

SIGNALLING PROCEDURES

Q.764

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1. Scope, Purpose, and Application

1.1 Relationship with Other Signalling System No. 7 Specifications.

This chapter describes the basic signalling procedures for the set-up and clear-down of national and international ISDN connections. The messages and signals are defined in Q.762 and their format and content are given in Q.763.

1.2 Numbering.

The procedures described assume that the ISDN uses the international numbering plan defined for the ISDN and thus provides a basic voice service between ISDN terminals and telephony terminals which may be interconnected via the existing international telephony network.

1.3 Address Signalling.

In general, the call set-up procedure described is standard for both voice and non-voice connections using en bloc address signalling for calls between ISDN terminals. *

1.4 Basic Procedures.

The basic call control procedure is divided into three phases; call set-up, the data/conversation phase and call clear-down. Messages on the signalling link are used to establish and terminate the different phases of a call. Standard inband supervisory tones or recorded announcements or both are returned to the caller on voice connections to provide information on call progress. Calls originating from ISDN terminals may be supplied with more detailed call progress information by means of additional messages in the access protocol supported by a range of messages in the network.

1.5 Layout of Q.764.

The procedures specified in section 2 of this part of the specification relate to basic calls (i.e., calls not involving user facilities). Section 3 of this part of the specification specifies the procedures relating to end-to-end signalling connections. The additional requirements to be met in the case of calls involving user facilities and network utilities are specified in section 4 of this chapter.

2. Basic Call Control and Signalling Procedures

2.1 Successful Call Set-up

2.1.1 Forward Address Signalling - En Bloc Operation

2.1.1.1 Actions Required at Originating Exchange

(1) *Circuit selection*

When the originating exchange has received the complete selection information from the calling party, and has determined that the call is to be routed to another exchange, selection of a suitable, free, inter-exchange circuit takes place and an Initial Address Message is sent to the appropriate destination. Appropriate routing information is either stored at the originating exchange or at a remote database to which a request may be made. *

Examination of the set-up message from the calling party will determine the requirements for the connection e.g. 64 kbit/s and Signalling System No. 7 signalling. This information (e.g. user service information and forward call indicators) will be included in the Initial Address Message to permit correct routing at intermediate exchanges. The seizing function at the receiving exchange is implicit in the reception of the Initial Address Message. *

A "*" indicates a change from the CCITT Red Book Vol. VI which is specific to the U.S.

(2) *Address information sending sequence*

The sending sequence of address information on international calls will be the country code (not sent to an incoming international exchange) followed by the national (significant) number. On national connections, the address information may be the local number or the national (significant) number as required by the Administration concerned. For calls to international operator positions (Code 11 and Code 12) refer to CCITT Recommendation Q.107. For calls to national operator positions, by operators, existing standard digital codes will be used.

(Text relating to ST signal deleted as it is not used in U. S. networks.)

(3) *Initial Address Message*

The Initial Address Message in principle contains all the information that is required to route the call to the destination exchange and connect the call to the required user.

All Initial Address Messages will include the calling party number, if available,¹ and a Protocol Control Indicator. The originating exchange will set the parameters in the Protocol Control Indicator to indicate: (i) the type of end-to-end signalling that can be accommodated (see section 3), (ii) the availability of CCITT No. 7 signalling, (iii) the use of the Integrated Services User Part and (iv) whether further information is available on request e.g. calling line identity. The originating exchange may also include in the Initial Address Message: (i) a local reference and point code (of the originating exchange) to enable the destination exchange to establish an end-to-end connection (see section 3) and (ii) other information related to user facilities and network utilities.

(4) *Transfer of information by end-to-end protocol*

As an alternative to the inclusion of call set-up user facility information in the Initial Address Message, any such information not to be examined at intermediate exchanges may be passed end-to-end from the originating exchange to the destination exchange. (see section 3).

(5) *Completion of transmission path*

If the information transfer capability in the user service information parameter indicates speech or audio (3.1 or 7 KHz), the transmission path should preferably be completed in the backward direction as soon as (a) the IAM is sent for the call, and if applicable (b) any continuity check on the outgoing circuit used for the connection is successfully completed.

Optionally, the completion of the transmission path in the backward direction may be delayed until receipt of an ACM, or one of the conditions for forward completion described below.

If the information transfer capability is unrestricted digital information, then the transmission path should be completed in both directions simultaneously as indicated below.

Independent of the information transfer capability, the transmission path is completed in the forward direction on receipt of the first of

- an ACM or CPG with an "interworking encountered" code in the backward call indicators parameter;
- an ACM or CPG with the user-network interaction indicator in the optional backward call indicators parameter coded to "user-network interaction occurs";
- an Answer Message.

1. The calling party number may be made available to other networks based on bilateral agreements.

2.1.1.2 Actions Required at an Intermediate Exchange

(1) *Circuit selection*

An intermediate exchange, on receipt of an Initial Address Message, will analyze the called party number and the other routing information (section 2.1.1.1 (1)) to determine the routing of the call. The intermediate exchange then seizes a free inter-exchange circuit and sends an Initial Address Message to the succeeding exchange.

When no echo suppressor or nature-of-circuit indication is received from a preceding circuit using a signalling system with fewer facilities, the indicators will be considered as received "no" unless positive knowledge is available.

(2) *Initial Address Message*

An intermediate exchange will examine the Protocol Control Indicator (see section 2.1.1.1 (3), the ISDN User Part Preference Information, and the User Service Information. *

- (a) If the ISDN User Part Preference Indicator is set to "no preference", then the call is set up no matter what the outgoing signalling system is (ISDN User Part, Telephone User Part, MF, ...). *
- (b) If the ISDN User Part Preference Indicator is set to "ISDN User Part preferred", the call may be set up even if it is not possible to find a circuit using the ISDN User Part. *
- (c) If the ISDN User Part Preference Indicator is set to "ISDN User Part required" and there is no available ISDN User Part circuit, the call is rejected and appropriate information is sent in the backward direction. *

If the call is still permitted, modify the parameters in the Protocol Control Indicator according to the capabilities that can be provided, e.g., if a Telephone User Part has been used instead of an ISDN User Part, the Protocol Control Indicator should be modified to indicate to succeeding exchanges that different user parts have been utilized. *

(3) *Completion of transmission path*

Through connection of the transmission path should preferably follow the procedures given in 2.1.1.1 (5). As an option, through connection of the transmission path may be completed at an intermediate exchange immediately after the Initial Address Message has been sent, except in those cases where conditions on the outgoing circuit prevent it (see section 2.1.7). *

(4) *Congestion*

In the case of congestion at an intermediate exchange, it will send a Release Message (including congestion information) to the preceding exchange indicating congestion and initiating release of the call at that exchange.

2.1.1.3 Actions Required at the Destination Exchange

(1) *Selection of called party*

Upon receipt of an Initial Address Message, the destination exchange will analyze the called party number to determine to which party the call should be connected. It will also check the called party's line condition and perform various checks, using for example the Service Indication received from the calling terminal, to verify whether or not the connection is allowed. These checks will include correspondence of compatibility checks, e.g., checks associated with user facilities.

At this point, certain call set-up information may need to be obtained by an end-to-end protocol. Examination of the Protocol Control Indicator will show whether an end-to-end interchange is feasible and which end-to-end technique may be used (see section 3).

In the case where the connection is allowed, the destination exchange will alert the called party in accordance with the applicable interface protocol. If the Initial Address Message indicates *

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continuity check, then alerting of the called party should be delayed until receipt of the continuity check successful indication.

(2) *Connection not allowed*

If the call cannot be connected due to, for instance, the called party being busy, a Release Message indicating the reason is sent to the preceding exchange.

2.1.2 Forward Address Signalling - Overlap Operation. (Not required in U.S. networks.)

2.1.3 Calling Party Address. The Calling Party Address will be included in the Initial Address Message when available (see section 2.1.1.1 (3)). Otherwise, it may be requested by the destination exchange. If the Calling Party Address is required at the destination exchange but is not included in the Initial Address Message, the destination exchange will analyze the Protocol Control Indicator to determine if the request and response should be conducted by end-to-end or link by link procedures. It may be necessary to withhold the sending of the Address Complete Message until the Calling Party Address has been successfully delivered to the destination exchange.

2.1.3A Exit Message

2.1.3A.1 Actions at a Gateway Exchange. The Exit Message may be generated at an outgoing gateway exchange in a network and sent backward to notify preceding exchanges that a call connection has been completed into a succeeding network. When an Initial Address Message is sent from the gateway exchange for the outgoing circuit, a timer should be set. The timer value is network dependent. The Exit Message should be returned for the incoming circuit at the expiration of this timer.

The message will consist of the message type, and optionally an outgoing trunk number parameter. When included, the outgoing trunk group number parameter should carry the number of the trunk group used to complete the connection from the exchange originating the Exit Message.

2.1.3A.2 Actions at Intermediate Exchange. Upon receipt of the Exit Message, an intermediate, non-gateway exchange will send the corresponding Exit Message to the preceding exchange.

2.1.3A.3 Actions at an Originating Exchange. Receipt of the Exit Message may be used to generate timing indications at the originating exchange. Upon receipt of the Exit Message at an originating or gateway exchange, no Exit Message is generated to preceding points, as the Exit Message is only used within a network.

2.1.4 Address Complete Message and Call Progress Message

2.1.4.1 Return of Address Complete Message from destination exchange. An Address Complete Message will be sent from the destination exchange to indicate that the path through the network is complete, and to convey indications such as called party status or interworking. In the case that the continuity check is performed, the destination exchange will withhold the ACM until a successful continuity indication has been received (see section 2.1.9).

The Address Complete Message is sent from the destination exchange under the following circumstances:

1) In the case where the terminating access is non-ISDN, the following action takes place:

- a. When the destination exchange has identified the called party, and determines that the subscriber is free, the Address Complete message is sent back with the indications:

Called line status = "subscriber free"
ISDN access indicator = "non-ISDN"

- b. When the status of the subscriber cannot be determined (e.g. customer behind PBX), the Address Complete Message contains the indications:

Called line status = "no indication"
ISDN access indicator = "non-ISDN"

2) In the case where the terminating access is ISDN, when the destination exchange has identified the called party, it initiates call establishment on the terminating access. Depending on the response, one of the following actions takes place:

- a. If the called party responds with an alerting indication, the Address Complete Message is sent with the indications:

Called line status = "subscriber free"
ISDN access indicator = "ISDN"

- b. If the called party responds with a progress indication, the Address Complete message is sent with the indications:

Called line status = "no indication"
ISDN access indicator = "ISDN"
Access Transport Parameter - contains any Progress Indicator from the access protocol

- c. As a network option, a timer may be run in call control, monitoring the delay in response from the called party. If call control indicates timer expiration, the Address Complete message is sent with the indications:

Called line status = "call delay"
ISDN access indicator = "ISDN"

2.1.4.2 Return of Answer Prior to Address Complete. If a connect indication is received from the ISDN access under the following conditions:

- no alerting indication has been received from the ISDN access, and
- an Address Complete Message has not yet been sent by the destination exchange

Then an Answer Message is sent by the destination exchange. This message signifies both address complete and answer conditions. The indicators in the Answer Message will indicate:

- Called line status = "subscriber free"
- ISDN access indicator = "ISDN"

The destination exchange will through connect on sending the Answer message.

2.1.4.3 Receipt of Address Complete Message at intermediate exchange. Upon receipt of an Address Complete Message an intermediate exchange will send the corresponding ACM to the preceding exchange. If an Answer Message is received at the exchange prior to an ACM, the Answer Message will be sent to the preceding exchange.

2.1.4.4 Receipt of ACM at the originating exchange.

1. When the originating exchange receives an ACM the appropriate exchange functions take place.
2. On receipt of an ACM with the called line status set to "subscriber free", an alerting indication is passed to the calling party if appropriate.
3. On receipt of the ACM the awaiting address complete timer (T7), if applicable, is stopped.
4. If the Answer Message is received prior to ACM, then the appropriate exchange functions take place and the awaiting address complete timer (T7), if applicable, is stopped.

2.1.4.5 Through Connection and Awaiting Answer Indication at Destination Exchange. The sending of the awaiting answer indication (i.e. audible ring) at the destination exchange depends on the type of call. On speech, 3.1 and 7 KHz Audio calls and calls to an non-ISDN called party, the audible

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ring indication is applied to the transmission path towards the calling party on receipt of an alerting indication from the called party or from information in the destination exchange that the called party will not provide inband indications. It may optionally be provided based on timer expiry in networks supporting the call delay indication (see 2.1.4.1).

Regardless of whether tones are to be provided or not, the destination exchange will through connect after the receipt of the connect indication from the called party.

If the destination exchange does not send the audible ring indication because the destination user provides for sending tones, then the destination exchange will through connect the transmission path in the backwards direction on receipt of a progress indication from the destination user.

Through connection of the transmission path at answer is described in 2.1.7.

2.1.4.6 Address Complete Message with Charging Information. The Address Complete Message received from the destination exchange or from a succeeding network may carry charging information.

2.1.4.7 Address Complete Message with Other Information. Additional information can be included in Address Complete Messages (e.g., related to user facilities, section 4).

2.1.4.8 Return of Address Complete Message In Interworking Situations. An Address Complete Message will not be sent until the cross-office check is made, if applicable.

If the succeeding network does not provide electrical called-party's-line-condition signals, the last Signalling System No. 7 exchange shall originate and send an Address Complete Message if:

- (1) the complete address has been received and
- (2) an outgoing circuit is successfully seized, e.g., if a seize signal has been sent and acknowledged.

If, in normal operation, delay in the receipt of an address complete signal from the succeeding network is expected, the last common channel signalling exchange will originate and send an Address Complete Message 15 to 20 seconds after receiving the Initial Address Message. The time-out condition is an upper limit considering the clauses of section 2.9.8.3 (20 to 30 seconds for outgoing international exchanges in abnormal release conditions).

2.1.4A Call Progress The Call Progress Message can be sent before or after the ACM, in order to indicate that an event has occurred which should be relayed to the user.

2.1.4A.1 Return of CPG from the destination exchange. The CPG is sent from the destination exchange if the ACM has already been sent and subsequently:

- an alerting indication is received from the called party.

In this case, the CPG carries an event information set to "alerting".

- a progress indication is received from the called party.

In this case, the CPG carries an event information set to "progress"

If access signalling information is received from the called party, this may be carried in the Access Transport Parameter of the CPG (transported transparently across the network).

2.1.4A.2 Action at an intermediate exchange. On receipt of a CPG, an intermediate exchange will send the corresponding CPG to the preceding exchange.

2.1.4A.3 Actions at the originating exchange. On receipt of the CPG at the originating exchange, no state change occurs (i.e. any timers in progress are not affected), and the appropriate indication is sent to the calling user. If the CPG contains information carried in the Access Transport Parameter, it is transferred unaltered into the indication returned to the calling user.

2.1.5 Answer Message

2.1.5.1 Return of Answer Message from Destination Exchange. When the called party answers, the destination exchange connects through the transmission path and the ringing tone is removed if applicable. Immediately following connection of the transmission path the destination exchange sends an Answer Message to the preceding exchange.

2.1.5.2 Receipt of Answer Message at Intermediate Exchange. Upon receipt of an Answer Message, an intermediate exchange sends the corresponding Answer Message to the preceding exchange and, if it is a controlling node, charging may begin.

2.1.5.3 Receipt of Answer Message at Originating Exchange. When the originating exchange receives an Answer Message indicating the required connection has been completed, charging, if applicable may begin and a connect indication is passed to the calling terminal in accordance with the applicable interface protocol.

2.1.5.4 Return of Answer from Automatic Terminals. When connections are set-up to terminals having an automatic answer feature, the alerting indication may be omitted from the interface protocol. If a destination exchange receives a connect indication in response to the set-up message, the Answer Message will be sent as soon as the transmission path is completed.

2.1.5.5 Answer with Charging Information. The initial answer indication received from the destination exchange or from a succeeding network may carry charging information.

2.1.6 Continuity-Check.² Because the signalling in Signalling System No. 7 does not pass over the circuit, facilities should be provided for making a continuity-check of the circuit in the circumstances described below.

The application of the continuity-check depends on the type of the transmission system used for the circuit.

For transmission systems having some inherent fault indication features giving an indication to the switching system in case of fault, a continuity-check is not required. However, a per-call or a statistical continuity check may be needed on fully digital circuits when circuits or bundles of circuits in primary multiplex groups are dropped or inserted en route between switches, and alarm indications carried on bits of the primary multiplex frame structure are lost in passing through an intermediate transmission facility that does not relay them transparently. Typically, per-call continuity checks may be needed when the transmission link between switches contains a TDMA satellite system, a digital circuit multiplication system or a digital access and cross connection system, where fault indications are lost.

For analogue circuits with pilot supervision it is sufficient to perform the continuity-check on a statistical basis or by test calls (see Appendix A, section 1.5). For analogue circuits not using pilot supervision a continuity check should be performed on a per call basis. For mixed circuit groups (i.e., analogue and digital circuits), a continuity check may be performed on a statistical or per call basis. Within mixed connections, i.e., connections composed of circuits with and without continuity-check on a per call basis, it shall be ensured that the continuity signal be forwarded to the destination point although no continuity-check may have been performed on one or more parts of the end-to-end connection. For circuit groups comprised of all digital circuits, in normal operation the continuity check will not be performed. However, the continuity check should be permitted on digital circuits as well as analogue circuits as part of the circuit turn-up procedures in an identical manner as on analogue circuits. Circuit administrative errors as well as circuit identity misunderstanding between System No.

2. Text from CCITT Red Book, Vol. VI, Fascicle VI.7 has been removed from this chapter but the subject material is contained in Appendix A to this chapter.

7 exchanges should be resolved with the Circuit Validation Test (see Appendix D). *

2.1.7 Completion of Transmission Path at an Interworking Exchange. In general, completion of the transmission path at an interworking point should occur as soon as possible during the call set-up phase. The actual point of switchthrough will vary depending on the interworking signalling system, e.g. whether inband or outband signalling is used or whether a continuity check procedure is applied.

When interworking with other internationally specified signalling systems, the rules on switchthrough given in Table 1 should be applied. *

Table 1. Cut Through When Interworking

Systems	Rules Upon Switch Through
No. 7 -> No. 7	(1) When no continuity check is to be made on the outgoing circuit, through connection should occur after sending the Initial Address Message. (2) When a continuity check is to be made on the outgoing circuit, through connection should happen after residual check tone has propagated through the return path of the speech circuit (Reference Appendix A, section 1.3).
No. 6 -> No. 7 No. 5 -> No. 7 R1 -> No. 7 No. 7 -> No. 6	(1) When no continuity check is to be made on the outgoing circuit, through connection can happen after sending the Initial Address Message. (2) When a continuity check is to be made on the outgoing circuit, through connection can happen after residual check tone has propagated through the return path of the speech circuit (Reference Appendix A, section 1.3).
R2 -> No. 7	Through connection should occur after sending address complete signal.
No. 7 -> No. 5 No. 7 -> R1	(1) Through connection can occur after sending ST (End of Pulsing) signal and removal of a possible check loop.
No. 7 -> R2	(1) Through connection should occur after receipt of an address complete signal.

When a continuity check is made on the outgoing circuit, and early connection is made, there is a possibility that the calling party has its go and return paths temporarily looped (from the instant of through connection to the instant of loop removal of the incoming end of the circuit). This problem can be prevented by using the optional single report continuity check procedure given in Appendix A, section 1.3. *

2.1.8 Cross Office Check. For digital exchanges, the requirements mentioned in CCITT Recommendation Q.504 shall be met. For other exchanges, Administrations shall ensure the reliability of a connection through a switching machine (cross-office check) either on a per call basis or by a statistical method. With either method, the probability of the connection being established with an unacceptable speech path transmission quality should not exceed 0.00001 as the long-term average. *

2.1.9 Charging Procedures.

2.1.9.1 Basic Call Charging. Charging will normally begin when the exchange(s) controlling charging receives the Answer Message from the network. Other charging methods are for further study. *

2.1.9.2 Network Charging Messages. When the controlling exchange does not have the capability to determine the charge rate for a particular call, charge information, in the form of a Charging Message(s), may be received during call set-up. Also, charge rate information may be returned during call set-up, followed subsequently by further Charging Messages during the conversation/data phase, *

should the original rate require to be changed during the call.

2.1.9.3 Charging for Transfer of User-to-user Data. The charging for the transfer of user-to-user data requires further study.

2.1.9.3A Charge Information.³ When an exchange wishes to forward charge information to the next exchange in an Initial Address Message it will include the originating line information parameter and possibly the charge number parameter. *

The charge number parameter will be included unless the charge number digits agree with those in the calling party number and the calling party number is in the Initial Address Message. In the case where the charge number digits agree with those in a calling party number parameter in the same Initial Address Message, the charge number parameter may be omitted. *

If the charge number parameter is included in the Initial Address Message and if the nature of address field in the charge number parameter is coded "ANI of the called party: not included" the numbering plan octet and the address digits octets in the charge number parameter would be omitted. This coding of the charge number parameter would be used only if the charge number digits are the same as those in the called party number parameter in the Initial Address Message. *

An exchange receiving an Initial Address Message with an originating line information parameter and no charge number parameter will identify the calling party address digits as the charge number digits. An exchange receiving a charge number parameter with a nature of address coded "ANI of the called party: not included" and no charge number digits will recognize the called party address digits as the charge number digits. *

2.1.10 Forward Transfer Message. The Forward Transfer Message may be sent in telephony semi-automatic working in either of the following two cases:

- (1) following a call switched automatically to a subscriber, or following a call established via a special operator, the controlling operator wishes to call in an assistance operator. On receipt of the Forward Transfer Message at the incoming international exchange, an assistance operator is called in.
- (2) following a call via codes 11 and 12, the controlling operator wishes to recall the incoming international exchange. Receipt of the Forward Transfer Message at the incoming international exchange recalls the incoming operator on calls completed via the operator positions at the exchange. Equivalent procedures, using standard digital operator codes, are available on national calls between operators. *

2.1.10A Transit Network Selection. If transit network selection information is included in the setup information from the calling party or is provided on a subscription basis, this information is carried in the transit network selection parameter, and is used for routing the call, e.g., to a specific carrier. The transit network selection parameter is removed before the call is passed to the indicated transit network. *

A sequence of transit networks may be specified by the calling party, in which case the transit network selection parameter is repeated in the order specified.⁴ *

3. Note: Procedure are given only for the case when charge information is included in the Initial Address Message. Possible extension of the procedures to allow the charge information to be sent in an Information Message in response to a request are for further study. *

4. Use of multiple transit network selection parameters is for further study. *

2.2 Unsuccessful Call Set-up.

If at any time in the call set-up the connection cannot be completed, a Release Message is returned. This message contains the reason of call refusal (failure) which can be access or network related. *

2.2.1 Actions at Exchange Initiating a Release Message. The initiating exchange sends a Release Message to the succeeding⁵ exchange and, at the same time, starts the release of the switched path (if established). A timer is started to ensure that a Release Complete Message is received from the succeeding exchange within time T_1 (expiration of timer T_1 is covered in section 2.9.6.2). *

2.2.2 Actions at Intermediate Exchange. On receipt of a Release Message from the preceding exchange, an intermediate exchange will:

- (1) 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.
- (2) at the same time, send a Release Message to the succeeding exchange. When the path has been fully disconnected, a timer is started to ensure that a Release Complete Message is received from the succeeding exchange within time T_1 (Expiration of this time is covered in section 2.9.6.2).

2.2.3 Actions at The Controlling Exchange. On receipt of a Release Message from the preceding exchange, the controlling exchange will 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.

In addition, the controlling exchange will either:

- (1) return an indication to the calling subscriber, or
- (2) attempt to re-route the call set-up, or
- (3) initiate release procedures to the preceding exchange. *

2.3 Normal Call Release.

The release procedures are based on a two message approach whereby the Release Message is transmitted through the network as quickly as possible. For ISDN calls, the same procedures are used in the network irrespective of whether they are initiated by the calling subscriber, the called subscriber or the network. The normal release procedure can be prevented by the network if this is required on a particular call (see section 2.6). *

2.3.1 Release Initiated by a Calling Subscriber

- (1) Actions at originating exchange

On receipt of a request to release the call from the calling subscriber, the originating exchange immediately starts the release of the switched path and, at the same time, sends a Release Message to the succeeding⁶ exchange. A timer is started to ensure that a Release Complete Message is received from the succeeding exchange within time T_1 (Expiration of this time is covered in section 2.9.6.2). *

- (2) Actions at an intermediate exchange

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

- (a) immediately start the release of the switched path; when the path has been fully *

5. In this section preceding exchange means the exchange which originates the particular signalling sequence, i.e., the exchange that sends the first message in the sequence, while the succeeding exchange receives the first message in the sequence. *

6. In this section preceding exchange means the exchange which originates the particular signalling sequence, i.e., the exchange that sends the first message in the sequence, while the succeeding exchange receives the first message in the sequence. *

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disconnected, a Release Complete Message is returned to the preceding exchange. *

- (b) at the same time, send a Release Message to the succeeding exchange. A timer is started *
to ensure that a Release Complete Message is received from the succeeding exchange *
within time T_1 (Expiration of this time is covered in section 2.9.6.2). *

(3) Actions at destination exchange

On receipt of a Release Message from the preceding exchange, the destination exchange will *
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. *

(4) Timing

Timing is stopped upon receipt of the Release Message at the timing exchange(s). *

(5) Collision of Release Messages

In the case when both the originating and destination exchanges initiate the release of a call, *
a Release Message may be received at an exchange from a succeeding or preceding exchange after *
sending a Release Message to the adjacent exchange. In this case the exchange will complete the *
disconnection of the switched path and return a Release Complete Message. *

2.3.2 Release Initiated by a Called Subscriber. The procedures in section 2.3.1 apply, except that *
the functions at the originating and destination exchanges are transposed. *

2.3.3 Release Initiated by the Network. The procedures in section 2.3.1 apply, except that they *
can be initiated at any exchange (originating, destination or intermediate). *

2.3.4 Release of Address and Routing Information. This is for further study (see CCITT *
Recommendation Q.724, § 6.1). *

2.4 Transfer of User-to-User Information.

The procedures for transfer of user-to-user information will be supplied in future service-specific *
documents. *

2.4A Transfer of Access Signalling Information.

Certain Q.931 signalling information has only significance to the user/network interfaces or *
users. This signalling information should be transported by the ISDN User Part without interpretation *
in the Access Transport Parameter. (Note that this signalling information does not include user-to-user *
information which is unstructured data having significance only to the users. See section 2.4 for the *
transfer of this information.) *

As each Q.931 information element has an identifier and length indicator, multiple Q.931 *
information elements with access significance can be serially placed after one another in the Access *
Transport Parameter. On receipt of the ISDN User Part message, the information in the Access *
Transport Parameter shall be passed directly to the access side of the exchange without further ISDN *
User Part action. *

2.5 Suspend, Resume Request

2.5.1 Suspend. The Suspend Message indicates a temporary cessation of communication without *
releasing the call. It can only be accepted during the connection/data phase. A Suspend Message can *
be either generated in response to a suspend request from a subscriber or generated by the network in *
response to a Clearback Message or on-hook condition respectively from an interworking node or from a *
called (telephone) party. *

2.5.1.1 Suspend Initiated by a Calling Party. A Suspend Message is generated in response to a *
suspend request from a subscriber. *

(1) Actions at originating exchange

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On receipt of a suspend request from the calling party, the originating exchange returns an acknowledgement and sends a Suspend Message to the succeeding⁷ exchange. *

(2) *Actions at an intermediate exchange* *

On receipt of the Suspend Message from the preceding exchange, the intermediate exchange sends a Suspend Message to the succeeding exchange. *

(3) *Actions at destination exchange* *

On receipt of the Suspend Message from the preceding exchange, the destination exchange informs the called party that a suspension has been requested. *

(4) *Additional actions at the suspend request controlling exchange* *

On receipt of the suspend request or the Suspend (ISDN) Message, the controlling exchange starts a timer to ensure that a resume request or Resume (ISDN) Message is received within time T_2 .⁸ If the timer expires, the procedures in section 2.5.3 apply. *

2.5.1.2 Suspend Initiated by a Called Party. The procedures in section 2.5.1.1 apply, except that the functions at the originating and destination exchanges are transposed. *

2.5.1.3 Suspend Initiated by the Network. A Suspend (network) Message can be generated by the network in response to a Clearback Message from an interworking node or an on-hook condition from a called (telephone) party. *

(1) *Action at terminating exchange (destination) or interworking exchange* *

On receipt of an on-hook condition from the called (telephone) party or a Clearback Message at the interworking exchange, the exchange will send a Suspend (network) Message to the succeeding exchange. *

(2) *Action at an intermediate exchange* *

On receipt of the Suspend (network) Message, from the preceding exchange, the intermediate exchange sends a Suspend (network) Message to the succeeding exchange. *

(3) *Additional action at the controlling exchange* *

On receipt of the Suspend (network) Message, the controlling exchange starts a timer to ensure that a Resume (network) Message or a Release Message is received. The value of this timer, T_{13} , is covered in CCITT Recommendation Q.118. If the timer expires, the procedures in section 2.5.3 apply. *

2.5.2 Resume. A Resume Message indicates a request to recommence communication. A request to release the call received from the calling or called party will override the suspend/resume sequence and the procedures given in section 2.3 will be followed. *

2.5.2.1 Resume Initiated by a Calling Party. Having initiated a suspend condition, a calling party may request a reconnection provided that time T_2 has not expired. The procedures in section 2.5.1.1 items (1), (2) and (3) apply except that the Resume Message replaces the Suspend Message. On receipt of the Resume Message, the controlling exchange cancels the timer. *

2.5.2.2 Resume Initiated by a Called Party. The procedures in section 2.5.2.1 apply except that the functions at the originating and destination exchange are transposed. *

7. In this section preceding exchange means the exchange which originates the particular signalling sequence, i.e., the exchange that sends the first message in the sequence, while the succeeding exchange receives the first message in the sequence. *

8. Further study of the exact value of T_2 is necessary.

2.5.2.3 Resume (network) Initiated by the Network. A Resume (network) Message can be generated by the network in response to a Reanswer Message from an interworking point or an off-hook condition from a called (telephone) party. *

(1) *Action at terminating exchange or interworking exchange*

On receipt of a Reanswer Message at the interworking exchange or off-hook condition from the called (telephone) party, the exchange will send a Resume (network) Message to the succeeding exchange. *

(2) *Actions at an intermediate exchange*

On receipt of a Resume (network) Message, the exchange will send a Resume (network) Message to the succeeding exchange.

(3) *Additional action at the controlling exchange*

On receipt of the Resume (network) Message the controlling exchange stops the timer (started in paragraph 2.5.1.3 (3)).

2.5.3 Expiration of Time T_2 or T_{13} . If a Resume Message is not received within time T_2 or T_{13} , as applicable, from the party initiating the suspend request, then the controlling exchange will initiate the release procedure outlined in section 2.3.3. *

2.6 Delayed Release.

The Delayed Release Message is generated by the network in response to a request to release the call if the network is applying a hold to the connection. The Delayed Release Message can be sent in either direction.

The local exchange receiving the disconnection request indicates to the user that disconnection has been delayed and sends a Delayed Release Message to the network. The connection is split, a time out T_3^9 is started (to prevent network lock up) and charging is stopped. At the other end of the connection, the Delayed Release Message causes an indication to be sent to the user indicating that disconnection has been delayed.

Receipt of a new connect demand or a Resume Message at the network during the held state (after the Delayed Release Message has been sent) will not cause the network to set up or resume the connection. When the hold condition is removed or the time out T_3^9 matures, the network generates the normal release sequence (see section 2.3.3).

2.7 In Call Modification.

Procedures for In Call Modification are for further study.

2.8 Network Features

2.8.1 Automatic Repeat Attempt. Automatic repeat attempt, as defined in CCITT Recommendation Q.12, is provided in Signalling System No. 7. An automatic repeat attempt will be made: *

- (1) on detection of dual seizure (at the non-control exchange) (see § 2.9.1.4),
- (2) on receipt of the Blocking Message after sending an Initial Address Message and before any backward signal has been received (see § 2.8.2),
- (3) on receipt of a Reset Circuit Message after sending an Initial Address Message and before a backward signal has been received,
- (4) on failure of the continuity check when a continuity check is performed,

9. The value of timer T_3 and T_4 is for further study.

- (5) on receipt of an unreasonable message during call setup or
- (6) on receipt of an Unequipped Circuit Identification Code Message on a first attempt.

2.8.2 Blocking and Unblocking of Circuits and Circuit Groups. The circuit Blocking (Unblocking) Message and the Group Blocking (Unblocking) Message are provided to permit the switching equipment or maintenance personnel to remove from (and return to) traffic the distant terminal(s) of a circuit or group because of a fault or to permit testing.

Since the circuits served by Signalling System No. 7 have bothway capability, the Blocking Message or Group Blocking Message can be originated by either exchange. The receipt of a Blocking Message or two Group Blocking Messages will have the effect of prohibiting calls on the relevant circuit(s) outgoing from the exchange until an Unblocking Message or an appropriate Group Unblocking Message is received, but will not prohibit calls incoming to that exchange. Acknowledgement sequences are always required for the Blocking and Unblocking Messages as well as for the Group Blocking and Group Unblocking Messages using the Blocking Acknowledgement Message, the Unblocking Acknowledgement Message, the appropriate Group Blocking Acknowledgement and the appropriate Group Unblocking Acknowledgement Message respectively. The acknowledgement is not sent until the appropriate action, either Blocking or Unblocking has been taken. The Release Message should not override the Blocking Message and return circuits to service which might be faulty. The blocked circuit(s) will be returned to service on transmission of the Unblocking Acknowledgement Message or the appropriate Group Unblocking Acknowledgement Message at one exchange and on receipt of the Unblocking Acknowledgement Message or the appropriate Group Unblocking Acknowledgement Message at the other exchange.

2.8.2.1 Other Actions on Receipt of a Blocking Message. In the event of the receipt of a Blocking Message:

- (1) after an Initial Address Message has been sent, and
- (2) before a backward message relating to that call has been received,

an automatic repeat attempt will be made on another circuit. The exchange receiving the Blocking Message should release the original attempt in the normal manner after sending the Blocking Acknowledgement Message.

If the Blocking Message is received:

- (1) in the outgoing exchange after at least one backward message relating to that call has been received, or
- (2) in the incoming exchange after the Initial Address Message relating to that call has been received,

the exchange will not seize that circuit for subsequent calls.

The fact that the circuit is engaged on a call will not delay transmission of the Blocking (Unblocking) Acknowledgement Message.

If a Blocking Message is sent and subsequently an Initial Address Message is received in the opposite direction, the following action is taken:

- (1) for test calls, the call should be accepted, if possible. In the case where the test call cannot be accepted, the Blocking Message must be returned,
- (2) for calls other than test calls, the Blocking Message must be returned.

Blocking of a circuit by use of the Blocking Message should not exceed five minutes, after which an alarm should be given at each terminal of the circuit. Should a call be in progress on the circuit involved, the five minutes time will commence when that call is cleared. If the work on the circuit must exceed five minutes, the circuit should be withdrawn from service.

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2.8.2.2 Group Blocking and Unblocking Messages. The following Group Blocking (Unblocking) Messages and the appropriate acknowledgement messages are provided:

- (1) maintenance oriented Group Blocking (Unblocking) Message,
- (2) hardware failure oriented Group Blocking (Unblocking) Message,
- (3) software generated Group Blocking (Unblocking) Message.

The range of circuits to be blocked (unblocked) is dependent on the coding of the range field.

- (1) if the range field is not coded all zero the circuits indicated in the status field have to be blocked (unblocked),
- (2) if the range field is coded all zero all circuits of the pre-determined circuit group have to be blocked (unblocked).

The same rule applies on the acknowledgements.

Since the effect of erroneous Group Blocking Messages generated by undetected errors may cause serious implications on the quality of service, each Group Blocking Message has to be sent twice. Therefore, at the receiving exchange actions only take place after a Group Blocking Message is received twice within 5 seconds. The Group Unblocking Message only has to be sent (and received) once. *

For the circuits blocked for maintenance reasons the same conditions apply and the same actions have to be taken as described in section 2.8.2.1.

For the circuits blocked for reason of hardware failure or software generated alarm the following actions will be taken:

- (1) the maintenance personnel have to be alerted,
- (2) all interconnected circuits have to be released by the appropriate signals for reasons of hardware carrier group alarm, *
- (3) the affected circuits are set to the condition idle blocked without any exchange of clearing messages. *

2.8.2.2A Receipt of an Initial Address Message on a Remotely Blocked Circuit. If an Initial Address Message is received for a circuit for which a Blocking Message was previously received, the exchange will remove the remotely blocked state and process the Initial Address Message except in the case of a test call. *

2.8.2A Circuit Query *

2.8.2A.1 General. The circuit-query test allows an exchange to audit the circuit states of circuits on a demand or routine basis. This test is necessary in order 1) to ensure that the circuits are not incorrectly put in maintenance states thereby denying them from service, and 2) to coordinate a circuit turn-up procedure. *

The range of the circuits to be tested is dependent on the coding of the range field. Range field code n, including n = 0 for a single circuit, indicates the range of circuits to be tested. *

2.8.2A.2 Interpretation of Circuit States. For the purposes of circuit query procedure, there are fourteen non-overlapping circuit states, which are classified into six major categories, as follows: *

- (1) unequipped, *
- (2) transient, *
- (3) active, *
- (4) remotely blocked, *
- (5) locally blocked, and *
- (6) locally blocked and remotely blocked. *

The last four of the above categories can be subdivided into three call processing categories: *

- (1) idle, *

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- (2) incoming circuit busy, and *
- (3) outgoing circuit busy, thus creating a total of fourteen states. *

A circuit is "unequipped" if the circuit is not activated for call processing or maintenance or it is not an ISDN User Part circuit. This is a unique state and will not overlap with any of the other states. *

The "transient" state refers to any call processing or maintenance set-up state e.g., waiting for an Address Complete or Blocking Acknowledgement Message. The circuit state is also considered transient if the circuit is in a state where Circuit Reset Messages are sent periodically. The transient state is non-overlapping with other states. *

The "active" state refers to an operationally available state i.e., equipped and a non-maintenance state. A circuit in an active state may be further qualified as being "idle", "incoming circuit busy", or "outgoing circuit busy". *

The "remotely blocked" state refers to the state marked by the exchange when the far-end exchange initiated blocking. This state can co-exist with "idle", "incoming circuit busy", or "outgoing circuit busy". *

The "locally blocked" state refers to the state marked by the exchange when it initiated blocking to the far-end exchange. This state can co-exist with "idle", "incoming circuit busy", or "outgoing circuit busy". *

The "idle" state is a call-processing state of an equipped, non-busy circuit. The "incoming circuit busy" or "outgoing circuit busy" refers to a stable call processing state. *

2.8.2A.3 Auditing Procedure *

The circuit-query test is designed for each end to audit circuit states using the data maintained by the near-end as well as the far-end exchange. The circuit query must not be allowed to the exchange which does not support the circuit query process. The routine of circuit query must be set up in each exchange in a manner to minimize glare if possible. *

The basic circuit state discrepancies and the required corrective actions are listed below: *

2.8.2A.3.1 Error in Call Processing States. *

- (1) Near-end shows the circuit is outgoing circuit busy or incoming circuit busy, the far-end shows the circuit is unequipped. *

Corrective action: *

- Mark circuit locally blocked *
- Idle circuit. *
- Print a message to maintenance. *

- (2) Near-end shows the circuit is unequipped, the far-end shows the circuit is outgoing circuit busy or incoming circuit busy. *

Corrective action: *

- Send a maintenance Blocking Message (if the circuit identification code exists) to prevent the circuit from being reseized. *
- Send a Release Message to idle the circuit at the far-end. *

- (3) Near-end shows the circuit is idle, the far-end shows the circuit is incoming circuit busy or outgoing circuit busy. *

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- Corrective action: *
 - Send a Release Message to idle the circuit at the far-end. *
 - (4) Near-end shows the circuit is outgoing circuit busy or incoming circuit busy, the far-end show the circuit is idle. *
 - Corrective action: *
 - Idle circuit. *
 - (5) Both ends are incoming circuit busy or outgoing circuit busy. *
 - Corrective action: *
 - Send a Release Message to idle circuit at the far-end. *
 - Idle circuit after Release Complete Message is received. *
- 2.8.2A.3.2 Error in Maintenance States.** *
- (1) The near-end shows the circuit is unequipped, the far-end shows the circuit is active. *
 - Corrective action: *
 - Initiate a maintenance Blocking Message (if the circuit identification code exists) to establish remote blocking thereby preventing the circuit from being seized for call processing or maintenance testing. *
 - (2) The near-end shows the circuit is active, the far-end shows the circuit is unequipped. *
 - Corrective action: *
 - Mark the circuit as locally blocked and withhold sending any blocking Message to the far-end. *
 - Print a message to maintenance. *
 - (3) Near-end shows the circuit is remotely blocked, the far-end shows the circuit is not locally blocked. *
 - Corrective action: *
 - Remove the remote blocking state. *
 - Print a message to maintenance. *
 - (4) The near-end shows the circuit is locally blocked, the far end show the circuit is not remotely blocked. *
 - Corrective action: *
 - Send a maintenance Blocking Message to establish the far-end remote blocking. *
 - (5) Far-end show the circuit is remotely blocked but the near-end show the circuit is not locally blocked. *
 - Corrective action: *
 - Send a maintenance Unblocking Message. *
 - (6) Far-end shows the circuit is locally blocked but the near-end shows the circuit is not remotely blocked. *
 - Corrective action: *

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- Mark the near-end circuit state remotely blocked.

All of the actions involved are given in Table 2.

2.9 Abnormal Conditions

2.9.1 Dual Seizure. Since Signalling System No. 7 circuits have the capability of bothway operation, it is possible that the two exchanges will attempt to seize the same circuit at approximately the same time.

2.9.1.1 Unguarded Interval. The exchange must detect dual seizure and take action as defined in § 2.9.1.4.

2.9.1.2 Detection of Dual Seizure. A dual seizure is detected by an exchange from the fact that it receives an Initial Address Message for a circuit for which it has sent an Initial Address Message.

2.9.1.3 Preventive Action. Different methods for circuit selection can be envisaged to minimize the occurrence of dual seizure. In the following, two methods are described. Further study is required to determine the field of application of each method and to ensure that the two methods do interwork satisfactorily.

Other methods for circuit selection may also be used provided that they give the same degree of protection against dual seizure also when one of the methods specified is used at the other end.

1. Method 1

An opposite order of selection is used at each terminal exchange of a bothway circuit group.

2. Method 2

(Not specified for the U.S.)

For call control purposes, a bothway circuit group can be subdivided into subgroups in an exchange.

It is necessary to take preventive action in cases where Signalling System No. 7 uses a signalling data link with long propagation time.

2.9.1.4 Action to be Taken on Detection of Dual Seizure. Each exchange will control one half of the circuits in a bothway circuit group. On detection of a dual seizure, the call being processed by the control exchange for that circuit will be completed and the received Initial Address Message will be disregarded.

Under these conditions, the call being processed by the control exchange will be allowed to mature. The call being processed by the non-control exchange will be backed off and the switch-path released. A Release Message will not be sent. The non-control exchange will make an automatic repeat on the same or on an alternative route.

For the purpose of resolution of dual seizure on bothway circuits, the exchange with the higher signalling point code will control all even-numbered circuits (circuit identification code) and the other exchange the odd-numbered circuits. The designation of control may also be used for maintenance control purposes.

2.9.2 Interruption Control on Digital Inter-Exchange Circuits. When fully digital circuits are provided between two exchanges, which have some inherent fault indication feature giving an indication to the switching system when faults on transmission systems are detected, the switching system should inhibit selection of the circuits concerned for the period the fault conditions persist.

2.9.3 Reset of Circuits and Circuit Groups. In systems which maintain circuit status in memory there may be occasions when the memory becomes mutilated. In such a case the circuits must be reset to the idle condition in both exchanges to make them available for new traffic. Since the exchange with the mutilated memory does not know whether the circuits are idle, busy outgoing, busy incoming,

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blocked, etc., Reset Circuit Messages or a Circuit Group Reset Message should be sent as appropriate for the affected circuits.

2.9.3.1 Reset Circuit Message. If only a few circuits are concerned, a Reset Circuit Message should be sent for each affected circuit.

On receiving of a Reset Circuit Message, the unaffected exchange will:

- (1) If the circuit is in any call state or in the idle state, the exchange should regard the Reset Circuit Message as a Release Message. I.e., the exchange should idle the circuit (if in a call state) and, in any case, send a Release Complete Message for the circuit. If an Initial Address Message for an outgoing call has been sent and no backward message has yet received for that call, the exchange should repeat the call attempt on another circuit.
- (2) If the exchange has previously sent a Blocking Message for the circuit, or if it is for some reason unable to release the circuit, it should send a Blocking Message before sending the Release Complete Message indicated above. The unaffected exchange should await the receipt of a Blocking Acknowledgement Message from the affected exchange. If such an acknowledgement is not received, the repetitive process indicated in section 2.9.4 should be followed. (The exchange should not wait for the Blocking Acknowledgement Message before sending a Release Complete Message, however.)
- (3) If a Blocking Message has been previously received for the circuit, the unaffected exchange should remove the blocked condition before sending the Release Complete Message indicated above.
- (4) If the exchange receives a Reset Circuit Message after sending a Reset Circuit Message, it should idle the circuit and send a Release Complete Message to the far end exchange.
- (5) Release any interconnected circuit. The cause value in the Release Message should be coded for "temporary failure".

The affected exchange should reconstruct its memory according to the response(s) it receives. It should idle any circuit for which it receives a Release Complete Message, and it should return a Blocking Acknowledgement Message in response to a Blocking Message.

If the affected exchange does not receive one of the expected responses to a Reset Circuit Message within 4-15 seconds, it should send another Reset Circuit Message. It should repeat this process until the expected response is received or until one minute has expired. If one minute expires without an expected response, maintenance personnel should be notified. Repeated Reset Circuit Messages should be sent at one minute intervals until maintenance intervenes or an expected response is received.

2.9.3.2 Circuit Group Reset Message. If a considerable number of circuits or all circuits are affected by the memory mutilation, Circuit Group Reset Messages should be used to make them available for new traffic.

Since the effect of erroneous Circuit Group Reset Messages generated by undetected errors may cause serious implications on the quality of service, each Circuit Group Reset Message has to be sent twice.

On receipt of two Circuit Group Reset Messages within 5 seconds for the same circuit group or parts thereof the unaffected exchange will:

- (1) if the range field is not coded all zero
 - (a) respond by a Circuit Group Reset Acknowledgment Message (note) in which the status indicator bits of the circuits available for service are coded 0 and the status indicator bit

note: Circuit Group Reset Acknowledgement Message will be sent after all the actions described in (3)(a-d) have been completed.

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- of all circuits locally blocked are set to 1, *
- (2) if the range field is coded all zero *
- (a) send the appropriate group blocking message(s) if it had previously sent any or all of the hardware failure oriented or software generated or maintenance group blocking message and/or individual blocking messages, *
 - (b) respond by a Circuit Group Reset Acknowledgement Message (note) in which the range field is coded all zero indicating that the restoration of the predetermined circuits has been completed, *
- (3) independent from the coding of the range field the following actions should take place in the unaffected exchange after receipt of two Reset Circuit Group Messages within 5 seconds: *
- (a) if it had previously sent or received a software generated Circuit Group Blocking Message, send the software generated Circuit Group Blocking Message, (if software generated blocking is supported) *
 - (b) if it had previously received a Blocking Message(s) or a Circuit Group Blocking Message(s) other than the software generated Circuit Group Blocking Message for one or more of the circuit(s) involved the blocked condition will be removed and the circuits will be made available for service, *
 - (c) restore the circuits involved not affected by (3)(a) above to the idle state; *
 - (d) if a Circuit Group Reset Message is received after having sent a Circuit Group Reset Message or a Reset Circuit Message(s) the circuits involved in both the sent and the received message(s), are made available for service, *
 - (e) appropriate signals should be sent on interconnected circuits to release them. *

The affected exchange will then reconstruct its memory according to the possibly received Blocking Messages and the received Circuit Group Reset Acknowledgement Message and from local status information. It will respond to the possibly received Circuit Group Blocking Messages in the normal way. *

If no acknowledgement to a Circuit Group Reset Message is received before 4-15 seconds, the Circuit Group Reset Message should be repeated (twice). If an acknowledgement for the message is not received within 1 minute after sending the initial Circuit Group Reset Message, maintenance personnel should be notified to permit manual restoration procedures. However, the sending of the Circuit Group Reset Message should continue at 1 minute intervals until maintenance intervention occurs.

2.9.4 Failure in the Blocking/Unblocking Sequence. An exchange will repeat the Blocking (Unblocking) Message or the Circuit Group Blocking (Unblocking) Messages on failure to receive the appropriate acknowledgement in response to one of these messages before 4-15 seconds. (see section 2.8.2.)

If an acknowledgement is not received within a period of one minute after sending the initial Blocking or Unblocking Message or Circuit Group Blocking (Unblocking) Messages, maintenance personnel should be alerted, the repetition of the Blocking (Unblocking) Message or Circuit Group Blocking (Unblocking) Messages should be continued at one minute intervals until maintenance intervention occurs and the circuit(s) taken out of service as appropriate.

2.9.5 Receipt of Unreasonable Signalling Information. The Message Transfer Part of the signalling system will avoid mis-sequencing, or double delivery, of messages with a high reliability (see Q.706). However undetected errors at the signalling link level and exchange malfunctions may produce signalling information messages that are either ambiguous or inappropriate.

In order to resolve some possible ambiguities in the state of a circuit when unreasonable messages are received the following will apply:

- (1) if a Release Message is received relating to an idle circuit it will be acknowledged with a Release *

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- Complete Message, *
- (2) if a Release Complete Message is received relating to an idle circuit it will be discarded, *
 - (3) (Text related to Released Message deleted.) *
 - (4) if a Blocking Message is received for a blocked circuit, a Blocking Acknowledgement Message will be sent, *
 - (5) if an Unblocking Message is received for an unblocked circuit, an Unblocking Acknowledgement Message will be sent, *
 - (6) if a Blocking Acknowledgement Message is received for which the exchange is not in the "Waiting for Blocking Acknowledgement" state: *
 - (a) relating to a locally blocked circuit, the Blocking Acknowledgement Message will be discarded, *
 - (b) relating to a circuit which is not locally blocked, an Unblocking Message will be sent, *
 - (7) if an Unblocking Acknowledgement Message is received for which the exchange is not in the "Wait for Unblocking Acknowledgement" state: *
 - (a) relating to a locally blocked circuit, the Blocking Message will be sent, *
 - (b) relating to a circuit which is not locally blocked, the Unblocking Acknowledgement Message will be discarded, *
 - (8) if other unreasonable signalling information is received, the following actions will be undertaken: *
 - (a) if the circuit is idle, the Reset Circuit Message is sent, *
 - (b) if the circuit is seized by a call, after receipt of a backward signal required for the call set-up, the unreasonable signalling information is discarded, *
 - (c) if the circuit is seized by a call, before receipt of a backward signal required for the call set-up, the Reset Circuit Message is sent. If the circuit is seized by an incoming call, the call will be released. If the circuit is seized by an outgoing call, an automatic repeat attempt is provided on another circuit. *

Except in certain cases (see § 2.9.1) any other unreasonable signalling information received will be discarded. If the discarding of the information prevents a call from being completed, that call will eventually be released by the expiry of a time out. Possible further actions to be taken on receiving unreasonable signalling information are for further study.

2.9.5A Receipt of Unrecognized Signalling Information If Q.763 or Q.764 describes specific actions or interpretations to be taken for receipt of unrecognized signalling information within the offending message or parameter, then these actions or interpretations are applied. Otherwise, *

- (1) If the message is a Release Message, then the message is treated as if the unrecognized information was not present. If release of the circuit is possible, the Release Message is forwarded onto any associated circuits. When there is no signalling system interworking, the message can be transferred transparently. In other cases, the unrecognized information is deleted. *
- (2) If the message is a Facility Request or Call Modification Request Message, the message is discarded and the appropriate Reject Message is returned. *
- (3) If the message is a circuit supervision, circuit group supervision, in-call modification, or facility message (other than as discussed in (1) or (2) above) then the message is discarded, and no other action is taken. *
- (4) If an unrecognized message is received, that message is discarded. Other actions are for further study. *
- (5) If an Initial Address Message is received with invalid information needed to route the call, the message is discarded and the circuit is released along with any associated circuits. *
- (6) For all other messages received with unrecognized optional parameters (other than those discussed in (1)-(4)), action shall be taken on those parameters which are recognized and have valid contents. Whether or not unrecognized parameters are relayed or discarded is for further *

study. *

2.9.6 Loss of Messages in the Release Sequence

2.9.6.1 Loss of Release Message. (No longer required with two message release sequence) *

2.9.6.2 Failure to Receive a 'Release Complete' (RLC) Message - Time T_1 . If a Release Complete Message is not received in response to a Release Message before 4-15 seconds, the exchange will retransmit a Release Message. *

If after repeating the Release Message for a period of one minute a Release Complete Message is not received, the exchange shall: *

- (1) send a Reset Circuit Message,
- (2) alert the maintenance personnel,
- (3) cease sending the Release Message,
- (4) remove the circuit from service,

The sending of the Reset Circuit Message shall continue at 1 minute intervals until maintenance action occurs. *

2.9.6.3 Failure to Receive a Released Message - Time T_{12} . (The Receive Released Message Timer T_{12} has been removed as it is no longer required with two message release procedure.) *

2.9.7 Failure to Receive a Response to a Facility Request or Information Request Message. When a Facility Request or Information Request Message is sent, the exchange sending the message sets a timer T_5 . (It is suggested that T_5 be no longer than 2 seconds.) If the timer expires before the receipt of the expected response, the exchange will send the Facility Request or Information Request Message a second time and reset the timer T_5 . If the timer expires again before an expected response is received, the exchange sending the request message will assume that the requested facility or information is unavailable. *

2.9.8 Other Failure Conditions

2.9.8.1 Inability to Release in Response to a Release Message. If an exchange is unable to return the circuit to the idle condition in response to a Release Message, it should immediately remove the circuit from service, alert maintenance personnel and send the Blocking Message. Upon receipt of the Blocking Acknowledgement Message, the Release Complete Message is sent in acknowledgement of the Release Message. *

2.9.8.2 Call Failure. The "temporary failure" cause value is sent in a Release Message (see section 2.2) whenever a call attempt fails and other specific signals do not apply. *

Reception of the Release Message at any Signalling System No.7 exchange will cause the Release Message to be sent to succeeding¹⁰ exchanges. If the signalling system does not permit the Release Message to be sent, the appropriate signal, tone or announcement is sent to succeeding exchange.

2.9.8.3 Abnormal Release Conditions. If the conditions for normal release as covered in section 2.3 are not fulfilled, release will take place under the following conditions:

- (1) *Outgoing international or national controlling exchange*

The exchange shall:

- (a) When an Initial Address Message is sent, the sending exchange sets a timer waiting for an *

10. In this section preceding exchange means the exchange which originates the particular signalling sequence, i.e., the exchange that sends the first message in the sequence, while the succeeding exchange receives the first message in the sequence. *

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Address Complete Message. The value of this timer is 20-30 seconds. If an expected response to the Initial Address Message is not received before the expiration of this timer, the exchange sending the Initial Address Message will release the connection and may notify maintenance. *

- (b) release all equipment and release the connection on failure to receive an Answer Message within the interval specified in CCITT Recommendation Q.118. (Only occurs at international gateway exchange.) *

(2) *Incoming international exchange*

An incoming international exchange shall:

- (a) release all equipment and the connection into the national network and send back a Release Message in the following cases: *
- (i) on failure to receive a Continuity Message if applicable before 10-15 seconds after receipt of the Initial Address Message, or
- (ii) on failure to receive a backward message from a national network (where expected) before 20-30 seconds after receipt of the Initial Address Message, or
- (iii) on receipt of a Release Message after an Address Complete Message has been generated. *
- (b) the procedures for Release Messages are detailed in section 2.2.2.

(3) *Transit exchange*

The exchange shall:

- (a) release all equipment and the connection and send back a Release Message in the following cases: *
- (i) on failure to receive a Continuity Message if applicable before 10-15 seconds after receipt of the Initial Address Message, or
- (ii) on failure to meet the conditions for normal release as covered in § 2.3 before 20-30 seconds after sending the Initial Address Message, or
- (b) the procedures for Release Messages are detailed in section 2.2.2.

2.9.8.3A Unequipped Circuit Identification Code Message. An Unequipped Circuit Identification Code Message is sent by an exchange in response to either the reception of an Initial Address Message or Reset Circuit Message on which it is unable to act as a consequence of its inability to perform a circuit identification code translation. The sending of the Unequipped Circuit Identification Code Message in response of other messages with "unequipped circuit identification codes" is for further study. *

If an Unequipped Circuit Identification Code Message is received for a Signalling System No. 7 circuit which has been seized and an Initial Address Message transmitted but the set-up sequence has not as yet resulted in the receipt of an Address Complete Message, the receiving exchange shall: *

- (1) Remove the indicated circuit from service and report the circuit to Maintenance for maintenance action. *
- (2) Reattempt the call on another circuit providing the rejected attempt was a first attempt. If the rejected attempt was a second attempt, either a Release Message should be returned if the incoming circuit uses Signalling System No. 7 or a recorded announcement should be connected if the incoming circuit uses in-band signalling. *

If an Unequipped Circuit Identification Code Message is received for a Signalling System No. 7 circuit subsequent to call set-up, the message should be ignored. However, if an Unequipped Circuit Identification Code Message is received in response to the transmission of the Reset Circuit Message, the circuit should be removed from service and the circuit reported to maintenance for maintenance action. *

In this situation, appropriate action should be taken to expedite the release of an associated incoming or outgoing circuit. *

2.9.8.4 If messages are lost during an end-to-end transfer, appropriate actions will be taken according to the type of end-to-end technique being used.

2.9.8.5 For calls involving the SCCP, expiration of the call supervision timer (concerned with Initial Address Message call setup) will result in the SCCP being notified of an error condition.

2.10 Multi-Level Precedence and Preemption.

Multi-level Precedence and Preemption provides a set of optional call handling procedures for use in an ISDN network. These procedures are applicable to any network which provides the Multi Level Precedence and Preemption capability. Utilization of Multi Level Precedence and Preemption procedures provides essentially non-blocking service to very high priority users. This ensures the ability to communicate during network congestion periods. *

Call treatment in a network which does not implement Multi Level Precedence and Preemption, but which receives messages containing parameters related to precedence or preemption is covered in section 2.10.3. *

2.10.1 Precedence Service. In networks that provide the option for Precedence Service, the precedence (or priority) level of a call is stored in the call data bases of the originating, intermediate and destination exchanges servicing the call. Each subscriber or terminal is assigned a maximum authorized precedence level. Five precedence levels are provided. *

The precedence level may either be selected by the subscriber on a per call basis and keyed into a terminal designated for precedence service or the terminal may be preprogrammed to originate calls at a specific level. The subscriber's originating exchange ensures the selected precedence level does not exceed the maximum level assigned to that terminal. *

The selected precedence level is coded into the calling party category parameter while the Initial Address Message is being assembled. Each exchange in the call route examines and stores the precedence level in its call data base. At each exchange, an idle circuit which is selected to service the call is marked busy at the selected precedence level. *

A call placed at the lowest precedence level is treated as specified in section 2.1 with the addition of the circuit precedence level marking capability. *

A call marked above the lowest precedence level that does not encounter congestion (i.e., trunk blocking) is treated as specified in section 2.1 with the addition of the circuit marking capability. A call marked above the lowest precedence level which encounters congestion invokes the preemption procedures described in section 2.10.2. *

2.10.2 Networks with Multi Level Precedence and Preemption Option

2.10.2.1 Successful Completion by Preemption. Circuit preemption based on call priority is provided. This feature permits the preemption of relatively low priority calls in order to complete higher priority call setups that encounter congestion successfully. The call setup procedures outlined in section 2.1 apply until all other methods for completing a call (i.e., alternate routing) have been attempted. A congestion condition has been encountered when: (1) it is determined that all circuits in the trunk group are busy, and; (2) all other network methods to route the call have been attempted and have failed. If the call cannot be completed by these methods, the following treatment is given to avert congestion during call setup. (The call that the network is trying to successfully complete is referred to as the "offered call". The call which may be preempted is referred to as the "established call.") *

- (1) A search proceeds for a circuit that is busy at a lower precedence level than the offered call. A successful search locates the lowest precedence circuit suitable for preemption. Individual networks may provide their own algorithms to specify the search method. Circuits that are in a *

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transition state (i.e., during call setup, release, etc.) are not considered for preemption. The circuit that is chosen will be in the stable state of an established call.

- (2) If such a circuit is found, the established call on that circuit is preempted as specified in 2.10.2.2 and the offered call setup continues.
- (3) If a suitable circuit is not found, the offered call is released as specified in section 2.2 when a call encounters congestion.

2.10.2.2 Network Release of Preempted Calls. Release of an established call because of preemption is initiated when a search successfully locates a preemptable inter-exchange circuit to service the offered call. The exchange performing the search is referred to as the preemption initiating exchange.

The exchanges which serve as originating and destination exchanges for the established call are referred to as end exchanges in this section.

At the preemption initiating exchange, circuit release sequences must be generated for those circuits terminating the switched connection serving the established call being preempted. Where both terminations of this switched connection are inter-exchange circuits, two different release sequences will be required. The two release sequences are:

- (1) Release of Circuit Reserved for Reuse
- (2) Release of Circuit Not Reserved for Reuse

Release sequence (a) is used to release the circuit selected to complete the offered call. Release sequence (b) is used to release circuits of the established call that will not be reused by the offered call.

Released circuits of a preempted call which are reserved for reuse are utilized to resume the routing of the offered call. To prevent a circuit intended for the offered call from being seized by another call, it will be marked "circuit reserved for reuse" when it is released. Otherwise, the circuit is marked as one of the pool of available circuits at an exchange.

- (1) **Actions at the preemption initiating exchange**
 - (a) **Release of Circuit Reserved for Reuse**

The preemption initiating exchange immediately starts the release of the switched path and, at the same time, sends a Release Message to the succeeding exchange. The Cause Indicators parameter of the Release Message is coded to indicate "preemption - circuit reserved for reuse" by (1) coding the cause value subfield with Cause 45 - "preemption", and (2) coding the location subfield as "local interface controlled by this signalling link". The circuit that has been selected for the offered call is marked "circuit reserved for reuse" in the exchange's call data base. This prevents another call from selecting the circuit between the time the circuit is released and the time the offered call resumes the setup sequence. A timer is started to ensure that a Release Complete Message is received from the succeeding exchange within Time T_1 . (Expiration of this time is covered in section 2.9.6.2).

Expiration of timer T_1 or receipt of a Reset Circuit Signal concerning the circuit reserved for reuse results in the preempt initiating exchange abandoning the selection of the reserved circuit to extend the offered call. The reserved circuit is treated according to the T_1 Expiration procedures of 2.9.6.2 or the Reset Circuit Procedures, whichever is appropriate. Selection of a new circuit to service the offered call is reattempted. The reattempt will search first for an idle circuit before entering the preemptable circuit search specified in section 2.10.2.1. Any call setup failure after initiating the reattempt results in abandoning the offered call as specified in section 2.2 for an unsuccessful call.

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Receipt of a Release Complete Message on the circuit reserved for reuse resumes the setup sequence on the offered call.

(b) Release of Circuit Not Reserved for Reuse

The preemption initiating exchange immediately starts the release of the switched path, and at the same time, sends a Release Message to the succeeding exchange. The Cause Indicators parameter of the Release Message is coded to indicate "preemption - circuit not reserved for reuse" by (1) coding the cause value subfield with Cause 45 - "preemption", and (2) 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 signalling link". A timer is started to ensure that a Release Complete Message is received from the succeeding exchange within Time T_1 . (Expiration of this time is covered in section 2.9.6.2).

(2) Actions at an intermediate exchange

(a) Receipt of Release Message Concerning a Circuit Reserved for Reuse

A preempted circuit that shall be reserved for reuse is indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with (1) a cause value of 45 - "preemption", and (2) a location subfield coded "local interface controlled by this signalling link". On receipt of this Release Message from the preceding exchange, an intermediate exchange will:

(i) immediately start the release of the switched path. The circuit from the preceding exchange is marked "circuit reserved for reuse" in the intermediate exchange's call data base. This prevents another call from selecting the reserved circuit between the time the circuit is released and the time the offered call resumes the setup sequence. When the path has been fully disconnected, a Release Complete Message is returned to the preceding exchange.

(ii) at the same time, send a Release Message to the succeeding exchange. The procedures for release of a circuit not reserved for reuse are employed. The Cause Indicators parameter of the Release Message is coded to indicate "preemption - circuit not reserved for reuse" by (1) coding the cause value subfield with Cause 45 - "preemption", and (2) coding the location subfield to convey appropriate location information to the succeeding exchange. The "local interface controlled by this signalling link" code may not be used in the location subfield. A timer is started to ensure that a Release Complete Message is received from the succeeding exchange within Time T_1 . (Expiration of this time is covered in section 2.9.6.2).

(b) Receipt of Release Message Concerning a Circuit Not Reserved for Reuse

A preempted circuit that is not reserved for reuse is indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with (1) a cause value of 45 - "preemption", and (2) any location subfield code other than "local interface controlled by this signalling link". On receipt of this Release Message from the preceding exchange, an intermediate exchange will:

(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, send a Release Message to the succeeding exchange. The procedures for release of a circuit not reserved for reuse are employed. The Cause Indicators parameter of the Release Message is coded to indicate "preemption - circuit not reserved

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for reuse" by (1) coding the cause value subfield with Cause 45 - "preemption", and (2) coding the location subfield to convey appropriate location information to the succeeding exchange. The "local interface controlled by this signalling link" code may not be used in the location subfield. A timer is started to ensure that a Release Complete Message is received from the succeeding exchange within Time T_1 . (Expiration of this time is covered in section 2.9.6.2).

(3) **Actions at an end exchange**

(a) **Receipt of Release Message Concerning a Circuit Reserved for Reuse**

A preempted circuit that shall be reserved for reuse is indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with (1) a cause value of 45 - "preemption", and (2) a location subfield coded "local interface controlled by this signalling link". On receipt of this Release Message from the preceding exchange, an end exchange will:

- (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" in the end exchange's call data base. This prevents another call from selecting the reserved circuit between the time the circuit is released and the time the offered call resumes the setup sequence. When the path has been fully disconnected, a Release Complete Message is returned to the preceding exchange.

(b) **Receipt of Release Message Concerning a Circuit Not Reserved for Reuse**

A preempted circuit that is not reserved for reuse is indicated by the receipt of a Release Message in which the Cause Indicators parameter is coded with (1) a cause value of 45 - "preemption", and (2) any location subfield code other than "local interface controlled by this signalling link". On receipt of this Release Message from the preceding exchange, an end exchange will:

- (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.

2.10.3 Networks without Multi Level Precedence and Preemption Option. The treatment in networks which do not implement Multi Level Precedence and Preemption procedures shall be limited to conveying, intact, the parameters and values associated with Multi Level Precedence and Preemption. Parameter values specified thus far are the calling party category precedence levels and the release cause for preemption. The network may change the location code associated with the preemption cause value as appropriate.

The network shall treat the calling party category, if coded with one of the five precedence levels, the same as if it were coded as an ordinary calling subscriber.

The network shall treat a preemption release the same as an unspecified network initiated release due to unavailable resources.

2.11 Automatic Congestion Control Procedures.

The Automatic Congestion Control (ACC) System allows a congested exchange to send a congestion indicator in a backward direction to the preceding exchange. The exchange receiving the congestion indication should respond by reducing the amount of traffic offered to the congested exchange.

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The preferred method of conveying the congestion indications is via the relevant common channel signalling system. *

a. Detection and transmission of congestion status *

An exchange should establish a critical operating system benchmark, e.g. the time required to perform a complete basic cycle of operations. The exchange should continuously monitor this benchmark and, when continued levels of nominal performance are not achieved, a state of congestion is declared. Thresholds should be established so that two levels of congestion can be identified, with congestion level 2 (CL2) indicating a more severe performance degradation than congestion level 1 (CL1). When either level of congestion is detected the exchange should have the capability to 1) code an ACC indication in the appropriate signalling messages, and 2) notify its network management support system of its current congestion status. *

The system can offer benefit, however, by recognizing a single level of congestion. Where this situation exists it should be regarded as congestion level 2. *

b. ACC control operation *

Exchanges receiving an ACC indication from an affected exchange or network operations center should have the capability to institute the appropriate ACC controls and to notify its network management support system of the receipt of an ACC indication. *

An exchange receiving an ACC indicator from a congested exchange should activate the assigned ACC controls and start a timer. (The provisional value of the timer is 5 seconds.) Subsequent received ACC indicators restart the timer. When the timer expires the ACC controls in the exchange are removed. *

An exchange receiving an ACC indication should not re-transmit that indication to preceding exchanges. *

c. ACC response *

An exchange should have the capability of assigning an ACC response category to individual circuit groups. One or more different response categories should be available from which to choose. Each category would specify how much traffic should be controlled in response to each of the received ACC indicators. The categories should be structured so as to present a wide range of response options to received ACC indicators. *

An exchange should have the capability of inhibiting the response to received ACC parameters for specific circuit groups, i.e., not controlling future calls based on the receipt of an ACC parameter. *

The control action options for further processing of calls denied access to the circuit group may be to "SKIP" or "CANCEL". The SKIP response allows a call to alternate route to the next circuit group in the routing pattern (if any). The CANCEL response blocks the call. *

NOTE: ACC response categories can be set and ACC responses can be inhibited locally in the exchange or by input from a network management center. *

Table 2 is an example of the flexibility that could be achieved in a control's response to an exchange that is experiencing congestion. *

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Table 2. Example of a 2-Level ACC Percentage Control Response Table

Congestion Level	Traffic Type	Response Category		
		A	B	C
CL1	ART	0	0	100
	DR	0	0	0
CL2	ART	100	100	100
	DR	0	75	75

In this example, different control actions would be taken based upon the distinction between Alternate Routed To (ART) and Direct Routed (DR) traffic types. In the future other distinctions between traffic could be identified that would expand the number of traffic types in Table X. These additional traffic types could be assigned different control percentages in order to give them different treatment during periods of congestion. It could also be possible to exclude priority calls from ACC control.

Methods used to achieve the percentages are implementation specific.

Additional response categories could also be added to Table X to give greater flexibility and more response options to the ACC control.

2.12 Examples of Call Set-up Sequences.

Examples of ISDN call set-up sequences have been removed, as they are superseded by the figures in Q.699.

3. End-to-End Signalling

3.1 Introduction.¹¹

End-to-end messages contain only information which is relevant for the two "endpoints" of a circuit-switched connection. "Endpoints" are signalling points (with user functions) within the Signalling Systems No. 7 network.

Two methods are available for ISDN end-to-end signalling.

- (1) the pass-along method and
- (2) the Signalling Connection Control Part (SCCP) method.

The choice of method is, to some extent, dependent on the size and architecture of the signalling network. Both methods may coexist in a given network. *

Pass-along signalling between two endpoints presently relies on the existence of a circuit-switched connection between the same two endpoints, while the SCCP method is independent of the existence of a circuit switched connection and in general, requires the allocation of a circuit independent call reference to a call.

3.2 Pass-Along Method.

In the pass-along method, use is made of an end-to-end connection which in fact is being set up whenever a physical connection between two end points is established. The end-to-end connection in this case consists of a number of connection sections in tandem which run in parallel with and use the same identification code as the circuits in the physical connection. The association of incoming and outgoing circuits in a transit exchange also establishes the coupling of the connection sections related to these circuits.

The pass-along method defines, section by section, the appropriate label for the message to be passed along end to end; but the content of pass-along messages is neither evaluated (except the message type code) nor changed within intermediate exchanges. The pass-along message group is characterized by a special message type code.

In a connection in which System No. 7 is used exclusively, pass-along messages may be sent in either the forward or backward direction.

A forward pass-along message may be sent after either a backward pass-along or address-complete message has been received and before the physical connection is released.

Call control path information (see § 3.5) included in the initial address and address-complete messages is used to indicate to the connection endpoints whether or not the call control path can support pass-along message transfer (e.g., whether or not Signalling System No. 7 is used in all parts of the connection between the endpoints).

A pass-along message that has been received at a transit exchange and cannot be transferred to the subsequent exchange is discarded without affecting call states and timers in that exchange.

3.3 SCCP Method.

In the SCCP method the ISDN User Part employs the services of the Signalling Connection Control Part (SCCP) for the transfer of end-to-end signalling information.

11. Text from CCITT Red Book, Vol. VI, Fascicle VI.7 related to the use of the pass-along method without physical circuits has been removed from this section.

3.3.1 Call Reference. A call reference is allocated to a call by the ISDN User Part when a possible need for an end-to-end transfer of signalling information exists and this transfer is to be performed by the SCCP. References for a given call are allocated independently in the two concerned signalling points and are exchanged during call set-up. The call reference consists of a call identity and the point code where the call identity is established.

Identification of a call between two signalling points A and B is initiated by signalling point A selecting a call identity CIA and sending it together with the point code of A, PCA, in the Initial Address Message to signalling point B. Signalling point B then allocates its own identity CIB to the call and returns it in a message together with the signalling point code of B, PCB and call identity CIA to signalling point A. Subsequent call related end-to-end signalling information transfers from signalling point A to signalling point B contain call identity CIB and are routed directly using destination point code PCB. Conversely, information transfers from signalling point B to signalling point A contain call identity CIA and are routed using destination point code PCA.

A linkage of call references at network boundaries has to be provided.

Connections relating to a call may be released independently of each other irrespective of whether they are physical (circuit switched connections) or logical (SCCP connections). With the release of the last connection (physical or logical) the call references are released. The release of call references without a connection requires further study.

3.3.2 Connectionless Service. For connectionless service, the ISDN User Part transfers the data to be transmitted to the SCCP together with a request for the appropriate protocol class of service. The signalling information formatting, transfer and delivery of this data to the distant ISDN User Part is controlled entirely by the SCCP. The association between the transferred information and a call is made by the ISDN User Part, which transfers the call reference as part of signalling information for this purpose.

3.3.3 Connection-Oriented Service. Two methods of establishing an end-to-end signalling connection are provided and are described in 3.3.3.1 and 3.3.3.2.

3.3.3.1 Connection Request Sent by the SCCP. In this case, the ISDN User Part behaves like any other user of the SCCP, that is, it transfers a request for connection set-up together with destination address and protocol class of service information to the SCCP. The SCCP then initiates the set up of an end-to-end connection by formatting and sending a connection request message to the destination signalling point. The SCCP also informs the ISDN User Part when connection set-up is complete.

3.3.3.2 Connection Request Embedded in a ISDN User Part Message. A connection request may be carried embedded in one of the forward or backward set-up messages which are used by the ISDN User Part to set up a physical connection. Embedded connection requests are responded to by the SCCP at the destination point, e.g., by returning a connection confirmation message.

If end-to-end connection set-up is to be initiated in the forward direction, e.g., from the originating local exchange, the connection request is carried in the Initial Address Message. Conversely, connection set-up in the reverse direction is initiated by transmitting a connection request in either an address complete message or, if the end-to-end connection is required before address complete can be sent, in a backward setup message.

The necessary information for a connection request is formed by the SCCP and passed to the ISDN User Part. *

3.3.3.3 Protocol Class of Service. The protocol class of service is assumed to be 2. If the connection to be set up by an embedded connection request is of protocol class 3 or 4, the ISDN User Part set-up message must include explicit protocol class and credit indication as well as the SCCP source local reference. The need for protocol classes greater than 2 is for further study.

3.3.3.4 Coupling of Connection Sections. End-to-end connections may consist of a number of connection sections in tandem. The coupling of two connection sections at the tandem signalling points is performed by the SCCP.

For this purpose, embedded connection requests received by the ISDN User Part in a tandem point are passed to the SCCP. The SCCP, in turn, furnishes the ISDN User Part with a connection request for the new connection section in order that it may be included in an outgoing call set-up message.

3.4 Use of the Protocol Control Indicator.

The Protocol Control Indicator is a control information field concerning the end-to-end signalling procedures. It has to be examined to determine the possibility of using the pass-along method or the SCCP method (when an embedded connection request is not included) for the end-to-end transfer messages. The Protocol Control Indicator field is provided within the Initial Address Message and the Address Complete Message.

The following indications are provided:

- (1) Information available that could be transmitted (end-to-end) to the other endpoint,
- (2) Signalling systems No. 7 path between the two endpoints, no interworking along the route (and the opposite),
- (3) Pass along method available,
- (4) SCCP method available,
- (5) ISDN User Part is used all the way.

3.5 Operation of the Pass-Along Method.

Figure 3-1 illustrates the operation of the pass-along protocol. In this figure the PCI is the Protocol Control Indicator in the Initial Address Message; a certain value requires an end-to-end interchange in the set-up phase. "Interworking" in the Initial Address Message or Address Complete Message indicates that the control path is not wholly Signalling System No. 7.

3.6 Operation of the SCCP Method-Connectionless Service.

The procedures for connectionless transfer of information are in accordance with those described in the SCCP specification. Signalling Connection Control Part of Signalling System No. 7.

3.7 Operation of the SCCP Method Connection-Oriented Service

3.7.1 Connection Request Sent by the SCCP. The procedures for connection set-up initiated by a connection request sent by the SCCP are in accordance with those described in the SCCP specification, Signalling Connection Control Part of Signalling System No. 7.

3.7.2 Connection Request Embedded in an ISDN User Part Message

3.7.2.1 Actions at the Originating End Point. The originating end point is the exchange in which the connection request originates.

The following actions are performed in an originating end point:

- (1) The ISDN User Part requests the SCCP to establish a signalling connection to the called address with embedded transfer of the connection request.
- (2) The SCCP forms a connection request and sends it to the ISDN User Part.¹²
- (3) The ISDN User Part transmits a connection request in either:
 - (a) The Initial Address Message, if the originating end point is also the originating point of the call, or
 - (b) in a backward call set-up message (e.g., an address complete message) if the originating end point is also the terminating point of the call.
- (4) The SCCP informs the ISDN User Part of successful or unsuccessful end-to-end connection set-up depending on whether a connection confirmation or a connection refused message was received, respectively, in response to the connection request transmitted within an ISDN User Part message.

3.7.2.2 Actions at an Intermediate Point. An intermediate point is an exchange in which two connection sections belonging to the same end-to-end connection are coupled.

The following actions are performed in an intermediate point:

- (1) Upon receiving an embedded connection request in one of the following set-up messages: Initial Address, Information Request, Information, Address Complete, or Answer, the ISDN User Part transfers the received connection request to the SCCP.
- (2) On receiving the connection request from the ISDN User Part, the SCCP performs the necessary coupling and forms a connection request for a new connection section.¹³
- (3) The ISDN User Part transmits the connection request in a message of the same type as that in which the SCCP call request was received, i.e., in one of the following set-up messages: Initial Address, Information Request, Information, Address Complete, or Answer.
- (4) The SCCP informs the ISDN User Part of successful or unsuccessful set-up depending on whether a connection confirmation or a connection refused was received, respectively, in response to the embedded connection request.

3.7.2.3 Actions at the Terminating Endpoint. The terminating endpoint is the exchange in which the connection request terminates.

The following actions are performed at a terminating end point:

- (1) On receiving an embedded connection request in either an initial address message or backward set-up message, the ISDN User Part passes the received connection request to the SCCP.
- (2) On receiving the connection request from the ISDN User Part, the SCCP initiates connection

12. The SCCP process enters the "connection pending" state.

13. The SCCP allocates an outgoing local reference, informs the ISDN User Part of its value and associates the incoming and outgoing local references and their corresponding point codes. The SCCP process enters the "connection pending" state.

confirmation or connection refused depending on the availability or non-availability respectively, of resources to establish the connection. Connection confirmation or connection refused is initiated in accordance with the procedures described in SCCP, Signalling Connection Control Part procedures.

- (3) If resources are available, the SCCP informs the ISDN User Part of a request to establish an end-to-end connection.
- (4) The ISDN User Part may either accept or refuse the request and informs the SCCP accordingly. The SCCP then either completes connection set-up or releases the connection in accordance with the procedures described in Q.714.

3.8 Interface Elements Between the ISDN User Part and SCCP (embedded transfer).

The ISDN User Part may either use the pure primitive interface to the SCCP or, in addition, the functional interface as designed in draft Q.711.

Three interface elements are defined for this function interface:

- (1) the Request Type 1,
- (2) the Request Type 2,
- (3) the Reply.

The contents of these three interface elements are shown in Annex B to section 3 of Q.764.

Figure 3-2 indicates the usage of the interface elements during set up of a circuit switched connection together with a SCCP connection. *

3.9 Examples of a SCCP Connection Set-up by the ISDN User Part. *

Examples of the set-up of a SCCP connection by the ISDN User Part may be found in Annex A to section 3 of Q.764. *

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COMPLETE SS NO. 7 PATH

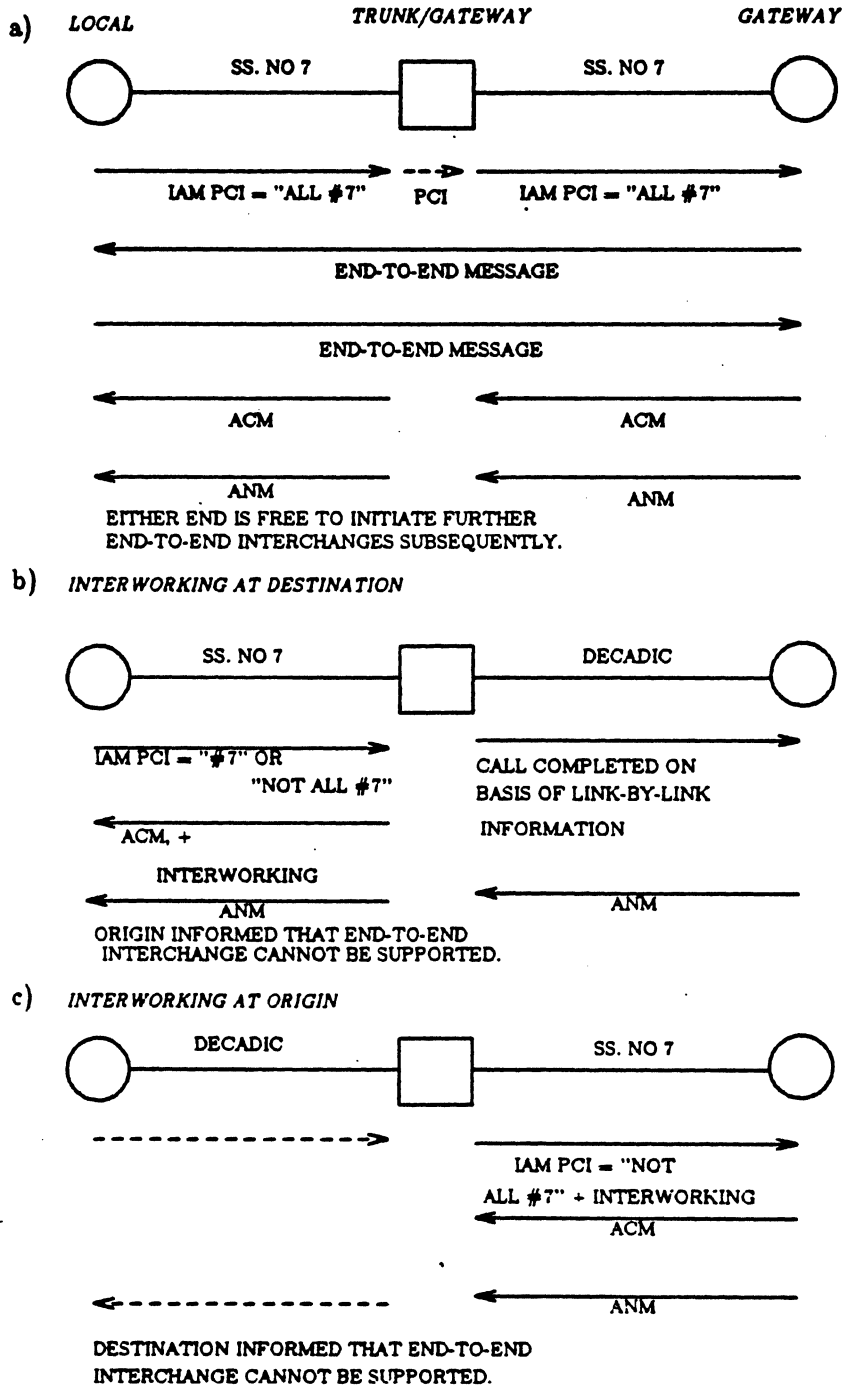


Figure 3-1/Q.764. Operation of end-to-end protocol (pass along method)

*

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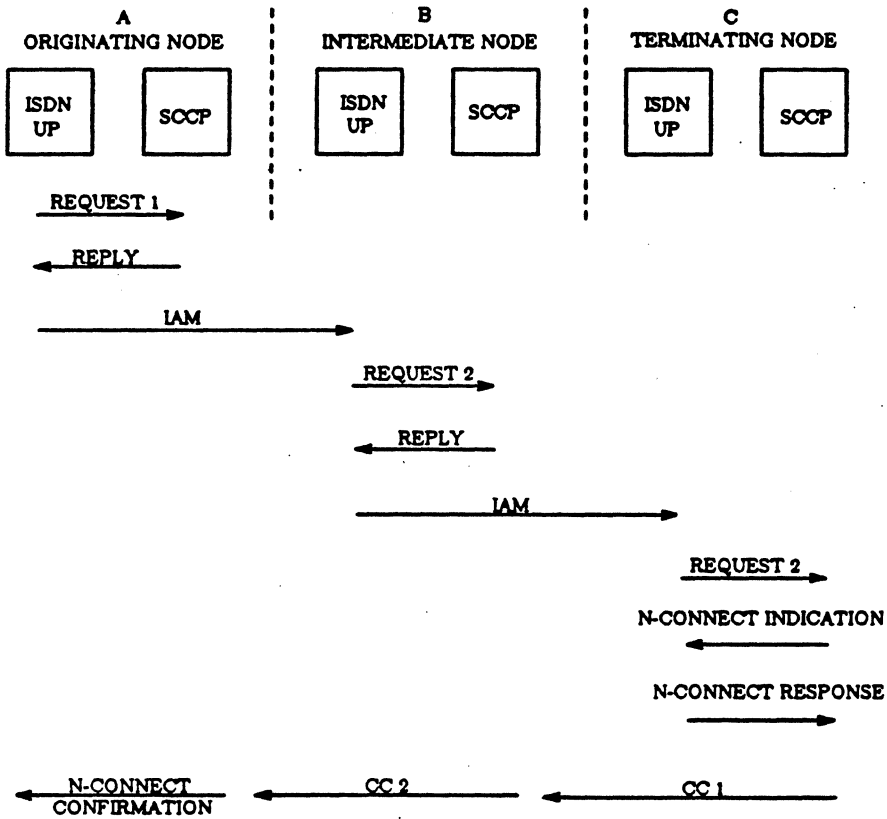


Figure 3-2/Q.764. Setup, resources available, coupling in B

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ANNEX A

(to Section 3 of Recommendation Q.764)

*Examples of the set up of an SCCP connection
by the ISDN User Part*

Figures A-3-1 through A-3-6 give examples for usage of the two methods for set up of SCCP connection controlled by the ISDN User Part. Square brackets [] indicate the ISDN User Part Call Reference(s) and round brackets () indicate SCCP messages.

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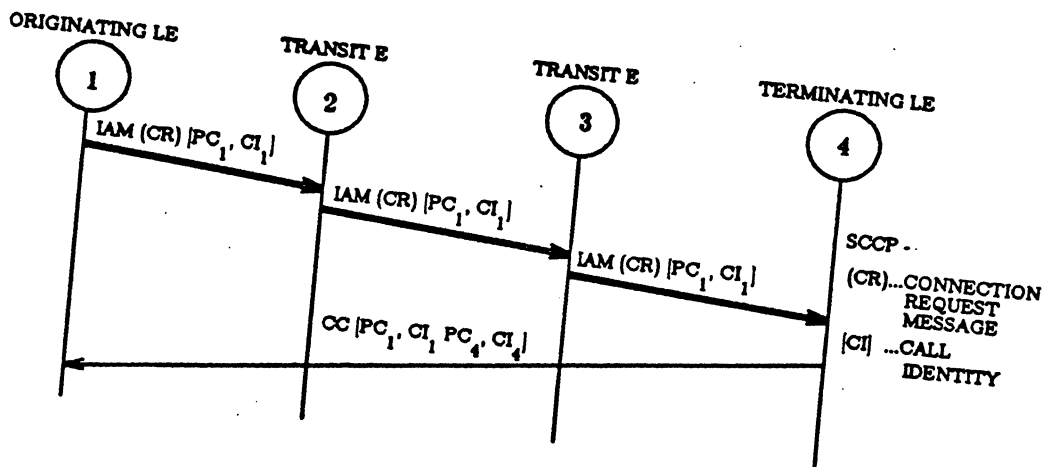


Figure A-3-1/Q.764. Case 1 - implicit setup of SCCP connection in IAM

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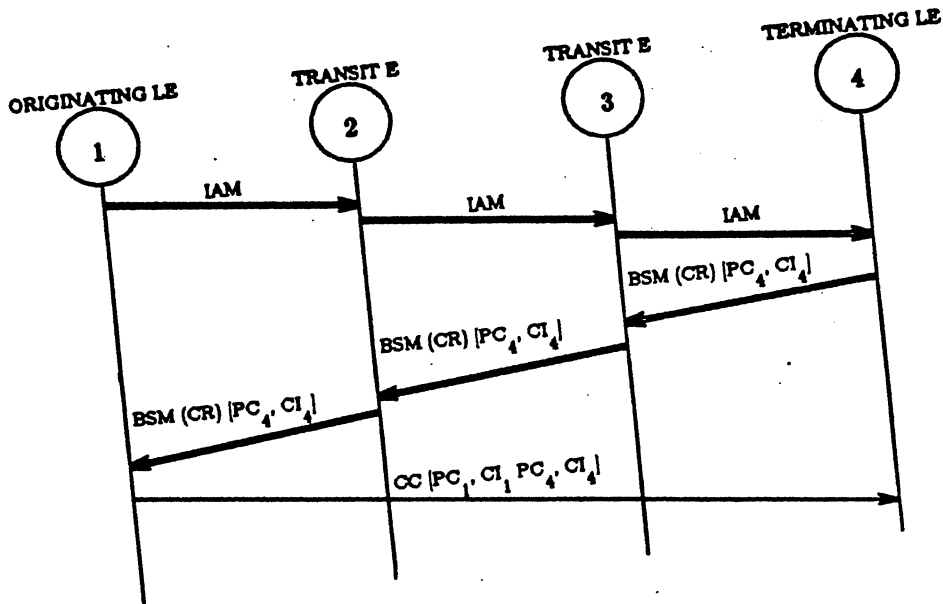


Figure A-3-2/Q.764. Case 2 - implicit setup of SCCP connection in BSM

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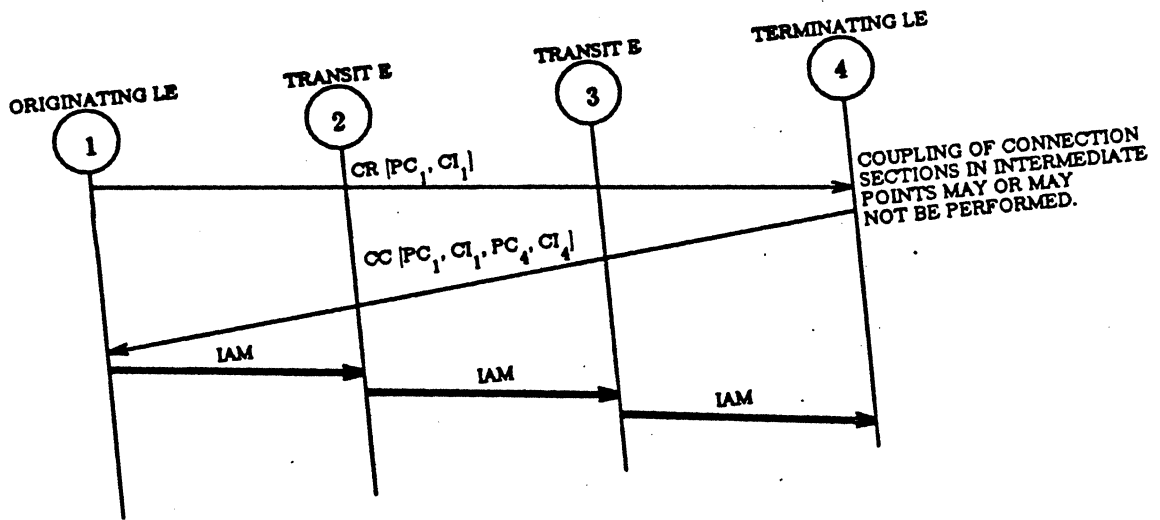


Figure A-3-3/Q.764. Case 3 - explicit setup of SCCP connection

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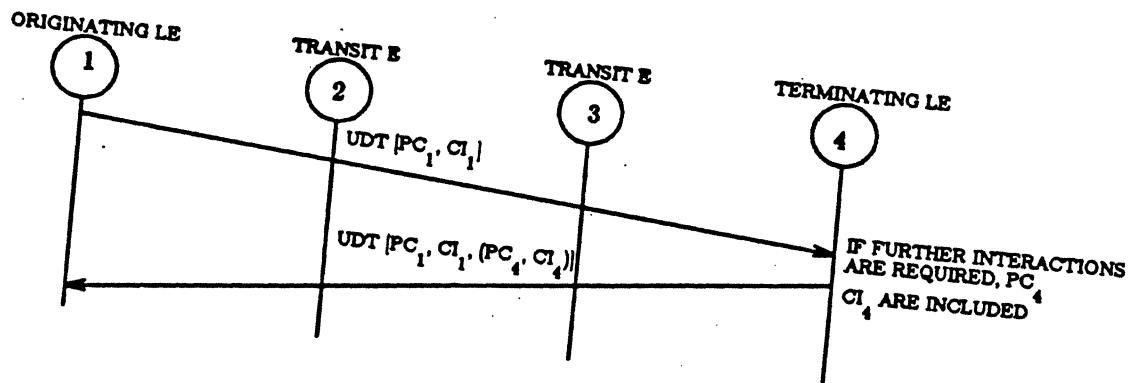


Figure A-3-4/Q.764. Case 4 - connectionless SCCP

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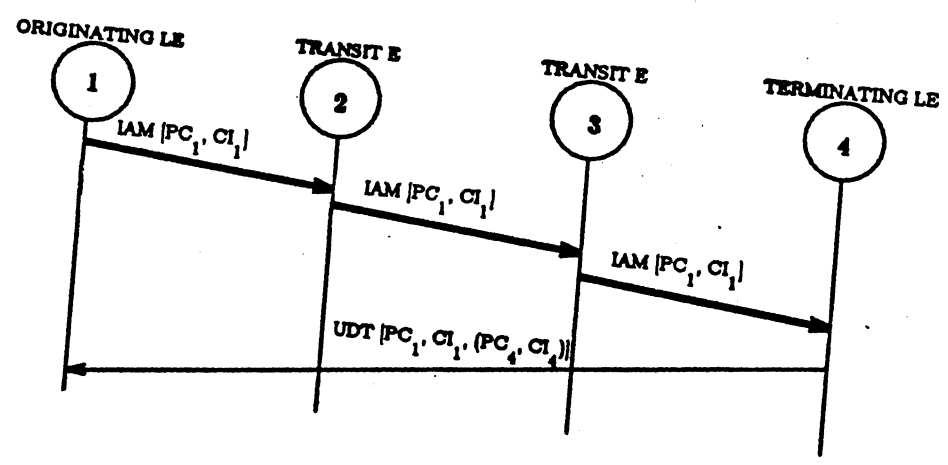


Figure A-3-5/Q.764. Case 5 - connectionless SCCP after transfer of call identity

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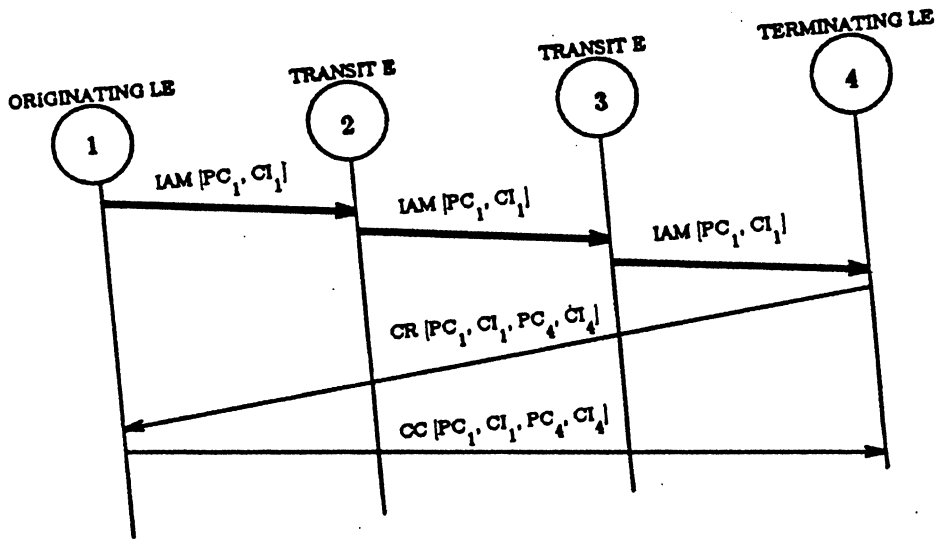


Figure A-3-8/Q.764. Case 6 - explicit SCCP setup after IAM

ANNEX B

(to section 3 of Recommendation Q.764)

CONTENTS OF INTERFACE ELEMENTS

These elements are defined in the SCCP specification and are included here for information.

B.1 Contents of the Request Type 1

The Request Type 1 interface element may contain the following parameters:

- (1) connection identification (for further study)*,
- (2) receipt confirmation selection (for further study)*,
- (3) expedited data selection,
- (4) quality of service parameter set.

B.2 Contents of the Request Type 2

The Request Type 2 interface element may contain the following parameters:

- (1) protocol class,
- (2) credit,
- (3) connection identification (for further study),
- (4) source local reference,
- (5) originating signalling point code,
- (6) reply request.

B.3 Contents of the Reply

The Reply interface element may contain the following parameters:

- (1) source local reference,
- (2) protocol class,
- (3) credit,
- (4) connection identification (for further study).

Figure 3-2 of Q.764 indicates the usage of the interface elements during set up of a circuit switched connection together with an SCCP connection.

* These parameters are also left for further study within Q.711, section 2.1.1.2.3 concerning the use within the primitive connect request.

4. User Facilities

Procedures in this section are for further study. *

4.1 Closed User Group.

Procedures for this facility are to be provided in other service-specific documents. *

4.2 User Access to the Calling Party Address Identification

4.2.1 General. User access to the calling party address identification is a user facility that enables a user to be informed on incoming calls of the address of the calling party. When provided, the facility applies to all incoming calls except for when the calling party has the calling party address presentation restricted facility or the complete address of the calling party is not available at the destination exchange.

The calling party address is the ISDN number of the calling party.

The calling party address presentation restricted facility enables a user to prohibit the forwarding of the calling party address to the called party.

In the case where a national network does not always provide the calling party address facility, the calling party address is the known part of the ISDN number at the interworking point (e.g., Trunk Code).

In the case where the calling party is a PABX, the network can send the ISDN number of the PABX or the DDI number of the extension as the calling party address.

Information indicating that a subscriber has the user access to the calling party address facility or the calling party address presentation restricted facility is available in the exchange to which the subscriber is connected.

4.2.2 Call Set-Up Procedure. The call control procedure and the information included in call control messages vary depending on whether the calling party has indicated a request to use the calling party address presentation restricted facility for this call and whether the calling party address is included in the Initial Address Message.

Two different call control procedures can be used to provide the calling party address facility. Both procedures are specified for international use.

4.2.2.1 The Calling Party Address is Included in the Initial Address Message. In the case where the calling party has indicated the calling party address presentation restricted facility the Initial Address Message includes the calling party address presentation restricted indicator. *

In the case where the complete address of the calling party is not available or not allowed to be forwarded outside the network:

- (1) in the international network, no information regarding the calling party address is included,
- (2) in national networks, the known part of the calling party address could be included. In this case a calling party address incomplete indicator is included in the message.

The calling party address is sent to the called party in accordance with the user-network interface protocol.

In the case where the destination exchange receives the calling party address presentation restricted indicator or the calling party incomplete address indicator in the response message, the calling party address is not forwarded to the called party. *

4.2.2.2 The Calling Party Address is Not Included in the Initial Address Message. In the case where the called party has the user access to the calling party address identification facility, a request is sent towards the originating exchange.

The request is included in an Information Request Message. *

When receiving the request for calling party address, the originating/interworking exchange sends a response including the calling party address. In the case where the calling party has the calling party address presentation restricted facility, the response sent from the originating exchange includes the calling party address presentation restricted indicator. The response is included in an Information Message. The information included in the response, in addition to the calling party address presentation restricted indicator (where applicable), is: *

- (1) In the case where the complete identity of the calling party is known, the originating exchange includes the complete ISDN number of the calling party.
- (2) In the case where the complete identity of the calling party address is not available or is not allowed to be forwarded outside the network the response includes:
 - (a) in international networks the calling party address unavailable signal,
 - (b) In national networks, in addition to the calling party address unavailable signal, the response can include the known part of the calling party address. In this case the response includes the calling party incomplete address indicator.

The calling party address is sent to the called party in accordance with the user-network interface protocol. *

In the case where the destination exchange receives the calling party address presentation restricted indicator or a calling party incomplete address indicator in the response message, the calling party address is not forwarded to the called party. *

4.3 User Access To Called Party Address Identification

4.3.1 General. Called party address identification is a user facility that enables a user to be informed on outgoing calls of the identity of the user to which the call has been connected.

The called party address is the ISDN number of the user to which the call has been connected.

In the case where the networks, needed for establishing the call, do not provide the called party address identity facility, the called party address identity is the ISDN number at the interworking point (e.g. Country Code, Trunk Code). When the called party has the address presentation restricted facility (e.g., in diversion), the user access to called party address identification facility is not provided.

Information indicating that a subscriber has the called party address identification facility is available at the exchange to which the user is connected.

In the case where the called party is a PABX, the called party address is either the ISDN number of the PABX or the DDI number of the extension to which the call is connected.

4.3.2 Call Set-Up Procedure. In the case of a call from a user having the called party address identification facility, the call control information forwarded by the originating exchange at call set-up includes a request for called party address identification. The request is included in the Initial Address Message.

When the destination/interworking exchange receives the request for called party address identification, the destination/interworking exchange returns a response, including the called party address identity. In the case that the called party has the address presentation restricted facility, the exchange also includes the called party address presentation restricted indicator. The response is included in an end-to-end message.

- (1) In the case where the networks needed to establish the call, provide the called party address identification facility, the called party address identity is the complete ISDN number of the user to which the call is connected,
- (2) In the case where the networks needed to establish the call do not provide for the called party address identification facility, the response includes the identity of the network at the

interworking point and an indication showing that the called party address identity is not complete.

4.4 Redirection of Calls.

Procedures for this facility are to be provided in other service-specific documents. *

4.5 Connect When Free and Waiting Allowed.

This service is not supported.

4.6 Completion of Calls to Busy Subscriber

Procedures for this facility are to be provided in other service-specific documents. *

4.7 Network Access to the Calling Party Address Identification.

[Note: The option of MCI with hold is not supported.] *

4.7.1 General. The network access to the calling party address identification is a network capability which enables a network to obtain the calling party address from within the network or from another network. The capability is used for example in malicious call identification, charging, etc.

4.7.2 Malicious Call Identification (MCI). The malicious call identification gives the possibility to obtain, by an appropriate request, the identification of the calling party and the original called party (in the case of a redirected call). The identification request prompts the destination exchange, or optionally the originating exchange, to obtain and store the following information: *

- (1) called party address, *
- (2) calling party address and possibly the original called party address, *
- (3) time and date of the call. *

The identification request can either be activated before, during or after the conversation phase.

Two different options of the facility are defined, namely:

- (1) MCI with hold,
- (2) MCI without hold.

One or both options should be provided in a national network.

In case a) the holding of the connection is requested in addition to the identification of the calling party. The clearing of the connection is subject to called party clearing.

In case b) only the identification of the calling party is requested.

4.7.3 Call Set-Up Procedure

4.7.3.1 Actions at the Destination Exchange. In case of an incoming call to a user having the MCI facility the call set-up procedure depends on whether or not the calling party address is included in the Initial Address Message and which options (without hold or with hold) the called party has been assigned.

- (1) The calling party address is included in the Initial Address Message:
 - (a) in the case where the called party has the MCI without hold indication the calling party address, and possibly the original called address, is stored in the destination exchange,
 - (b) In the case where the called party has the MCI with hold indication the calling party address and possibly the original called party address, is stored at the destination exchange and a request for holding of the circuit is sent to the originating exchange.
- (2) The calling party address is not included in the Initial Address Message:
 - (a) in the case where the called party has the MCI without hold indication, an Information

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- Request Message is sent to the originating exchange requesting the calling party address,
- (b) In the case where the called party has the hold indication, the Information Request Message will include a request for the holding of the circuit and for the calling party address.

In addition to the information mentioned above the request will also include the MCI request indicator. The request will be sent in a general request message.

4.7.3.2 Actions at Intermediate Exchange. When receiving the MCI request, the transit exchange will normally repeat the request to the preceding exchange. However, in two cases the transit exchange acts differently:

- (1) In the case of interworking with networks that do not provide the calling party address facility, the relevant transit exchange will send a response including the identity of the transit exchange. The identity of the transit exchange could either be the known part of the calling party address in that exchange or, in national networks, the signalling point code of the transit exchange. In addition to the identity of the transit exchange the response can also include the identity of the incoming circuit. The interworking exchange may also arrange the holding of the incoming circuit even if not explicitly requested. *

In the case where the information request also includes the hold request the transit exchange will make the clearing of the circuit subject to the called party clearing.

- (2) In the case where the MCI cannot operate (due to administrative or technical reasons) the relevant exchange includes in the Information Message the MCI not provided indicator.

4.7.3.3 Actions at the Originating Exchange. On receipt of the information request, the originating exchange sends an Information Message containing the calling party address and the hold provided information. If holding of the connection is provided the clearing of the circuit will be subject to the called party clearing (i.e., subject to the receipt of the Release Message from the called party).

4.7.4 Release Procedures

4.7.4.1 In the case where no holding of the circuit is requested, the normal release procedure will apply.

4.7.4.2 In the case where the holding of the circuit is requested, the following procedures apply:

- (1) If the calling party hangs-up first the originating exchange will apply the hold of the connection and stop the charging (if applicable). Moreover the originating exchange may send forward the Delayed Release Message.

When receiving the Delayed Release Message, an intermediate exchange stops the charging (if applicable) and forwards the Delayed Release Message to the succeeding exchange. *

When receiving the delayed release signal the destination exchange starts a timer T_{10} . The purpose of this timer is to allow release of the network hold in the case that the called party does not activate MCI or release the call

The value of T_{10} is a national option.

- (2) Regardless of whether or not the calling party has attempted to release the call, one of the following procedures applies:
 - (a) In the case where the facility request is made before the called party disconnects, no Release Message will be sent until appropriate action has been taken (e.g., maintenance action). If applicable, T_{10} is stopped when the facility request is received.
 - (b) When the called party disconnects, the destination exchange may start a timer T_{11} to allow a facility request to be made after the conversation has been terminated.

The actions at the destination exchange will depend on whether facility request has been made or not.

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- (i) In the case where the facility request was not made, the expiration of the timer T_{11} will result in sending of the Release Message. The timer T_{10} is stopped (if applicable).
- (ii) In the case where the called party makes the facility request before the timer T_{11} expires, no release signals will be sent until appropriate actions have been taken. The timers T_{11} and T_{10} (if applicable) are stopped when the facility request has been received.

4.8 Screening List Entry Validation

Procedures for this facility are to be provided in other service-specific documents.

*
*
|

**APPENDIX I CONTINUITY CHECK PROCEDURES
(ADOPTED FROM TUP)**

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The following sections relative to the continuity check have been extracted from Recommendation Q.724, Sections 7 and 8 since these specifications are directly applicable to the ISDN-UP Signaling Procedures Recommendation Q.764.

1. Continuity-Check For 4 Wire speech Circuits

1.1 General. This specification relates only to that part of a 4-wire connection served by Signalling System NI. 7. The part of the speech path to be checked may include a circuit with speech interpolation. As the presence of active echo suppressors in the circuit would interfere with the continuity-check, it is necessary to disable the suppressors during the check and to re-enable them, if required, after the check has been completed.

The *transceiver* (check-tone transmitter and receiver) is connected to the *go* and *return* paths of the outgoing circuit at the first and each succeeding exchange, excluding the last exchange, in that part of the connection served by Signalling System No. 7. The *check loop* should be connected to the *go* and *return* paths of the incoming circuit at each exchange except the first in that part of the connection served by Signalling System No. 7. A continuity-check is considered successful when a tone is sent on the *go* path and is received on the *return* path within acceptable transmission and timing limits. (See however, Section 1.3 for an optional national continuity check procedure.)

1.2 Transmission Requirements.

1.2.1 Transmitting equipment. The *check-tone* frequency will be 2000 ± 20 Hz. For international and national applications the sending level of the check-tone will be -12 ± 1 dBm0. * *

1.2.2 Check-loop. The check-loop will have loss of $0 \pm .1$ dB, taking into account any difference between the relative levels of the two paths at the point of attachment. * *

1.2.3 Receiving Equipment. The check-tone receiver will have the following characteristics:

a. *Operating requirements*

Check-tone frequency: 2000 ± 30 Hz

Check-tone level range for international and national applications:

The absolute power level N of the check-tone shall be within the limits $(-18 + n) \leq (-6 + n)$ dBm where n is the relative power level at the receiver input.

Recognition time: 30-60 ms

The frequency and level range tolerances allow for variations at the sending end and for variations in line transmission that are considered acceptable.

b) *Non-Operating requirements*

Signal frequency: outside the frequency band 2000 ± 200 Hz

Signal level for international applications: below or equal to $-22 + n$ DBm.

An asterisk (*) indicates a change from the CCITT Red Book which is specified to the U.S.

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The limit is 10 dB below the nominal absolute level of the check-tone at the input of the receiver. If the level falls below this point, transmission is considered unacceptable.

Signal duration: shorter than 30 ms

the level range of $(-18+n) \leq N \leq (-6+n)$ dBm will serve as a Go/No-go check on the links in that part of the international connection served by Signalling System No. 7.

c) Release requirements

If the receiver is used to test for the removal of check-tone (see § 1.3):

- after recognition of tone, interruptions of up to 15 ms shall be ignored; this will prevent switching through the speech path prematurely;
- the indication of tone removal should not be delayed more than 40 ms; and
- the release level of the receiver shall be lower than $-27 = n$ dBm for international application.

1.3 Continuity-check Procedure. Decision on whether continuity-check should be performed or not on a given circuit should be made by an outgoing exchange according to the criteria described in Recommendation Q.764 section 2.1.6. The outgoing exchange will indicate whether continuity-check is required or not by the continuity-check indicator in the initial address message (Recommendation Q.763 Section 3.2.3). If it is required, the outgoing exchange will connect a transceiver to the speech circuit when it sends an initial address message. If continuity-check is not required either on the incoming circuit or on the outgoing circuit, the outgoing exchange can switch-through the speech path immediately after having sent the initial address message.

A description of the procedure using the specification and description language is given in the state transition diagrams in Figures 4/Appendix IV and 5/Appendix IV. The Signalling System No. 7 exchange will send forward the continuity signal after completion of all the following actions:

- the continuity-check performed on the outgoing circuit is completed;
- the speech path across the exchange has been checked and found correct (See Recommendation Q.764 Section 2.1.6); and
- if the continuity-check indicator in the received initial address message indicates that continuity-check is being (has been) performed on previous circuit(s), receipt of a continuity signal from the preceding exchange.

The speech path may be switched through at an international transit or incoming exchange and the transceiver disconnected after the continuity-check of the circuit has been successfully completed. However, the switching through of the speech path should be delayed until the residual check-tone has propagated through the return path of the speech circuit.

This determination may be made by timing, or by using the check-tone receiver to test for the removal, or other appropriate means.

As a national option the following single report procedure may be used to assure that on terrestrial circuits a complete check of both directions of transmission in the face of high noise and in the double seizing situations has been made. With this procedure, the continuity check is not considered successful

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until the check tone is recognized and its subsequent removal recognized within the continuity check timing interval. On tone recognition it must be ensured that at least 60 ms of continuity check tone has been sent. In the double seizing case, this procedure will ensure that both ends will recognize the check tone if both directions of transmission are within acceptable transmission limits. The end originating the continuity check, in the case of double seizing the control end, insures that the continuity signal is sent on successful completion of the check. The exchange at the other end of circuit removes the loop (or transceiver in the case of double seizing) on receipt of the continuity signal. If this exchange is the last common channel signalling exchange, the address complete signal is not returned until either the loop (transceiver in the double seizing case) is disconnected. With the single report continuity check procedure, the first exchange that has initiated the continuity check must delay through-connect until receipt of an address complete signal to avoid the potential hazards associated with delayed loop removal.

On receipt of the continuity signal in the following international exchange, the continuity-check loop will be removed if inserted. Also, any digits of the national number which were withheld may be released (see Section 1.2).

At Signalling System No. 7 exchange, on failure of the outgoing circuit to satisfy the continuity-check:

- the continuity-check transceiver will be removed and an automatic repeat attempt will be made on another circuit.
- a continuity-failure signal will be send to the following exchange.

A repeat of the continuity-check of the speech path will be made on the failed outgoing circuit within 1-10 seconds of detection of the continuity-check failure.

The second continuity-check will be initiated by the Signalling System No. 7 exchange detecting the failure using the continuity-check-request signal.

If the repeated check passes on this call, the speech circuit will be returned to idle with a released/release complete sequence. If the second check fails, the maintenance staff will be alerted that a failure has occurred and the check will be repeated at intervals of 1-3 minutes. The repeated continuity-check will only be finished when continuity is detected or manual intervention occurs.

According to transmission maintenance requirements, Signalling System No. 7 may provide for:

- a. a print-out each time a second continuity-check is started. In such cases, the circuit involved should be identified;
- b. a print-out each time a continuity-check results in a warning being given to maintenance personnel.

Since a continuity-check failure can be caused by a faulty transceiver, precautions should be taken to ensure a low probability of selecting a faulty one for both the initial continuity-check and the second check, e.g., by ensuring the selection of a different transceiver for each of the checks.

1.4 Continuity-check Timing

1.4.1 Time-out Period. The continuity-check is considered to have failed if the receiver has not responded within a period determined by the Administration concerned. This period should not exceed two seconds.

The time-out period of the continuity-check should always exceed the continuity recognition time, T_{CR} , given by:

$$T_{CR} = 2T_p = T_{IAM} + T_{TC} + T_L + T_R - T_T$$

where

- T_p One-way propagation time of the speech circuit and the signalling link (where these times are the same),
- T_{TC} Speech interpolation clip time for two speech interpolation systems in series (for connections not using speech interpolation $T_{TC} = 0$),
- T_R Receiver response time,
- T_L Loop connecting time (maximum),
- T_T Transceiver Connecting Time (minimum),
- T_{IAM} Emission time of the longest initial address message.

If retransmission of an initial address message is to be included in T_{CR} , the following formula may be used:

$$T_{CR} = 4T_p + 2T_{IAM} + T_{FISU} + 2T_x + T_L - T_T$$

where

- T_{FISU} Emission time of a fill-in signal unit (length of a fill-in signal unit),
- T_x Time between receiving an initial address message and emitting a signal unit containing an acknowledgement for that initial address message, or time between receiving a signal unit asking for retransmission and emitting the initial address message to be retransmitted.

1.4.2 Switching of Continuity-check Equipment. The connection and disconnection of the equipment used for the continuity check and also the disabling and subsequent enabling of echo suppressors should be related to the following stages of progress in the establishment of the connection:

- a. *Preparation at Signalling System No. 7 exchange applying the transceiver* - Action should be initiated when the initial address message is available for transmission in the Message Transfer Part.
- b. *Preparation at Signalling System No. 7 exchange connecting the check-loop* - Action should be initiated at the moment of recognition of the initial address message received.
- c. *Disconnection at Signalling System No. 7 exchange connecting the check-loop* Action follows the receipt of the continuity signal, the continuity-failure signal or the released signal, or the emission of signals indicating that the call cannot be established, e.g., circuit-group-congestion signal.
- d. *Disconnection at Signalling System No. 7 exchange applying the transceiver* - Action should be initiated on the successful completion or the failure of the continuity-check.

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Exceptionally, if disconnection has not previously occurred, action should be initiated at the moment of recognition of the address-complete signals, the answer signals, signals indicating that the call cannot be established, or on the emission of a released signal.

It is recommended that the mean time, both for the connection and for the disconnection, be less than 100 ms. A mean time of 200 ms should not be exceeded.

1.5 Continuity-check Test Calls The following procedure may be used in the cases when continuity-check is performed by test calls. This procedure is used to test a single interexchange circuit, which must be idle when the procedure is initiated.

When the outgoing Signalling System No. 7 exchange intends to initiate the procedure, it sends to the following exchange a continuity-check-request message and it connects the transceiver to the outgoing speech circuit. On receipt of the continuity-check-request message, the following exchange connects the loop to the involved circuit. On detection of the backward tone within the time-out specified in section 1.4.1 the outgoing exchange will disconnect the transceiver and the circuit will be returned to idle with a release/release complete sequence.

In the case that no backward tone is detected within the specified time-out, the same actions apply as in the case of continuity-check failure during normal call set-up see Section 1.3 (the clause referring to the repeat attempt is not relevant in this case).

If an exchange will receive an initial address message relating to a circuit for which it has sent a continuity-check-request message (i.e., in case of collision on a both-way operated circuit), it will abort the continuity-check test call, disconnect the transceiver and complete the incoming call.

An exchange receiving a continuity-check-request message after having send an initial address message, will ignore it and continue the call set-up procedure.

2. Continuity-Check For 2-Wire Speech Circuits

In general the same procedure as described in Section 1 is used for the continuity-check of 2-wire speech circuits except the check-loop has to be replaced by a transponder and in the backward direction the frequency 1780 ± 20 Hz is used. A more detailed specification of this particular case needs further study.

APPENDIX II FUNCTIONAL BLOCK DIAGRAM AND SIGNALLING PROCEDURE CONTROL

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1. State Transition Diagram Organization

The state transition diagrams (STDs) for ISDN-UP are organized such that a main signalling procedure control (SPRC) message dispenser acts as the interface for Common Channel Signalling (CCS) message reception and transmission. The SPRC message flow is covered in this appendix, while the Call Processing Control (CPC) and Maintenance Process Control (MPC) STDs are presented in separate appendices. Figure 1 shows a functional block diagram indicating the relationship between the various controlling modules; the STDs for SPRC are shown in Figure 2.

Note that in the STDs in this and the two related appendices, functional blocks other than SPRC are considered internal, and SPRC is considered to be external to these functions. Messages between functional blocks other than SPRC are thus shown as internal messages; message to and from SPRC are shown as external messages.

2. Functional Block Diagram and SDL Abbreviations

The abbreviations used in the Attached functional block diagram and STDs are listed in Table 1 below.

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TABLE II-1 Block Diagram and SDL Abbreviations

BLR -	Blocking/Unblocking Signal Reception
BLS -	Blocking/Unblocking Signal Sending
CCO -	Continuity Check Outgoing
CCI -	Continuity Check Incoming
CGRR -	Circuit Group Reset Reception
CPC -	Call Processing Control
CRI -	Continuity Recheck Incoming
CRO -	Continuity Recheck Outgoing
CRR -	Circuit Reset Reception
CRS -	Circuit Reset Sending
DCO -	Demand Continuity Outgoing
HBUR -	Hardware Blocking/Unblocking Reception
HBUS -	Hardware Blocking/Unblocking Sending
HGA -	Hardware Carrier Group Alarm
L3 -	Level 3 (Signalling network functions)
L4 -	Level 4 (ISDN User Part)
MBUS -	Maintenance Blocking/Unblocking Sending
MBUR -	Maintenance Blocking/Unblocking Reception
MPC -	Maintenance Process Control
SBUR -	Software Blocking/Unblocking Reception
SBUS -	Software Blocking/Unblocking Sent
SCGA -	Software Carrier Group Alarm
SPRC -	Signalling Procedure Control

APPENDIX II FUNCTIONAL BLOCK DIAGRAM AND
SIGNALLING PROCEDURE CONTROL

Q.764

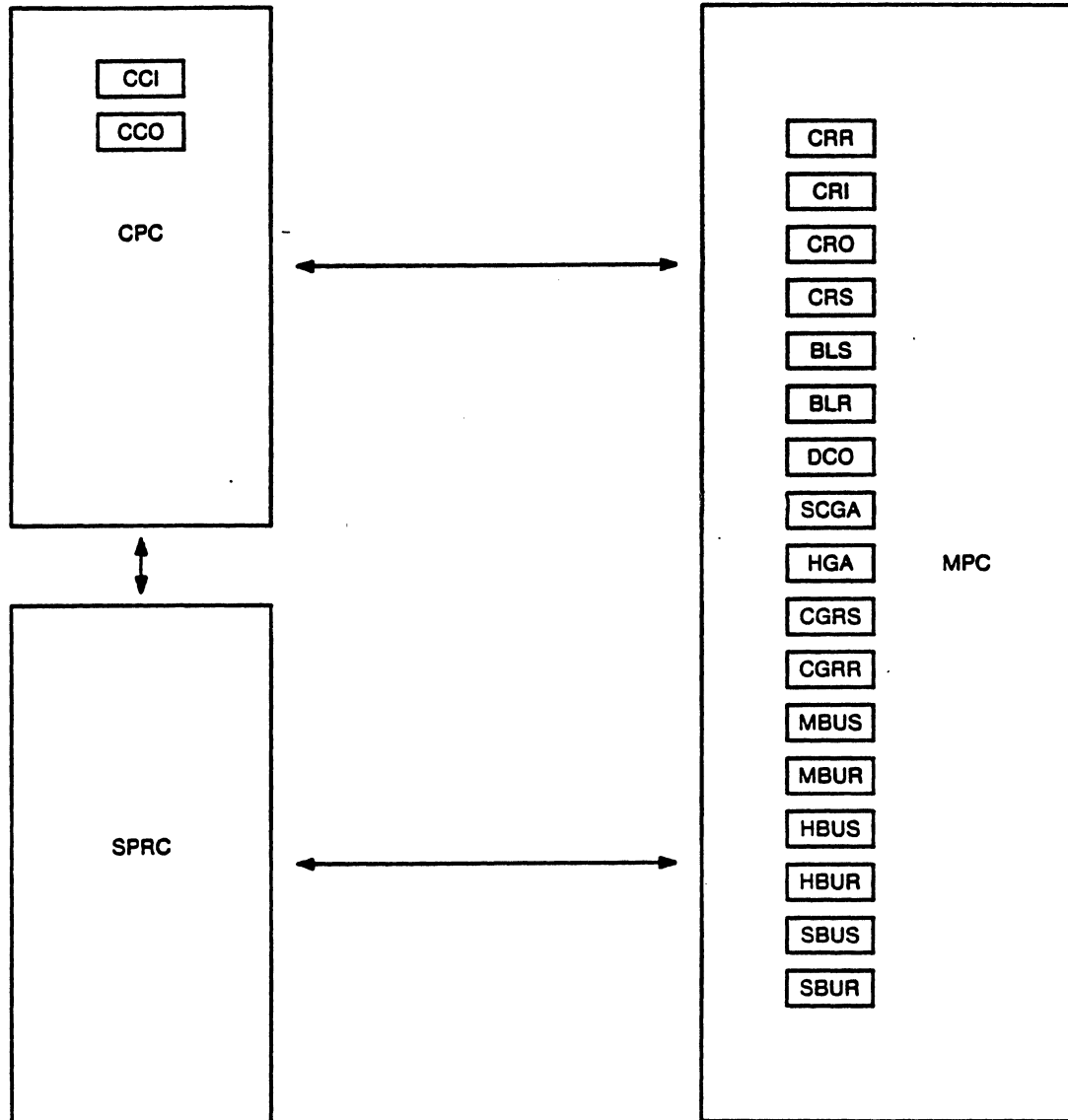


Figure II-1/Q.764
Functional block diagram

BCA313

APPENDIX II FUNCTIONAL BLOCK DIAGRAM AND
SIGNALLING PROCEDURE CONTROL

Q.764

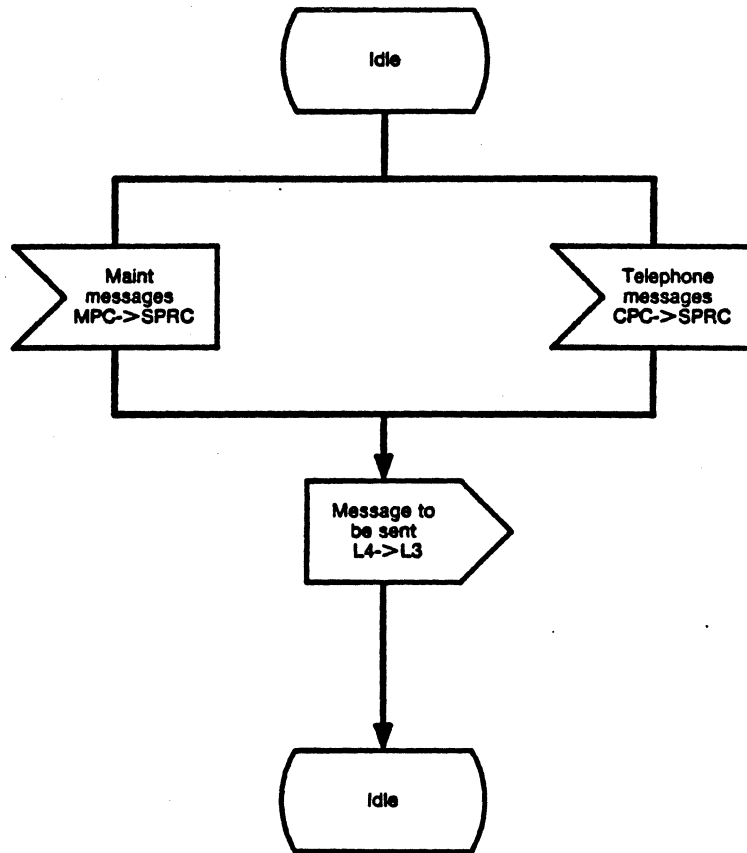


Figure II-2/Q.764 (Sheet 1 of 3)
Signalling process control (SPRC)

APPENDIX II FUNCTIONAL BLOCK DIAGRAM AND
SIGNALLING PROCEDURE CONTROL

Q.764

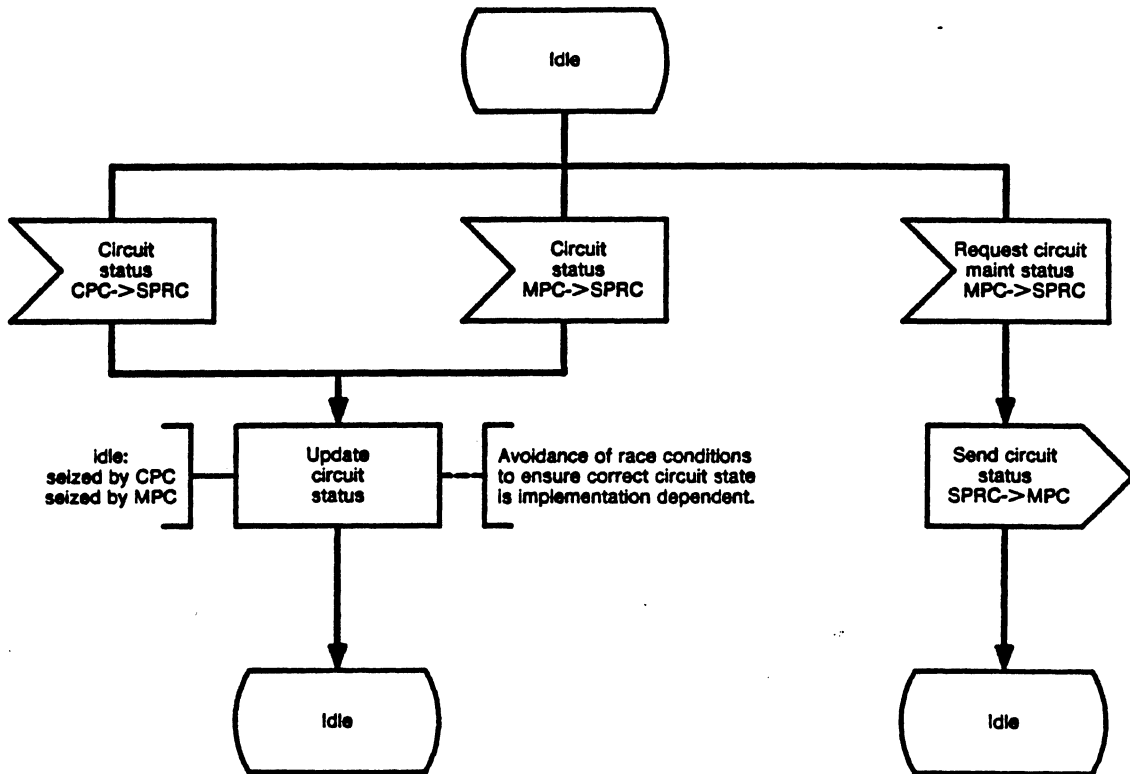
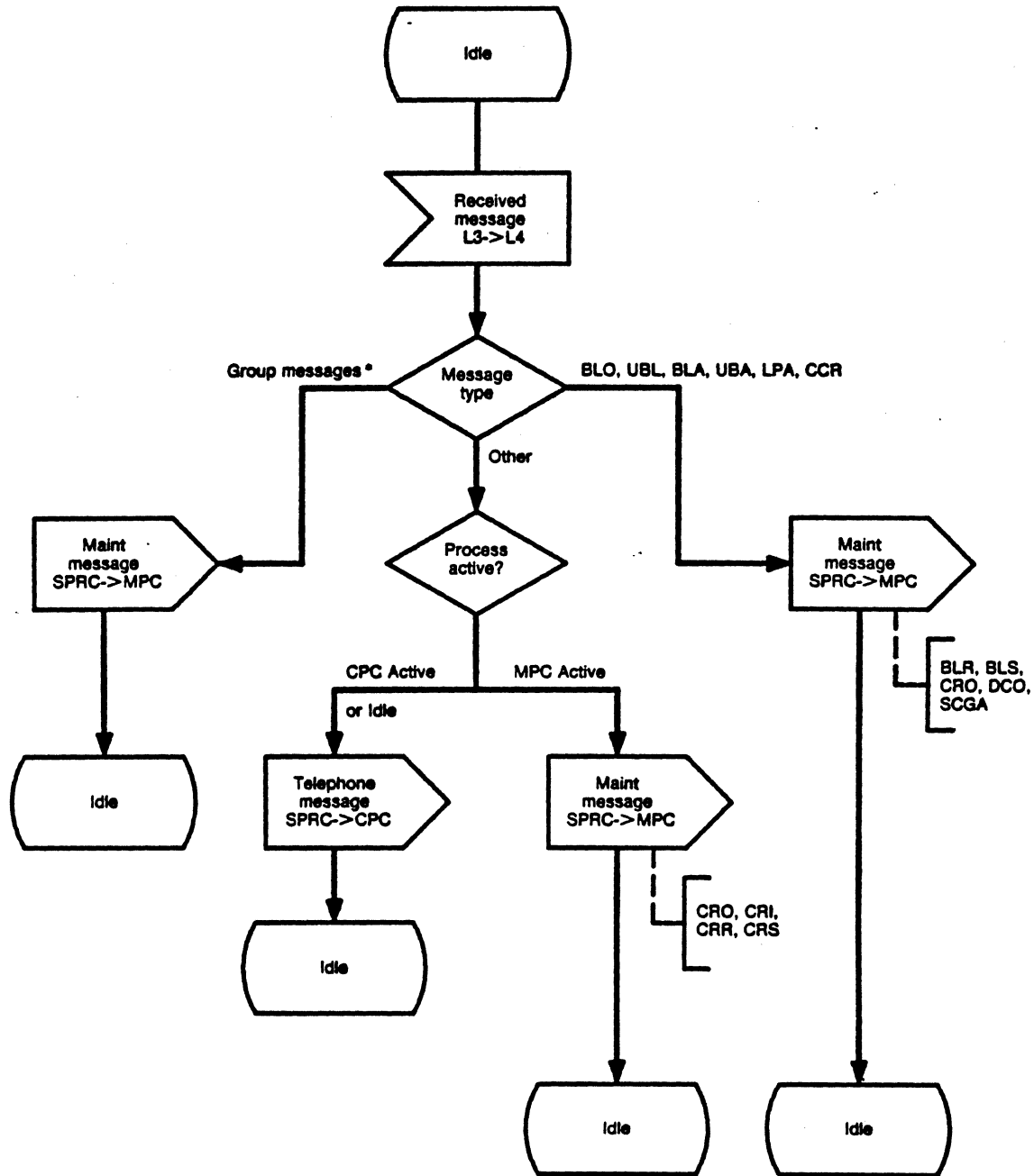


Figure II-2/Q.764 (Sheet 2 of 3)
Signalling process control (SPRC)

APPENDIX II FUNCTIONAL BLOCK DIAGRAM AND
SIGNALLING PROCEDURE CONTROL

Q.764



* Hardware Group Blocking, Hardware Group Blocking Acknowledgment, Hardware Group Unblocking, Hardware Group Unblocking Acknowledgment, Maintenance Group Blocking, Maintenance Group Blocking Acknowledgment, Maintenance Group Unblocking, Maintenance Group Unblocking Acknowledgment, Software Group Blocking, Software Group Blocking Acknowledgment, Software Group Unblocking, Software Group Unblocking Acknowledgment, Group Reset, Group Reset Acknowledgment

Figure II-2/Q.764 (Sheet 3 of 3)
Signalling process control (SPRC)

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

The following sections relate to the call processing control state transition diagrams.¹

1. Introduction

This Appendix covers the CCITT Specification and Description Language (SDL) diagrams to indicate the signalling procedures of the Integrated Services Digital Network User Part (ISDN-UP).

The attached diagrams cover most of Section 2 of Recommendation Q.764, the basic call setup control and signalling procedures (but do not include any of the procedures from the user facilities section). The maintenance procedures are covered in Appendix IV although maintenance interfaces are indicated on the diagrams. User flow control and network management are not included in this Appendix and are for further study.

2. SDL Diagram Organization

The SDL diagrams attached for ISDN-UP are organized such that a main signalling procedure control (SPRC) message dispenser (see Appendix II) acts as the interface for Common Channel Signalling (CCS) message reception and transmission.

Note that in the SDL diagrams, functional blocks other than SPRC are considered internal, and SPRC is considered to be external to these functions. Messages between functional blocks other than SPRC are thus shown as internal messages; messages to and from SPRC are shown as external messages.

This Appendix contains diagrams for Call Processing Control (CPS), which receives and transmits message to SPRC, and performs the appropriate call processing actions necessary. The CPC diagrams have been divided into incoming and outgoing circuit states and actions, to facilitate the later specifications for interworking with other protocols. The CPC SDL diagrams are shown in Figures 1-3.

1. These sections are not in the international specification and normally would be annotated with an * unless otherwise shown.

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

3. CPC SDL States, Abbreviations and Timers

3.1 CPC SDL Diagram States. The ISDN-UP states used in the attached SDL diagrams are shown in Table III-1 below. As in the CPC diagrams, these states have been divided into those used in incoming and outgoing circuit handling.

TABLE III - 1 Call Processing Control States

	State Name	State Name
Incoming States	Idle	0
	Wait for Additional Digits ²	
	Wait for OGC Selection	2
	Wait for COT	3
	Wait for OGC Complete	4
	Wait for Answer	5
	ICC Answered	6
	ICC Network Suspend	7
	Wait for RLC	9
Outgoing States	Idle	0
	Wait for Continuity Reports	1
	Wait for Address Complete	2
	Wait for Answer	3
	OGC Answered	4
	OGC Network Suspend	5
	Wait for RLC	7

2. This state is not required in U.S. Networks.

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

3.2 CPC Abbreviations. The abbreviations used in the attached SDL diagrams are listed in Table III-2 below.

TABLE III - 2 Call Processing Control Abbreviations

<i>General</i>	
OGC -	Outgoing Trunk Circuit
ICC -	Incoming Trunk Circuit
CCH -	Continuity Check Indicator
VPA -	Voice Path Assurance
CFL -	Call Failure
TRD -	Timed Release Disconnect
<i>Function Block Names</i>	
SPRC -	Signalling Procedure Control
CPC -	Call Processing Control
*BLR -	Blocking/Unblocking Signal Reception
*BLS -	Blocking/Unblocking Signal Sending
CCO -	Continuity Check Outgoing
CCI -	Continuity Check Incoming
*CRI -	Continuity Recheck Incoming
*CRO -	Continuity Recheck Outgoing
*CRR -	Circuit Reset Reception
*CRS -	Circuit Reset Sending
LS -	Level 3 (Signalling network functions)
L4 -	Level 4 (ISDN User Part)
<i>Messages</i>	
ACM -	Address Complete Message
ANS -	Answer
BLA -	Blocking Acknowledgment
BLO -	Blocking
COT -	Continuity
FOT -	Forward Transfer
IAM -	Initial Address Message
NP -	Network Pause (Suspend)
NR -	Network Resume
REL -	Release
RLC -	Release Complete
RST -	Reset Circuit
SAM -	Subsequency Address Message ³
SSD -	Second Start Dial ⁴
UBA -	Unblocking Acknowledgment
UBL -	Unblocking

*Maintenance Function Interface

3. Procedure associated with the SAM will be removed in Issue 2.

4. For further study.

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

3.3 CPC Timers. A list of the timers used in the CPC SDL diagrams in given in Table III-3 below.

TABLE III - 3 Call Processing Control Timers

Timer Name	Description
COT timer	Timer while Release while waiting for continuity message (10 to 15 seconds)
Digit timer	Timer while waiting for SAMs after IAM is received (4 seconds) 5
Recvd RLS timer	(deleted)
Send RLS timer	Timer for sending repeated Release message while waiting for Release Complete (4 to 15 seconds) (T1)
RLC timer	Timer while waiting for Release Complete (1 minute)
TRD timer	Timed Release Disconnected timer; timer when clear back is received while waiting for possible reanswer (10 seconds) (T13)
ACM timer	Timer while waiting for Address Complete message (20 to 30 seconds)

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

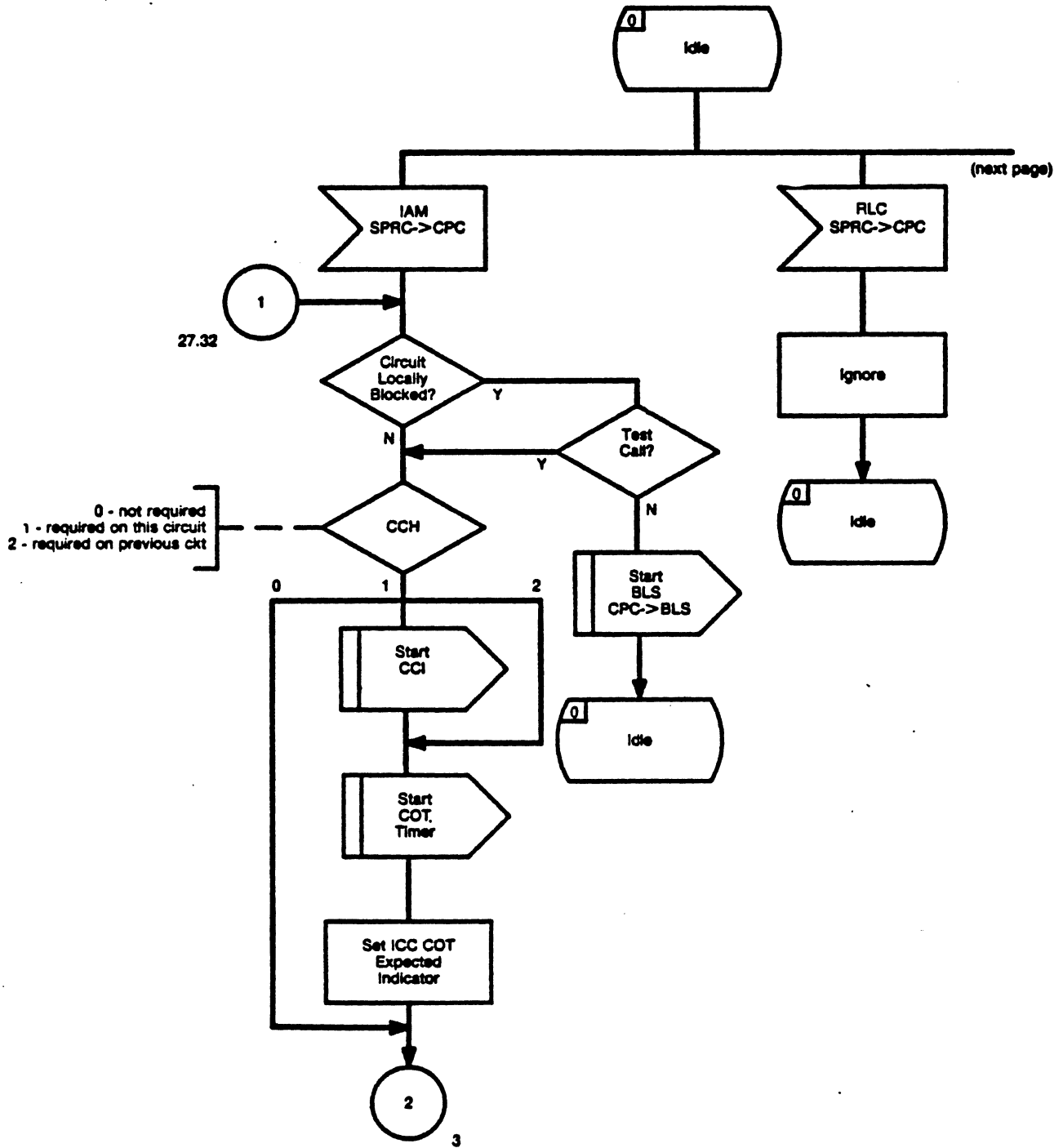


Figure III-1/Q.764 (Sheet 1 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

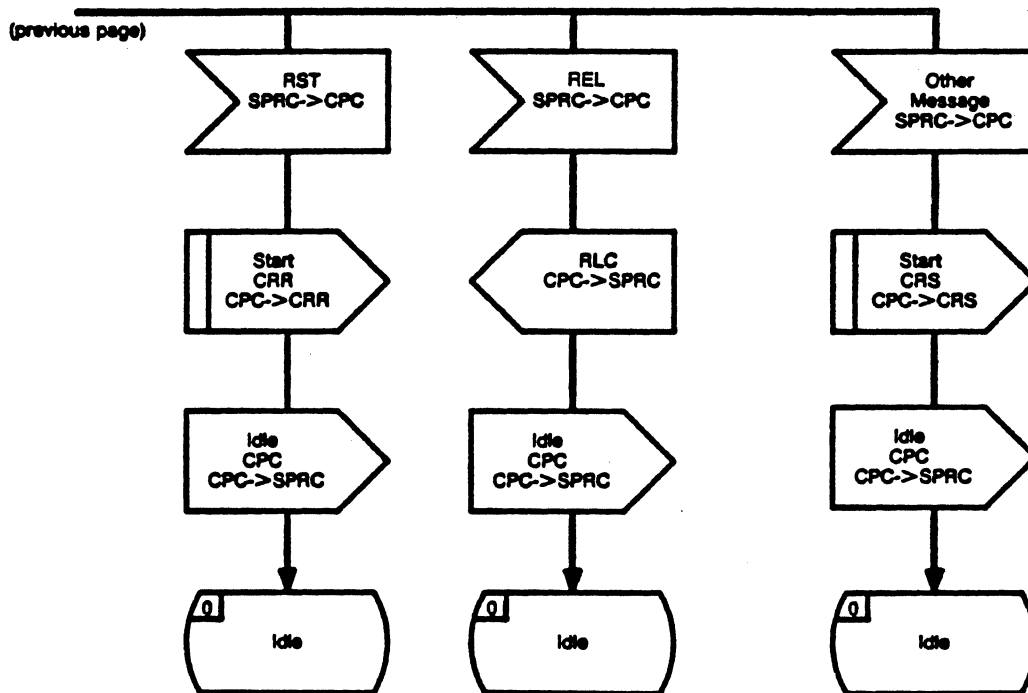


Figure III-1/Q.764 (Sheet 2 of 41)
Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

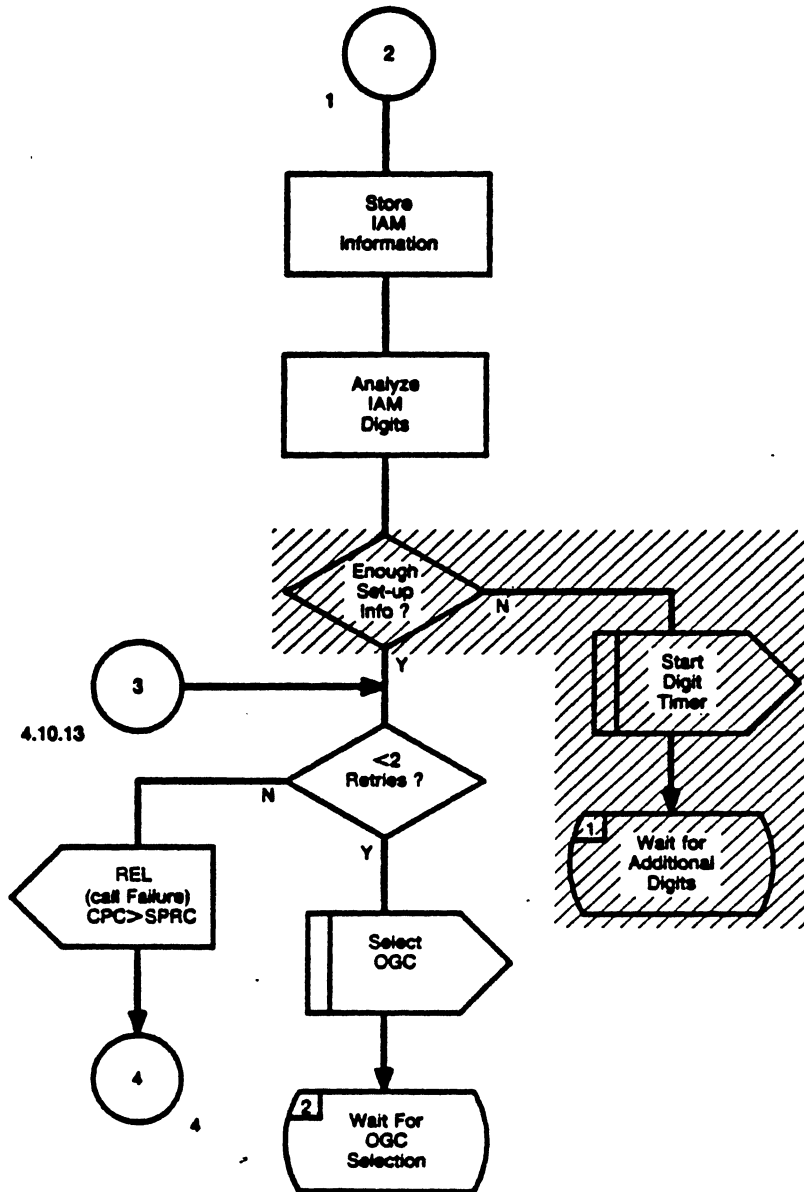
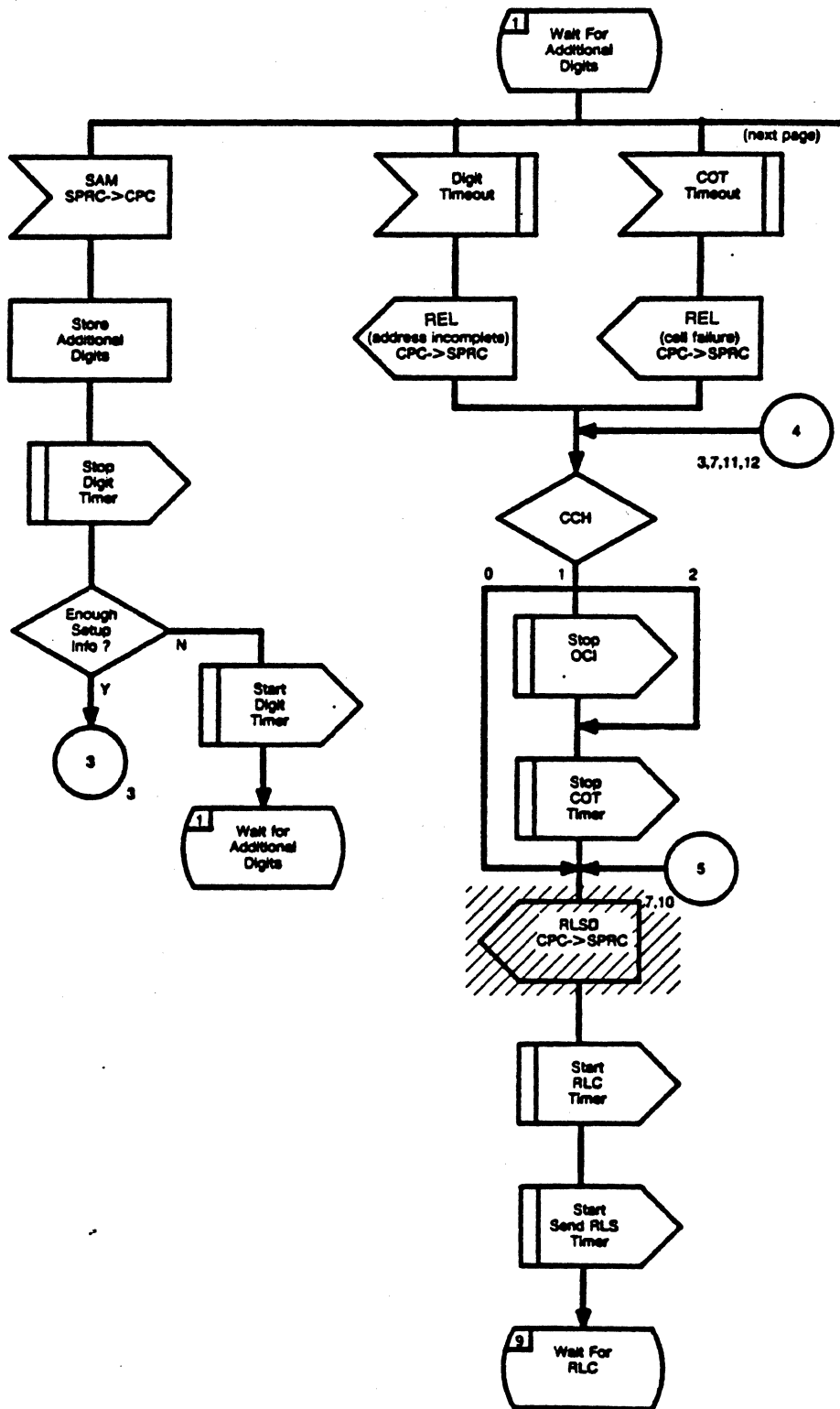


Figure III-1/Q.764 (Sheet 3 of 41)
 Call Processing Control (CPC) Incoming

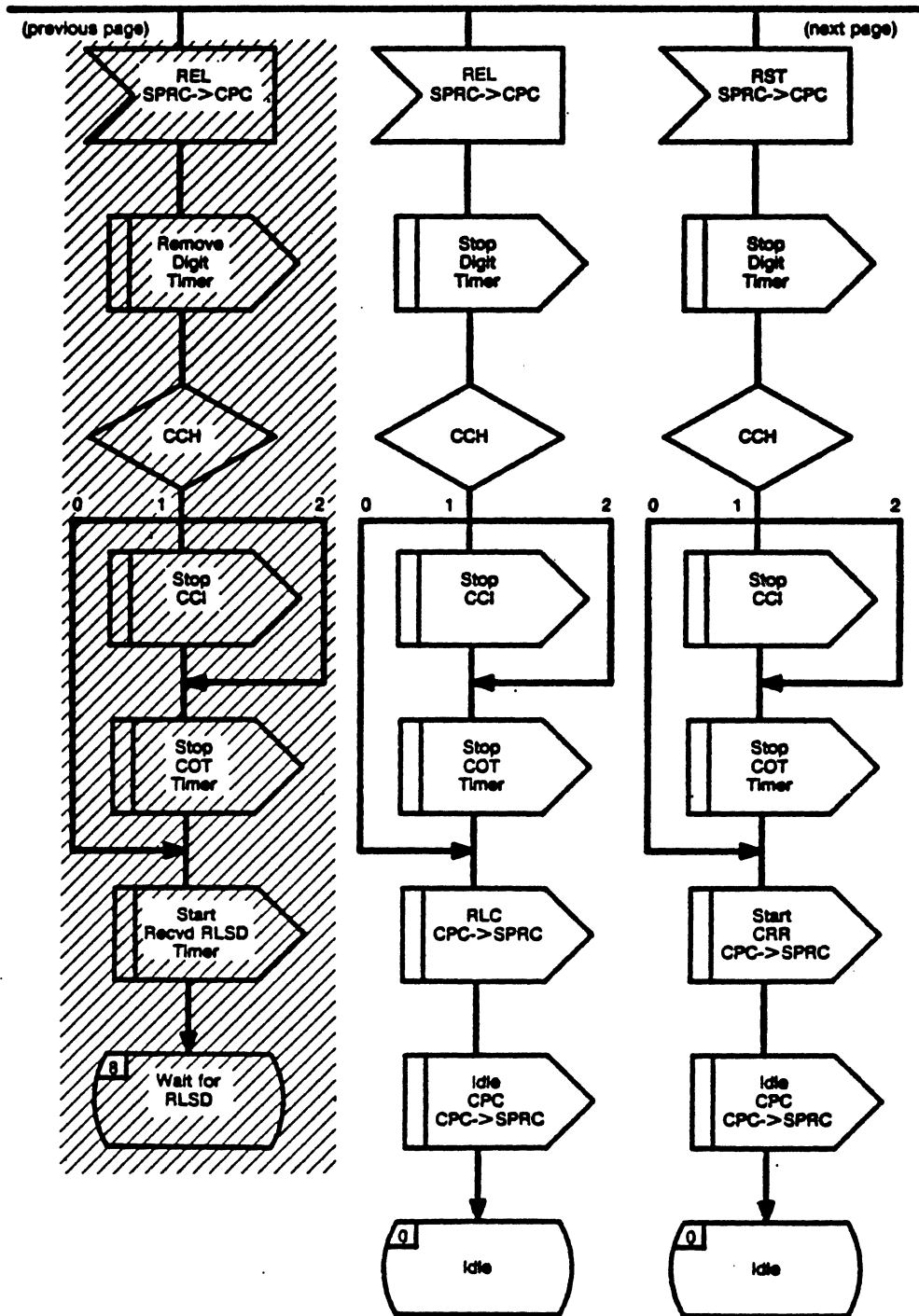
APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS



[Not used in U. S. Networks]

Figure III-1/Q.764 (Sheet 4 of 41)
 Call Processing Control (CPC) Incoming

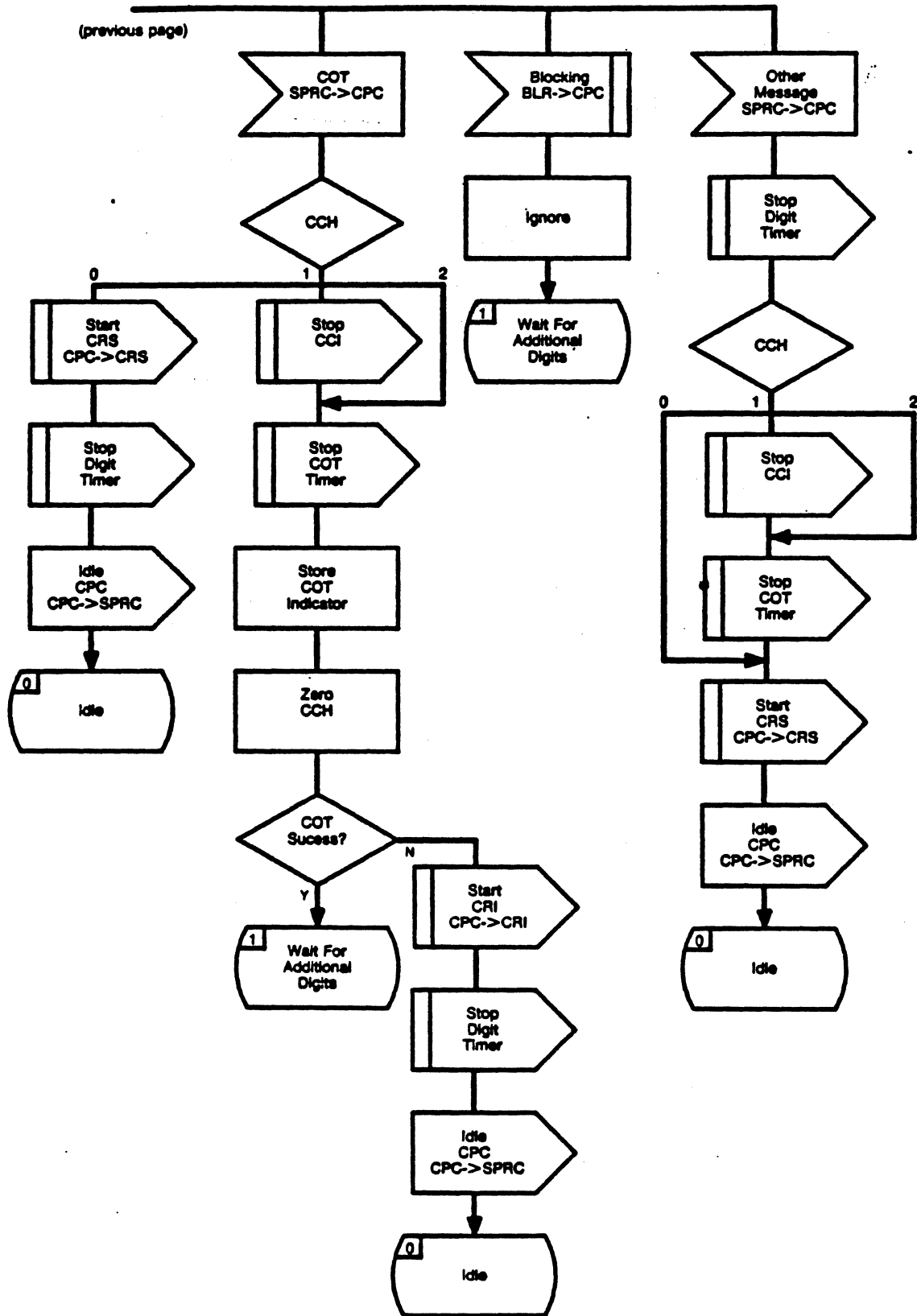
APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS



[Not used in U. S. Networks]

Figure III-1/Q.764 (Sheet 5 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS



[Not used in U. S. Networks].
 Figure III-1/Q.764 (Sheet 6 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

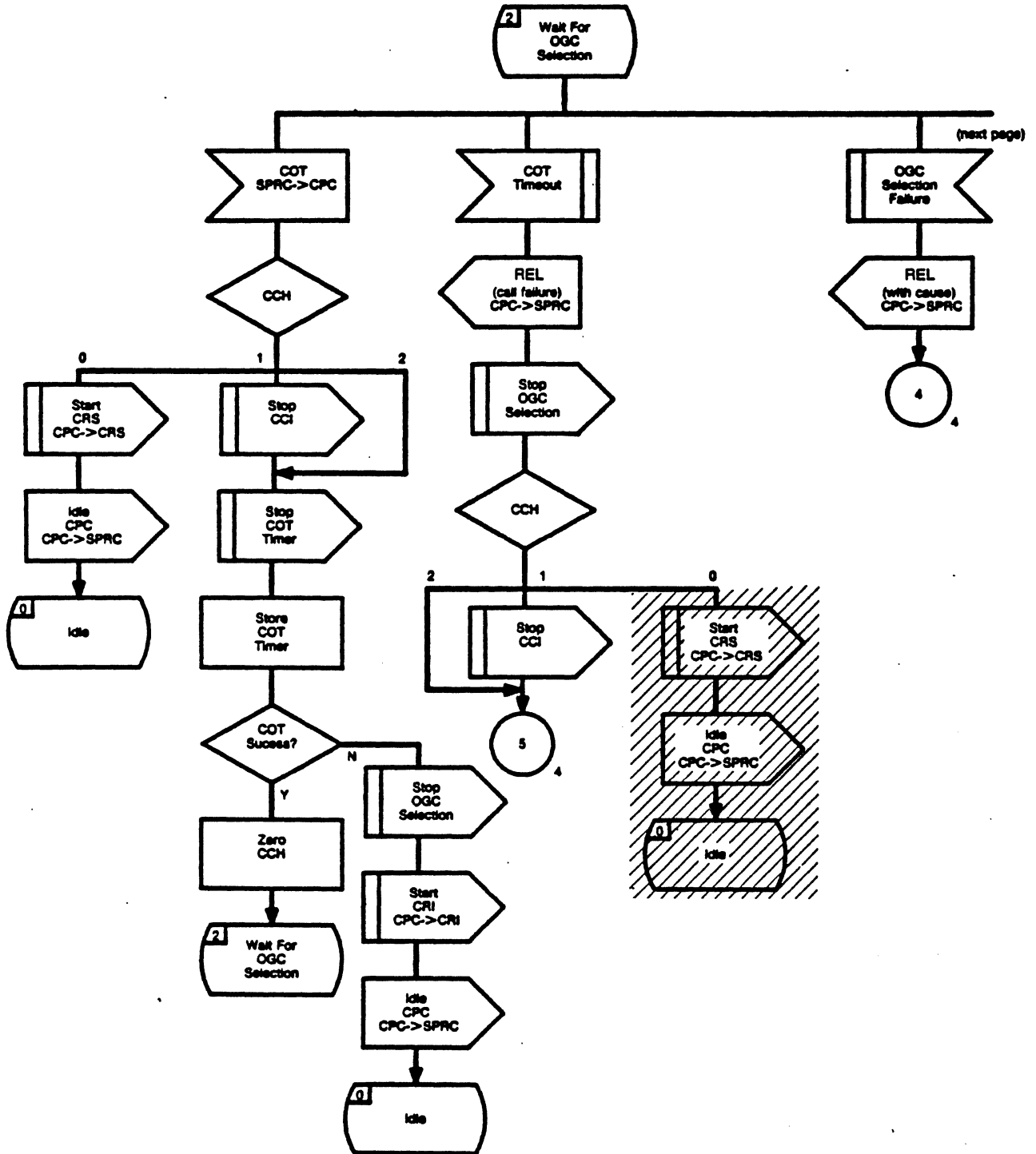


Figure III-1/Q.764 (Sheet 7 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

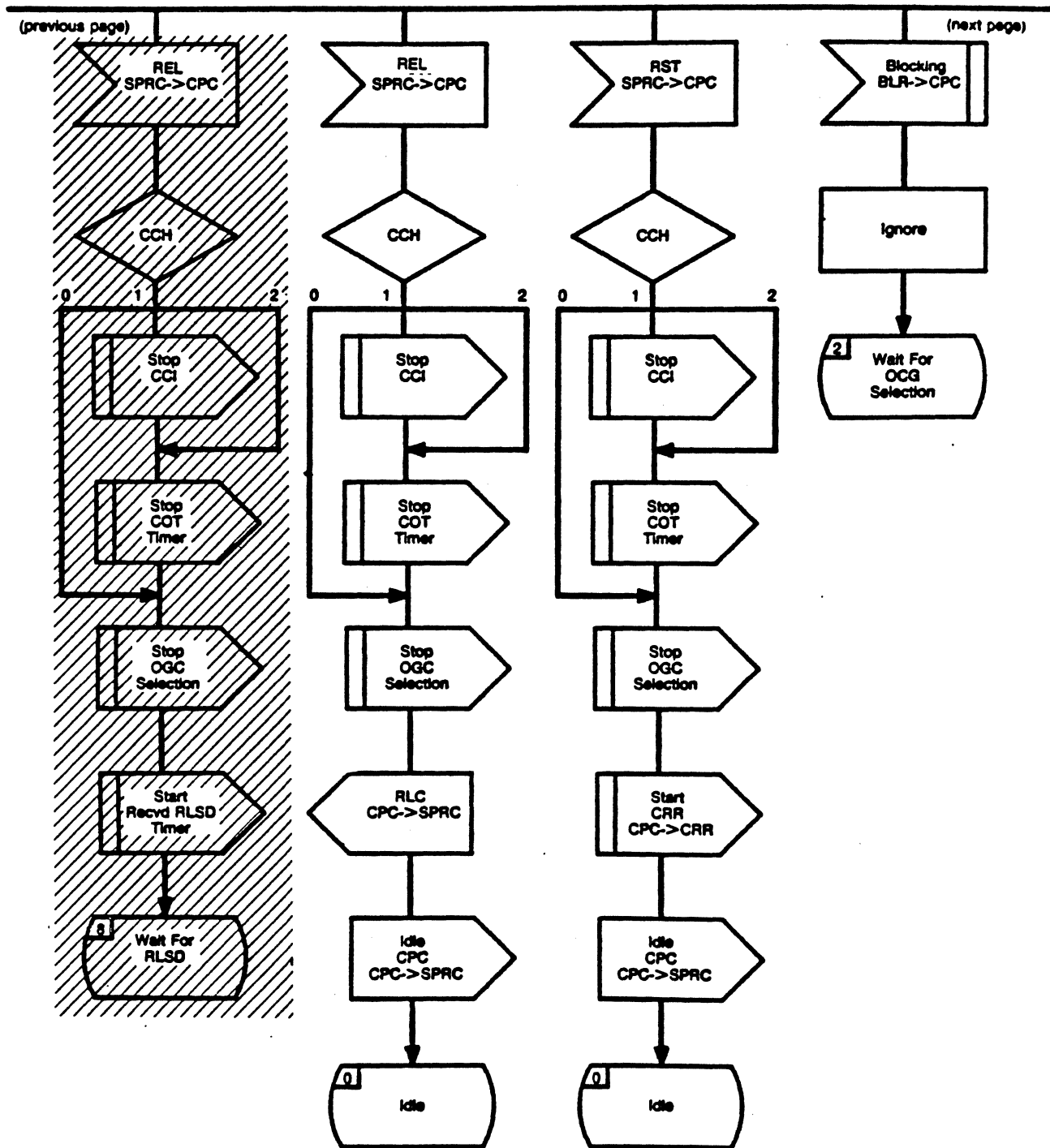


Figure III-1/Q.764 (Sheet 8 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

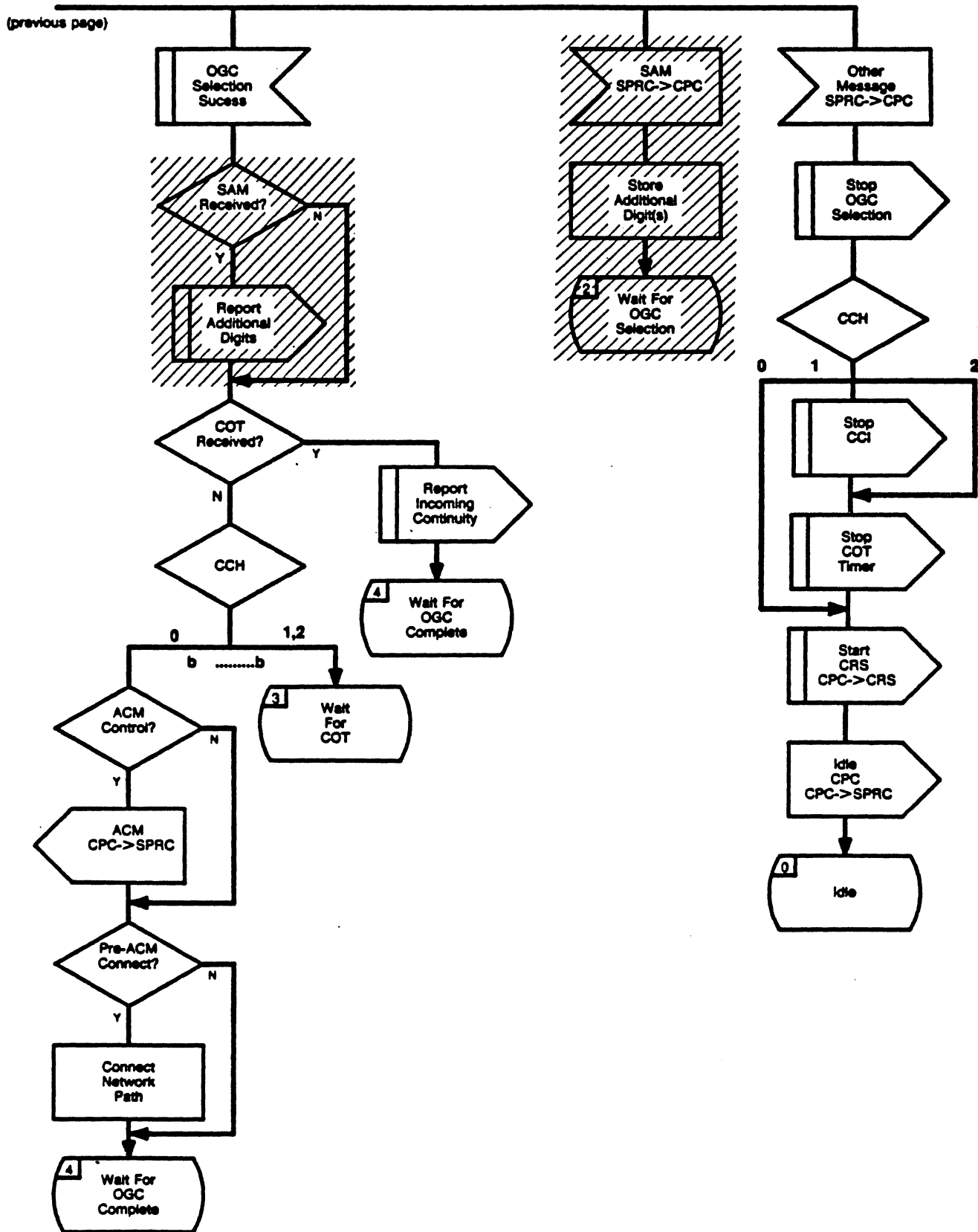


Figure III-1/Q.764 (Sheet 9 of 41)
Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

Q.764

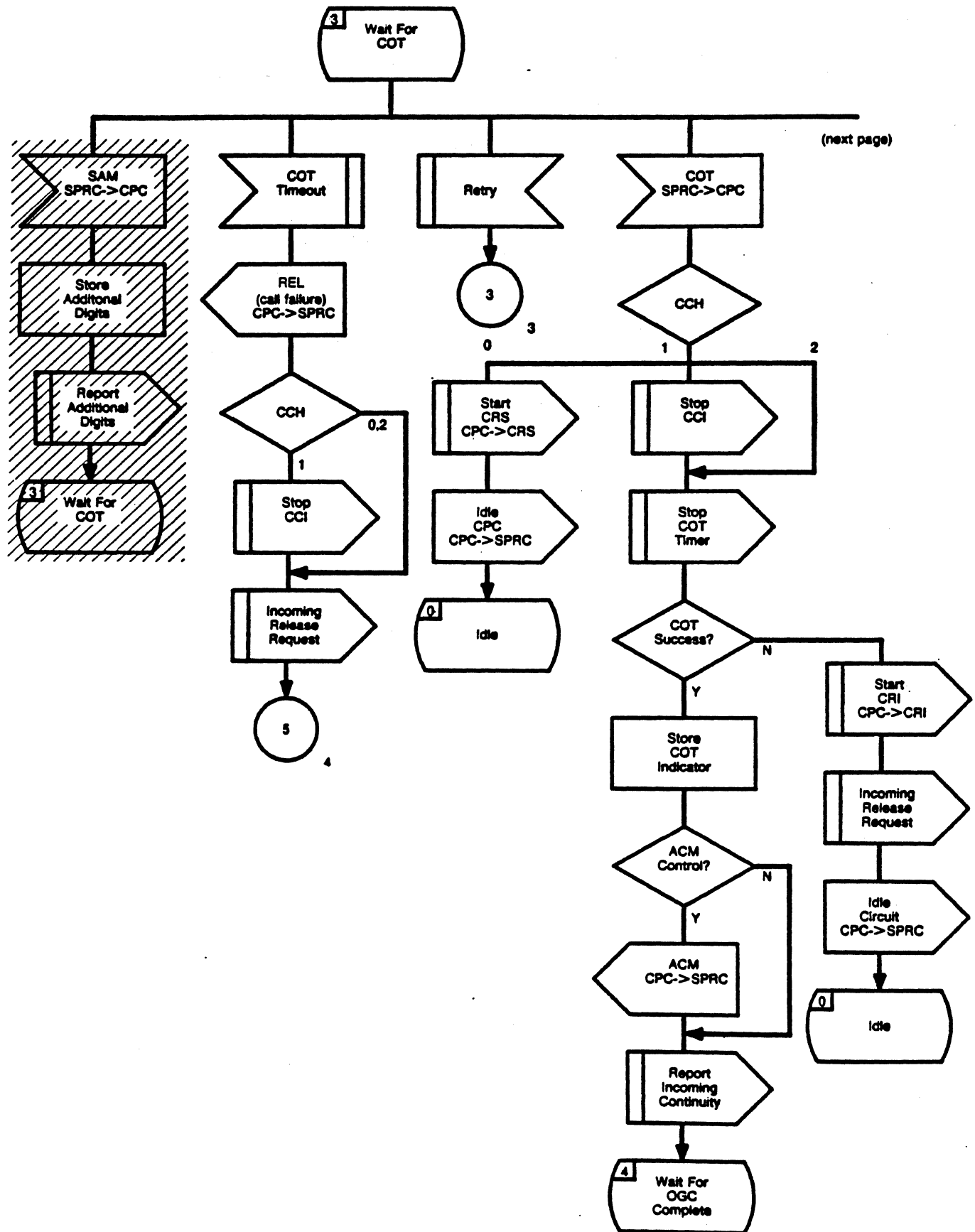


Figure III-1/Q.764 (Sheet 10 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

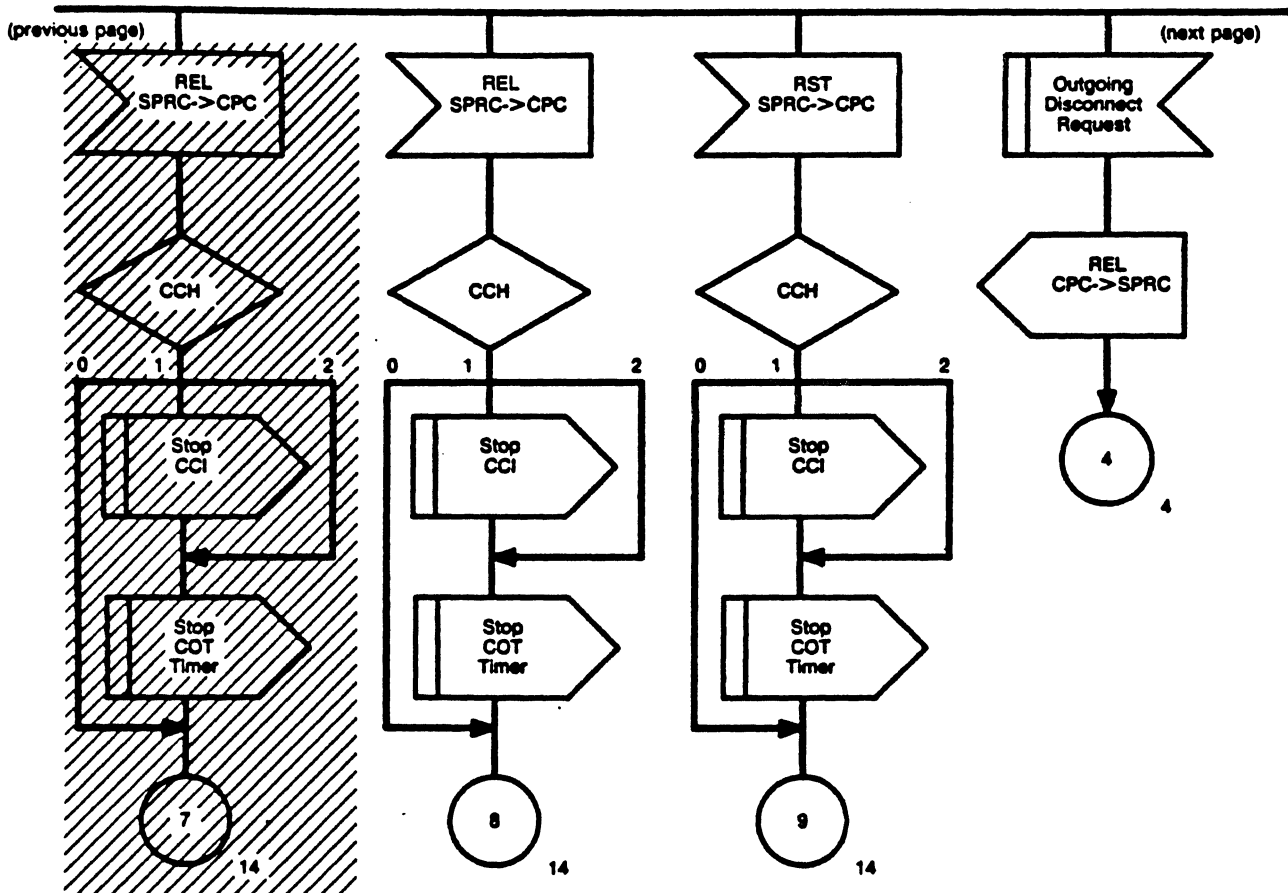


Figure III-1/Q.764 (Sheet 11 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

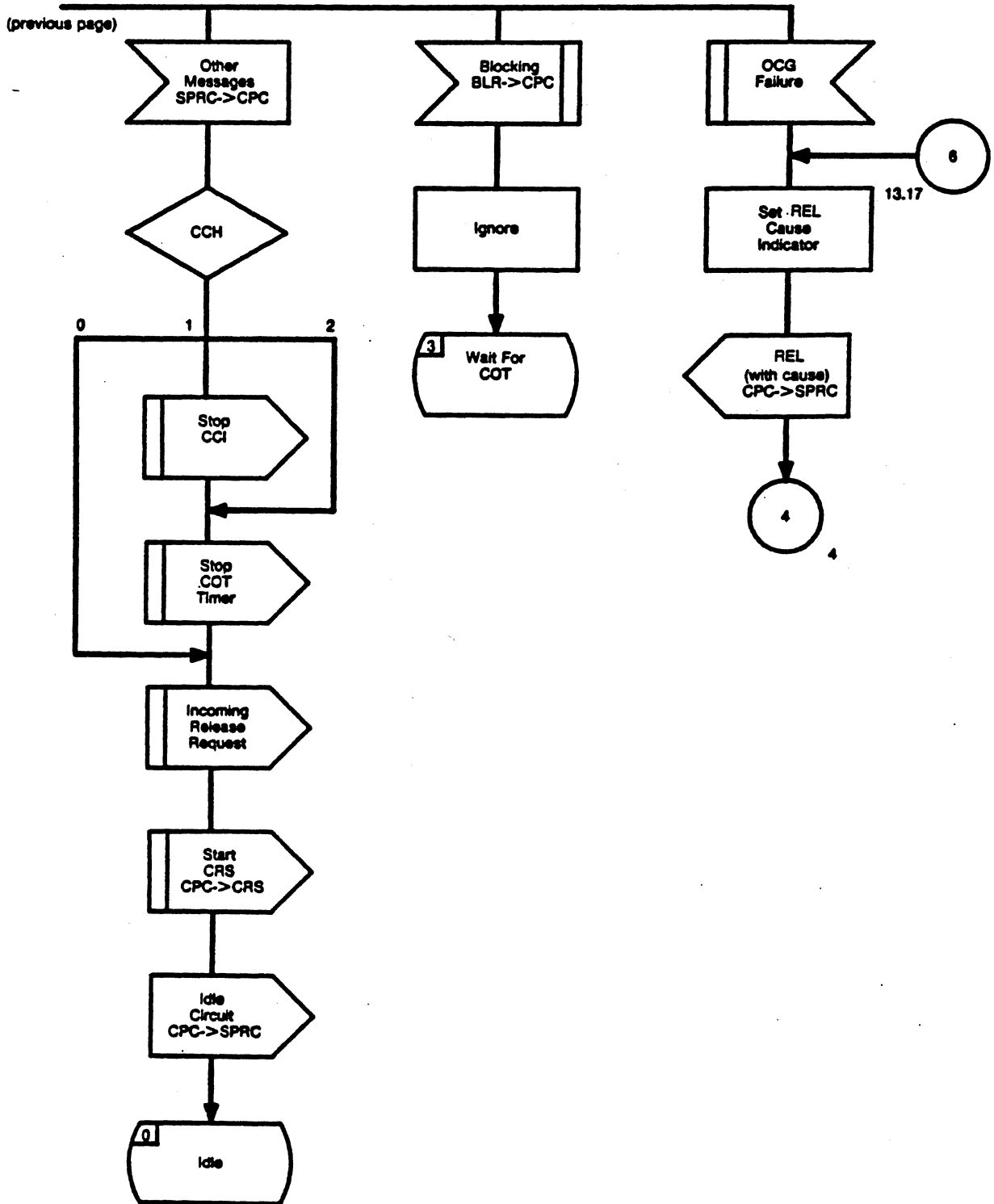


Figure III-1/Q.764 (Sheet 12 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

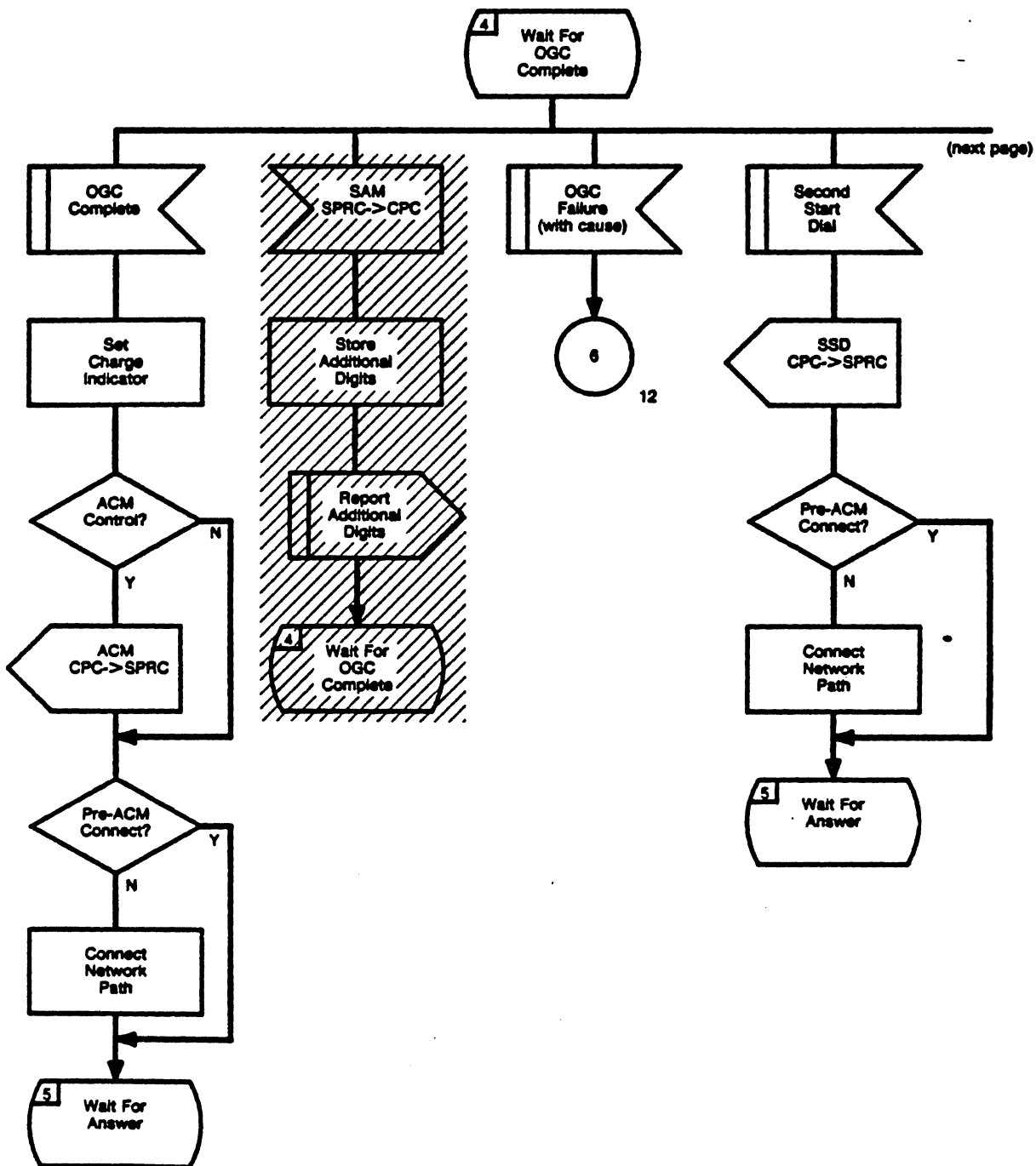


Figure III-1/Q.764 (Sheet 13 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

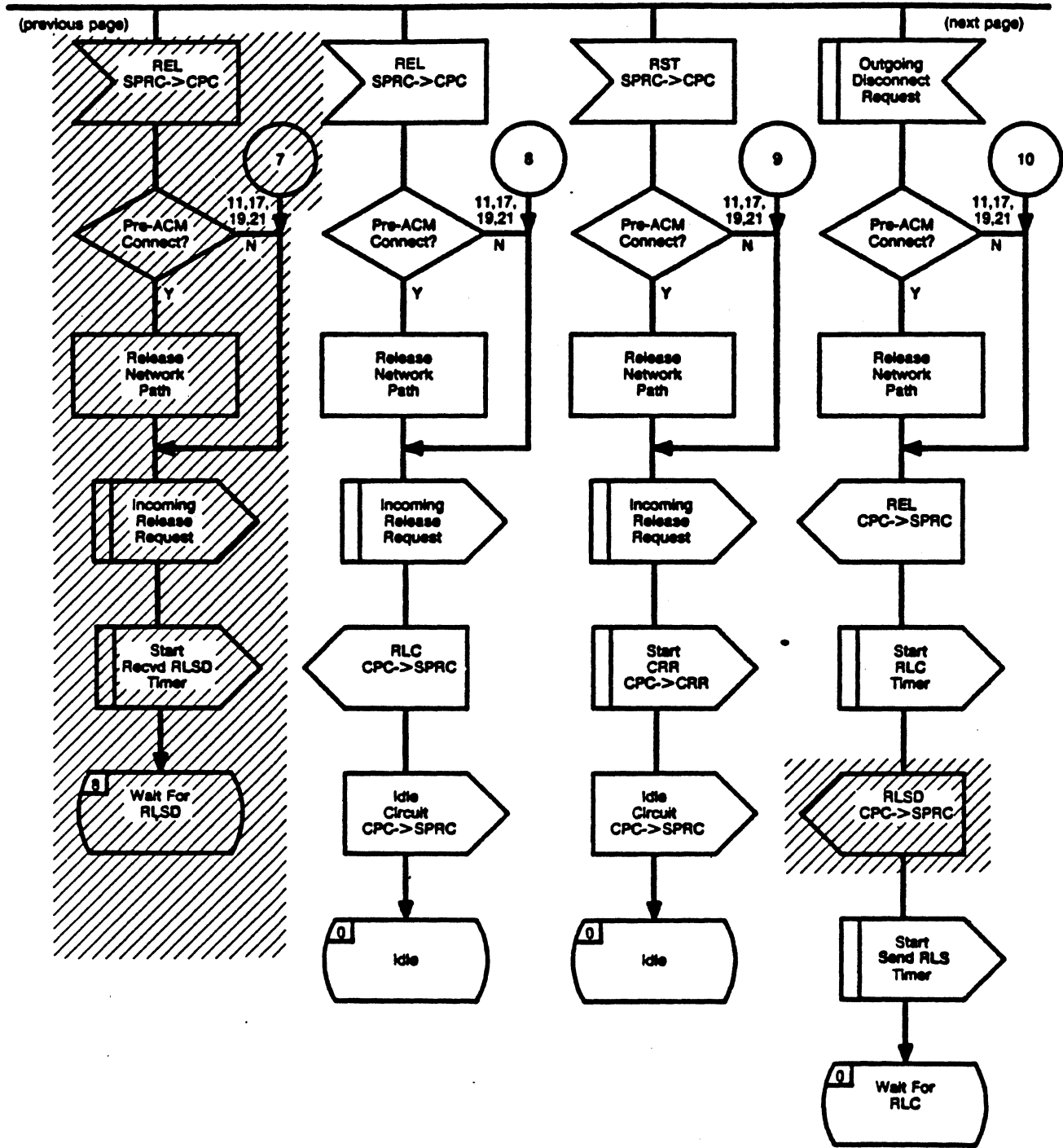


Figure III-1/Q.764 (Sheet 14 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

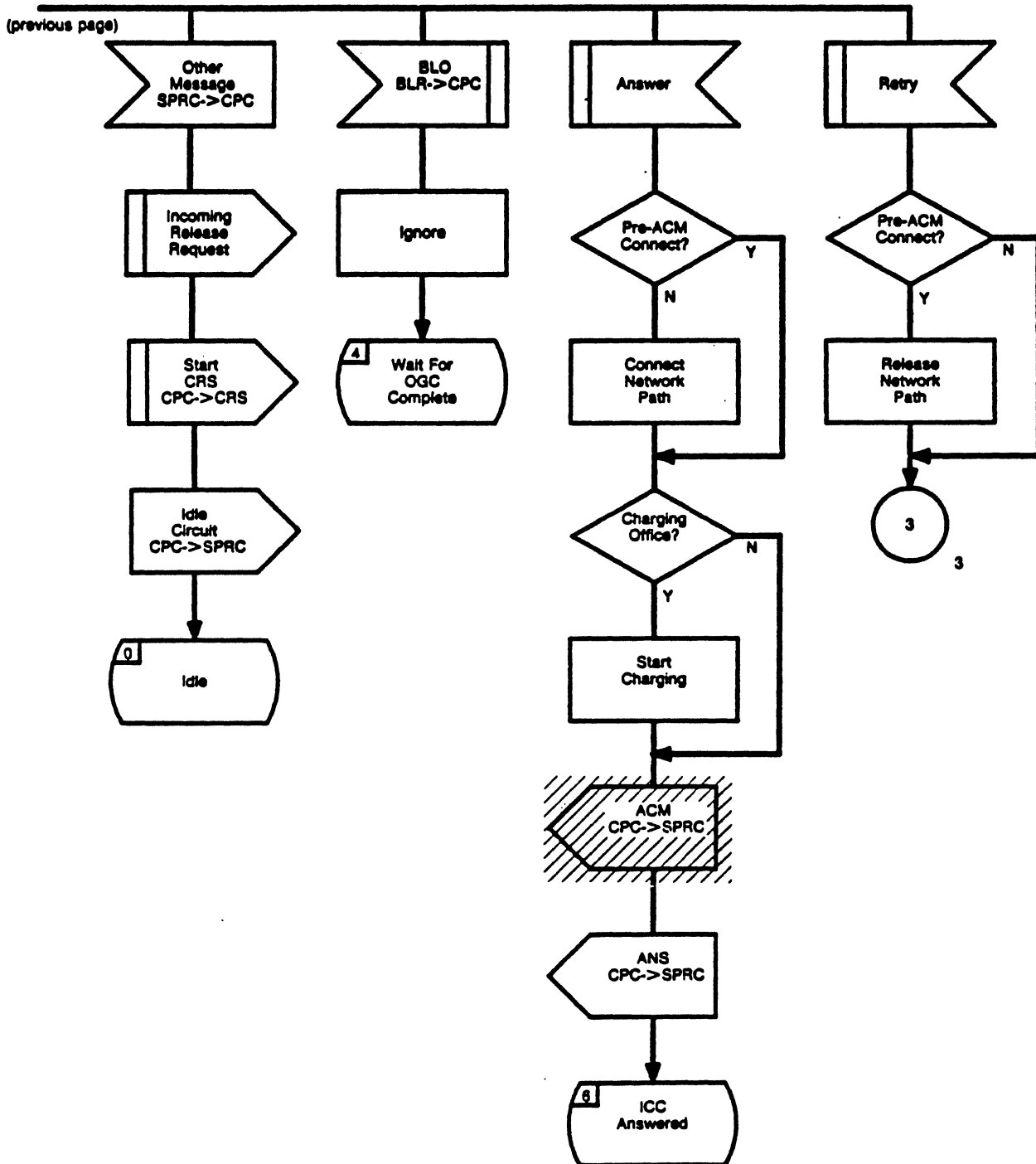


Figure III-1/Q.764 (Sheet 15 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

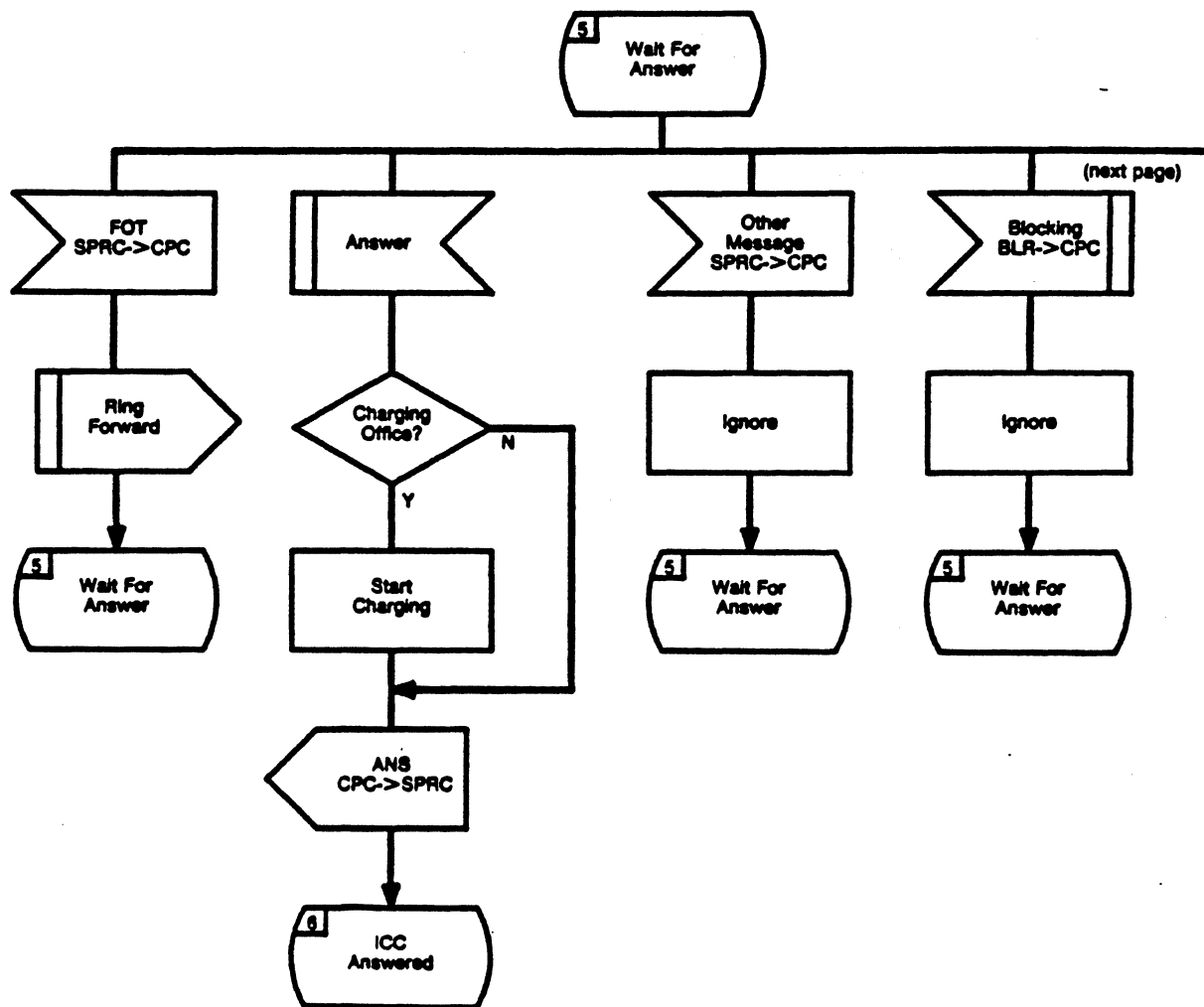


Figure III-1/Q.764 (Sheet 18 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

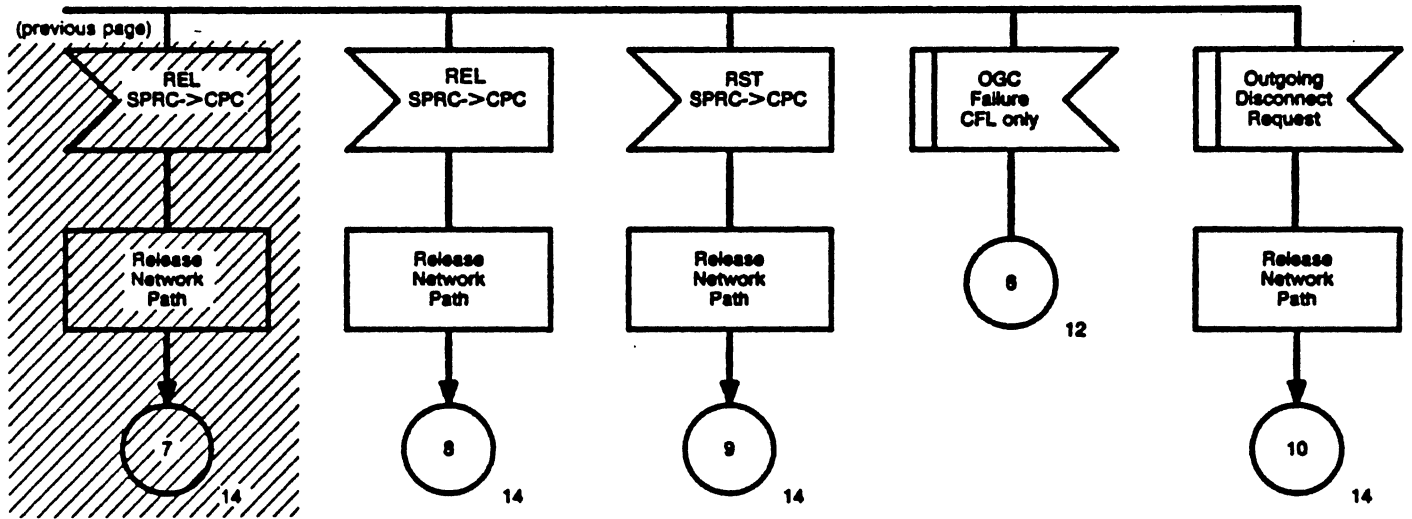


Figure III-1/Q.764 (Sheet 17 of 41)
Call Processing Control (CPC) Incoming

**APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS**

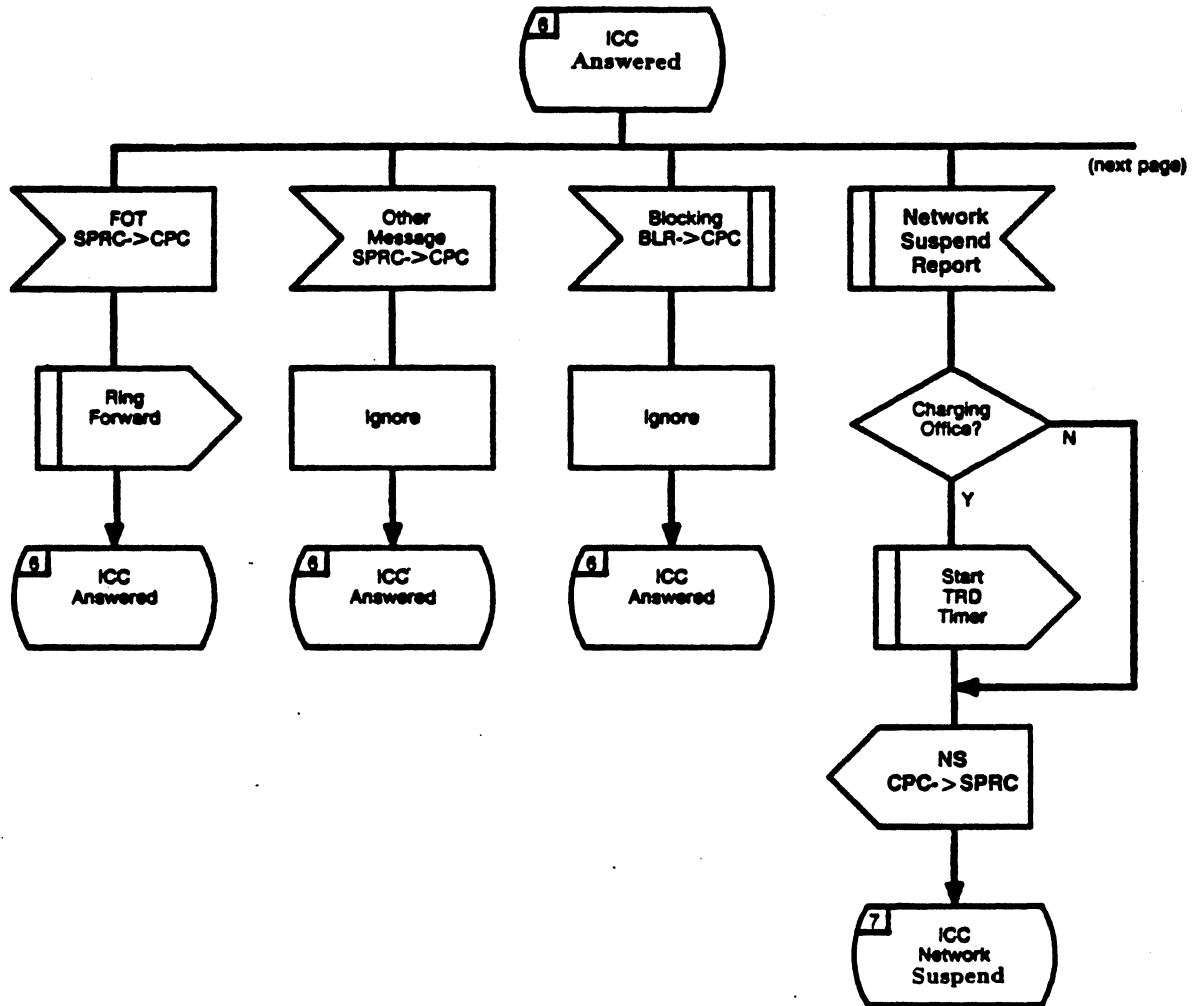


Figure III-1/Q.764 (Sheet 18 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

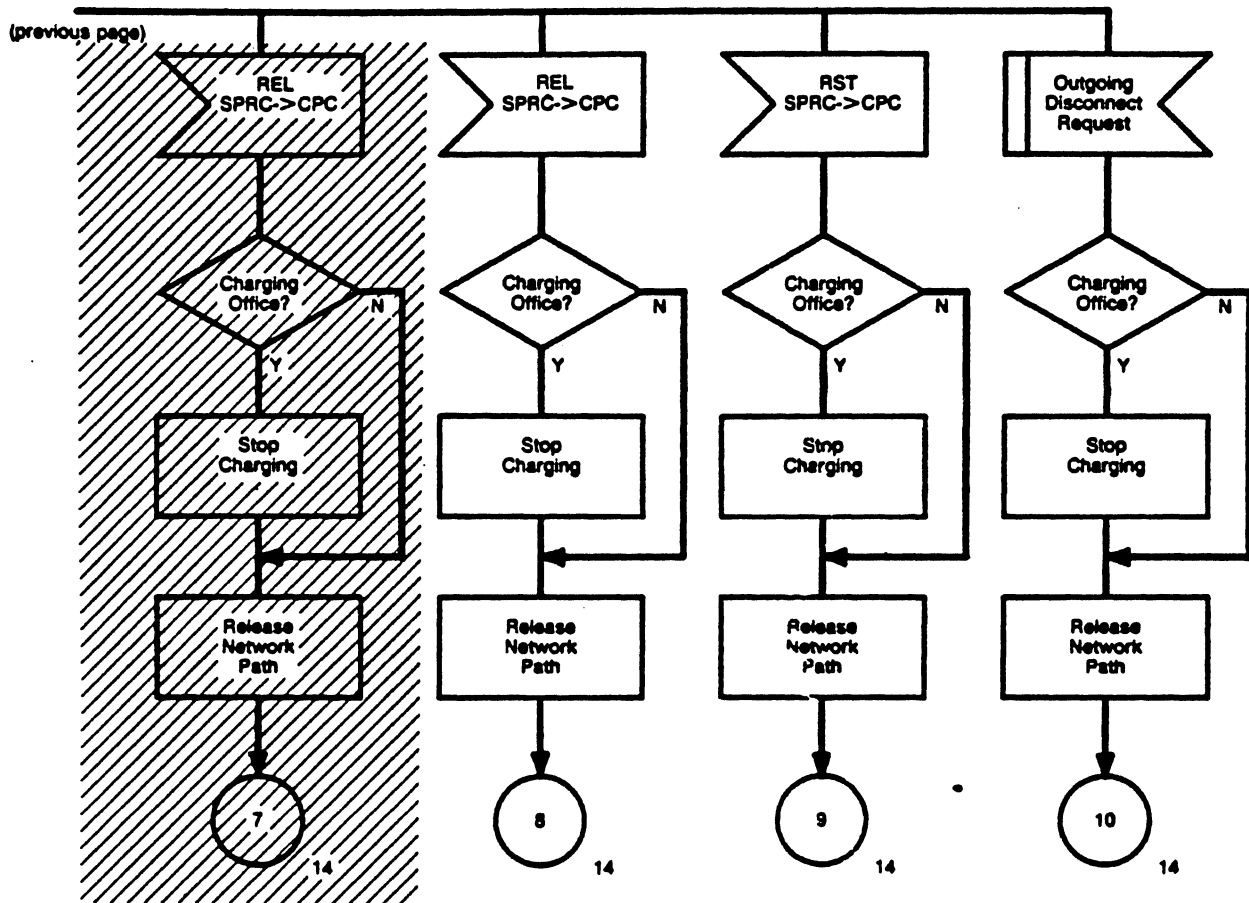


Figure III-1/Q.764 (Sheet 19 of 41)
Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

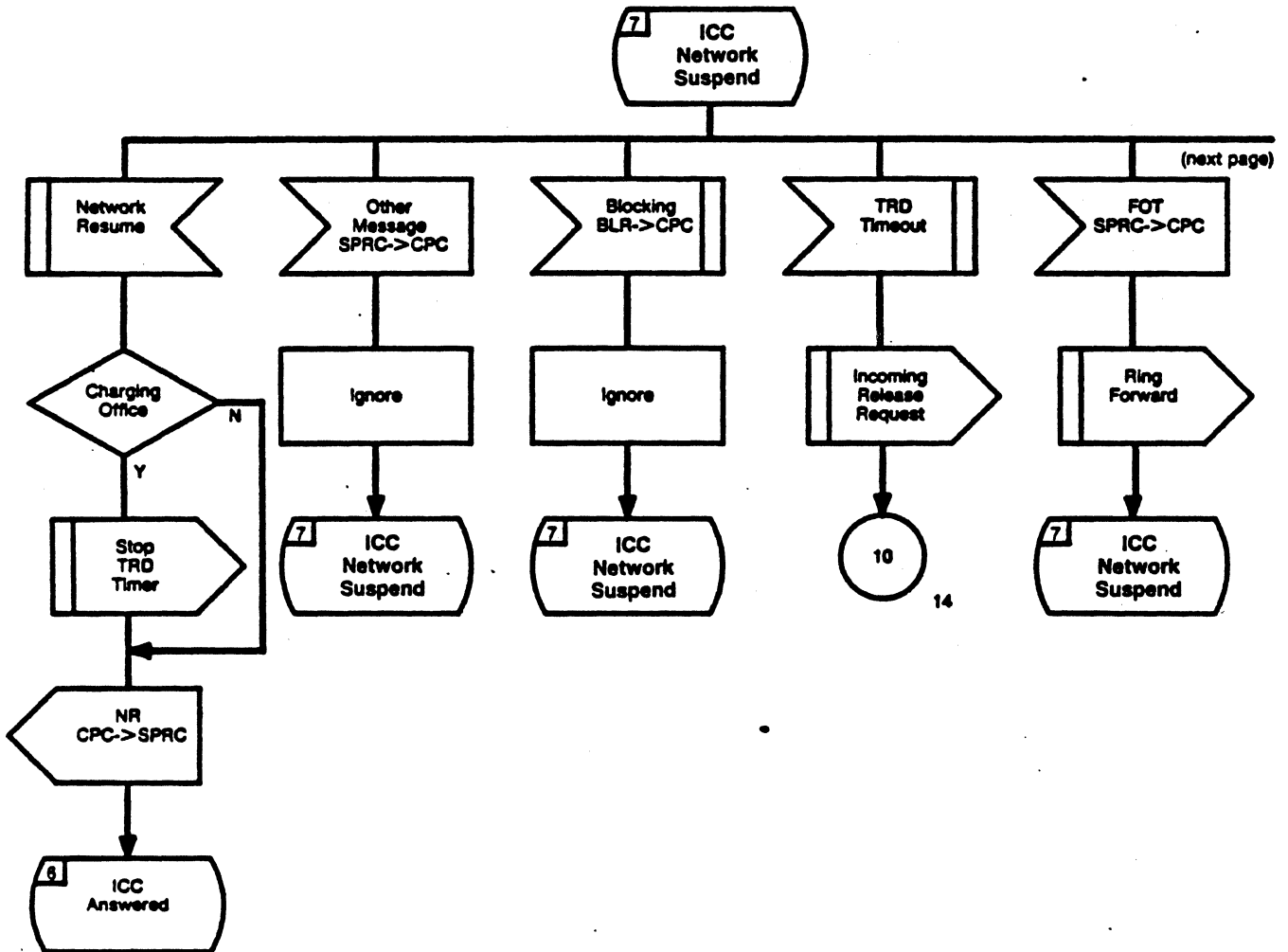


Figure III-1/Q.764 (Sheet 20 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

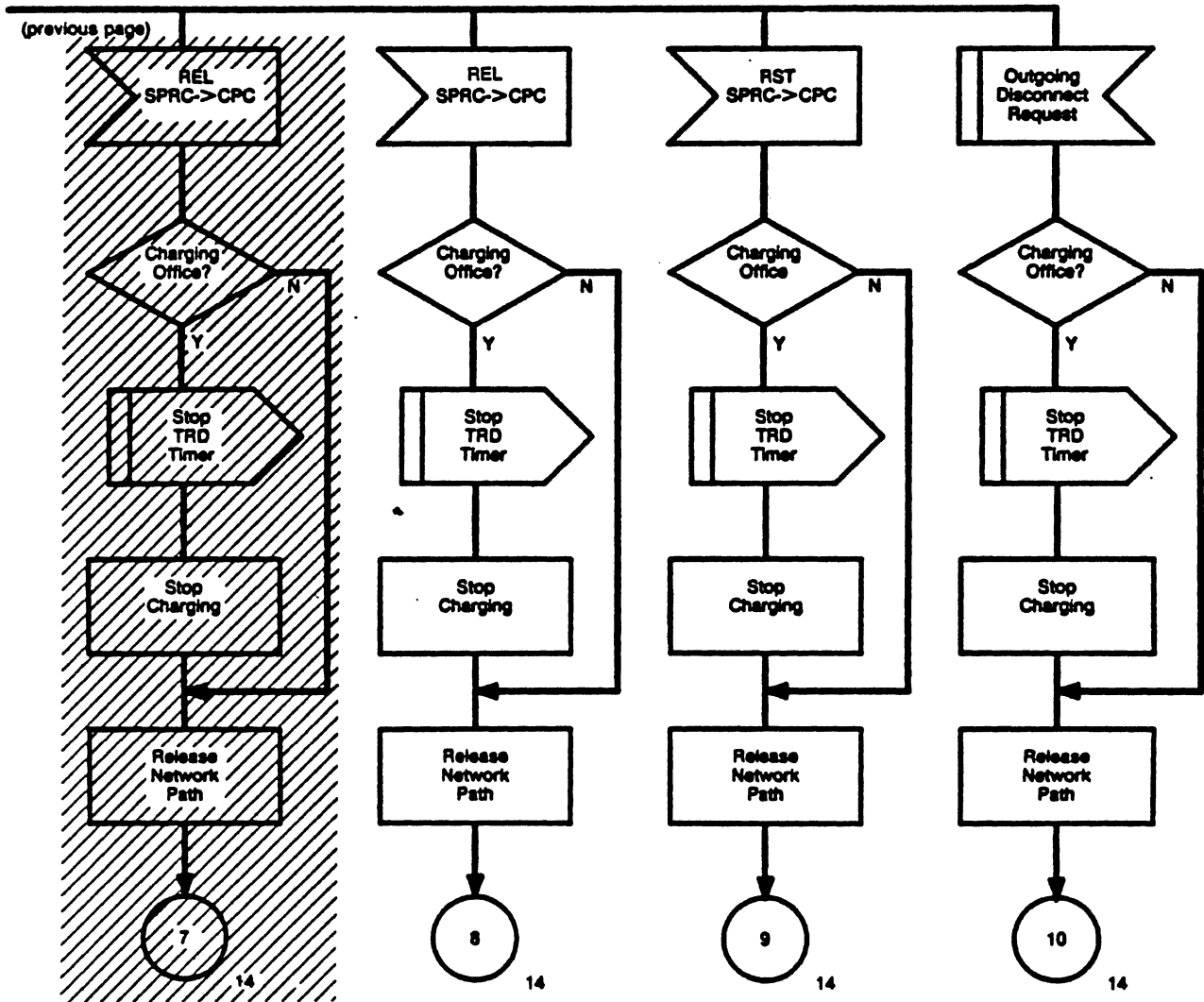


Figure III-1/Q.764 (Sheet 21 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

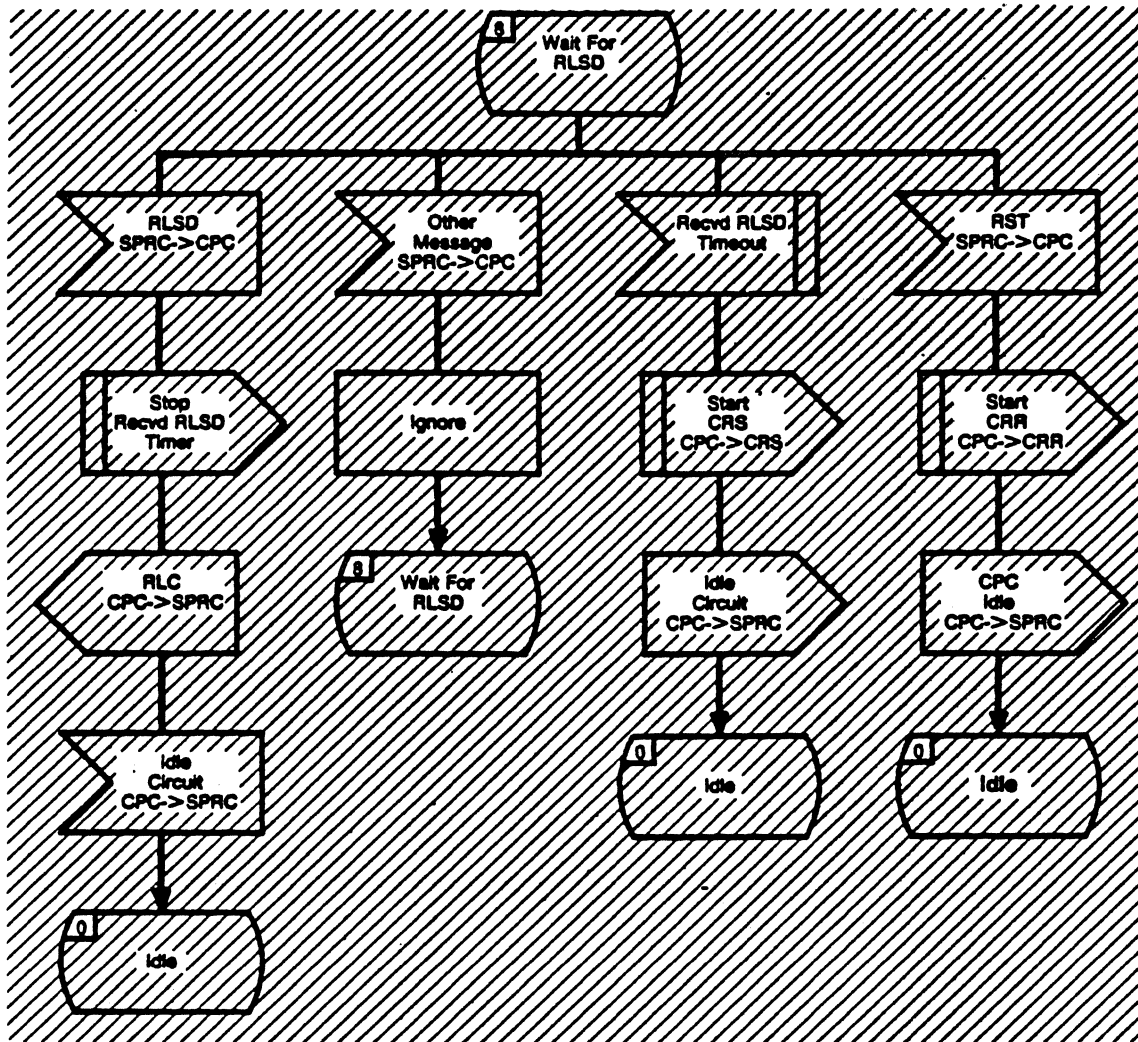


Figure III-1/Q.764 (Sheet 22 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

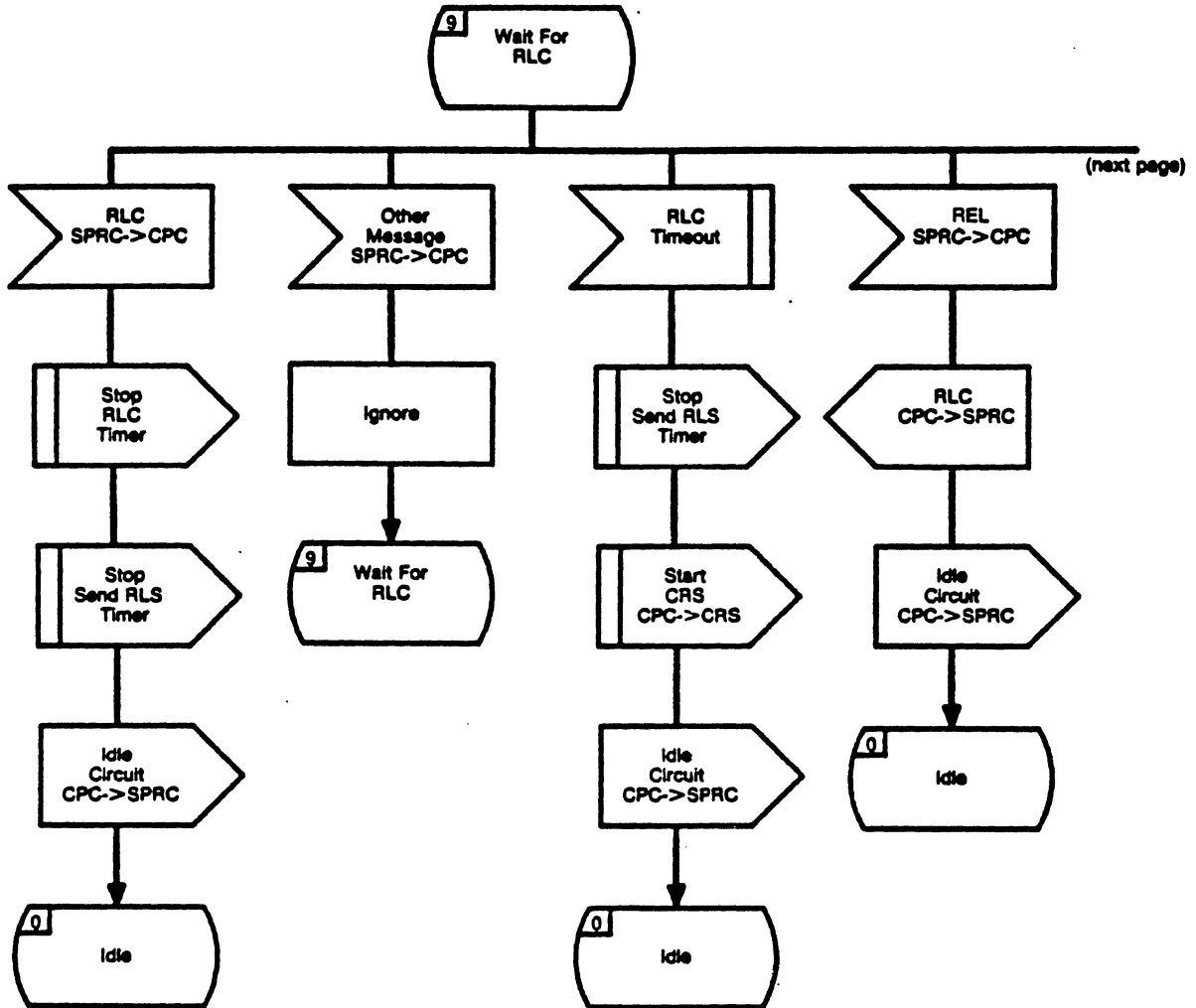


Figure III-1/Q.764 (Sheet 23 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

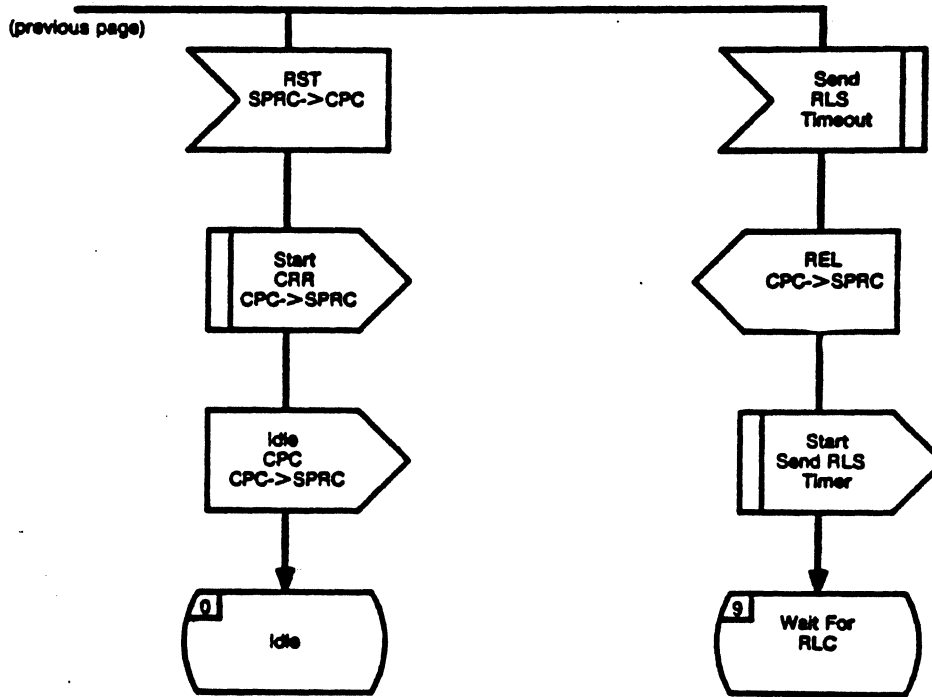


Figure III-1/Q.764 (Sheet 24 of 41)
Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

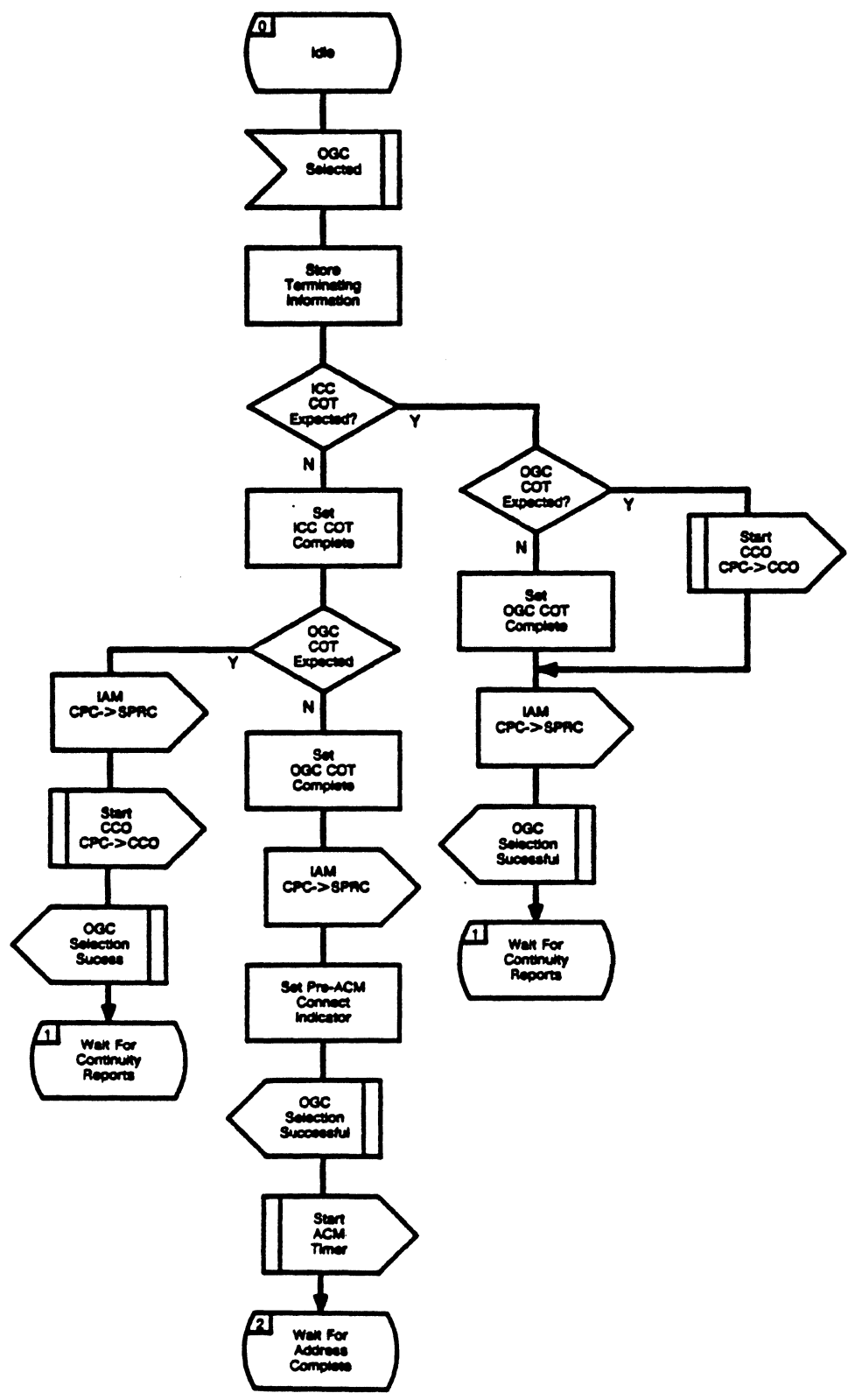


Figure III-1/Q.764 (Sheet 25 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

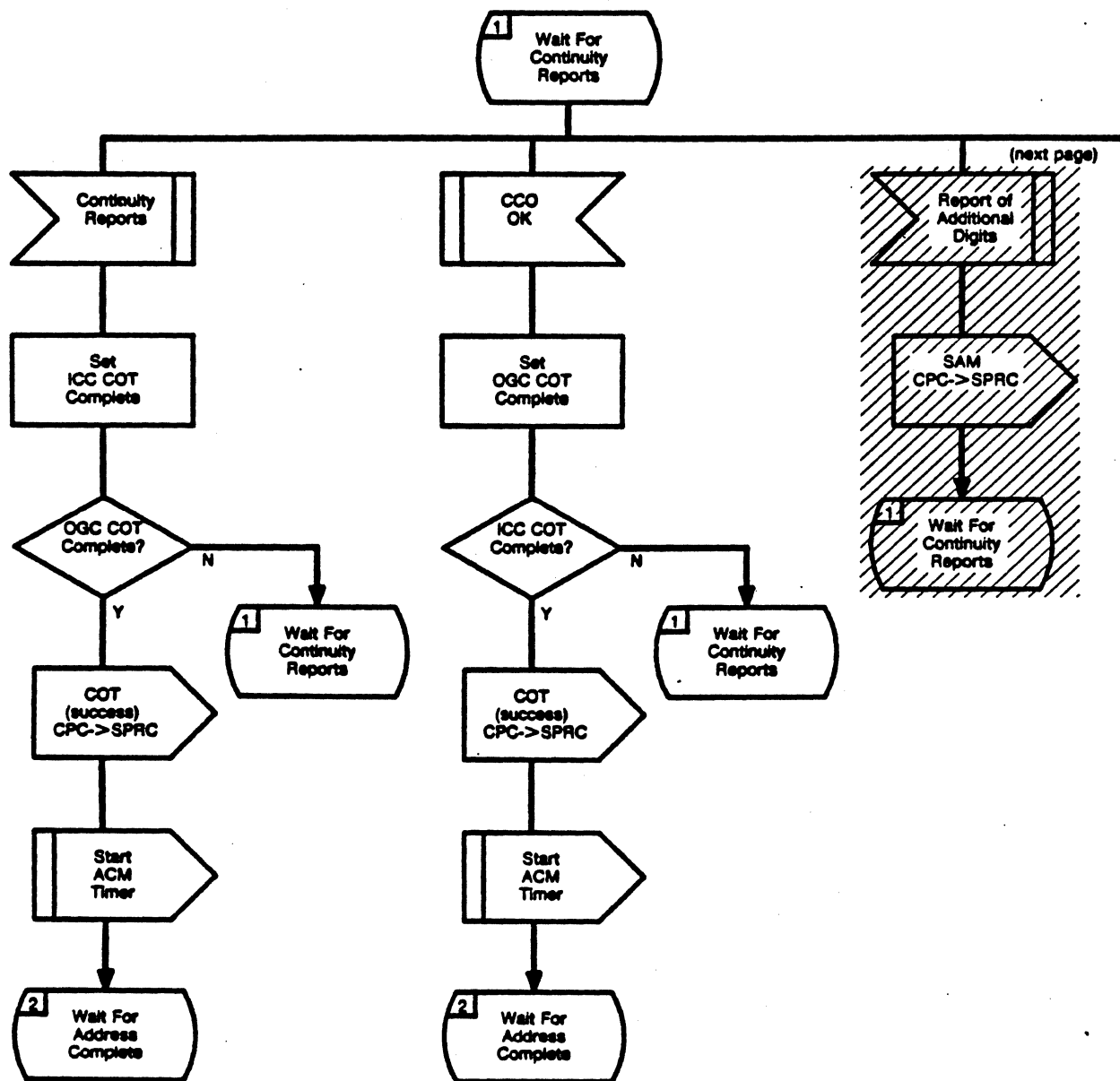


Figure III-1/Q.764 (Sheet 26 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

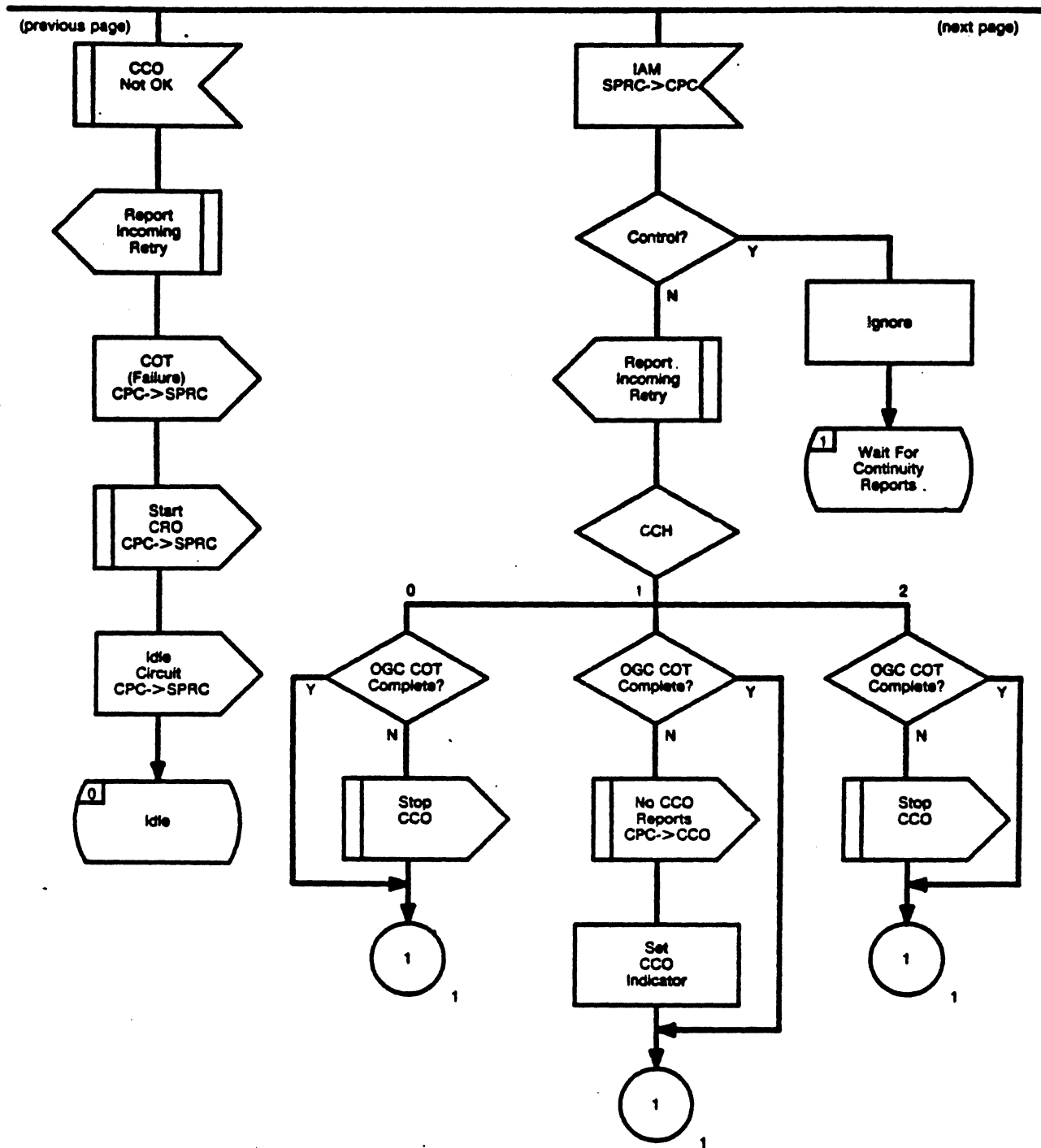


Figure III-1/Q.764 (Sheet 27 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

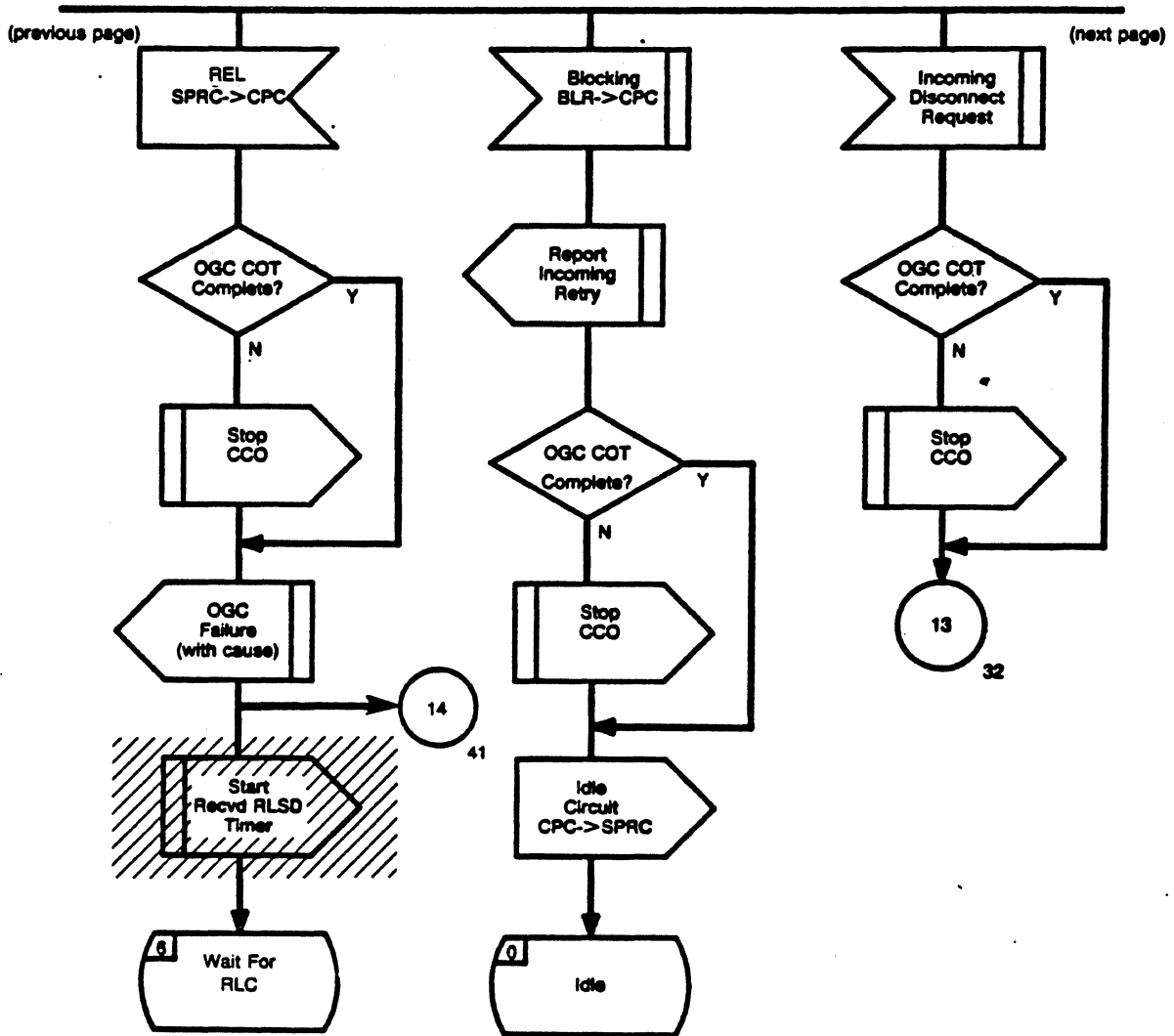


Figure III-1/Q.764 (Sheet 28 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

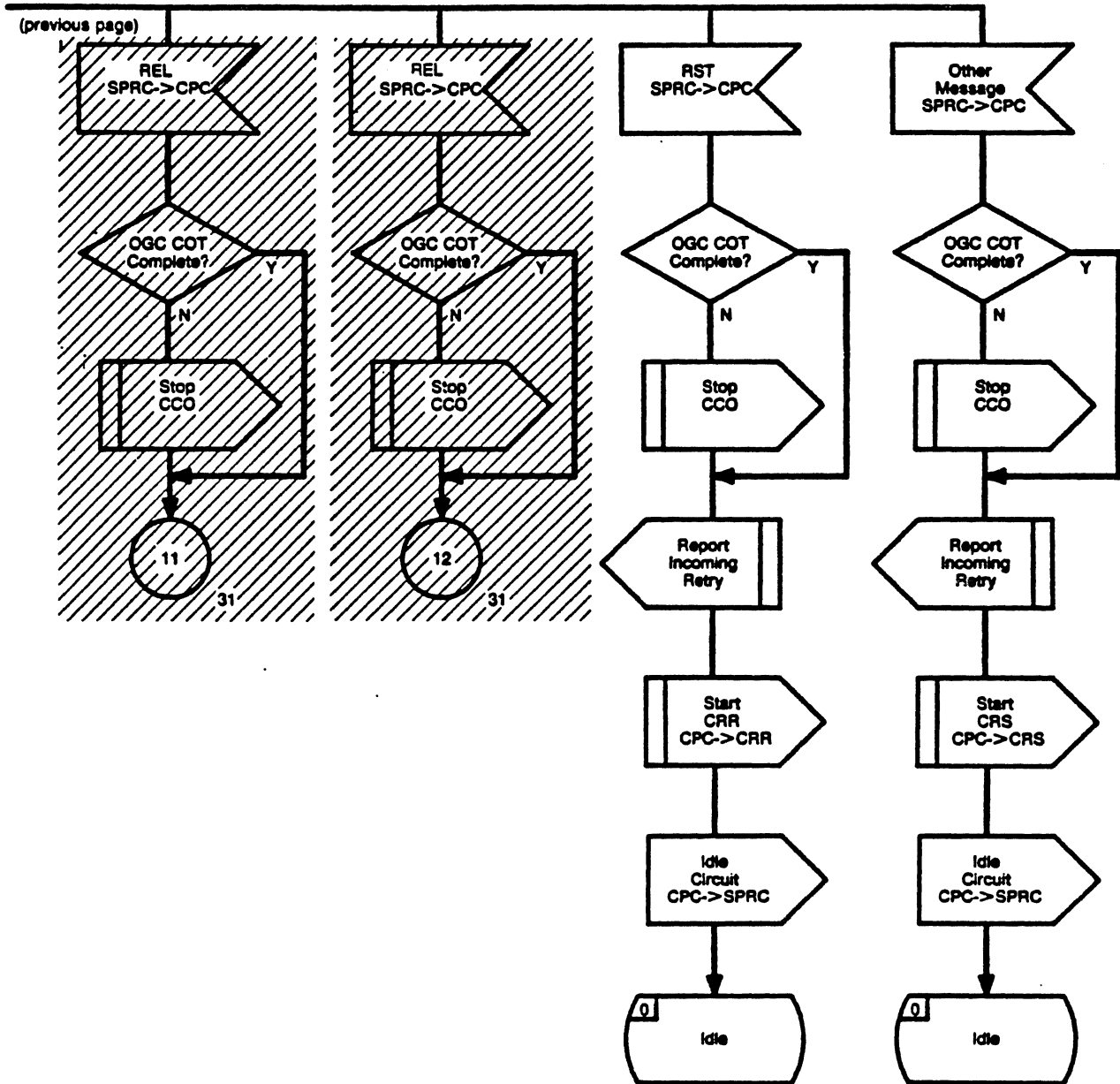


Figure III-1/Q.764 (Sheet 29 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

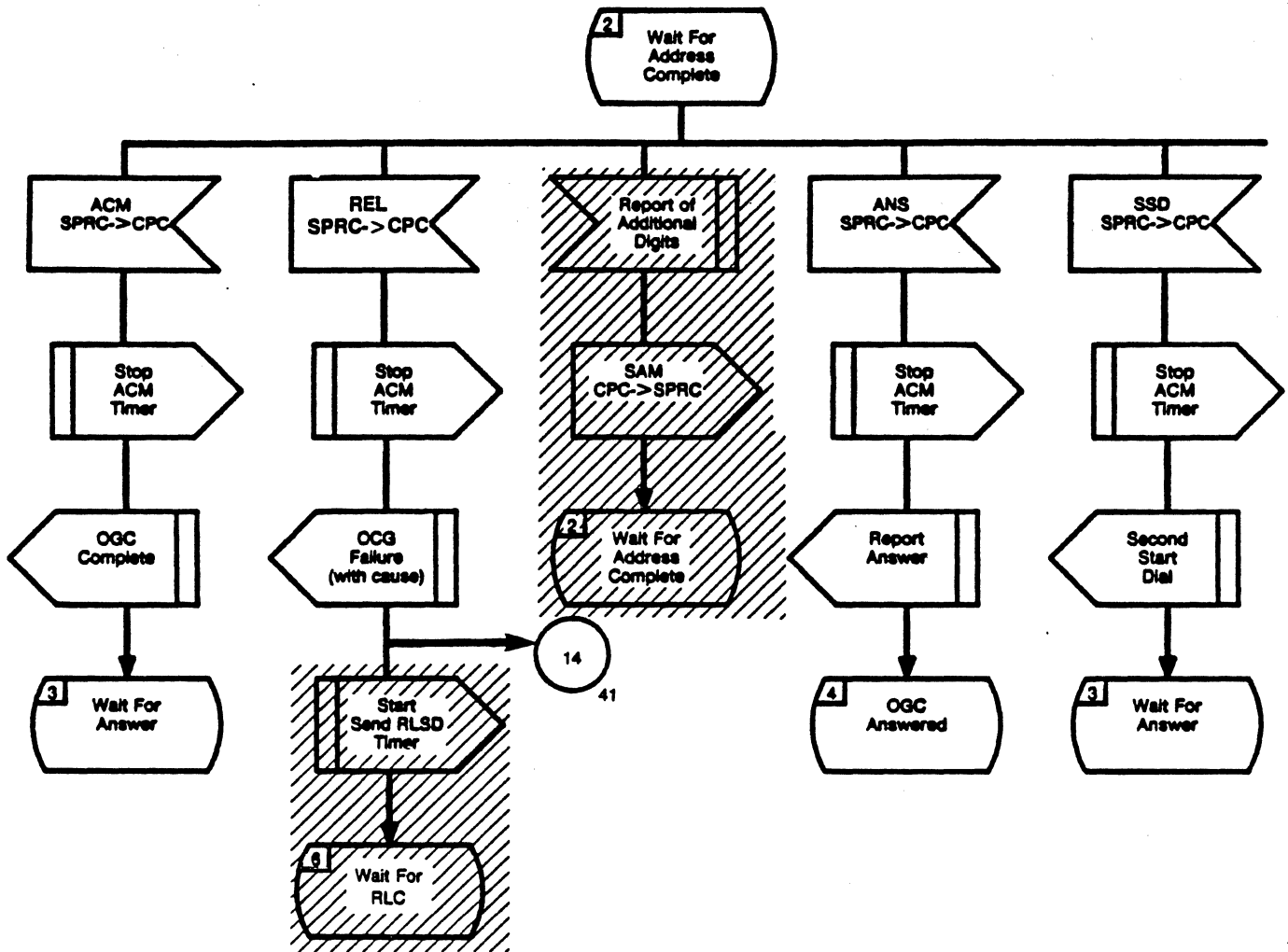


Figure III-1/Q.764 (Sheet 30 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

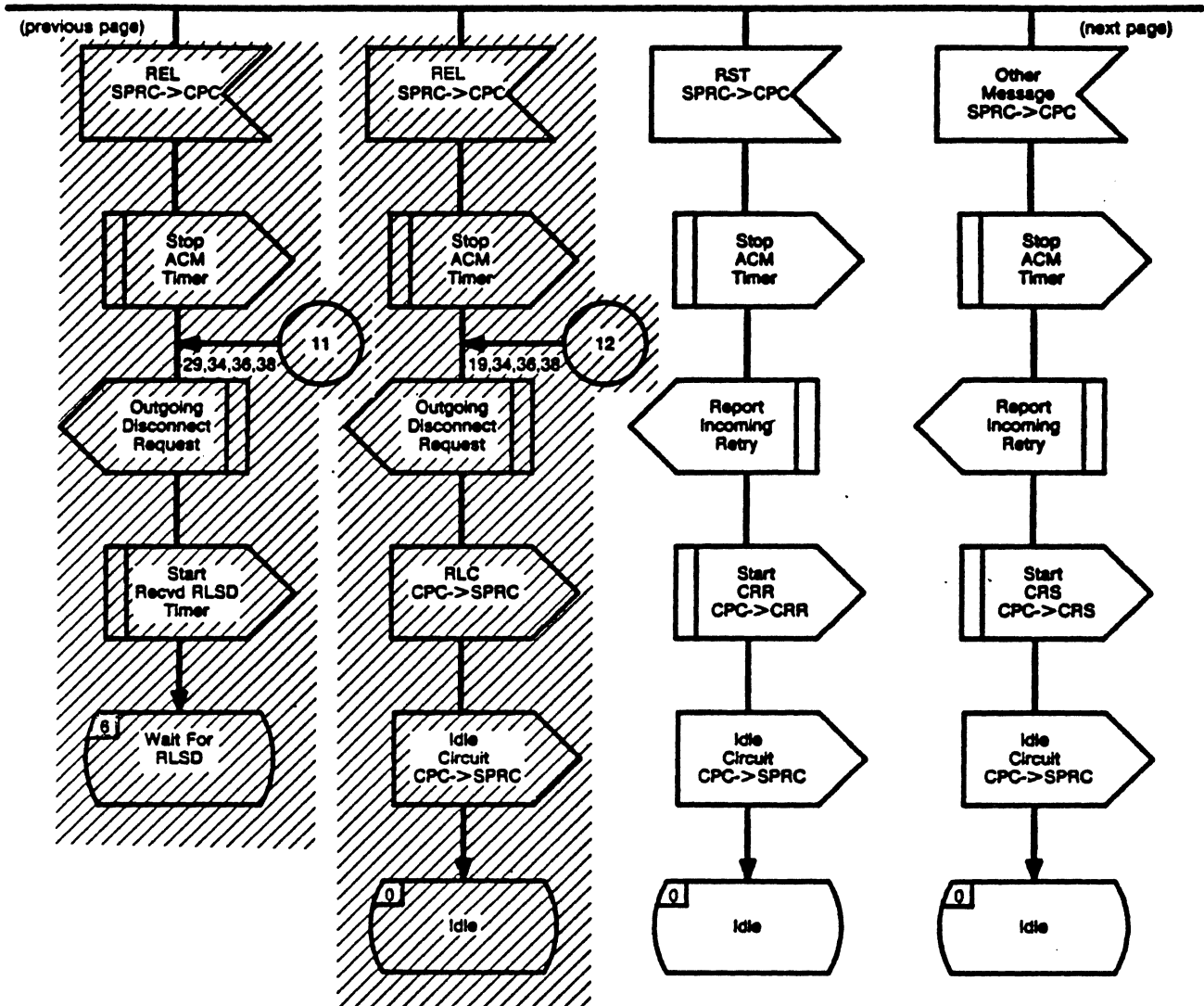


Figure III-1/Q.764 (Sheet 31 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

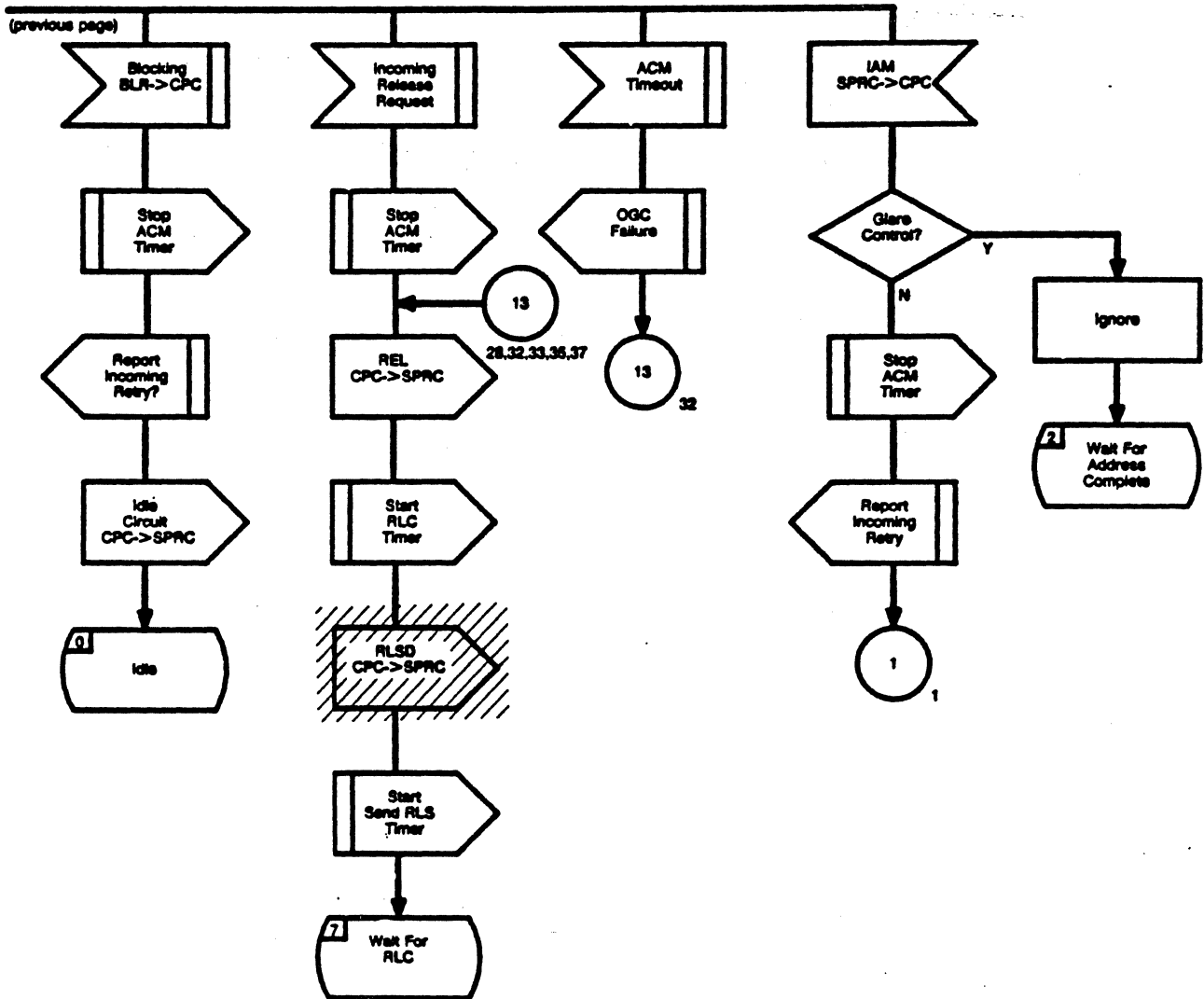


Figure III-1/Q.764 (Sheet 32 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

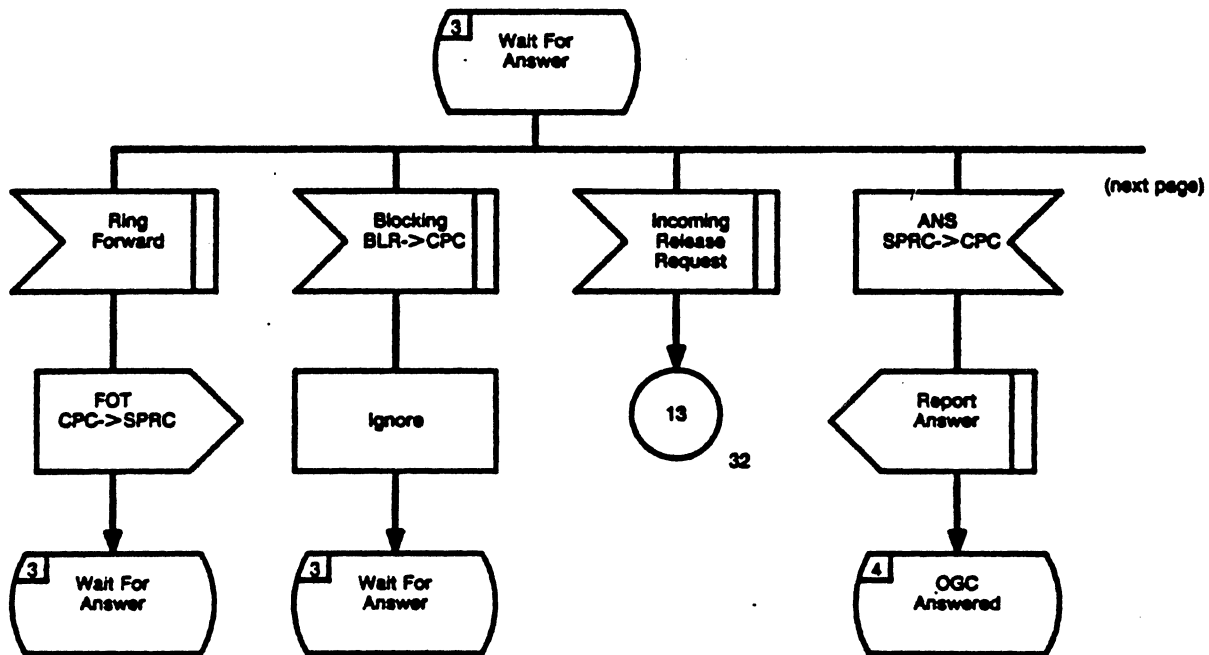


Figure III-1/Q.764 (Sheet 33 of 41)
Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

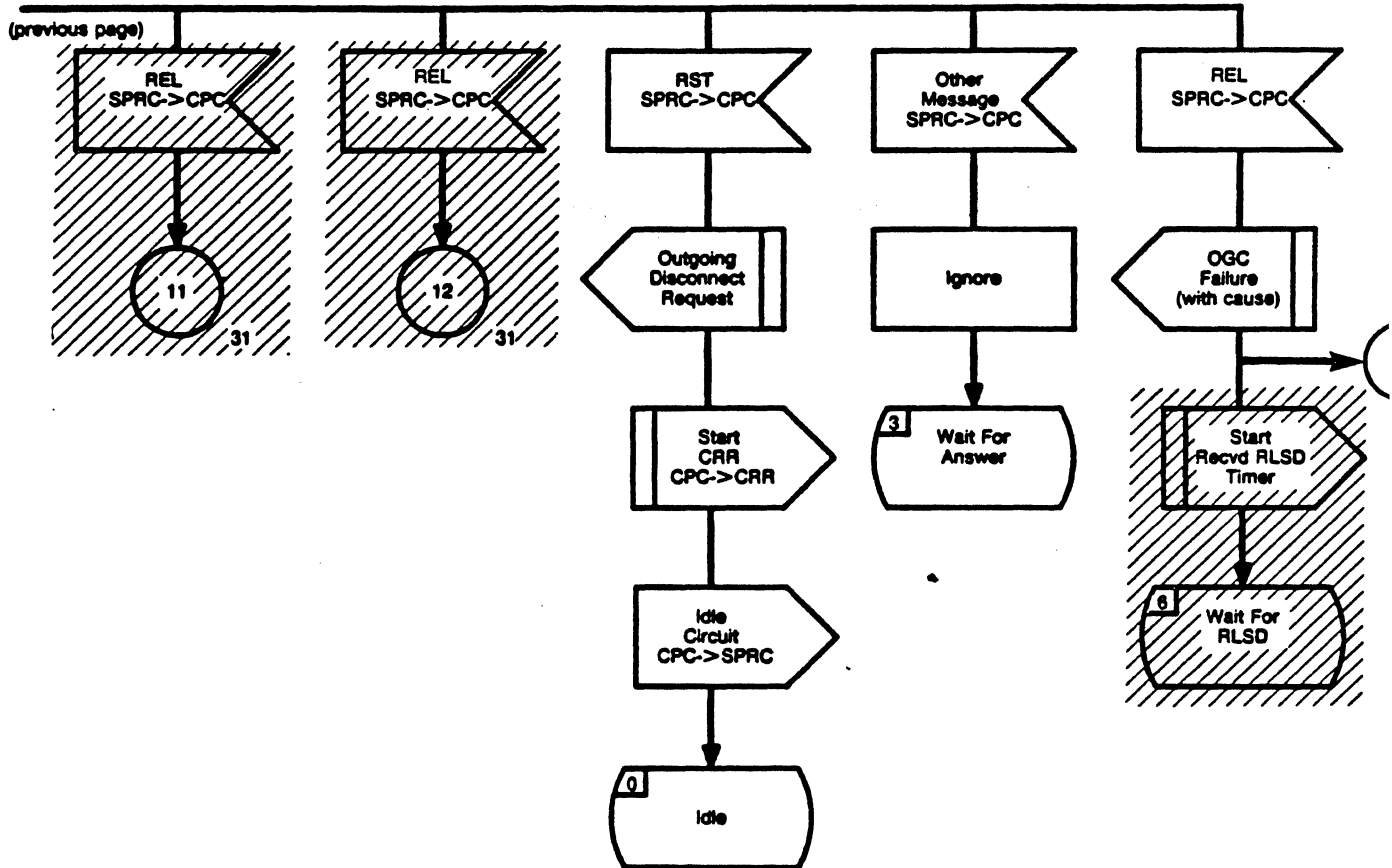


Figure III-1/Q.764 (Sheet 34 of 41)
 Call Processing Control (CPC) Incoming

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

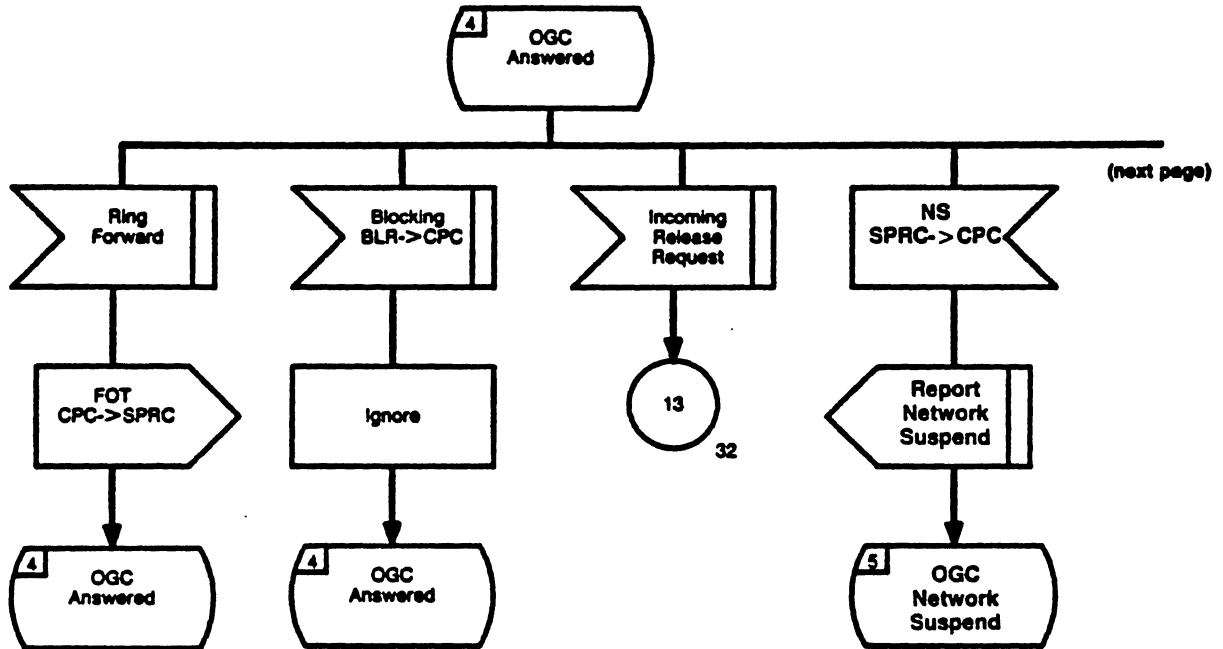


Figure III-1/Q.764 (Sheet 35 of 41)
Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

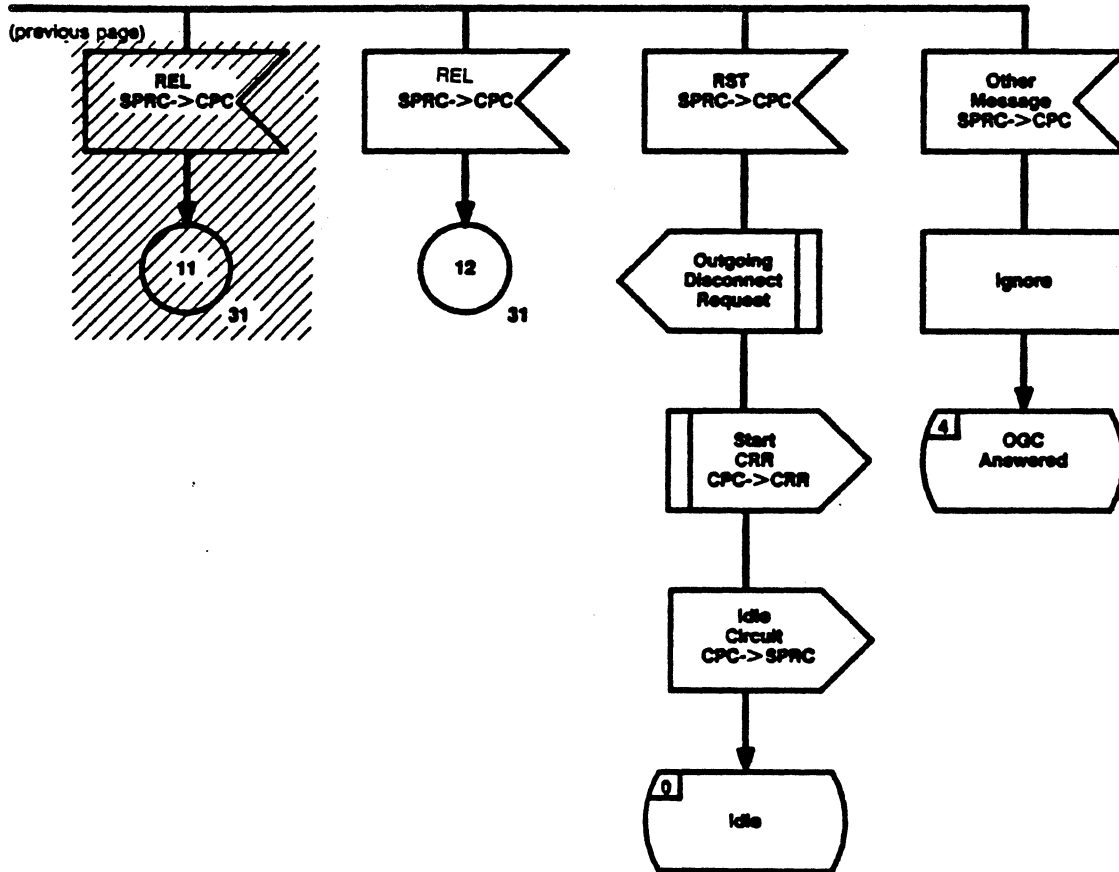


Figure III-1/Q.764 (Sheet 36 of 41)
Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

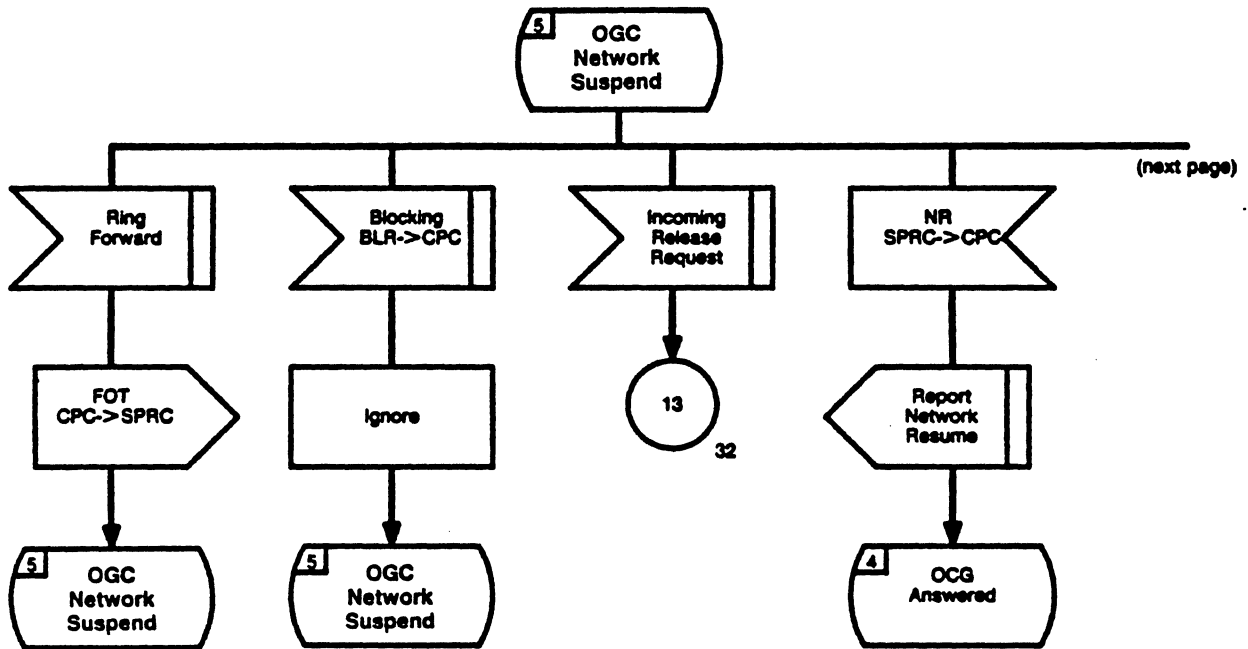


Figure III-1/Q.764 (Sheet 37 of 41)
Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

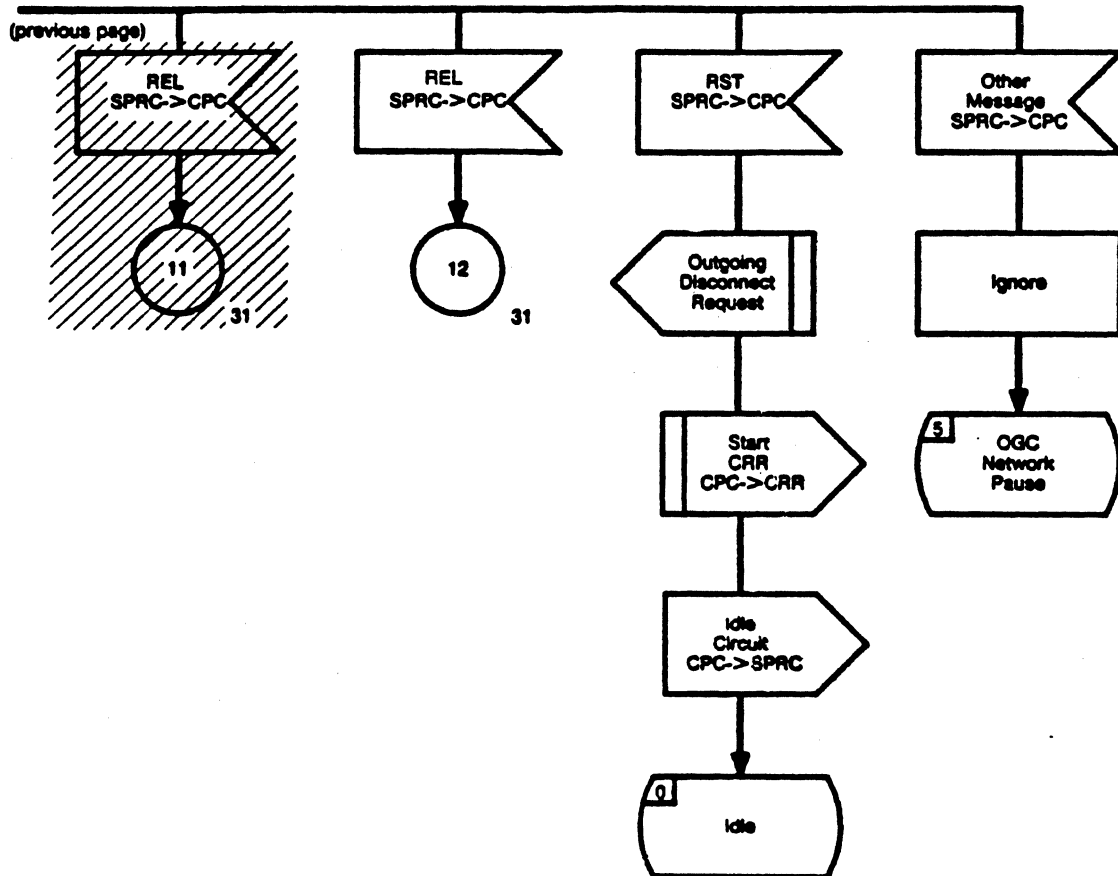


Figure III-1/Q.764 (Sheet 38 of 41)
Call Processing Control (CPC) Outgoing

**APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS**

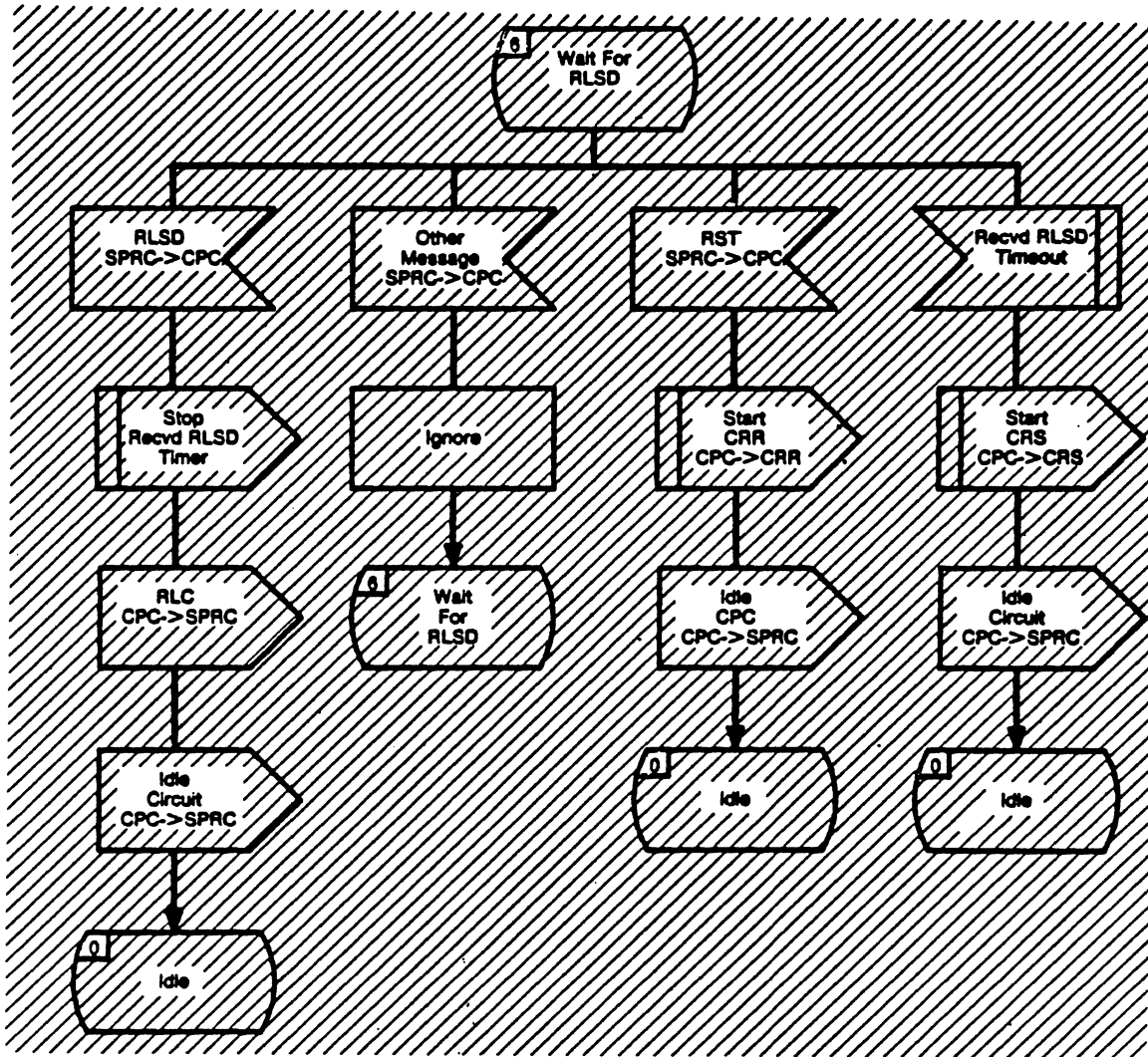


Figure III-1/Q.764 (Sheet 39 of 41)
 Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

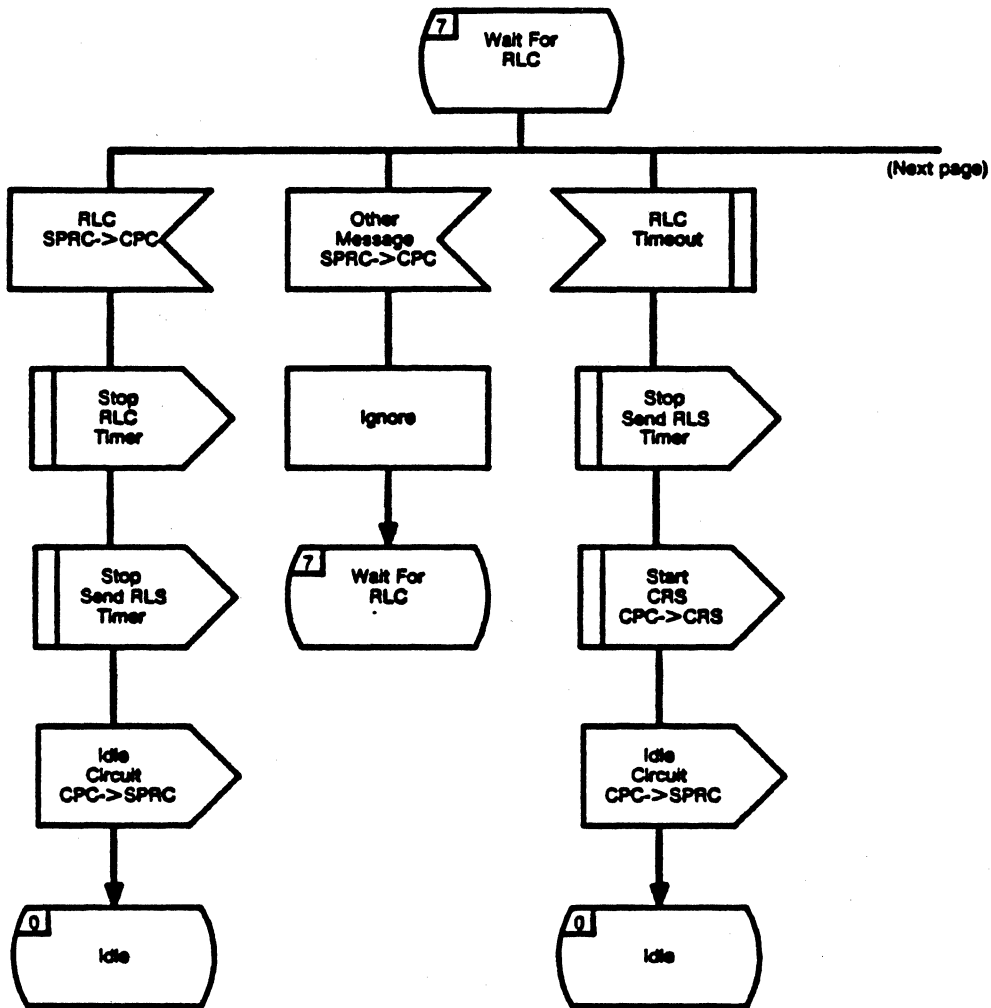


Figure III-1/Q.764 (Sheet 40 of 41)
Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

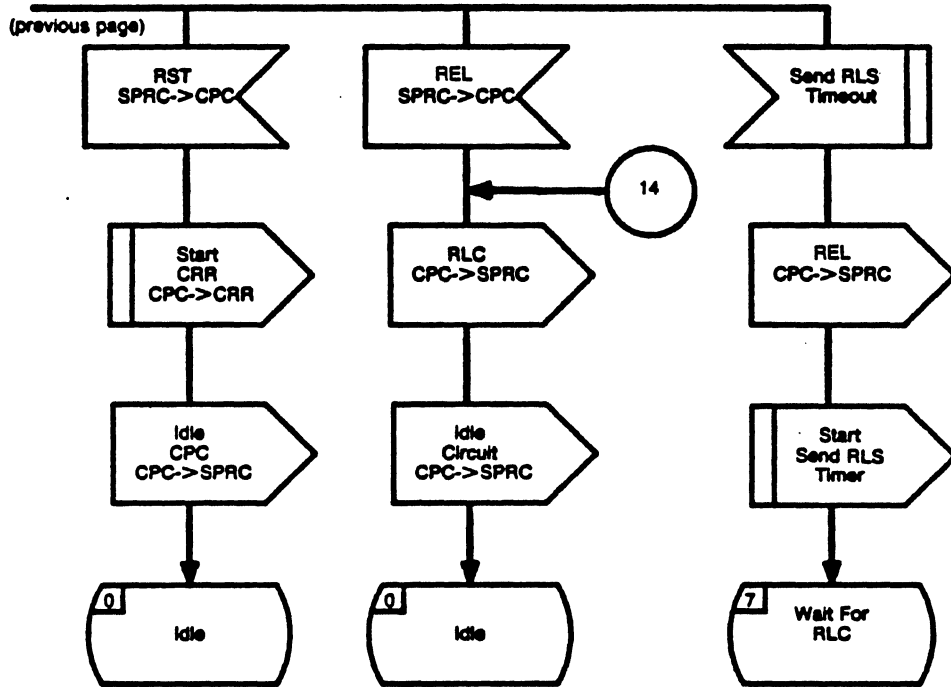


Figure III-1/Q.764 (Sheet 41 of 41)
Call Processing Control (CPC) Outgoing

APPENDIX III CALL PROCESSING CONTROL STATE
TRANSITION DIAGRAMS

Q.764

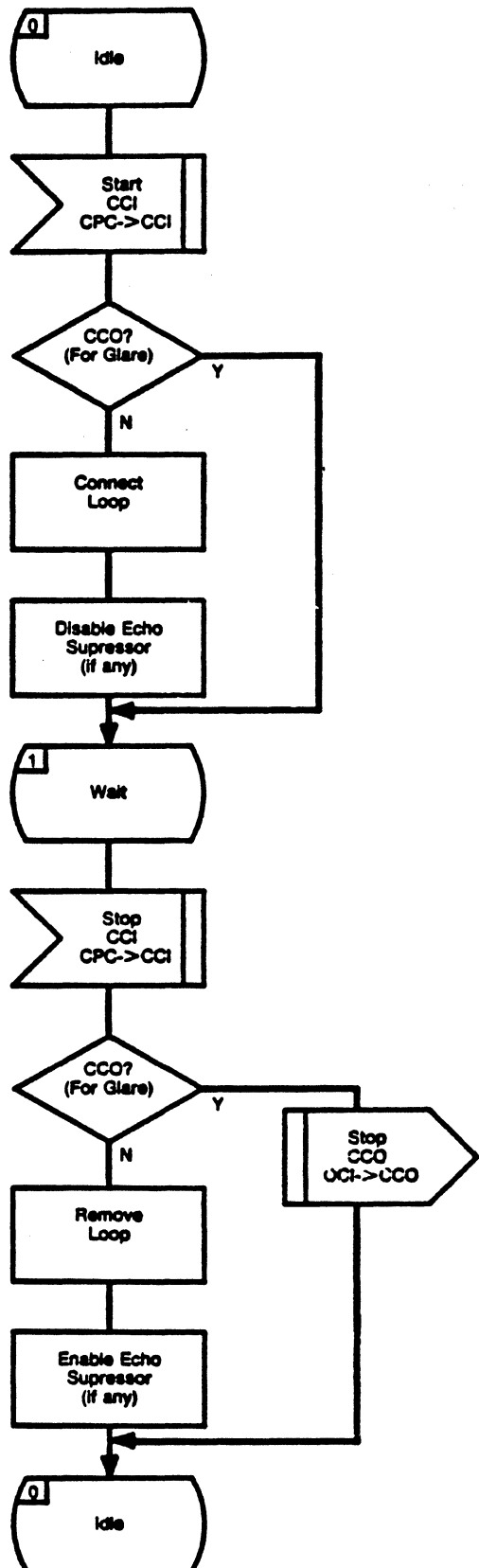


Figure III-2/Q.764
Continuity Check Incoming (CCI)

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

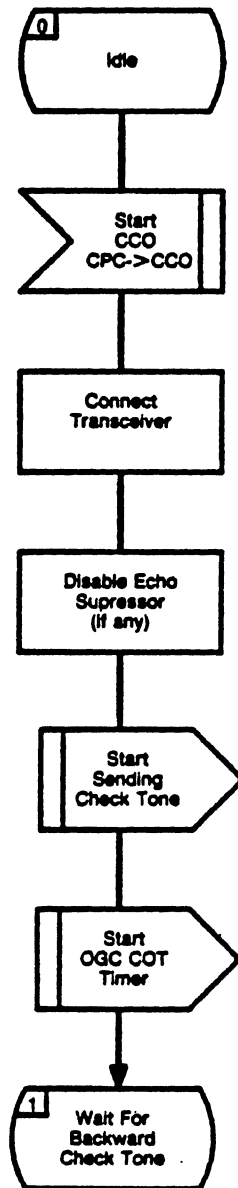


Figure III-3/Q.764 (Sheet 1 of 3)
Continuity Check Outgoing (CCO)

APPENDIX III CALL PROCESSING CONTROL STATE
 TRANSITION DIAGRAMS

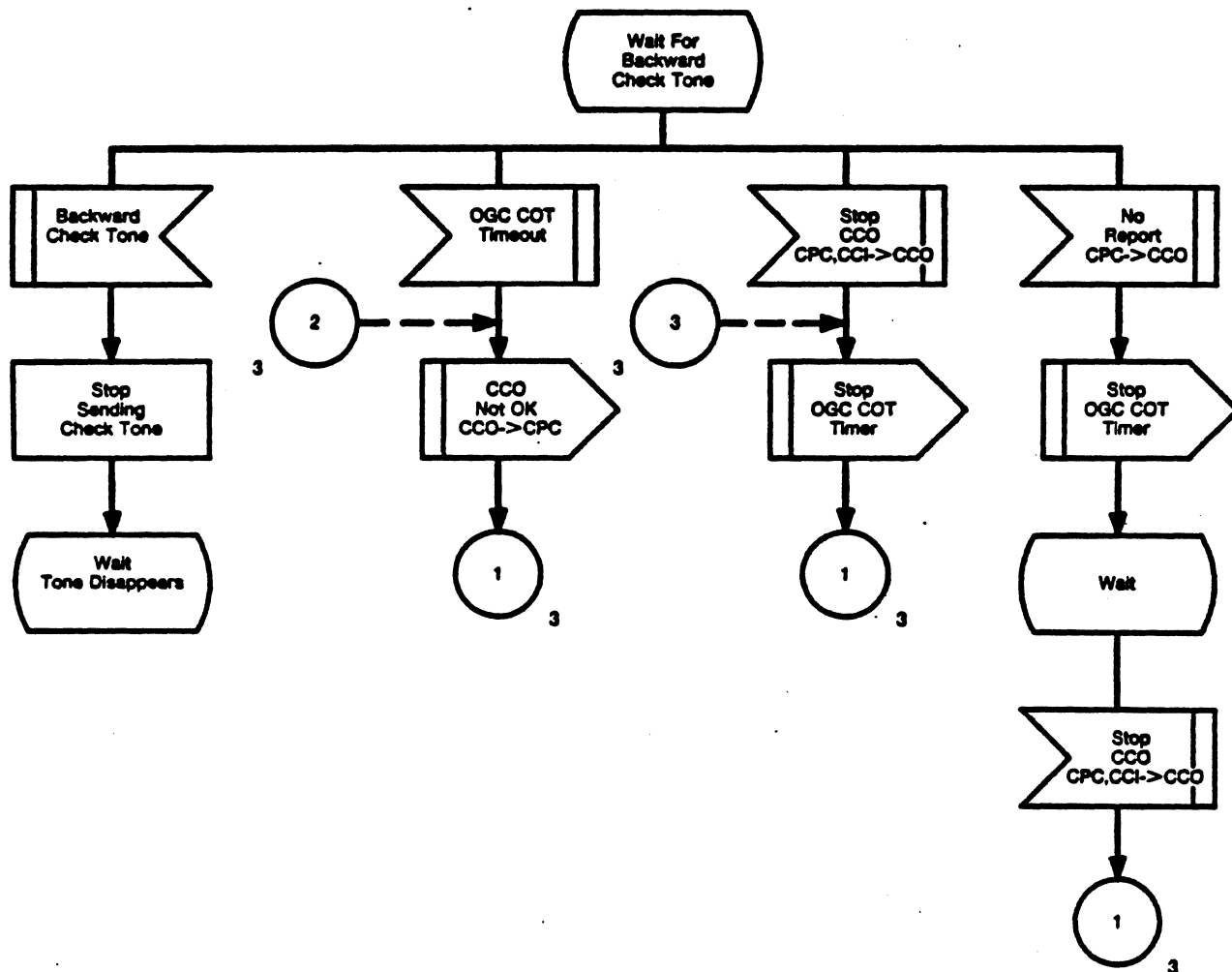


Figure III-3/Q.764 (Sheet 2 of 3)
 Continuity Check Outgoing (CCO)

APPENDIX III CALL PROCESSING CONTROL STATE TRANSITION DIAGRAMS

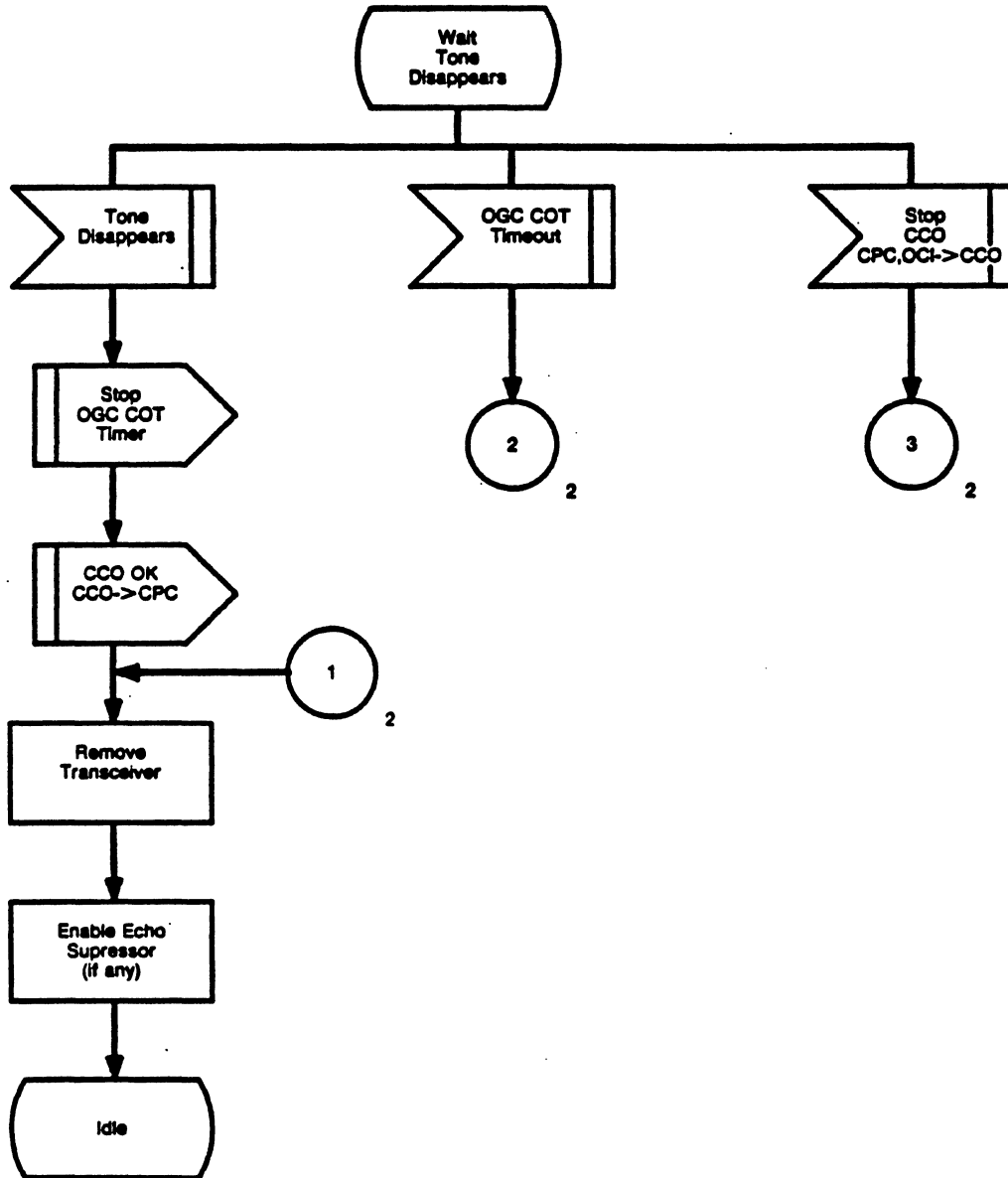


Figure III-3/Q.764 (Sheet 3 of 3)
Continuity Check Outgoing (CCO)

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APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

The following sections relate to circuit and circuit group maintenance requirements.¹

1. Test Calls

Test Calls over Common Channel signalling circuits may be used to test the transmission quality of circuits. To initiate a test call (except a continuity check test call), an Initial Address Message is sent with the fields coded as follows:

Parameter	Value
Message type	IAM
Nature of connection indicator	Continuity check 00 - no continuity check request
Forward call indicator	As appropriate
Calling party category	Test call
Nature of Address	Test Line Test Code
Numbering Plan	Unknown
User Service Information	As appropriate
Called party address	As appropriate

1.1 Continuity Check Test Calls. Continuity check test calls are initiated with a Continuity Check Request message.

2. Software Carrier Group Alarm

2.1 Facility Groups. Facility groups that do not have inherent fault indication features may use a Software Carrier Group Alarm (SCGA) to provide the fault indication necessary to remove the faulty group from service by inhibiting new seizures for as long as the fault condition persists.

2.2 Detection of the Carrier Failure. The carrier failure indication is based on the detection of two or more continuity check failures on a given carrier group. Normally the first failure occurs as a result of a continuity check failure in processing an ordinary call. When this occurs and the facility group is protected by SCGA, a demand continuity check is initiated within 5 seconds on another idle circuit in the same facility group. If this check fails, it is assumed the entire group has failed. All circuits associated with the group are removed from service locally and software group blocking signals are sent to the far exchange. On receipt of two of those messages within 5 seconds, the far exchange blocks the same circuits preventing new attempts on the blocked circuits. The far exchange responds with a software group block acknowledgement signal. If the demand continuity check passes or if all circuits are busy in the facility group, it is assumed the failure is a single circuit failure and the continuity repeat check (CRO) procedure is initiated on the failed circuit.

2.3 Detection of Carrier Restoral. Both exchanges initiate SCGA restoral procedures by periodically initiating a demand continuity check on one of the circuits in the failed group. The period between tests is increased as a function of the duration of the outage. If the failure persists for more than 2 minutes, maintenance personnel are notified but restoral testing continues at the maximum reduced rate (provisionally 2 minutes) until maintenance intervention occurs. If a demand continuity check passes, software group

1. These sections are not in the international specification and normally would be annotated with a * unless otherwise shown.

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

blocked condition is removed on the circuits in the previously failed facility group. The exchange that initiates the test that passes, sends a software group unblocking signal to the other exchange and that exchange responds with a software group unblocking acknowledgement signal subsequent to restoring the affected circuit to service. If maintenance was alerted as a consequence of the failure, maintenance is notified of the restoral.

3. Hardware Carrier Group Alarm

3.1 Detection of Carrier Failure. The loss of carrier for analog circuits reported by a data carrier failure detector or for digital circuits reported by a data channel failure detector will require special handling for CCS7 circuits. The detecting exchange upon a carrier loss will 1) locally block all the circuits for the group associated with the carrier 2) initiate two hardware group blocking signals to the far exchange, and 3) wait for the failure detector to report the restoral of the carrier. The notification to maintenance will not be made if the carrier restoral occurs within 5 minutes of the failure detection.

The far exchange when it receives both hardware group blocking signals within 5 seconds will mark the circuits blocked and will respond with a group blocking acknowledgement signal.

3.2 Detection of Carrier Restoral. When the carrier restoral is reported, the detecting exchange will restore the associated circuits to their previous states before the failure and will initiate a hardware unblocking signal to the far exchange. Maintenance is informed of the carrier restoral if a failure notification was made.

The far exchange when it receives a hardware group unblocking signal will mark circuits unblocked and will respond with a group unblocking acknowledgement signal.

3A. Circuit Validation Test Procedures The purpose of a CVT is to ensure that two exchanges having a circuit group between them have sufficient and consistent translation data for placing a call on a specific circuit of that circuit group. A CVT may be initiated by either exchange on demand by maintenance or operations personnel. The test is particularly useful during circuit turnup procedures, but is only performed after network routing has been validated.

3A.1 Translation Test Both near end and far end checks are required to perform a complete CVT. The initiating end starts the test by accessing the circuit, as identified by maintenance personnel with a Circuit Identification Number (CIN), and performing a translation check.

The translation check at the initiating end must perform adequate tests to ensure that translation data exists for: 1) deriving a physical appearance for the circuit so that a transceiver may be connected to it, and 2) deriving a Circuit Identification Code (CIC) and routing label so that a SS7 circuit related message may be generated.

If the near end test fails, maintenance personnel are notified with the reason for the near end failure (e.g. failure reason - circuit unequipped) and a CVT request message is not generated for the circuit under test. If the near end passes the test, a CVT request message is sent to the far end exchange.

The far end receiving the CVT request message must perform adequate tests to ensure that translation data exists for deriving a physical port from the received routing label and the CIC so that a loop or transceiver may be connected to the physical port. If the far end translation check fails, the CVT reply message will contain a fail indication in the Test Response Indicator parameter and should include a Common Language Location Identification (CLLI) code when available. If the far end checks pass, the CVT reply message will contain a success indication and the CIN when available. At the near end, a comparison of near end CIN with the far end CIN may be made. The CVT result should be reported to the maintenance personnel at the near end.

The CVT response message will also contain data about the circuit with respect to the characteristics of the circuit group that it is part of. The circuit group characteristics will include whether:

APPENDIX IV
CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

1. Whether the exchange controls odd or even CICs in the case of double seizing;
2. the carrier group containing the circuit is processed by software carrier handling or hardware carrier handling;
3. whether the circuit group contains analog, digital or a mix of analog and digital circuits;
4. whether the circuit group employs per call, statistical or no continuity checks.

3A.2 Timing Constraints The end initiating the test allows a maximum of 10 seconds for the far end to respond with a CVT response message. If the timer expires, another CVT request message may be sent. If the timer expires again, the fact is reported to maintenance personnel.

4. Maintenance Processing Control State Transition Diagrams

These diagrams are provided to support Section 2 of Recommendation Q.764 which has a textual description of the maintenance signalling procedures (to be known as the Maintenance Processing Control (MPC)). The call processing interfaces for the procedures are indicated as appropriate.

4.1 Definitions. A normal ISDN-UP circuit group is any arbitrary size group not exceeding 24 circuits arranged in the order of consecutive Circuit Identification Codes (CICs), sharing a common facility and destined to the same exchange. The range and status subfields provided in the ISDN-UP message will be used to indicate how many and what circuits within the consecutive order are affected. A range field of zero is interpreted to mean a predefined group. The definition and uses of a predefined group are still under study.

The definitions of basic circuit states are given in Appendix III.

4.2 SDL Diagram Organization. The SDL diagrams attached for ISDN-UP are organized such that a main signalling procedure control (SPRC) message dispenser acts as the interface for Common Channel Signalling (CCS) message reception and transmission. The SPRC message flow is covered in Appendix II.

Note that in the SDL diagrams, functional blocks other than SPRC are considered internal, and SPRC is considered to be external to these functions. Messages between functional blocks other than SPRC are thus shown as internal messages; messages to and from SPRC are shown as external messages.

This proposal contains diagrams for Maintenance Processing Control (MPC), which receives and transmits messages to SPRC, and performs the appropriate maintenance recovery actions necessary.

The MPC SDL diagrams are shown in Figures IV - 1 through 17.

APPENDIX IV
CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

4.3 MPC Abbreviations, SDL States and Timers.

4.3.1 MPC Abbreviations. The abbreviations used in the attached SDL diagrams are listed below.

TABLE IV - 1 - MPC Function Block Names

BLOCK	DESCRIPTION
BLR	- Blocking/Unblocking Reception (Figure 1)
BLS	- Blocking/Unblocking Sending (Figure 2)
CRO	- Continuity Recheck Outgoing (Figure 3)
CRI	- Continuity Recheck Incoming (Figure 4)
CRS	- Circuit Reset Sending (Figure 5)
CRR	- Circuit Reset Reception (Figure 6)
SCGA	- Software Carrier Group Alarm (Figure 7)
HGA	- Hardware Carrier Group Alarm (Figure 8)
DCO	- Demand Continuity Outgoing (Figure 9)
CGRS	- Circuit Group Reset Sending (Figure 10)
CGRR	- Circuit Group Reset Receiving (Figure 11)
MBUS	- Maintenance Group Blocking/Unblocking Sending (Figure 12)
MBUR	- Maintenance Group Blocking/Unblocking Reception (Figure 13)
HBUS	- Hardware Group Blocking/Unblocking Sending (Figure 14)
HBUR	- Hardware Group Blocking/Unblocking Reception (Figure 15)
SBUS	- Software Group Blocking/Unblocking Sending (Figure 16)
SBUR	- Software Group Blocking/Unblocking Reception (Figure 17)

APPENDIX IV

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TABLE IV-2 - MPC Signals

SIGNAL	DESCRIPTION
BLA	- Blocking Acknowledgement
BLO	- Blocking
CCR	- Continuity Check Request
COT	- Continuity
GRA	- Group Reset Acknowledgement
GRS	- Group Reset
HBA	- Hardware Group Blocking Acknowledgement
HGB	- Hardware Group Blocking
HGU	- Hardware Group Unblocking
HUA	- Hardware Group Unblocking Acknowledgement
LPA	- Loop-back Acknowledgement
MBA	- Maintenance Group Blocking Acknowledgement
MGB	- Maintenance Group Blocking
MGU	- Maintenance Group Unblocking
MUA	- Maintenance Group Unblocking Acknowledgement
RLC	- Release Complete
REL	- Release
RSC	- Reset Circuit
SGB	- Software Group Blocking
SGA	- Software Group Blocking Acknowledgement
SGU	- Software Group Unblocking
SUA	- Software Group Unblocking Acknowledgement
UBA	- Unblocking Acknowledgement
UBL	- Unblocking

APPENDIX IV

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4.3.2 MPC SDL Diagram States. The ISDN-UP states used in the attached SDL diagrams are shown below:

TABLE IV-3A - MPC States

FUNCTION	STATE NAME	STATE NUMBER
BLR	Idle	0
	Remote Blocked	1
BLS	Idle	0
	Wait for BLA	1
	Locally Blocked	2
	Wait for UBA	3
CRO	Idle	0
	Wait for Timeout	1
	Wait for SCGA	2
	Wait for Continuity	3
	Wait for RLC	4
CRI	Idle	0
	Wait for CCR	1
	Wait for COT	2
	[Text deleted]	
CRS	Idle	0
	Wait for release	1
CRR	Idle	0
	Wait for RLC	1

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
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FUNCTION	STATE NAME	STATE NUMBER
SCGA	Idle	0
	Wait for Initial DCO	1
	Wait for SCGA Restoral	2
	Wait for Subsequent DCO	3
HGA	Idle	0
	Wait for HGA Restoral	1
DCO	Idle	0
	Wait for LPA	1
	Wait for tone	2
	Wait for tone disappearance	3
CGRS	Idle	0
	Wait for GRA	1
CGRR	Idle	0
	Wait for second GRS	1
MBUS	Idle	0
	Wait for MBA	1
	M-Blocked	2
HBUS	Idle	0
	Wait for HBA	1
	H-Blocked	2
SBUS	Idle	0
	Wait for SBA	1
	M-Blocked	2

TABLE IV-3B - MPC States (continued)

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS**

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FUNCTION	STATE NAME	STATE NUMBER
MBUR	Idle	0
	Wait for second MGB	1
	M-Blocked	2
HBUR	Idle	0
	Wait for second HGB	1
	H-Blocked	2
SBUR	Idle	0
	Wait for second SGB	1
	S-Blocked	2

TABLE IV-3C - MPC States (continued)

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS**

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4.4 MPC Timers. A list of the times used in the MPC SDL diagrams is given below:

FUNCTION	TIMER NAME	VALUE	DESCRIPTION
BLR	T1	5 Min	Maintenance alert timer
BLS	T2	5 Min	Circuit Blocked Report
	T3	4 - 15 Secs	Resend BLO
	T4	1 Min	Failed to receive BLA
	T5	4 - 15 Secs	Resend UBL
	T6	1 Min	Failed to receive UBA
CRO	T7	1 - 10 Secs	Wait before initial retest
	T8	1 - 3 Minutes	Wait before subsequent retest
	T9	4 - 15 Secs	Wait for RLC
	T10		Unused
CRI	T11	20 Secs	Wait time for CCR request
	T12	10 - 15 Secs	Wait for COT
	T13	>3 Min	Wait for repeated check
	T14	1 Min	Wait for RLSD
CRS	T15	4 - 15 Secs	RSC repeat timer
	T16	1 Min	Maint Alert Timer
CRR	T17	4 - 15 Secs	Wait for RLC
SCGA	T18	5 - 120 Secs	Restoral timer
HGA	T19	2 Minute	Maint Alert Timer
DCO	T20	2 Secs	Wait for LPA
	T21	2 Secs	Wait for tone & removal
	T22		Unused

TABLE IV-4 - MPC Function Timers

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS**

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FUNCTION	TIMER NAME	VALUE	DESCRIPTION
CGRS	T23	4 - 15 Secs	GRS Repeat Timer
	T24	1 Min	Maint alert timer
CGRR	T25	5 Secs	Wait for second GRS
MBUS HBUS SBUS	T26	4 - 15 Sec	MGB repeat timer
			HGB repeat timer
			SGB repeat timer
MBUS HBUS SBUS	T27	1 Min	Maint alert timer
MBUS HBUS SBUS	T28	4 - 15 Secs	MGU repeat timer
			HGU repeat timer
			SGU repeat timer
MBUS HBUS SBUS	T29	1 Min	Maint alert timer
MBUR HBUR SBUR	T30	5 Secs	Wait for second MGB
			Wait for second HGB
			Wait for second SGB
MBUR HBUR SBUR	T31	1 Min	Maint alert timer

TABLE IV-5 - Circuit and Circuit Group Maintenance Requirements

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

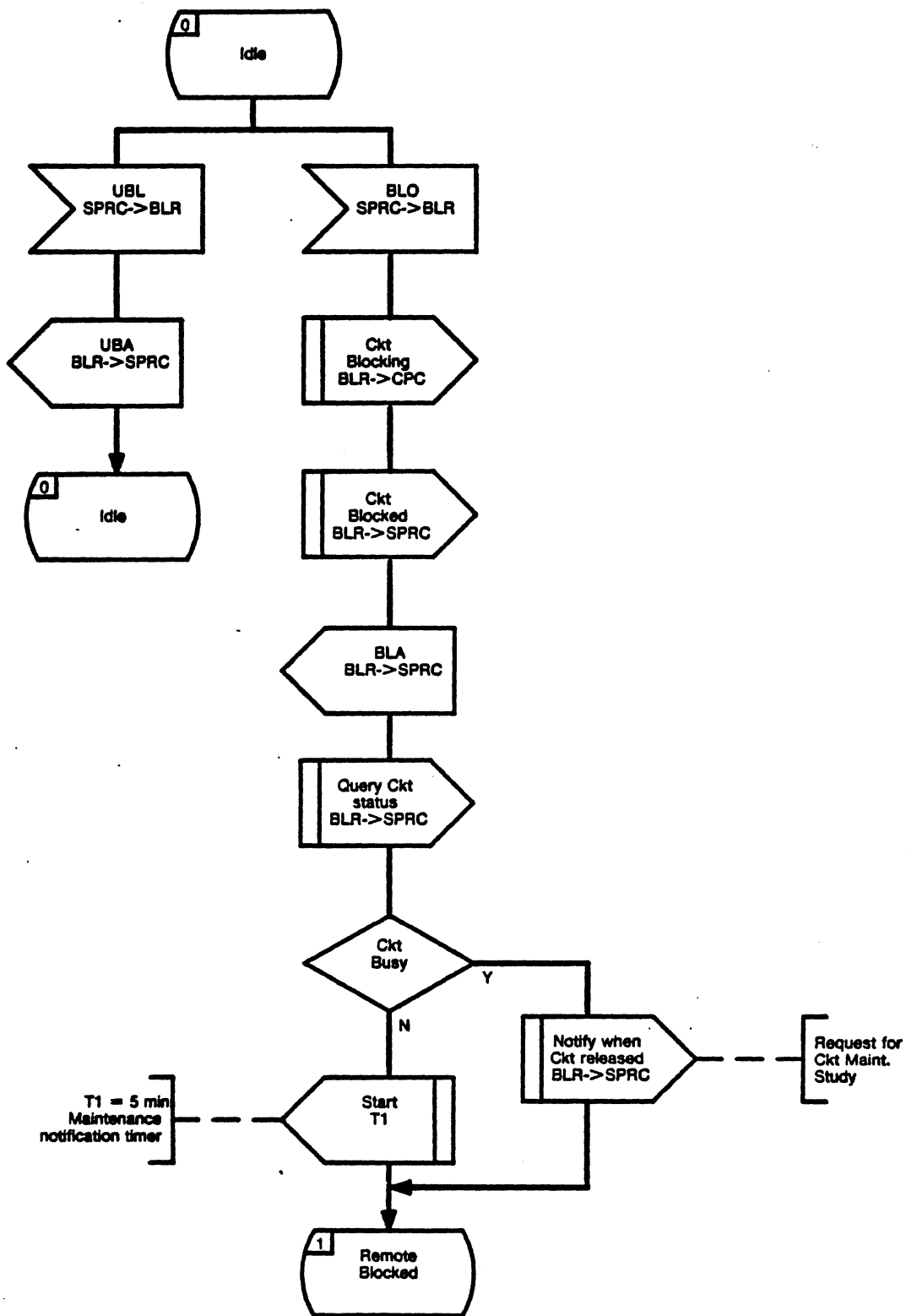


Figure IV-1/Q.764 (Sheet 1 of 2)
Blocking/Unblocking Signal Reception (BLR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

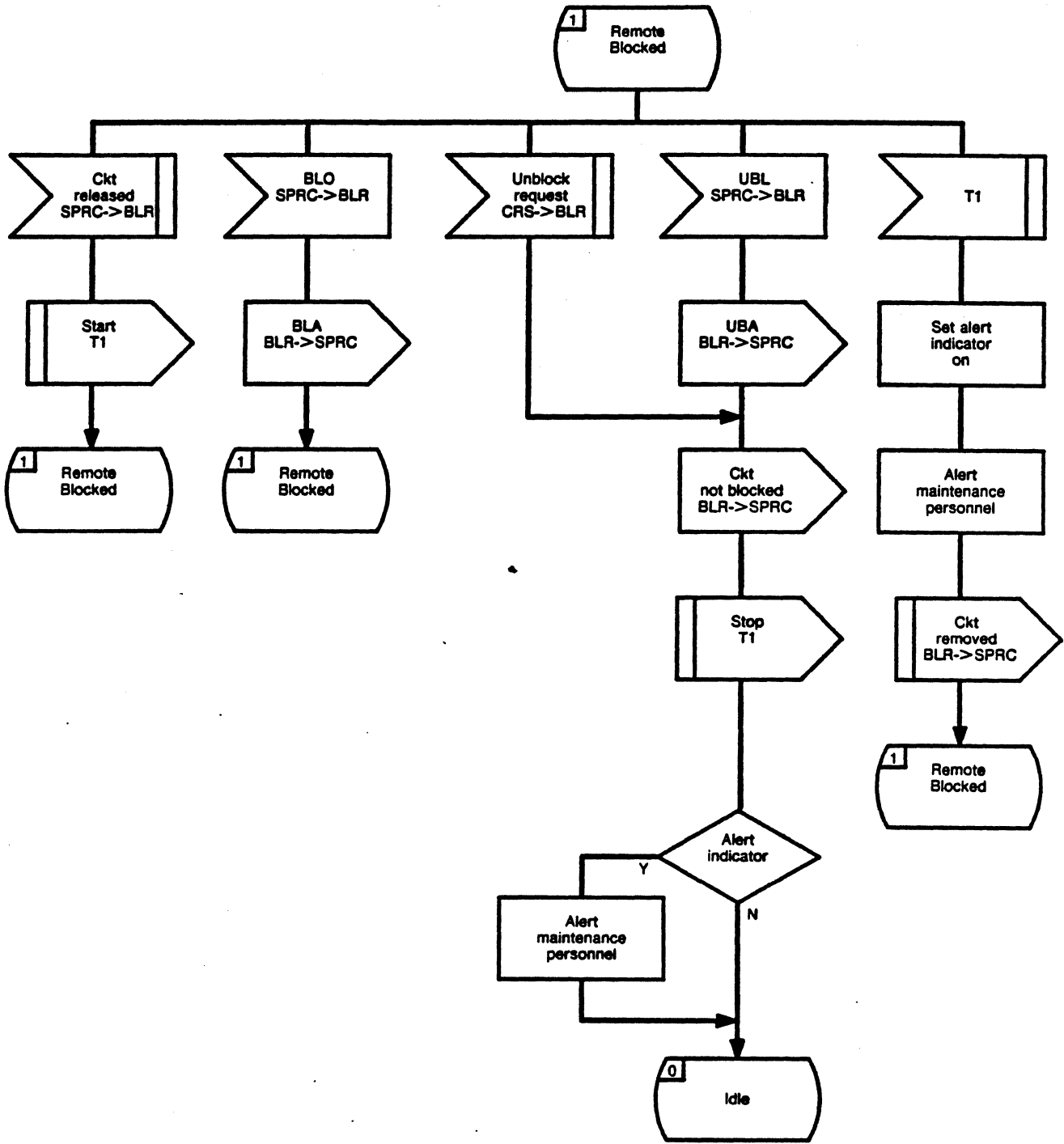


Figure IV-1/Q.764 (Sheet 2 of 2)
Blocking/Unblocking Signal Reception (BLR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

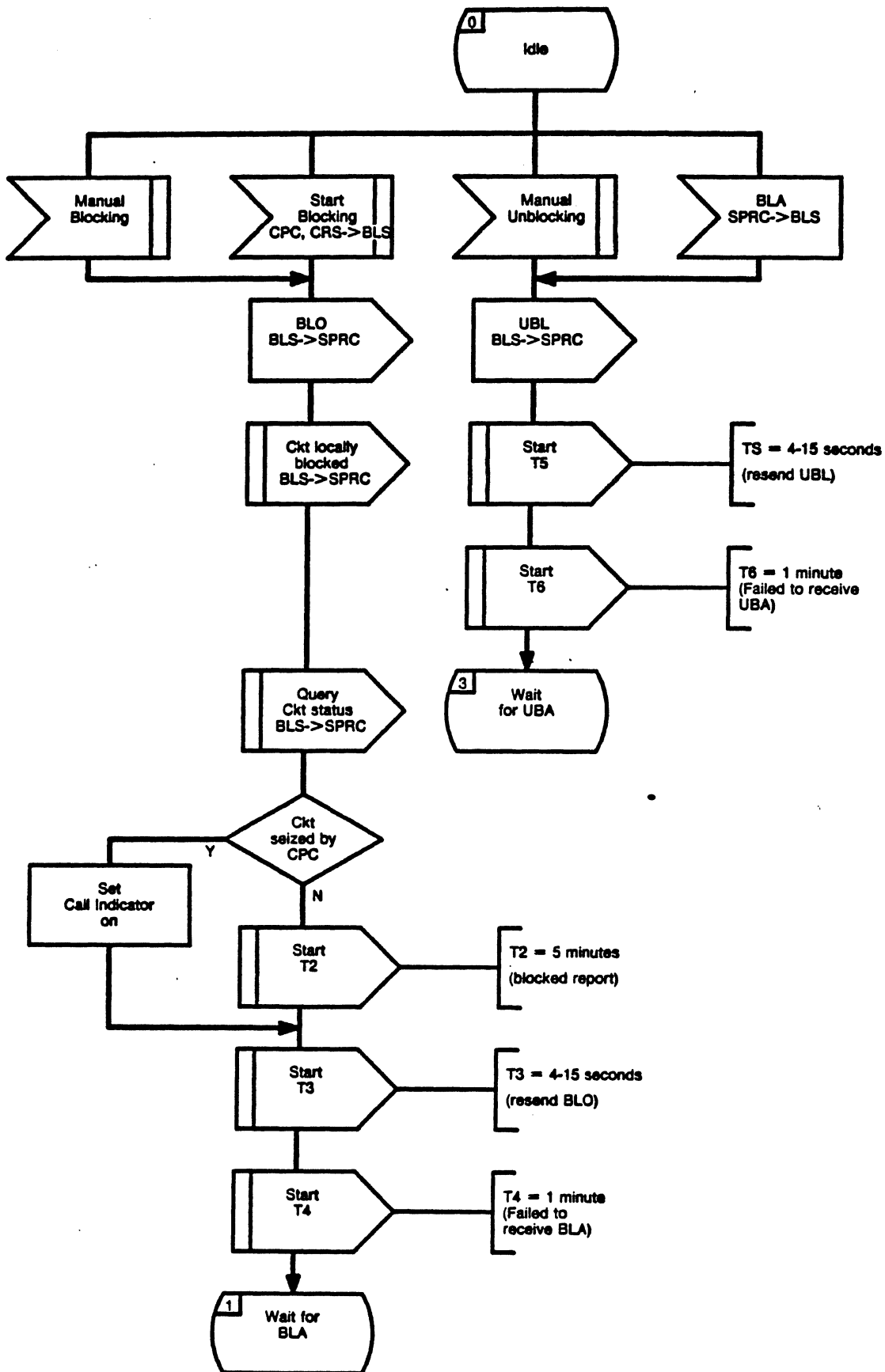


Figure IV-2/Q.764 (Sheet 1 of 4)
Blocking/Unblocking Signal Sending (BLS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

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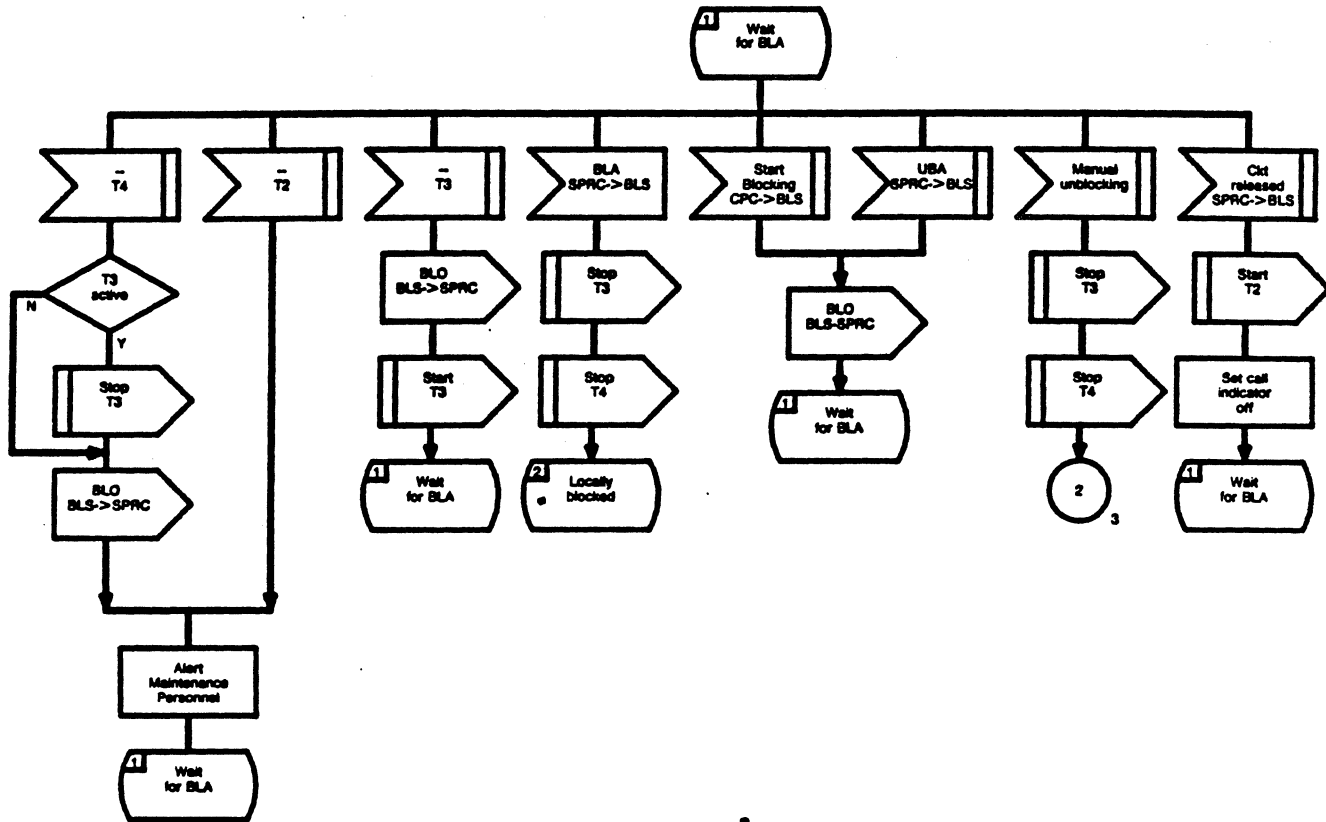


Figure IV-2/Q.764 (Sheet 2 of 4)
Blocking/Unblocking Signal Sending (BLS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

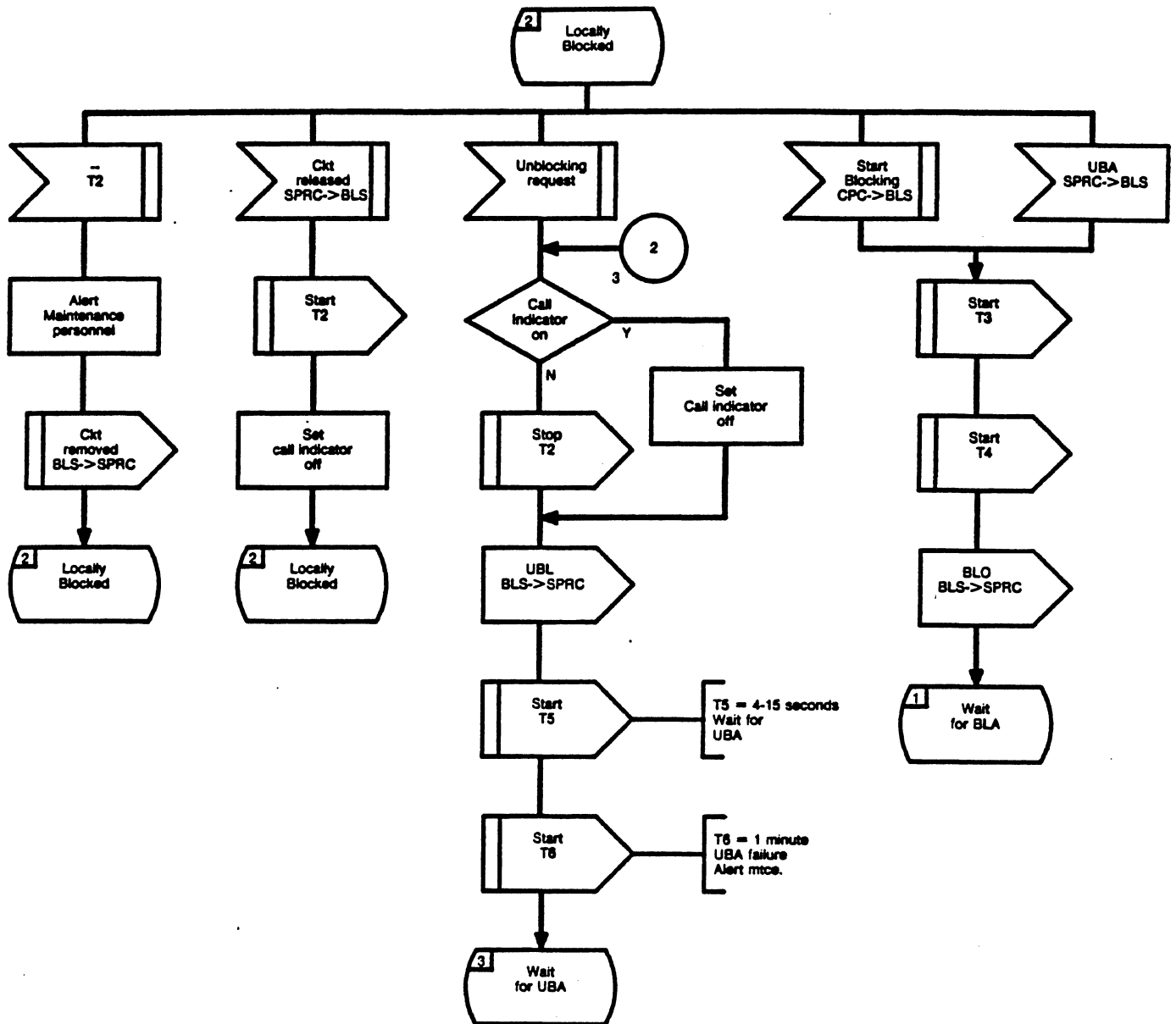


Figure IV-2/Q.764 (Sheet 3 of 4)
Blocking/Unblocking Signal Sending(BLS)

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS**

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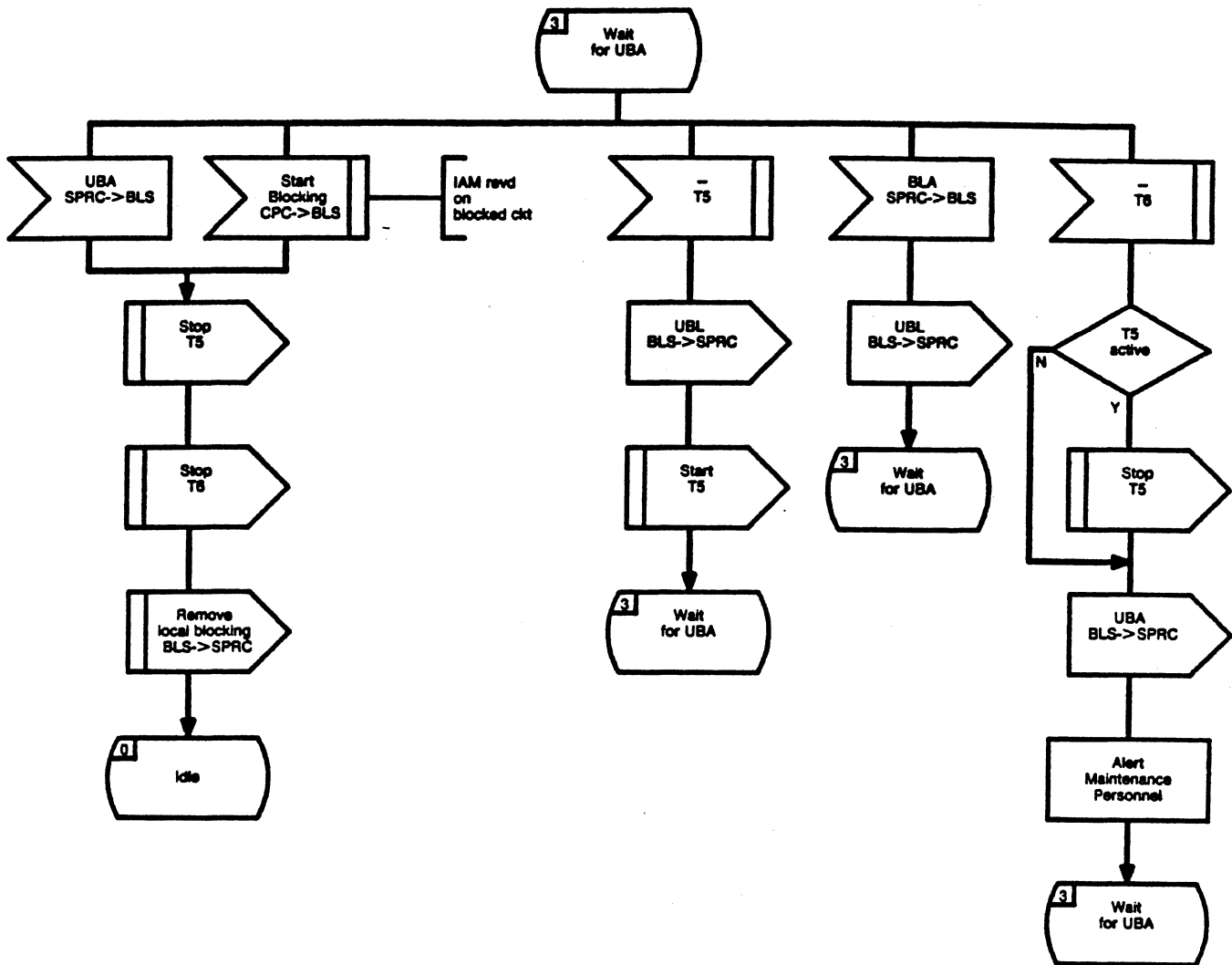


Figure IV-2/Q.764 (Sheet 4 of 4)
Blocking/Unblocking Signal Sending (BLS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

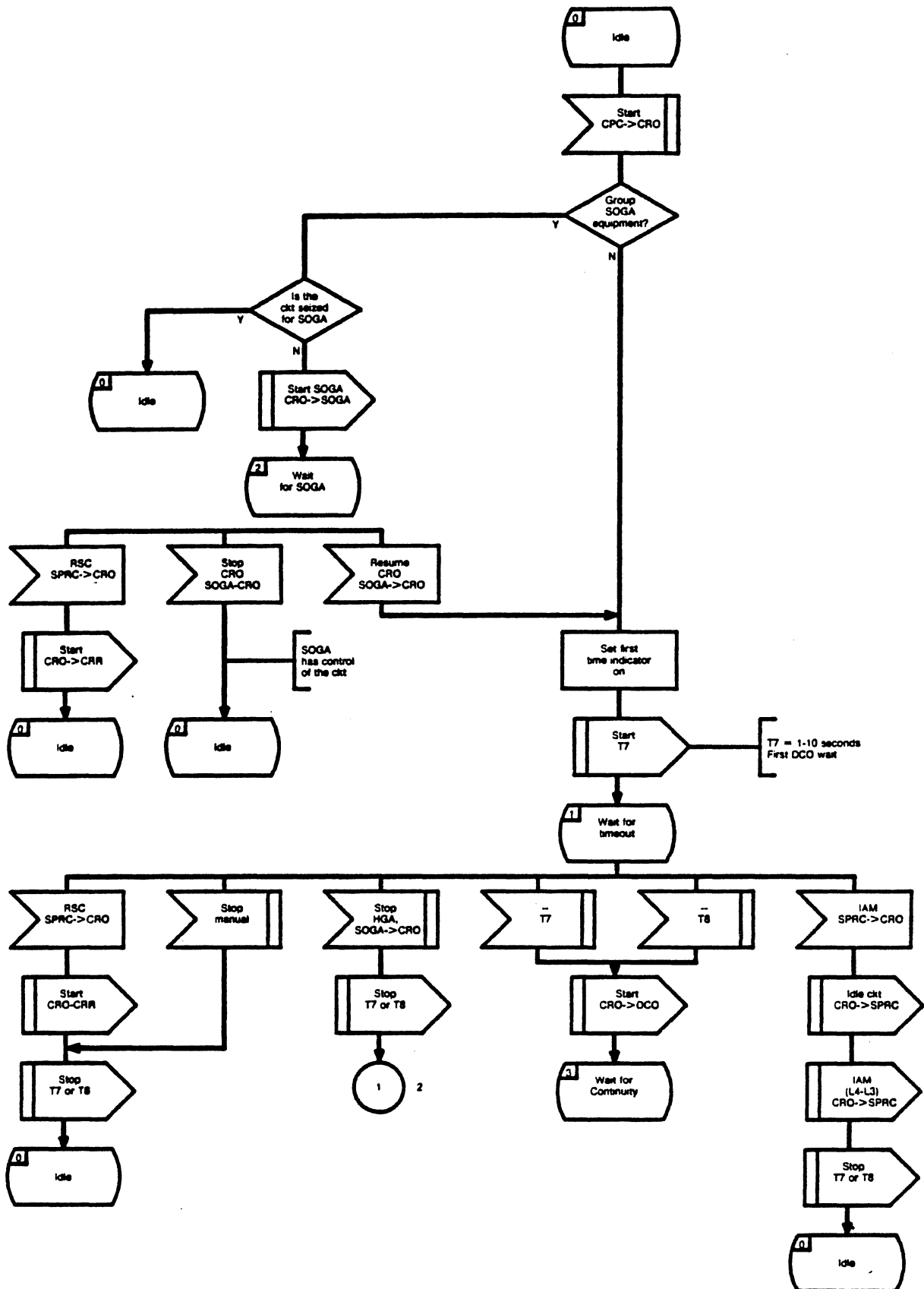


Figure IV-3/Q.764 (Sheet 1 of 4)
Continuity Recheck Outgoing (CRO)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

Q.764

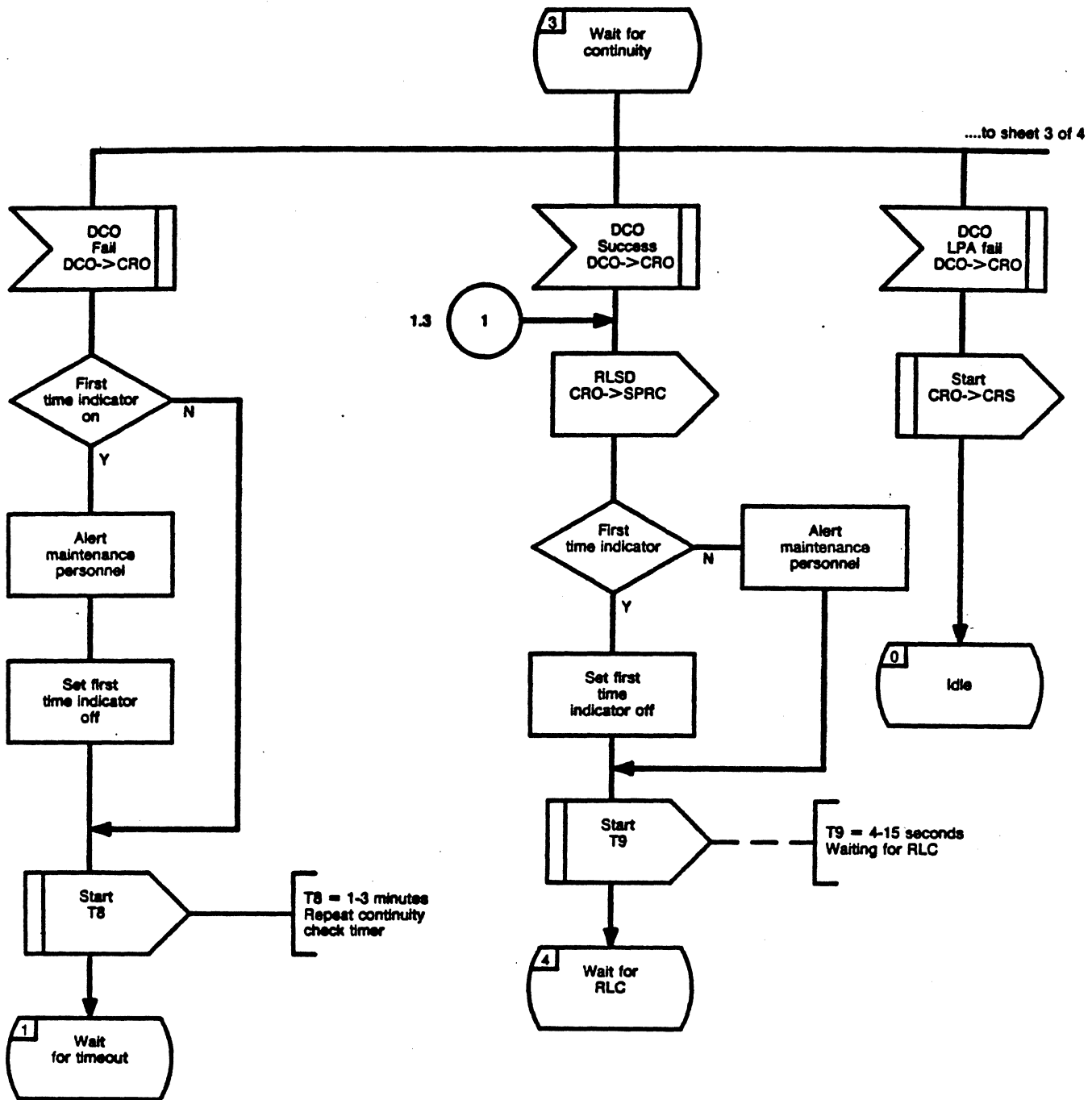
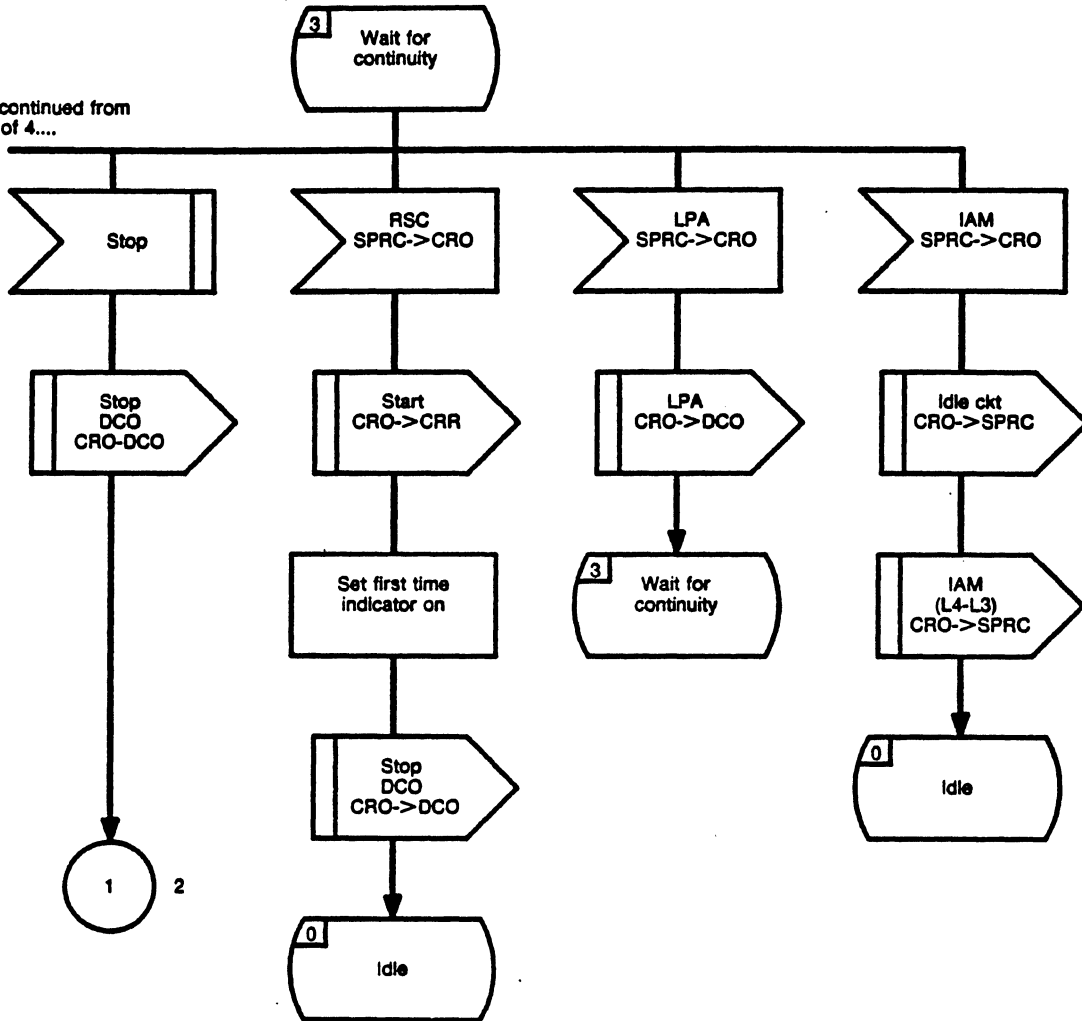


Figure IV-3/Q.764 (Sheet 2 of 4)
 Continuity Recheck Outgoing (CRO)

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS**

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State 3 continued from
sheet 2 of 4....



**Figure IV-3/Q.764 (Sheet 3 of 4)
Continuity Recheck Outgoing (CRO)**

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
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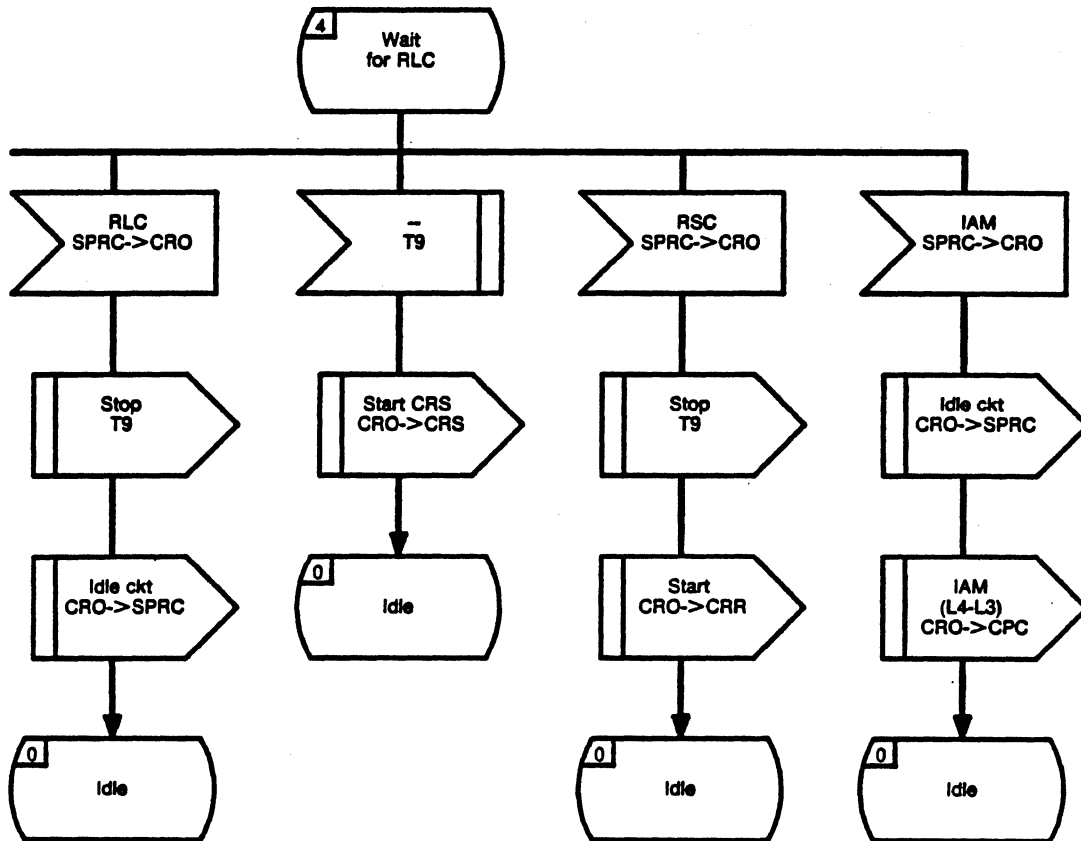


Figure IV-3/Q.764 (Sheet 4 of 4)
Continuity Recheck Outgoing (CRO)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

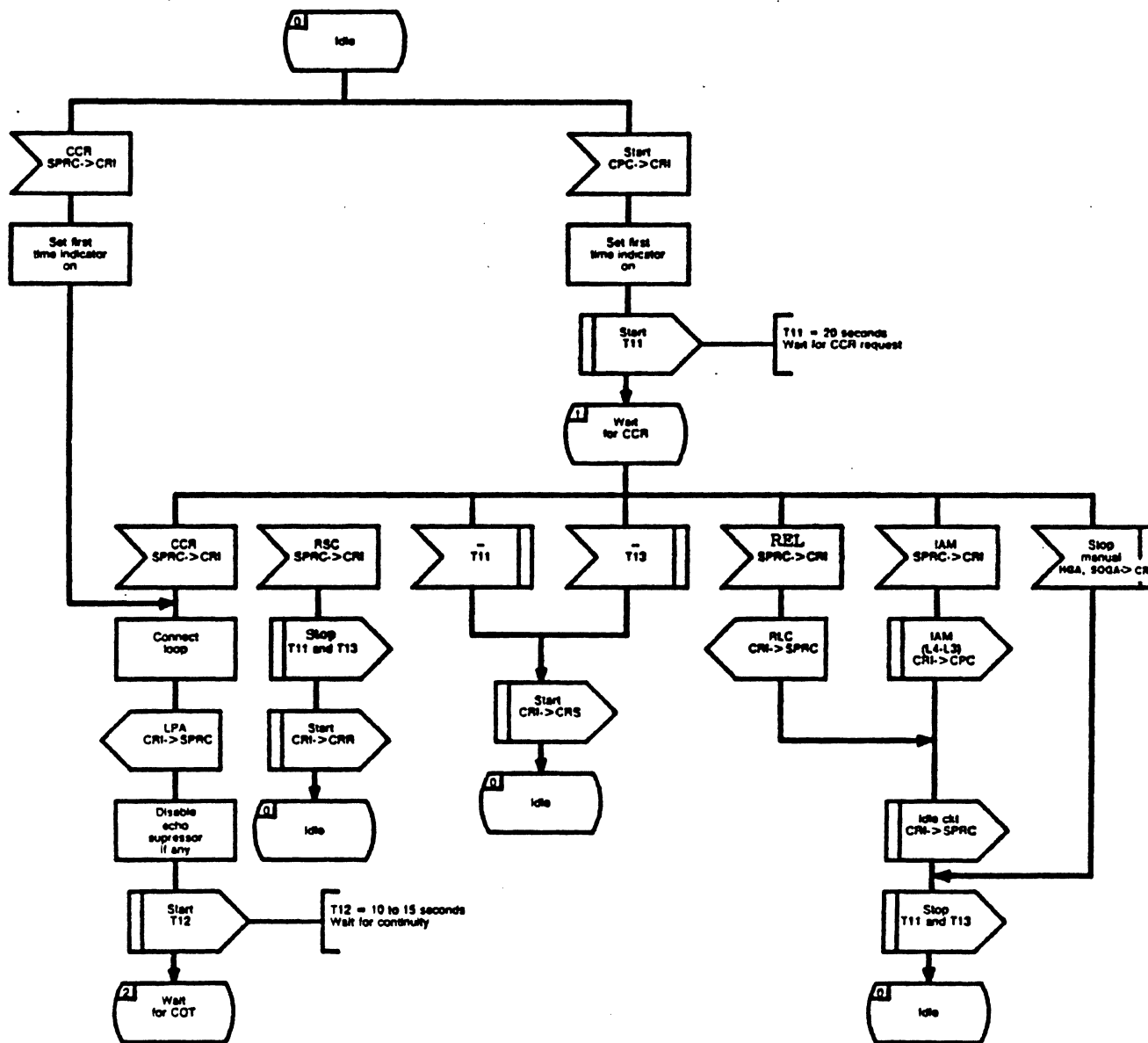


Figure IV-4/Q.764 (Sheet 1 of 3)
 Continuity Recheck Incoming (CRI)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

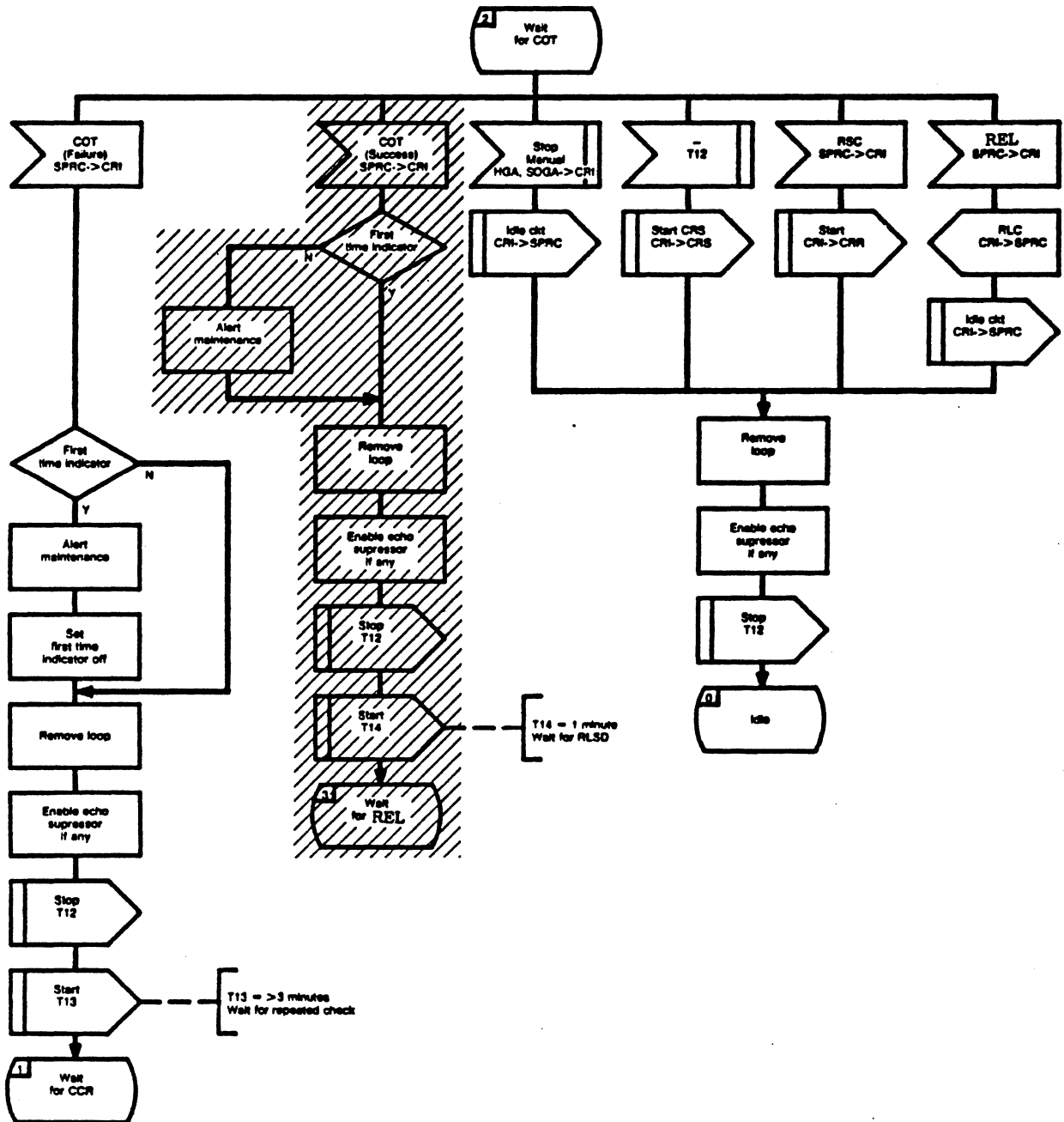


Figure IV-4/Q.764 (Sheet 2 of 3)
 Continuity Recheck Incoming (CRI)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

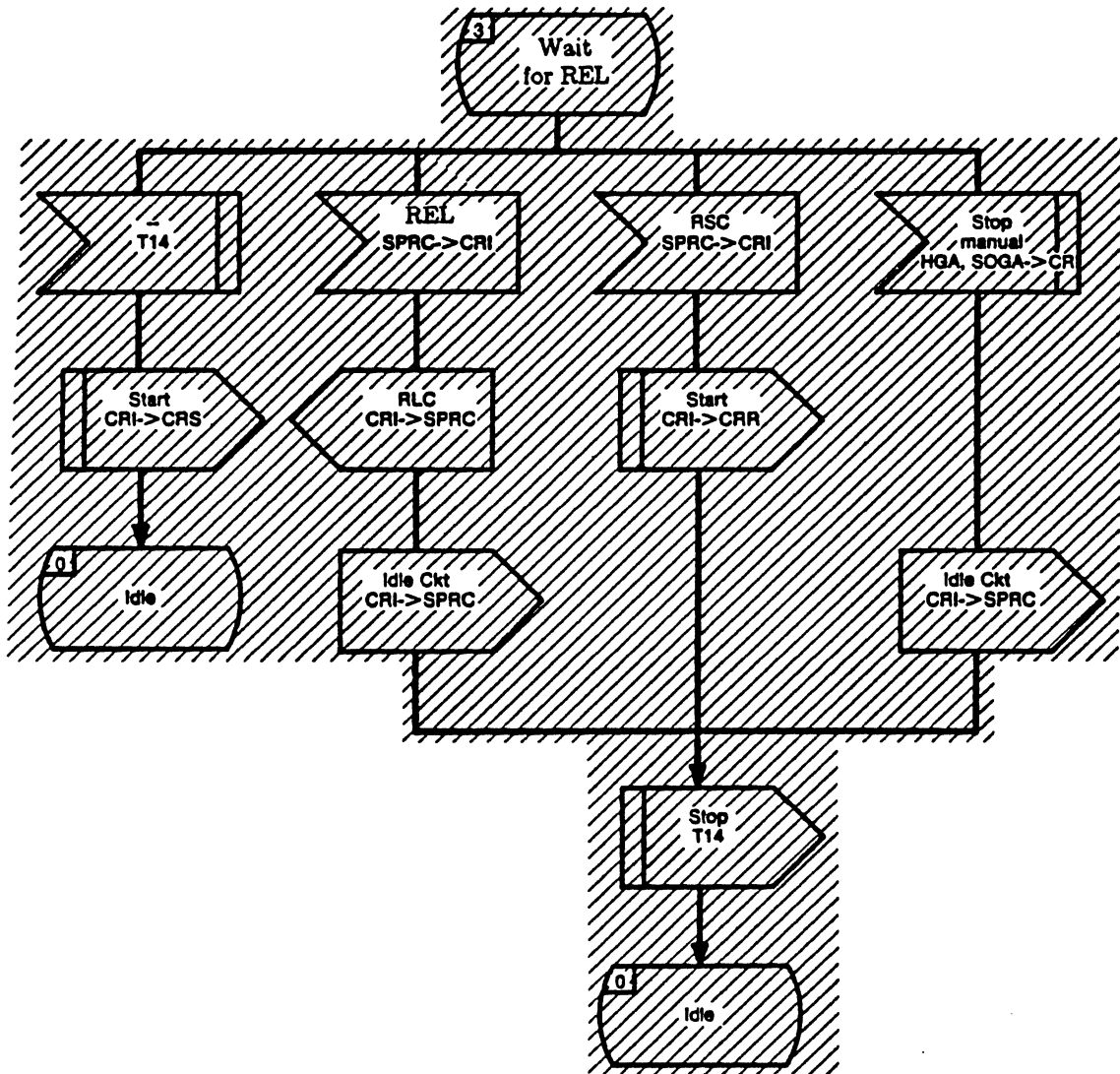


Figure IV-4/Q.764 (Sheet 3 of 3)
 Continuity Recheck Incoming (CRI)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

Q.764

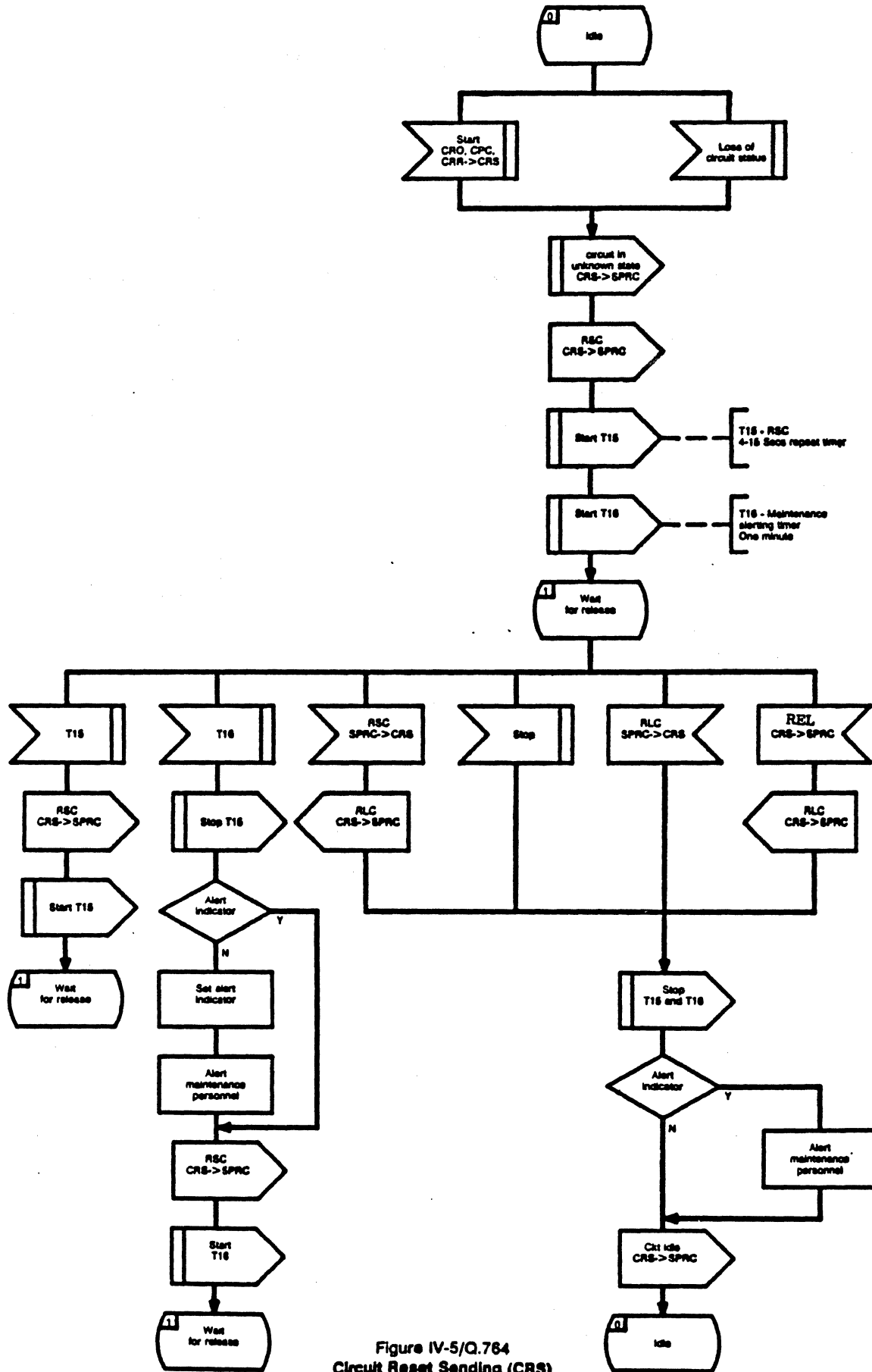


Figure IV-5/Q.764
 Circuit Reset Sending (CRS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

Q.764

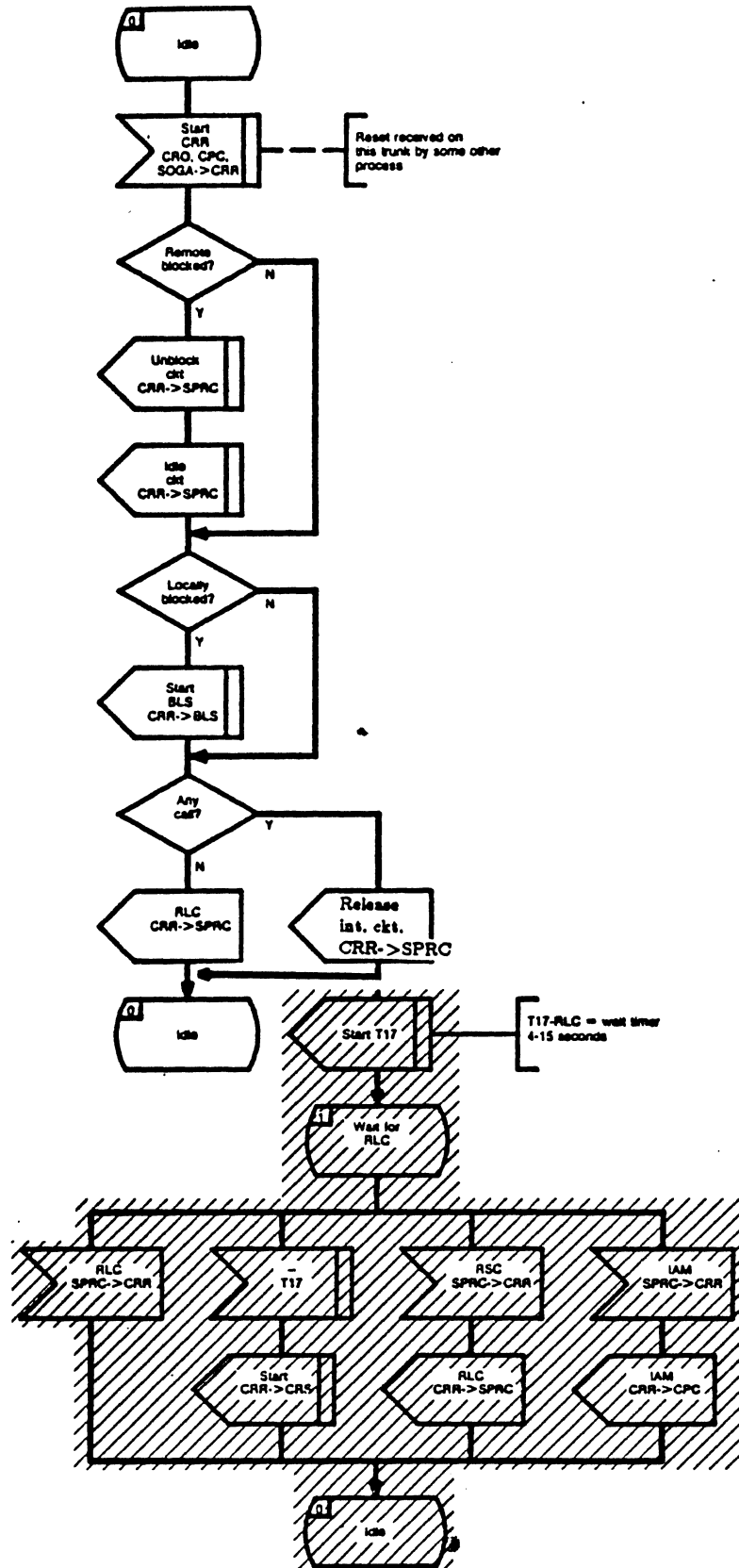


Figure IV-6/Q.764
 Circuit Reset Reception (CRR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

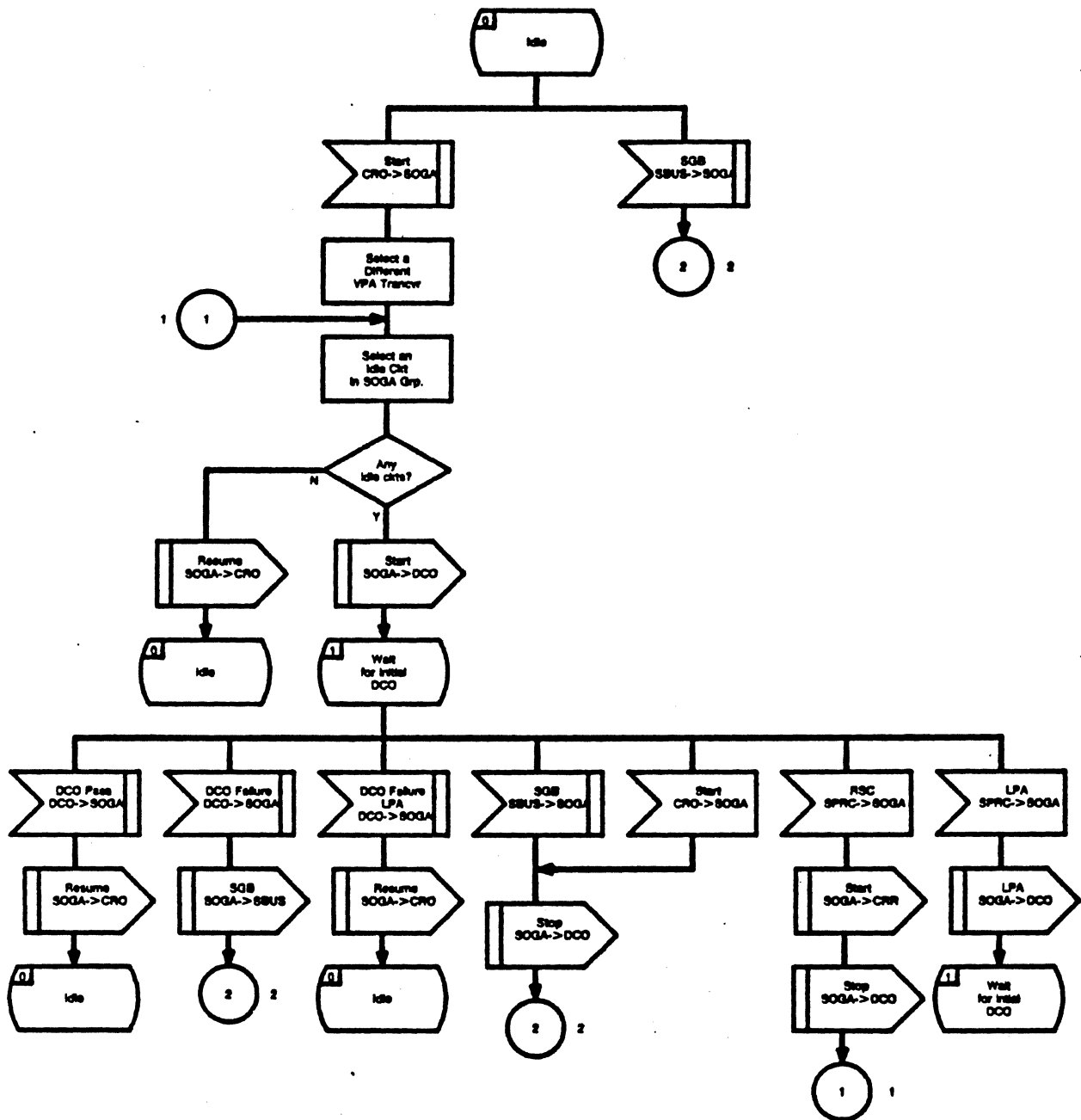


Figure IV-7/Q.764 (Sheet 1 of 3)
 Software Carrier Group Alarm (SCGA)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

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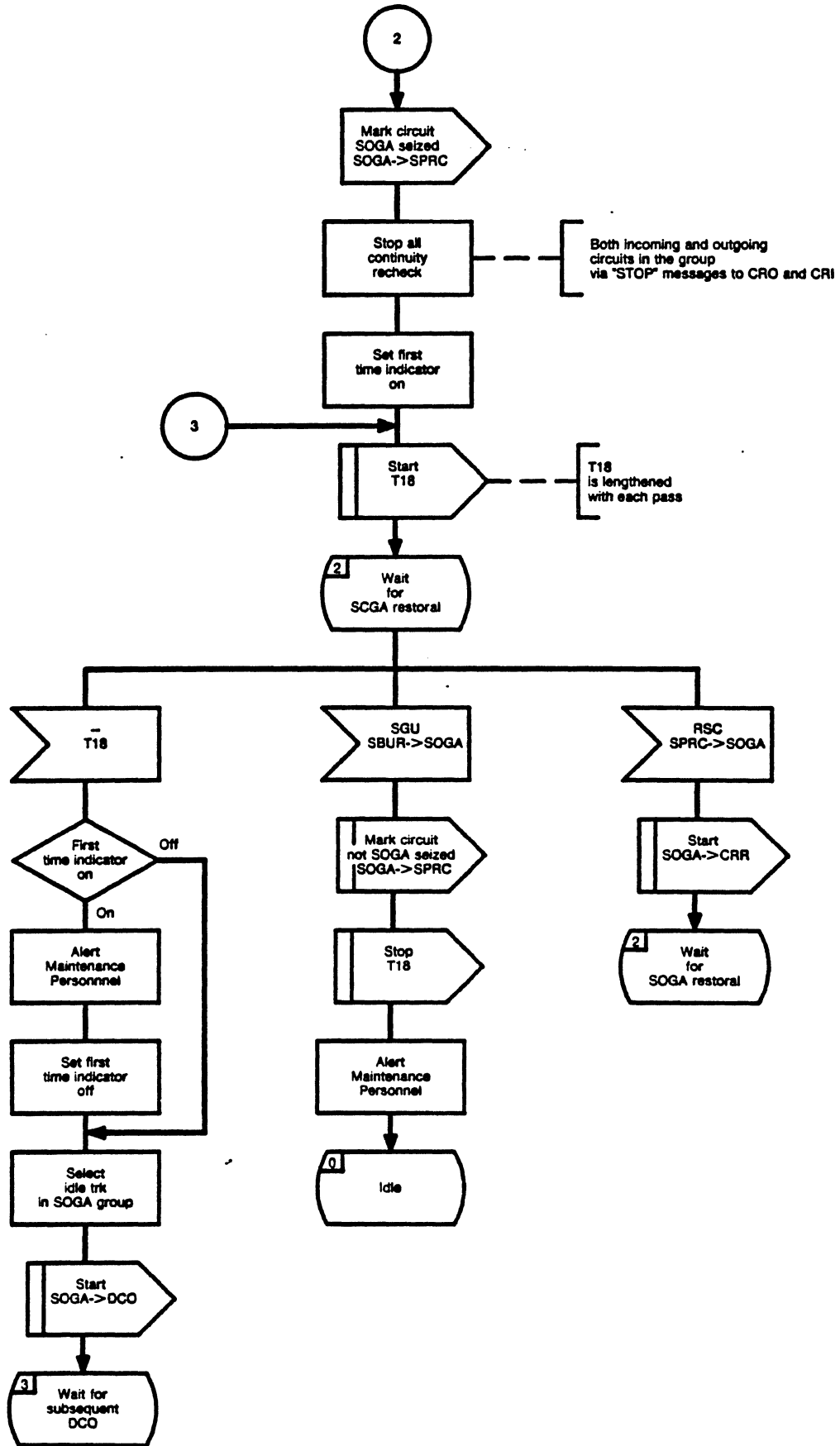


Figure IV-7/Q.764 (Sheet 2 of 3)
Software Carrier Group Alarm (SCGA)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

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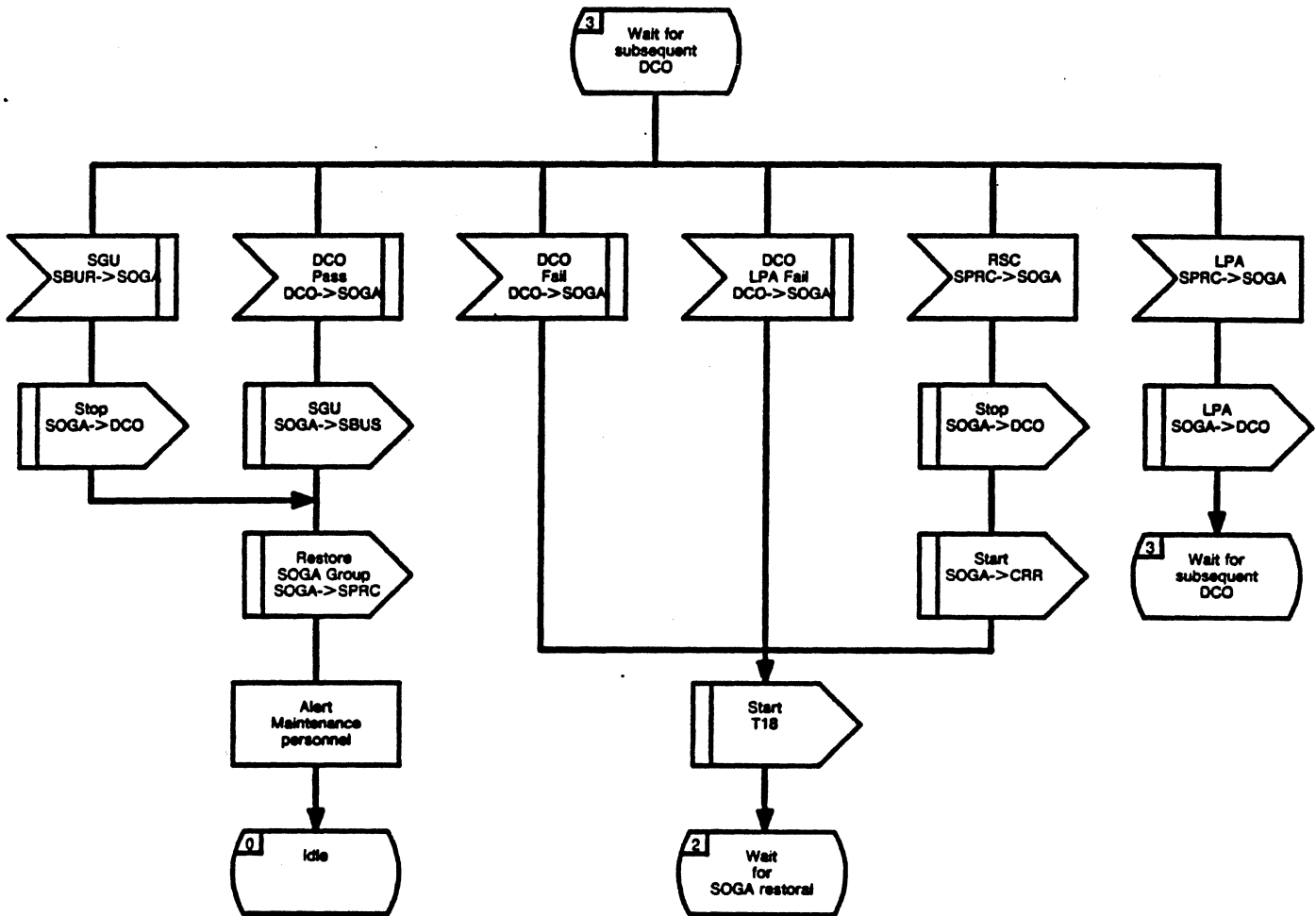


Figure IV-7/Q.764 (Sheet 3 of 3)
Software Carrier Group Alarm (SCGA)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

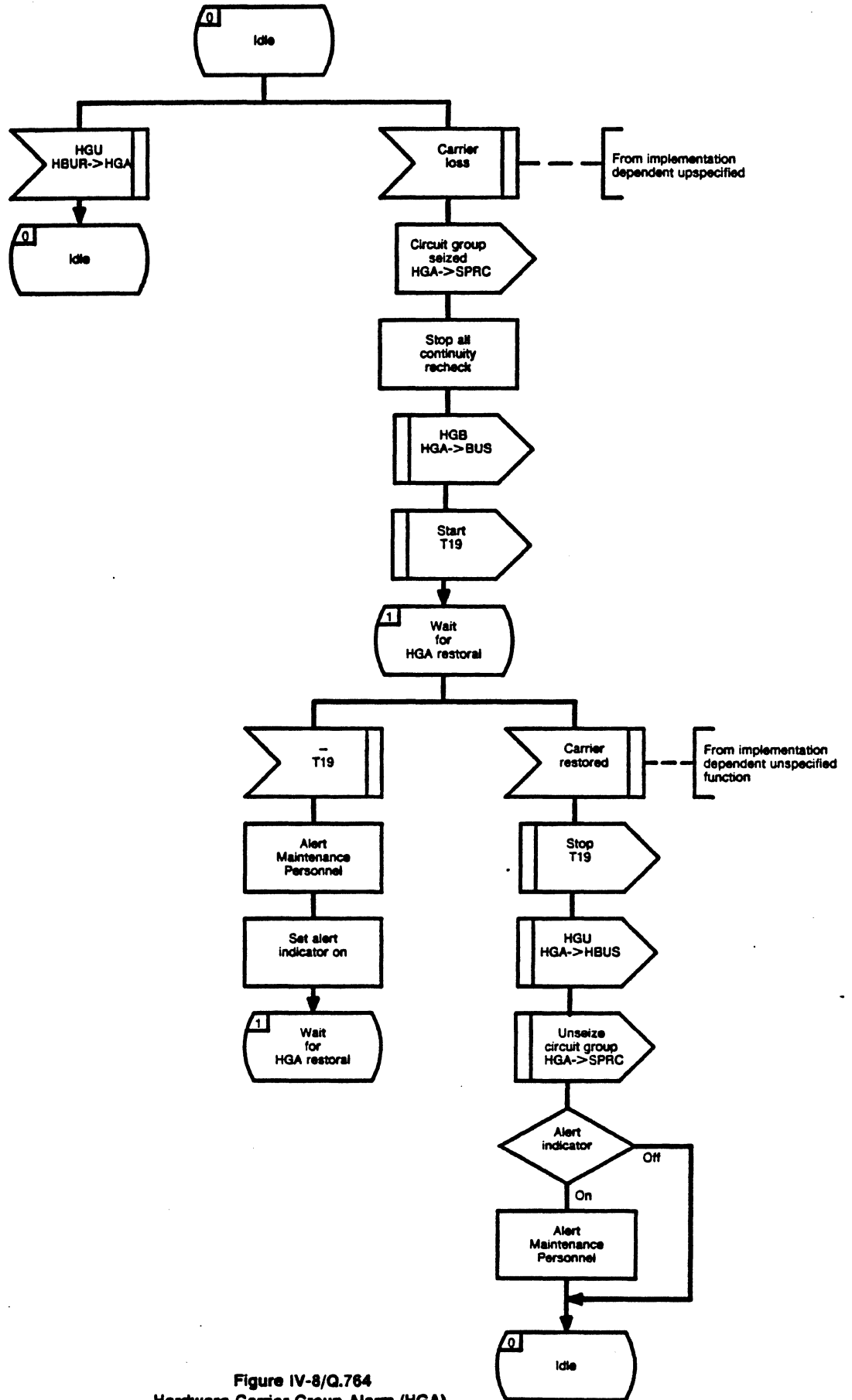


Figure IV-8/Q.764
Hardware Carrier Group Alarm (HGA)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

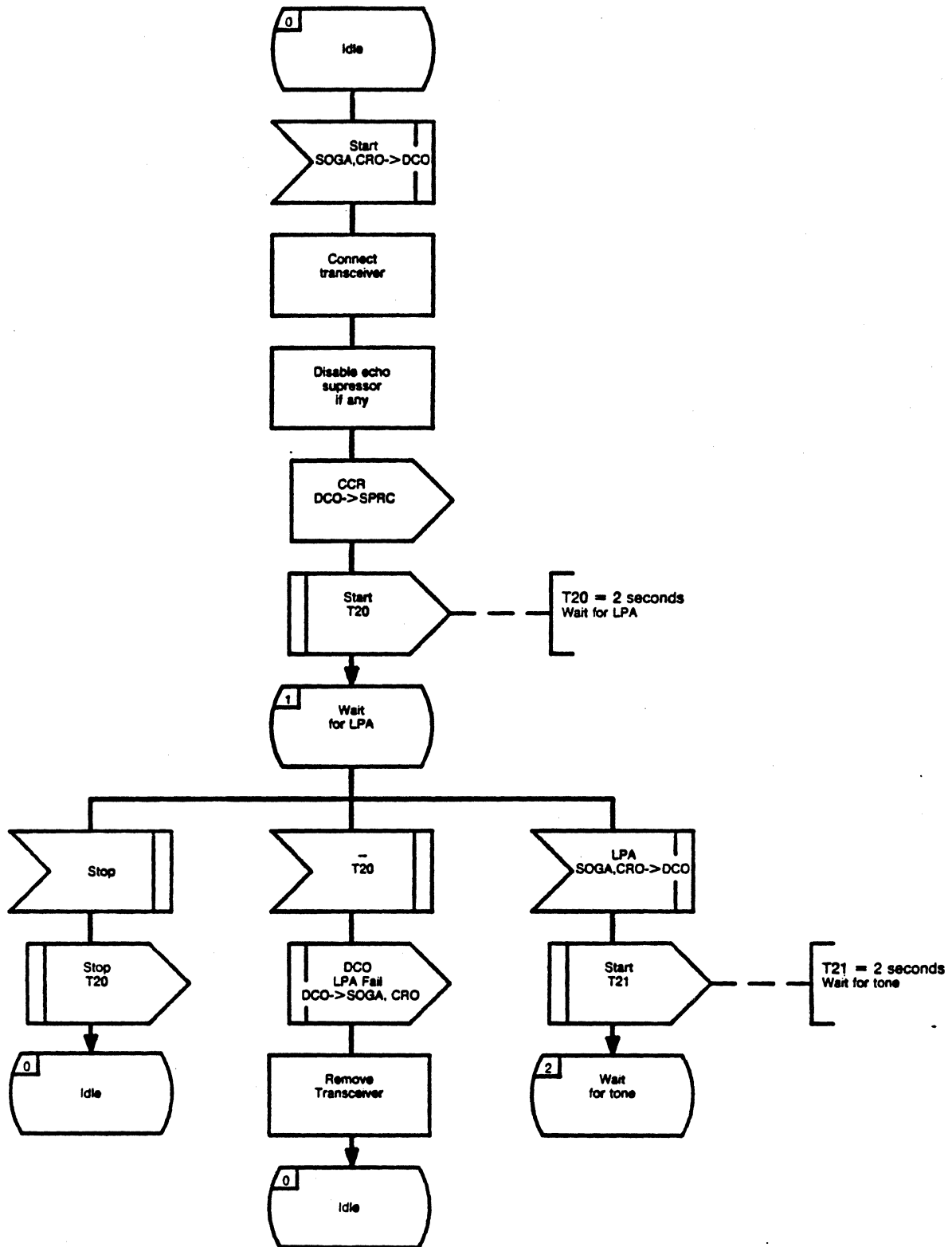


Figure IV-9/Q.764 (Sheet 1 of 3)
Demand Continuity Outgoing(DCO)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

Q.764

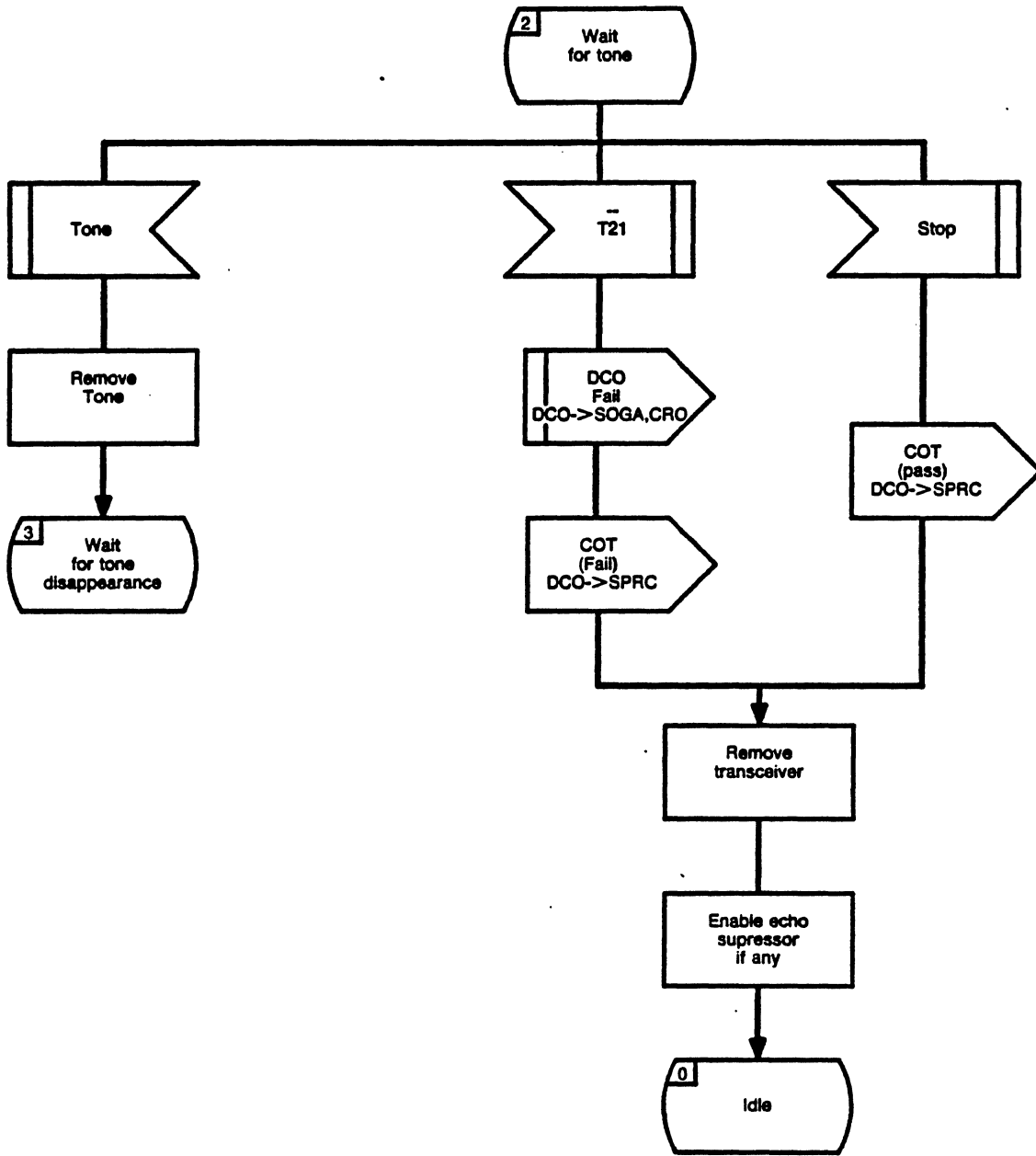


Figure IV-9/Q.764 (Sheet 2 of 3)
 Demand Continuity Outgoing (DCO)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

Q.764

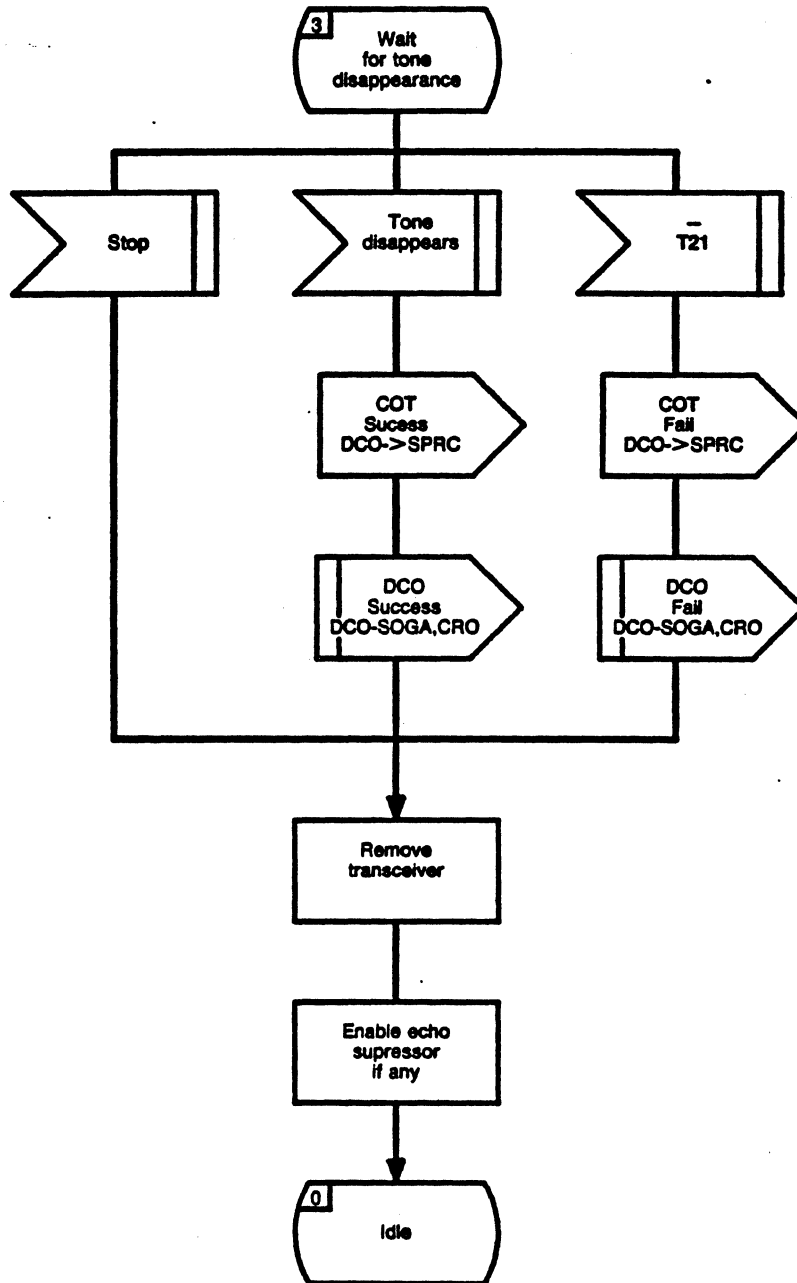


Figure IV-9/Q.764 (Sheet 3 of 3)
 Demand Continuity Outgoing (DCO)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

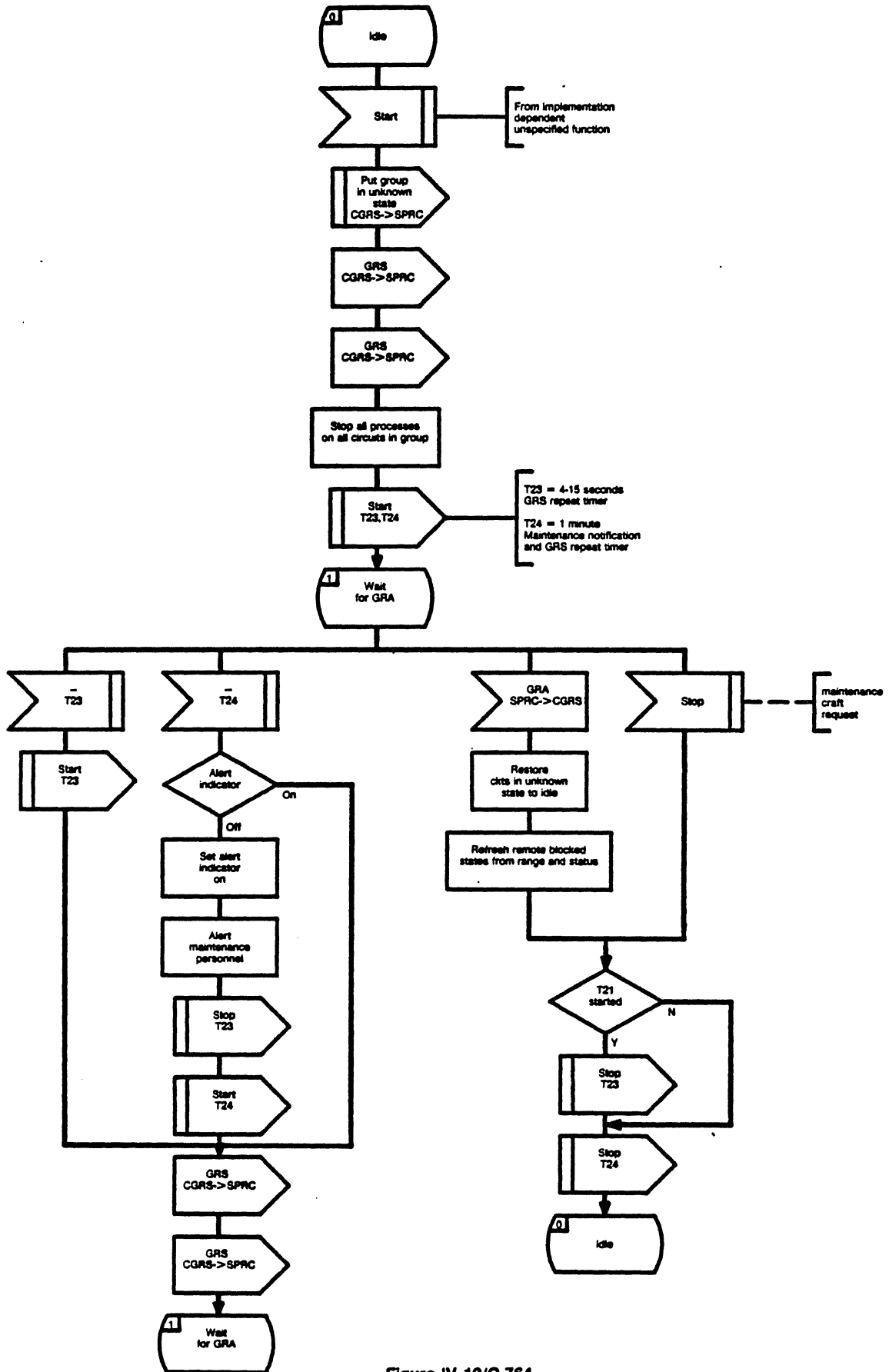


Figure IV-10/Q.764
Circuit Group Reset Sending (CGRS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

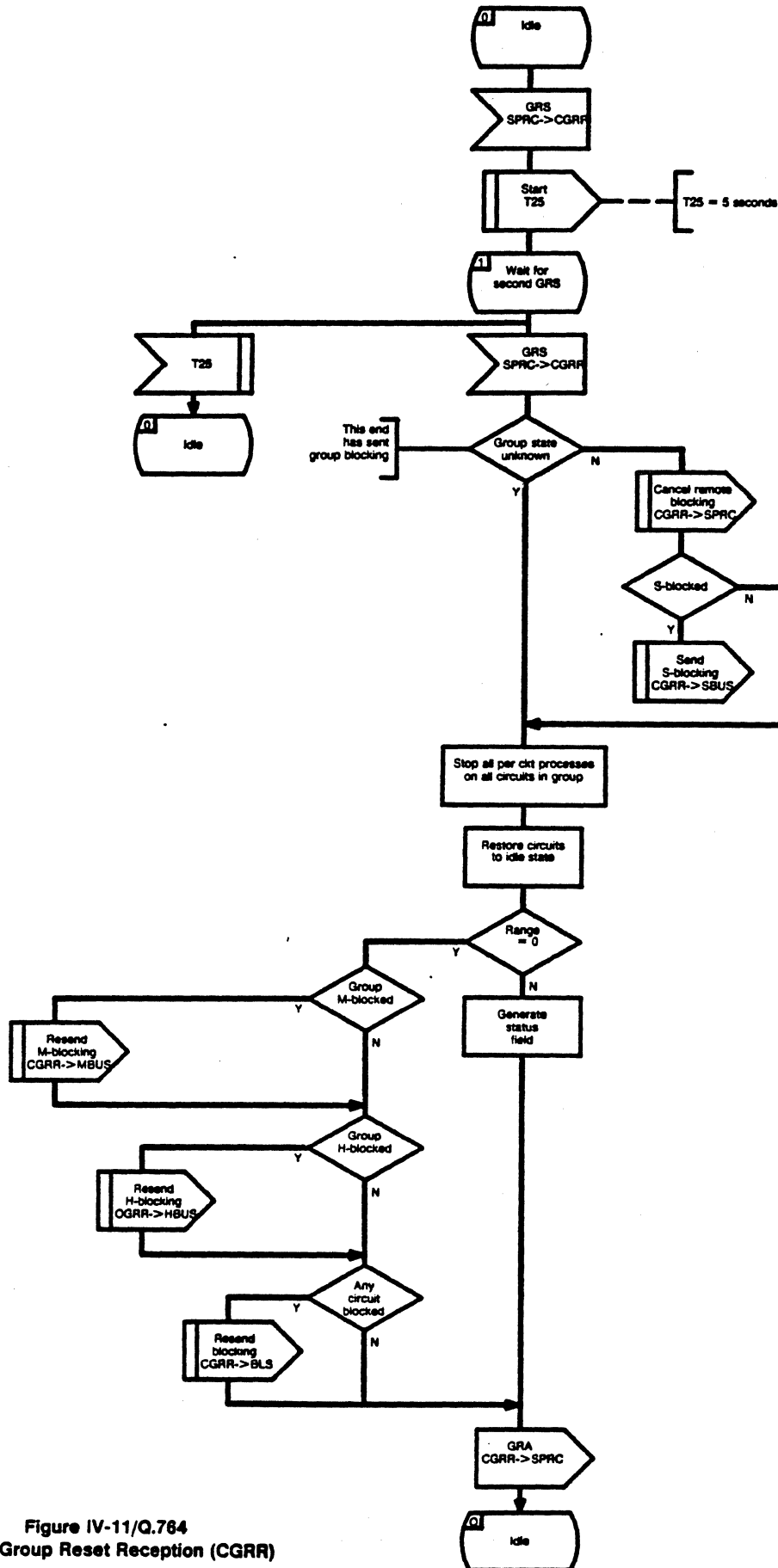


Figure IV-11/Q.764
Circuit Group Reset Reception (CGRR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

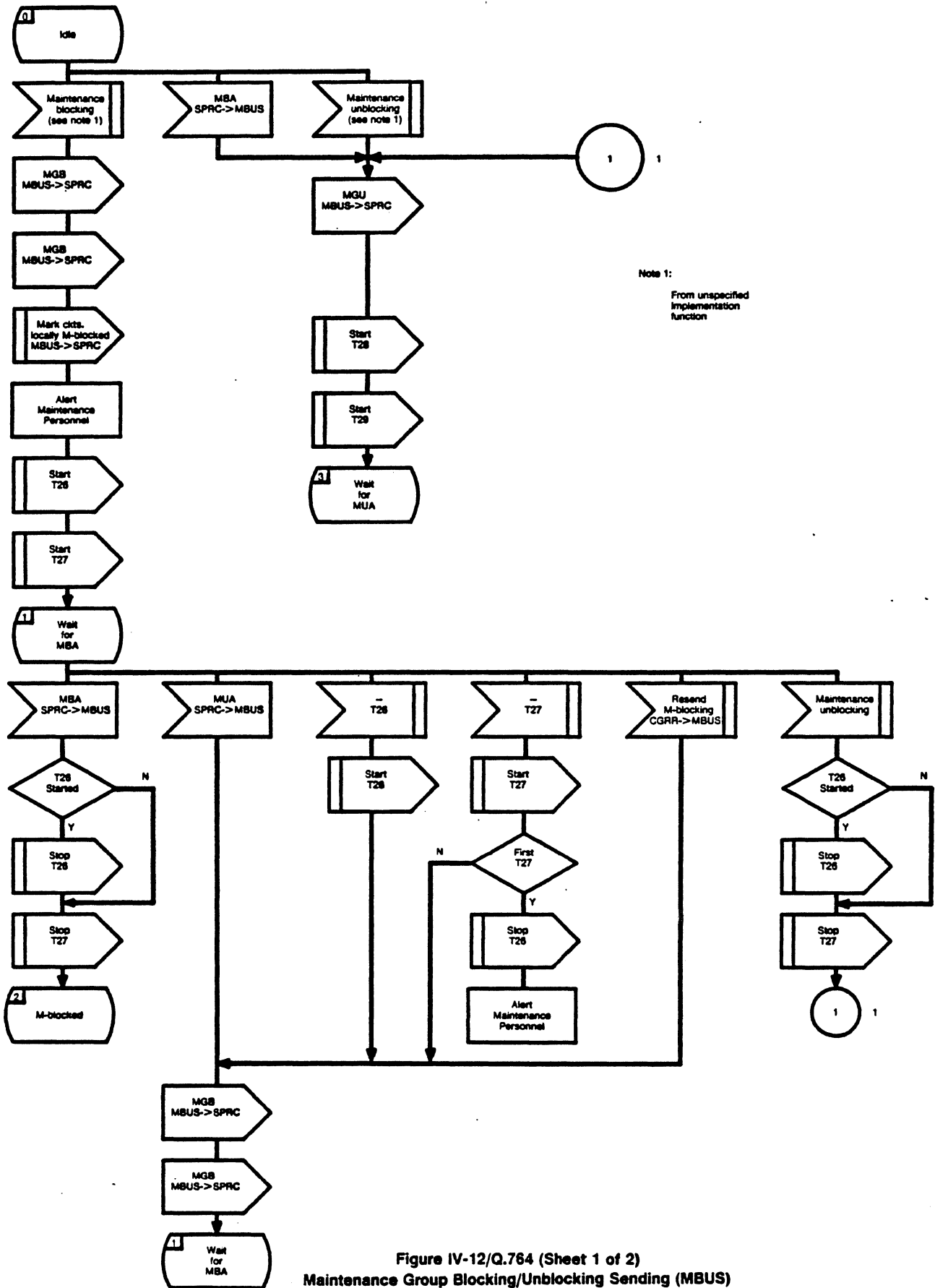


Figure IV-12/Q.764 (Sheet 1 of 2)
Maintenance Group Blocking/Unblocking Sending (MBUS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

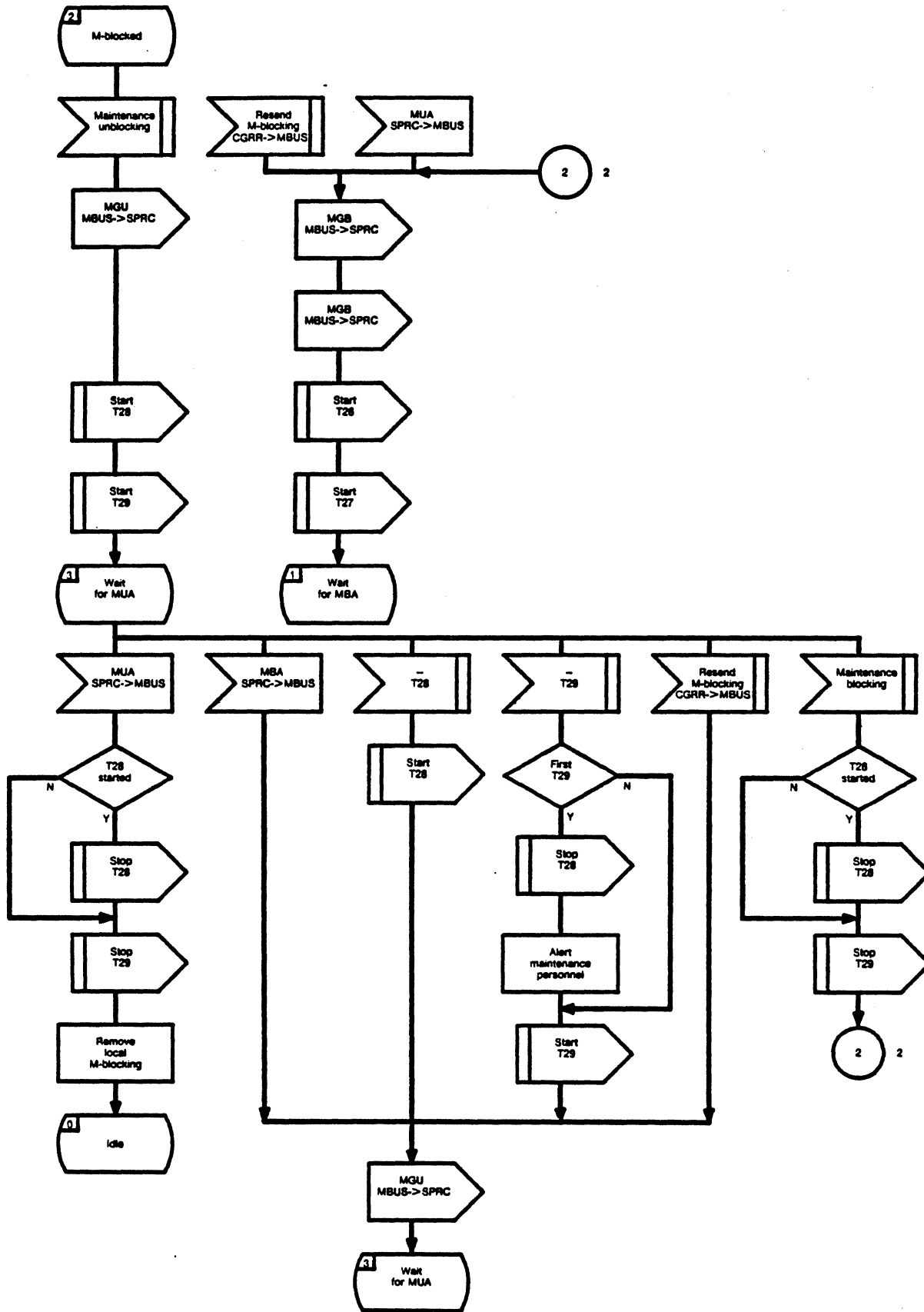


Figure IV-12/Q.764 (Sheet 2 of 2)
Maintenance Group Blocking/Unblocking Sending (MBUS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

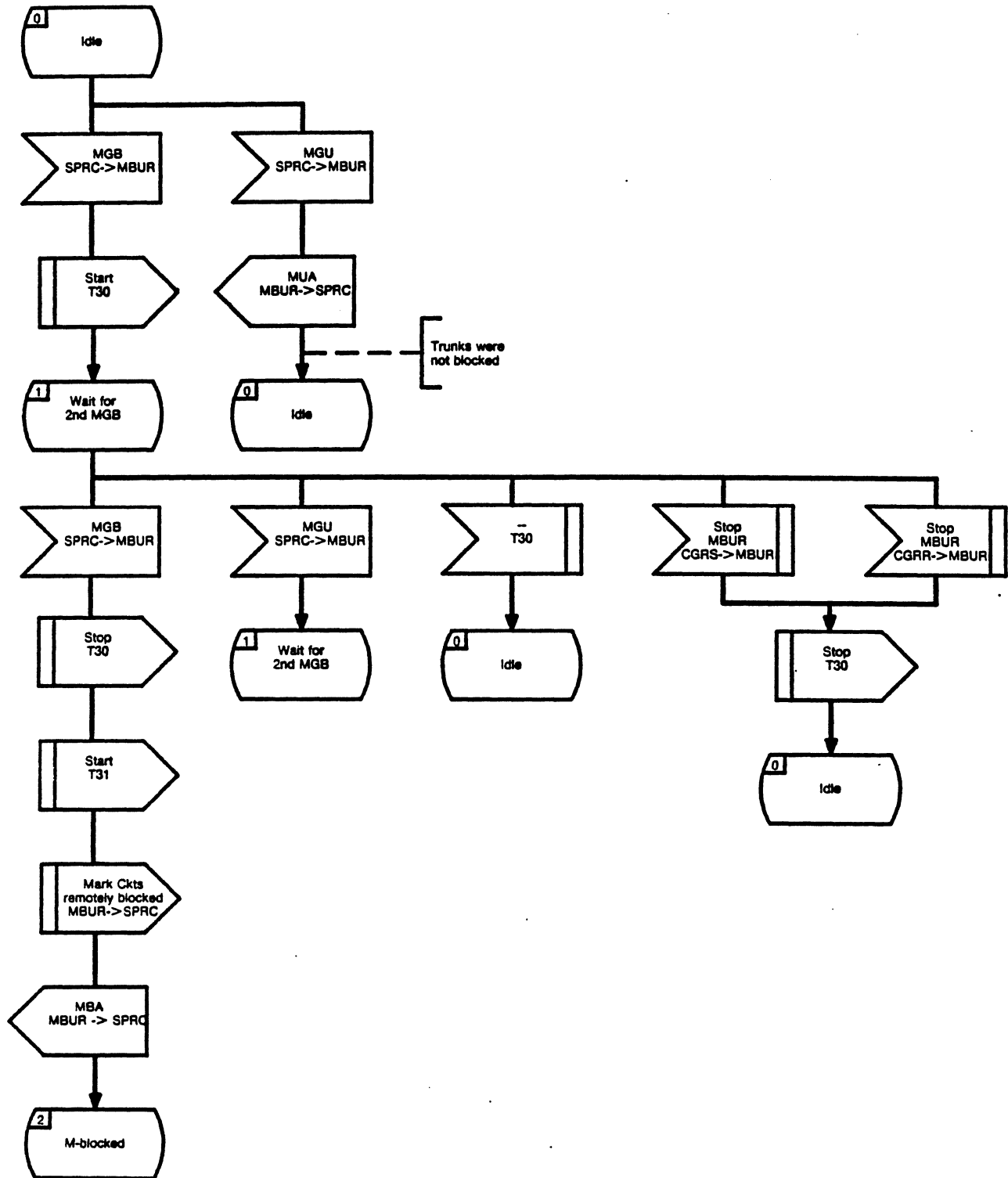


Figure IV-13/Q.764 (Sheet 1 of 2)
Maintenance Group Blocking/Unblocking Reception (MBUR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

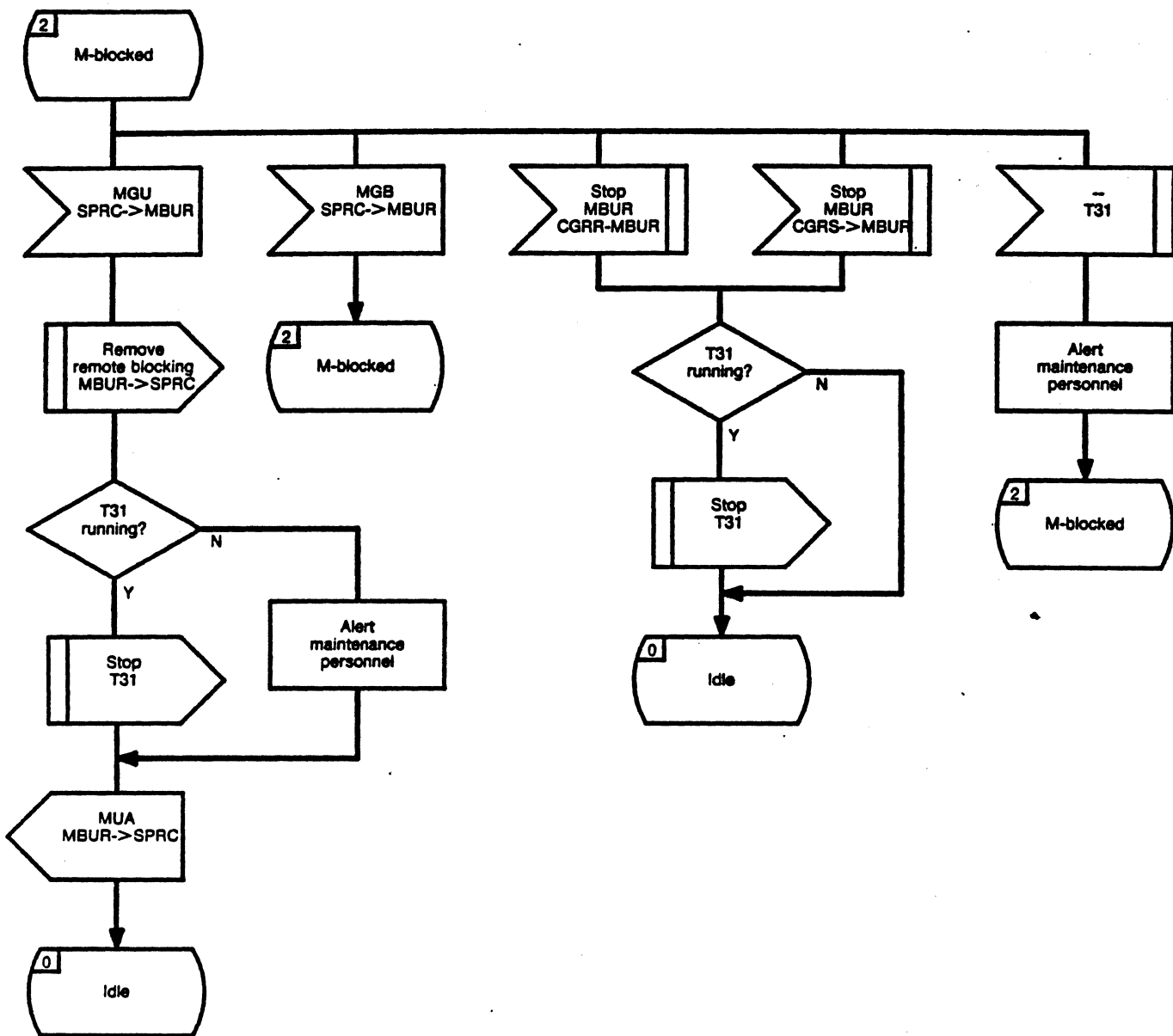


Figure IV-13/Q.764 (Sheet 2 of 2)
Maintenance Group Blocking/Unblocking Reception (MBUR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

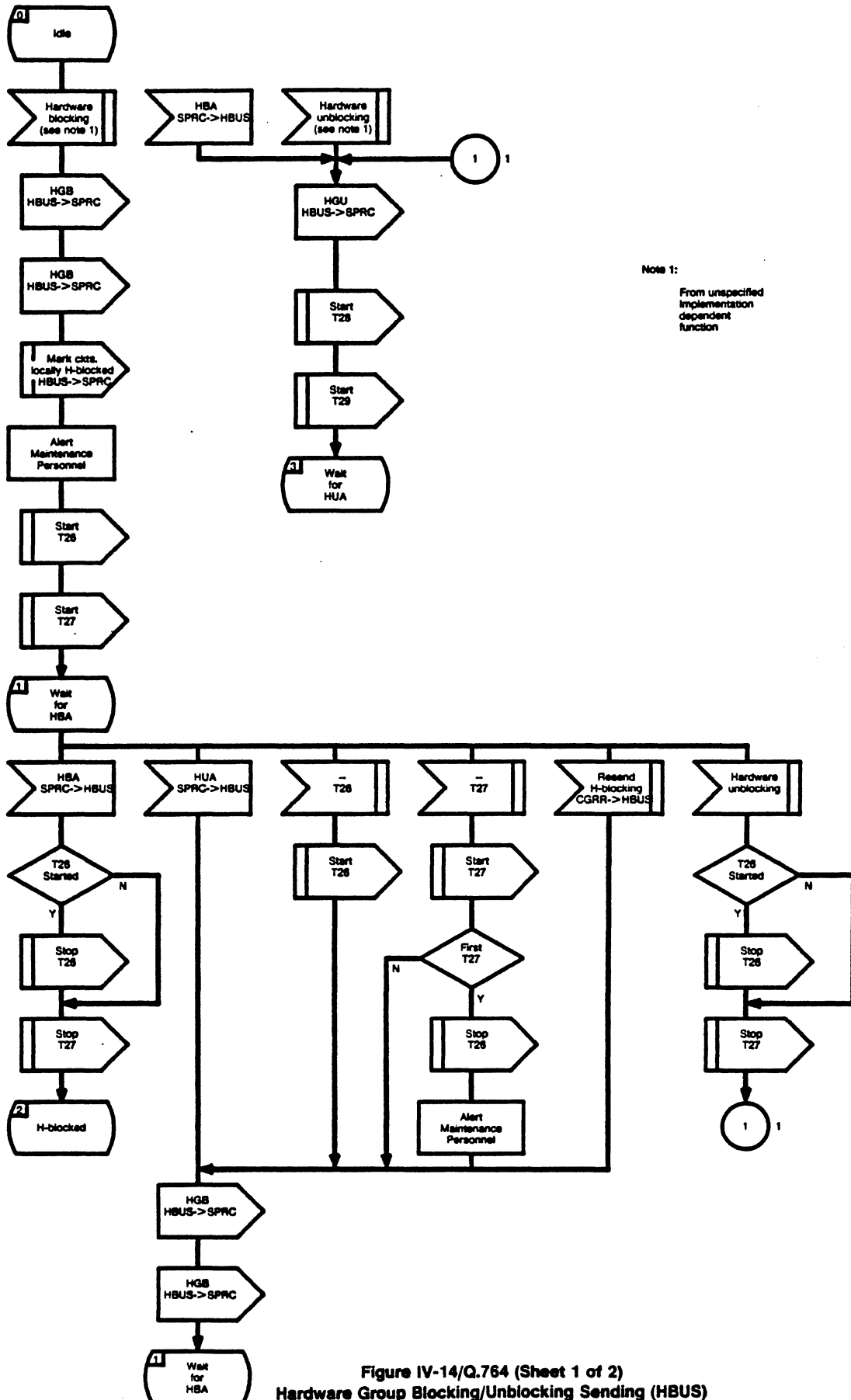


Figure IV-14/Q.764 (Sheet 1 of 2)
Hardware Group Blocking/Unblocking Sending (HBUS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

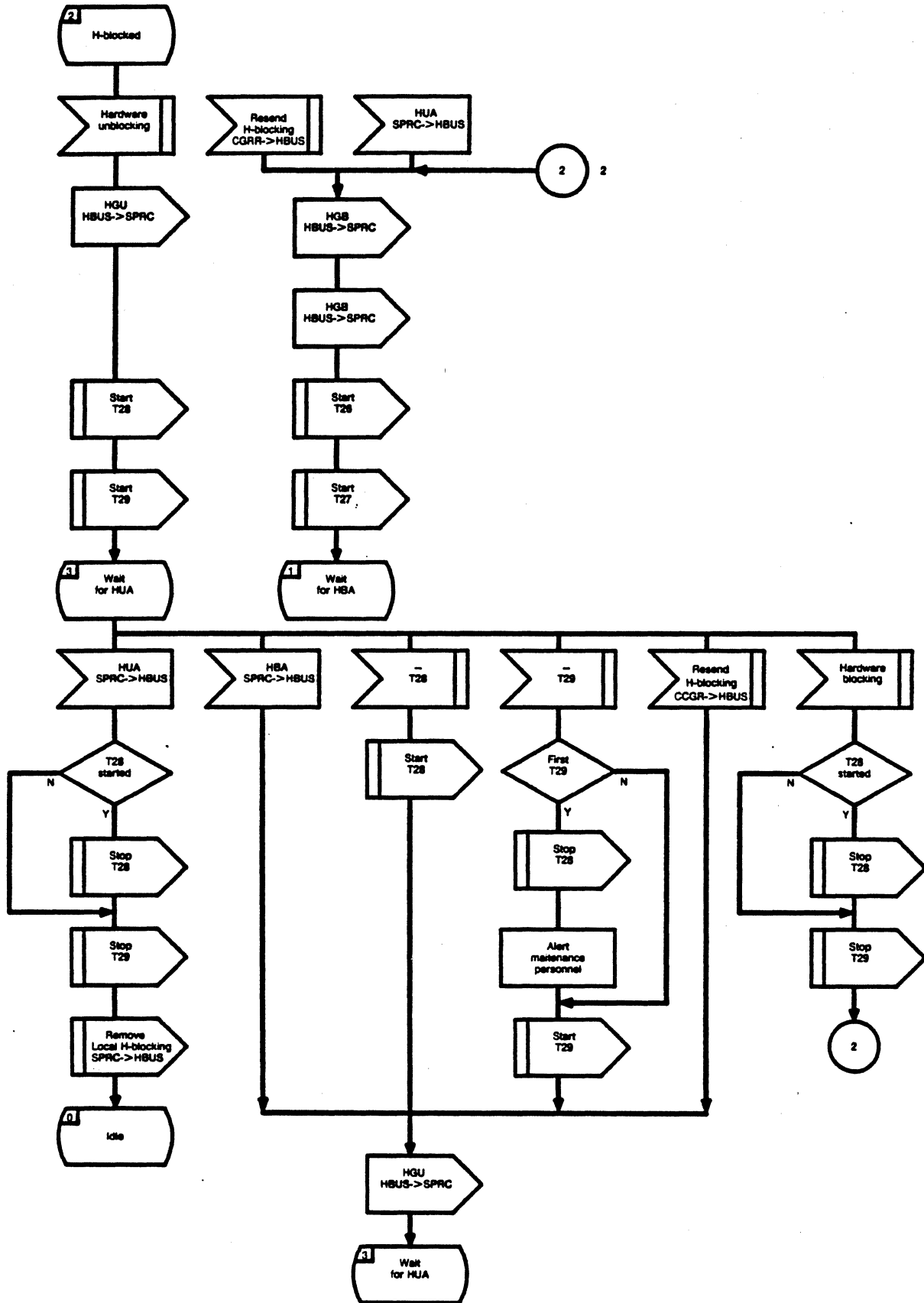


Figure IV-14/Q.764 (Sheet 2 of 2)
Hardware Group Blocking/Unblocking Sending (HBUS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

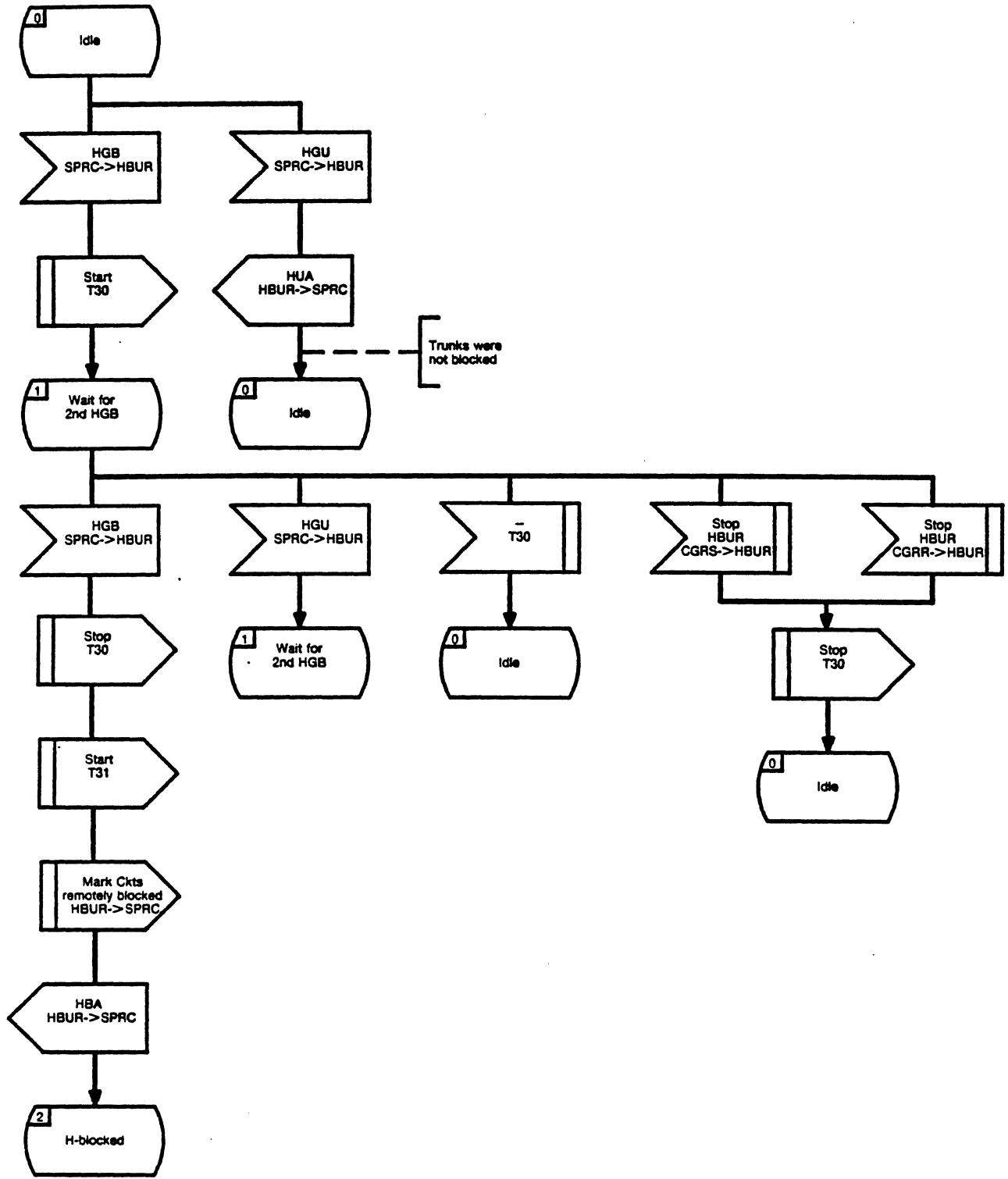


Figure IV-15/Q.764 (Sheet 1 of 2)
Hardware Group Blocking/Unblocking Reception (HBUR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS

Q.764

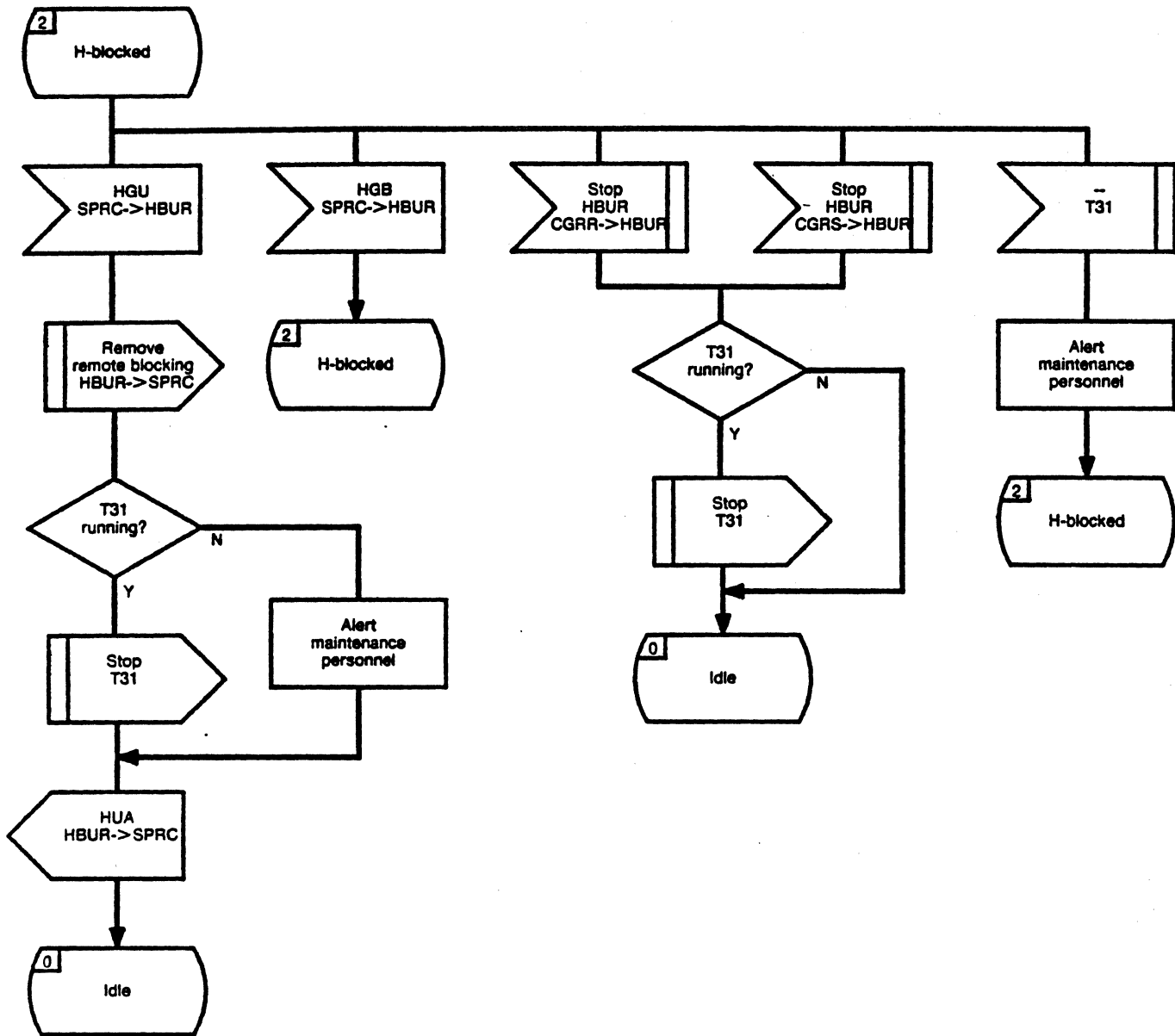


Figure IV-15/Q.764 (Sheet 2 of 2)
Hardware Group Blocking/Unblocking Reception (HBUR)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

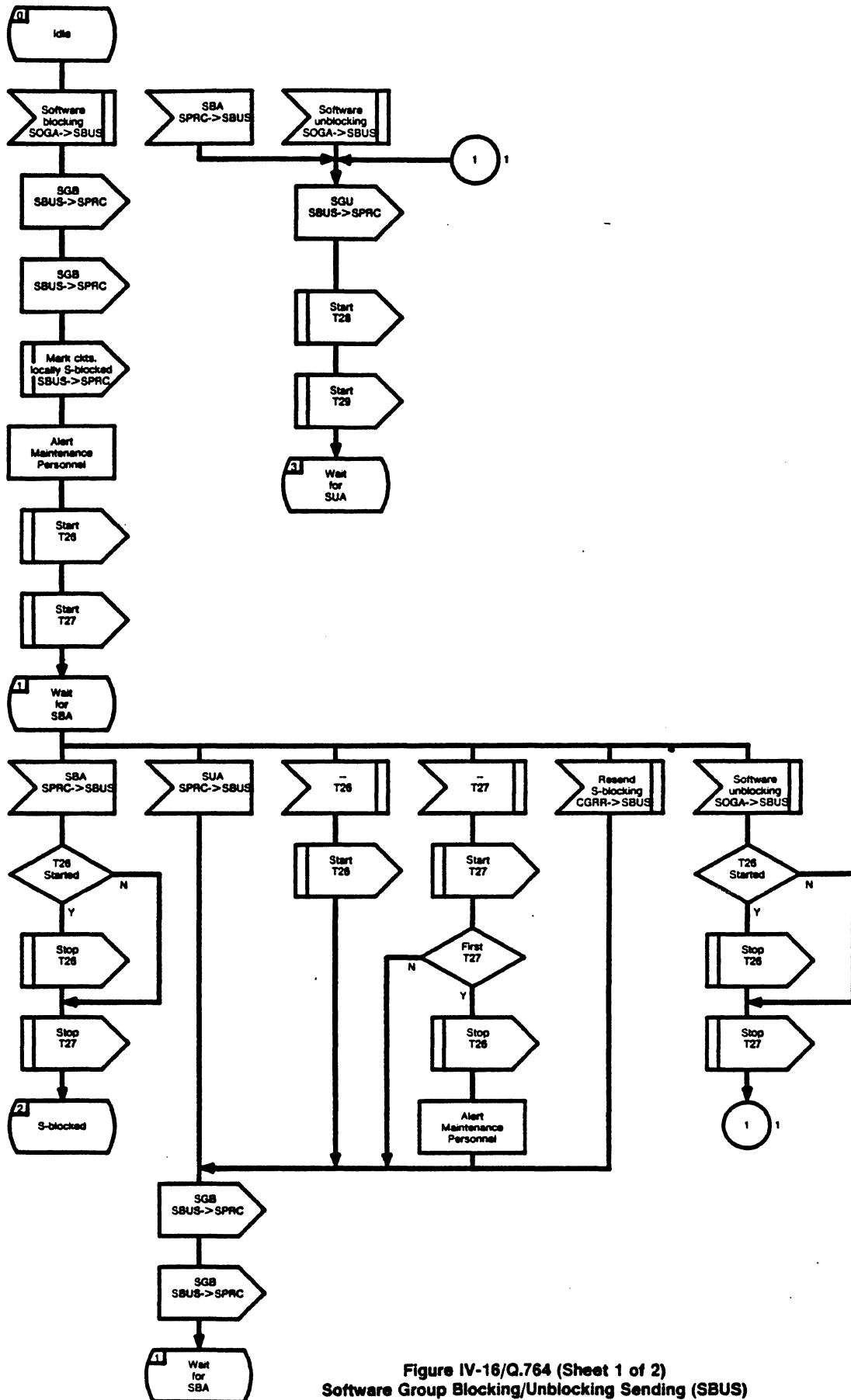


Figure IV-16/Q.764 (Sheet 1 of 2)
Software Group Blocking/Unblocking Sending (SBUS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP MAINTENANCE REQUIREMENTS

Q.764

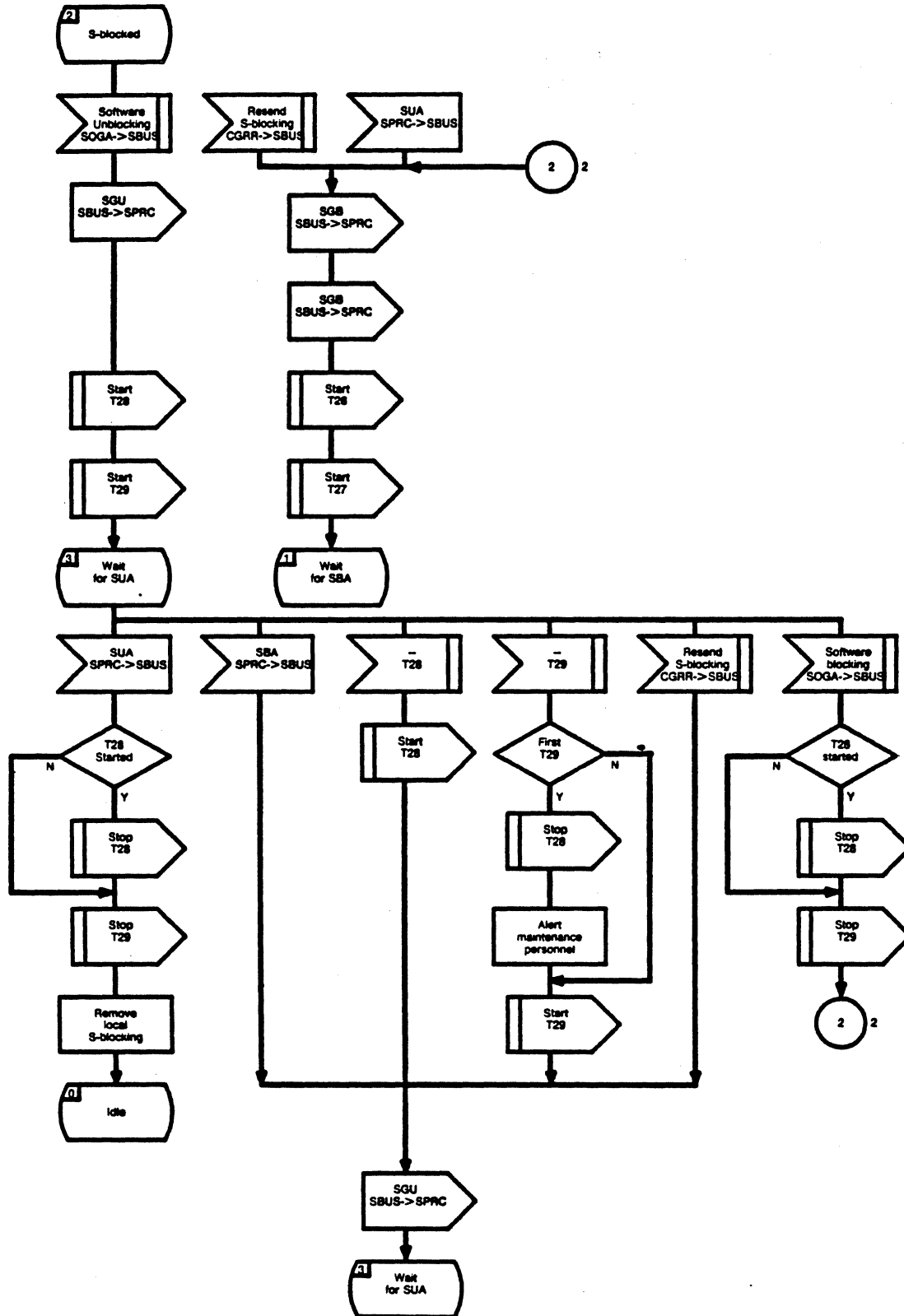


Figure IV-16/Q.764 (Sheet 2 of 2)
Software Group Blocking/Unblocking Sending (SBUS)

APPENDIX IV CIRCUIT AND CIRCUIT GROUP
 MAINTENANCE REQUIREMENTS

Q.764

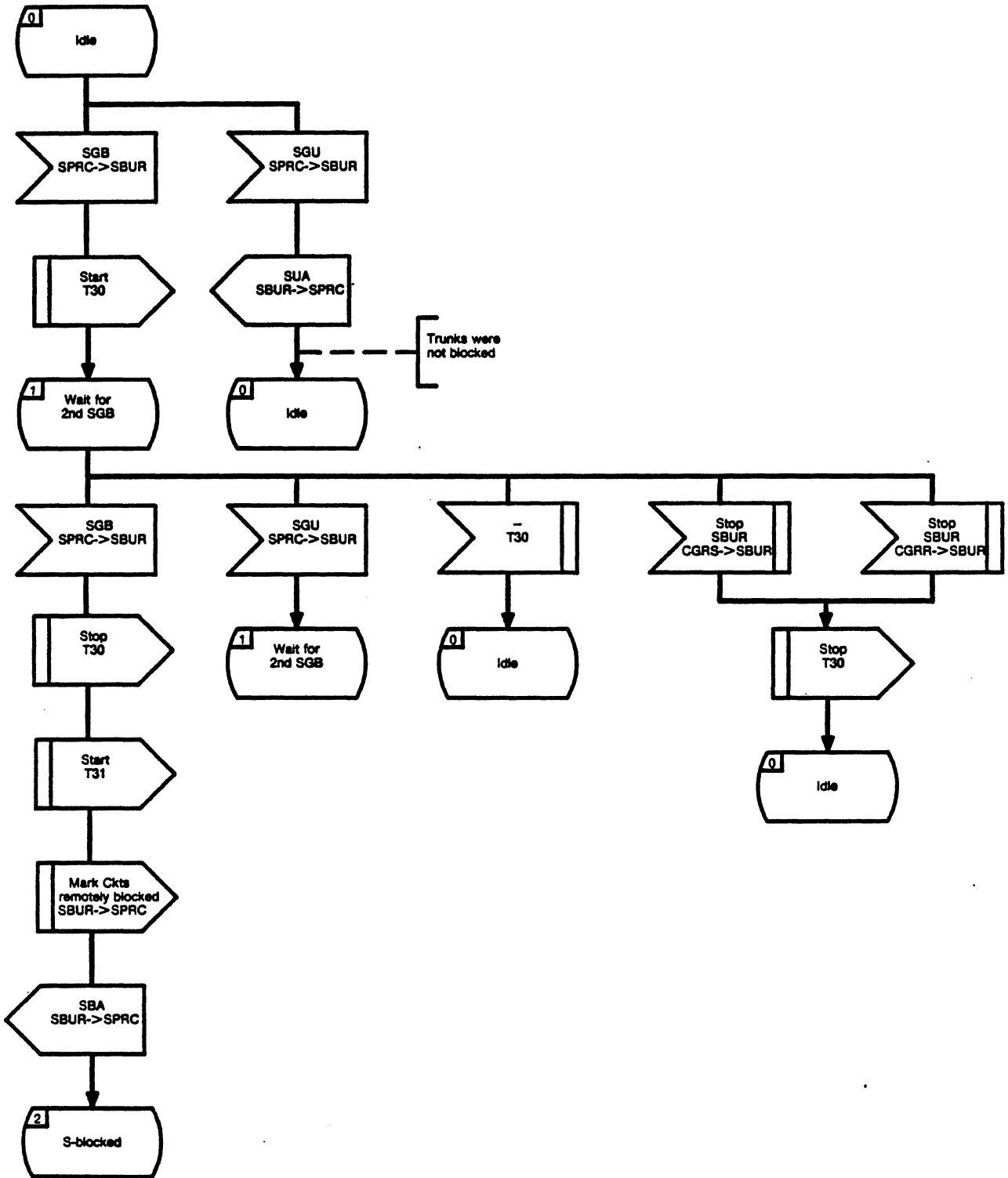


Figure IV-17/Q.764 (Sheet 1 of 2)
 Software Group Blocking/Unblocking Reception (SBUR)

**APPENDIX IV CIRCUIT AND CIRCUIT GROUP
MAINTENANCE REQUIREMENTS**

Q.764

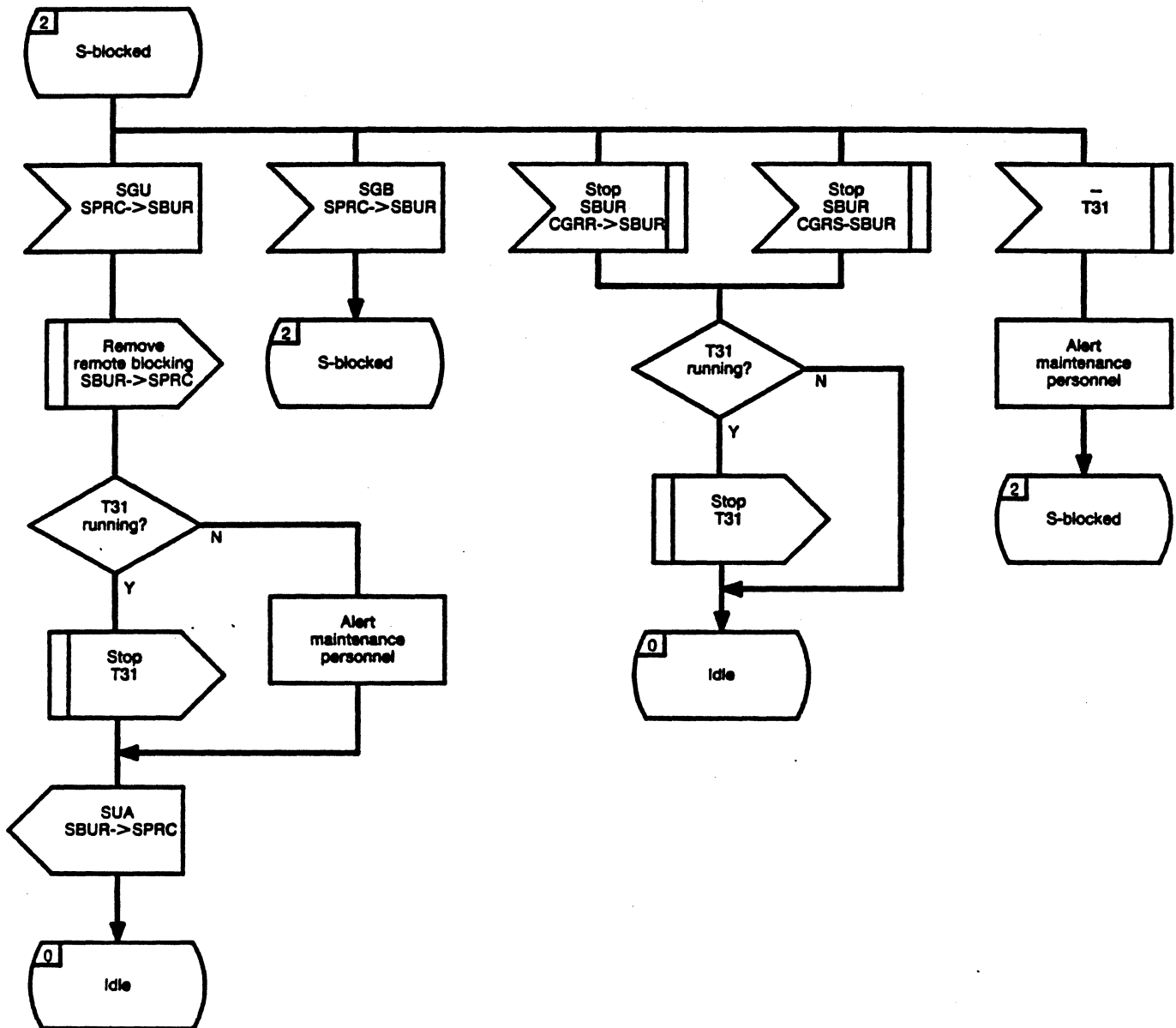


Figure IV-17/Q.764 (Sheet 2 of 2)
Software Group Blocking/Unblocking Reception (SBUR)