ATIS-1000619.1992(R2010)

Integrated Services Digital Network (ISDN) – Multi-Level Precedence and Preemption (MLPP) Service Capability

American National Standard for Telecommunications

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American National Standard
for Telecommunications –

Integrated Services Digital Network (ISDN) – Multi-Level Precedence and Preemption (MLPP) Service Capability

Secretariat
Exchange Carriers Standards Association

Approved February 28, 1992
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Foreword (This foreword is not part of American National Standard T1.619-1992.)

This American National Standard defines and describes the multi-level precedence and preemption (MLPP) supplementary service in the context of an integrated services digital network (ISDN). The MLPP service provides a prioritized call handling service. This service has two parts – precedence and preemption. Precedence involves assigning to a call, on a per call basis, a priority level and validating the priority level. Preemption involves seizing of resources, which are in use by calls of lower precedences, by a higher precedence call in the absence of idle resources. Preemption may occur in the network or user access. As a service provider option, before preemption of lower precedence calls, a network may provide a search and reservation of network resources via a look-ahead for busy (LFB) function to ensure that network and called user access resources are available to complete the higher precedence call prior to preemption. This service applies to both an ISDN basic rate access and an ISDN primary rate access. It is intended to supplement

a) the basic circuit mode bearer services contained in ANSI T1.604-1990, *American National Standard for Telecommunications – Integrated services digital network (ISDN) – Minimal set of bearer services for the basic rate interface*;

b) the signalling system number 7 (SS7) basic call signaling procedures contained in ANSI T1.113-1988, *American National Standard for Telecommunications – Signalling system number 7 (SS7) – Integrated services digital network (ISDN) user part*;

c) the digital subscriber signaling system number 1 (DSS1) basic call signaling procedures contained in ANSI T1.607-1990, *American National Standard for Telecommunications – Integrated services digital network (ISDN) – Layer 3 signaling specification for circuit-switched bearer service for digital subscriber signaling system number 1 (DSS1)*;

d) the generic procedures for use with ISDN supplementary services contained in ANSI T1.610-1990, *American National Standard for Telecommunications – Digital subscriber signaling system number 1 (DSS1) – Generic procedures for the control of ISDN supplementary services*.

This standard also defines the interactions of the MLPP service with other ISDN supplementary services.

Manufacturers of ISDN user terminals and customer premise equipment (CPE) and manufacturers of ISDN switching equipment can apply this standard to the design and development of their products.

There are five annexes to this standard. Annex A is normative and is considered part of this standard; annexes B to E are informative and are not considered part of this standard.

This standard was develped over the past several years by Technical Subcommittee T1S1 of Accredited Standards Committee T1 – Telecommunications.

Suggestions for improvement of this standard will be welcome. They should be sent to the Exchange Carriers Standards Association, 1200 G Street, NW, Suite 500, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Telecommunications, T1. Committee approval of the standard does not imply that all committee members voted for its approval. At the time it approved this standard, Accredited Standards Committee T1 had the following members:

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American National Standard
for Telecommunications –

Integrated Services Digital Network (ISDN) – Multi-Level Precedence and Preemption (MLPP) Service Capability

1 Scope, purpose, and application

1.1 Scope and purpose

This standard is one of a series that defines and describes service capabilities within the context of an integrated services digital network (ISDN). This service capability may be made available on a demand or subscription arrangement. The interaction of this service capability with other service capabilities defined in other American National Standards is also included. The purpose of this standard is to allow maximum compatibility among network- and user-owned telecommunications equipments in order to increase the attractiveness and usefulness of ISDN-based capabilities.

The multi-level precedence and preemption (MLPP) 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.

1.2 Application

This standard applies to both an ISDN basic rate access and ISDN primary rate access and is intended to supplement the basic circuit mode call control procedures described in ANSI T1.607 and ANSI T1.113. It should be used in conjunction with other American National Standards for ISDN supplementary services for a complete understanding of the interactions between this and other services.

This supplementary service is applicable to the following circuit mode bearer services:

a) speech;

b) 3.1-kHz audio (voice-band data);

c) 64-kbit/s unrestricted (data).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated on the next page.

ANSI T1.113-1988, *Telecommunications – Signaling system number 7 (SS7) – Integrated services digital network (ISDN) user part* [1)]

ANSI T1.114-1988, *Telecommunications – Signaling system number 7 (SS7) – Transaction capability application part (TCAP)*[1)]

ANSI T1.607-1990, *Telecommunications – Integrated services digital network (ISDN) – Layer 3 signaling specification for digital subscriber signaling system number 1 (DSS1)*

ANSI T1.609-1990, *Telecommunications – Interworking between the ISDN user – network interface protocol and the signaling system number 7 ISDN user part*

ANSI T1.610-1990, *Telecommunications – Digital subscriber signaling system number 1 (DSS1) – Generic procedures for the control of ISDN supplementary services*

3 Definitions and abbreviations

3.1 Definitions

The following terminology is used throughout this standard:

3.1.1 domain: An MLPP domain consists of a set of MLPP subscribers (MLPP users) and the network and access resources that are in use by that set of MLPP subscribers at any given time. Connections and resources that are in use by MLPP subscribers may only be preempted by higher precedence calls from MLPP subscribers within the same domain.

3.1.2 network: In this standard, "network" refers to all telecommunications equipment that has any part in processing a call or a supplementary service for the user referred to. It may include local exchanges, transit exchanges, and NT2s but does not include the ISDN terminal and is not limited to the "public" network or any other particular set of equipment.

3.1.3 service provider: This is a company, organization, administration, business, etc., that sells, administers, maintains, charges for, etc. the service. The service provider may or may not be the provider of the network.

3.1.4 precedence: Precedence is the priority associated with a call.

3.1.5 precedence call: A precedence call is a call with a precedence level higher than the lowest level of precedence.

3.1.6 MLPP call: An MLPP call is a call that has a precedence level established and is either being setup or is setup. In DSS1, an MLPP call is a call from an MLPP subscriber for which a SETUP has been sent but no DISCONNECT has been sent or received. In SS7, an MLPP call is a call with a precedence level for which the exchange has sent an initial address message (IAM) but has not sent or received a release (REL) message.

3.1.7 preempting call: A preempting call is a call with a precedence level higher than the lowest (i.e., ROUTINE) level of precedence, for which a call setup request has been received at the exchange.

3.1.8 active call: An active call is a call that has the connection established and the calling and called parties are active on the call.

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

[1)] At the time of publication, a revision of this standard was submitted to ANSI for approval. Contact the secretariat for more recent information.

3.1.10 preemption initiating exchange: A preemption initiating exchange is the exchange that is congested (i.e., no idle circuits) and has received a preempting call setup.

3.1.11 congestion: Congestion has been encountered when it is determined that all circuits capable of routing the MLPP call are busy (i.e., no idle circuits).

3.1.12 Response timer T_K: Response timer T_K is started when the network notifies the called user of a precedence call (for example, this would be the preemption notification if preemption occurs at the user interface). This timer establishes the time that the called party of the precedence call has to accept the incoming precedence call. The length of this timer is in the range of 4 – 30 seconds.

3.1.13 alternate party: An alternate party is the party to which a precedence call will be diverted. Diversion will occur either when the response timer T_K expires, when the called party is busy on a call of equal or higher precedence, or when the called party is busy with access resources non-preemptable. Alternate party diversion is an optional terminating feature that is subscribed to by the called party; thus, the alternate party to which a precedence call is diverted is specified by the called party at the time of subscription.

3.1.14 users A and B: Users A and B are parties of the MLPP call A-B for scenarios involving preemption in the network. User A is also a party of the MLPP Call A-D for scenarios depicting preemption in the user access area.

3.1.15 user C: User C is the calling party of the preempting higher precedence call.

3.1.16 user D: User D is the called party of the preempting higher precedence call from user C. User D is also a party of the MLPP Call A-D for preemption in the user access area.

NOTE – In DSS1 examples:

a) users A and B are parties of an MLPP call;

b) user C and user B are, respectively, the calling party and the called party of the preempting higher precedence call; and

c) users D and E are parties of a preempted MLPP call.

3.1.17 LFB (look-ahead for busy): LFB is an optional information unit used to find out whether network resources are available to support the higher precedence call. Available resources include idle circuits and circuits used for lower precedence calls. This information unit will provide call path reservation.

3.1.18 LFB RESP: LFB RESP is the response information unit to the LFB information unit. Possible responses are: Ack (network resources are available to support the higher precedence call and the necessary circuits are properly marked as "reserved") and Nak (network resources are not available to support the higher precedence call).

3.1.19 LFBU RESP: LFBU RESP is the response information unit to indicate the status of the called party. Possible responses are: available and unavailable. Available means that the called party is either

a) not busy;

b) busy with a call of lower precedence with preemptable access resources;

c) busy with a call of equal or higher precedence with call completion services (i.e., call waiting or call forwarding busy) or an alternate party; or

d) busy with access resources non-preemptable with call completion services or an alternate party. Unavailable means that the called party is busy with a call of equal or higher precedence and no call completion services or an alternate party are available or is busy with nonpreemptable resources and no call completion services or an alternate party are available.

3.1.20 TIMER T_L: TIMER T_L is a timer that is started when a functional entity sends an LFB information unit. This timer establishes the amount of time the network has to complete an LFB search for network and access resources before preemption is initiated [if the functional entity (FE) initiated the search] or an LFB RESP ack is returned to the previous FE. The expected value of this timer is in the range of 5 to 20 seconds.

3.1.21 PREEMPTED: This is the notification sent to the parties of the preempted calls.

3.1.22 NOTI PREMT: This is the notification of intended preemption sent to the busy party that is the called party of the preempting call.

3.1.23 ACPT PREMT: This term indicates acceptance of NOTI PREMT.

3.1.24 PREEMPT NOTIFICATION: This is the notification of preemption at the user interface sent to the preempted user to release the existing MLPP call and to reserve the interface for the preempting call.

3.1.25 SETUP(PREC) and LFB(PREC): These terms indicate the SETUP and LFB information units containing precedence level and domain information.

3.1.26 OE (originating exchange): OE (originating exchange) is an exchange that is directly connected to a calling user.

3.1.27 DE (destination exchange): DE (destination exchange) is an exchange that is directly connected to a called user.

3.1.28 user: A user is identified by a terminal, which is addressed by its ISDN number. A called user is considered busy if he is active on a call.

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

3.2 Abbreviations

3.2.1 CC: Call control.

3.2.2 CCA: Call control agent.

3.2.3 FE: Functional entity.

3.2.4 LE: Local exchange.

3.2.5 LFB: Look-ahead for busy.

3.2.6 MLPP: Multi-level precedence and preemption.

3.2.7 MLPPA: MLPP agent.

3.2.8 MPLC: MLPP service precedence level control.

3.2.9 MPRC: MLPP service preemption control.

3.2.10 MSRC: MLPP service search and reservation control.

3.2.11 TE: Terminal equipment.

3.2.12 TR: Transit exchange (same as intermediate exchange).

4 Description of MLPP service from the user's perspective

This clause defines MLPP in terms of procedures and other aspects visible to the user or users without regard to means of implementation. It describes interworking with non-ISDNs and interactions between MLPP and other ISDN service capabilities. This clause does not suggest how the required

functions should be divided between customer and network equipment. It does not address the protocol needed for implementing this service in a standard way. It provides a prose description and a diagrammatic description of MLPP in the form of a specification and description language diagram.

4.1 Description

4.1.1 General description

The MLPP service is provided as a service provider's option to domains of a network. The MLPP service applies to a domain only, i.e., all subscribers and the network and access resources that belong to the domain. Connections and resources that belong to a call from an MLPP subscriber shall be marked with a precedence level and domain identifier and shall only be preempted by calls of higher precedence from MLPP users in the same domain. Connections and resources belonging to calls from non-MLPP users and users from other MLPP domains shall not be preempted. 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 provides preferred handling of MLPP service requests. It involves assigning and validating priority levels to calls and prioritized treatment of MLPP service requests (e.g., with respect to interactions with other supplementary services such as call waiting).

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 nonpreemptable) are optionally diverted to a predetermined alternate party. This alternate party shall be another valid network address. If no alternate party is selected by the called party, the treatment of these calls shall be the same as basic call; however, a precedence call blocked indication will be sent to the calling party for precedence calls that encounter busy with equal or higher precedence conditions.

Preemption may take one of two forms. First, the called party may be busy with a lower precedence call which must be preempted in favor 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 shall be preempted to complete the higher precedence call. There are three characteristics of preemption:

a) Any party whose connection was terminated (whether that resource is reused or not) shall receive a distinctive preemption notification;

b) Any called party of an active call that is being preempted by a higher precedence call shall be required to acknowledge the preemption before being connected to the new calling party; and

c) When there are no idle resources, preemption of the lowest of these lower level 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.

4.2 Procedures

4.2.1 Provision/withdrawal

For a given ISDN number, a maximum authorized precedence level may be subscribed to for each bearer service, set of bearer services, or collectively for all bearer services (see table 1).

4.2.2 Normal procedures

Normal procedures are described in this clause and are also shown in the form of specification and description language (SDL) in figures 1 and 2. In case of conflict between the text and the SDLs, the text takes precedence.

Table 1 – Subscription options for the MLPP service (per ISDN number/bearer service, set of bearer services, or all bearer services)

Subscription options	Values
Maximum authorized precedence level (Note 1)	1) 0 (FLASH OVERRIDE – highest) 2) 1 (FLASH) 3) 2 (IMMEDIATE) 4) 3 (PRIORITY) 5) 4 (ROUTINE – lowest)
Alternate party:	1) Yes – alternate party network address 2) No
Access resources nonpreemptable:(Note 2)	1) Yes 2) No

NOTES

1 A call of higher precedence level can preempt calls of lower precedence. For example, a FLASH call can preempt IMMEDIATE, PRIORITY, or ROUTINE calls.

2 A user having this option will not experience preemption of calls by higher precedence calls, if the cause for preemption would be due to called party busy condition. However, the user may still experience preemption of calls due to a lack of network resources other than the user's own access resources.

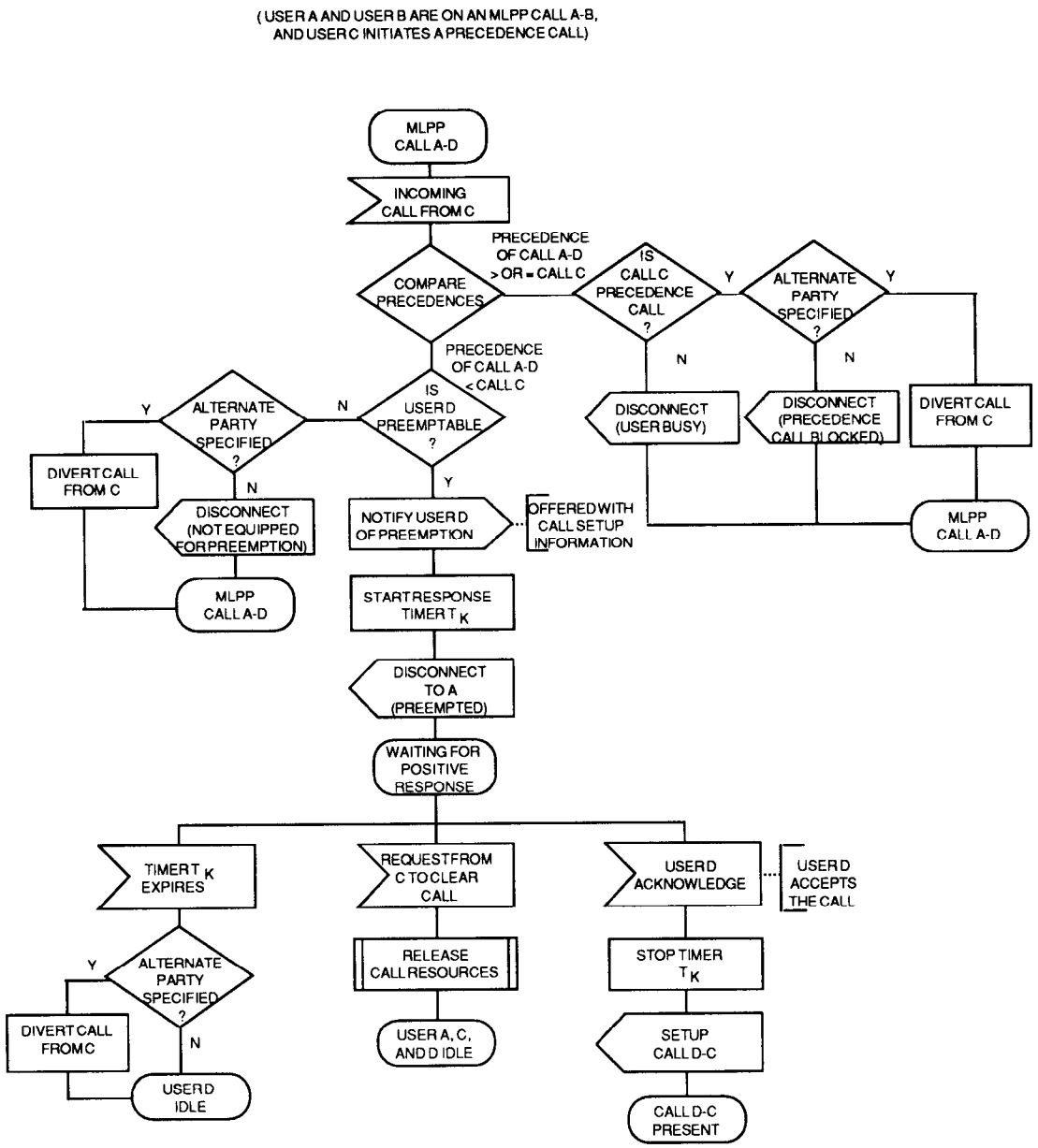


Figure 1 – SDL diagram of MLPP (preemption at the called user's interface)

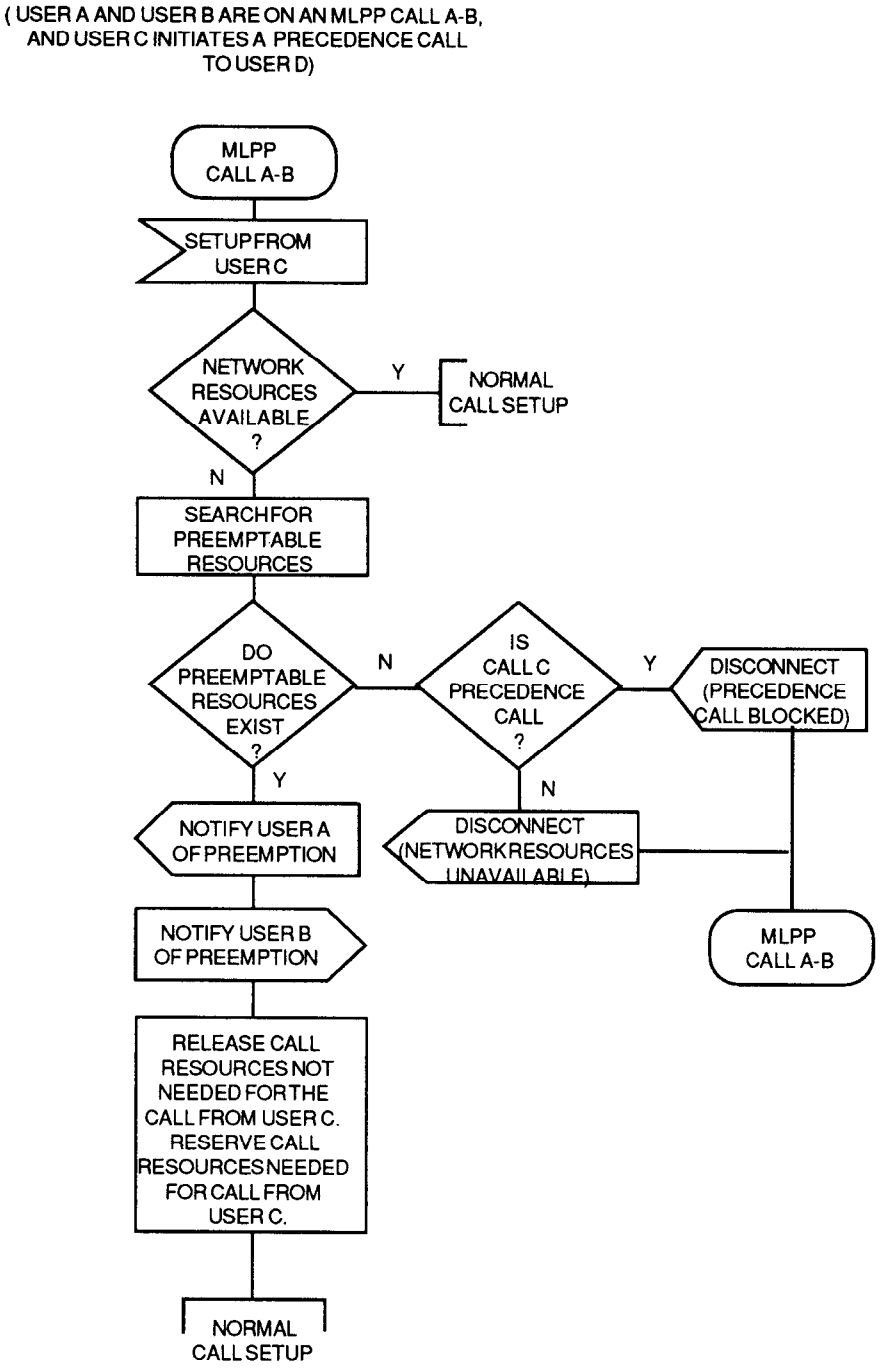


Figure 2 – SDL diagram of MLPP (preemption in the network)

4.2.2.1 Activation/deactivation

(None identified.)

4.2.2.2 Invocation and operation

The precedence level is selected by the subscriber on a per call basis. The subscriber may select any precedence level up to and including his maximum authorized precedence level. The network at the subscriber's originating interface ensures that the selected precedence level does not exceed the maximum level assigned to that ISDN number. Once set for a call, this precedence level cannot be changed.

An MLPP call is automatically established with the lowest precedence unless a higher precedence is specified.

4.2.2.3 Operation

During a call setup, if there is a shortage of a network resource, then the network shall determine if resources are held by calls of lower precedence. The network can then release the lowest of these lower precedence call(s) and seize the necessary resources that are required to set up the higher precedence call. These resources can include interoffice circuits, channels, conference bridges, and circuit-switched data circuits.

The preemption operation depends on whether the network needs to preempt a common network facility, such as an interswitch trunk that is currently being used by a different subscriber than the intended called subscriber or whether it needs to preempt a channel on the user access of the desired called subscriber.

If a common network facility is preempted, all existing parties are notified of the preemption and the existing connection is immediately disconnected. The new call is then set up using the preempted facility in the normal manner without any special notification to the new called party.

If a called user access channel is to be preempted, both the called party and its connected-to parties shall be notified of the preemption and the existing MLPP call shall be immediately cleared. The called party must acknowledge the preemption before the higher precedence call is completed. The called party is then offered the new MLPP call.

After attempting a precedence call, the served user shall receive a distinctive in-band alerting indication when the call is successfully offered to the called party as a precedence call. If the call is offered to the called party as a normal call (e.g., because the called party is in a non-MLPP network), the calling user shall receive a normal alerting indication.

4.2.3 Exceptional procedures

4.2.3.1 Activation/deactivation

(None identified.)

4.2.3.2 Invocation and operation

If the network cannot complete a precedence call request, the calling party should receive a notification that the precedence call is unsuccessful. Possible causes are:

a) the requested precedence level is not subscribed to;

b) equal or higher precedence calls have prevented completion;

c) the dialed number is nonpreemptable; and

d) there are no idle network resources to make a connection to the dialed number and the called subscriber belongs to a network that does not support preemption.

If the called party subscribes to the option, a precedence call should be diverted to the predetermined alternate party, if the called party (user D) does not acknowledge preemption or does not answer a precedence call (a call of precedence level 0-3) before the response timer expires. The

procedures for this alternate party diversion are as defined for call forwarding no reply. The mechanism to prevent infinite diversions, will be the same mechanism utilized by call forwarding to prevent an infinite number of forwarding attempts. In either of these cases, if no alternate party has been specified by the called party, the precedence alerting indication will be returned to the calling party for the precedence call.

In addition, a precedence call should be diverted to a predetermined alternate party if the called party is busy on a call of equal or higher precedence or is busy and nonpreemptable. The procedures for this alternate party diversion are as defined for call forwarding busy. If no alternate party has been specified by the called party, a precedence call blocked notification will be returned to the calling party for the precedence call.

4.3 Interworking considerations

In public networks that support the MLPP service, the network should ensure that only MLPP calls from the same domain as the preempting call are a subject of preemption and the connections and resources belonging to non-MLPP users are not preempted. The precedence level and domain of a call shall not be changed when interworking with other MLPP networks.

Calls from non-MLPP users that enter a private network that only supports MLPP calls may be assigned a precedence level and domain identification at the network boundary and may be preempted within the private MLPP network. The resources of the non-MLPP users that exist within the calling network are not preemptable.

When a precedence call enters a network that does not support the MLPP service, the call is treated as an ordinary call and does not cause preemptions. A network that does not support the MLPP service is required, if technically possible within the existing system, to convey the parameters of the MLPP service (e.g., precedence level, domain, etc.) intact. In this case, the network should pass them on with no action taken. In other words, the network will not act on these parameters and pass them on transparently.

4.4 Interaction with other supplementary services

Within the following interactions with other supplementary services, preemption applies only within an MLPP domain.

4.4.1 Call waiting

In the case of unavailability of network resources, the call waiting and MLPP services do not interact, that is, the preemption of the network resources takes place regardless of the state of a call waiting service on the call being preempted or the call waiting service being subscribed to by the intended destination of the precedence call.

In the case of no access channels being available at the access of the called party, the interaction between the invocations of MLPP and call waiting depends on the relative precedence levels of the new incoming MLPP call and that of the lowest precedence MLPP call at the called access as follows:

a) If the precedence level of the incoming call is higher than that of the lowest precedence existing MLPP call, preemption shall occur (unless the called subscriber is nonpreemptable, in which case call waiting shall be invoked);

b) If the precedence level of the incoming call is the same as that of the lowest precedence existing MLPP call, call waiting shall be invoked;

c) If the precedence level of the incoming call is lower than that of the lowest precedence existing MLPP call, call waiting shall be invoked. Whether or not an optional network-provided in-band call waiting tone is applied in this case is an option of the service provider and is not described in this standard.

Note that the call waiting service may be used by an MLPP subscriber in combination with the access resources non-preemptable option. In this case, a called user that is busy on an MLPP call shall receive notification of an incoming higher precedence call without the lower precedence call being preempted. As a result, the called user may either disconnect or place the lower precedence call on hold in order to accept the incoming higher precedence call.

4.4.2 Calling line identification presentation

No interaction.

4.4.3 Calling line identification restriction

No interaction.

4.4.4 Call hold

A held call may be preempted due to a lack of network resources or channels at the held party's interface. The call is cleared and the served user, who invoked the call hold service, will be notified of the preemption.

For the case of multiple terminals on an interface, an idle channel that is reserved for a call held by another terminal may be seized in order to complete a higher precedence call. In addition, an active channel that is reserved for a held call may be preempted and seized in order to complete a higher precedence call. In both cases, the held call is not preempted and may be retrieved when a channel becomes available.

4.4.5 MLPP

MLPP does not alter the basic call procedures under glare conditions.

4.5 Network capabilities for charging

It shall be possible for the service provider to charge accurately for this service.

5 Functional capabilities and information flows needed for MLPP service

This clause identifies a way of dividing the overall functionality for MLPP into functional units, each of which could be placed in one location. The overall functionality results from communication between the functional units (called entities) using information flows, which are also identified in this clause. An information flow is an abstraction which is subsequently realized in clauses 6 through 8 by means of additions to existing signaling system messages or by new messages. Finally, this clause identifies one or more specific ways in which the functional entities of MLPP can be located in specific network or user equipments.

5.1 Functional entity model for MLPP

This clause identifies a way of partitioning the MLPP functionality into functional entities and identifies actions that occur in each functional entity. Each functional entity is an abstract representation which could be implemented in more than one kind of telecommunication equipment (e.g., in terminal equipment, in a local switching machine, or in a database).

5.1.1 Functional model for preemption

As a service provider option, before preemption of a lower precedence call, the network may provide a search and reservation of network resources. This procedure utilizes an optional look-ahead for busy (LFB) function to ensure that network and called user resources are available to complete the call prior to preemption.

The functional model is shown in figure 3 for MLPP. See annex B for an illustrated breakdown of the functional entities with and without the LFB function.

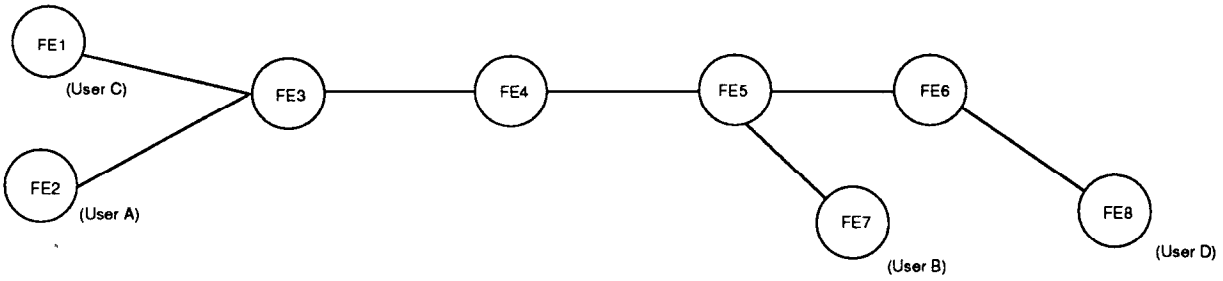


Figure 3 – Functional model for the MLPP service

For simplicity, the functional model for the MLPP service in figure 3 shows only one transit exchange (TR), FE4, in the physical allocations that are used as examples. Other physical allocations, as defined in 5.5, are possible. The functionalities in the model are described in the following subclauses with emphasis on functions required for the MLPP service.

5.1.2 Description of functional entities

The functional entities (FEs) that are used throughout this service description (i.e., FE1 through FE8) are groupings of the components that are described in the following clauses.

5.1.2.1 Call control agent (CCA) component

CCAs serve the users and are responsible for initiating functional requests and interacting with the call control (CC) components.

5.1.2.2 MLPP agent (MLPPA) component

For the MLPP service, the MLPPA will

– access the MLPP service-providing capabilities of the CC components via the CCA, using MLPP service requests for the establishment and release of a single call;

– receive MLPP indicators relating to the call from the CC component via the CCA and relay them to the user;

– maintain call state information as perceived from this functional endpoint of the service.

5.1.2.3 Call control (CC) component

CCs interact with each other to provide the services requested by the CCAs. In particular, for the MLPP service, the CC will

– establish, manipulate, and release a single call (upon request of the CCA component) and originate MLPP indicators;

– associate and relate the CCA components involved in a particular call, or service, or both;

– manage the relationship between the CCA components involved in a call (i.e., reconcile and maintain the overall perspective of the call and/or service);

– provide network status information to the MSRC component for conducting a search for network resources that can be utilized to complete an MLPP call.

5.1.2.4 MLPP service precedence level control (MPLC) component

The MPLC component will

– validate the user-requested precedence level of the call for the MLPP service (obtained from the CCA serving the user);

- assign the lowest precedence level when none is selected by the user;
- provide prioritized treatment of MLPP service requests, based on the precedence levels (e.g., in relation to interactions with other supplementary services such as call waiting);
- provide in-band precedence ringback tone, instead of normal alerting ringback tone, for incoming precedence calls.

5.1.2.5 MLPP service search and reservation control (MSRC) component

The MSRC component will

- obtain network status information from the CC component for initiating/conducting search for network resources that can be used to complete the MLPP call;
- check the status of the called user;
- search for and mark as "reserved" (without preempting) network resources that can be utilized to complete an MLPP call.

This component is optional for use only when the search and reservation (LFB) option is chosen.

5.1.2.6 MLPP service preemption control (MPRC) component

The MPRC component will

- provide "indication of intended preemption" to the busy user that is the called party of the higher precedence call and receive or relay the called user response to the above indication, or receive and relay the response;
- initiate preemption of network resources, as appropriate, in order to connect a higher precedence call;
- preempt one or more calls to connect a higher precedence call.

5.1.2.7 Functional entity 1 (FE1)

FE1 serves user C, who initiates an MLPP call to either user B or user D. FE1 is connected to FE3 and consists of the MLPPA and the CCA components.

5.1.2.8 Functional entity 2 (FE2)

FE2 serves user A, who is on an MLPP call with user B or user D. FE2 is also served by FE3 and consists of the CCA and MLPPA components.

5.1.2.9 Functional entity 3 (FE3)

FE3 serves FE1 and FE2. FE3 consists of the MPLC, MPRC, and CC components. When LFB is supported, FE3 also consists of the MSRC component.

5.1.2.10 Functional entity 4 (FE4)

FE4 connects FE3 to FE5. FE4 consists of the MPRC and CC components. When LFB is supported, FE4 also consists of the MSRC component.

5.1.2.11 Functional entity 5 (FE5)

FE5 serves FE7 and connects FE4 to FE6. FE5 consists of the MPLC, MPRC, and CC components. When LFB is supported, FE5 also consists of the MSRC component.

5.1.2.12 Functional entity 6 (FE6)

FE6 serves FE8. FE6 consists of the MPLC, MPRC, and CC components. When LFB is supported, FE6 also consists of the MSRC component.

5.1.2.13 Functional entity 7 (FE7)

FE7 serves user B, who may be on an MLPP call with user A. FE7 is served by FE5 and consists of the CCA and MLPPA components.

5.1.2.14 Functional entity 8 (FE8)

FE8 serves user D, who is the called party of an MLPP call from user C. FE8 is served by FE6 and consists of the CCA and MLPPA components.

5.2 Information flow model for MLPP

This subclause identifies what information needs to be passed between functional entities, and when, to permit overall operation of the MLPP service capability. Each information flow is an abstract representation that could be implemented as a new message or as an addition to an existing message in a call-control signaling system.

Figure 4 shows the information flow for successful preemption in the network utilizing the search and reservation (LFB) option. The called party (user D) of the preempting call may or may not be busy with a call of lower precedence than that of the preempting call (from user C to user D).

Figure 5 shows the information flow for successful preemption in the network without the search and reservation (LFB) option. Again, the called party (user D) of the preempting call may or may not be busy with a call of lower precedence than that of the preempting call (from user C to user D).

In the general case of figures 4 and 5, the congestion need not be encountered at FE3, and FE1 and FE2 need not be connected to the same FE (FE3). For clarity, this case is used as an example.

Figure 6 shows the information flow for successful preemption in the access area. The called party (user D) of the preempting call is busy with a call of lower precedence (with user A) than that of the preempting call.

5.3 SDLs

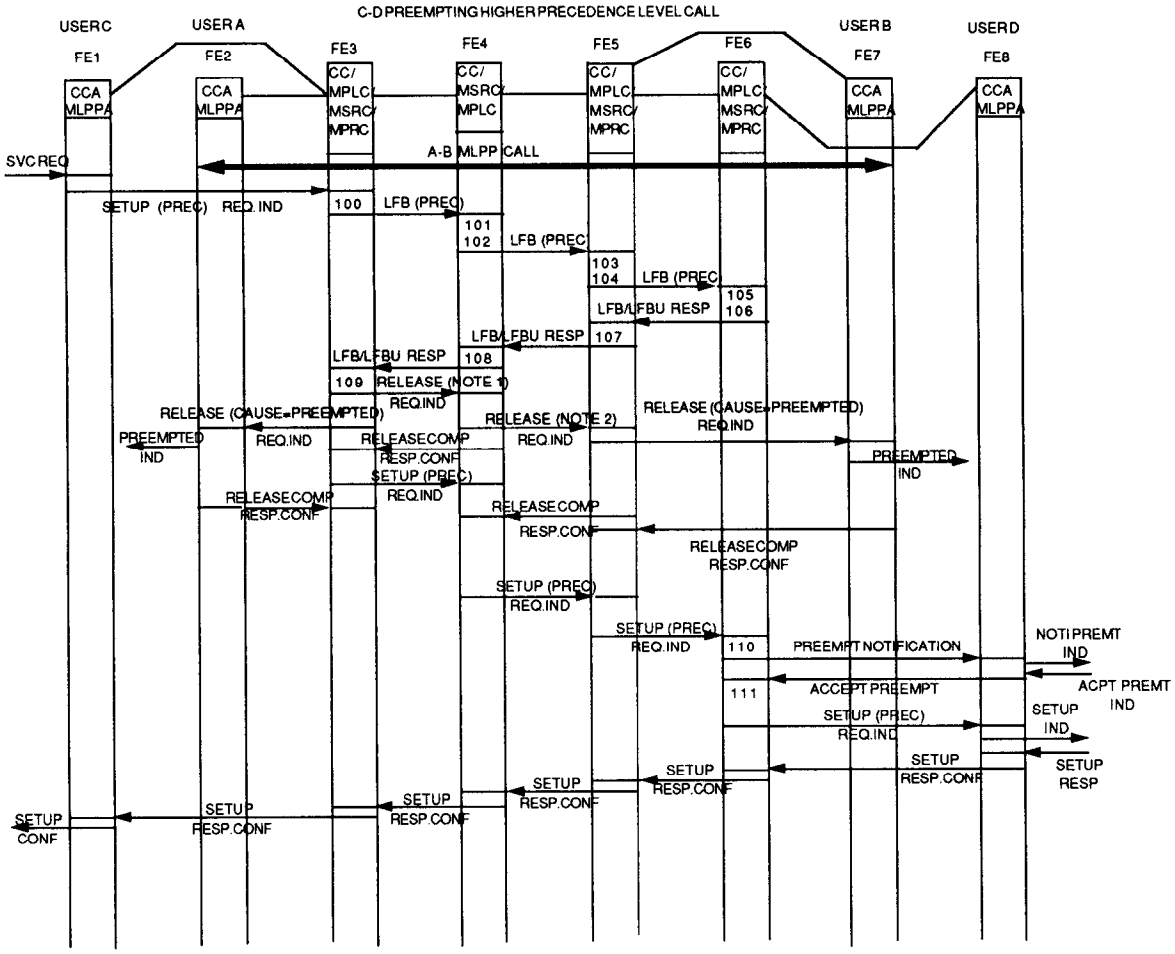
The following contains the SDLs for the functional entities as defined in figure 3. These SDLs reflect preemption in the network and at the user–network interface for networks with and without the LFB option. SDLs are not provided for FE1, FE2, FE7, and FE8 because the actions required at these FEs are clearly defined in the information flow diagrams.

5.3.1 SDLs for FE3

Figures 7(a), (b), and (c) contain the SDL for MLPP call setup, preemption, and LFB procedures for FE3. It should be noted that the LFB procedures are only initiated once per call, since multiple LFB procedures could greatly delay call setup. In addition, the release (preemption) procedures for the call A-B are only shown for this FE, since normal call release procedures are used to release the call once preemption is initiated by FE3. The only exception to this is preemption indications from the FEs that directly serve the users (i.e., FE1, FE2, FE7, and FE8) are required to produce. However, SDLs for these FEs are not needed since these actions are illustrated in the information flow diagrams.

5.3.2 SDLs for FE4

The SDL for MLPP call setup, preemption, LFB initiation, and LFB continuation procedures for FE4 is given in figures 8(a), (b), (c), and (d). It should be noted that the LFB initiation procedures will only apply if no LFB operation has been performed at FE3. In addition, the call being preempted in figure 8(b) is not necessarily call A-B, but some other call that happens to exist between FE4 and FE5. This gives a general case for the MLPP call setup C-D, where multiple preemptions may be required when establishing a call of high precedence.



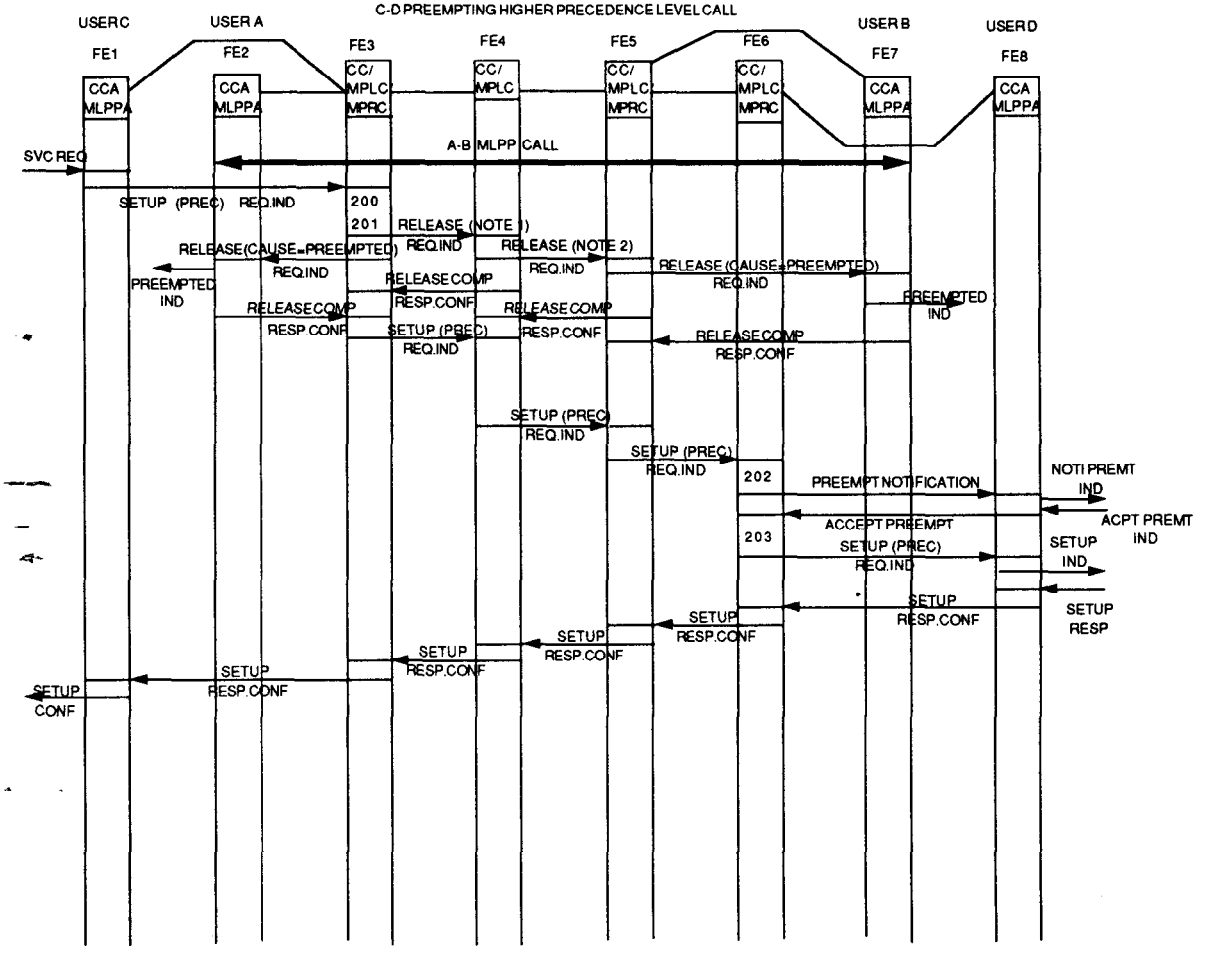
NOTES

1 Cause = Preempted circuit reserved for reuse.

2 Cause = Preempted circuit released not for reuse: because it was used for the same call as the circuit between FE3 and FE4 (Call A-B) and not used for the preempting call (call C-D). The preempting call reserved an idle circuit between FE4 and FE5 during the LFB procedures. Therefore, no release is required in conjunction with call C-D setup.

Information Flow	**DSS1 Message**	**SS7 Message**
Setup req	Setup	IAM
Release req	Disconnect	Release
Release complete resp	Release	Release complete
Setup resp	Connect	ANM
Preempt notification	Hold	N/A
Accept preempt	Hold ack	N/A
LFB	Register	LFB
LFB/LFBU Resp	Release complete	LFB resp

Figure 4 – Information flow for preemption in the network with the LFB option



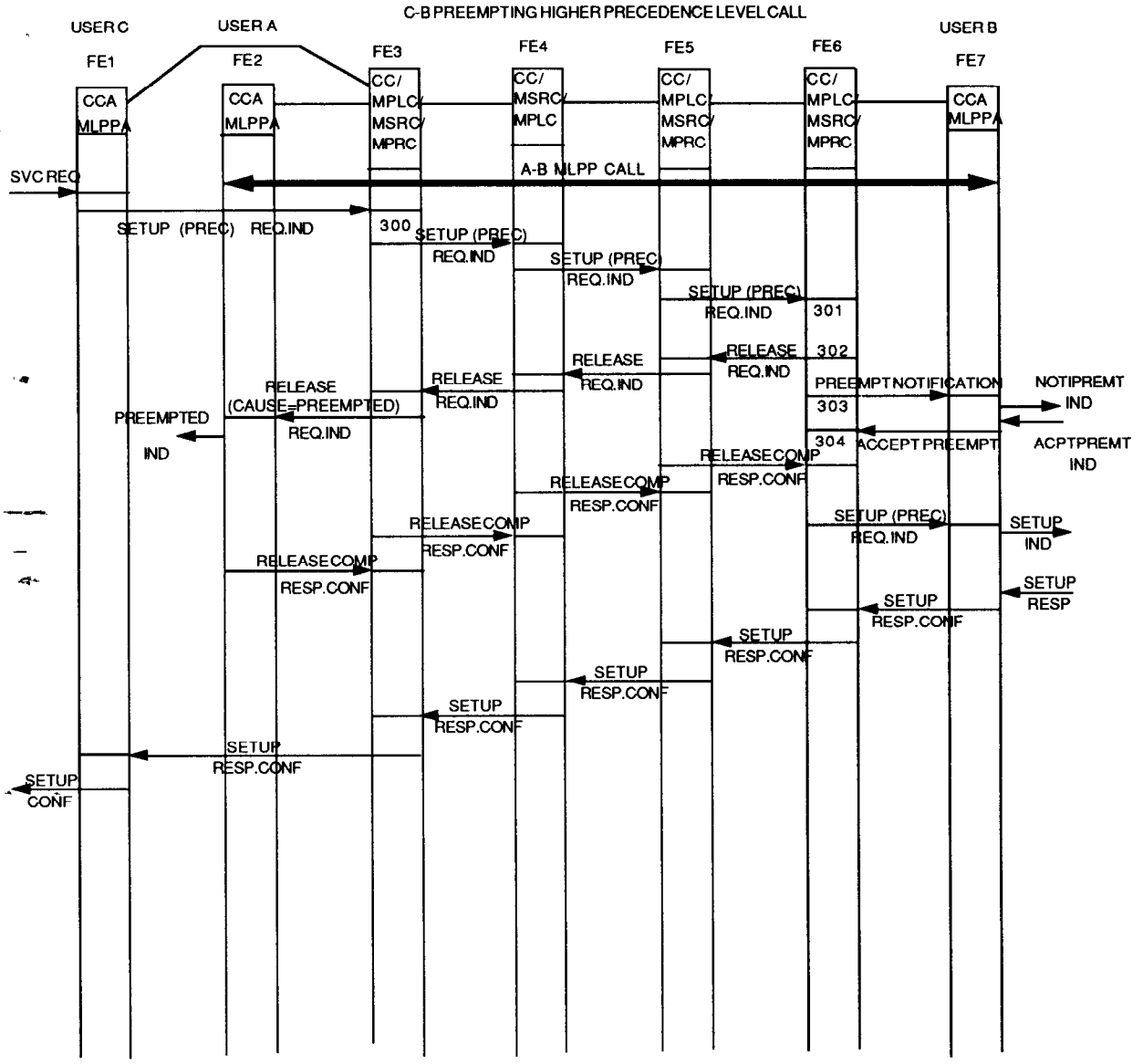
NOTES

1 Cause = Preempted circuit reserved for reuse.

2 Cause = Preempted circuit released not for reuse: because it was used for the same call as the circuit between FE3 and FE4 (call A-B) and not used for the preempting call (call C-D).

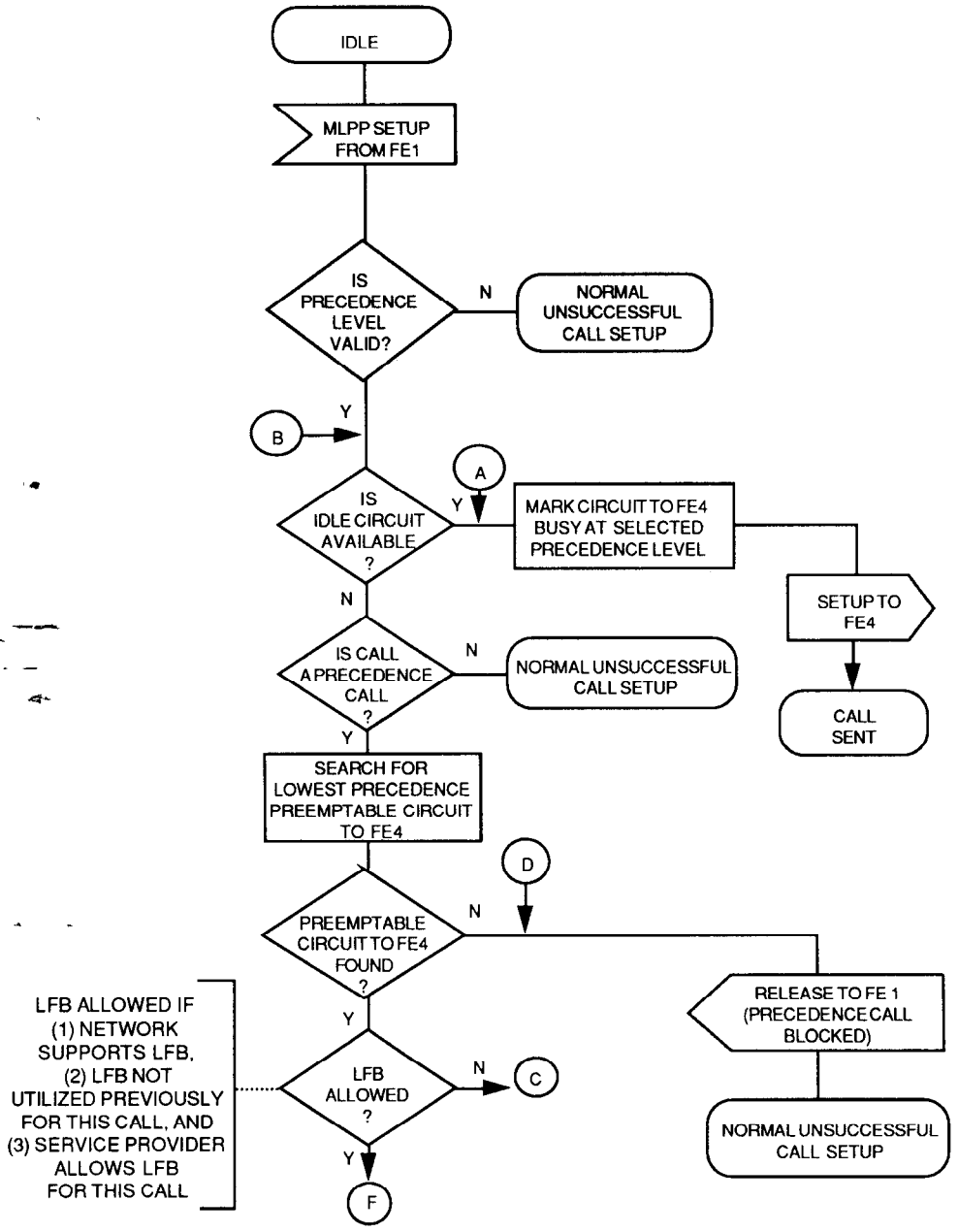
Information Flow	**DSS1 Message**	**SS7 Message**
Setup req	Setup	IAM
Release req	Disconnect	Release
Release complete resp	Release	Release complete
Setup resp	Connect	ANM
Preempt notification	Hold	N/A
Accept preempt	Hold ack	N/A

Figure 5 – Information flow for preemption in the network without the LFB option



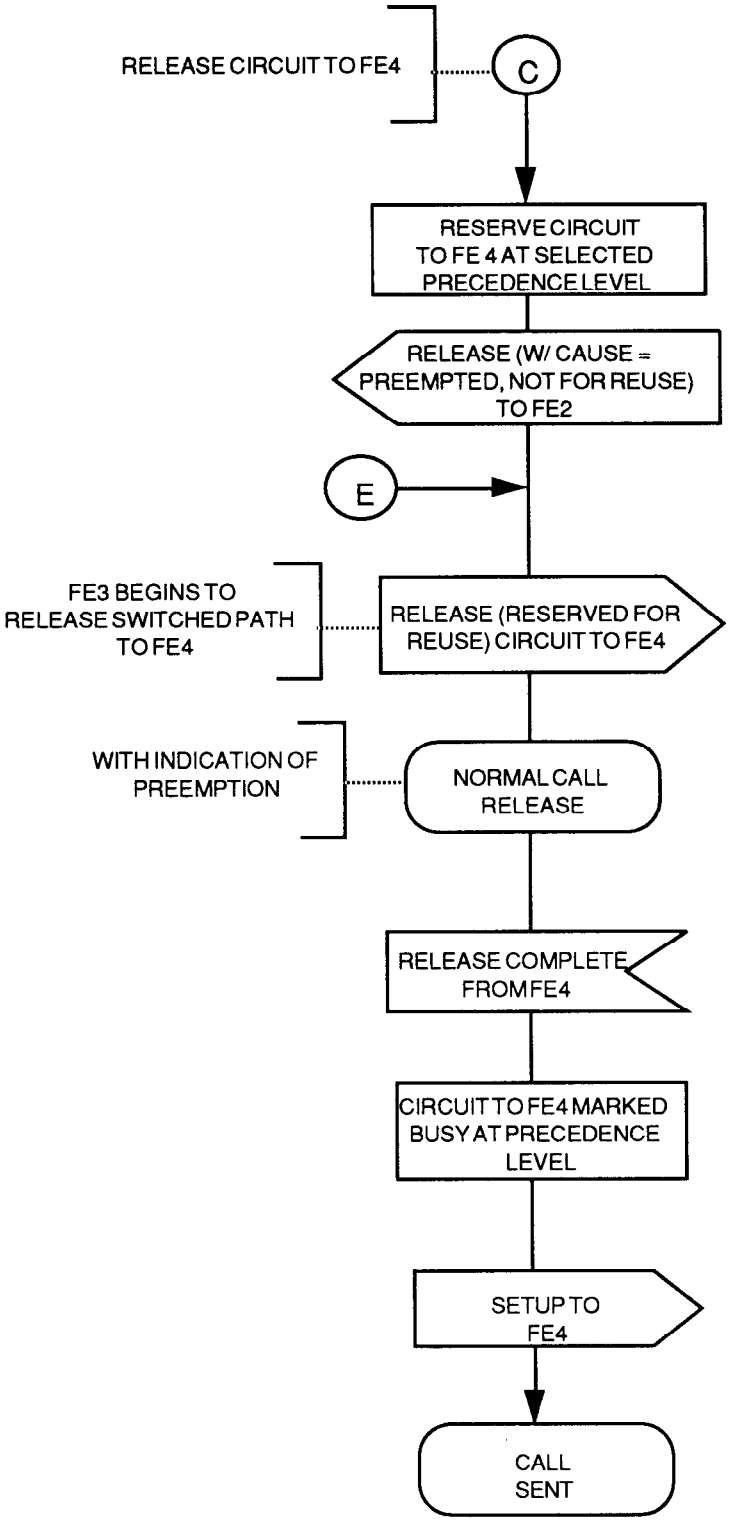
Information Flow	**DSS1 Message**	**SS7 Message**
Setup req	Setup	IAM
Release req	Disconnect	Release
Release complete resp	Release	Release complete
Setup resp	Connect	ANM
Preempt notification	Hold	N/A
Accept preempt	Hold ack	N/A

Figure 6 – Information flow for preemption in the user access area



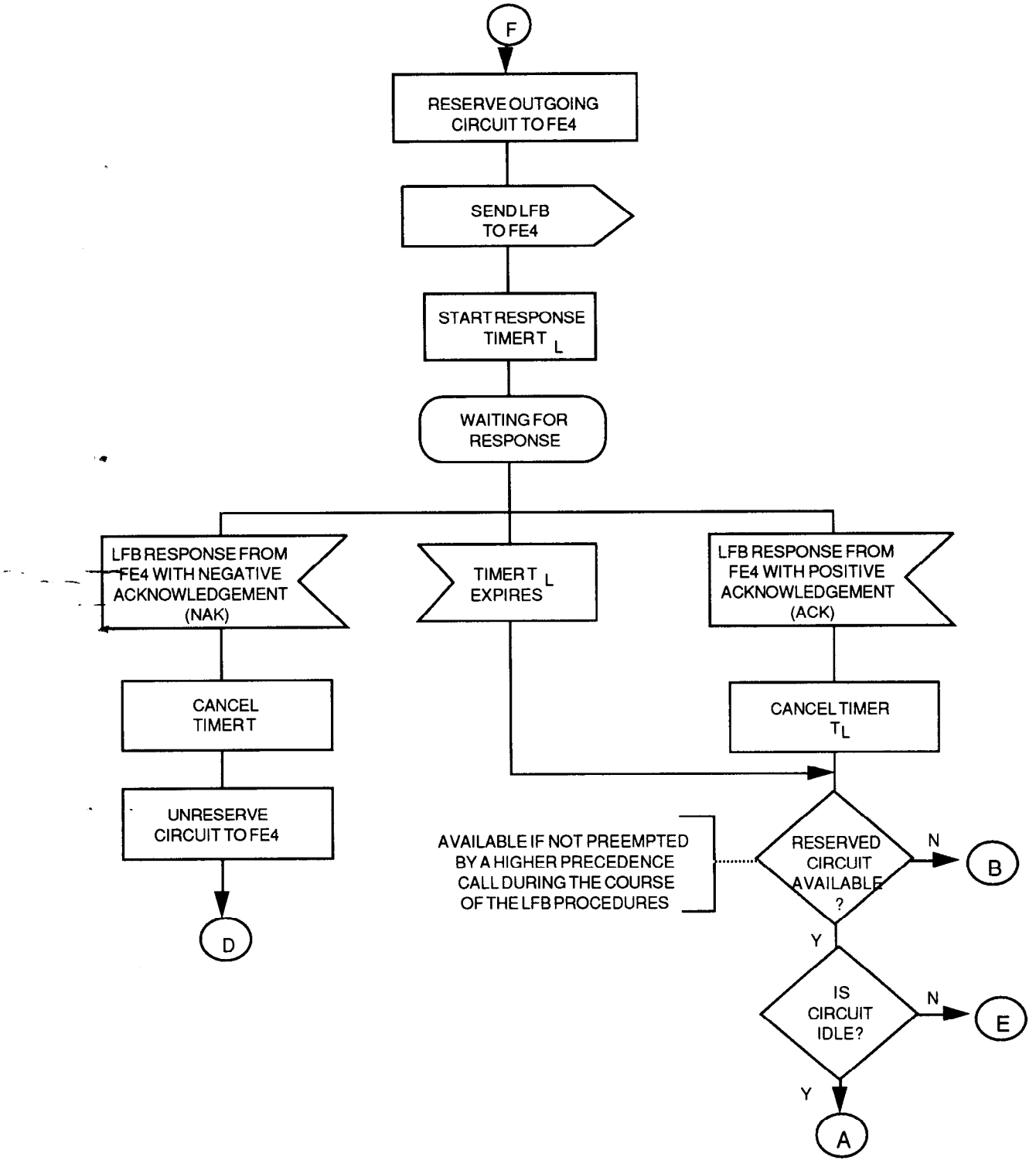
(a) Incoming call from FE1

Figure 7 – SDL for FE3



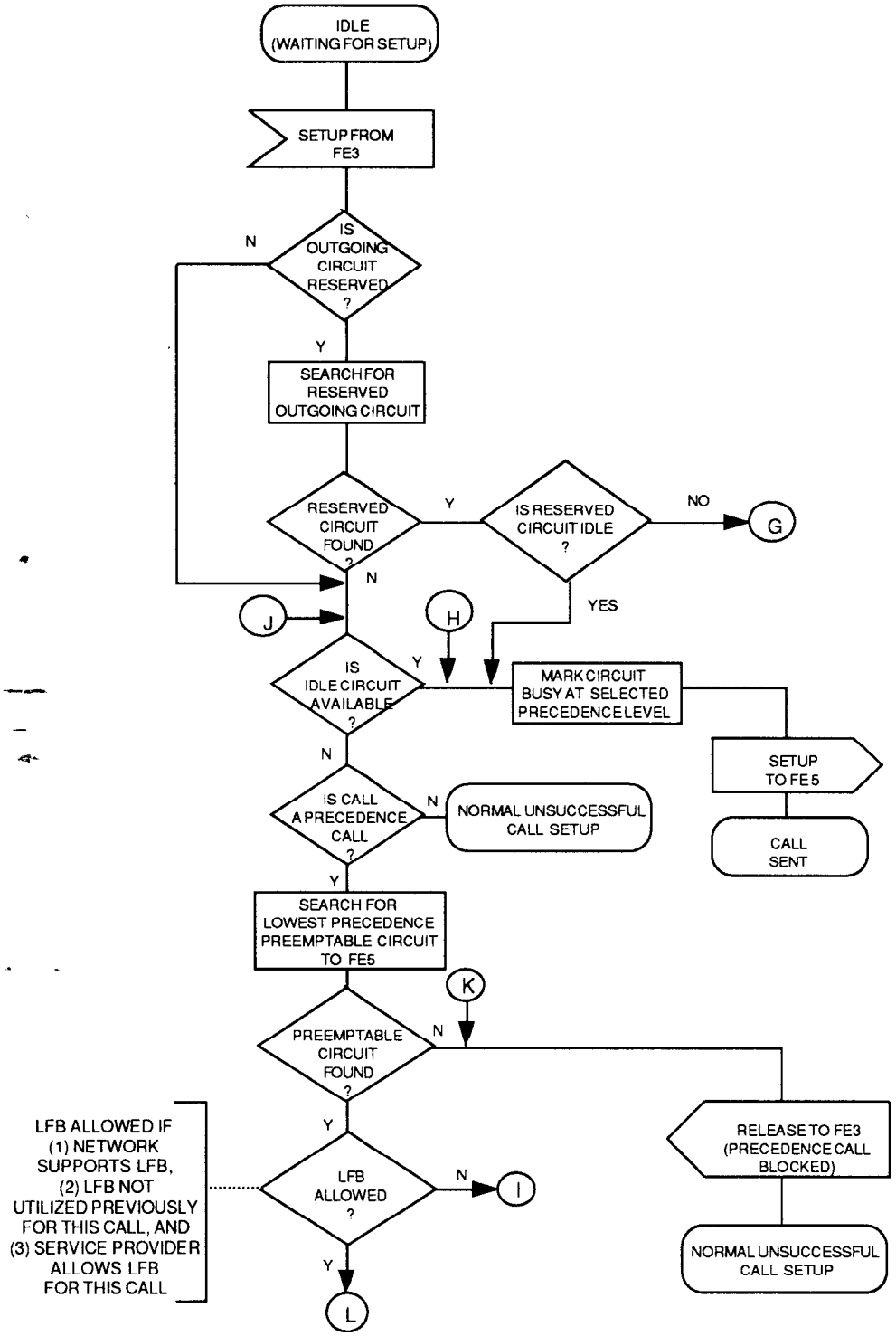
(b) Release and preemption of call A-B

Figure 7 *(continued)*



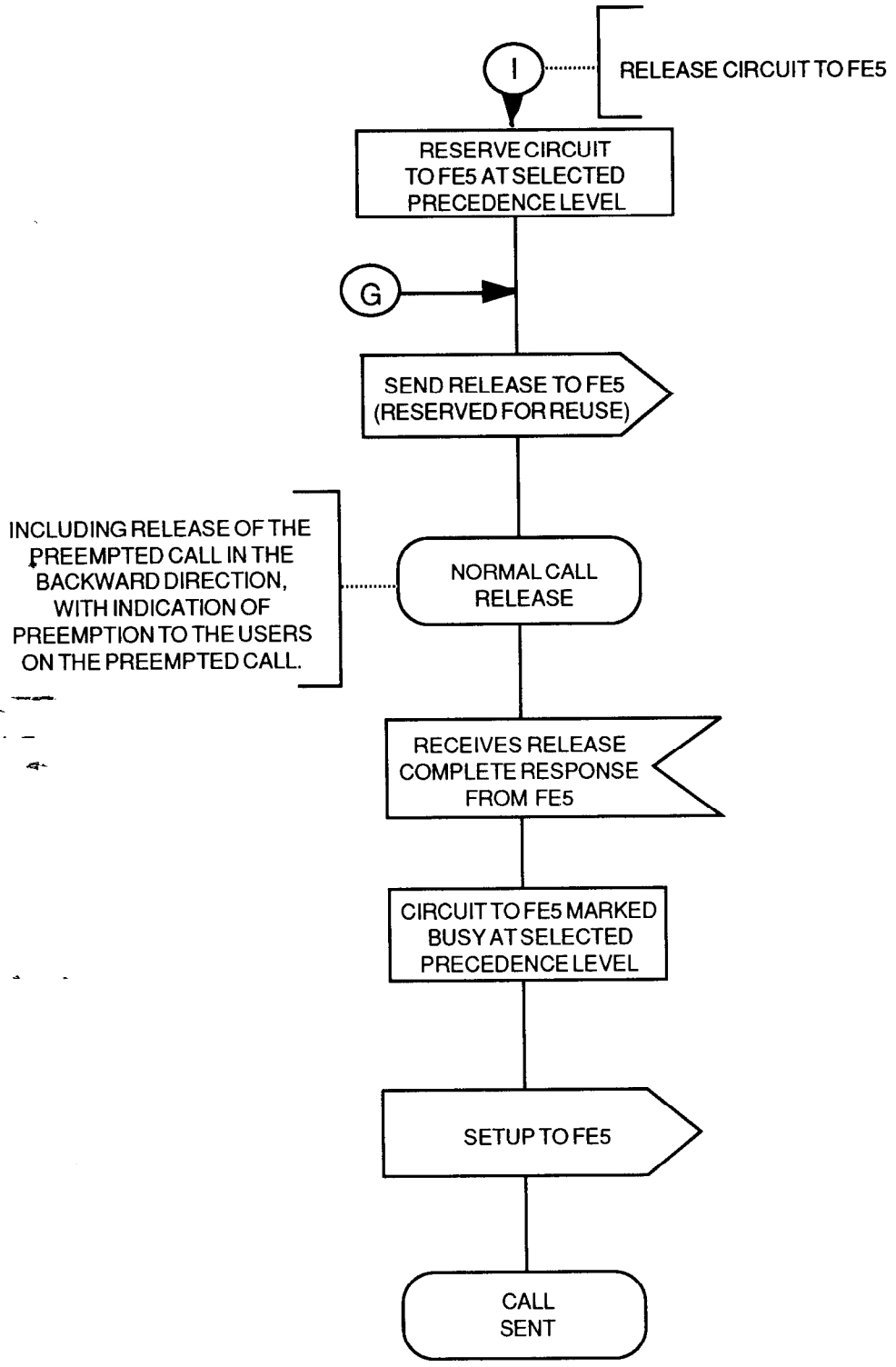
(c) LFB procedure

Figure 7 *(concluded)*



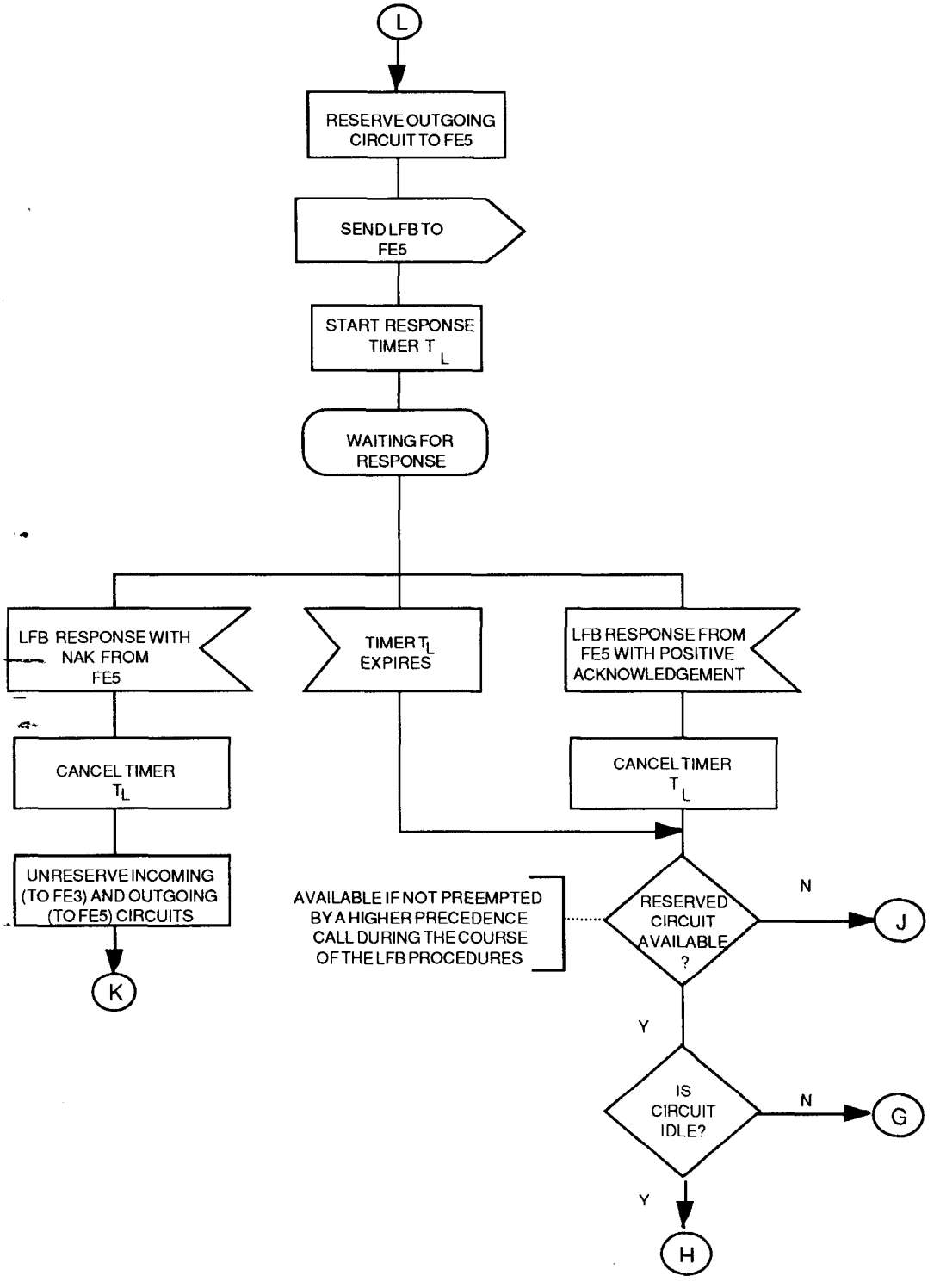
(a) Incoming MLPP call from FE3

Figure 8 – SDL for FE4



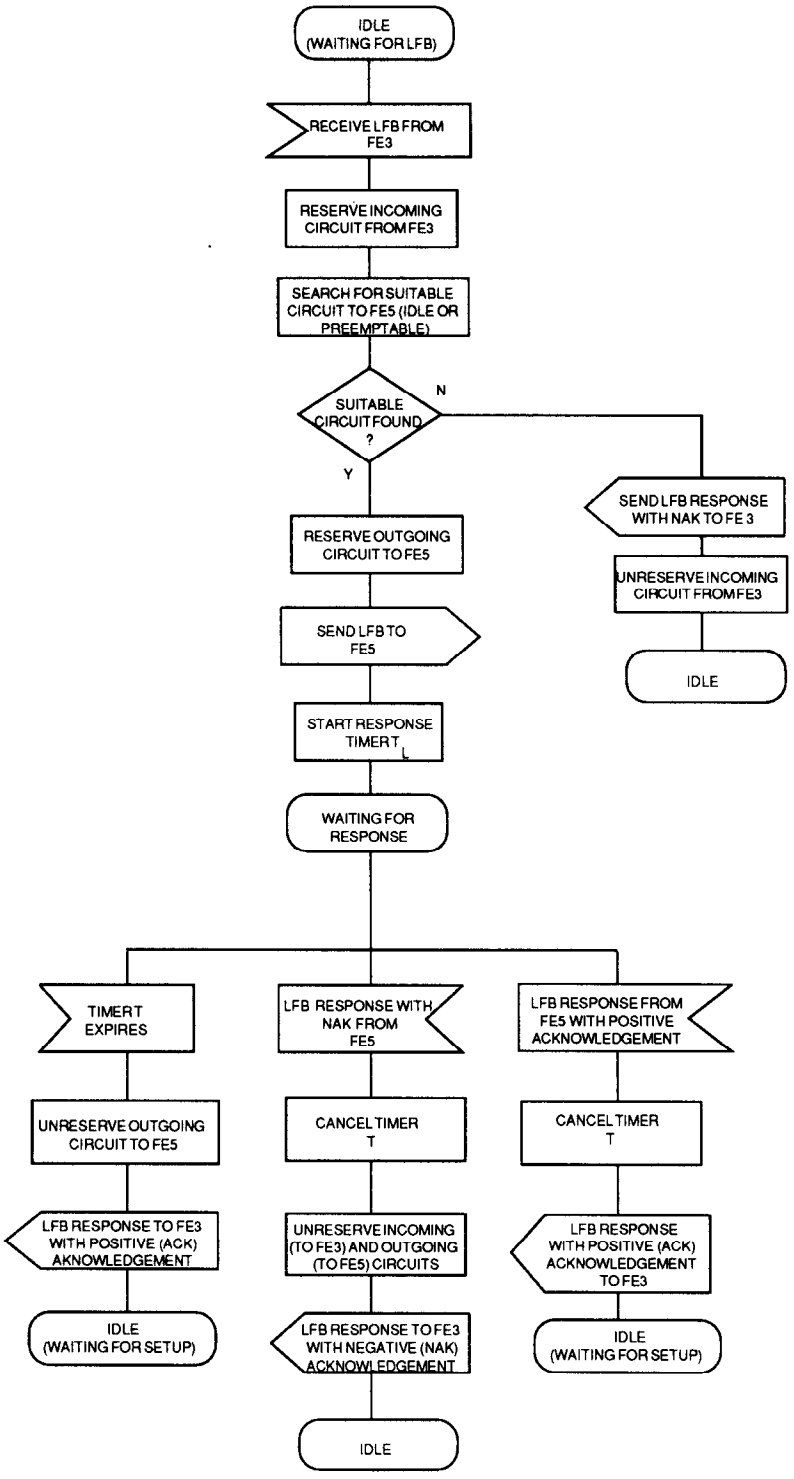
(b) Release and preemption of an MLPP call

Figure 8 *(continued)*



(c) LFB initiation procedures

Figure 8 *(continued)*



(d) Continuation procedures

Figure 8 *(concluded)*

5.3.3 SDLs for FE5

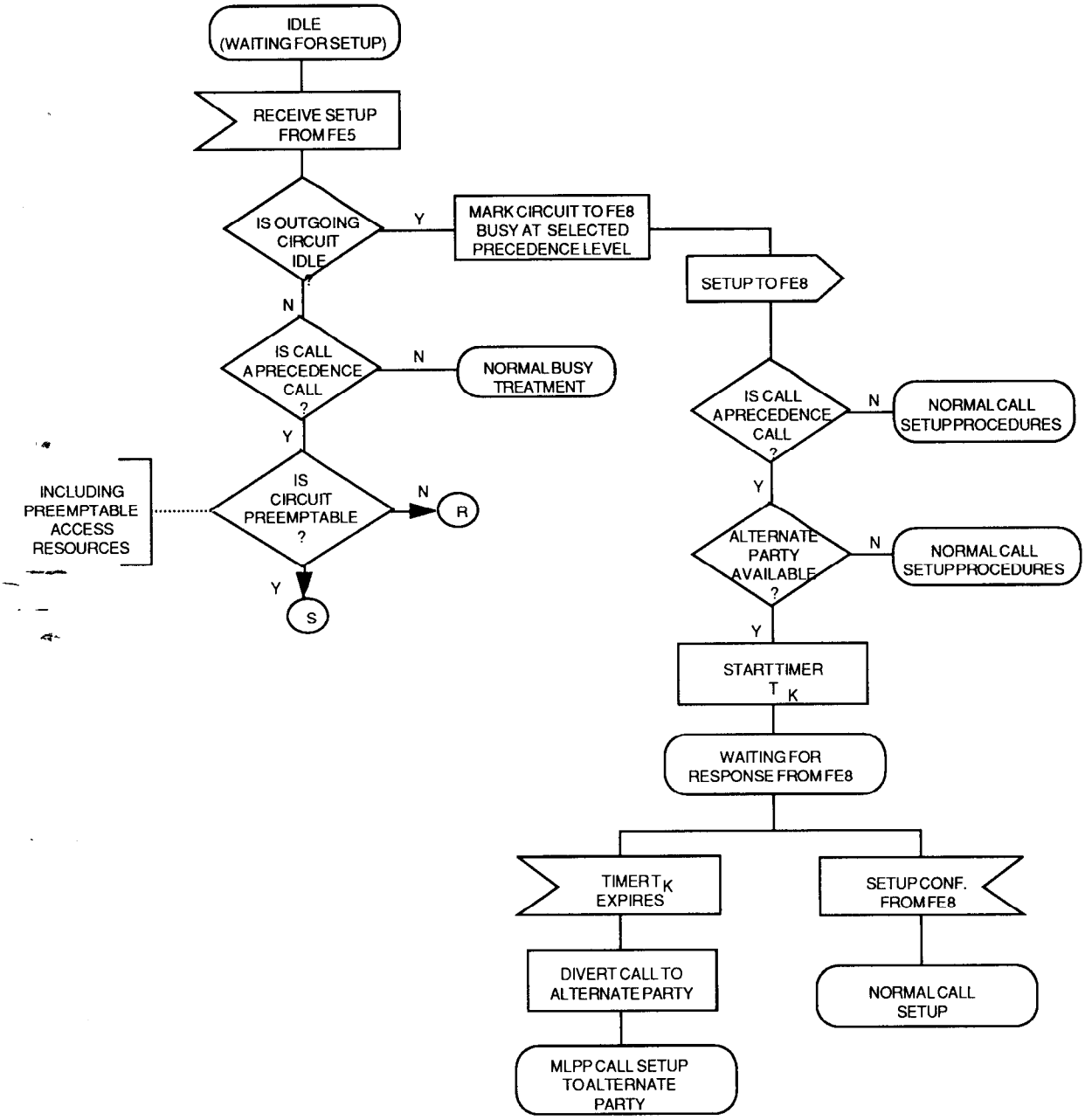
The SDL for FE5 is quite similar to that for FE4. As a result, they have not been incorporated in order to eliminate redundancy. The operation of the FE is essentially the same with only the differences cited herein

a) Outgoing information and circuits are from FE5 to FE6 for the FE5 SDL (instead of from FE4 to FE5);

b) Incoming information and circuits are from FE4 to FE5 for the FE5 SDL (instead of from FE3 to FE4).

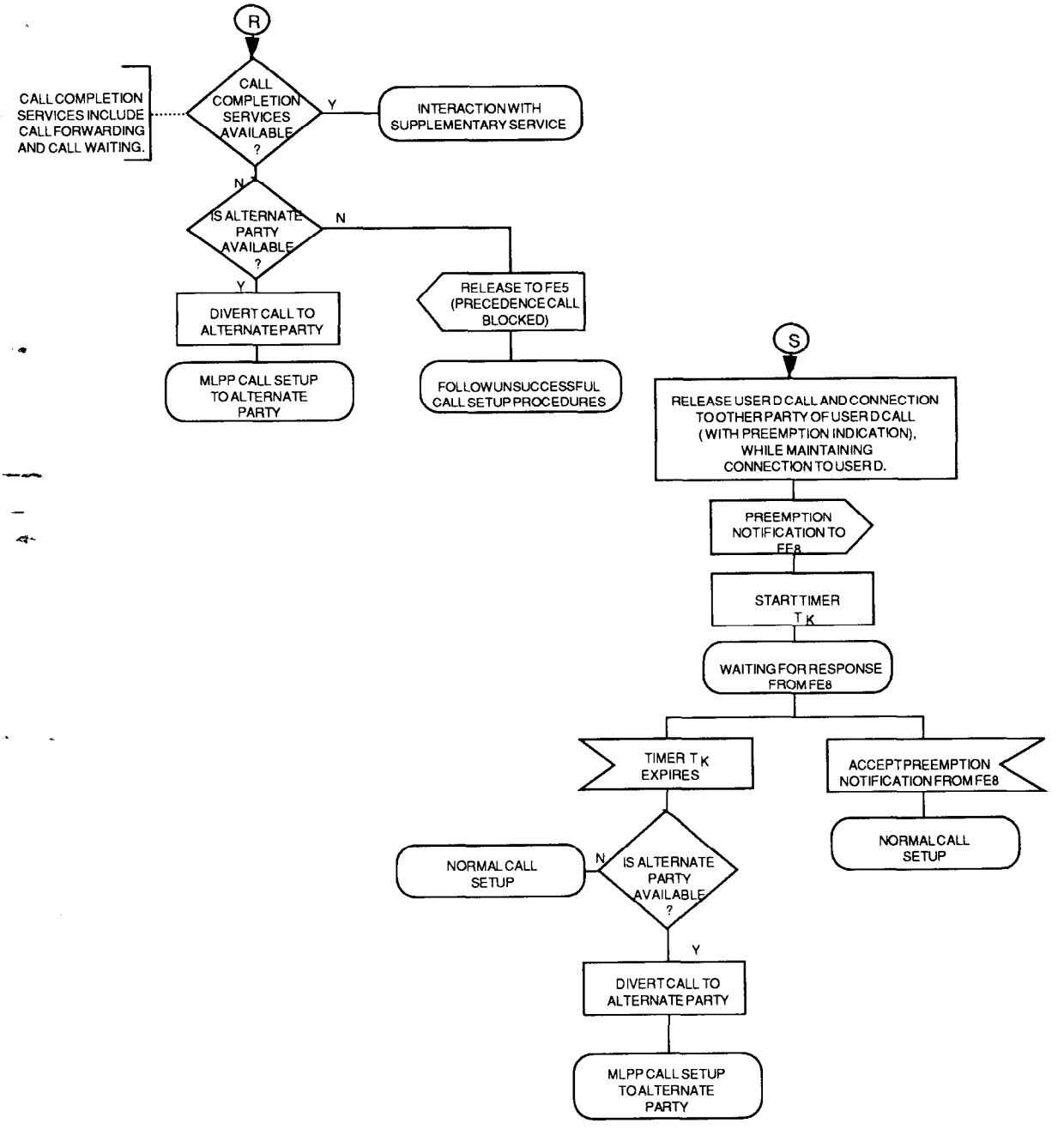
5.3.4 SDLs for FE6

The SDL diagram for MLPP call setup, preemption, and LFB procedures at FE6 are shown in figure 9(a), (b), and (c).



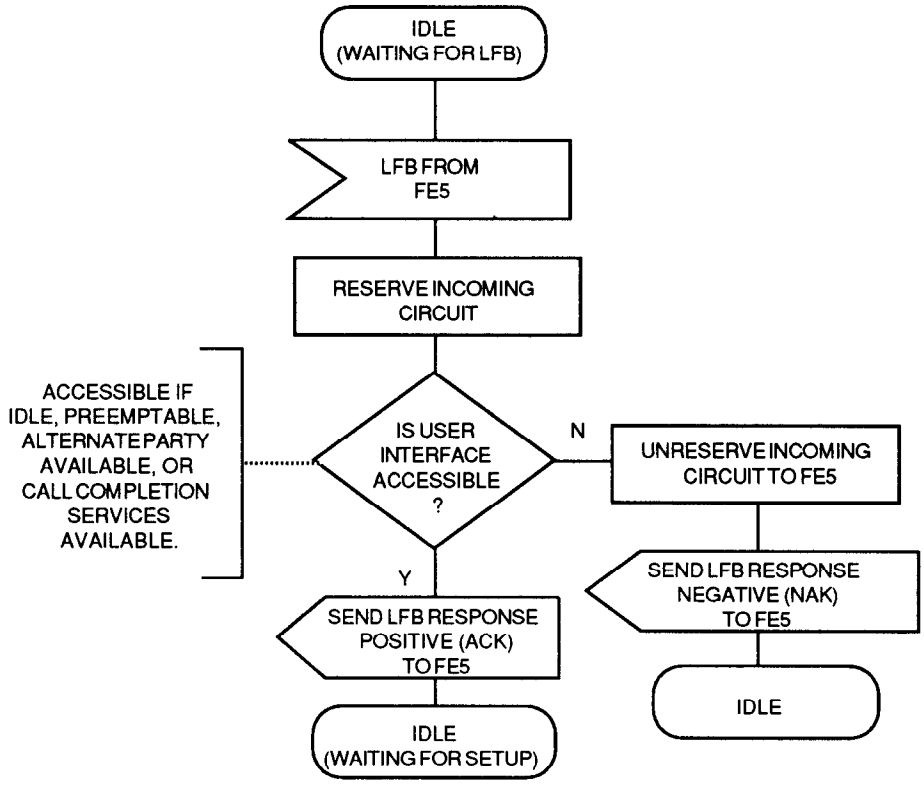
(a) Incoming MLPP call from FE5

Figure 9 – SDL for FE6



(b) Release and preemption of an MLPP call

Figure 9 *(continued)*



(c) LFB procedures

Figure 9 *(concluded)*

5.4 Functional entity actions

Functional entities are assumed to have the basic capabilities required to properly perform their assigned functions in the ISDN (e.g., synchronism, signaling capabilities, etc.). In addition, the actions that occur at the functional entities during call processing stages for providing the MLPP service described in this standard have been given reference numbers and brief descriptions. The reference numbers are shown on the information flow diagrams (figures 4, 5, and 6).

5.4.1 Preemption in the network

5.4.1.1 Preemption in the network with the search and reservation (LFB) option

Reference number	Action
100	Receive a higher precedence call request from user [via SETUP(PREC)]
	Validate the precedence level of the call
	Queue the call request if all outgoing network resources to the called user are busy — that is, if congestion is encountered (if idle resources are available, continue normal call setup)
	Initiate search for preemptable network resources (circuits) [via LFB(PREC)]
	Identify and mark as "reserved", if any, the preemptable network resources (circuits) for the higher precedence call. (This happens to be the circuit of MLPP call A-B between FE3 and FE4.) If no preemptable or idle circuits are available, release the call with a "precedence call blocked" indication to user C.

Send LFB to the next FE on the route

Start timer T_L (if no LFB RESP is received before timer T_L expires, preemption is initiated)

101 Receive LFB

Mark as "reserved," if any, the preemptable circuit to the preceding FE

102 Identify and mark as "reserved," if any, the preemptable or idle network resource (circuit) for the higher precedence call (this happens to be an idle circuit between FE4 and FE5)

Send LFB to the next FE on the route

Start timer T_L (if no LFB RESP is received before timer T_L expires, the circuit to FE5 is unreserved and an LFB RESP Ack is returned to FE3)

103 Receive LFB

Mark as "reserved," if any, the preemptable or idle circuit to the preceding FE

104 Identify and mark as "reserved," if any, the preemptable or idle network resource (circuit) for the higher precedence call (this happens to be an idle circuit between FE5 and FE6)

Send LFB to the next FE on the route

Start timer T_L (if no LFB RESP is received before timer T_L expires, the circuit to FE6 is unreserved and an LFB RESP Ack is returned to FE4)

105 Receive LFB

Mark as "reserved," if any, the preemptable or idle circuit to the preceding FE

106 Send the status of the circuit between this FE (FE6) and the FE encountering network congestion [via LFB RESP]

Obtain and send the called user status, intended for the FE encountering network congestion [via LFB RESP, if needed]

107/108 Relay LFB/LFBU RESP to the preceding FE

Cancel timer T_L

109 Receive LFB/LFBU RESP

Cancel timer T_L

Determine the status of the called user

Determine if the network resources (circuits) are available to support the preempting higher precedence call

Preempt the lower precedence call (A-B) and initiate call setup from preemption initiating exchange (setup information includes calling party number and reservation indicator, in addition to precedence level)

110 Send "indication of intended preemption" to the called user, if busy with a call of lower precedence [via NOTI PREMT]. Start timer T_K

111 Receive called user acceptance of intended preemption [via ACPT PREMT] (If no acceptance of intended preemption is received before the expiry of timer T_K, call diversion is initiated to the alternate party)

If the LFB search and reservation information flow encounters a network that does not support LFB procedures, the LFB gateway exchange will send back an LFB Ack positive response (since the LFB was capable of reaching the interworking point, it was able to reserve available circuits to that point) to the preemption initiating exchange. Upon receiving the response, the preemption initiating exchange will invoke preemption and begin call setup.

As indicated in figure 4, normal call release sequences with appropriate cause information and preempted indications to the preempted users and normal call setup sequences are used, starting from the FE encountering congestion, to connect the preempting higher precedence call, utilizing the network resources (circuits) marked "reserved." The setup messages will carry the reservation indication and calling party number, in addition to the precedence level.

The resources that are marked as "reserved" during the course of the LFB procedures are subject to preemption by higher precedence calls. If reserved resources are preempted, the call must initiate normal search for idle or preemptable resources when the setup information reaches the FE where the reserved resources were preempted.

If the called user (user D) is not busy and does not respond to the precedence call setup indication within timer T_K and an alternate party is subscribed to, the network will initiate alternate party diversion. In addition, if the called party (user D) is busy on a call of equal or higher precedence or is busy with nonpreemptable access resources, an alternate party is subscribed to, and no call completion services (i.e., call waiting or call forwarding busy) are available, the network will initiate alternate party diversion.

5.4.1.2 Preemption in the network without the search and reservation (LFB) option

Reference number	Action
200	Receive a higher precedence call request from user [via SETUP(PREC)]
	Validate precedence level of the call
	Queue the call request if all outgoing network resources to the called user are busy – that is, if congestion is encountered (if idle resources are available, continue normal call setup)
201	Preempt the lower precedence call (A-B) and initiate call setup from preemption initiating exchange (setup information includes calling party number and reservation indicator, in addition to precedence level)
202	Send "indication of intended preemption" to the called user, if busy with a call of lower precedence [via NOTI PREMT]. Start timer T_K
203	Receive called user acceptance of intended preemption [via ACPT PREMT] (If no acceptance of intended preemption is received before the expiry of timer T_K, call diversion is initiated to the alternate party)
	Reserve user access channel for preempting call.

As indicated in figure 5, normal call release sequences with appropriate cause information and preempted indications to the preempted users and normal call setup sequences are used, starting from the FE encountering congestion, to connect the preempting higher precedence call. The setup messages will carry the calling party number, in addition to the precedence level.

If the called user (user D) is not busy and does not respond to the call setup indication within timer T_K when an alternate party is subscribed to, the network will initiate alternate party diversion. In addition, if the called party (user D) is busy on an equal or higher precedence call or is busy with access resources nonpreemptable, an alternate party is subscribed to, and no call completion services (i.e., call waiting or call forwarding busy) are available, the service network will initiate alternate party diversion.

5.4.2 Preemption of access resources

Reference number	Action
300	Receive a precedence call request from user [via SETUP(PREC)]
	Validate precedence level of the call and initiate call setup (call setup information includes calling party number also)
301	Receive setup information
	Determine the status of the called user D (busy with lower precedence level call in this case)
302	Initiate preemption of current call between user A and user D by sending release request indication to FE5
303	Send "indication of intended preemption" to the called user [via NOTI PREMT]. Start timer T_K
304	Receive called user acceptance of intended preemption [via ACPT PREMT] (If no acceptance of intended preemption is received before the expiry of timer T_K, call diversion is initiated to the alternate party)
	Reserve user access channel for preempting call.

As indicated in figure 6, normal call release sequences with appropriate cause information and preempted indications to the preempted user and normal call setup sequences follow. Starting from the FE encountering congestion, the preempting higher precedence call, is established utilizing the access resources (circuits) marked "reserved." The setup messages will carry the reservation indication and calling party number, in addition to precedence level.

5.5 Allocation of functions to equipment

This subclause identifies a number of different plans, called scenarios, for allocating the functional subdivision of MLPP to specific network or user equipments. Each scenario implicitly identifies what protocol is impacted by the MLPP information flows.

The functional model relates to preemption of call(s) in the network to connect a higher precedence call. The following matrix contains additional, nonexhaustive scenarios. Note that FE5 serves as a local exchange (LE) for FE7 and a TR for FE8 in scenarios 1 and 3. There may exist one or multiple TRs between the LEs in the various scenarios.

	Functional entities							
	FE1	**FE2**	**FE3**	**FE4**	**FE5**	**FE6**	**FE7**	**FE8**
Scenarios								
1	TE	TE	LE	TR	LE	LE	TE	TE
2	TE	TE	NT2	LE	LE	NT2	TE	TE
3	TE	TE	NT2	LE	LE	LE	TE	TE
4	TE	TE	LE	TR	LE	NT2	TE	TE

6 Switching and signaling specification for MLPP at the user–network interface

This clause contains the detailed specification of switching and signaling capabilities that will support the service capabilities described in earlier clauses. It identifies the digital subscriber signaling system number 1 (DSS1) messages and procedures needed to support the information flows and functional entity actions for the scenarios of clause 5.5.

6.1 Formats and coding for MLPP

This subclause identifies the messages, codesets, information elements, and codepoints specified for MLPP to realize the information flows between telecommunications equipments associated with the user–network access interface as identified in 5.5.

6.1.1 Messages

The following messages are applicable for the operation of the MLPP service: SETUP, ALERTING, PROGRESS, REGISTER, HOLD, HOLD ACK, HOLD REJECT, DISCONNECT, RELEASE, and RELEASE COMPLETE.

The SETUP, ALERTING, PROGRESS, NOTIFY, DISCONNECT, RELEASE, and RELEASE COMPLETE messages shall be as defined in 3.1 of ANSI T1.607. For the SETUP, PROGRESS, NOTIFY, DISCONNECT, and RELEASE COMPLETE messages the following changes are required:

a) The SETUP message may contain precedence level information element (IE). It shall contain the optional calling party number, called party number, and channel identification IEs as mandatory IEs. It shall also contain: (a) the signal IE when a precedence call is delivered to the called user, and (b) the call identity IE – as defined in this standard – as appropriate to the MLPP procedure. The PROGRESS message shall contain the signal IE to provide required tones, as described in the MLPP procedure. The NOTIFY message shall contain the notification indicator IE to indicate delay in call setup, as described in the MLPP procedure. The DISCONNECT message shall include the Cause and Signal IEs, coded as described in this standard;

b) The RELEASE COMPLETE message shall contain the Facility IE (with the return result component) when it is sent in response to the REGISTER message (as defined in 7.1.5 of ANSI T1.610) that shall be used to invoke an MLPP DSS1 look-ahead for busy (LFB) query.

The REGISTER, HOLD, HOLD ACK, and HOLD REJECT messages shall be as defined in 7.1 of ANSI T1.610. The REGISTER message shall contain the precedence level, bearer capability, calling party number, called party number, and channel identification IEs encapsulated within the Invoke component of the facility IE. The HOLD message shall also contain the cause, call identity, and signal IEs, coded as appropriate to the MLPP procedure. The HOLD ACK message shall contain the call identity IE, as described in the MLPP procedure.

6.1.2 Codesets

All information elements (IE), except the Precedence level IE, are in codeset 0. Precedence level IC, however, is in American National Code.[2)] Cause values 45 and 46, contained in the cause IE, and signal value 66, contained in signal IE, are American National codes, as described in ANSI T1.607. An additional meaning for signal value 66 is provided in annex D of this standard. Signal value 9, which is also defined in annex D, will be described as an American National code in a future American National Standard.[2)]

[2)] An American National Standard for this code is under development. Contact the secretariat for more recent information.

6.1.3 Information elements

The following IEs are applicable.

6.1.3.1 Precedence level information element

For selecting precedence level and reservation in the DSS1, the precedence level IE, as shown below, shall be used:

8	7	6	5	4	3	2	1	Octet
Precedence level information element identifier								1
0	1	0	0	0	0	0	1	
Length of precedence level contents								2
1 Ext	Coding standard		Spare	Precedence level				3
0/1 Ext	Spare			Change value	Spare	LFB indication		4
0/1 Ext	MLPP service domain							4a,b,..

Precedence level IE identifier shall be defined as "0 1 0 0 0 0 0 1" and will be an American National Code.[2)]

Octet 3:

Bit 8 Set to 1 as an extension bit

Bits

7-6 (Coding standard)

0 0 CCITT standardized coding
1 0 National standard

Bits

5 (Spare)

Bits

4 3 2 1 (Precedence level)

0 0 0 0 0 (FLASH OVERRIDE – highest)
0 0 0 1 1 (FLASH)
0 0 1 0 2 (IMMEDIATE)
0 0 1 1 3 (PRIORITY)
0 1 0 0 4 (ROUTINE – lowest)
0 1 0 1
to Spare
1 1 1 1

Octet 4:

Bit 8	Set to 0/1 as an extension bit
Bits	
7 6 5	(Spare)
Bit 4	(Change value)
0	Precedence level coding privilege may be changed at network boundaries
1	Precedence level coding privilege may not be changed at network boundaries
Bit 3	(Spare)
Bits	
2-1	(LFB indication)
0 0	LFB allowed
0 1	LFB not allowed
1 0	Path reserved
1 1	Spare

Octet 4a:

Bit 8	Set to 0/1 as an extension bit
Bits	
7 6 5 4 3 2 1	(MLPP service domain)
0 0 0 0 0 0 0	Defense switched network
0 0 0 0 0 0 1	
to	Spare
1 1 1 1 1 1 1	

Octet 4b..:

Used for MLPP service domain, as needed.

6.1.3.2 Facility information element

For the functional protocol, the Facility IE, as described in 8.2.2 of ANSI T1.610, shall be used. The invoke and return result components within the Facility IE are, respectively, shown in figures C.1 and C.2 of annex C.

Facility information element contains MLPP operation value of 0 0 0 1 1 0 0 0 for the MLPP DSS1 LFB query and two parameters, each one octet-long, within the return result component for MLPP DSS1 LFB query results, coded as shown in the ASN.1 notation (6.1.3.7) for the Facility IE.

6.1.3.3 Cause information element

For indicating the preemption of the call in the network and in the access, the Cause IE, as described in 4.5.11 of ANSI T1.607, shall be used with the following two American National codepoints for cause values:

Number	Cause	Location coding and diagnostics
45	Preemption	Location is coded "0 1 1 0 – local interface controlled by this exchange" to indicate that the call is being preempted, circuit is reserved for reuse Location is coded with any other code (not "0 1 1 0") to indicate that the call is being preempted, circuit is not reserved for reuse
46	Precedence call blocked	No preemptable circuit or called user is busy with a call of equal or higher precedence level

6.1.3.4 Notification indicator information element

For indicating call completion delay, the Notification indicator IE, as described in 4.5.20 of ANSI T1.607, shall be used with the following notification description:

Notification description (Octet 3)
Bits
7 6 5 4 3 2 1

0 0 0 0 1 0 0 Call completion delay

6.1.3.5 Signal information element

For providing tones and announcements, the Signal IE, as described in 4.5.24 of ANSI T1.607, shall be used with the following two US national codepoints for signal values:

Signal value (Octet 3)
Bits
8 7 6 5 4 3 2 1

0 0 0 0 1 0 0 1 (9) Preemption tone

0 1 0 0 0 0 1 0 (66) Alerting on – pattern 2 (Special/priority alerting) (See annex D for North American practice for MLPP service)

6.1.3.6 Call identity information element

For uniquely identifying a call over the user–network interface, the Call identity IE, as described below, shall be used.

8	7	6	5	4	3	2	1	Octet
Call identity information								
0	0	0	1	0	0	0	0	1
element identifier								
Length of call identity contents								2
Call identity (any bit pattern allowed)								3, etc.

6.1.3.7 ASN.1 notation for facility information element

ASN.1 notation for the Facility IE follows:

```
- -Begin MLPP look-for-busy (LFB) query ASN.1 notation

MLPP_LFB_query      OPERATION
                    ARGUMENT    MLPP_LFB_arg
                    RESULT      MLPP_LFB_resp
                    ERRORS
                                {
                                 Notsubscribed
                                }
                    ::= 24

MLPP_LFB_arg        ::= [APPLICATION 0] SEQUENCE
                        {
                         bC_IE          IMPLICIT OCTET STRING,
                         pREIEVL_IE     IMPLICIT OCTET STRING,
                         cALLING_IE     IMPLICIT OCTET STRING,
                         cALLED_IE      IMPLICIT OCTET STRING,
                         cHNLID_IE      IMPLICIT OCTET STRING
                        }

                        - -Bearer capability IE, Calling
                        party number IE, Called party number IE,
                        and Channel identification IE shall be
                        as defined in ANSI T1.607.

                        - -Precedence level IE shall be as defined in 6.1.3.1.

MLPP_LFB_resp       ::= IMPLICIT SEQUENCE {sTATUS, lOCATION}

                        - -The MLPP DSS1 LFB query response
                        contains two parameters, sTATUS,
                        and lOCATION
```

```
sTATUS              ::= ENUMERATED
                        {
                        sUCCESS (1),
                        - -Many cases as described in the MLPP
                        procedure with LFB option
                        fAILURE (2),
                        - -Many cases as described in the
                        MLPP procedure with LFB option
                        bEARER_CAPABILITY_CHECK_CaseA (3),
                        - -bearer capability check failure,
                        not authorized
                        bEARER_CAPABILITY_CHECK_CaseB (4),
                        - -bearer capability check failure,
                        not implemented
                        bEARER_CAPABILITY_CHECK_CaseC (5),
                        - -bearer capability check failure,
                        not available
                        pATH_RESERVATION_DENIED (6)
                        - -circuit cannot be reserved at the
                        far end
                        }
IOCATION            ::= IMPLICIT OCTET STRING
                        - -a bit string which conforms to
                        Octet 3 of the Cause information
                        element as defined in ANSI T1.607,
                        except that bit 8 is marked as a spare
Notsubscribed       ERROR
                    ::= 0
                        - -LFB option is not allowed by the
                        service provider
    - -End of MLPP LFB query operation
```

6.1.4 Codepoints

Codepoints shall be as described in 6.1.3.

6.2 Procedures for MLPP

This subclause specifies detailed switching and signaling procedures for MLPP for activation, invocation, notification, operation, and deactivation. It defines service states, timers, and error handling at the user–network interface.

6.2.1 Support assumptions

User subscription options of the MLPP service for maximum authorized precedence level, alternate party, and access resources preemptable shall be as stated in 4.2.1.

Tones and announcements shall be provided from the originating exchange, or terminating exchange, or both, as appropriate, and as described in this standard.

6.2.1.1 Terminal support assumptions

Terminal equipment invoking MLPP service should be able to indicate the precedence level of the call in the SETUP message and should support the US national cause values: 45, "preemption" and 46, "precedence call blocked" and US national signal value 9, "preemption tone."

Terminal equipment that receive MLPP calls should support the HOLD family of messages, US national cause values: 45, "preemption" and US national signal values: 9, "preemption tone" and 66, "alerting on-pattern 2." The terminal should be capable of producing the desired ringing cadence (for "precedence call alerting") in response to the signal value 66. Terminal equipment receiving MLPP calls do not have to subscribe to the call hold service.

6.2.1.2 Network support assumptions

See 4.1.1.

6.2.2 Service states and timers

No additional call states, beyond those specified in ANSI T1.607 and T1.610, are identified for the MLPP service. Four additional timers T_K, T_L, T_{LR}, and T_{RR} beyond those specified in ANSI T1.607 and T1.610, shall be employed with the MLPP operation, as described in this standard.

Network timer T_K is started when the serving exchange notifies a user of a precedence call. This timer has a range of values from 4 to 30 seconds.

Timer T_L is started when the MLPP DSS1 LFB query is invoked. This timer has an approximate value of 15 seconds.

Timer T_{LR} is started when the MLPP DSS1 LFB query successfully locates and marks as reserved a preemptable circuit. This timer has an approximate value of 30 seconds.

Timer T_{RR} is started when the call is released with the DISCONNECT message and the circuit is reserved for reuse. This timer has a value of 12 seconds.

6.2.3 Activation/deactivation

No activation/deactivation procedures are identified for MLPP.

6.2.4 Invocation

The calling user will invoke the MLPP service by including the Precedence level IE in the SETUP message. If the Precedence level IE is not included, the precedence level is assumed to be the lowest precedence level (i.e., precedence level = ROUTINE). The precedence level inserted by the user may be up to and including the maximum subscribed to precedence level on a per call basis.

6.2.5 Notification

Notification to the calling, called, and preempted users (as a result of preemption in the network or access) shall be conveyed in call control messages using cause 45 and 46 in the Cause IE, as described in this standard.

Notification to the calling user of delay in call setup shall be conveyed in the NOTIFY message using notification description "0 0 0 0 0 1 0 0" in the Notification indicator IE, as described in this standard.

6.2.6 Normal operation

Normal operation without an optional MLPP DSS1 LFB query is illustrated in figure 10 and described in 6.2.6.1. The optional MLPP DSS1 LFB procedure is described in 6.2.6.2.

6.2.6.1 MLPP DSS1 procedure without LFB option

6.2.6.1.1 Procedure at originating exchange (OE)

Upon receipt of a SETUP message for an MLPP service call, the originating exchange (OE) will do the following:

a) If the Precedence level IE is not present in the SETUP message for a call invoking MLPP service, the originating exchange (OE) shall formulate a Precedence level IE with a precedence level equal to ROUTINE;

b) If the Precedence level IE is present in the SETUP message for a call invoking the MLPP service, it shall validate the precedence level to ensure that it falls within the range that the calling user is authorized. If the precedence level is exceeded, the originating exchange (OE) shall return a RELEASE COMPLETE message with cause 50, "requested facility not subscribed." An announcement of "precedence level exceeded" may also be provided to the calling user.

In both cases in (a) and (b) above, the originating exchange (OE) shall also set appropriate codes for LFB Indication ("LFB allowed" or "LFB not allowed," depending whether LFB option is subscribed to for this precedence level or not) and MLPP service domain in the Precedence level IE;

c) Upon formulating the Precedence level IE with a precedence level equal to ROUTINE or receiving the Precedence level IE with a valid precedence level, the originating exchange shall send the CALL PROCEEDING message toward the calling user and one of the following will occur:

1) If the originating exchange (OE) is an LE, a setup request indication shall be sent toward the network;

2) If the originating exchange (OE) is an NT2, then

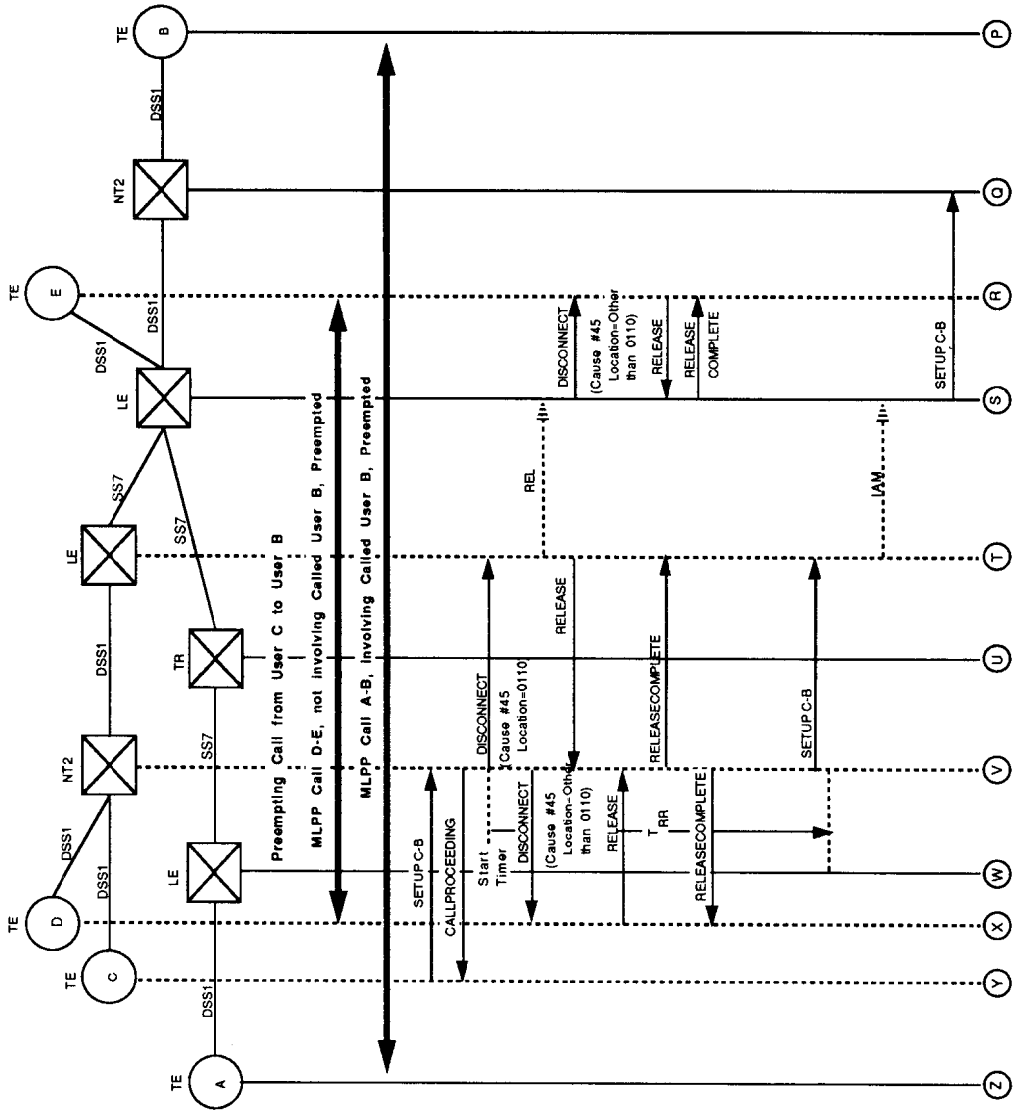
i) if there is an idle circuit to propagate the call to the next exchange, a SETUP message shall be sent after marking the circuit busy at the precedence level and the MLPP service domain of the MLPP call;

ii) if there are no idle circuits (i.e., congestion is encountered), the following will occur:

A) if the call is a ROUTINE call, it shall be cleared backward (toward calling user) employing the "normal clearing" procedures as described in 5.3 of ANSI T1.607 with cause 34, "no circuit/channel available";

B) if the call is a precedence call and a preemptable circuit is not located, it shall be cleared backward (toward calling user) employing the DISCONNECT message with cause 46, "precedence call blocked." An announcement of "precedence call blocked" may also be provided to the calling user;

C) if the call is a precedence call and a preemptable circuit is located, then the MLPP call on that circuit shall be cleared: (a) forward (toward network) using a DISCONNECT message with cause 45, "preemption" (with location coded "0 1 1 0" to indicate that circuit is reserved for reuse), and (b) backward (toward to be preempted user) using a DISCONNECT message with cause 45, "preemption" (with location coded other than "0 1 1 0" to indicate that circuit is not reserved for reuse). The circuit reserved for reuse is marked with the precedence level and MLPP service domain of the preempting call. A timer T_{RR} is started upon sending the DISCONNECT message in case (a) to ensure that the circuit reserved for reuse is unreserved at the expiry of timer T_{RR}. A PROGRESS message with signal IE, containing signal value 9, shall be sent to the preempted user in case (b) prior to sending the DISCONNECT message so that a "preemption tone"


TE
B
DSS1
NT2
TE
E
DSS1
DSS1
LE
SS7
SS7
LE
DSS1
TR
SS7
NT2
DSS1
DSS1
LE
TE
D
TE
C
DSS1
TE
A
P
Q
R
S
T
U
V
W
X
Y
Z
Preempting Call from User C to User B
MLPP Call D-E, not involving Called User B, Preempted
MLPP Call A-B, involving Called User B, Preempted
DISCONNECT
(Cause #45 Location-Other than 0110)
RELEASE
RELEASE COMPLETE
SETUP C-B
REL
IAM
RELEASE
RELEASECOMPLETE
SETUP C-B
DISCONNECT
Cause #45 Location-0110
SETUP C-B
CALLPROCEEDING
Start Timer
DISCONNECT
(Cause #45 Location-Other than 0110)
RELEASE
T RR
RELEASECOMPLETE

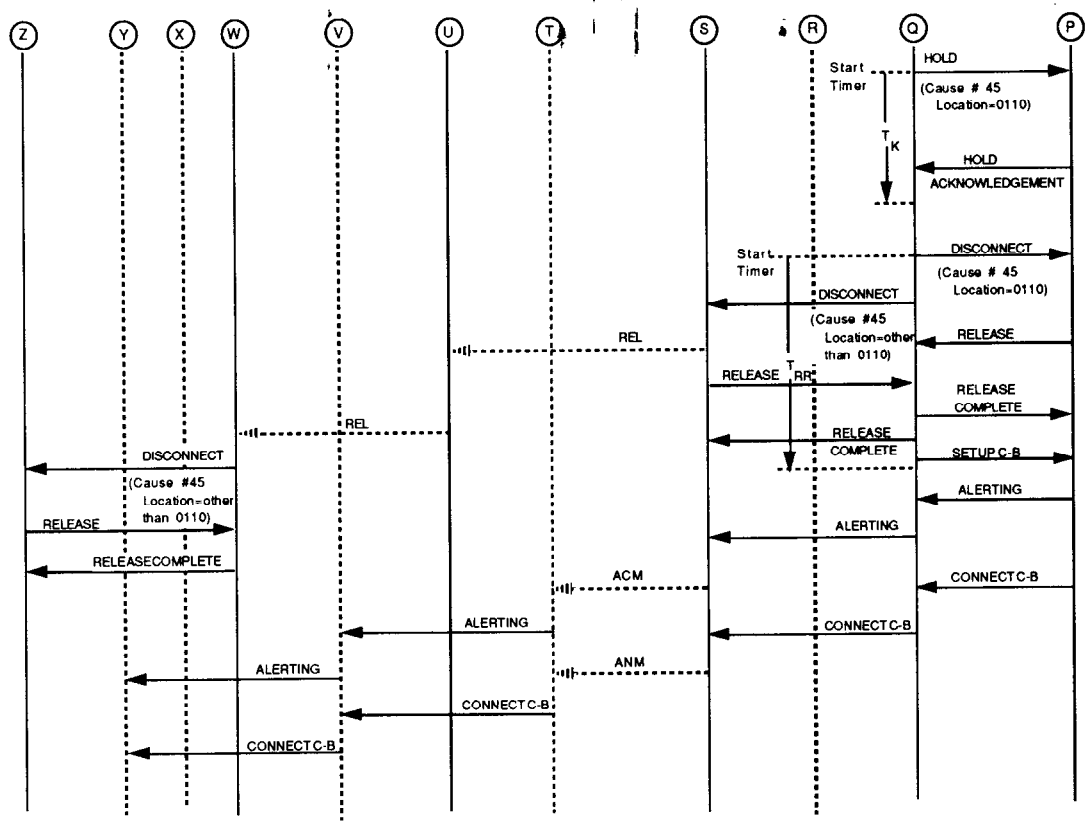


Figure 10 – Normal operation for MLPP without LFB option (successful preemption)

may also be applied to the preempted user. After the existing MLPP call has been cleared, timer T_{RR} is stopped and the same (reserved) circuit shall be used to continue the preempting call using a SETUP message, which shall contain the channel identification of the reserved circuit. At the expiry of timer T_{RR}, the procedure in 6.2.6.1.1(c)(2) shall be followed, if this was the first attempt to setup the MLPP call; otherwise, the call shall be cleared backward (toward calling user) employing the DISCONNECT message with cause 46, "precedence call blocked." An announcement 48 of "precedence call blocked" may also be provided to the calling user;

d) The precedence call may not be completed as a result of a network exchange being busy with calls of equal or higher precedence (on the path toward the called user) or no preemptable circuit in the called DSS1 interface. In this case, upon receipt of the RELEASE message (when OE is a LE) or DISCONNECT message (when OE is an NT2) with cause 46, "precedence call blocked," from the network side, the originating exchange shall return a DISCONNECT message with the same cause to clear the call. An announcement of "precedence call blocked" may also be provided to the calling user;

e) The precedence call may not be completed as a result of called user, who has not subscribed to alternate party, is busy with either: (a) a call of equal or higher precedence than the calling user and no call completion services (call waiting or call forwarding busy are examples) are available or (b) nonpreemptable access resources and no call completion services are available. In this case, upon receipt of the RELEASE message (when OE is a LE) or DISCONNECT message (when OE is an NT2) with cause 46, "precedence call blocked," from the network side, the originating exchange shall return a DISCONNECT message with the same cause to clear the call. An announcement of "precedence call blocked" may also be provided to the calling user;

f) An MLPP call may be preempted as a result of preemption in the network or access. In this case, upon receipt of the RELEASE message (when OE is a LE) or DISCONNECT message (when OE is an NT2) with cause 45, "preemption," from the network side, the originating exchange shall deliver a DISCONNECT message with the same cause to clear the call. A PROGRESS message with Signal IE, containing signal value 9, shall be sent to the preempted user prior to sending the DISCONNECT message so that a "preemption tone" may also be applied to the preempted user.

6.2.6.1.2 Procedure at local exchange (LE) on the called user side

Upon receipt of the setup indication (from IAM message), the local exchange (LE), which is not a DE, shall set appropriate codes for LFB indication ("LFB allowed" or "LFB not allowed") and MLPP service domain in the Precedence level IE and do the following:

a) If there is an idle circuit to propagate the call to the next exchange, then a SETUP message shall be sent after marking the circuit busy at the precedence level and MLPP service domain of the incoming MLPP call;

b) If there are no idle circuits (i.e., congestion is encountered), the following will occur:

1) If the incoming call is a ROUTINE call, normal clearing of the calling user shall be initiated with cause 34, "no circuit/channel available";

2) If the incoming call is a precedence call and a preemptable circuit is not located, clearing of the calling user shall be initiated with cause 46, "precedence call blocked";

3) If the incoming call is a precedence call and a preemptable circuit is located, then the MLPP call on that circuit shall be cleared: (a) forward (toward called user) using a DISCONNECT message with cause 45, "preemption" (with location coded "0 1 1 0" to indicate that circuit is reserved for reuse), and (b) backward (toward to be preempted user) using a disconnect indication with cause 45, "preemption" (with location coded other than "0 1 1 0" to indicate that circuit is not reserved for reuse). The circuit reserved for reuse is marked with the precedence level and MLPP service domain of the preempting call. A timer T_{RR} is started upon sending the DISCONNECT message in case (a) to ensure that the circuit reserved for

reuse is unreserved at the expiry of timer T_{RR}. After the call has been cleared, timer T_{RR} is stopped and the same (reserved) circuit shall be used to continue the call using a SETUP message, which shall contain the channel identification of the reserved circuit. At the expiry of timer T_{RR}, the procedure in 6.2.6.1.2 shall be followed, if this was the first attempt to setup the MLPP call; otherwise, the call shall be cleared backward (toward calling user) employing the disconnect indication with cause 46, "precedence call blocked".

6.2.6.1.3 Procedure at destination exchange (DE)

Upon receipt of the SETUP message (when DE is an NT2) or a setup indication (from the IAM message when DE is an LE), destination exchange (DE) that serves the called user will do the following:

a) *For SETUP message receipt:*

The incoming circuit (identified by channel identification within the SETUP) shall be marked busy at the precedence level and MLPP service domain of the MLPP call. Then

1) if LFB indication in the Precedence level IE of the SETUP message is set to "path reserved", timer T_{LR} is stopped. Then

i) if the reserved (or marked) circuit to the called user (as identified by a match between the calling party number within the SETUP of the MLPP call and calling party numbers of the "reserved" circuits) is found and it is not idle, the procedure in 6.2.6.1.3(b)(3)(i)(A)(I) shall be followed if the called user is busy; otherwise, the procedure in 6.2.6.1.3(b)(3)(i) shall be followed;

ii) if the reserved circuit to the called user is found and it is idle, the procedure in 6.2.6.1.3(b)(1)(ii) shall be followed;

iii) if the reserved circuit to the called user is not found, the procedure in 6.2.6.1.3(b) shall be followed;

2) if LFB Indication in the Precedence level IE of the SETUP message is not set to "path reserved", the procedure in 6.2.6.1.3(b) shall be followed.

b) *For setup indication or SETUP message receipt:*

1) If the called user is idle and an idle circuit to deliver the call to the called user exists, it shall mark the idle circuit busy at the precedence level and MLPP service domain of the incoming MLPP call. Then

i) if the incoming call is a ROUTINE call, a SETUP message shall be delivered to the called user and normal call completion procedures, as described in 5.2.5 of ANSI T1.607, shall be followed;

ii) if the incoming call is a precedence call, a SETUP message shall be delivered to the called user. The SETUP message shall contain the Signal IE with signal value 66 so that a "precedence call alerting" may be provided to the called user. Then

A) if an alternate party is subscribed to, then

I) upon receipt of ALERTING message, indicating that the called user has been notified of the precedence call, timer T_K is started. If no CONNECT message is received before the expiry of timer T_K, timer T_K is stopped and the precedence call shall be diverted to the alternate party, using the call forwarding procedures as described in the CF service. The setup sent to the alternate party (i.e., redirection number = the ISDN number of the alternate party) shall contain the precedence level of the diverted precedence call, LFB indication set to "LFB not allowed", and the reason for redirection = call forwarding no reply). If the CONNECT message is received before the expiry of timer T_K (indicating called user acceptance of preemption), timer T_K is stopped and normal call completion procedures, as described in 5.2.5 of ANSI T1.607, shall be followed;

II) if no ALERTING message is received, the precedence call shall be diverted to the alternate party, using the call forwarding procedures as described in the CF service. The setup sent to the alternate party (i.e., redirection number = the ISDN number of alternate party) shall contain the precedence level of the diverted precedence call, LFB indication set to "LFB not allowed", and the reason for redirection = call forwarding no reply);

B) if no alternate party is subscribed to, normal call completion procedures, as described in 5.2.5 of ANSI T1.607, shall be followed;

2) if the called user is idle, but an idle circuit to deliver the call to the called user does not exist, then

i) if the call is a ROUTINE call, clearing of the calling user shall be initiated by sending a RELEASE COMPLETE message (for receipt) or a release complete indication (for setup indication receipt) to the network side with cause 34, "no circuit/channel available";

ii) if the call is a precedence call and the existing MLPP call is at lower precedence, the existing MLPP call to the busy user (i.e., "other user") on the called interface shall be cleared toward: (a) the busy user with cause 45 (with location coded to "0 1 1 0"), and (b) the network with cause 45 (with location coded other than "0 1 1 0") and the preempting call setup continues employing the procedure in 6.2.6.1.3(b)(1)(ii) (if preemptable access resources exist) or 6.2.6.1.3(b)(3)(ii)(A)(I) (if preemptable access resources do not exist) shall be followed except that the "called user" is to be interpreted as the "other user" under consideration on the called interface;

iii) if the call is a precedence call and the existing call is at equal or higher precedence, clearing of the calling user shall be initiated by sending a DISCONNECT message (for SETUP message receipt) or a disconnect indication (for setup indication receipt) to the network side with cause 46, "precedence call blocked";

3) if the called user is busy, then

i) if the call is a ROUTINE call, clearing of the calling user shall be initiated by sending a RELEASE COMPLETE message (for SETUP message receipt) or a release complete indication (for setup indication receipt) to the network side with cause 17, "user busy";

ii) if the call is a precedence call, then

A) if the called user is busy with a call of lower precedence, then

I) if preemptable access resources exist, the existing MLPP call shall be placed on hold, using a HOLD message delivered to the called user with cause 45, "preemption" (in order to notify the called user of intended preemption) and timer T_K is started. The HOLD message shall also contain the call identity IE and signal IE with signal value 9 so that a "preemption tone" may be applied to the called user. An announcement of "intended preemption" may also be provided to the called user.

If no HOLD ACK message, containing the Call identity IE, is received before the expiry of the timer T_K, timer T_K is stopped. Then, if an alternate party is subscribed to, the existing MLPP call shall be cleared to the called and remote (to be preempted) users with a cause 45 (with location coded as other than "0 1 1 0") and the incoming (preempting) call shall be diverted to alternate party, using the call forwarding procedures as described in the CF service. The setup sent to the alternate party (i.e., redirection number = the ISDN number of alternate party) shall contain: the precedence level of the diverted precedence call, LFB indication set to "LFB not allowed", and the reason for redirection = call forwarding busy). Otherwise (i.e., when no HOLD ACK message is received before the expiry of the timer T_K and no alternate party is subscribed to), the existing MLPP call shall be cleared to: (a) the called user with a cause 45 (with location coded as "0 1 1 0"), and (b) the remote (to be preempted) user with a cause 45 (with location coded as other than "0 1 1 0") and the setup shall be continued for the incoming (preempting) call, using a SETUP message and by employing the circuit that was held (reserved).

If the HOLD ACK message, containing the call identity IE, is received before the expiry of timer T_K (indicating the acceptance of intended preemption), timer T_K is stopped, the existing MLPP call shall be cleared to: (a) the called user with a cause 45 (with location coded as "0 1 1 0") and (b) the remote (to be preempted) user with a cause 45 (with location coded as other than "0 1 1 0"). The setup shall be continued for the incoming (preempting) call, using a SETUP message and by employing the circuit that was held (reserved).

If a STATUS message is received in response to the HOLD message sent by the network indicating that the called user does not support the HOLD family of messages, the existing MLPP call shall be cleared to: (a) the called user with a cause 45 (with location coded as "0 1 1 0"), and (b) the remote (to be preempted) user with a cause 45 (with location coded as other than "0 1 1 0"). The setup shall be continued for the incoming (preempting) call, using SETUP message and by employing the circuit previously used by the existing MLPP call (see 6.2.7).

In all cases above, the SETUP message shall contain the call identity IE and signal IE with signal value 66 so that a "precedence call alerting" may be provided to the called user;

II) if preemptable access resources do not exist, then

– if call completion services are available, interactions with call completion services shall be initiated;

– if call completion services are not available, but alternate party is subscribed to, the incoming precedence call shall be diverted to the alternate party, using the call forwarding procedures as described in the CF service. The setup sent to the alternate party (i.e., redirection number = the ISDN number of alternate party) shall contain the precedence level of the diverted precedence call, LFB indication set to "LFB not allowed," and the reason for redirection = call forwarding busy);

– if call completion services are not available and no alternate party is subscribed to, clearing of the calling user shall be initiated by sending a DISCONNECT message (for SETUP message receipt) or a disconnect indication (for setup indication receipt) to the network side with cause 46, "precedence call blocked";

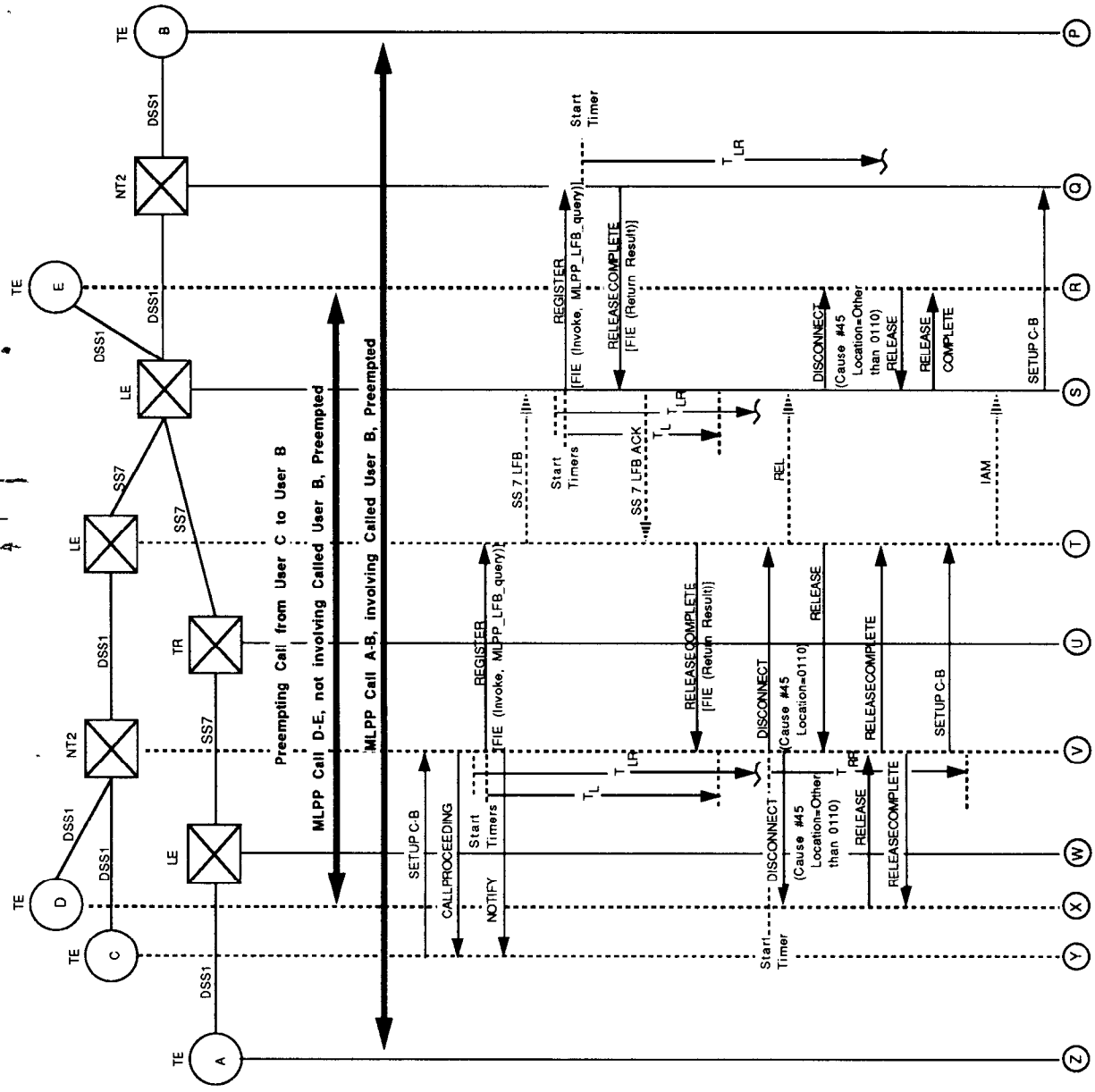
B) if the called user is busy with a call of equal or higher precedence, the procedure in 6.2.6.1.3(b)(3)(ii)(A)(I) shall be followed.

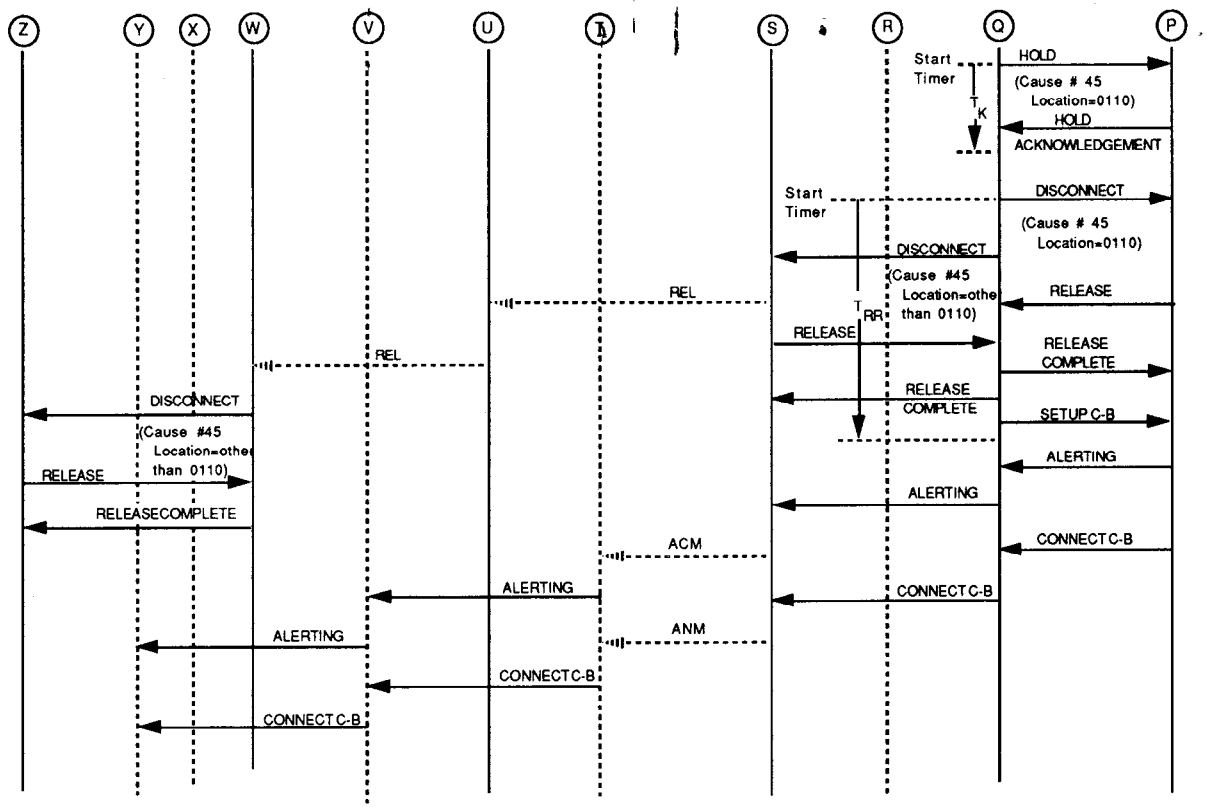
c) An MLPP call may be preempted as a result of preemption in the network or access. In this case, upon receipt of the RELEASE message (when DE is an LE) or DISCONNECT message (when DE is an NT2) with cause 45, "preemption," from the network side, the destination exchange (DE) shall deliver a DISCONNECT message with the same cause to clear the call. A PROGRESS message with the signal IE, containing signal value 9, shall be sent to the preempted user prior to sending the DISCONNECT message so that a "preemption tone" may also be applied to the preempted user.

6.2.6.2 Optional MLPP DSS1 LFB procedure

When the LFB option is supported by the service provider and the LFB indication in the precedence level IE contained in the SETUP message is coded to "LFB allowed", then the MLPP DSS1 LFB query shall be invoked in the DSS1 environment at the preemption initiating exchange when congestion (no idle circuits) is encountered. Note that this query shall also be invoked in the DSS1 environment to continue the SS7 LFB query. The DSS1 shall employ the invoke component of the MLPP_LFB_query operation in the facility IE of the REGISTER message to invoke the query and the return result component of the MLPP_LFB_query operation contained in the facility IE of the RELEASE COMPLETE message to report on the results of the query.

The optional MLPP DSS1 LFB procedure is illustrated in figure 11 and described below.


TE
B
DSS1
NT2
TE
E
DSS1
DSS1
LE
SS7
SS7
LE
TR
DSS1
NT2
SS7
DSS1
DSS1
LE
TE
D
TE
C
DSS1
TE
A
Preempting Call from User C to User B
MLPP Call D-E, not involving Called User B, Preempted
MLPP Call A-B, involving Called User B, Preempted
P
Q
R
S
T
U
V
W
X
Y
Z
Start Timer
REGISTER
[FIE (Invoke, MLPP_LFB_query)]
RELEASECOMPLETE
[FIE (Return Result)]
DISCONNECT
(Cause #45 Location=Other than 0110)
RELEASE
RELEASE COMPLETE
SETUP C-B
SS 7 LFB
Start Timers
SS 7 LFB ACK
REL
IAM
REGISTER
[FIE (Invoke, MLPP_LFB_query)]
RELEASECOMPLETE
[FIE (Return Result)]
DISCONNECT
(Cause #45 Location=0110)
RELEASE
RELEASECOMPLETE
SETUP C-B
SETUP C-B
CALLPROCEEDING
Start Timers
NOTIFY
DISCONNECT
(Cause #45 Location=Other than 0110)
RELEASE
RELEASECOMPLETE
Start Timer



TE (Terminal Equipment), TR (Transit Exchange), LE (Local Exchange)

Figure 11 – Normal operation for MLPP with LFB option (successful preemption)

6.2.6.2.1 Procedure at originating exchange (OE)

If the originating exchange is an NT2 that encounters congestion (i.e., no idle circuit) and locates a preemptable circuit and if LFB query is being invoked on the call for the first time, then the NT2 shall mark the circuit, as identified by its channel identification (with precedence level, MLPP service domain, and calling party number), for preemption and reserved for use by the preempting call. Otherwise, the procedure in 6.2.6.1.1(c)(2) shall be followed. A timer T_{LR} is started to ensure that the marked circuit is unreserved at the expiry of timer T_{LR}. It shall then invoke the MLPP DSS1 LFB query with a REGISTER message sent towards the called user with an operation value set to "0 0 0 1 1 0 0 0" in the invoke component of the facility IE. Timer T_L is started when the REGISTER message is sent. At the same time the REGISTER message is sent, a NOTIFY message is sent toward the calling user to indicate delay in call completion. The notification description field in the notification indicator IE within the NOTIFY message shall be coded to indicate "call completion delay". The REGISTER message launches an SS7 LFB query in the network, the results of which are returned in the SS7 LFB query response (see 7.2.3.3.2). The SS7 LFB query response shall launch the RELEASE COMPLETE message in the DSS1 containing the same operation value in the return result component of its facility IE. The following actions then occur:

a) If no RELEASE COMPLETE message is received and the timer T_L expires, LFB Indication is set to "LFB Not Allowed", timers T_L and T_{LR} are stopped, the circuit previously marked as reserved is unreserved, and procedure described in 6.2.6.1.1(c)(2) shall be followed;

b) If the RELEASE COMPLETE message is received before the expiry of timer T_L, indicating success of the SS7 LFB query (see 7.2.3.3.2), timer T_L is stopped, LFB indication is set to "path reserved", and one of the following will occur:

1) If the circuit that was previously reserved for use by the preempting call is found and it is not idle, procedure described in 6.2.6.1.1(c)(2)(i)(A) shall be followed;

2) If the circuit that was previously reserved for use by the preempting call is found and it is idle, procedure described in 6.2.6.1.1(c)(2)(i) shall be followed;

3) If the circuit that was previously reserved for use by the preempting call is not found, LFB Indication is set to "LFB Not Allowed", timer T_{LR} is stopped, and the procedure described in 6.2.6.1.1(c)(2) shall be followed;

In cases (a) and (b) above, timer T_{LR} is stopped when subsequent SETUP for the preempting call is sent;

c) If the RELEASE COMPLETE message is received before the expiry of timer T_L, containing Path Reservation Denied indication, the same action as in (a) above shall take place;

d) If the RELEASE COMPLETE message is received before the expiry of timer T_L, indicating failure of the SS7 LFB query (see 7.2.3.3.2 of this standard), timers T_L and T_{LR} are stopped, the circuit previously marked as reserved is unreserved, and the incoming precedence call shall be cleared backward (toward calling user) using a DISCONNECT message with cause 46, "precedence call blocked". An announcement of "precedence call blocked" may also be provided to the calling user.

6.2.6.2.2 Procedure at local exchange (LE) on the called user side

When an LFB option is provided in the DSS1, upon encountering congestion (i.e., no idle circuit) after the receipt of a setup indication (from IAM message) and locating a preemptable circuit or upon receipt of the SS7 LFB query indication, the local exchange (LE), which is not a DE, will do the following, if LFB is invoked on the call for the first time; otherwise, the procedure in 6.2.6.1.2 shall be followed:

a) *For SS7 query indication receipt:*

If a preemptable or idle circuit is not located, then a failure indication shall be launched toward the network.

b) *For either SS7 query indication or setup indication receipt:*

Preemptable or idle (for SS7 LFB query only) circuit, as identified by its channel identification, shall be marked (with precedence level, MLPP service domain, and calling party number) for preemption and reserved for use by the preempting call. A timer T_{LR} is started to ensure that the marked circuit is unreserved at the expiry of timer T_{LR}. It shall then invoke the MLPP DSS1 LFB query with a REGISTER message sent towards the called user with an operation value set to "0 0 0 1 1 0 0 0" in the invoke component of the facility IE. Timer T_L is started when the REGISTER message is sent. For the setup indication receipt, at the same time the REGISTER message is sent, a NOTIFY message is sent toward the calling user to indicate delay in call completion. The notification description field in the notification indicator IE within the NOTIFY message shall be coded to indicate "call completion delay". The response to the REGISTER message shall be received in the RELEASE COMPLETE message containing the same operation value in the return result component of its facility IE. The following actions then occur:

1) If no RELEASE COMPLETE message is received and the timer T_L expires, timers T_L and T_{LR} are stopped and the circuit previously marked as reserved is unreserved. Then

i) *For SS7 query indication receipt:* A success indication shall be launched toward the network.

ii) *For setup indication receipt:* LFB indication is set to "LFB not allowed", and procedure described in clause 6.2.6.1.2 shall be followed.

2) If the RELEASE COMPLETE message is received before the expiry of timer T_L, indicating success of the DSS1 LFB query, timer T_L is stopped. Then

i) *For SS7 query indication receipt:* A success indication shall be launched toward the network. The timer T_{LR} is stopped when subsequent SETUP for the preempting call is sent.

ii) *For setup indication receipt:* LFB indication is set to "path reserved", and one of the following will occur:

A) If the circuit that was previously reserved for use by the preempting call is found and it is not idle, procedure described in 6.2.6.1.2(b)(3) shall be followed;

B) If the circuit that was previously reserved for use by the preempting call is found and it is idle, procedure described in 6.2.6.1.2(a) shall be followed;

C) If the circuit that was previously reserved for use by the preempting call is not found, LFB indication is set to "LFB not allowed", timer T_{LR} is stopped, and the procedure described in 6.2.6.1.2 shall be followed.

In cases 6.2.6.2.2(b)(2)(ii)(A) and 6.2.6.2.2(b)(2)(ii)(B), timer T_{LR} is stopped when subsequent SETUP for the preempting call is sent;

3) If the RELEASE COMPLETE message is received before the expiry of timer T_L, containing "path reservation denied" indication, the same action as in 6.2.6.2.2(b)(2)(ii)(A) shall take place;

4) If the RELEASE COMPLETE message is received before the expiry of timer T_L, indicating failure of the DSS1 LFB query, timers T_L and T_{LR} are stopped and the circuit previously marked as reserved is unreserved. Then

i) *For SS7 query indication receipt:* A failure indication shall be launched toward the network;

ii) *For setup indication receipt:* The incoming precedence call shall be cleared backward (toward calling user) using a disconnect indication with cause 46, "precedence call blocked".

6.2.6.2.3 Procedure at destination exchange (DE)

When an LFB option is provided in the DSS1, upon receipt of the REGISTER message (when DE is an NT2) or SS7 LFB query indication (when DE is an LE), the destination exchange (DE) that serves the called user will do the following:

a) *For REGISTER message receipt:*

1) If the incoming reserved circuit, as indicated by the channel identification in the REGISTER message, is available, it shall be marked (with precedence level, MLPP service domain, and calling party number) reserved for use and the procedure in 6.2.6.2.3(b) shall be followed;

2) If the incoming reserved circuit, as indicated by the channel identification in the REGISTER message, is not available, LFB indication in the Precedence level IE is set to "path reservation denied" and a RELEASE COMPLETE message shall be returned with the query results parameter of the return result component coded to "path reservation denied";

b) *For REGISTER message or SS7 query indication receipt:*

1) If the bearer capability indicated in the REGISTER message or SS7 query indication does not pass the bearer capability check, a RELEASE COMPLETE message (for REGISTER message receipt) or an SS7 query response indication (for SS7 query indication receipt) shall be returned with the query results parameter of the return result component coded to bearer capability "not authorized", or "not implemented", or "not available", as appropriate;

2) If the bearer capability indicated in the REGISTER message or SS7 query indication passes the bearer capability check, then the following will occur:

i) If the called user is idle and an idle circuit to deliver the call to the called user exists, then it shall mark a circuit to the called user (with precedence level, MLPP service domain, and calling party number) as reserved for use by the preempting call, set LFB indication to "path reserved", and return a RELEASE COMPLETE message (for REGISTER message receipt) or an SS7 query response indication (for SS7 query indication receipt), indicating *success* within the query results parameter of the return result component;

A timer T_{LR} is started after marking the circuit reserved for use to ensure that the reserved circuit is unreserved at the expiry of timer T_{LR};

ii) If the called user is idle, but an idle circuit to deliver the call to the called user does not exist, then the procedure in 6.2.6.2.3(b)(2)(iii)(A) or 6.2.6.2.3(b)(2)(iii)(B), as appropriate, shall be followed. In the procedure when comparing the precedence levels, the precedence level of the active MLPP call on the called interface instead of that of the MLPP call to the called user is employed and the "called user" is to be interpreted as the "other user" under consideration on the called interface;

iii) If the called user is busy, then

A) if preemptable access resources exist, it shall compare the precedence levels of the preempting call with the MLPP call with which the called user is busy and do the following:

I) if the called user is busy with a call of lower precedence than the calling user, the busy circuit to the called user shall be marked (with precedence level, MLPP service domain, and calling party number) reserved for use by the preempting call, LFB indication shall be set to "path reserved", and a RELEASE COMPLETE message (for REGISTER message receipt) or an SS7 query response indication (for SS7 query indication receipt) shall be returned, indicating *success* within the query results parameter of the return result;

A timer T_{LR} is started after marking the circuit reserved for use to ensure that the reserved circuit is unreserved at the expiry of timer T_{LR};

II) if the called user is busy with a call of equal or higher precedence than the calling user, then the following procedure in 6.2.6.2.3(b)(2)(iii)(A) shall be followed;

B) If preemptable access resources do not exist, then

I) if call completion services are available, a RELEASE COMPLETE message (for REGISTER message receipt) or an SS7 query response indication (for SS7 query indication receipt) shall be returned, indicating *success* within the query results parameter of the return result;

II) if call completion services are not available, but an alternate party is subscribed to, a RELEASE COMPLETE message (for REGISTER message receipt) or an SS7 query response indication (for SS7 query indication receipt) shall be returned, indicating *success* within the query results parameter of the return result component;

III) if call completion services are not available and no alternate party is subscribed to, a RELEASE COMPLETE message, after unreserving the previously marked circuit (for REGISTER message receipt) or an SS7 query response indication (for SS7 query indication receipt) shall be returned, indicating *failure* within the query results parameter of the return result component.

NOTE – In all the above cases, the timer T_{LR} is stopped when subsequent SETUP for the preempting call is sent.

6.2.7 Error handling

a) If the called user does not support the HOLD family of messages, the user may return a STATUS message with cause 98, "message not compatible with call state or message type nonexistent or not implemented," or cause 97, "message type non-existent or not implemented," in response to the HOLD message sent by the destination exchange. The destination exchange (DE) shall clear the existing MLPP call to: (a) the called user with a cause 45 (with location coded as "0 1 1 0"), and (b) the remote (to be preempted user) user with a cause 45 (with location coded as other than "0 1 1 0"). The setup shall be continued for the incoming (preempting) call, using SETUP message and by employing the circuit previously used by the existing MLPP call;

b) If the incoming call is a precedence call and the called user is busy with a call of lower precedence and has preemptable access resources, then the following takes place if the called user responds with a HOLD REJ message within response timer T_K to the HOLD message sent by the network. The existing MLPP call shall be cleared to: (a) the called user with a cause 45 (with location coded as "0 1 1 0"), and (b) the remote (to be preempted) user with a cause 45 (with location coded as other than "0 1 1 0") and the setup shall be continued for the incoming (preempting) call, using a SETUP message and by employing the circuit that was reserved.

6.3 Interactions for MLPP

6.3.1 Basic call

The interactions with basic call have been described in 6.2.

6.3.2 Other services

6.3.2.1 Call waiting

If the incoming call to be delivered to the called user (on the basis of the ISDN number/bearer service) is an MLPP call and the called access is busy (i.e., no access channel is available), then

a) if the incoming MLPP call is at a higher precedence level than the MLPP call of the lowest precedence level with which the called access is busy, then preemption of that MLPP call shall occur as described in 6.2.6.1.3, if the user of that MLPP call has not subscribed to the "nonpreemptable access resources" option; otherwise, CW shall be invoked by sending a SETUP message to the called user, which shall contain the signal IE with the signal value coded to "call waiting tone on" so that the called user may be provided this tone, if busy;

b) if the incoming MLPP call is at the same precedence level as that of the MLPP call of the lowest precedence level with which the called access is busy, then CW shall be invoked by sending a SETUP message to the called user, which shall contain the Signal IE with the signal value coded to "call waiting tone on" so that the called user may be provided this tone, if busy;

c) if the incoming MLPP call is at a lower precedence level than the MLPP call of the lowest precedence level with which the called access is busy, then CW shall be invoked by sending a SETUP message to the called user, which shall contain the Signal IE with the signal value coded to "call waiting tone on". Based on the precedence level comparison, the terminal may prevent the application of call waiting tone to the called user and may use alternate methods (i.e., out-of-band indication) to inform the called user, if busy that a lower precedence call is waiting.

For each of the three cases, the SETUP message, used for invoking the CW service, shall contain the precedence level of the incoming MLPP call in its Precedence level IE and the number of calls per ISDN number/bearer service counter and the number of waiting calls per ISDN number/bearer service counter shall each be incremented.

6.3.2.2 Calling line identification presentation

None required.

6.3.2.3 Calling line identification restriction

None required.

6.3.2.4 Call hold

A held MLPP call may be preempted due to a lack of resources in the network to complete a higher precedence MLPP call in the same MLPP service domain. In this situation, the clearing of the held MLPP call at the served user's (call hold subscriber's) interface shall be initiated by the network sending a RELEASE message with cause 45, "preemption", to the served user in order to notify the served user that the held call is preempted.

A held MLPP call may also be preempted as a result of a lack of channels at the held party's (or remote user's) interface when a higher precedence MLPP call in the same MLPP service domain needs to be set up over that interface. In this situation, the preemption of the held MLPP call at the remote user's interface shall be achieved by employing the normal call clearing procedures as described in 5.3 of ANSI T1.607, with the first clearing message containing cause 45, "preemption" (with location coded "0 1 1 0" to indicate that the held channel is reserved for reuse). The reserved channel at the remote user's interface, may then be reused by the incoming or outgoing higher precedence MLPP call by the network or user sending a SETUP message containing channel id = "reserved channel's id". The clearing of the held MLPP call at the served user's (call hold subscriber's) interface shall be initiated by the network sending a RELEASE message with cause 45, "preemption," to the served user in order to notify the served user that the held call is preempted.

If a multipoint configuration exists at the served user's (user–network) interface, an "idle" or "active" channel that is reserved for a held MLPP call of the served user (call hold subscriber) may be used by the incoming or outgoing higher precedence MLPP call to or from the same or another user on the interface. To accomplish this

a) for an "idle" channel, the incoming or outgoing higher precedence MLPP call may be completed or continued by the network or user sending a SETUP message with channel id = "idle channel's id";

b) for an "active" channel, the call on that channel shall be preempted following the normal call clearing procedures as described in ANSI T1.607, with the first clearing message toward the user containing cause 45, "preemption" (with location coded "0 1 1 0" to indicate that the held channel is reserved for reuse) and the first clearing message toward the remote user of the "active" channel containing cause 45, "preemption" (with location coded "other than 0 1 1 0" to indicate that the

held channel at the remote user's interface is not reserved for reuse). Then, the incoming or outgoing higher precedence MLPP call may be completed or continued by the network or user sending a SETUP message with channel id = "channel id of the cleared call".

In both of the above cases, the held MLPP call shall not be cleared.

6.3.2.5 MLPP

None required.

6.4 SDLs for MLPP

This subclause specifies actions within telecommunication equipments associated with the user–network access interface to support MLPP in diagrammatic form (see annex C).

6.5 Flow diagrams

See figures 10 and 11.

7 Switching and signaling specification for MLPP at interexchange interfaces

This clause contains the detailed specifications of switching and signaling capabilities that will support the service capabilities described in the earlier clauses. It identifies the signaling system number 7 (SS7) messages and procedures needed to support the information flows and functional entity actions for the scenarios of 5.5.

7.1 Formats and coding for MLPP

This subclause identifies the call control and other messages, codesets, parameters, and codepoints specified for MLPP to realize the information flows between telecommunication equipments associated with the interexchange facilities as identified in 5.5.

7.1.1 ISDN-user part formats and parameter codings

7.1.1.1 Messages

7.1.1.1.1 Initial address message (IAM)

The format of the initial address message (IAM) message is shown in chapter 3 of ANSI T1.113.

7.1.1.1.2 Release message (REL)

The format of the release message (REL) message is shown in chapter 3 of ANSI T1.113.

7.1.1.2 Parameters

7.1.1.2.1 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 whether a path has been reserved or path reservation is allowed.

8	7	6	5	4	3	2	1
ext	LFB		spare	Precedence level			
ext	MLPP service domain						

The following codes are used in the precedence parameter subfields:

Extension indicator (ext)

0	Octet continues through the next octet
1	Last octet

LFB

0 0	LFB allowed
1 0	LFB not allowed
0 1	Path reserved
1 1	spare

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 1 1 1 1	spare

MLPP service domain

0 0 0 0 0 0 0	Defense switched network
0 0 0 0 0 0 1 to 1 1 1 1 1 1 1	spare

7.1.1.2.2 Cause indicator parameter – Format and coding

The format of the cause indicator parameter field is shown in chapter 3 of ANSI T1.113.

The following coding is the standard for cause values 45-preemption and 46-precedence call blocked:

Cause value	
0 1 0 1 1 0 1	(45) preemption
0 1 0 1 1 1 0	(46) precedence call blocked

7.1.1.2.3 Notification indicator parameter – Format and coding

The format of the notification indicator parameter is shown below.

8	7	6	5	4	3	2	1
ext	Notification indicator						

Notification indicator parameter

The following codes shall be used to indicate call completion delay:

0 0 0 0 1 0 0	Call completion delay

7.1.2 Transaction capabilities application part (TCAP) format and parameter codings

7.1.2.1 Application service element (ASE) for TCAP look-ahead for busy (LFB)

7.1.2.1.1 Parameter – Provide value (for look-ahead for busy query)

parameter-ProvideValue PARAMETER	OPERATION SET {LookAheadForBusyResponse, BearerCapabilitySupported, serviceKey ServiceKey}
RESULT	SET{LookAheadForBusyResponse, BearerCapabilitySupported}
ERRORS	{dataUnavailable, taskRefused, unexpectedDataValue}
LookAheadForBusyResponse BearerCapabilitySupported ServiceKey	::=[X] IMPLICIT OCTET STRING ::=[19] IMPLICIT OCTET STRING ::=[10] IMPLICIT SET {destNum Digits, CircuitIdentificCode, BearerCapReq, Precedence, CallRef, callingNum Digits}
Digits CircuitIdentificationCode BearerCapabilityRequested Precedence CallReference	::=[4] IMPLICIT OCTET STRING ::=[X] IMPLICIT OCTET STRING ::=[18] IMPLICIT OCTET STRING ::=[X] IMPLICIT OCTET STRING ::=[X] IMPLICIT OCTET STRING
unexpectedDataValue PARAMETER ::=2	ERROR SET {ProblemData}
dataUnavailable PARAMETER ::= 6	ERROR SET { }
taskRefused PARAMETER ::=7	ERROR SET { }
::=(33025)	- - family = 00000001, specifier = 00000001

7.1.2.2 Parameters

7.1.2.2.1 Look-ahead for busy response

The look-ahead for busy response parameter is used to indicate whether the preemptable resources were found. The parameter is coded contextual. It is 1 octet long and is of type OCTET STRING.

H	G	F	E	D	C	B	A
X	X	X	X	X	X	X	X

Look-ahead for busy response identifier

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 controlled by this signaling link	0	1	1	0
International network	0	1	1	1
Network beyond interworking point	1	0	1	0
All other values are reserved				

Spare: Bits FE

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:

Acknowledgment type	H	G
Path reservation denied	0	0
Negative acknowledgment	0	1
Positive acknowledgment	1	0
Spare	1	1

7.1.2.2.2 Bearer capability requested

The format and coding of the bearer capability requested parameter is shown in ANSI T1.114.[3)]

7.1.2.2.3 Bearer capability supported

The bearer capability supported parameter is used to indicate the reason a bearer capability requested was not available.

H	G	F	E	D	C	B	A
1	0	0	1	0	0	1	1

Bearer capability supported

[3)] This parameter will be shown in the revised version of ANSI T1.114, which is currently under development. Contact the secretariat for more recent information.

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

7.1.2.2.4 Digits

The format and coding of the digits parameter is shown in ANSI T1.114.

7.1.2.2.5 Circuit identification code

The circuit identification code parameter is used to identify the physical path between two exchanges. The parameter is coded contextual.

H	G	F	E	D	C	B	A
X	X	X	X	X	X	X	X

Circuit identification code identifier

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 identification code (most significant bits)					

7.1.2.2.6 Precedence

The precedence parameter is used to identify the MLPP call in terms of priority treatment and MLPP service domain.

H	G	F	E	D	C	B	A
X	X	X	X	X	X	X	X

Precedence identifier

The parameter is variable in length and is of type OCTET STRING. The contents are coded as follows:

H	G	F	E	D	C	B	A
ext	Spare			Precedence level			
ext	MLPP service domain						

a) Bit H extension indicator

0 octet continues through the next octet

1 last octet

b) Bits GFE are spare.

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

Precedence level	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

d) Bits GFEDCBA indicate an identity of the MLPP service domain and are coded as follows:

MLPP service domain	G	F	E	D	C	B	A
Defense switched network	0	0	0	0	0	0	0
	0	0	0	0	0	0	1
Spare	to						
	1	1	1	1	1	1	1

7.1.2.2.7 Call reference

The call reference parameter is used to identify a particular MLPP call independent of the physical circuit.

H	G	F	E	D	C	B	A
X	X	X	X	X	X	X	X

Call reference identifier

The parameter is 6 octets in length and is of type OCTET STRING. The 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 Octet 5 Octet 6	Point code							

Call identity:

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

Point code:

Octets 6–4 indicate the code of the signaling point in which the call identity is relevant.

7.2 Procedures for MLPP

This subclause specifies detailed switching and signaling procedures for MLPP for activation, invocation, notification, operation, and deactivation. It defines service states, timers, and error handling.

7.2.1 Support considerations

7.2.1.1 IAM priority assignments

The following table shows the standard service IAM message priorities described in ANSI T1.113 for each MLPP service domain.

MLPP service domain	MLPP precedence level				
	0	1	2	3	4
1. DSN (see note) 2. TBD . . n. TBD	*	*	1	1	0

* American National Standards allow for IAMs at priority levels 0 and 1. Since DSN needs may exceed these priority levels, priority for FLASH OVERRIDE and FLASH IAMs will be negotiated with the service provider and any other network(s) that may be required to support this case.

NOTE – The national communications system (NCS) voice precedence system specifies the purpose of each precedence category and the types of calls which may be assigned the respective precedences within the defense switched network (DSN) domain.

7.2.2 Timers

The following table shows the MLPP-network protocol timer values:

	Timer values
T_1	Defined in 2.9.6.2 of chapter 4 of ANSI T1.113
T_{RR}	Approximately 15 seconds
T_L	Approximately 15 seconds
T_{LR}	Approximately 30 seconds

7.2.3 Normal operation for networks supporting multi-level precedence and preemption

This subclause details the ISDN-user part and (optional) TCAP procedures associated with MLPP service, in networks that support the MLPP calls. Error treatment procedures are provided as further subclauses to this subclause.

In a network that supports multi-level 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 7.2.3.2 is followed. If there are no idle circuits to complete the requested call, the procedure in 7.2.3.3 is followed.

7.2.3.1 Maintenance of precedence level

If an exchange receives an MLPP call request, the precedence level and MLPP service domain associated with the call is maintained at the exchange for the duration of the call.

7.2.3.2 Procedures when no circuit congestion is encountered

If an exchange receives an MLPP call request, it establishes and maintains the precedence level and MLPP service domain associated with the call as specified in 7.2.3.1, 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 chapter 3 of ANSI T1.113, 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, e.g., defense switched network. This value is used at gateway exchanges to identify those IAMs associated with standard services and to identify within networks, where multiple MLPP services may exist, the MLPP calls of the same domain.

Subsequent call setup action follows the procedures for a basic call specified in chapter 4 of ANSI T1.113.

7.2.3.3 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 7.2.3.1, 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 setup, specified in chapter 4 of ANSI T1.113 is followed.

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

a) 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;

b) If such a circuit is found, it is marked "reserved for reuse" by the preempting call and the call setup continues in accordance with ISDN-UP procedures specified in 7.2.3.3.1. As a network option, the TCAP look-ahead for busy (LFB) procedure (7.2.3.3.2) 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;

c) If a suitable circuit is not found, the preempting call is released as specified in 7.2.3.3.3.2 when the search for preemptable circuits is unsuccessful.

7.2.3.3.1 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 (7.2.3.3.1.1) and the preempting MLPP call setup continues (7.2.3.3.3.1) using the ISDN-user part protocol.

7.2.3.3.1.1 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 interexchange 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 (a) release of circuit reserved for reuse, and (b) release of circuit not reserved for reuse.

Release sequence (a) is used to release the circuit selected to complete the preempting call. Release sequence (b) 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.

a) *Actions at the preemption initiating exchange*

1) *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

i) coding the cause value subfield with standard cause 45 – "preemption";

ii) coding the location subfield as "local interface controlled by this signaling link".

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 setup 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 of chapter 4 of ANSI T1.113.)

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 T1 expiration procedures in 2.9.6 of chapter 4 of ANSI T1.113 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 setup failure after initiating the reattempt results in abandoning the preempting call as specified in 7.2.3.3.3.2 for an unsuccessful call.

Receipt of a release complete (RLC) message on the circuit reserved for reuse resumes the setup sequence for the preempting call as specified in 7.2.3.3.3.1 and cancels timer T_1.

2) *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

i) coding the cause value subfield with standard cause 45 – "preemption";

ii) coding the location subfield to convey appropriate location information to the succeeding exchange.

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 signaling 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 of chapter 4 of ANSI T1.113.)

b) *Actions at an intermediate exchange*

1) *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

i) a standard cause value of 45 – "preemption";

ii) a location subfield coded "local interface controlled by this signaling link".

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 setup 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 of chapter 4 of ANSI T1.113. 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

A) coding the cause value subfield with standard cause 45 – "preemption";

B) coding the location subfield to convey appropriate location information to the succeeding exchange. The "local interface controlled by this signaling link" code may not be used in the location subfield.

2) *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

i) a standard cause value of 45 – "preemption";

ii) any location subfield code other than "local interface controlled by this signaling link".

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 of chapter 4 of ANSI T1.113. 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

A) coding the standard cause value subfield with cause 45 – "preemption";

B) coding the location subfield to convey appropriate location information to the succeeding exchange. The "local interface controlled by this signaling link" code may not be used in the location subfield.

c) *Actions at an end exchange*

1) *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

i) a standard cause value of 45–"preemption";

ii) a location subfield coded "local interface controlled by this signaling link".

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 setup 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.

2) *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

i) a standard cause value of 45 – "preemption";

ii) any location subfield code other than "local interface controlled by this signaling link".

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.

7.2.3.3.2 TCAP look-ahead for busy (LFB) procedures

Look-ahead for busy is a set of TCAP operations that may be performed as a network option to look through the network for available circuits and reserve these circuits before attempting call setup. It checks the status of circuits ahead (i.e., whether they are idle, preemptable or nonpreemptable), 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 7.2.3.3.1 and 7.2.3.3.3 are followed as if the LFB option is not supported in the network.

The following paragraphs describe the LFB query 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 (a) equal or higher precedence calls, or (b) Bearer capability not being supported;

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 (glare) or preemption by a higher precedence level call.

When a succeeding exchange has a problem processing an LFB query, 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.

7.2.3.3.2.1 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.

a) *Sending a TCAP LFB query:* 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 TCAP LFB query to the exchange at the far end of the outgoing circuit.

This message has a query package type and contains a single component. This single component has an invoke (last) 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 response parameter. The service key in the parameter set contains the calling party number,[4] 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 7.1.2. This TCAP LFB query is sent using point code routing, with the destination point code (DPC) of the far-end exchange.

At the same time the LFB query is sent, an ACM is sent toward the originating exchange to indicate call progress and cancel any call setup control timers. The notification indicator parameter fields shall be included and coded as specified in 7.1.1.2.3 to indicate "call completion delay".

Upon sending the LFB query the preemption initiating exchange starts timer T_L.

b) *Awaiting a TCAP LFB response:* After reserving a preemptable circuit and sending a TCAP LFB query to the succeeding exchange, the preemption initiating exchange waits for a TCAP LFB response. The bearer capability supported (BCS) and LFB response parameters shall be returned in each response. However, the bearer capability values received are only used when the LFB response value is set to negative acknowledgment. The BCS parameter returned with any other LFB response shall be ignored. Subsequent action is determined by the following events:

1) *TCAP LFB response with negative acknowledgment is received:* If a TCAP LFB response with acknowledgment type subfield in the look-ahead for busy response parameter coded "negative acknowledgment" is received, the preempting call is cleared using the procedure specified in 7.2.3.3.3.2 and timer T_L is canceled;

2) *TCAP LFB response with positive acknowledgment is received:* If a TCAP LFB response with acknowledgment type subfield in the look-ahead for busy response 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 7.2.3.3.1 and 7.2.3.3.3 to preempt MLPP calls and set up the preempting call;

3) *TCAP LFB response with reservation denial indication is received:* If a TCAP LFB response with acknowledgment type subfield in the look-ahead for busy response 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 7.2.3.3.1 and 7.2.3.3.3;

4) *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 7.2.3.3.1 and 7.2.3.3.3.

7.2.3.3.2.2 Actions at the intermediate exchange

a) *Receiving a TCAP LFB query:* The following procedures describe actions taken when an intermediate exchange receives a TCAP LFB query. This query contains information requesting a search for available network circuits to complete the preempting call and reservation of available paths.

1) 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 query;

2) The intermediate exchange searches for a suitable outgoing circuit based on relevant routing data and the destination number, bearer capability requested, and precedence parameters

[4] Calling party number is required by DSS1.

contained in the service key parameter of the incoming query. 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 query is used to uniquely identify the preempting call reserving the circuit;

3) 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};

4) Upon completion of the circuit selection and reservation, the intermediate exchange sends an LFB query to the succeeding exchange at the far-end of the outgoing circuit. The parameter of the operation in the invoke component of the LFB query are coded exactly as described in 7.2.3.3.2.1(a), second paragraph, except that the circuit identification code is the one assigned to the outgoing circuit reserved for the preempting call;

5) Upon sending the LFB query the intermediate exchange starts timer T_L.

b) *Sending a TCAP LFB response*: A TCAP LFB response is sent from an intermediate exchange if (a) reservation of incoming circuit fails; (b) the search for a suitable outgoing circuit (7.2.3.3.2.2(a)) fails; (c) a TCAP LFB response has been received from the succeeding exchange; or if (d) timer T_L expires, whichever occurs first.

1) *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 an LFB response parameter coded "path reservation denied". The bearer capability supported parameter shall be coded "supported".

2) *Search for a suitable outgoing circuit fails:* If the search for a suitable outgoing circuit fails after a TCAP LFB query is received at an intermediate exchange, the exchange will reply with a TCAP message of the response package type and a return result component type. The incoming circuit is unreserved. The look-ahead for busy response 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 TCAP response is sent using point code routing, with the destination point code (DPC) of the preceding exchange.

3) *TCAP LFB response is received from the succeeding exchange:* If TCAP LFB response is received from the succeeding exchange while timer T_L is still running, then a TCAP LFB response 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 canceled. The look-ahead for busy response parameter indicates if LFB procedures were successfully performed end-to-end. The acknowledgment type and location subfields of the look-ahead for busy response parameter for the TCAP 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 response 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 TCAP LFB queries previously received and sent, and also the asso-

ciated 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 response 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 response 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}.

4) *Timer TL expires:* If timer T_L expires before a TCAP LFB response is received from the succeeding exchange, the exchange will "unreserve" the outgoing circuit reservation identified by the CIC and CR values and send a TCAP message which is a response package 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 TCAP LFB response is sent using point code routing, with the DPC of the preceding exchange.

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

7.2.3.3.2.3 Actions at the end exchange

a) *Receiving a TCAP LFB query:* When an end exchange receives a TCAP LFB query 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 7.2.3.3.2.2(b)(1), 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.

b) *Sending a TCAP LFB response*

1) *Procedure at the destination exchange:* Upon labeling 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 nonpreemptable, 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 TCAP 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 LFB response 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 TCAP LFB response 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 TCAP 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 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 nonavailability. 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 TCAP LFB response 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 TCAP message that 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 acknowledgment". The location subfield is coded with the appropriate location code. The bearer capability supported parameter shall be coded "supported". The TCAP LFB response is sent using point code routing, with the DPC of the preceding exchange.

2) *Procedures at the gateway exchange within a network:* Upon labeling 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 TCAP message that is a response package type containing a return result component. The acknowledgment type subfield of the look-ahead for busy response 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 TCAP LFB response 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 TCAP message which is a response package type containing a return result component. The acknowledgment type subfield of the look-ahead for busy response 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 TCAP LFB response 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 7.2.3.3.2.2.

7.2.3.3.3 MLPP call setup

7.2.3.3.3.1 Successful MLPP call setup

a) *Call setup action at the preemption initiating exchange:* Upon successful release of the "circuit reserved for reuse" (7.2.3.3.1.1(a)) 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 chapter 3 of ANSI T1.113, the precedence parameter, and if the TCAP 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 setup. In this case the LFB indicator will not be changed.

1) The LFB indicator subfield of the precedence parameter is coded "LFB allowed" if the TCAP LFB procedures were not performed for the preempting call;

2) The LFB indicator subfield of the precedence parameter is coded "path reserved" if the TCAP LFB procedures were performed for the preempting call and the acknowledgment type subfield of the look-ahead for busy response parameter received in the TCAP LFB response message indicated "positive acknowledgment";

3) The LFB indicator subfield of the precedence parameter is coded "LFB not allowed" if the preempting call setup request indicated "LFB not allowed", or when either (a) the IAM is sent upon expiration of timer T_L at the initiating exchange or (b) the TCAP LFB response message indicated "path reservation denied".

The call reference parameter contains the call reference value assigned by the exchange when the circuit was "reserved" (7.2.3.3.2.1(a)).

Subsequent call setup is performed according to the procedures for normal call setup specified in chapter 4 of ANSI T1.113.

b) *Call setup 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.

1) If incoming circuit is marked "reserved for reuse", timer T_{RR} is canceled;

2) 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 7.2.3.2 is followed. If there are no idle circuits to complete the requested call, procedure in 7.2.3.3 is followed;

3) If the LFB indicator subfield is set to "path reserved" and if the optional look-ahead for busy (LFB) procedure (7.2.3.3.2) 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 canceled. 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 7.2.3.3.1.1(a);

4) 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 setup failure after initiating the reattempt results in abandoning the preempting call.

c) *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.

7.2.3.3.3.2 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 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 chapter 4 of ANSI T1.113 for unsuccessful call setup treatment.

7.2.4 Normal operation for networks without multilevel precedence and preemption option

This subclause provides the ISDN-user part procedures associated with MLPP calls, in networks that do not support MLPP service. Error treatment procedures are provided as further subclauses to this subclause.

The treatment in networks that do not implement multilevel precedence and preemption procedures shall be limited to two cases:

a) Such a network should convey intact the ISDN-UP parameters and values associated with MLPP. These parameters are the precedence parameter and release causes for preemption (standard cause 45) and precedence call blocked (standard cause 46);

b) In the case of signaling 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 a release of preempted calls the same as a normal release.

7.3 Interactions for MLPP

No interactions identified.

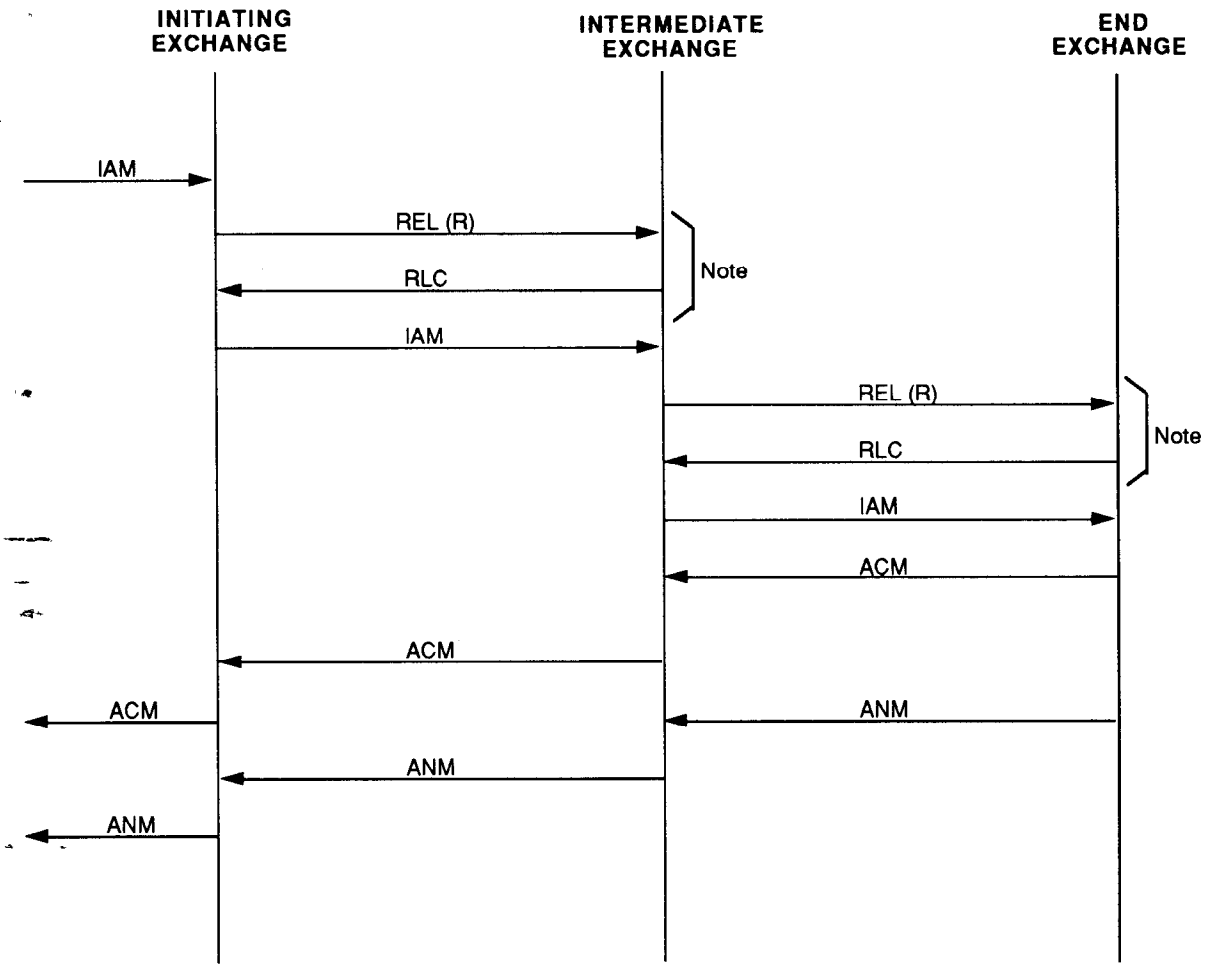
7.4 SDLs for MLPP

This subclause specifies actions within telecommunication equipments associated with interexchange facilities to support MLPP in diagrammatic form. They are shown in annex E.

7.5 Flow diagrams

In figures 12 through 16 the ISDN-user part messages are denoted by solid lines between exchanges and TCAP messages are indicated by dashed lines. Specific notations used in the figures are detailed below.

Notation	*Meaning*
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 the standard cause value "preemption (45)" and location "local interface controlled by this signaling link" in the cause indicator parameter ("release with circuit reserved for reuse") NOTE – The release sequence denoted by "*" is performed only if a busy and preemptable circuit had been reserved by the preceding LFB query
LFB query	TCAP query package type message sent to perform the look-ahead for busy operation. Its parameter set is shown in figure 14
LFB response (ACK)	Response to the LFB query with the acknowledgment type subfield of the look-ahead for busy response parameter set to "positive acknowledgment"
R	Circuit reserved for reuse



NOTE – Performed only if circuit was busy and preemptable.

Figure 12 – MLPP successful call setup without LFB option

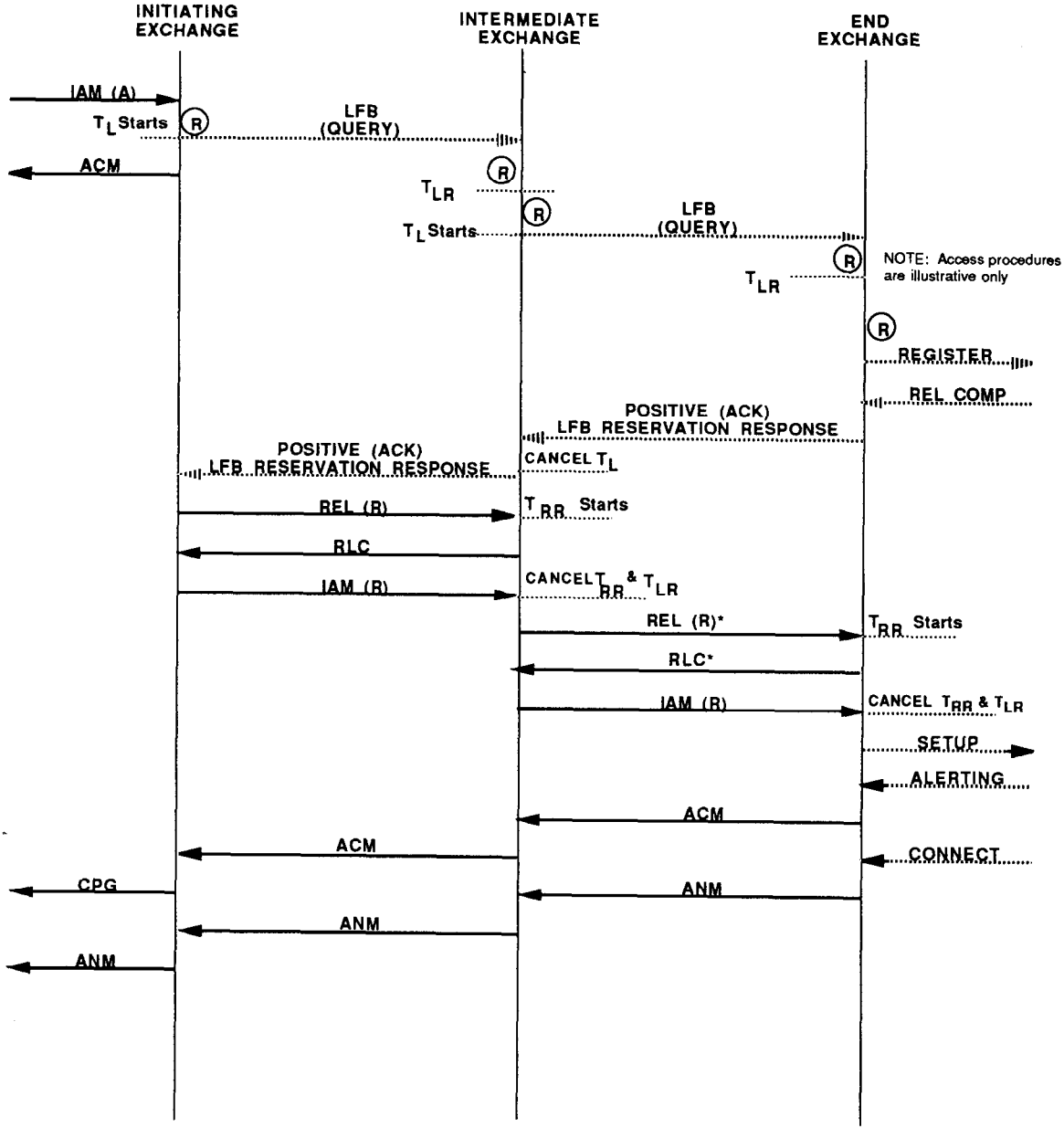


Figure 13 – MLPP successful call setup with LFB option

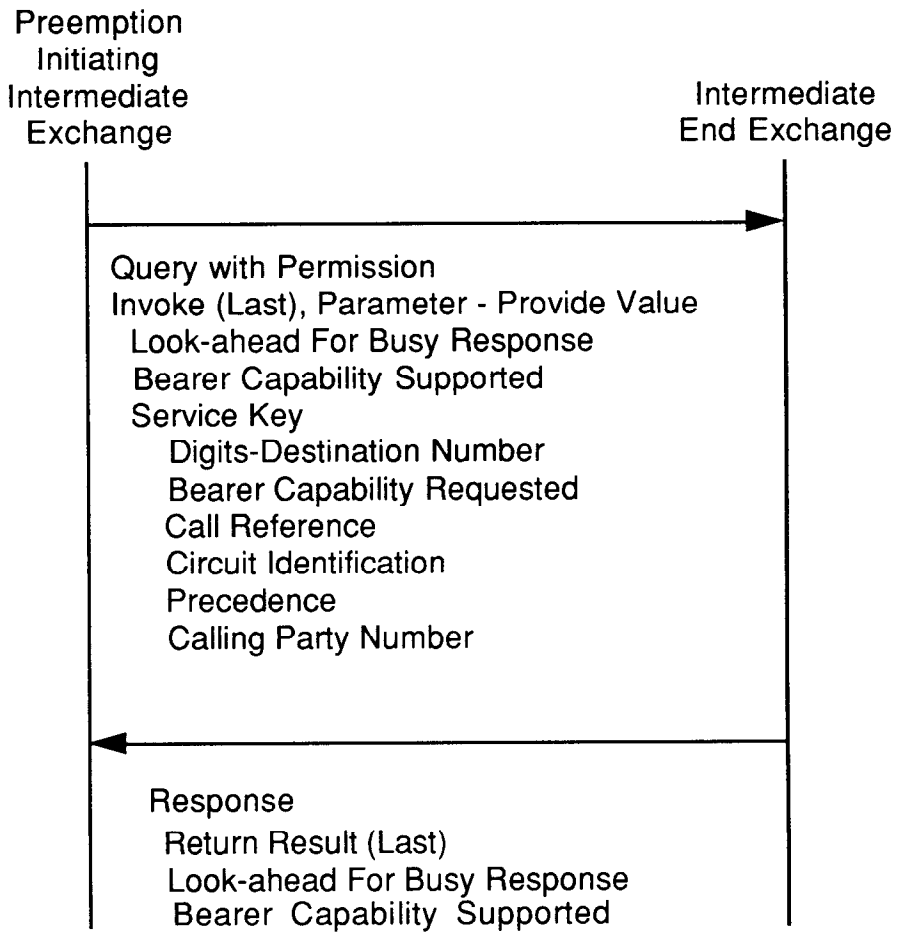


Figure 14 – Parameter – Provide value for LFB query

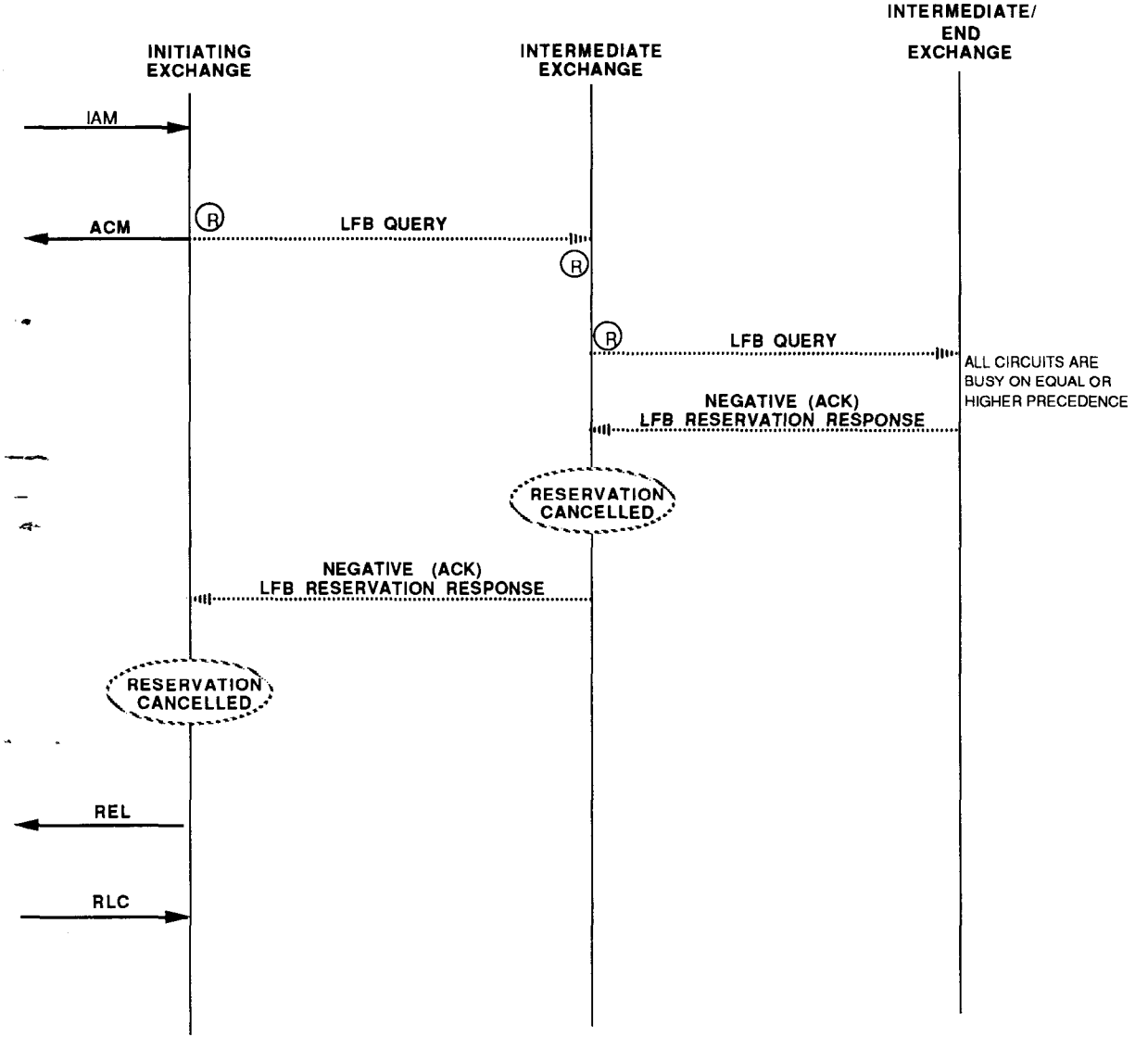


Figure 15 – MLPP unsuccessful call setup with LFB option

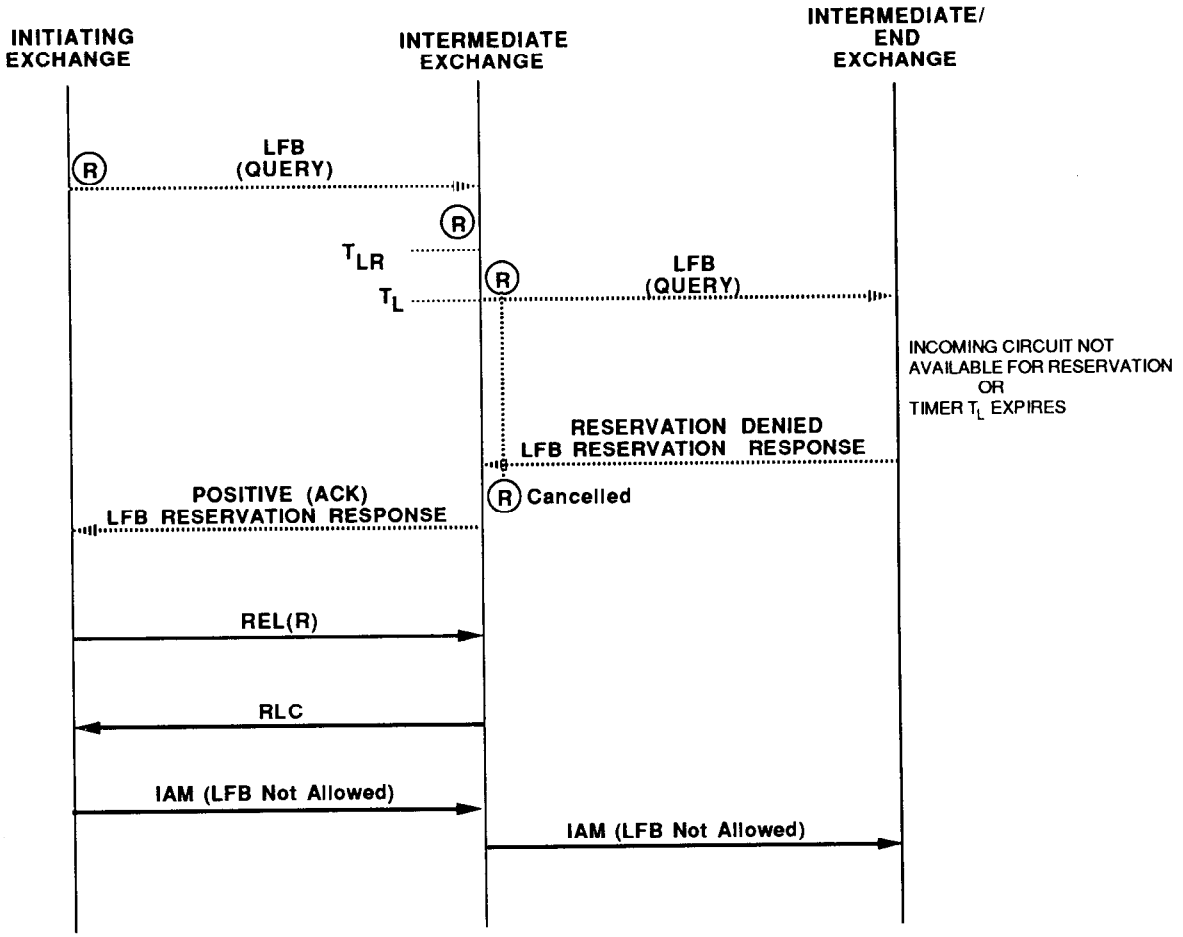


Figure 16 – MLPP resevation response indicates path reservation denied; also sent on expiration of timer T_L

8 Specifications for protocol interworking

This clause specifies the translation of information fields between signaling protocol classes DSS1 and SS7 for MLPP. It also specifies interworking of protocol classes DSS1 and SS7 with other signaling systems and networks.

8.1 Interworking between SS7 and DSS1

The SS7 shall be able to convey cause values 45 and 46, respectively to indicate "preemption" and "precedence call blocked" to the calling, called, or preempted users as appropriate and as described in this standard.

8.1.1 Relevant messages mapping

DSS1	SS7 (ISDN-UP)
SETUP	IAM
DISCONNECT	RELEASE
NOTIFY	ACM

Figure 17 shows the LFB transaction messages for SS7 and DSS1 interworking.

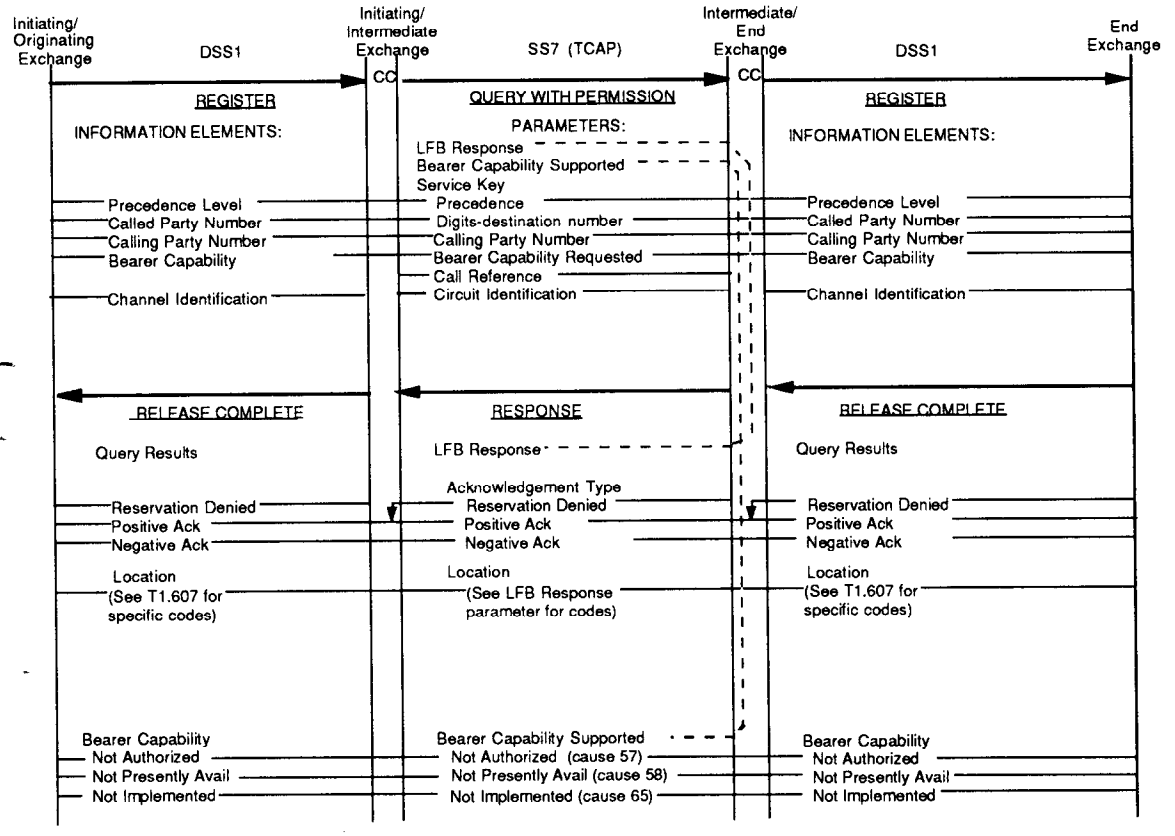
8.1.2 Information elements and parameter mapping

DSS1	SS7
Cause	Cause
Bearer capability	Bearer capability requested
Precedence level	Precedence
Called party number	Digits-destination number
(for search)	
Calling party number	Call reference
Precedence level	Precedence
Channel identification	Circuit identification
(for reservation)	

Figure 17 also shows the information elements and parameters mapping in the LFB transaction messages.

8.2 Interworking between SS7 and MF

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 7.2.3.3.2.3(b)(2) 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.



NOTE – If the LFB query originates in the SS7 network, the negative ack result will be returned to DSS1 in a REL message with appropriate cause code to indicate either the lack of bearer capability (cause 57, 58, or 65) or preemptable resources (standard cause 46), and location code.

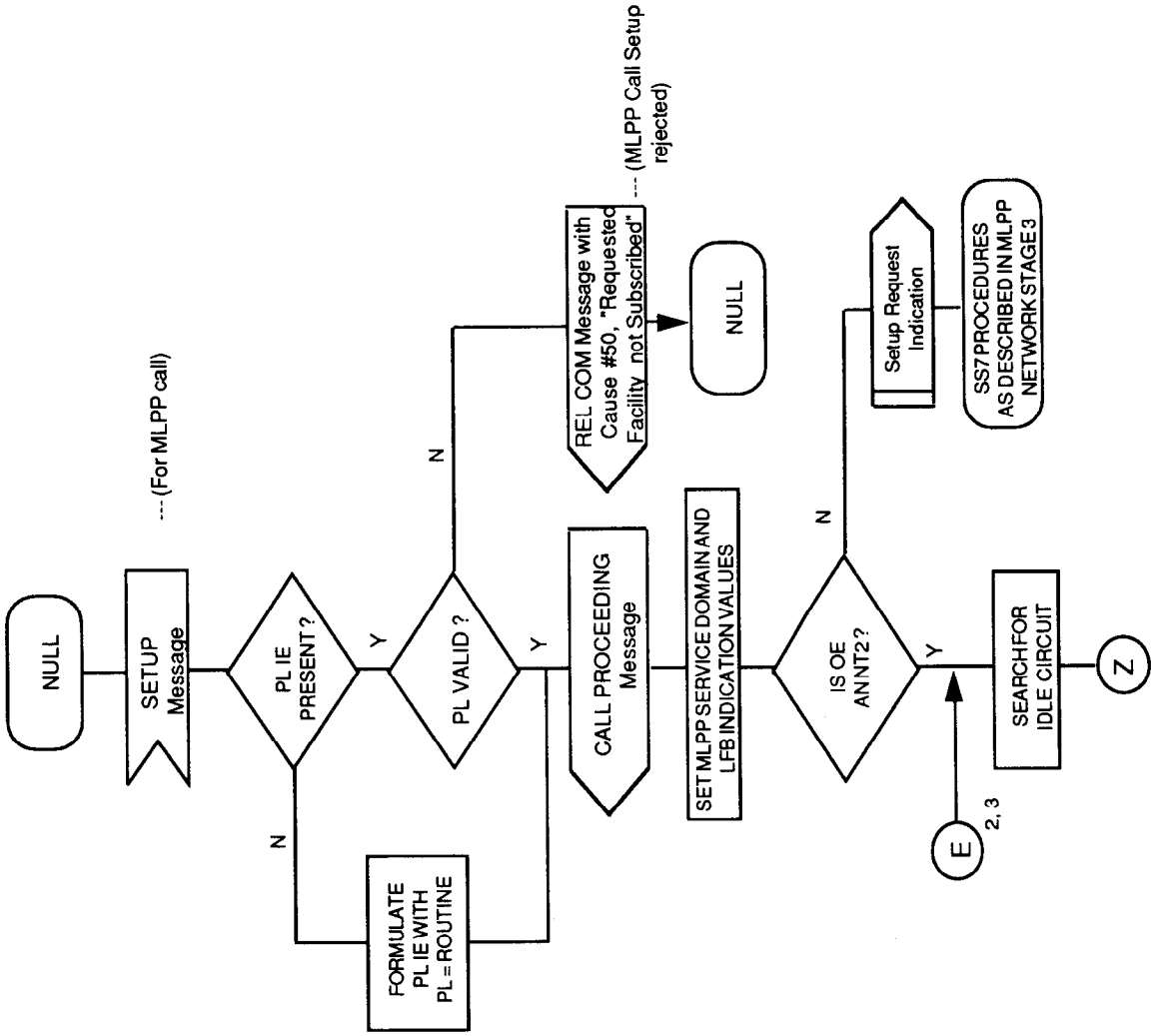
Figure 17 – LFB transaction messages (SS7/DSS1)

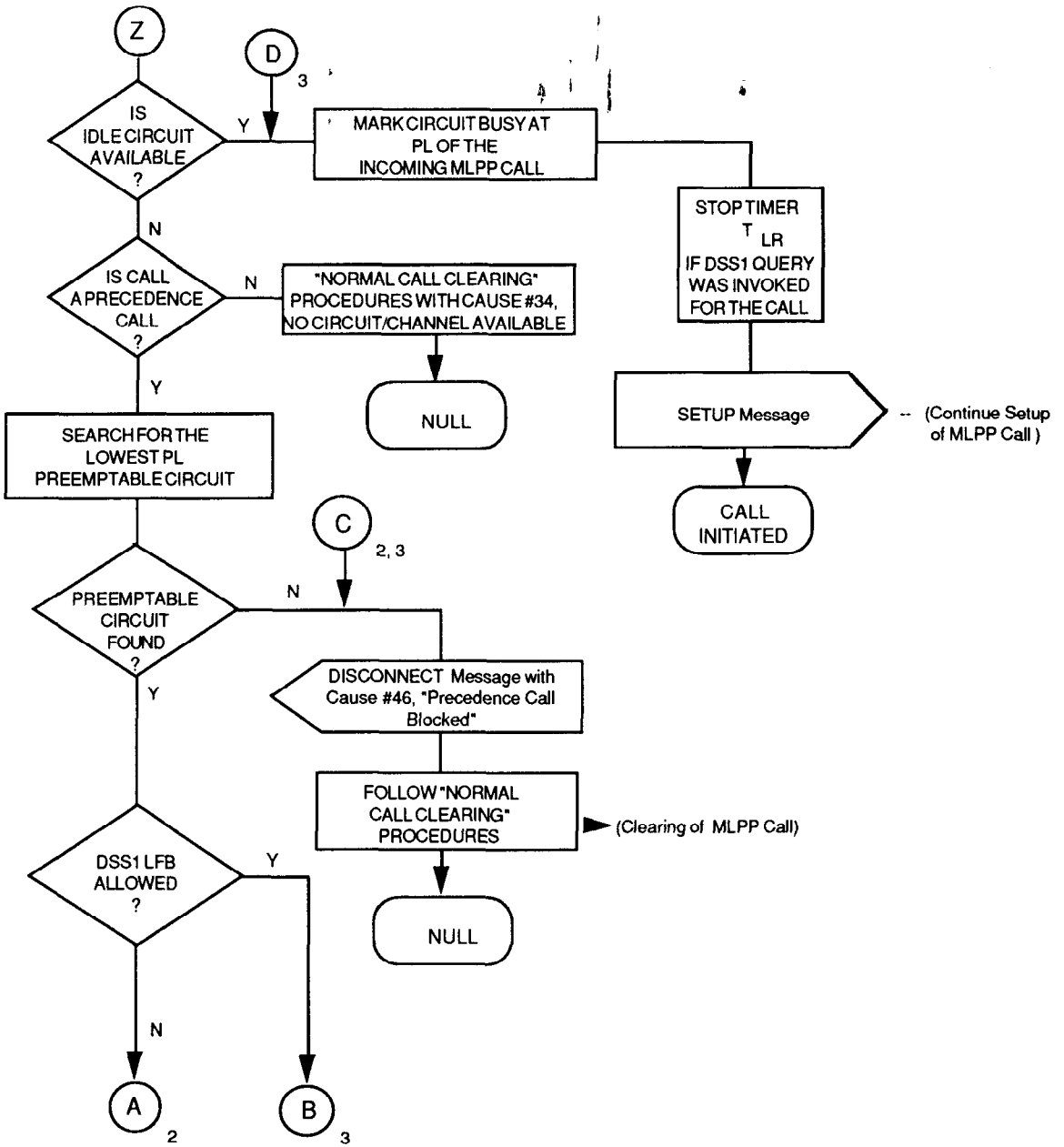
Annex A
(normative)

DSS1 SDL diagrams for MLPP

In the event of conflict between the SDL diagrams in this annex and the text in clause 6, the text shall take precedence.

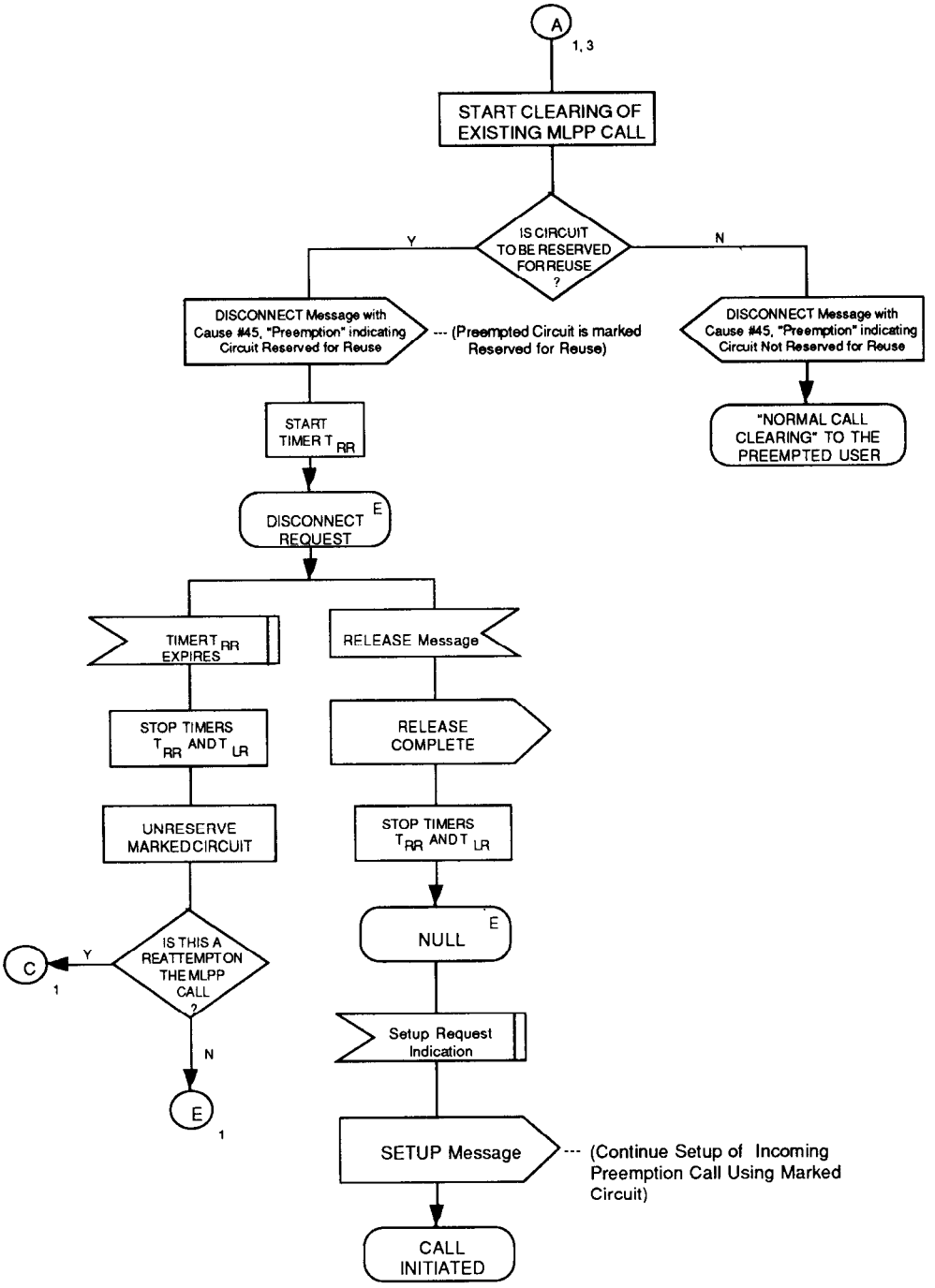
This annex contains the SDL diagrams for the DSS1 processing of MLPP calls. The SDLs are divided into three figures: figure A.1(a), (b), and (c) covers the originating exchange (OE); figure A.2(a), (b), and (c), the local exchange (LE) connected via a DSS1 interface to an NT2 on the called interface; and figure A.3(a), (b), and (c), the destination exchange (DE).


NULL
SETUP Message
---(For MLPP call)
PL IE PRESENT?
Y
N
PL VALID ?
Y
N
REL COM Message with Cause #50, "Requested Facility not Subscribed"
--- (MLPP Call Setup rejected)
NULL
FORMULATE PL IE WITH PL = ROUTINE
CALL PROCEEDING Message
SET MLPP SERVICE DOMAIN AND LFB INDICATION VALUES
IS OE ANNT2?
N
Y
Setup Request Indication
SS7 PROCEDURES AS DESCRIBED IN MLPP NETWORK STAGE3
SEARCH FOR IDLE CIRCUIT
Z
E
2, 3



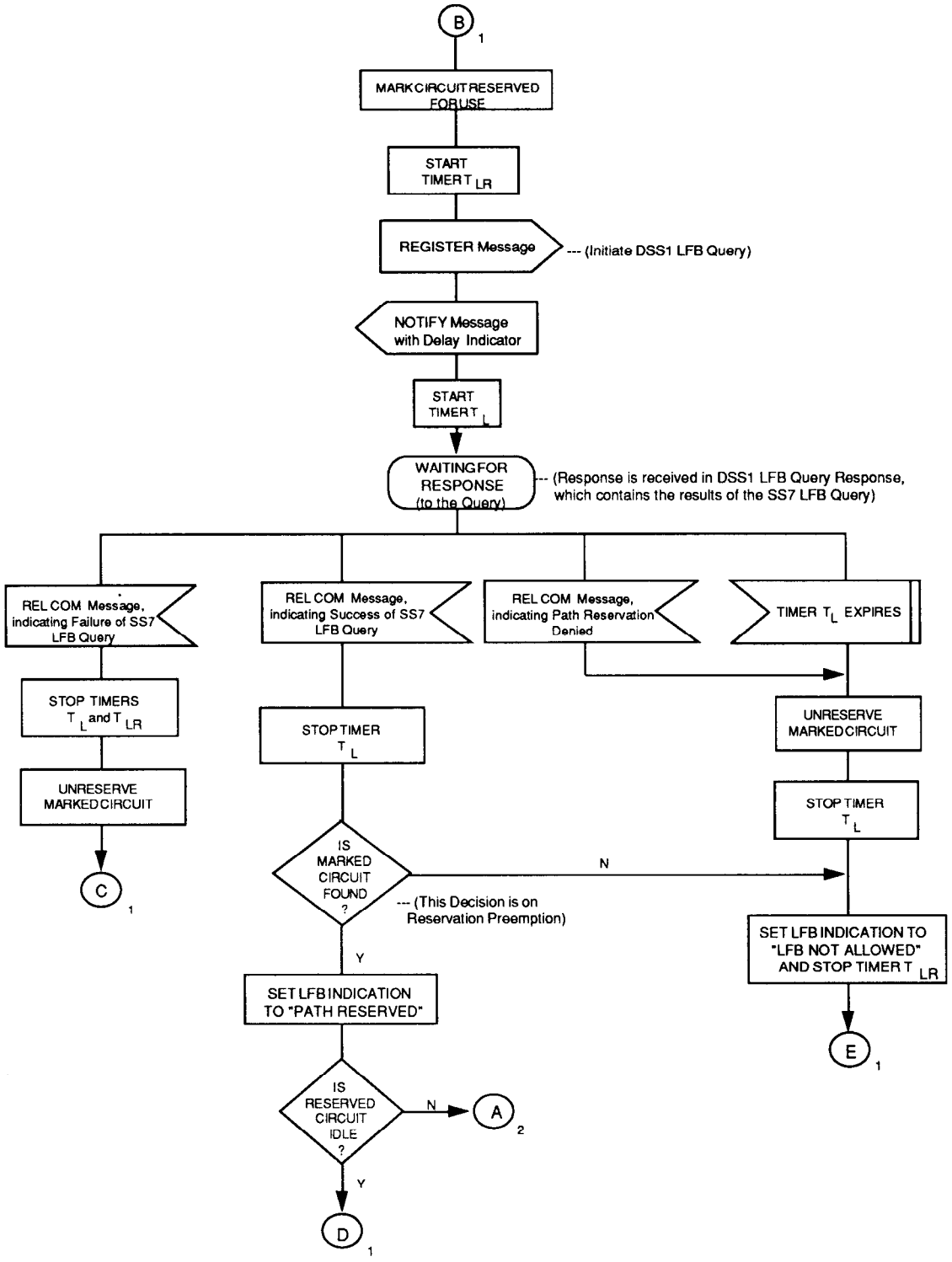
(a) Procedures for MLPP call

Figure A.1 – Originating exchange (OE)



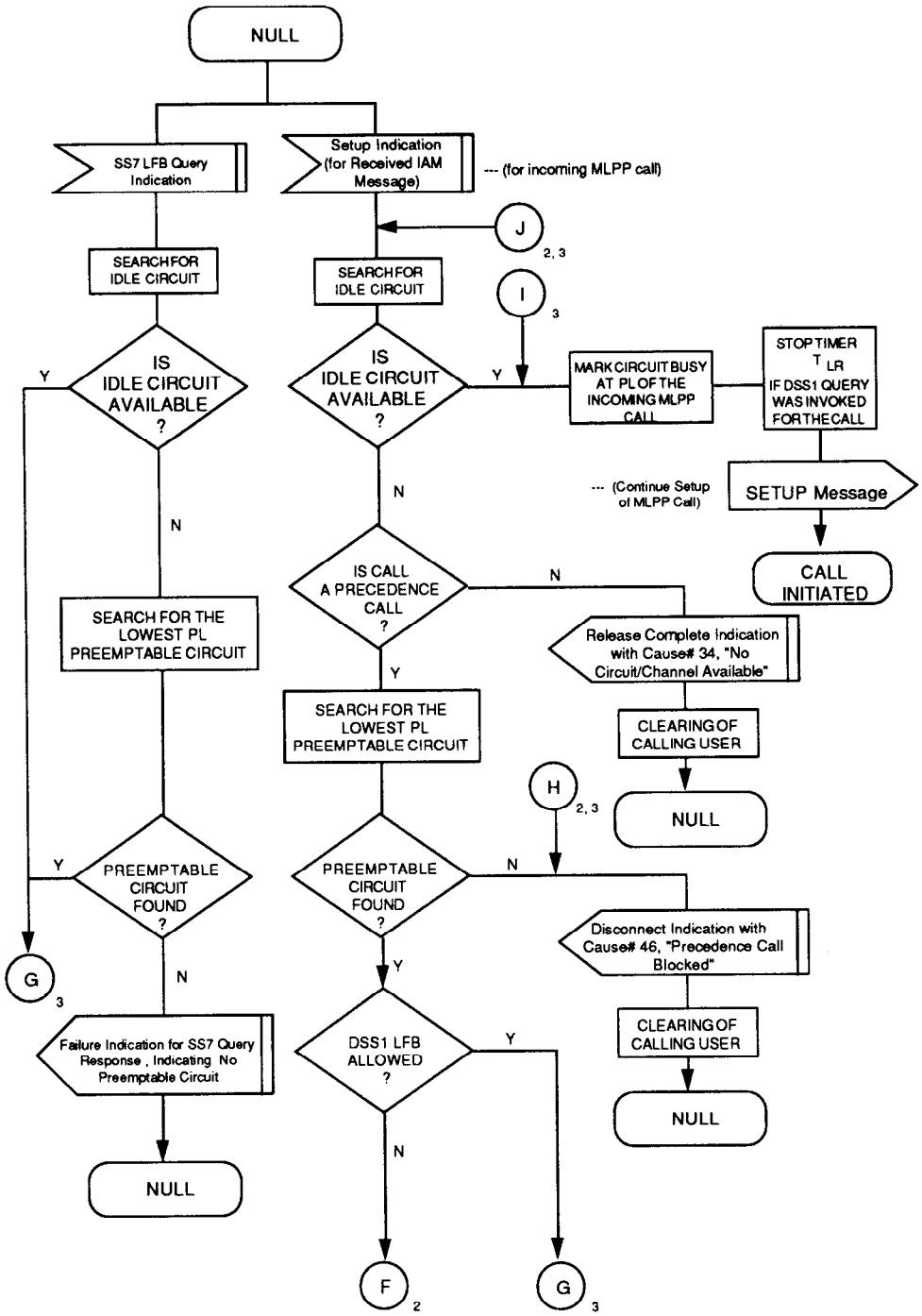
(b) Procedures without DSS1 LFB query

Figure A.1 *(continued)*



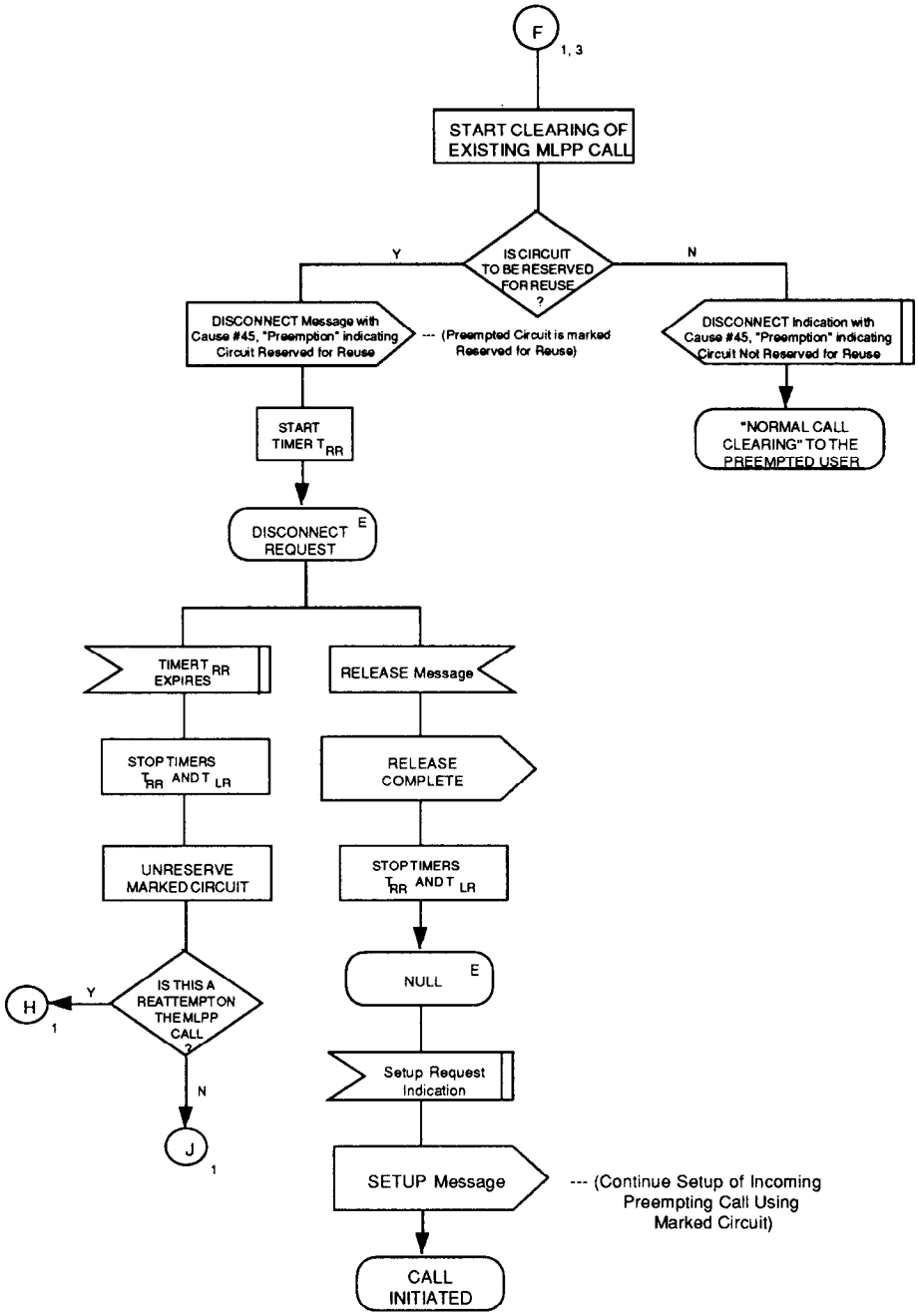
(c) Originating exchange (OE)

Figure A.1 *(concluded)*



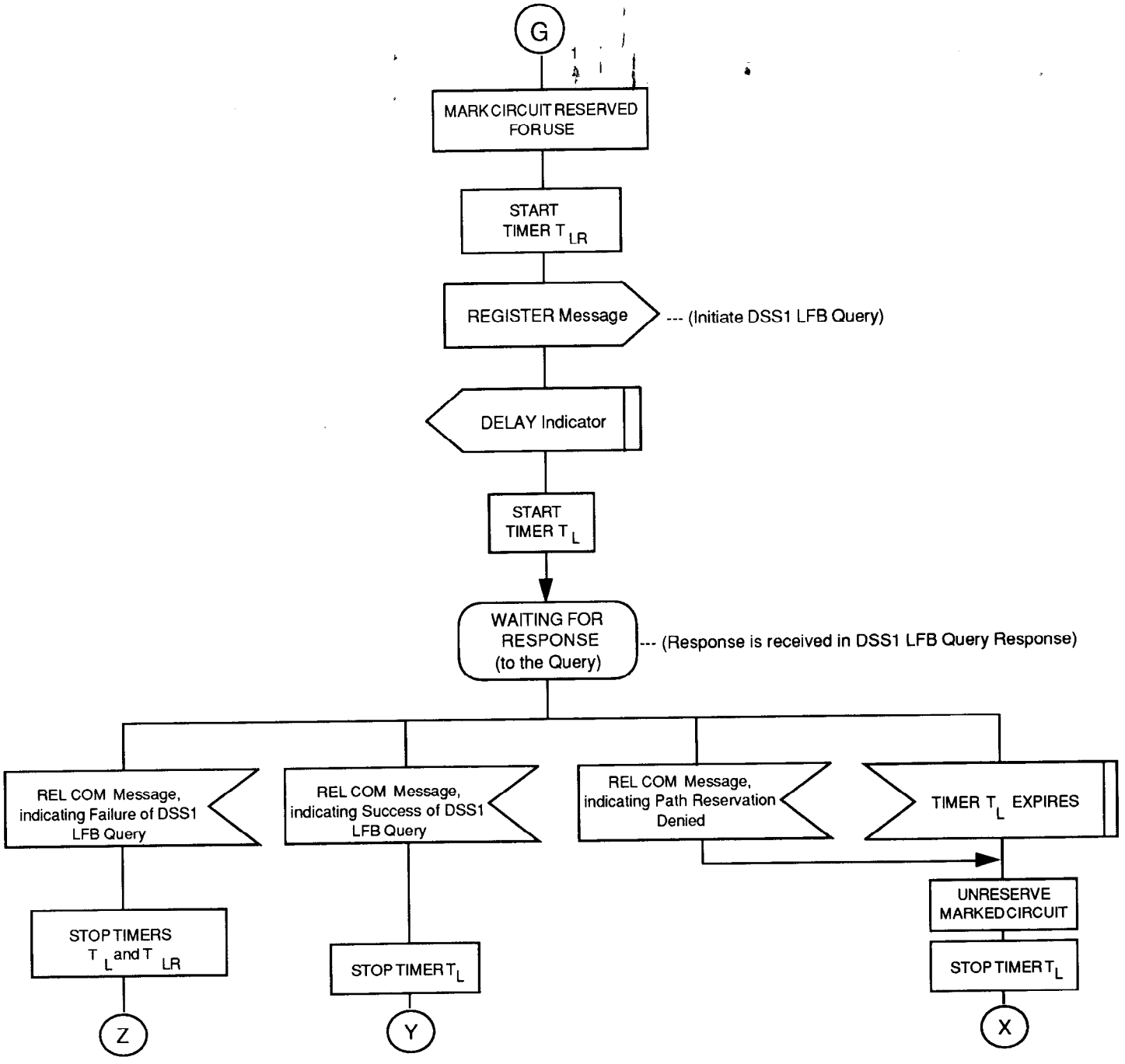
(a) Procedures for incoming MLPP call/SS7 LFB query

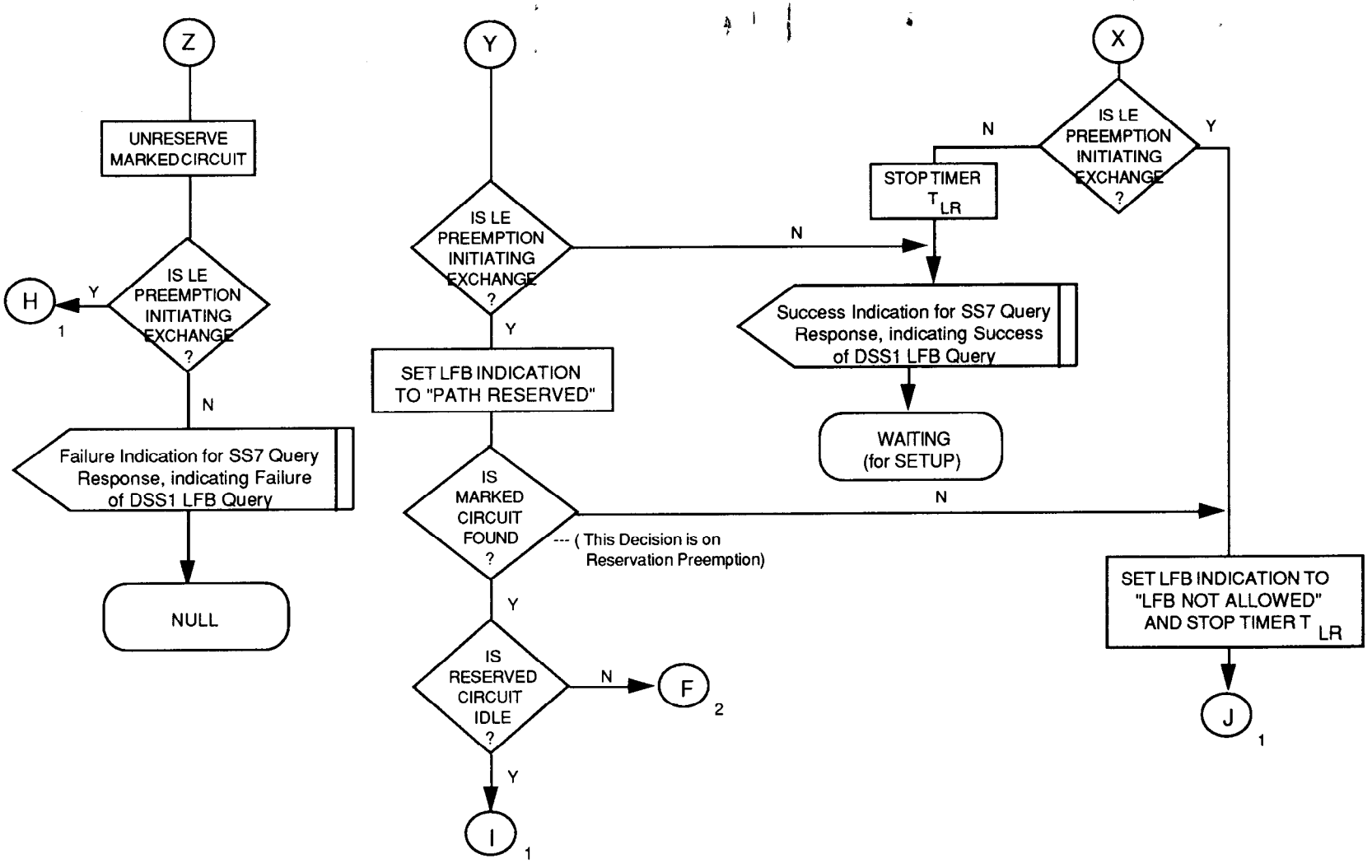
Figure A.2 – Local exchange (LE) connected via a DSS1 interface to a NT2 on the called interface *(continued)*



(b) Procedures without DSS1 LFB query

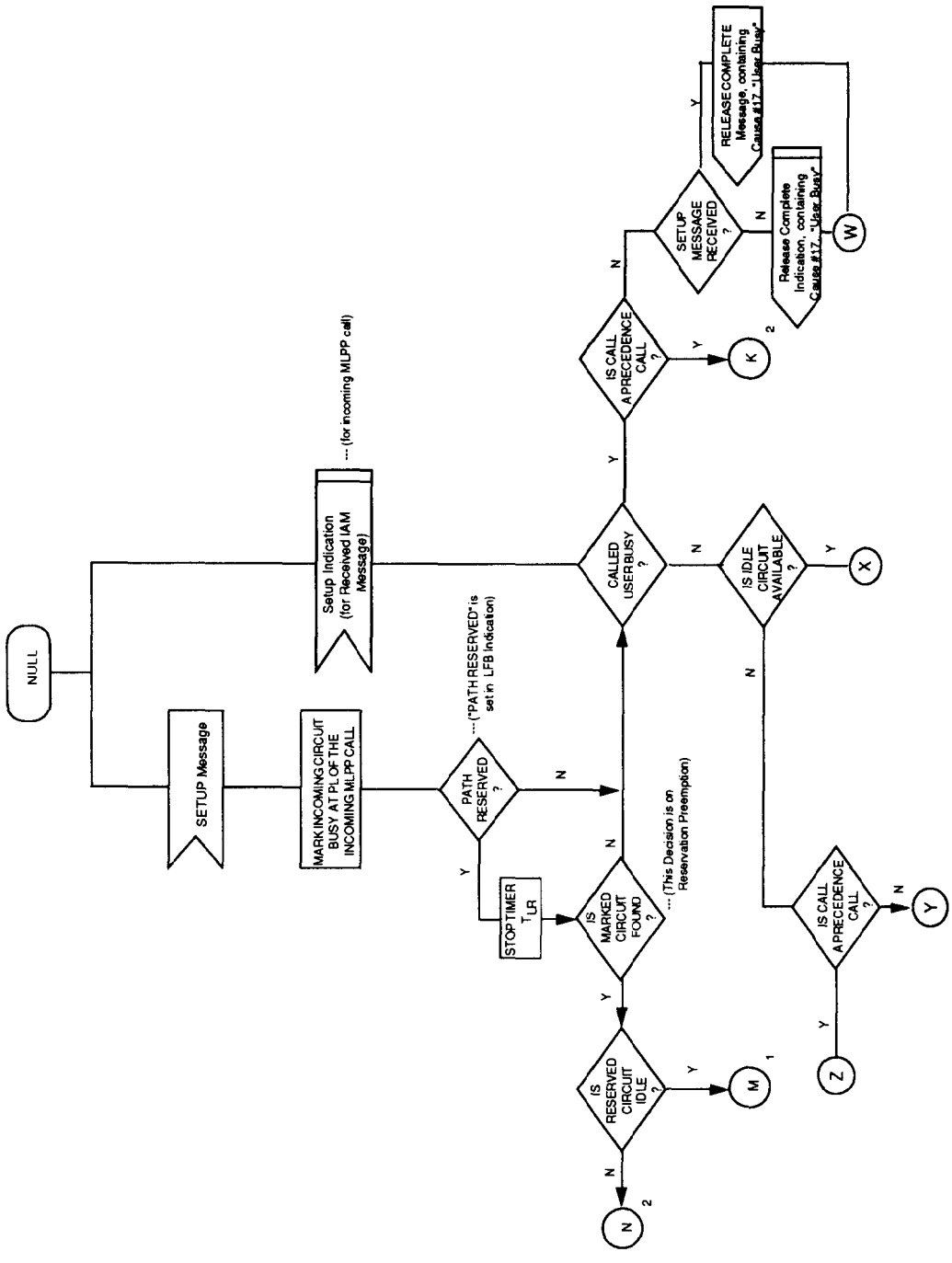
Figure A.2 *(continued)*

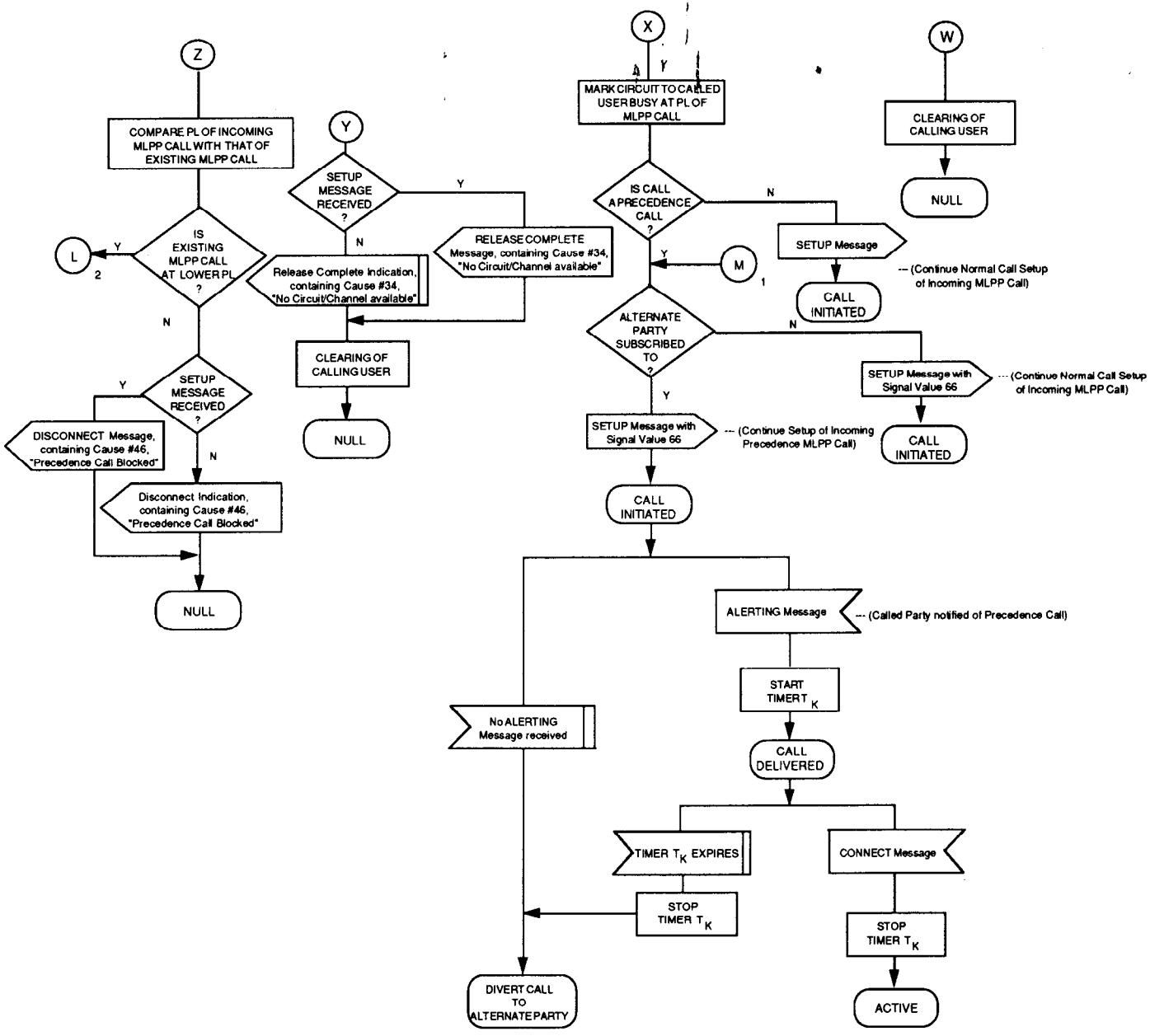

G
1
MARK CIRCUIT RESERVED FOR USE
START TIMER T_{LR}
REGISTER Message
--- (Initiate DSS1 LFB Query)
DELAY Indicator
START TIMER T_L
WAITING FOR RESPONSE (to the Query)
--- (Response is received in DSS1 LFB Query Response)
REL COM Message, indicating Failure of DSS1 LFB Query
REL COM Message, indicating Success of DSS1 LFB Query
REL COM Message, indicating Path Reservation Denied
TIMER T_L EXPIRES
STOP TIMERS T_L and T_{LR}
STOP TIMER T_L
UNRESERVE MARKED CIRCUIT
STOP TIMER T_L
Z
Y
X



(c) DSS1 LFB procedures

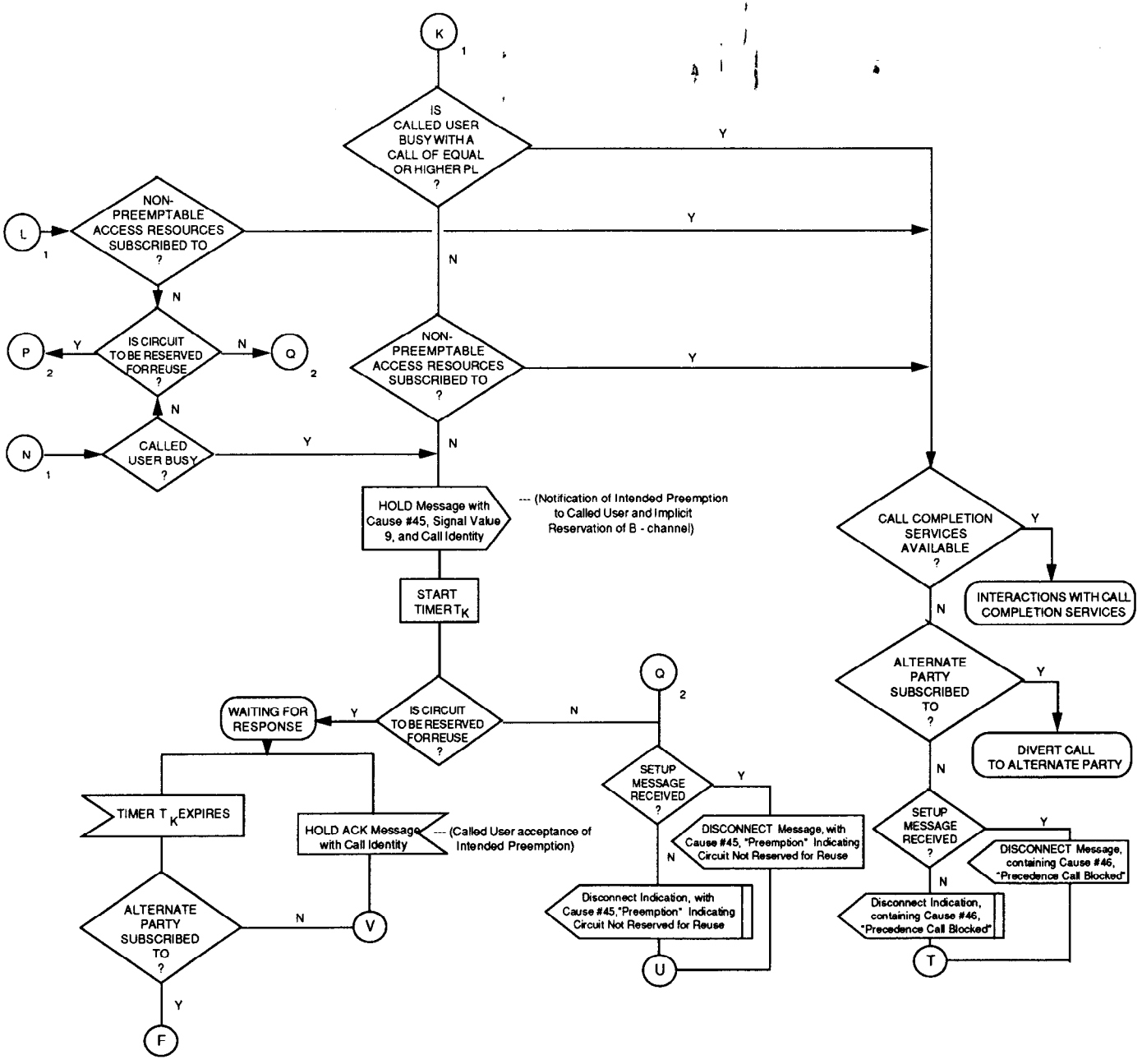
Figure A.2 *(concluded)*

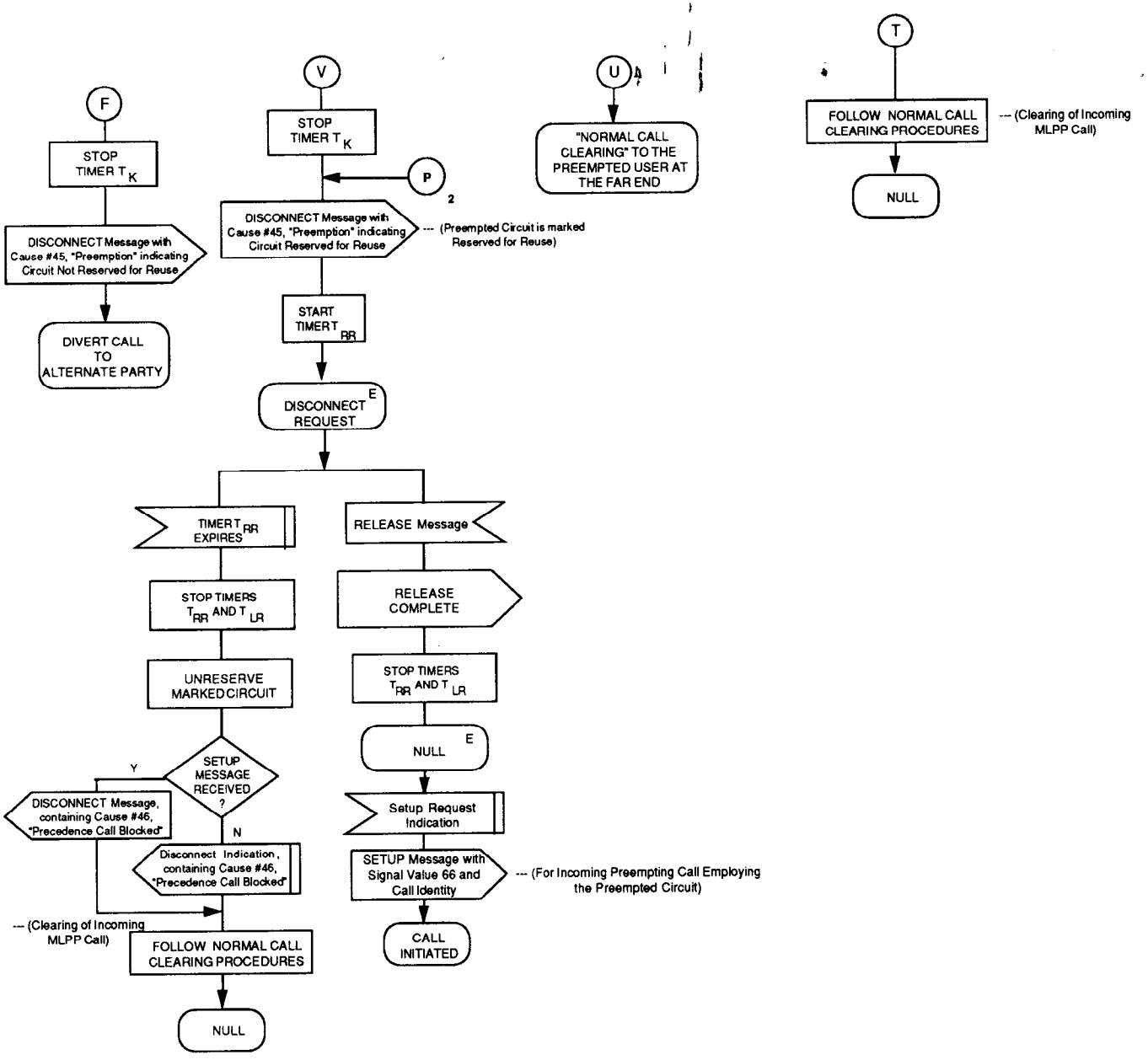

NULL
SETUP Message
Setup Indication (for Received IAM Message)
--- (for incoming MLPP call)
MARK INCOMING CIRCUIT BUSY AT PL OF THE INCOMING MLPP CALL
PATH RESERVED ?
--- ("PATH RESERVED" is set in LFB indication)
STOP TIMER TUR
IS MARKED CIRCUIT FOUND ?
--- (This Decision is on Reservation Preemption)
IS RESERVED CIRCUIT IDLE ?
CALLED USER BUSY ?
IS CALL A PRECEDENCE CALL ?
SETUP MESSAGE RECEIVED ?
RELEASE COMPLETE Message, containing Cause #17 - "User Busy"
Release Complete Indication, containing Cause #17 - "User Busy"
IS IDLE CIRCUIT AVAILABLE ?
IS CALL A PRECEDENCE CALL ?
Y
N
K
M
N
W
X
Z



(a) Procedures for incoming MLPP call

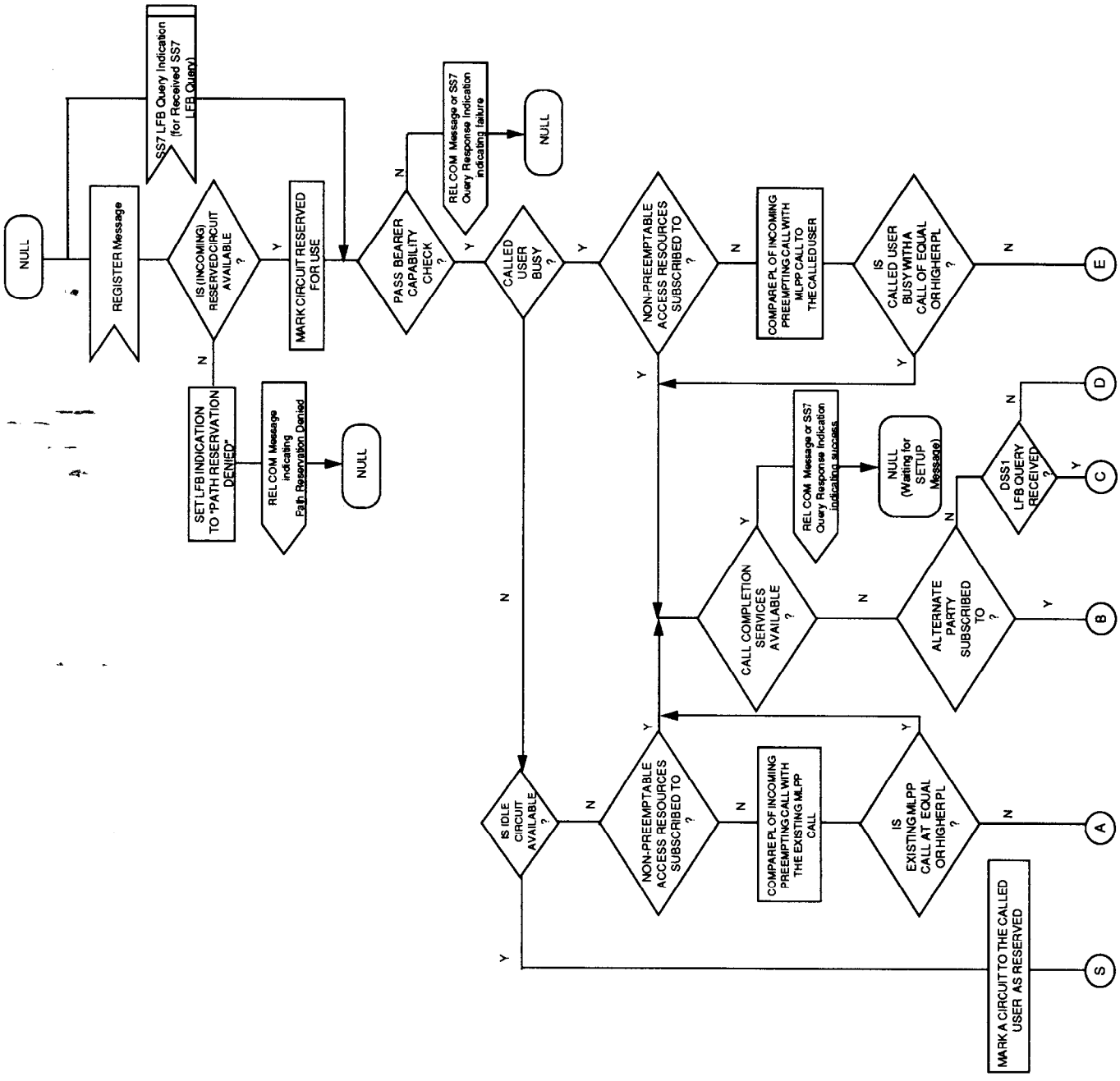
Figure A.3 – Destination exchange (DE)

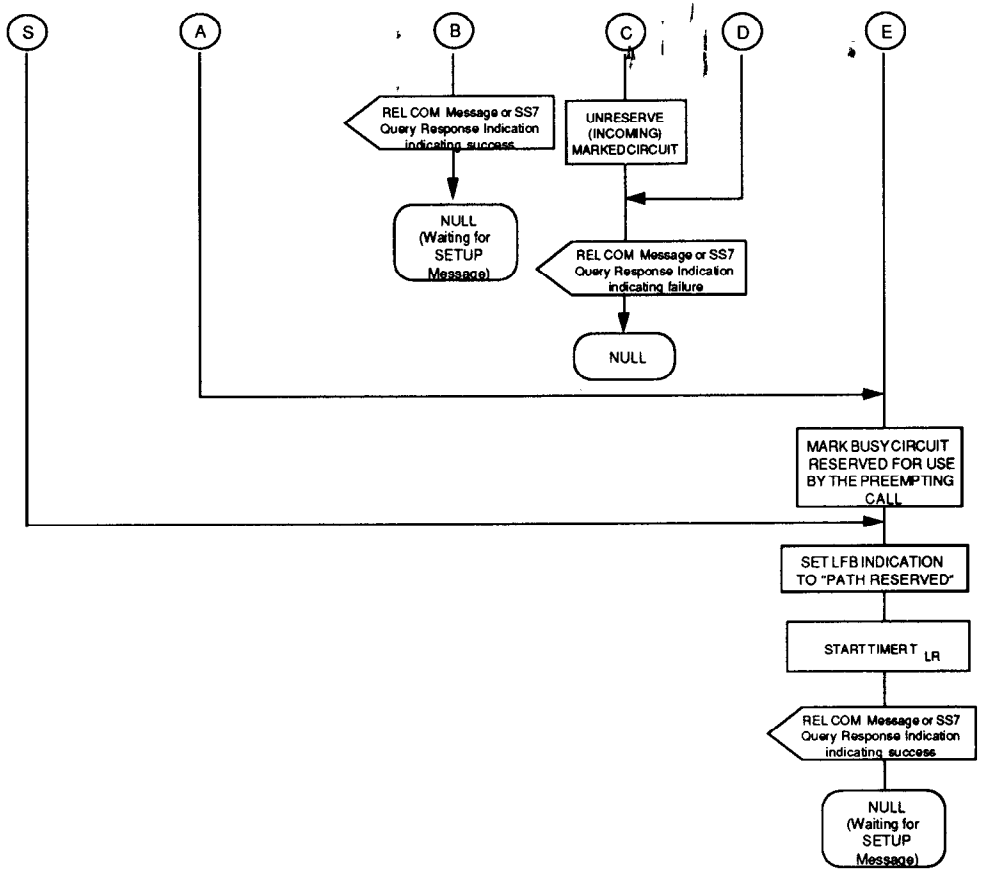

K
1
IS CALLED USER BUSY WITH A CALL OF EQUAL OR HIGHER PL ?
Y
L
1
NON-PREEMPTABLE ACCESS RESOURCES SUBSCRIBED TO ?
Y
N
N
P
2
Y
IS CIRCUIT TO BE RESERVED FOR REUSE ?
N
Q
2
N
N
1
CALLED USER BUSY ?
Y
NON-PREEMPTABLE ACCESS RESOURCES SUBSCRIBED TO ?
Y
N
HOLD Message with Cause #45, Signal Value 9, and Call Identity
--- (Notification of Intended Preemption to Called User and Implicit Reservation of B - channel)
START TIMER T_K
CALL COMPLETION SERVICES AVAILABLE ?
Y
INTERACTIONS WITH CALL COMPLETION SERVICES
N
ALTERNATE PARTY SUBSCRIBED TO ?
Y
DIVERT CALL TO ALTERNATE PARTY
N
Q
2
WAITING FOR RESPONSE
Y
IS CIRCUIT TO BE RESERVED FOR REUSE ?
N
SETUP MESSAGE RECEIVED ?
Y
DISCONNECT Message, with Cause #45, "Preemption" Indicating Circuit Not Reserved for Reuse
N
SETUP MESSAGE RECEIVED ?
Y
DISCONNECT Message, containing Cause #46, "Precedence Call Blocked"
N
TIMER T_K EXPIRES
HOLD ACK Message with Call Identity
--- (Called User acceptance of Intended Preemption)
Disconnect Indication, with Cause #45, "Preemption" Indicating Circuit Not Reserved for Reuse
Disconnect Indication, containing Cause #46, "Precedence Call Blocked"
ALTERNATE PARTY SUBSCRIBED TO ?
N
V
Y
F
U
T



(b) Procedures without DSS1 LFB query

Figure A.3 *(continued)*


NULL
REGISTER Message
SS7 LFB Query Indication (for Received SS7 LFB Query)
IS (INCOMING) RESERVED/CIRCUIT AVAILABLE ?
N
Y
SET LFB INDICATION TO "PATH RESERVATION DENIED"
REL COM Message indicating Path Reservation Denied
NULL
MARK CIRCUIT RESERVED FOR USE
PASS BEARER CAPABILITY CHECK ?
N
REL COM Message or SS7 Query Response Indication indicating failure
NULL
Y
CALLED USER BUSY ?
Y
NON-PREEMPTABLE ACCESS RESOURCES SUBSCRIBED TO ?
N
COMPARE PL OF INCOMING PREEMPTING CALL WITH MLPP CALL TO THE CALLED USER
IS CALLED USER BUSY WITH A CALL OF EQUAL OR HIGHER PL ?
N
E
Y
N
IS IDLE CIRCUIT AVAILABLE ?
N
Y
NON-PREEMPTABLE ACCESS RESOURCES SUBSCRIBED TO ?
N
COMPARE PL OF INCOMING PREEMPTING CALL WITH THE EXISTING MLPP CALL
IS EXISTING MLPP CALL AT EQUAL OR HIGHER PL ?
N
A
Y
Y
MARK A CIRCUIT TO THE CALLED USER AS RESERVED
S
CALL COMPLETION SERVICES AVAILABLE ?
Y
N
REL COM Message or SS7 Query Response Indication indicating success
NULL (Waiting for SETUP Message)
ALTERNATE PARTY SUBSCRIBED TO ?
N
Y
B
DSS1 LFB QUERY RECEIVED ?
N
D
Y
C



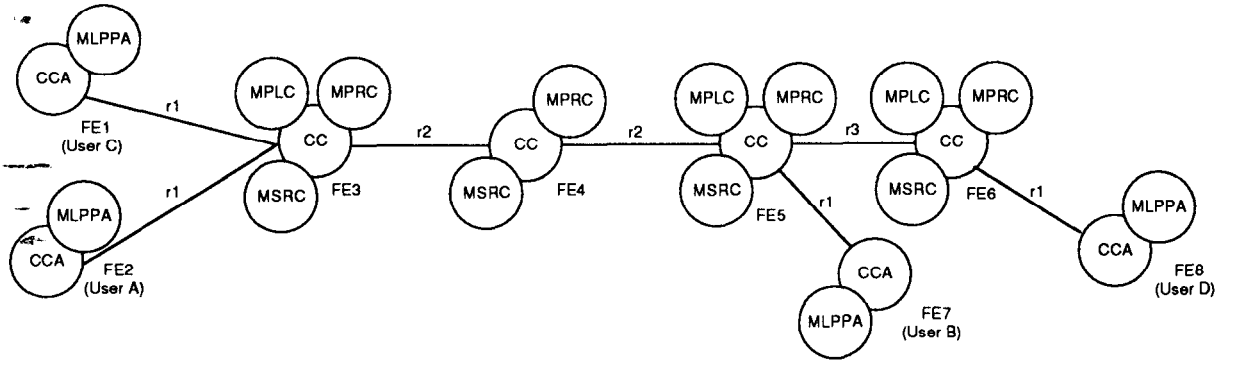
(c) DSS1 LFB procedures

Figure A.3 *(concluded)*

Annex B
(informative)

Breakdown of functional models for the MLPP service with and without the LFB option

This annex depicts the breakdown of functional entities with and without the LFB function, respectively, in figures B.1 and B.2.



KEY

CC – Call control

CCA – Call control agent

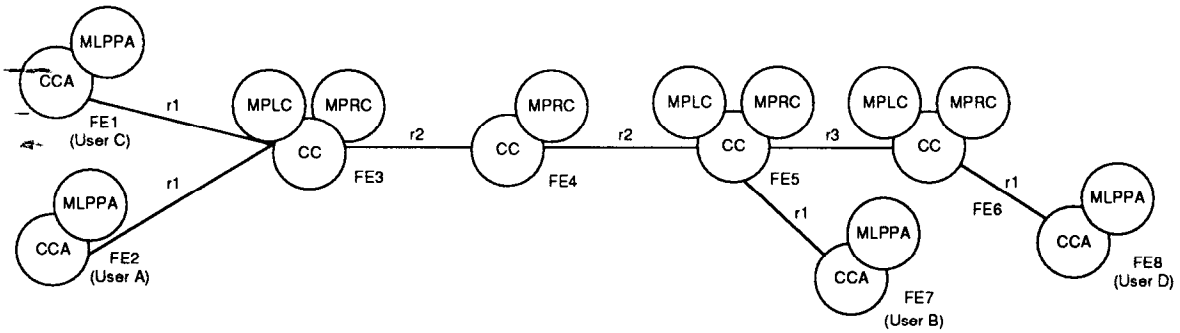
MPLC – MLPP service precedence level control

MSRC – MLPP service search and reservation control

MPRC – MLPP service preemption control

MLPPA – MLPP agent

Figure B.1 – Breakdown of functional model for the MLPP service with the LFB option



KEY

CC – Call control

CCA – Call control agent

MPLC – MLPP service precedence level control

MPRC – MLPP service preemption control

MLPPA – MLPP agent

Figure B.2 – Breakdown of functional model for the MLPP service without the LFB option

Annex C
(informative)

Invoke and return result components within the facility information element of DSS1 for MLPP

This annex depicts the invoke and return result components within the Facility IE, respectively, in figures C.1 and C.2.

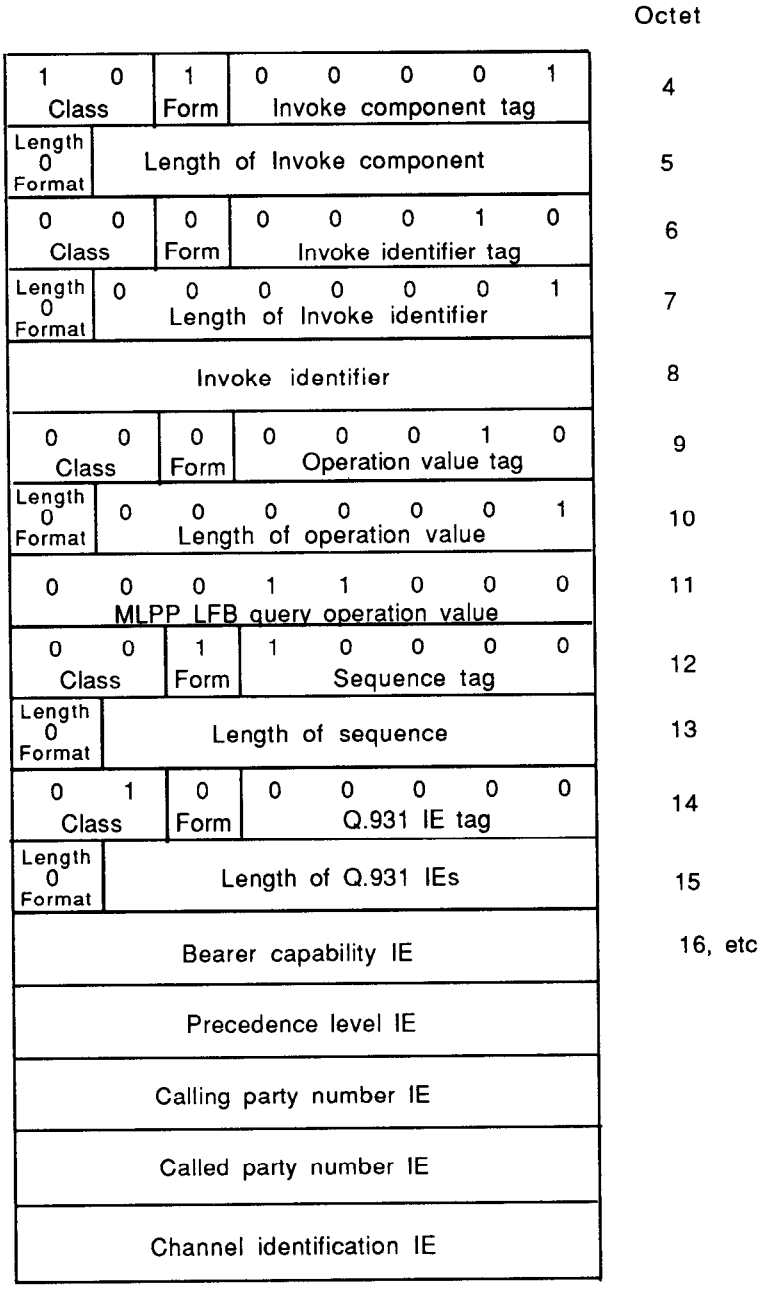


Figure C.1 – Invoke component of the Facility IE for the MLPP DSS1 LFB query

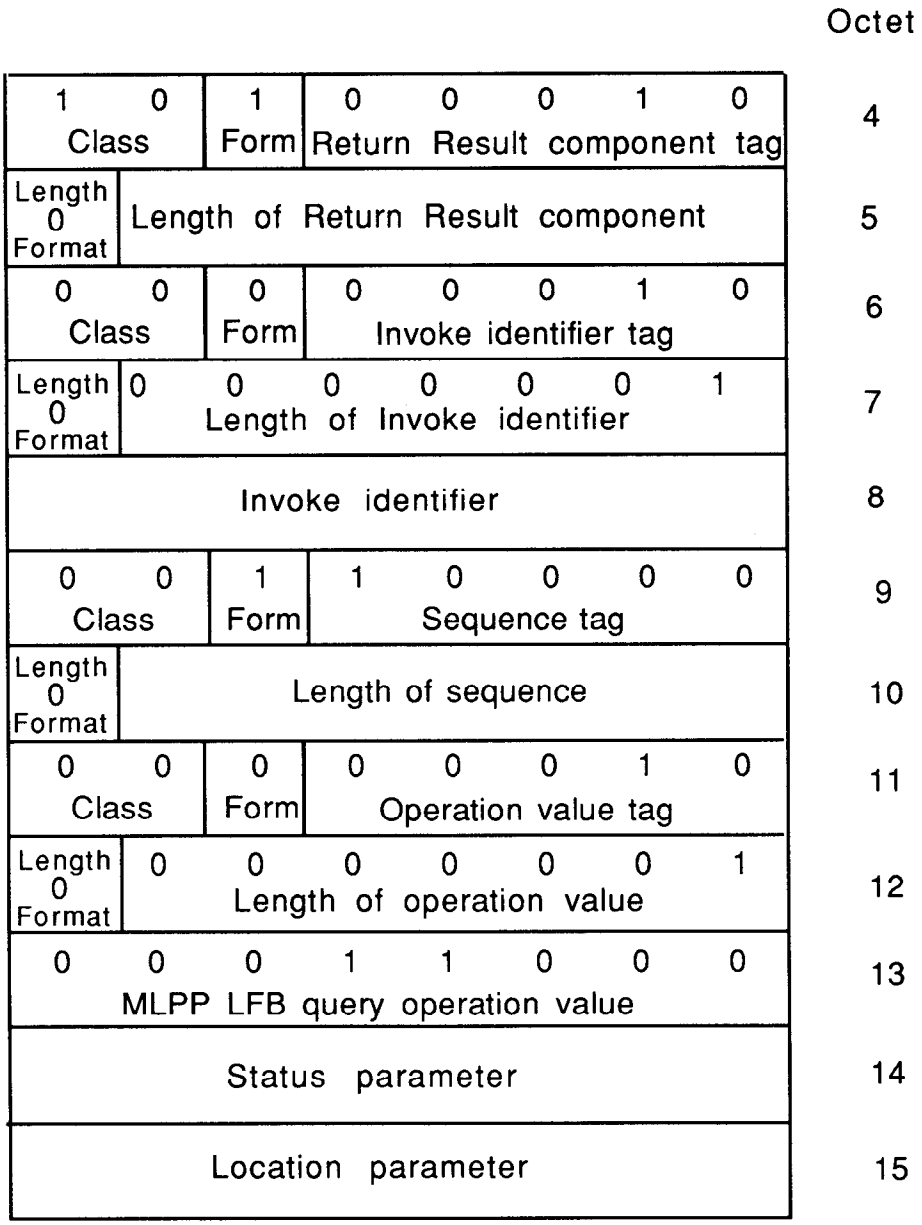


Figure C.2 – Return result component of the Facility IE for the MLPP DSS1 LFB query

Annex D
(informative)

Application of the signal information element to tones and alerting patterns for MLPP service

This annex is intended to assist users of this standard in the application of signal information element to the provision of call progress tones and alerting ("ringing") cadences. It maps the codepoints in this standard to existing practices in the North American telephone network (see table D.1).

Table D.1 – Tones and alerting cadences

Single value	Explanation	North American practice
9	Preemption tone on	Precise tone is a continuous 440 Hz tone added to a 620 Hz tone
–	Precedence call alerting ringback tone on	Ringback tone (audible ringing tone) is a 440 Hz tone added to a 480 Hz tone repeated in a 1.64 s on, 0.36 s off pattern
66	Alerting on – pattern 2 (Special/priority alerting)	Precedence call alerting 1.64 s on, 0.36 s off

NOTE – No signal value is assigned to "precedence call alerting ringback tone on" since the tone is always applied by the destination exchange. This ringback tone is as indicated in the table.

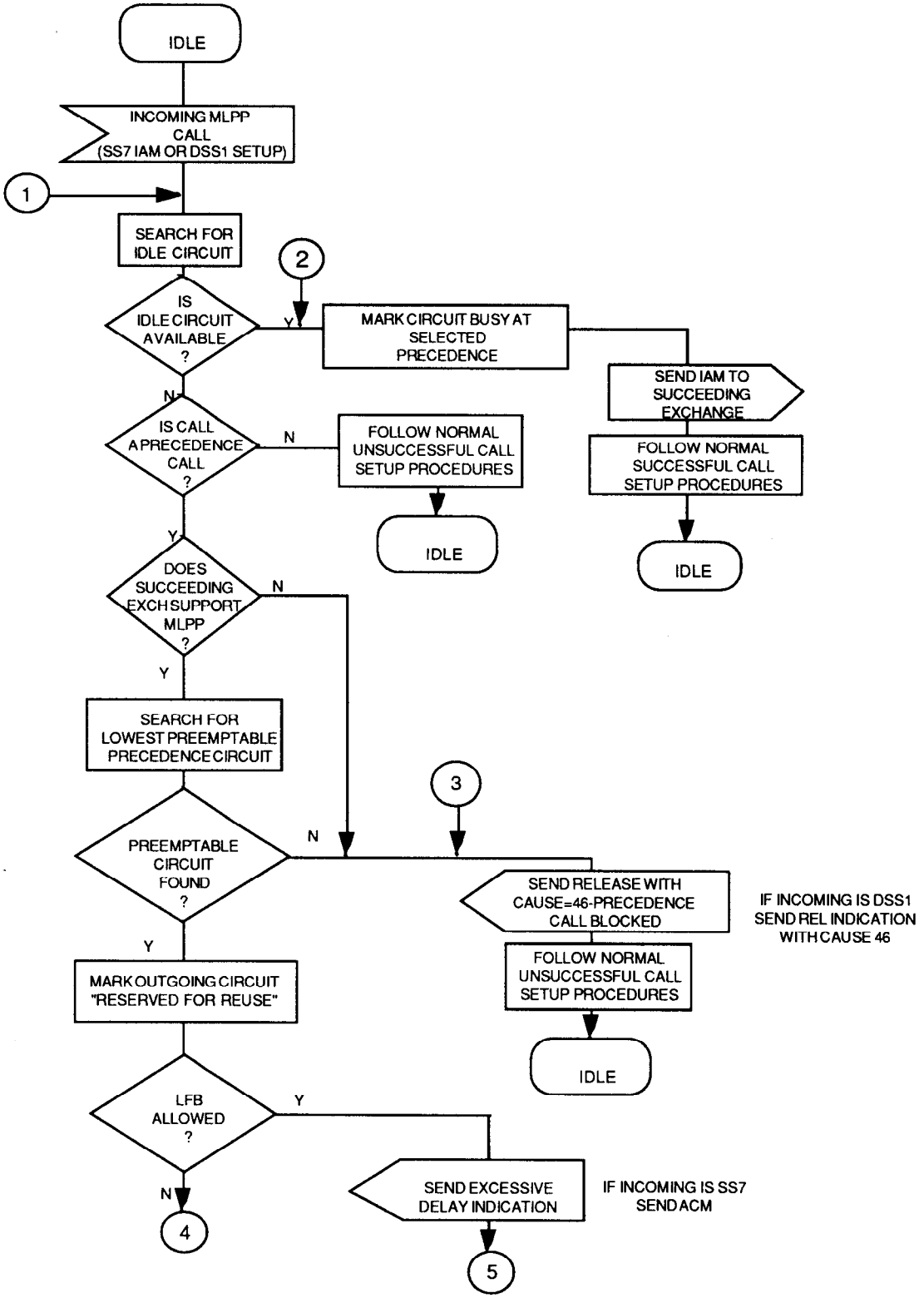
Annex E
(informative)

SS7 SDL diagrams for MLPP

In the event of conflict between the SDL diagrams in this annex and the text in clause 7, the text shall take precedence.

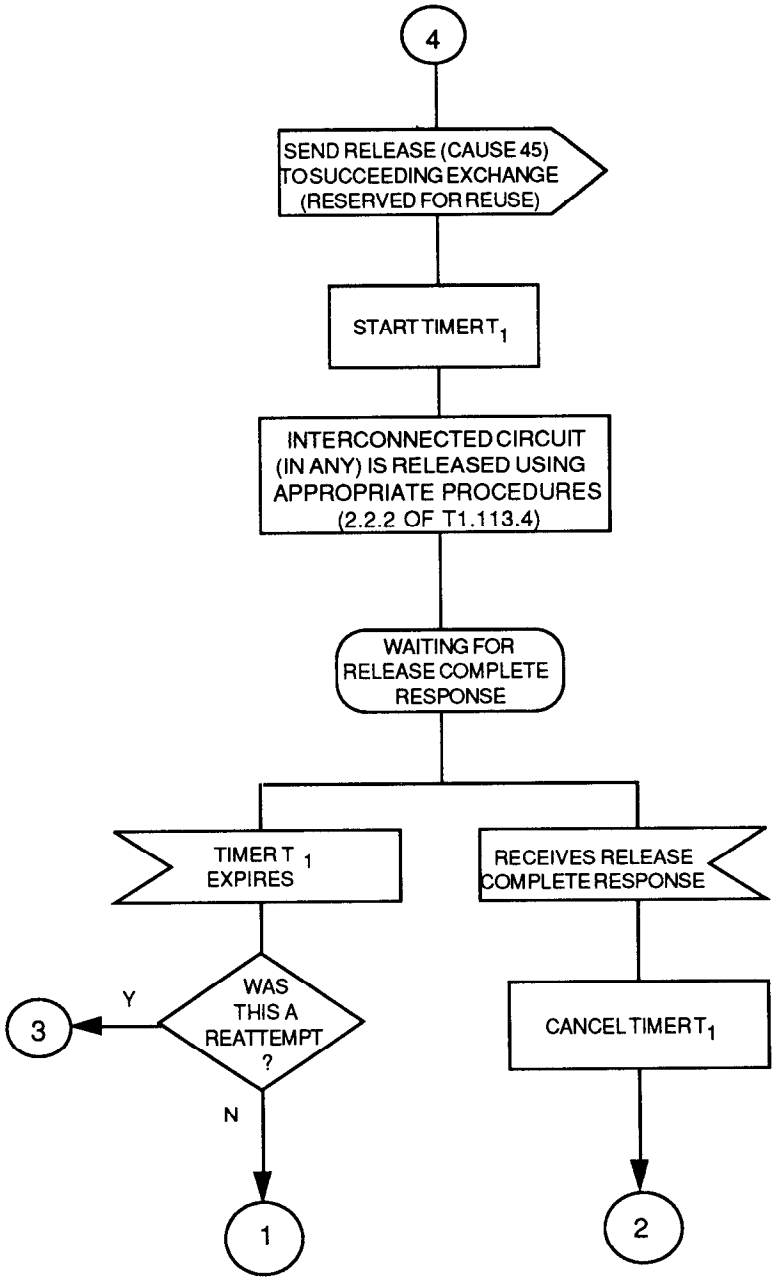
This annex contains the SDL diagrams for both ISDN-UP and TCAP (LFB) processing of MLPP calls. The SDLs are divided into three figures: figure E.1(a), (b), and (c) covers the preemption initiating exchange; figure E.2(a), (b), and (c) the intermediate exchange; and figure E.3(a), (b), and (c) the end exchange.

The SDLs show only the exchanges and messages involved in the setup 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 DSS1 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.



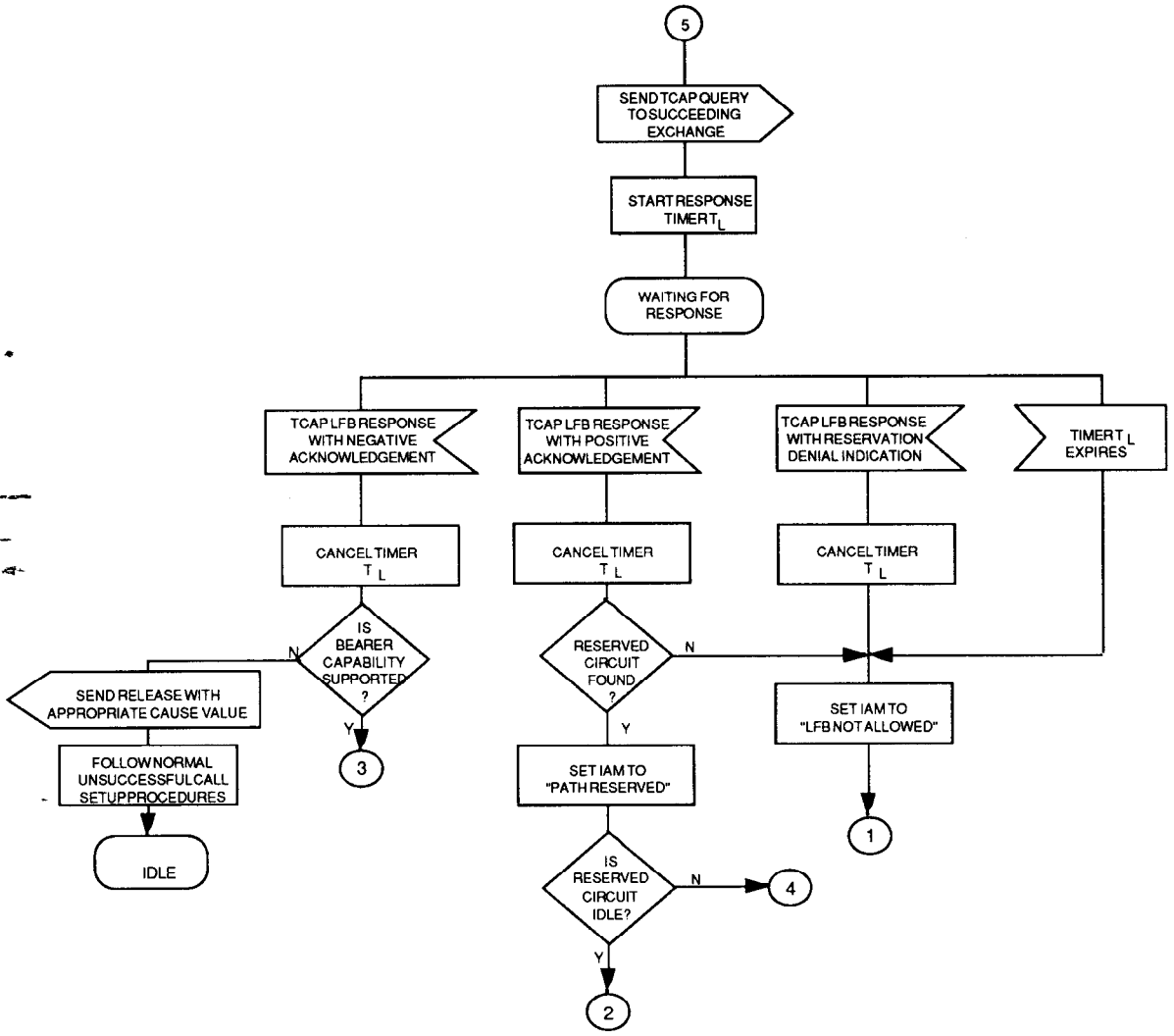
(a) Procedures for incoming MLPP call

Figure E.1 – Preemption initiating exchange



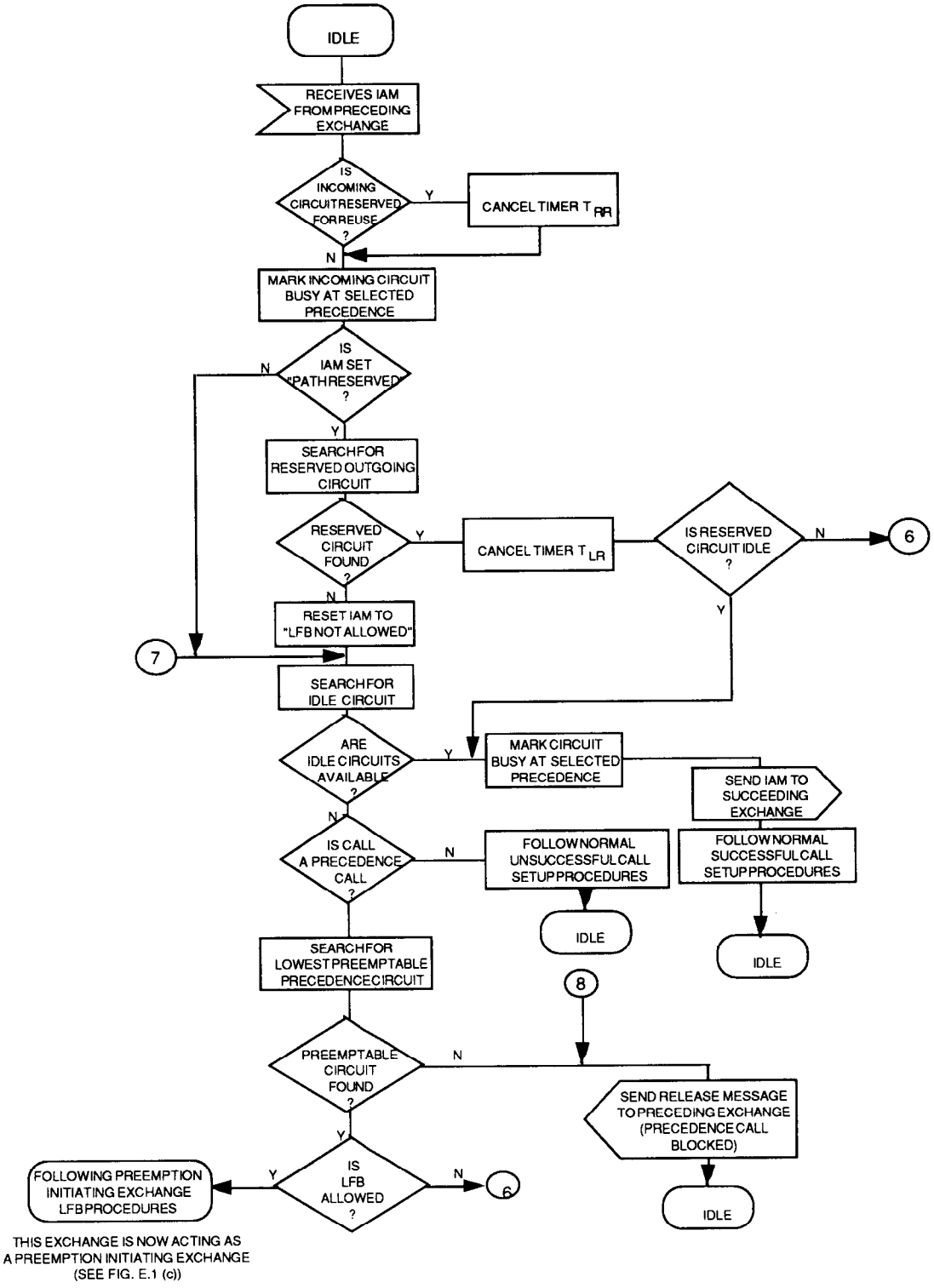
(b) Release of resources

Figure E.1 *(continued)*



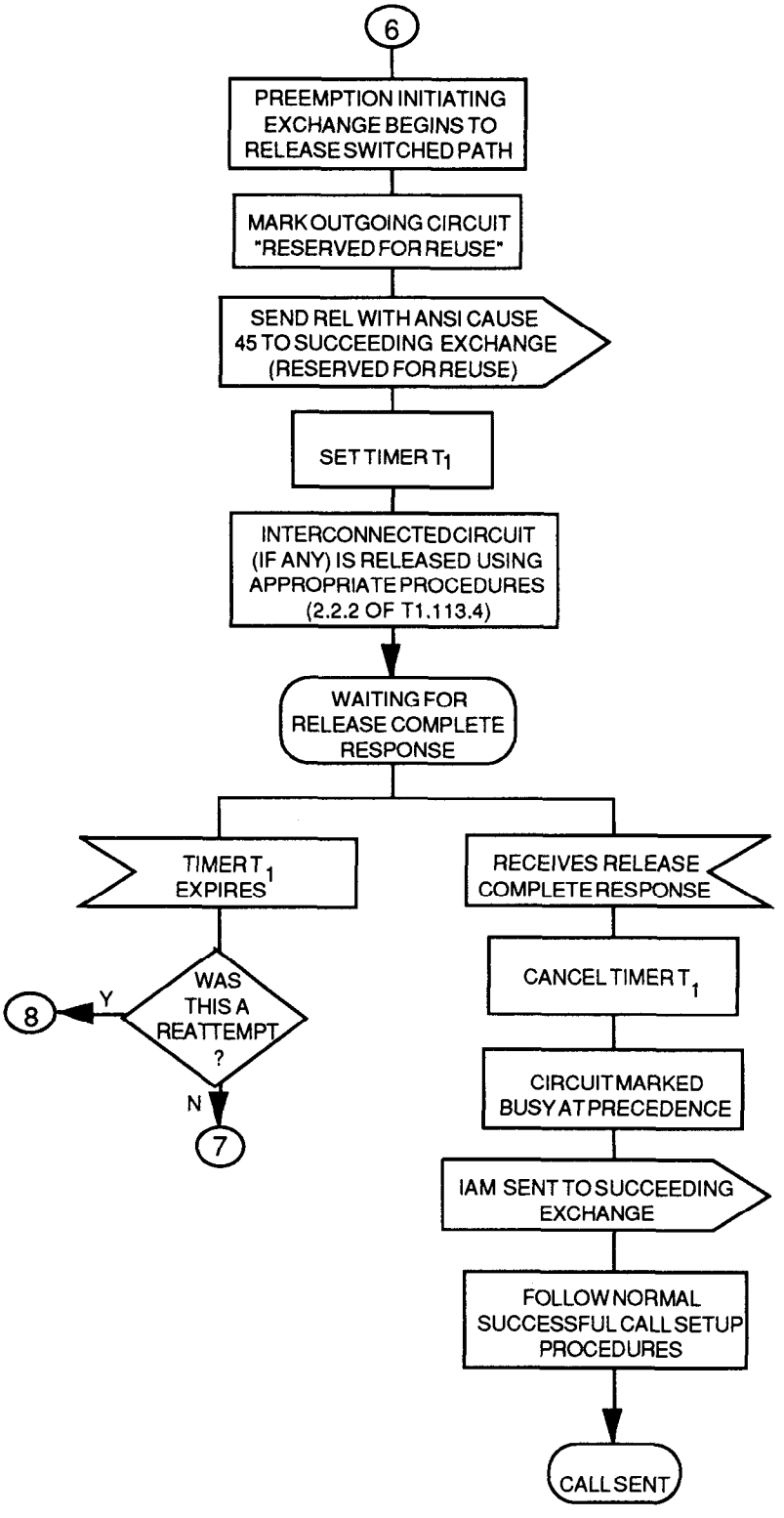
(c) LFB procedures

Figure E.1 *(concluded)*



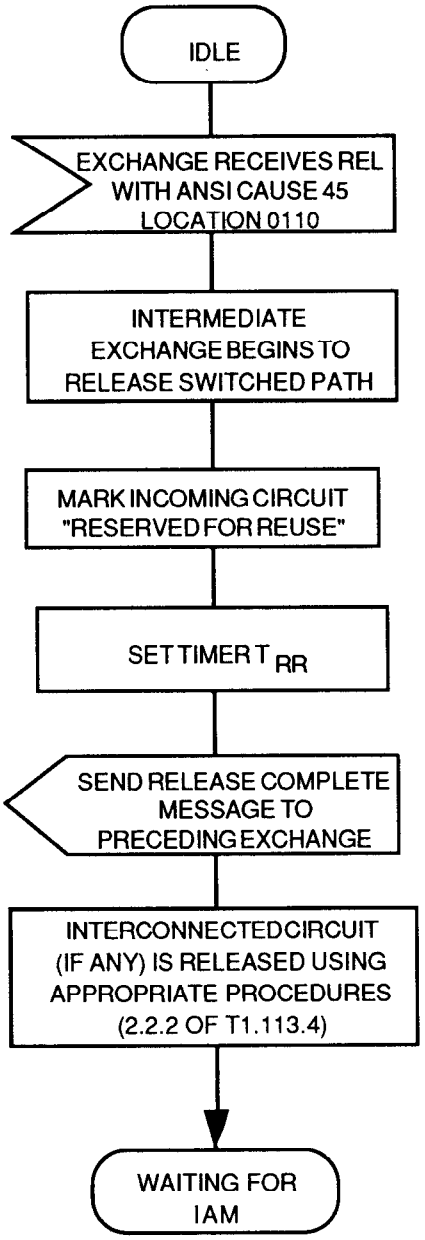
(a) Receipt of IAM from proceeding exchange

Figure E.2 – Intermediate exchange



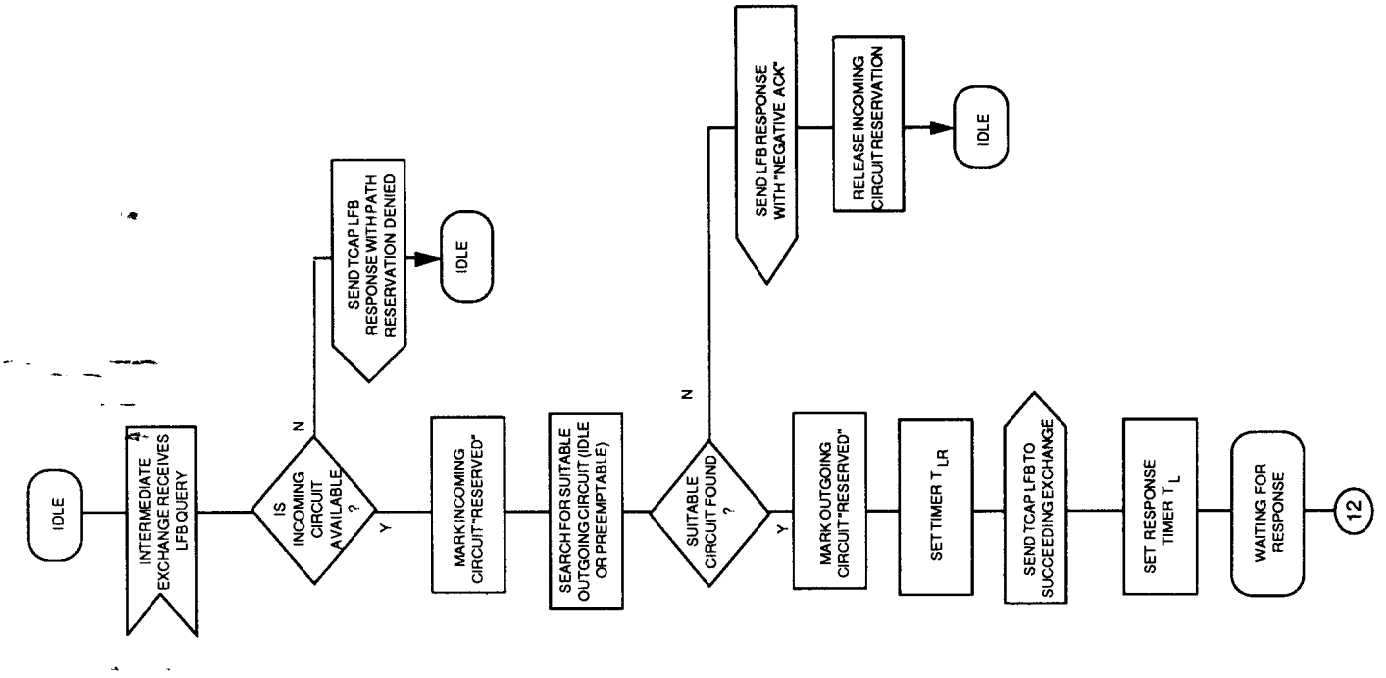
(b) Release procedures

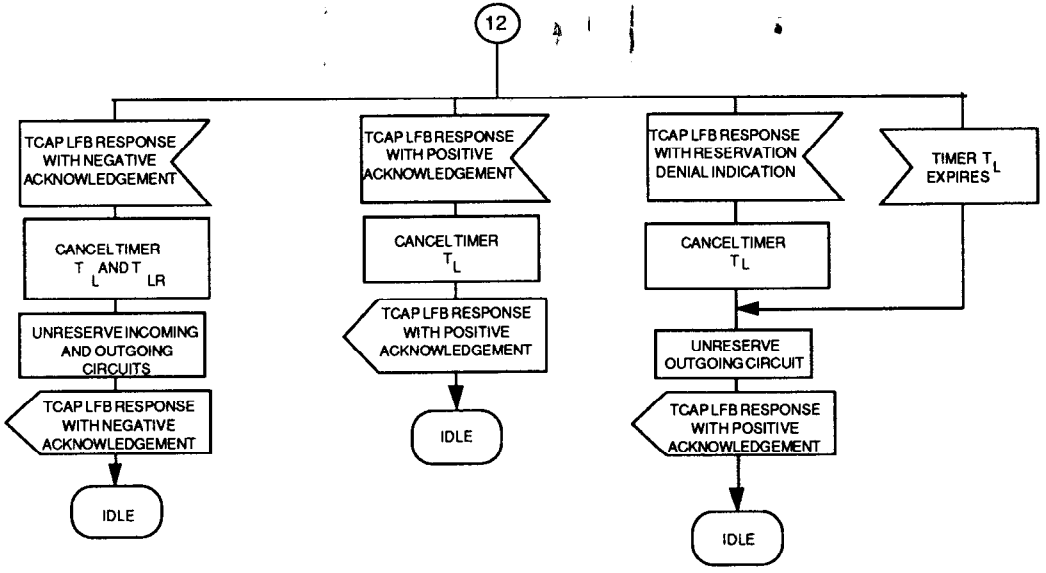
Figure E.2 *(continued)*



***(b)** (concluded)*

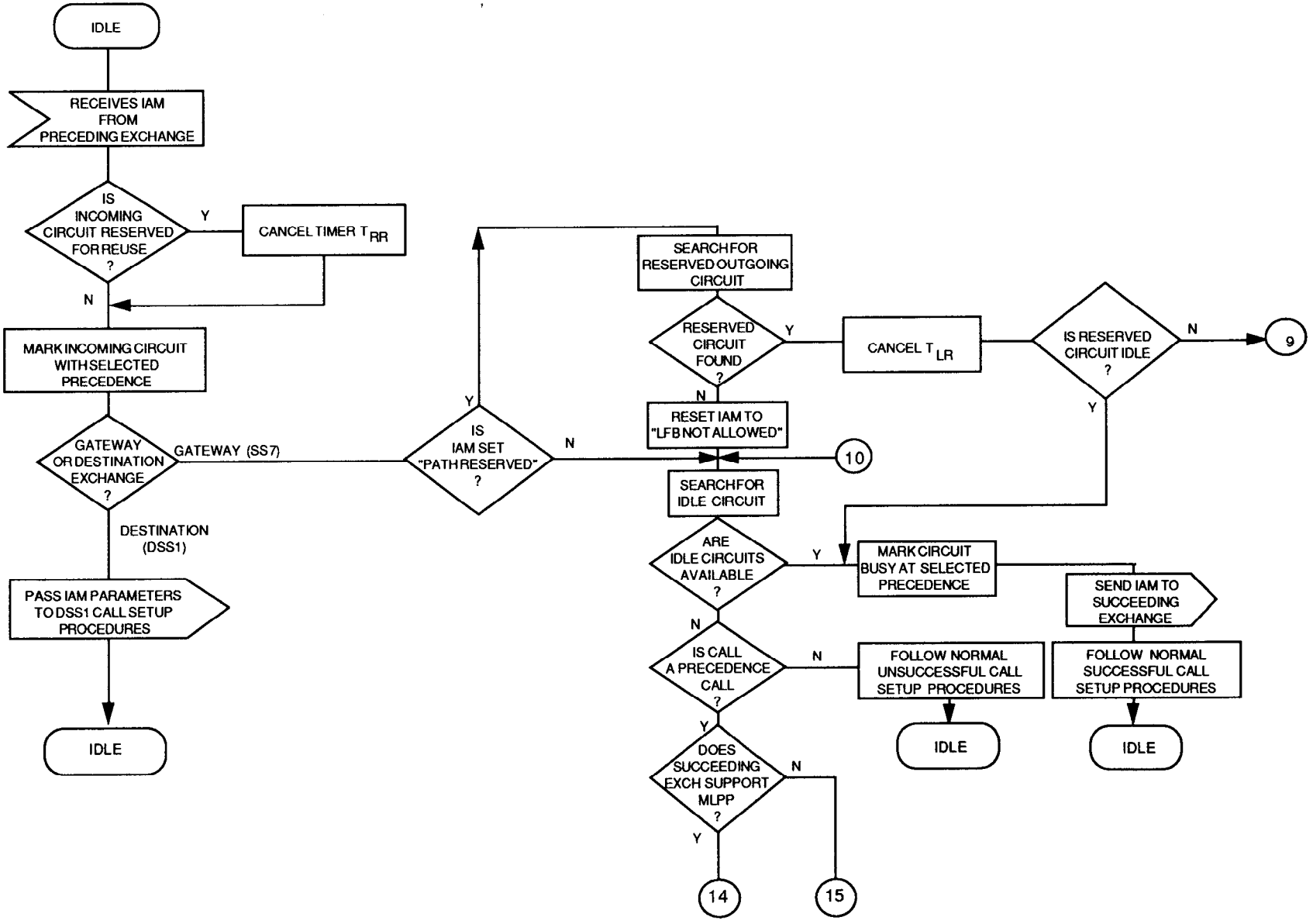
Figure E.2 *(continued)*

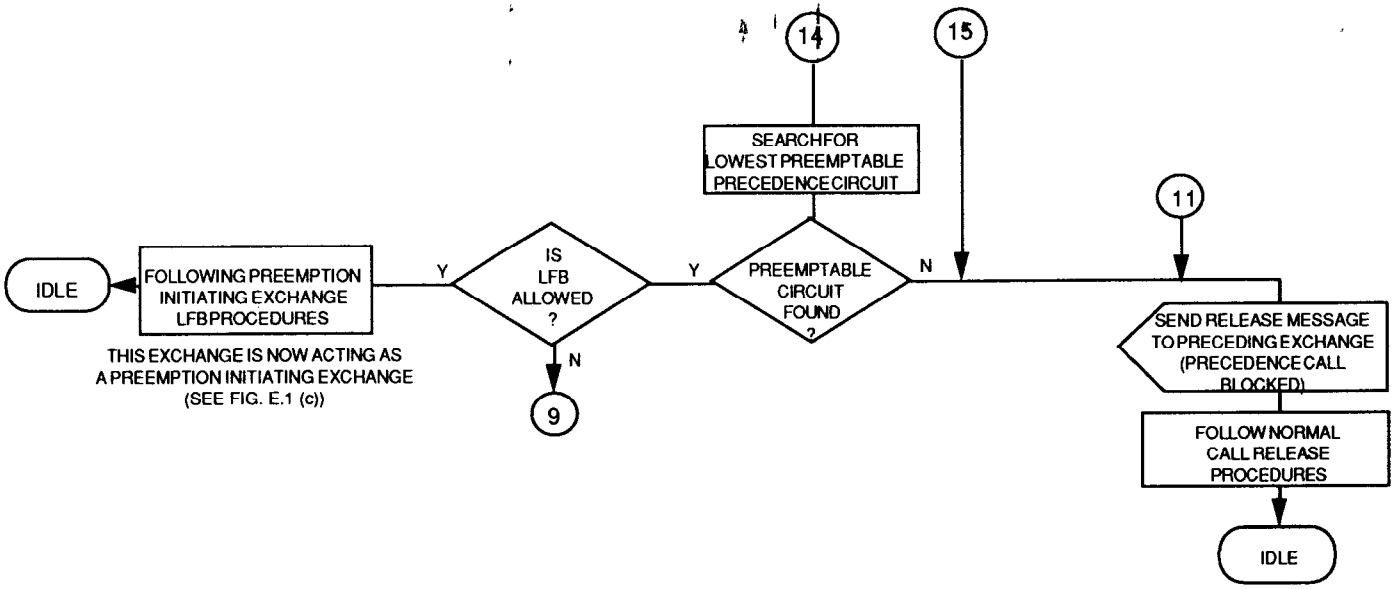

IDLE
INTERMEDIATE EXCHANGE RECEIVES LFB QUERY
IS INCOMING CIRCUIT AVAILABLE ?
N
Y
SEND TCAP LFB RESPONSE WITH PATH RESERVATION DENIED
IDLE
MARK INCOMING CIRCUIT "RESERVED"
SEARCH FOR SUITABLE OUTGOING CIRCUIT (IDLE OR PREEMPTABLE)
SUITABLE CIRCUIT FOUND ?
N
Y
SEND LFB RESPONSE WITH "NEGATIVE ACK"
RELEASE INCOMING CIRCUIT RESERVATION
IDLE
MARK OUTGOING CIRCUIT "RESERVED"
SET TIMER T_{LR}
SEND TCAP LFB TO SUCCEEDING EXCHANGE
SET RESPONSE TIMER T_L
WAITING FOR RESPONSE
12



(c) LFB procedures

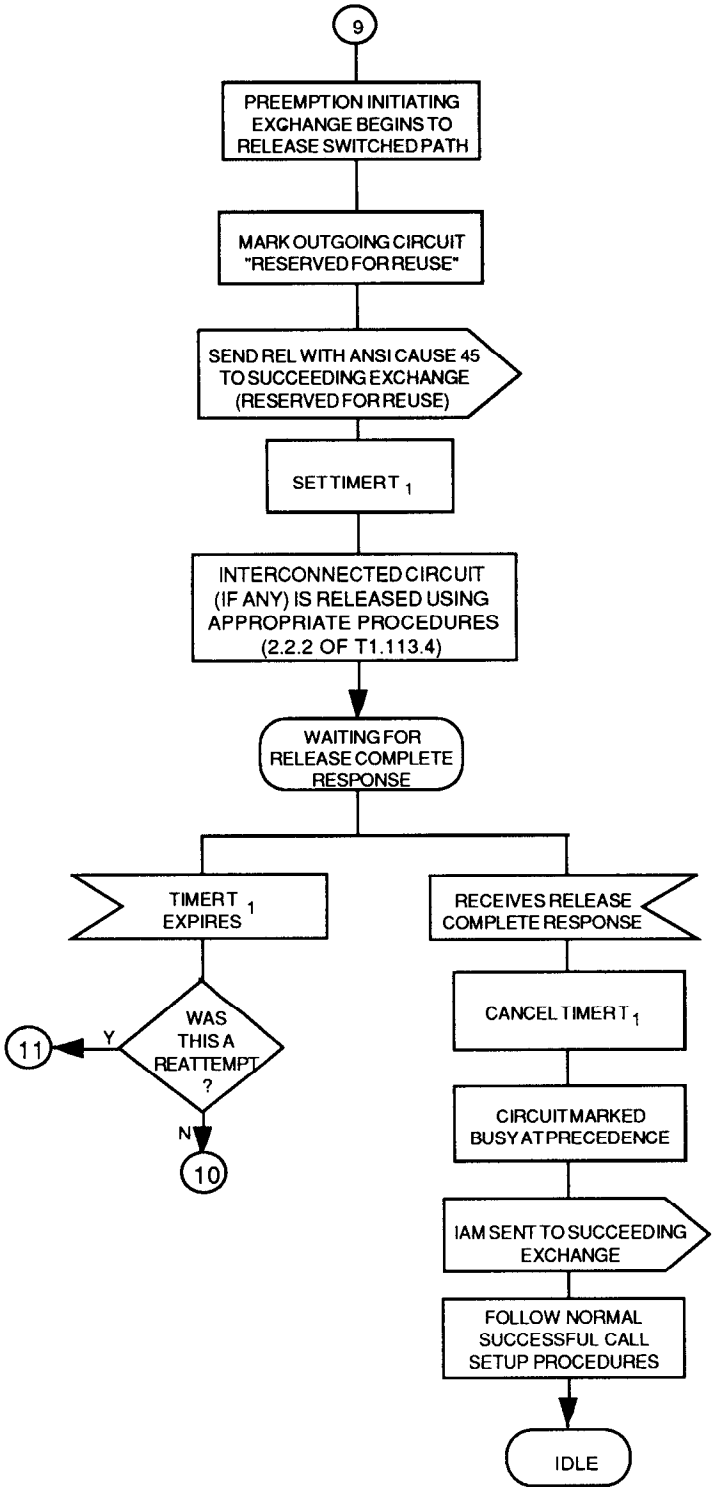
Figure E.2 *(concluded)*


IDLE
RECEIVES IAM FROM PRECEDING EXCHANGE
IS INCOMING CIRCUIT RESERVED FOR REUSE ?
Y
CANCEL TIMER T RR
N
MARK INCOMING CIRCUIT WITH SELECTED PRECEDENCE
GATEWAY OR DESTINATION EXCHANGE ?
GATEWAY (SS7)
DESTINATION (DSS1)
PASS IAM PARAMETERS TO DSS1 CALL SETUP PROCEDURES
IDLE
IS IAM SET "PATH RESERVED" ?
Y
N
SEARCH FOR RESERVED OUTGOING CIRCUIT
RESERVED CIRCUIT FOUND ?
Y
CANCEL T LR
IS RESERVED CIRCUIT IDLE ?
N
9
Y
N
RESET IAM TO "LFB NOT ALLOWED"
10
SEARCH FOR IDLE CIRCUIT
ARE IDLE CIRCUITS AVAILABLE ?
Y
MARK CIRCUIT BUSY AT SELECTED PRECEDENCE
SEND IAM TO SUCCEEDING EXCHANGE
N
IS CALL A PRECEDENCE CALL ?
N
FOLLOW NORMAL UNSUCCESSFUL CALL SETUP PROCEDURES
FOLLOW NORMAL SUCCESSFUL CALL SETUP PROCEDURES
IDLE
IDLE
Y
DOES SUCCEEDING EXCH SUPPORT MLPP ?
N
Y
14
15



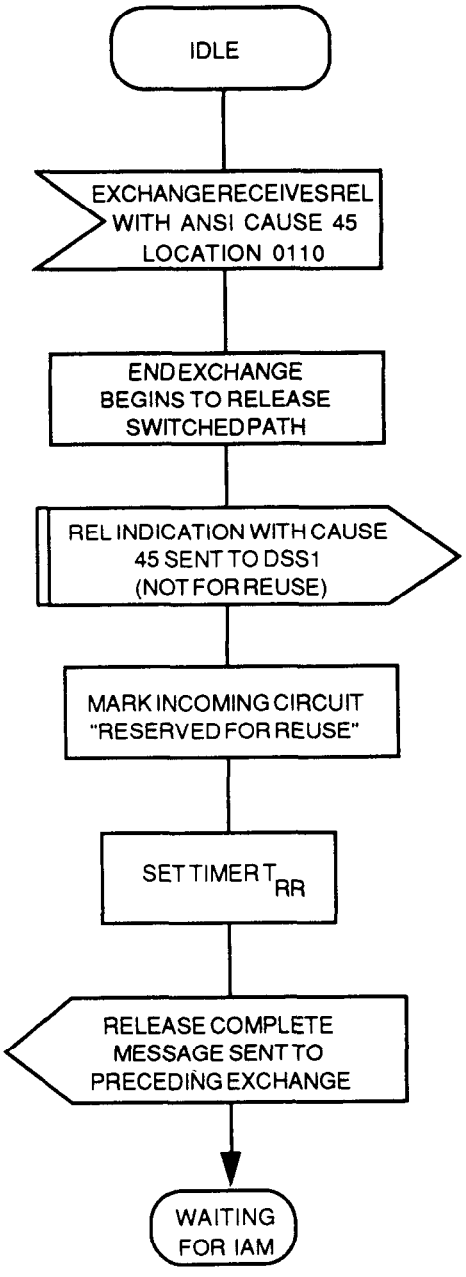
(a) Receipt of IAM from proceeding exchange

Figure E.3 – End exchange



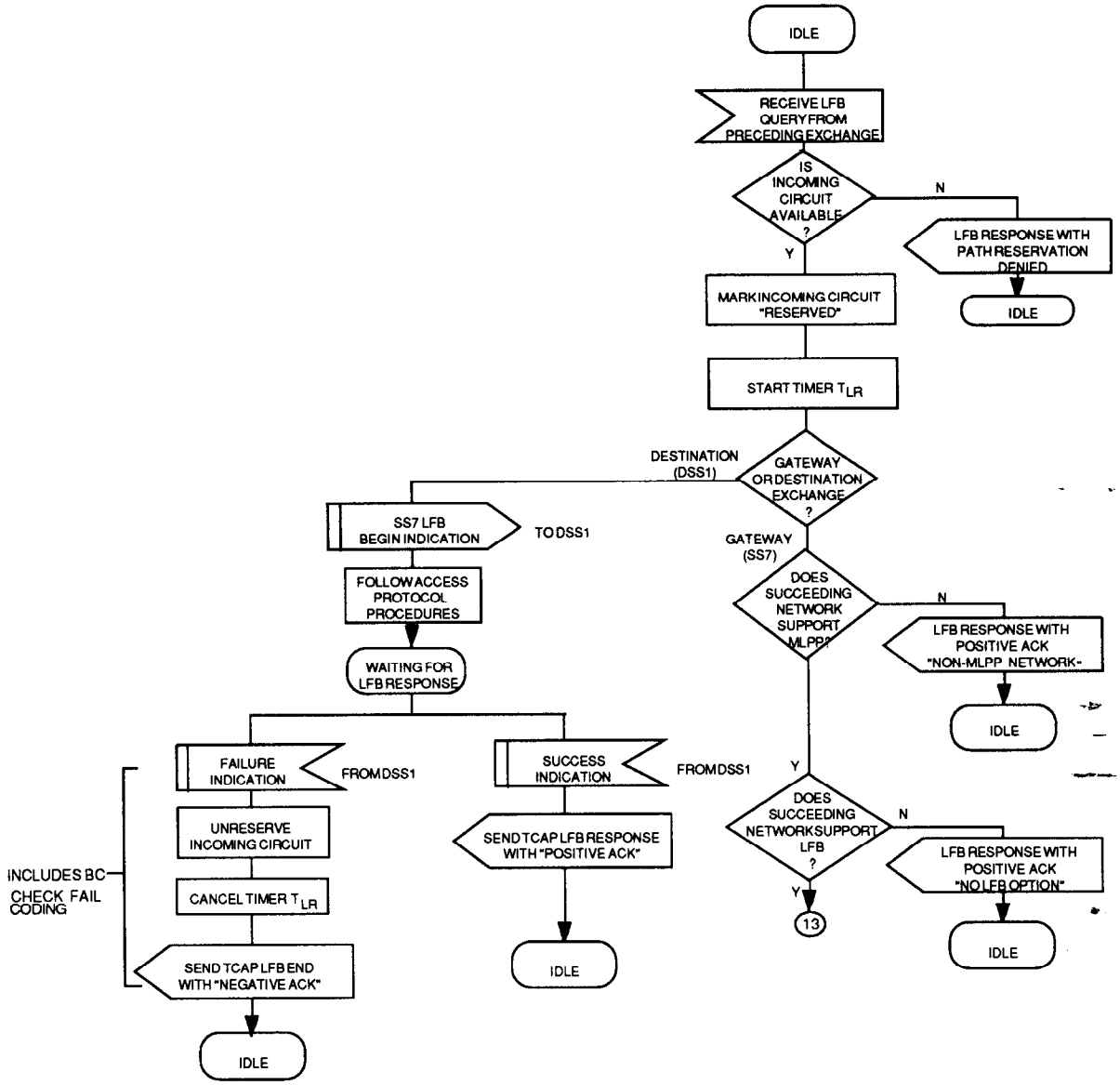
(b) Release procedures

Figure E.3 *(continued)*



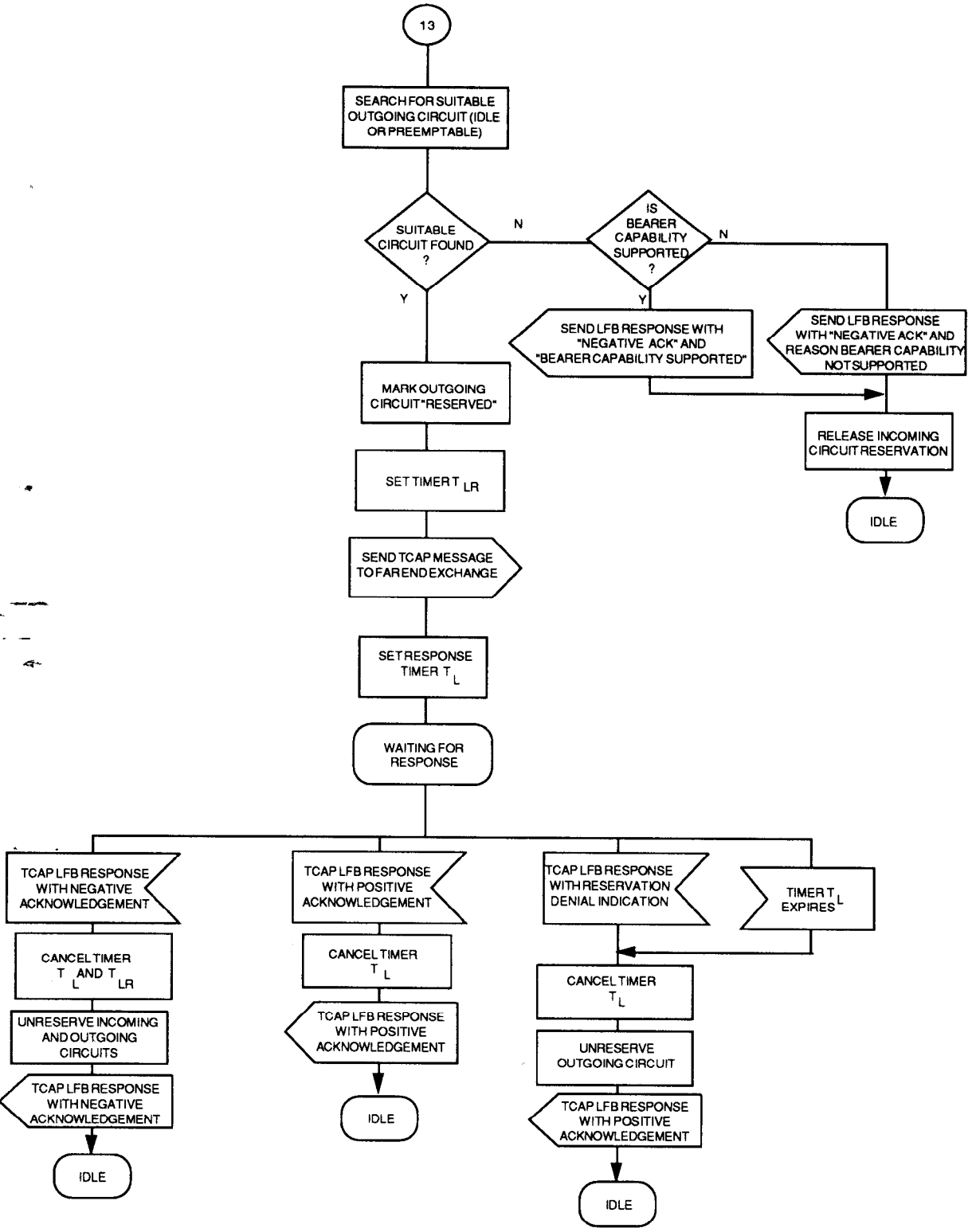
***(b)** (concluded)*

Figure E.3 *(continued)*



(c) LFB procedures

Figure E.3 *(continued)*



(c) (concluded)

Figure E.3 *(concluded)*