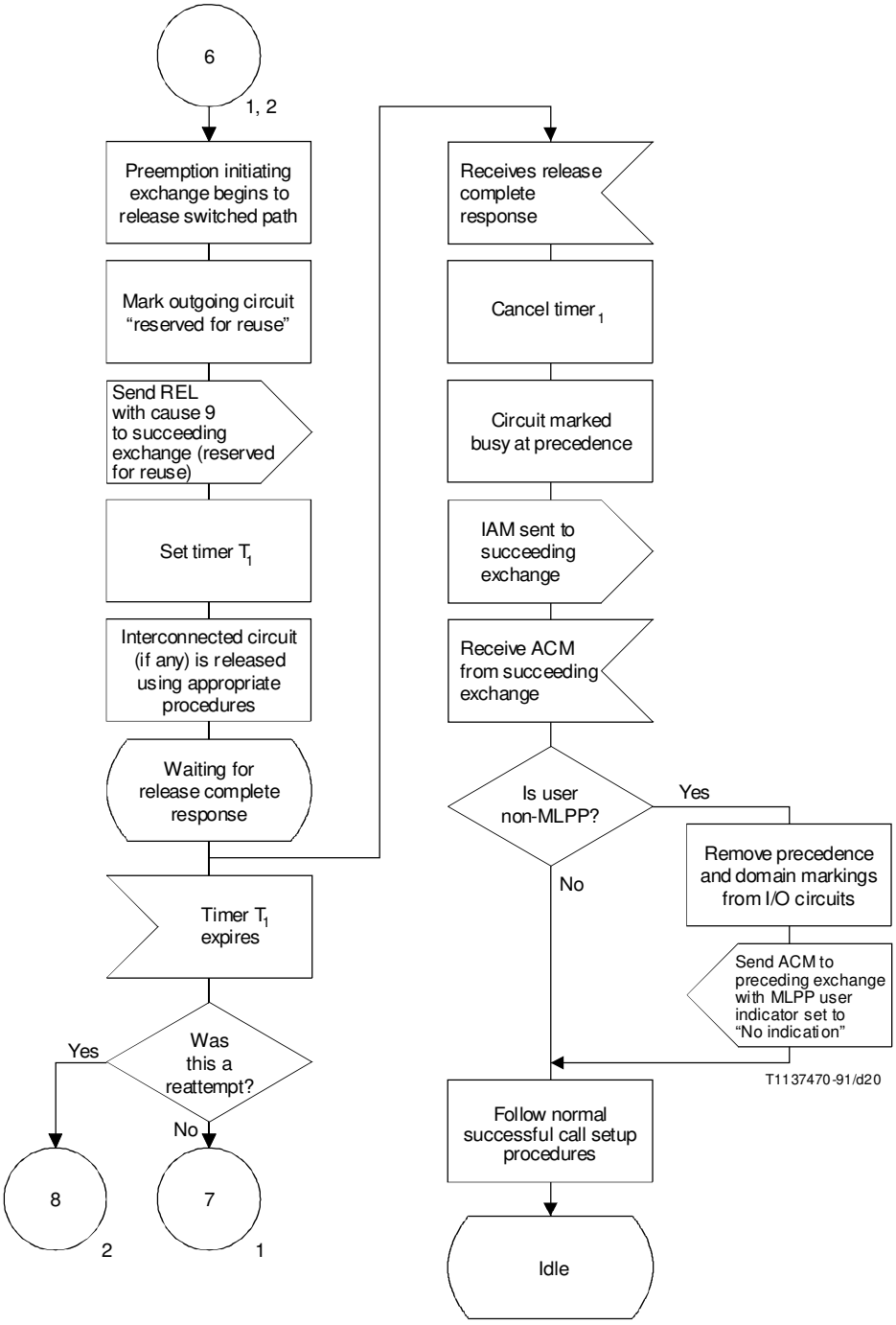


FIGURE 3-8/Q.735 (sheet 3 of 6)

Intermediate exchange – Release procedures

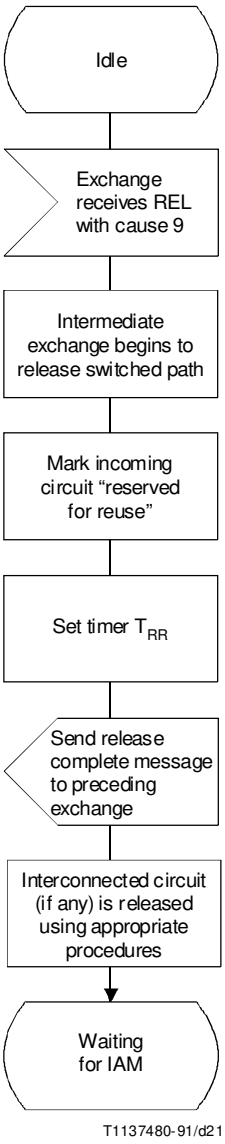


FIGURE 3-8/Q.735 (sheet 4 of 6)

Intermediate exchange – Release procedures

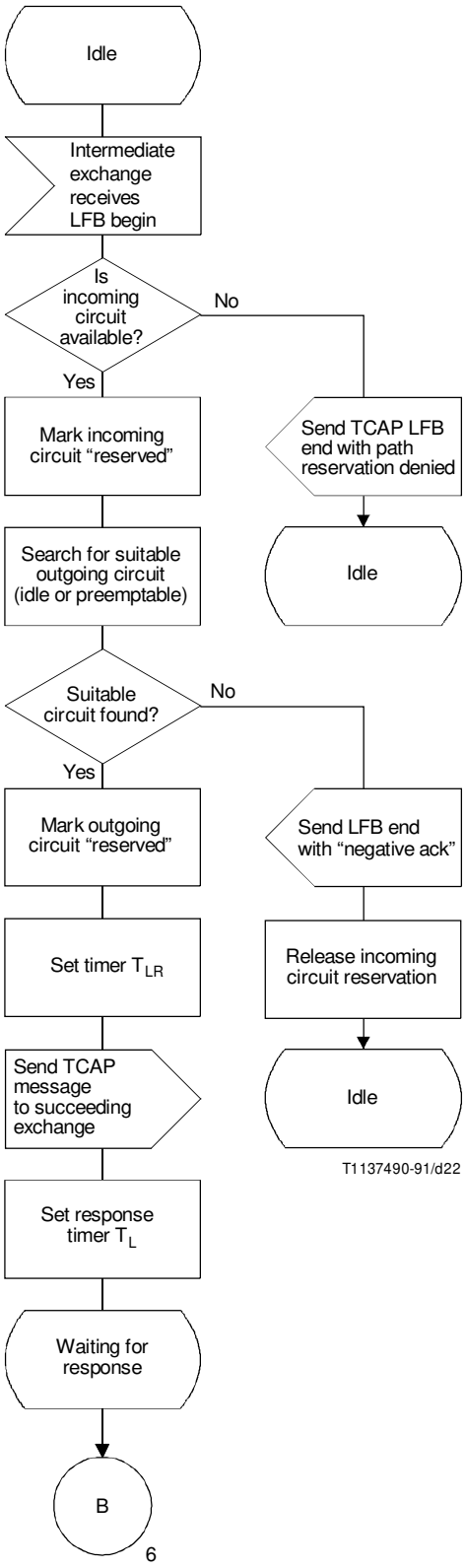


FIGURE 3-8/Q.735 (sheet 5 of 6)

Intermediate exchange – LFB procedures

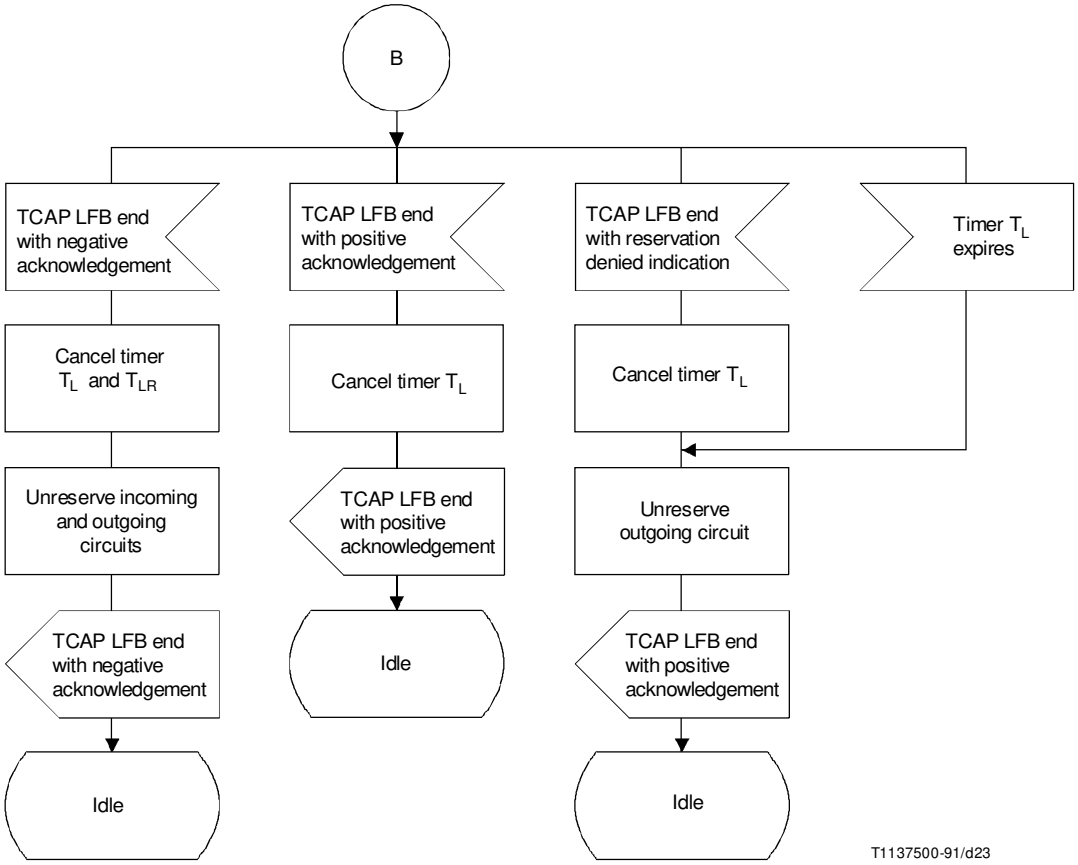


FIGURE 3-8/Q.735 (sheet 6 of 6)

Intermediate exchange – LFB procedures

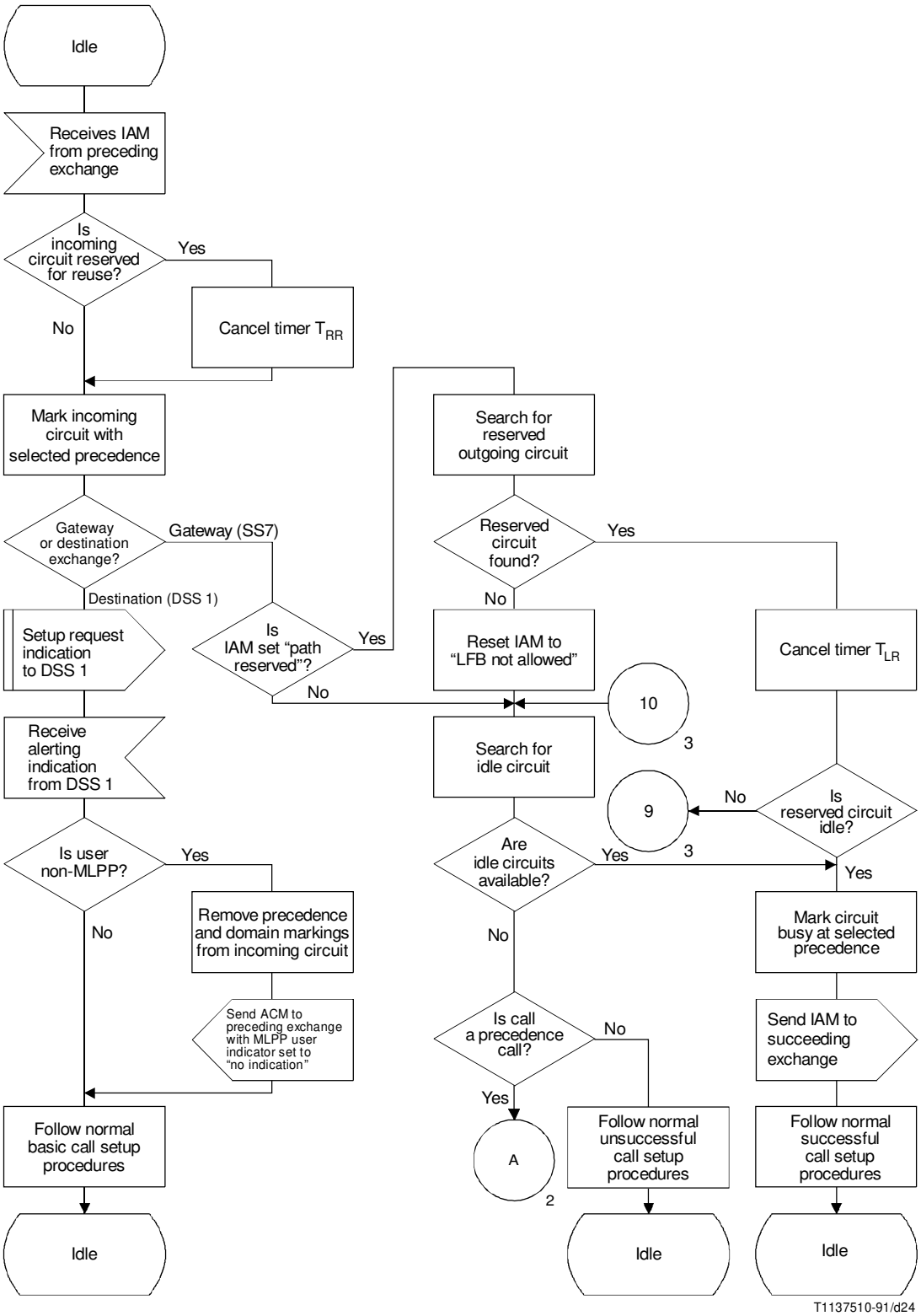


FIGURE 3-9/Q.735 (sheet 1 of 8)

End exchange – Receipt of IAM from preceding exchange

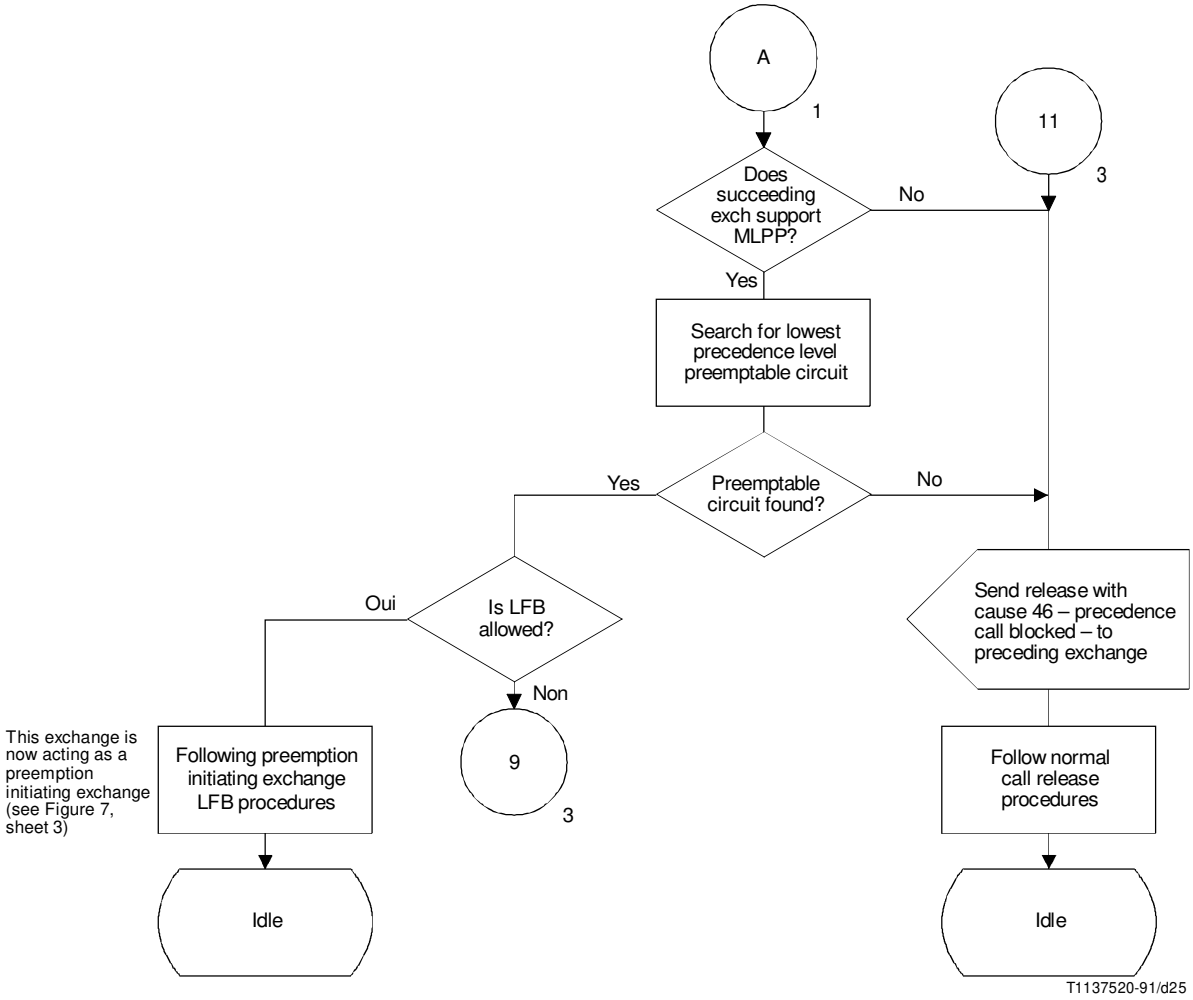


FIGURE 3-9/Q.735 (sheet 2 of 8)

End exchange – Receipt of IAM from preceding exchange

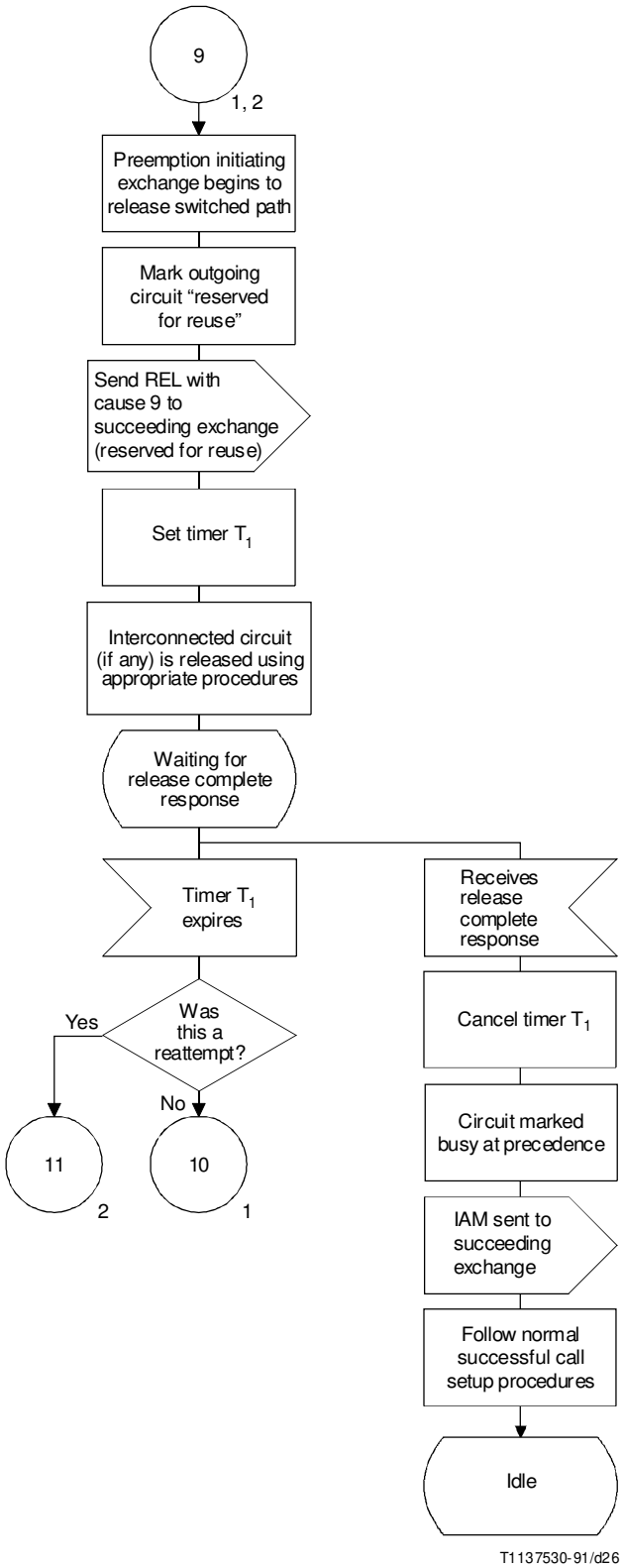


FIGURE 3-9/Q.735 (sheet 3 of 8)

End exchange – Release procedures

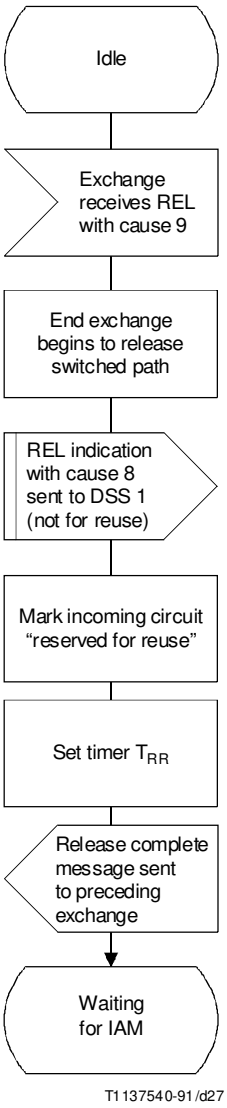


FIGURE 3-9/Q.735 (sheet 4 of 8)

End exchange – Release procedures

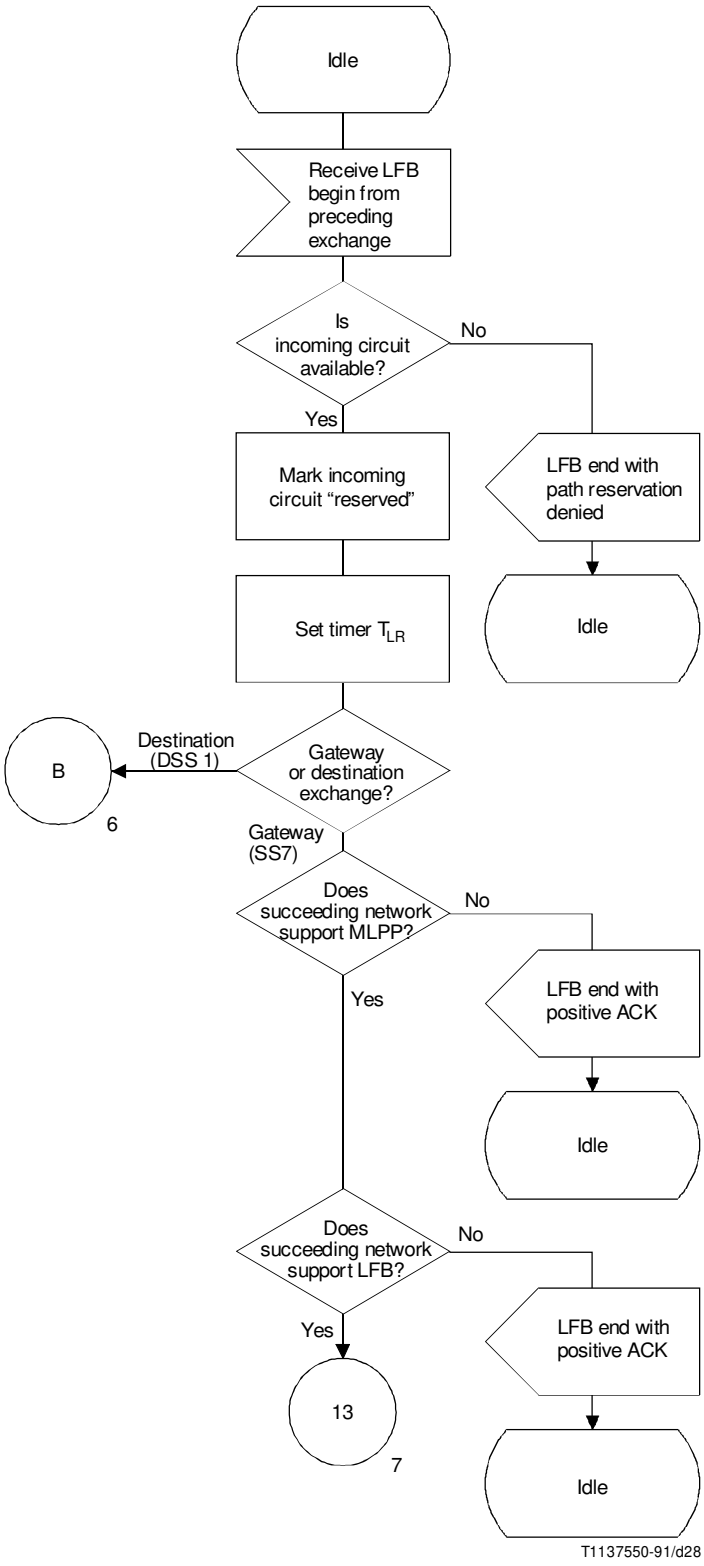


FIGURE 3-9/Q.735 (sheet 5 of 8)

End exchange – Release procedures

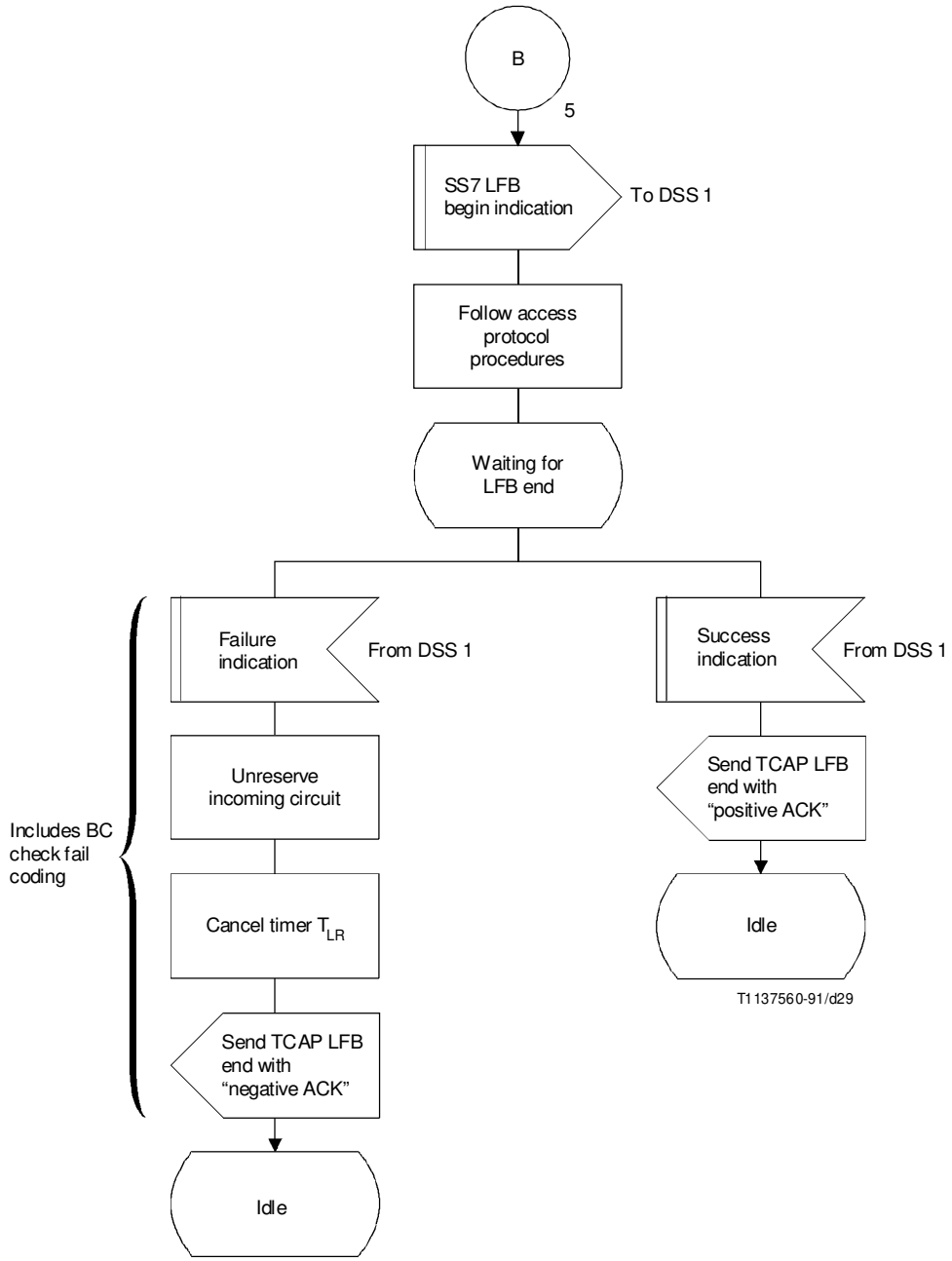


FIGURE 3-9/Q.735 (sheet 6 of 8)

End exchange – LFB procedures

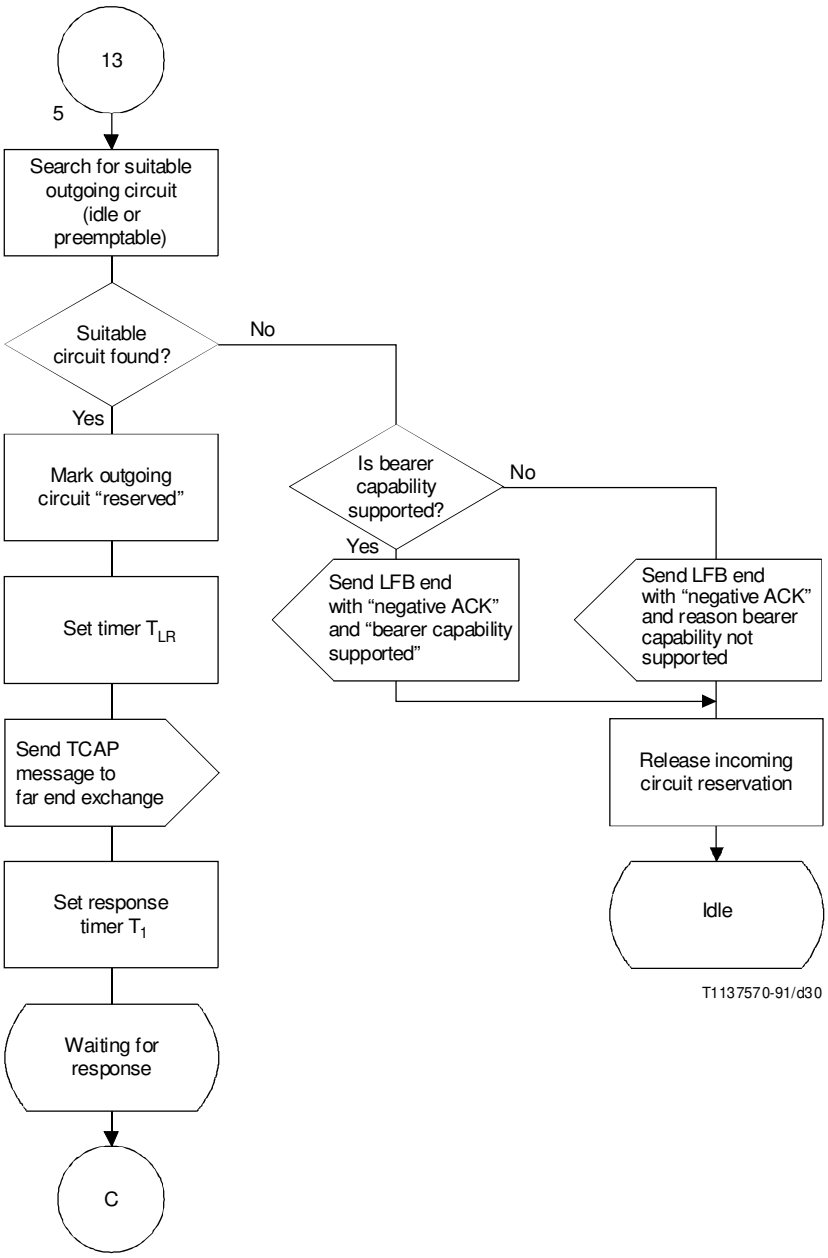


FIGURE 3-9/Q.735 (sheet 7 of 8)

End exchange – LFB procedures

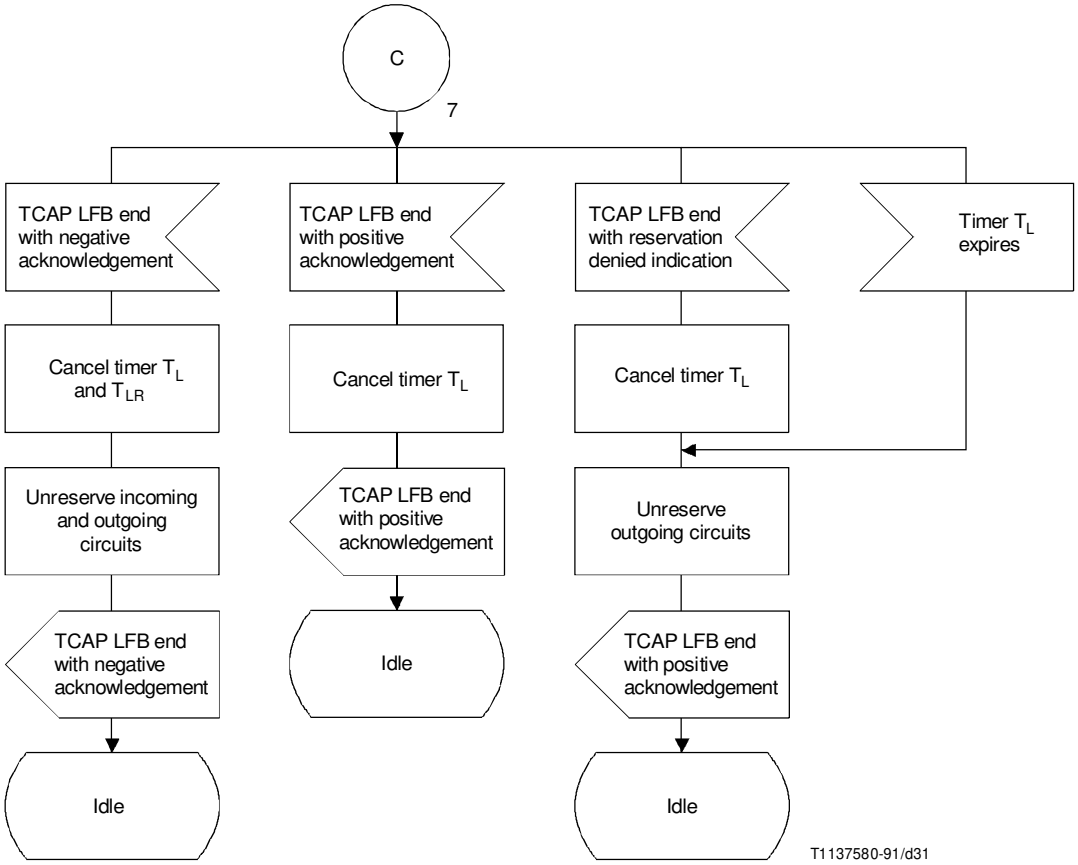


FIGURE 3-9/Q.735 (sheet 8 of 8)

End exchange – LFB procedures

Appendix I

(to clause 1)

(This appendix does not form an integral part of this Recommendation)

```
Closed-User-Group-service-operations
                    { ccitt recommendation q 735 cug (1) }

DEFINITIONS ::=

BEGIN


IMPORTS

OPERATION,      ERROR

FROM TCAPMessages  { ccitt recommendation q 773 moduleA (0) }
```

```
PresentedNumberScreened, PartyNumber

FROM Addressing-Data-Elements
        { ccitt recommendation q 932 addressing-data-elements (7) };

CUGCheck1 ::= OPERATION

ARGUMENT SEQUENCE                   { BearerCapability,
                                      CallIndicator,
                                      CallingPartyNumber,
                                      LocalIndex OPTIONAL,
                                      HighLayerCompatibility OPTIONAL }

RESULT  SEQUENCE                    { CallIndicator,
                                      CUGInterlockCode OPTIONAL }

ERRORS                              { unsuccessfulCheck }

cUGCheck1    CUGCheck1 ::= 1

CUGCheck2 ::= OPERATION

ARGUMENT SEQUENCE                   { BearerCapability,
                                      CallIndicator,
                                      CalledPartyNumber,
                                      CUGInterlockCode OPTIONAL,
                                      HighLayerCompatibility OPTIONAL }

RESULT  SEQUENCE                    { CallIndicator,
                                      LocalIndex OPTIONAL }

ERRORS                              { unsuccessfulCheck }

cUGCheck2    CUGCheck2 ::= 2

CallingUserIndex ::= LocalIndex

CalledUserIndex ::= LocalIndex

LocalIndex ::= INTEGER (0..32767)

-- Some networks may specify a maximum value of the
-- CUG index from 0 to 9999.

CallIndicator ::= CUGCallIndicator

CugCallIndicator ::= ENUMERATED

                                    { nonCUGCall (0),
                                      nonCUGCall (1),
                                      outgoingAccessAllowedCUGCall (2),
                                      outgoingAccessNotAllowedCUGCall (3) }

CallingPartyNumber ::= PresentedNumberScreened

-- Address of calling party

CalledPartyNumber ::= PartyNumber

-- Address of called party

CugInterlockCode ::= SEQUENCE

                                    { NetworkIdentity,
                                      BinaryCode }

NetworkIdentity ::= OCTET STRING (SIZE (2))

-- Four digits coded in BCD

BinaryCode ::= OCTET STRING (SIZE (1..2))

UnsuccessfulCheck       ERROR

  PARAMETER          Cause
```

```
Cause ::= [7] IMPLICIT INTEGER
                { requestedFacilityNotSubscribed (50),
                  outgoingCallsBarredWithinCUG (53),
                  incomingCallsBarredWithinCUG (55),
                  inconsistencyInDesignatedOutgoingAccessInformationAnd
                  SubscriberClass (62),
                  userNotMemberOfCUG (87),
                  incompatibleDestination (88),
                  protocolErrorUnspecifiednonExistentCUG (90) }

unsuccessfulCheck       UnsuccessfulCheck ::= 1

BearerCapability ::= [8] IMPLICIT OCTET STRING (SIZE (5..11))

-- Bearer capability is encoded as in Recommendation Q.931
-- (octets 3-7 + optional extension to octets 4 & 5)

HighLayerCompatibility ::= [9] IMPLICIT OCTET STRING (SIZE (2))

-- HLC is encoded as in Recommendation Q.931 (octets 3 & 4)

END -- of Closed User Group service operations.
```